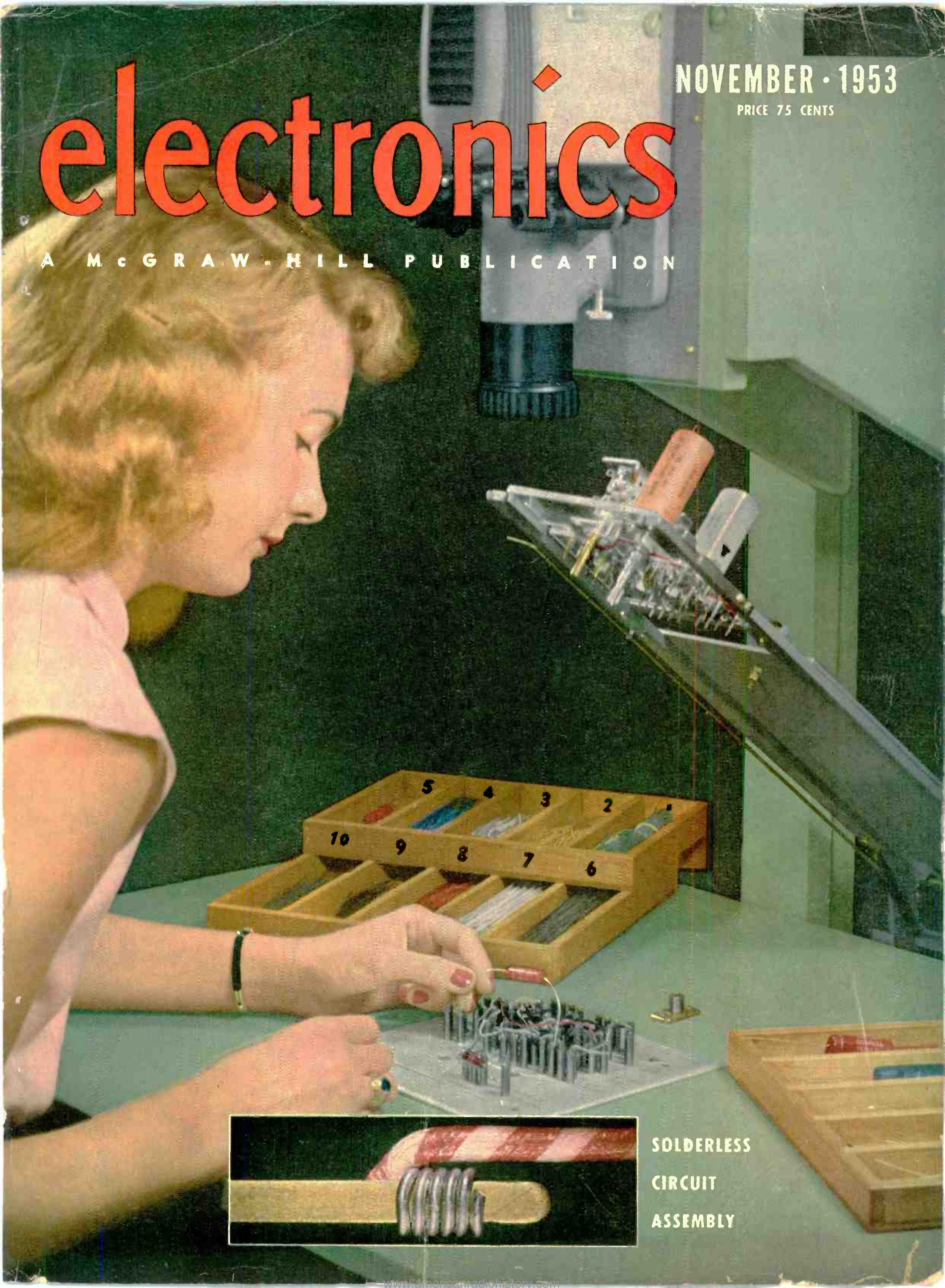
electronics

NOVEMBER · 1953

PRICE 75 CENTS

A McGRAW-HILL PUBLICATION



SOLDERLESS CIRCUIT ASSEMBLY

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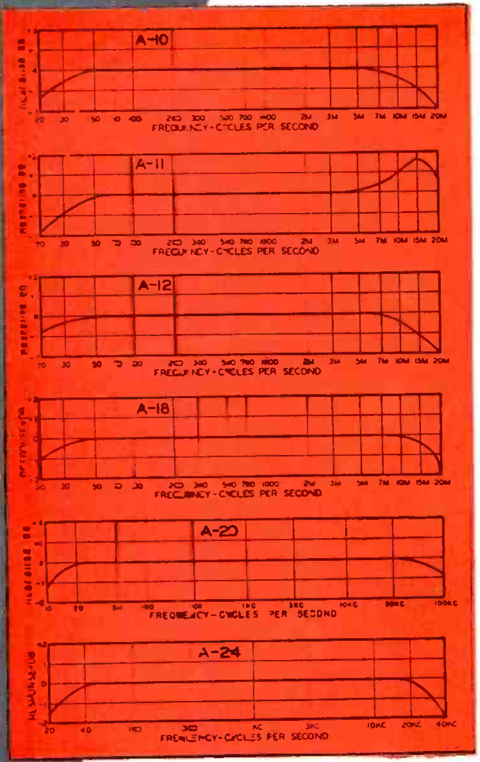
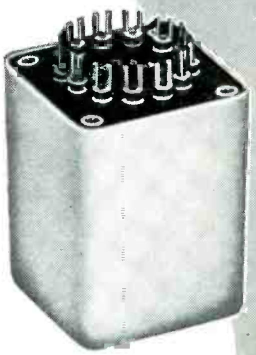
HIGH FIDELITY.... SMALL SIZE.... FROM STOCK

UTC Ultra compact audio units are small and light in weight, ideally suited to remote amplifier and similar compact equipment. High fidelity is obtainable in all individual units, the frequency response being ± 2 DB from 30 to 20,000 cycles.

True hum balancing coil structure combined with a high conductivity die cast outer case, effects good inductive shielding.



Type No.	Application	Primary Impedance	Secondary Impedance	List Price
A-10	Low impedance mike, pickup, or multiple line to grid	50, 125/150, 200/250, 333, 500/600 ohms	50 ohms	$16.00
A-11	Low impedance mike, pickup, or line to 1 or 2 grids (multiple alloy shields for low hum pickup)	50, 200, 500	50,000 ohms	18.00
A-12	Low impedance mike, pickup, or multiple line to grids	50, 125/150, 200/250, 333, 500/600 ohms	80,000 ohms overall, in two sections	16.00
A-14	Dynamic microphone to one or two grids	30 ohms	50,000 ohms overall, in two sections	17.00
A-20	Mixing, mike, pickup, or multiple line to line	50, 125/150, 200/250, 333, 500/600 ohms	50, 125/150, 200/250, 333, 500/600 ohms	16.00
A-21	mixing, low impedance mike, pickup, or line to line (multiple alloy shields for low hum pickup)	50, 200/250, 500/600	50, 200/250, 500/600	18.00
A-16	Single plate to single grid	15,000 ohms	60,000 ohms, 2:1 ratio	15.00
A-17	Single plate to single grid 8 MA unbalanced D.C.	As above	As above	17.00
A-18	Single plate to two grids. Split primary	15,000 ohms	80,000 ohms overall, 2.3:1 turn ratio	16.00
A-19	Single plate to two grids 8 MA unbalanced D.C.	15,000 ohms	80,000 ohms overall, 2.3:1 turn ratio	19.00
A-24	Single plate to multiple line	15,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	16.00
A-25	Single plate to multiple line 8 MA unbalanced D.C.	15,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	17.00
A-26	Push pull low level plates to multiple line	30,000 ohms plate to plate	50, 125/150, 200/250, 333, 500/600 ohms	16.00
A-27	Crystal microphone to multiple line	100,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	16.00
A-30	Audio choke, 250 henrys @ 5 MA 6000 ohms D.C., 65 henrys @ 10 MA 1500 ohms D.C.			12.00
A-32	Filter choke 60 henrys @ 15 MA 2000 ohms D.C., 15 henrys @ 30 MA 500 ohms D.C.			10.00

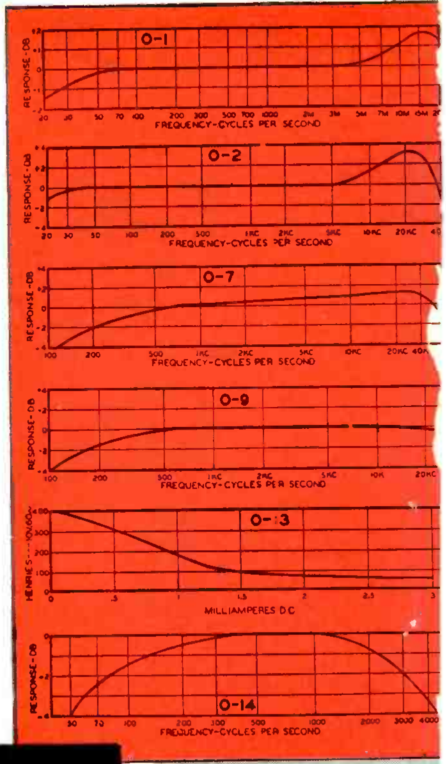


TYPE A CASE
1½" x 1½" x 2" high

UTC OUNCER components represent the acme in compact quality transformers. These units, which weigh one ounce are fully impregnated and sealed in a drawn aluminum housing ⅞" diameter... mounting opposite terminal board. High fidelity characteristics are provided, uniform from 40 to 15,000 cycles, except for 0-14, 0-15, and units carrying DC which are intended for voice frequencies from 150 to 4,000 cycles. Maximum level 0 DB.

OUNCER CASE
⅞" Dia. x 1⅛" high

Type No.	Application	Pri. Imp.	Sec. Imp.	List Price
0-1	Mike, pickup or line to 1 grid	50, 200/250 500/600	50,000	$14.00
0-2	Mike, pickup or line to 2 grids	50, 200/250 500/600	50,000	14.00
0-3	Dynamic mike to 1 grid	7.5/30	50,000	13.00
0-4	Single plate to 1 grid	15,000	60,000	11.00
0-5	Plate to grid, D.C. in Pri.	15,000	60,000	11.00
0-6	Single plate to 2 grids	15,000	95,000	13.00
0-7	Plate to 2 grids, D.C. in Pri.	15,000	95,000	13.00
0-8	Single plate to line	15,000	50, 200/250, 500/600	14.00
0-9	Plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600	14.00
0-10	Push pull plates to line	30,000 ohms plate to plate	50, 200/250, 500/600	14.00
0-11	Crystal mike to line	50,000	50, 200/250, 500/600	14.00
0-12	Mixing and matching	50, 200/250	50, 200/250, 500/600	13.00
0-13	Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C.,		6000 ohms	10.00
0-14	50:1 mike or line to grid	200	½ megohm	14.00
0-15	10:1 single plate to grid	15,000	1 megohm	14.00



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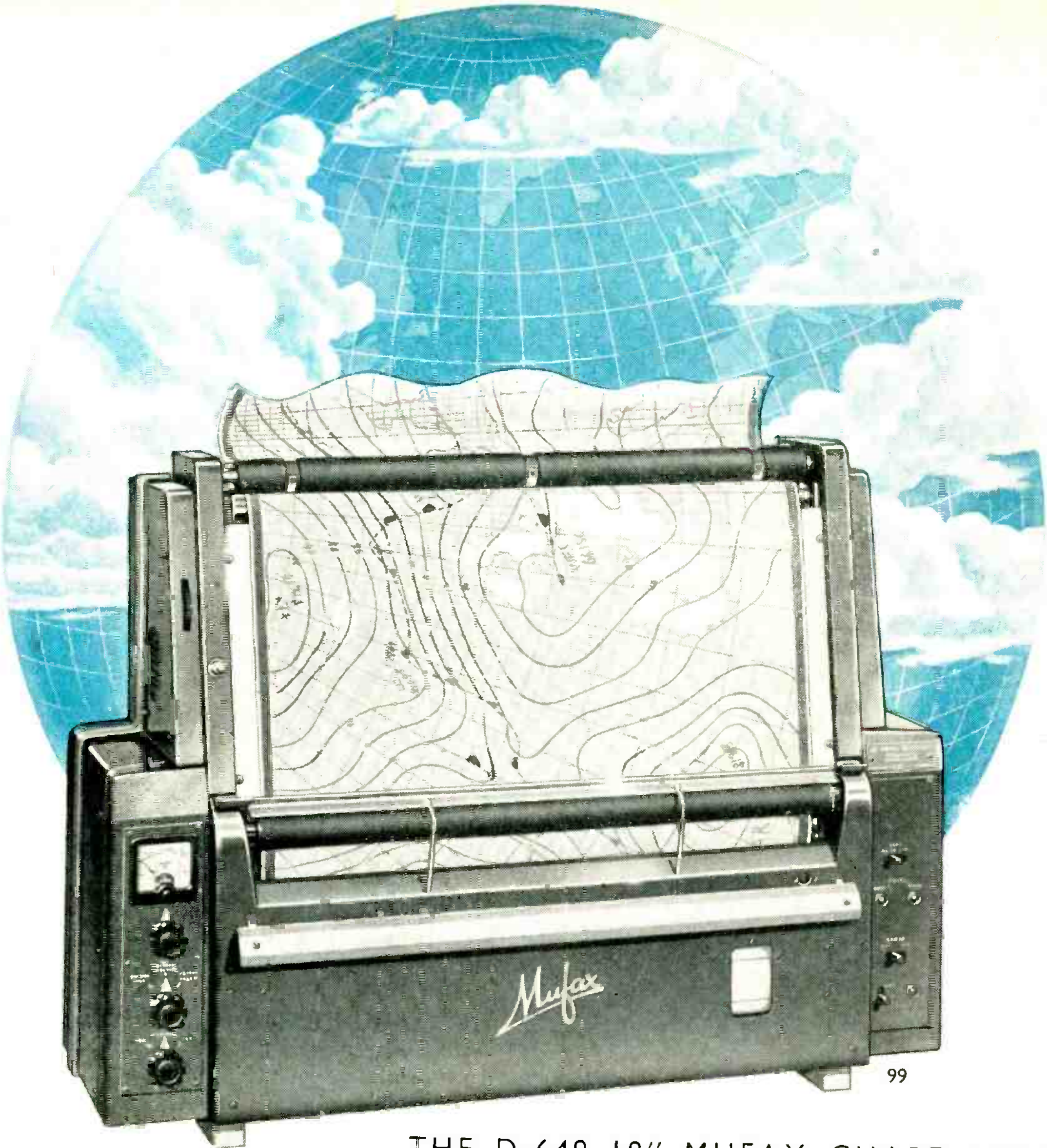

THE D-649 18″ MUFAX CHART RECORDER

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The D-649 18″ Mufax Chart Recorder offers the most convenient method yet devised of receiving facsimile weather maps transmitted by radio or landline. It can be used side by side with American equipment on existing systems; alternatively, a private network can be set up by using it in conjunction with the D-658 18″ Mufax Chart Transmitter. Recording is on inexpensive Mufax paper supplied in 100-foot rolls, enabling the recorder to operate unattended for days at a time. The transmitted map, measuring 18″ x 22″, is received full size, and can be examined while recording is still taking place. Picture quality is better than that obtainable by any other direct recording system, even when using the double speed facility which is exclusive to Mufax equipment. The record, which is black on white, is instantly visible and requires no processing. No other system can offer these advantages—write now for full descriptive literature.

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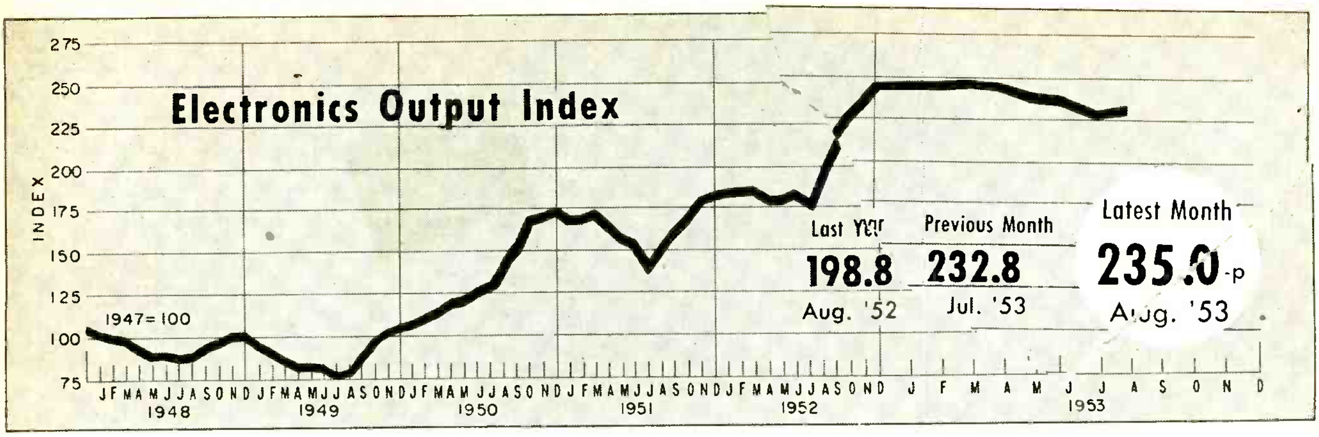

FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RETMA)	Year Ago	Previous Month	Latest Month
	Aug. '52	Jul. '53	Aug. '53
Television sets	397,769	316,289	603,760
Home sets	235,728	172,197	299,939
Clock Radios	108,753	87,620	169,301
Portable sets	105,006	78,434	145,460
Auto sets	94,315	336,208	376,937

RECEIVER SALES

(Source: RETMA)	Aug. '52	Jul. '53	Aug. '53
Television sets, units	......	340,406	430,101
Radio sets (except auto)	......	366,666	491,431

RECEIVING TUBE SALES

(Source: RETMA)	Aug. '52	Jul. '53	Aug. '53
Receiv. tubes, total units	30,141,536	26,462,069	38,600,494
Receiving tubes, new sets	19,583,879	15,393,307	25,837,055
Rec. tubes, replacement	7,463,893	9,480,208	10,460,032
Receiving tubes, gov't.	1,706,868	313,684	560,565
Receiving tubes, export	1,386,896	1,274,870	1,742,842
Picture tubes, to mfrs.	394,605	421,248	704,495

SEMICONDUCTOR SALES

(Source: RETMA)	Aug. '52	July '53	Aug. '53
Germanium Diodes	......	742,102-r	836,334

INDUSTRIAL TUBE SALES

	Quarterly Figures		
(Source: NEMA)	Year Ago	Previous Quarter	Latest Quarter
	2nd '52	1st '53	2nd '53
Vacuum (non-receiving)	$12,110,000	$11,340,000	$10,400,000
Gas or vapor	$3,150,000	$3,140,000	$3,300,000
Phototubes	$480,000	$930,000	$700,000
Magnetrons and velocity modulation tubes	$9,830,000	$10,070,000	$10,500,000
Gaps and T/R boxes	$2,140,000	$2,050,000	$1,700,000

TV AUDIENCE

(Source: NBC Research Dept.)	Year Ago	Previous Month	Latest Month
	Sept. '52	Aug. '53	Sept. '53
Sets in Use—total	18,711,800	24,895,000	25,233,000

BROADCAST STATIONS

(Source: FCC)	Sept. '52	Aug. '53	Sept. '53
TV Stations on Air	111	253	288
TV Stns CPs—not on air	51	270	246
TV Stns—Applications	855	521	415
AM Stations on Air	2,364	2,476	2,488
AM Stns CPs—not on air	119	117	113
AM Stns—Applications	276	177	183
FM Stations on Air	624	579	571
FM Stns CPs—not on air	18	18	21
FM Stns—Applications	10	7	5

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	Jul. '52	June '53	Jul. '53
Aeronautical	33,462	39,315	40,655
Marine	36,068	40,357	41,473
Police, fire, etc.	11,274	13,631	13,869
Industrial	13,968	17,378	17,951
Land Transportation	5,120	5,922	6,069
Amateur	113,863	111,289	110,862
Citizens Radio	1,697	3,829	3,877
Disaster	80	191	191
Experimental	489	414	463
Common carrier	985	1,214	1,222

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	July '52	June '53	July '53
Prod. workers, comm. equip.	264,700	399,300-r	391,800
Av. wkly. earnings, comm.	$62.96	$66.83-r	$65.67
Av. wkly. earnings, radio	$60.25	$64.80-r	$63.67
Av. weekly hours, comm.	39.4	40.5 -r	39.8
Av. weekly hours, radio	39.2	40.0 -r	39.3

STOCK PRICE AVERAGES

(Source: Standard and Poor's)	Sept. '52	Aug. '53	Sept. '53
Radio—TV & Electronics	304.3	280.0	265.5
Radio Broadcasters	288.3	274.8	263.1

p—provisional; r—revised

FIGURES OF THE YEAR

	1952 Total	TOTALS FOR FIRST EIGHT MONTHS 1952	1953	Percent Change
Television set production	6,096,279	2,914,925	4,754,285	+ 63.1
Radio set production	10,934,872	6,588,303	8,932,638	+ 36.2
Television set sales	6,144,990	2,569,384	3,546,407	+ 38.0
Radio set sales (except auto)	6,878,547	3,505,516	3,875,293	+ 10.6
Receiving tube sales	368,519,243	211,269,893	308,222,911	+ 45.8
Cathode-ray tube sales	6,120,292	2,479,539	5,276,426	+112.8

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New York City Tests Conelrad

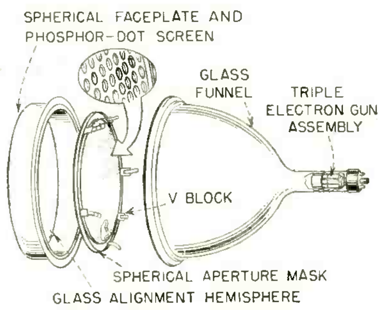
RECENT Civil Defense drill staged by New York City gave the first large-scale test of Conelrad during daylight hours. Between 9:30 and 9:45 a.m. the big city's radio and television listeners and lookers had an opportunity to discover how their habits will be changed in the event of enemy aircraft attack.

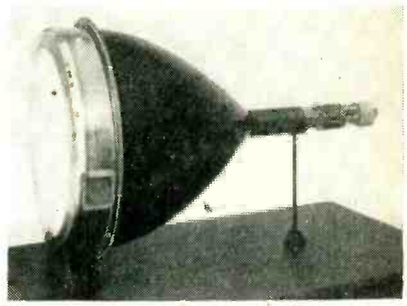
Television and f-m stations go off the air after a brief explanatory announcement. Radio carries on, using 640 and 1,240 kc. Individual stations lose their identity by reducing power and broadcasting program from a central source. While some stations go off the air completely, others take turns carrying the program.

▶ **Classified Information**—Official evaluation has not been published, and may not be, to show how well the technique denied navigational information to aircraft while furnishing citizens with vital information. Unofficial observers had comments to make upon the effectiveness of the scheme from the listeners' viewpoint.

One individual using a crystal receiver in nearby New Jersey reported that he could follow the program from the 1,240-kc chain, but lost a part of it when he was tuned to 640 kc. At the same location, the program was always good on a table-model receiver, although there was some fading and heterodyning.

Stations broadcasting seemed to stay on the air from 12 to 18 seconds and, while they broadcast in sequence, the sequence was not always the same.





SPHERICAL FACEPLATE shortcuts design problems, as . . .

CBS Ships Tricolor Tube Samples

Production of 15,000 monthly foreseen next year; possibly 21-inch rectangular types

SAMPLES of the Columbia Broadcasting System's spherical-faceplate tricolor tube for television will go out to tv set manufacturers this month.

Pilot plant production of the new tube will begin in February at Newburyport, Mass. Full-scale production of 15,000 tubes a month is scheduled for next fall, when much of CBS-Hytron's new 250,000 sq ft Kalamazoo, Mich. plant will be devoted to color-tube manufacture. Other tubemakers may be licensed when patents are granted.

Although the tube shown at last month's demonstration in Danvers, Mass. were 15-inch round ones, the spherical-faceplate design permits manufacture of larger-diameter units no longer than current monochrome models. The space-saving rectangular shape is also feasible.

▶ **How It Works**—The tube contains three electron guns, one for each color. The screen consists of 250,000 tiny phosphor dots of each color: red, green and blue. An aperture mask perforated with 250,000 holes 0.009-inch in diameter makes the three electron beams converge in such a manner that each beam hits only its corresponding phosphor dots.

For proper color reproduction, the phosphor-dot pattern and the aperture mask must be aligned with utmost precision. The spherical-shaped faceplate and aperture mask shown in the sketch are aligned by a unique photoengraving process in which the mask serves as the negative. The faceplate interior is coated with each of the color phosphors in turn. After each coat, a photosensitive emulsion is applied and exposed by a pencil of light following the path of one of the electron beams. The developed emulsion binds the dots in their proper places.

Three aperture mask v blocks clip to glass alignment hemispheres on the faceplate. The mask can expand and contract freely without undue strain. Thus heating of the mask by beam current or during degassing does not cause it to warp or become

Color TV Timetable

FORMAL demonstration by NTSC on Oct. 15 gave FCC something solid on which to base decision . . . conducted in New York, color telecasts by NBC, CBS and DuMont were picked up on color sets provided by Admiral, CBS-Columbia, Crosley, Emerson, General Electric, Hallicrafters, Hazeltine, Motorola, Philco, RCA, Sylvania, Westinghouse and Zenith . . . several mono-chrome receivers monitored . . . the program opened with studio program received directly from the NBC transmitter in N.Y.C. then transmitted by coaxial cable and then by microwave relay to Washington and back to New York . . . next was a pick-up of outdoor scenes from a local museum garden broadcast by CBS . . . program concluded with a transmission from the DuMont transmitter, showing NTSC color slides.

• • •

Counterproposals to NTSC color tv by three dissidents dismissed under procedural rule adopted by Commission in 1950 . . . FCC characterized ideas as "merely paper systems" . . .

• • •

Jockeying for favorable positions is spurring engineers to new heights of activity . . . NBC put on closed-circuit show for Chicago from New York Colonial studio . . . announced total color investment of $25 million to date and proposal to spend another $15 million to launch commercial color-casting. . .

• • •

Chromacoder camera by CBS uses single image orthicon and converts sequenial signals to NTSC-type for compatible broadcasts . . . President Frank Stanton claims installation savings of $3.8 million for 100-station network and operating-cost savings of $6 million a year.

materially misaligned.

The spherical faceplate allows a wide electron-beam deflection angle that permits development of large-screen tubes and improves beam convergence at the edges of the picture; electron beams and mask holes are essentially at right angles even at the edges of the tube.

▶ **Cost**—The "colortron" lends itself to mass production. The tubes are light, relatively easy to assemble and few rejects are expected. CBS predicts that by 1955 or 1956 mass production techniques will have reduced the price to roughly 30 percent over comparable monochrome models.

▶ **Camera**—Following its showing at the Danvers plant, the Colortron was also featured in a New York demonstration of several new CBS color-television-system components. The camera used in this demonstration employed just one orthicon pickup tube. The unit was called as a refinement of the field-sequential camera, adapted for transmitting NTSC-standard pictures.

Estimated cost for studio equipment based upon the new camera range is from $9,690 for a network station to $781 for a medium-market station. A single operator reportedly can perform all master control functions necessary to operate the equipment satisfactorily.

D. C. McGraw Elected McGraw-Hill President

DONALD C. MCGRAW was elected President of the McGraw-Hill Publishing Company, Inc., publishers of ELECTRONICS, at a meeting of the Board of Directors at McGraw-Hill Building, 330 West 42nd Street. He succeeds his brother, the late Curtis W. McGraw.

Donald C. McGraw

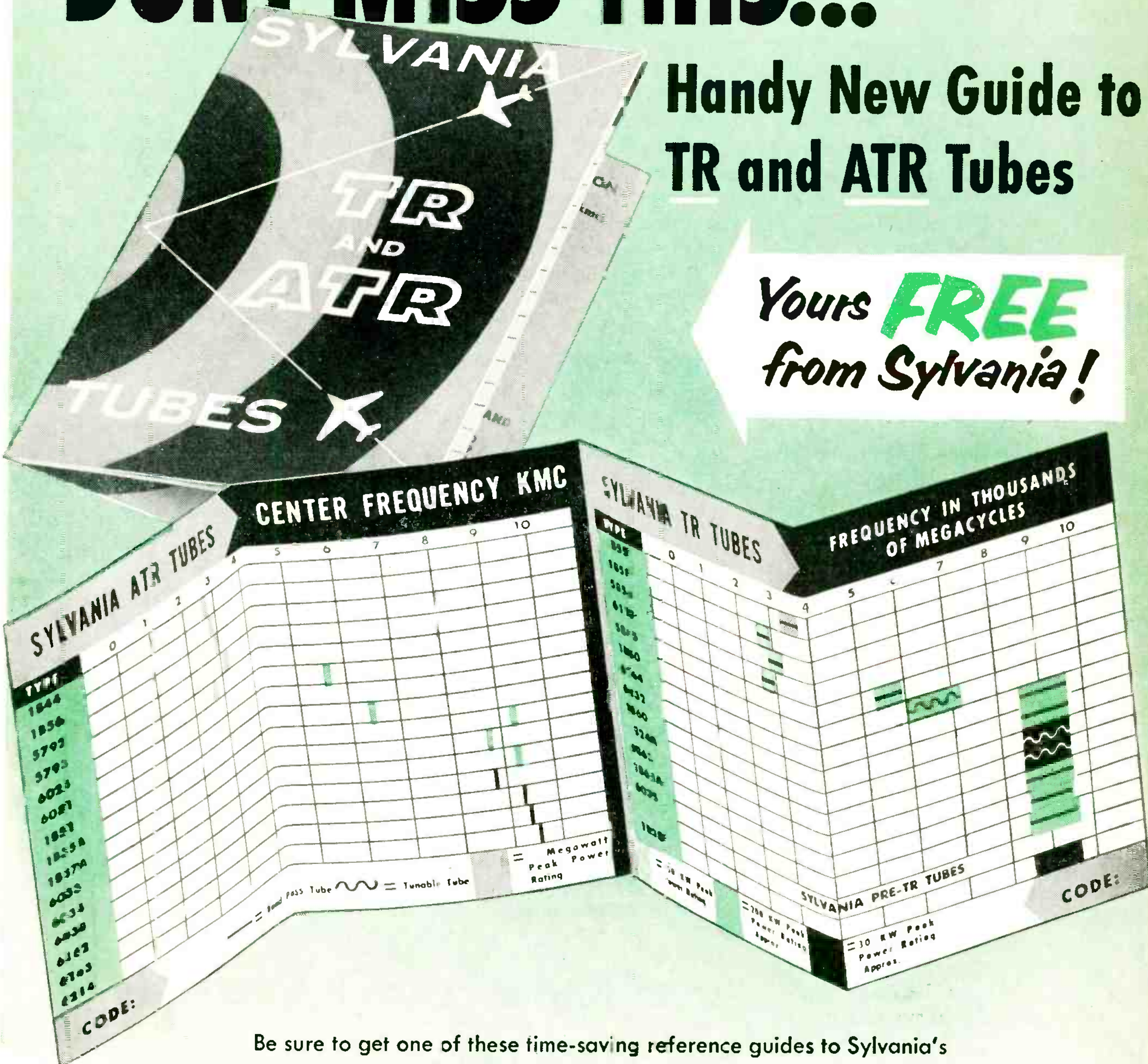
Mr. McGraw, youngest son of the late James H. McGraw, Sr., founder, has been associated with the company since 1919. He has been a director since 1935, and vice-president since 1945. During World War II, he was a consultant to the Publishing and Printing Division of the War Production Board.

A native of Madison, N. J., Mr. McGraw now is a resident of Summit, N. J. He is a graduate of Lawrenceville School and attended Princeton University. During World War I, he served with the U. S. Navy.

Mr. McGraw joined McGraw-Hill in 1919 as a member of the advertising staff of Chemical and Metallurgical Engineering, which has since become Chemical Engineering. Two years later, he transferred to the pressroom and composing room. McGraw-Hill then operated its own printing plant in its building at 36th Street and Tenth Avenue. In 1924, he

(Continued on page 8)

DON'T MISS THIS...



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assumed supervision of the operation of the building and of the printshop.

Since 1933, when he was made Secretary of the company and put in charge of production and manufacturing, he has been responsible for the handling of all contracts for printing and binding, engraving, and paper supply for the entire McGraw-Hill operation.

Mr. McGraw in 1945 was named Vice-President for Manufacturing and General Services, the position he has held until now. In 1950, he became a director of the McGraw-Hill Book Company, a McGraw-Hill subsidiary, and of the Newton Falls Paper Mill in which McGraw-Hill has a half-interest.

Guided Missile Production Lags

Army misses target date as critics query infallibility; steering-group head quits

VELVET CURTAIN of security for guided missiles was broken twice last month with apparently contradictory items. President Eisenhower accepted the resignation of Chrysler Board Chairman K. T. Keller, since 1950 director of the Defense Department's Office of Guided Missiles. Keller, in leaving, recommended that the agency he headed be abolished. The reason given was that guided missiles had now reached such an advanced stage of development that efforts of the steering group were no longer needed. No successor has been named to the post.

▶ **Production**—On the heels of this development came an announcement by Army spokesmen that no unit armed with Nike, the Army's supersonic antiaircraft rocket, is ready to meet a surprise Russian air attack.

Promised for this summer, the missile characterized by Army Secretary Robert T. Stevens as the best antiaircraft weapon now available, is now slated to guard important industrial centers beginning this fall. In tests against remotely controlled B-17 bombers Nike rockets scored at least 65 kills out of 100.

▶ **Planning**—Critics of the guided missile program have recently warned against lumping all our air defense eggs in one basket. Pointing to successful employment of electronic countermeasures against enemy radar during World War II, particularly during the Normandy invasion, they plug for piloted interceptors whose human pilot can overrule jammed or deceived electronic guidance equipment.

To keep up with today's high-flying supersonic bombers, piloted interceptors, too, need electronic equipment in the form of airborne radar and electronically controlled gunsights.

Thus the electronics industry will undoubtedly carry much of the responsibility for air defense.

RUBBER DOME protects intricate antennas from weather as . . .

Arctic Radar Fence Is Readied

Results of Project Lincoln are almost set for performance tests by the military

EXPERIMENTAL units of a line of radar stations 1,200 miles from the north pole, which will give at least six hours advance warning of an airborne threat from that direction, are nearing completion in the vicinity of Barter Island, Alaska. The decision to extend the line from Alaska to Greenland will hinge on the performance of this initial installation.

Known as the Distant Early Warning Line, the apparatus, some of it entirely new in concept, is the result of study and development work by Lincoln Laboratory of MIT working closely with Bell Telephone Laboratories of American Telephone & Telegraph.

▶ **Equipment**—Unlike World War II radar, which required constant observation, the new equipment automatically sounds an alarm whenever aircraft approach, reducing drastically the personnel required for service in the Arctic. Both the radar and radio transmitters which link it with the command centers are designed to overcome magnetic storms which knock out conventional electronic

(Continued on page 10)

Want more information? Use post card on last page.

equipment in the Arctic during substantial parts of the year.

▶ **Project**—The system was started last December when top Bell officials were requested by the Defense Department to construct the initial section of the DEW line and have it functioning within a year. Every piece of the electronic equipment had to be specially made or converted and transported to the point of construction, 2,800 sea miles away from the loading point, all within two summer months beginning in July. Early during the same period, a pilot installation was assembled in the U. S. to test the equipment, train personnel and to learn the nature of the functional problems and solve them in advance of actual installation in the Arctic.

Electronic Firms Eye U.S. Spending

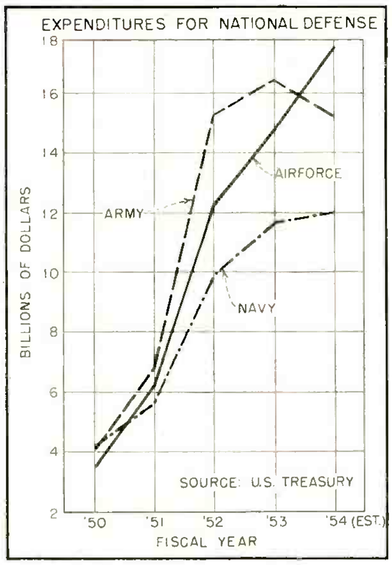
Pending shift in Pentagon strategy could spell more business for the industry

JOINT CHIEFS OF STAFF review of the entire military program which went to Defense Secretary Wilson in mid-October called for a beefing up of continental U.S. defenses. But the conclusions came too late to be inserted in the fiscal 1955 military appropriations requests that had already been prepared.

As a result, the military may push through a supplemental appriation which will, for the first time, put an open price tag on the cost of defending the country from direct attack. The report, however, must be approved by the National Security Council if it calls for any major change in strategy.

▶ **Spending Increase**—Prior to the report, Wilson had estimated that defense spending beginning next July might run $40 billion, about $2 billion less than estimates for this year. But if the new JCS plan is approved, total military spending for the first full year of such a program, including maintenance of forces already active, may run between $43 and $45 billion with the bulk of the new money going to the electronics industry.

Depending on how fast the build up progressed and how much was required initially, spending might hit close to $50 billion in fiscal 1956. As a result, electronic manufacturers may have at least four more years of top defense business ahead.



▶ **Breakdown**—Indication of how the military spends its appropriations is shown in the chart. Air Force, with an estimated $17.5 billion in its till, is expected to be the top spender in the present fiscal year which began last July, followed by Army and Navy, in that order. Secretary Wilson states that the U. S. is figuring on spending about a half billion dollars currently for the radar early warning network. That figure may increase as plans are completed and the U. S. and Canadian fences are merged.

More guided missile business for electronic manufacturers may also be available this fiscal year. The military may convert National Guard units to guided missile outfits equipped with the Army's Nike for better domestic defense. However, the plan is still tentative and may not become a part of home defense strategy.

Medical Sales Boost Betatron Business

Total for one firm will reach $10 million with installation of units now on order

ACCEPTANCE of the betatron in medical therapy to supplement high-voltage x-ray equipment has given another impetus to the fast-expanding medical electronic business. By early 1954, Allis-Chalmers alone will have installed the huge 24-million-electron-volt machines in the following seven hospitals:

University of Illinois Medical Center, Chicago
M. D. Anderson Hospital, Houston, Texas
Memorial Center for Cancer and Allied Diseases, New York City
Mallinckrodt Institute of Radiology, St. Louis, Mo.
Columbia Presbyterian Medical Center, New York City
Saskatchewan Cancer Clinic, Saskatoon, Canada
French Ministry of Public Health, Paris

Similar installations are in various stages of planning and construction at the following medical laboratories:

University of California Medical Center, Los Angeles
The Lincoln Laboratory, Bedford Air Base, Massachusetts
Royal Victoria Hospital, Montreal

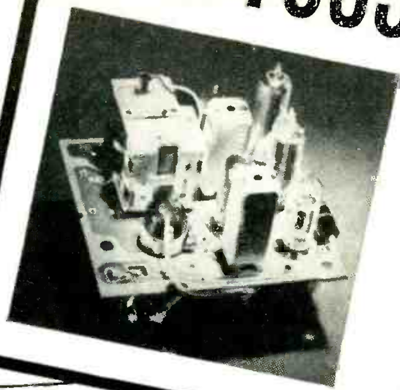
▶ **New Doughnut**—Delivery of the first permanently-sealed electron-beam betatron tube to New York City's Memorial Center installation (p 146, Oct. 1953 ELECTRONICS) makes available a new method of treating cancerous tumors in critical areas such as the brain. This new doughnut-shaped ceramic tube has a thin beryllium window that passes electrons yet preserves the required vacuum.

▶ **Total Sales**—There are now 18 other betatrons in operation in industrial production and research locations, with two more being installed. Chief industrial use has been for inspection of ammunition having casings too thick for ready penetration by conventional industrial x-ray equipment.

Total cost of the 10 medical and 20 industrial betatrons now in use

(Continued on page 14)

1953



SPECIAL "PLUG-IN" STYLE COMPONENTS FOR PRINTED OR ETCHED CIRCUIT CHASSIS

135,000,000 (estimated) radio and TV sets in use.

1951

WORLD'S SMALLEST VARIABLE RESISTOR

114,000,000 radio and TV sets in use.

1947

1st TV HIGH VOLTAGE CERAMIC CAPACITORS

66,000,000 radio and TV sets in use.

1943

1st PRINTED ELECTRONIC CIRCUIT

58,000,000 radio sets in use.

1942

1st OFFERED FINE CERAMICS TO THE INDUSTRY

59,000,000 radio sets in use.

1938

1st 24-CONTACT PER SINGLE-SECTION SWITCH

41,000,000 radio sets in use.

1929

1st COMBINATION VARIABLE RESISTOR AND SWITCH

10,500,000 radio sets in use.

1922

1st COMPOSITION VARIABLE RESISTOR

400,000 radio sets in use.

Again CENTRALAB is first

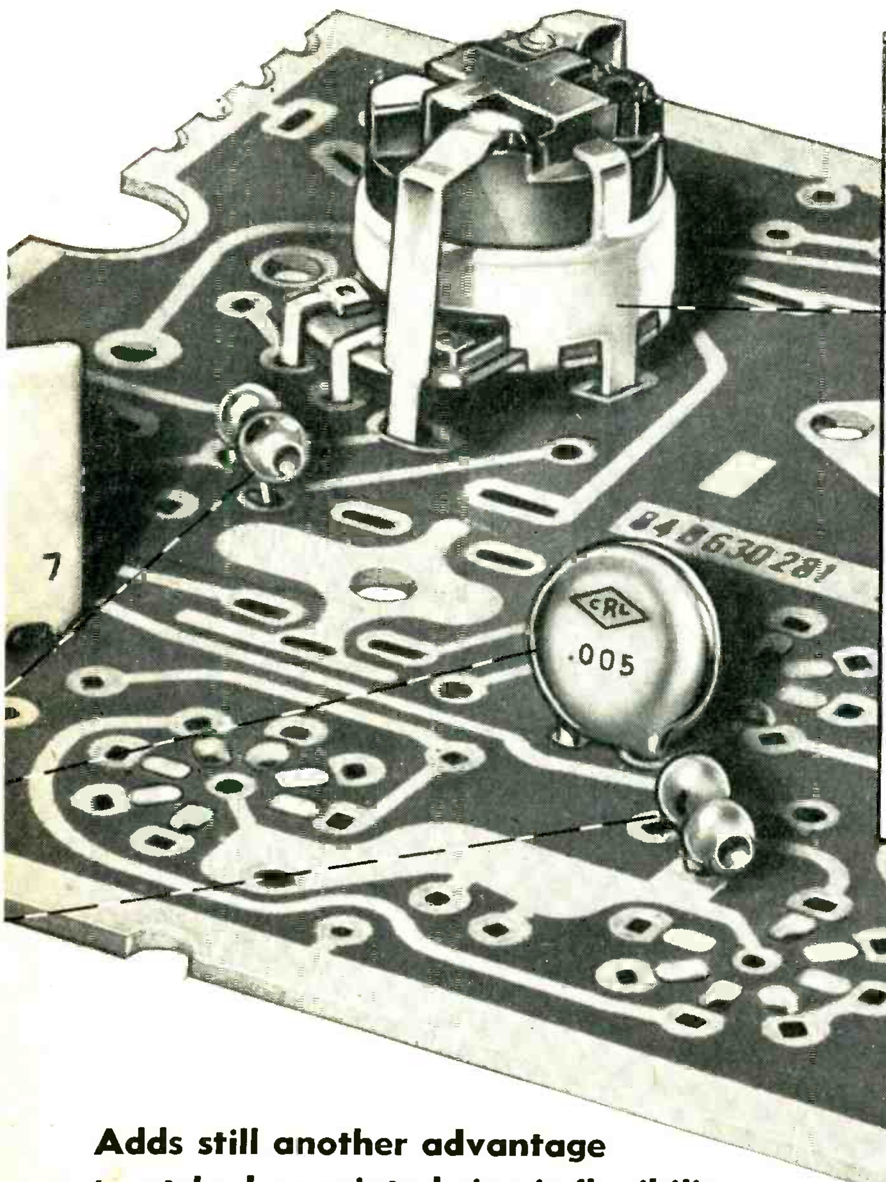
in developing NEW components for NEW advancements in electronic design

For new economies now possible with etched chassis . . . . . SEE NEXT TWO PAGES

chassis...Here are 2 NEW WAYS to NEW PROFITS with

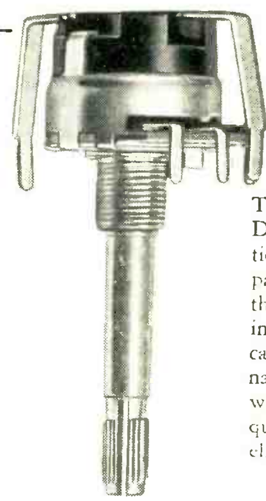
Plug-in Components

(1) Capacitors (disc, tubular or plate) (2) PEC* plates (3) Controls



NEW CONTROLS

These special controls plug *directly* into any etched, printed or plated chassis. Reverse-bend tabs are 1.16" wide with a standard length of 1/8" from mounting surface on .679" radius. Plug-in controls are available in any standard taper and resistance value. †



This feature is *another* Centralab exclusive!

This Centralab designed SPST or DPST switch eliminates all conventional wiring in printed or etched paths. Switch solder lugs are so made that they, too, can be plugged directly into the chassis. One lug is automatically grounded to one control terminal, taking the place of the jumper wire which would otherwise be required. Gives you an *extra plus* in eliminating two extra steps!

†Plug-in components shown separately are actual size.

*Trademark — Printed Electronic Circuits

Adds still another advantage to etched or printed circuit flexibility

It's only natural that Centralab, pioneer of so many electronic "firsts," should bring users even greater potential profits, by broadening the money-saving advantages of printed or etched circuits.

You'll want *all the facts* on Centralab "plug-in" components so you can properly evaluate their many potential savings for you. Technical information and *manufacturer's samples* are available on request. Use handy coupon, or write for details on components of your choice.

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CENTRALAB, A Division of Globe-Union Inc.
914-K E. Keefe Ave., Milwaukee 1, Wisconsin

Please send technical data on NEW Centralab Plug-in style components for:

☐ CONTROLS ☐ TUBULAR CAPACITORS
☐ PRINTED ELECTRONIC CIRCUIT PLATES
☐ DISC CAPACITORS ☐ PLATE CAPACITORS

Name...

Address...

City...State...................

or being installed will come to approximately $10,000,000. The machines sell for around $100,000 apiece, plus installation costs, associated electronic test equipment, construction of the required heavy-wall concrete room and, for industrial uses, cost of the heavy overhead crane used for positioning the machine with respect to the parts being inspected.

TV Manufacturers Get Color Set Data

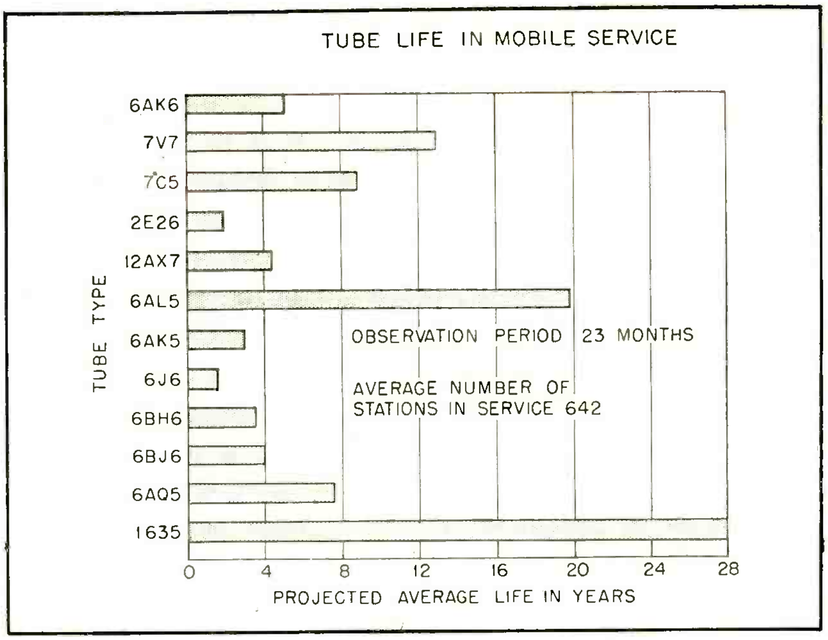
Technical details of its basic color receiver are given to its licensees by RCA

ENGINEERS representing virtually all tv set manufacturers were given full details of design and performance of RCA's basic color tv receiver at a color tv symposium held by the company in New York City. The receiver described to the 250 tv industry representatives is the latest field-tested design from which will be evolved the production design for color sets.

Data on special components, tubes, circuitry and test equipment were provided along with latest technical information on the company's tricolor tube. The engineers were also briefed on color broadcast station equipment progress and the color plans of other divisions of the company.

▶ **Production**—Within six to nine months, or sooner, after FCC approves compatible standards, RCA plans to have its first color receiver production line in operation, according to E. C. Anderson, vice-president of the company, who presided at the meeting. He stated that the company will supply domestic receiver licensees with complete manufacturing information on its first color set when it is placed in commercial production. This includes complete manufacturing drawings, bill of material, sources of supply and inspection of the production setup. Licensees would be invited to the plant before the commercial release of RCA color sets.

▶ **Kit**—During the meeting, the company offered to supply tv set manufacturers with a limited quantity of developmental kits, containing specially designed color set components, to enable licensees to initiate experimental design and production programs for color tv sets. The kit includes a tricolor picture tube, receiver tubes, transformers and coils.



VACUUM-TUBE reliability demonstrates well-defined pattern, as . . .

Studies Probe Equipment Failures

Railroaders indict tubes as leading failure cause; Navy finds old tubes best

RESULTS of a 23-month study conducted by Missouri-Pacific radio engineers reveal that 63 percent of all mobile equipment faults arise from vacuum-tube failures. Four tube types, the 6AK5, 6J6, 2E26 and 6BH6 accounted for 78 percent of all tube failures. These types represented only 55 percent of the tubes in use. The figures were presented to the 30th annual session of the American Association of Railroads communications section.

The study involved 53 base and 936 mobile units incorporating 29,000 vacuum tubes. The railroad's activities extend over 9,600 track miles in 11 midwestern states.

▶ **Tube Life**—On the basis of the study, average tube lives were extrapolated for the types studied. The results are given in the bar graph. Shortest predicted life was for the 6J6—20.2 months; while theoretically the type 1635 should last 28 years. Auto-battery type vibrators were found to have an average life of 21.5 months on the basis of 840 studied. Dynamotors, on the other hand, seemed destined to last indefinitely.

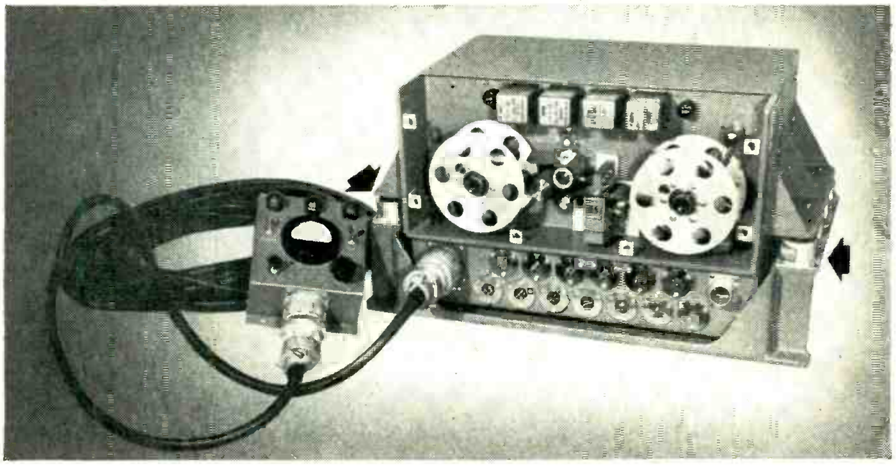
A low failure rate was noted for 7C5 and 7V7 loctal types while the 12AX7 had a life span three times as long as the similar 6J6. No pretested or selected tubes were employed in the equipment studied.

▶ **Navy Test**—According to the U. S. Navy, one-third of the tubes replaced by maintenance technicians could be left in their sockets without malfunctioning of the equipment. This result, shown in the pie

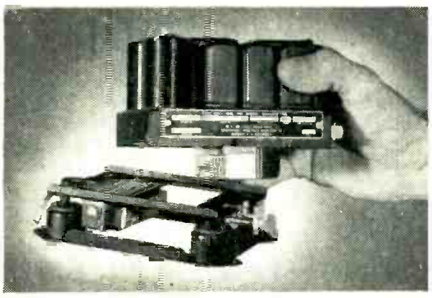
(Continued on page 16)

SHOCK – VIBRATION – NOISE

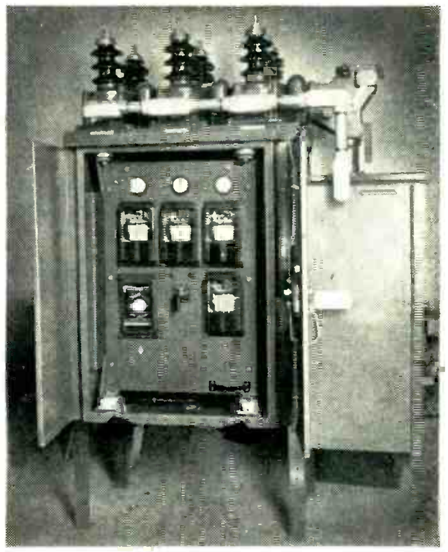
ISOLATION NOTES

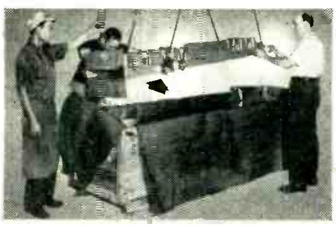


UNDISTORTED FLIGHT DATA are recorded by this Davies Laboratories aircraft data recorder. Tubes, relays, and recorder mechanism are protected against vibration by air-damped BARRYMOUNTS.



70% SIZE REDUCTION and 50% weight reduction, with no loss in performance, is achieved in this Minneapolis-Honeywell aircraft-fuel-gage power unit. Miniaturized air-damped BARRYMOUNTS helped make this saving possible, in protecting the reliability of the unit from vibrations and shock.





SENSITIVE ADJUSTMENTS ARE HELD when instrument and control panels are mounted on BARRYMOUNTS. Vibration from nearby heavy machinery cannot shake equipment out of calibration. Result: insured reliability of equipment and service.

NO SHIPPING DAMAGE, plus simplified packing, is Philco's experience with BARRYMOUNTS built into the packaging of microwave equipment. Pre-assembled equipments, with tubes and crystals in place, are shipped all over the world without damage, thanks to this modern packaging method. Write us for details.

The wide range of Barry products and the experience of Barry engineers can help you solve shock, vibration, and noise problems in any area of military or industrial activity. Call our nearby sales representative or write directly to us.

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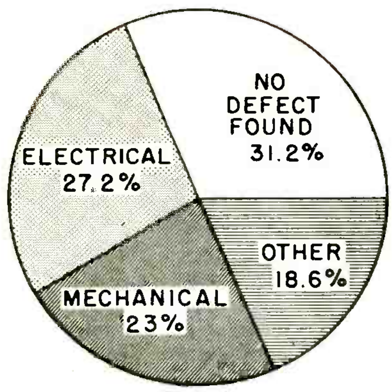
chart, is based on a two-year study of tubes thrown out by maintenance men at 10 large military installations. Although a few of the good tubes had intermittent defects, the majority were either sound or had merely a slightly low transconductance.

According to the Navy, many of the tubes had just reached a condition of equilibrium and were at their peak of reliability when replaced. The other-defects classification shown on the chart refers to tubes used in special service that were changed for operational reasons.

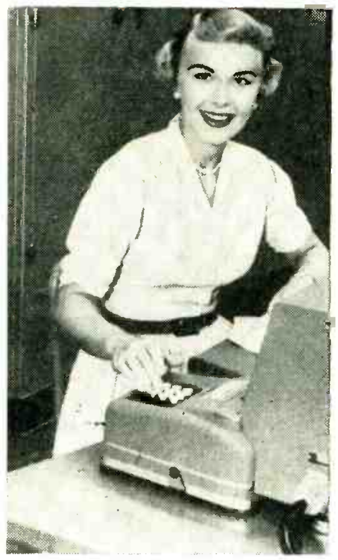


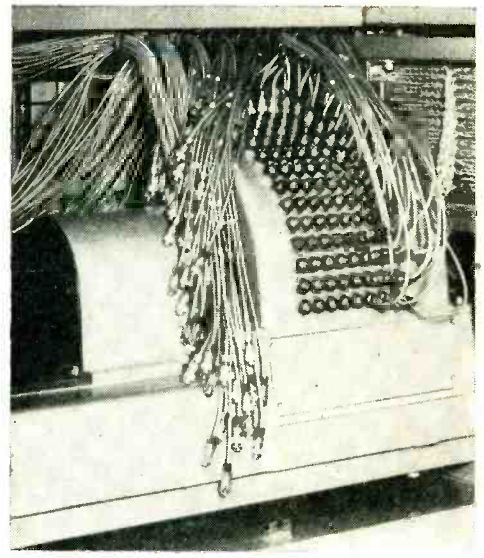
Tubes discarded by military technicians

▶ **Design Changes**—Pointing out that tube testing equipment is not adequate to determine whether a tube is functioning well in a particular equipment, the Navy announced that a small cathode-ray tube has been developed to be installed in equipment for checking critical waveforms.

Another design change recommended was soldering tubes permanently in plug-in circuits to ease maintenance chores and avoid tube-socket troubles.

Flexible-lead tubes were advocated to permit interchange of tubes with like electrical characteristics but different bases or pin connections. Other design changes listed included ceramic tubes and tubes having a flexible shield clamped to the bulb to ease mechanical shocks and provide cooling fins for heat dissipation.





MAGNETIC DRUM tallies mail-order data fed from keyboards, as . . .

Computers Aid Inventory Control

Several calculator firms aim at business market but output is still low

BUYERS for John Plain and Co., Chicago mail-order house are now supplied with up-to-the-minute inventory information that formerly took two weeks to process.

Heart of the system is a magnetic-drum memory device that is fed with order information from as many as ten adding-machine type keyboards. The machine can tally 13,000 items in each of three categories. Print-out is on adding-machine tape. Remington Rand's engineering research associates division believes the machine will prove useful for keeping perpetual inventory in a variety of business and industrial establishments.

▶ **Multipurpose Unit**—Several dozen orders are reportedly on hand for IBM's model 650 medium-sized drum calculator currently in production at the company's Endicott, N. Y. plant. Users of the machine will include railroads, steel mills, public utilities, aircraft plants, universities, mail-order houses, a salt factory and a camera manufacturer.

▶ **Other Firms**—The electronic computer division of the Underwood Corp. lists four machines in use and four on order. The firm specializes in low-cost ($80,000-250,000), general purpose calculators for business use. Customers include an electrical manufacturer, airplane maker and an oil company. The oil company will use its machine in connection with product distribution.

The Monrobot Corp. is concentrating exclusively on defense production at the Monroe Calculating Machine Company's new 100,000 sq ft plant in Morris Plains, N. J. Four machines have been completed and three are on order.

ARRL Warns UHF-TV Receiver Makers

DUAL-CONVERSION uhf-tv adapters, while providing uhf reception with uhf receivers at low cost, may be useless in certain areas in the vicinity of properly-operating amateur stations, according to an announcement by the American Radio Relay League. The ARRL report points out the possibility of trouble from beats between uhf-tv signals and amateur signals in the two-meter band.

Most vulnerable are receivers with 21.25-mc i-f's in areas serviced by tv stations on channels 14 to 18,

(Continued on page 18)

41 to 48 and 69 to 77. Receivers having 41.25-mc i-f's may be incapable of receiving channels 20 to 25, 51 to 58 and 82 and 83 in the presence of strong two-meter signals.

▶ **Goal**—The ARRL hopes that manufacturers of uhf converters and receivers with dual-conversion strips will take design steps to prevent interference of the type mentioned and to provide for service measures where such interference does occur. The league's aim is to prevent the country's 110,000-member amateur fraternity from having to "go through another difficult period, again not of its own making, carrying the burden of public misunderstanding and abuse which arises solely because of the inadequacy of television receiving apparatus."

Facsimile Speeds RR Ticket Sales

Customer at branch office receives ticket by facsimile from central sales bureau

TICKET sales at the Pennsylvania Railroad's Pittsburgh passenger station are greatly speeded up by a facsimile network that handles Pullman space reservations.

Customers' orders are received at the central ticket bureau from branch stations by facsimile and compared with a master file of preprinted tickets indicating available space on all trains out of Pittsburgh. The passenger's actual space coupon is transmitted to him by facsimile. Space information is displayed in the central sales office continuously on a 2 × 3-ft translucent screen in 1½-inch high letters.

Many firms with several men traveling Pullman daily are connected directly with the ticket-sales network by private facsimile wire. Heart of the system is Western Unions Deskfax equipment.

Pullman ticket orders received by facsimile are compared with preprinted space coupons on file at central ticket bureau. Passenger receives space coupon by return fax. Translucent screen in background shows available Pullman space

▶ **Other Uses**—Several novel uses for facsimile have been in the news lately. The Federal Reserve Bank of New York transfers $1 billion daily between member banks over its private facsimile system. A bank in White Plains, N. Y. recently caught a check forger by using fax to compare check signatures with the depositer's record card.

A traffic judge in Baltimore uses fax to check an offender's violation record on file with the state motor vehicle bureau before pronouncing sentence and American Express has a fax network to circulate numbers of stolen traveler's checks. In all, 10,000 units are installed in 50 different cities. Another 7,500 units will be installed during 1954.

Currently in the works at Western Union is a 300 word-per-minute letter facsimile unit and a special coupon transmitter for error-free transmission of waybills, wheel reports and other vital railroad operating data.

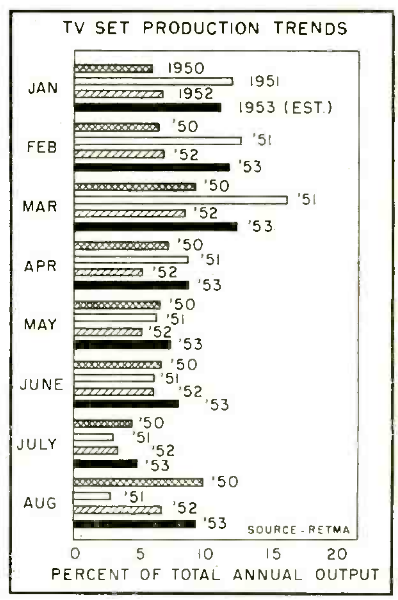
▶ **Canadian Weather**—A newly installed facsimile system links stations of the Royal Canadian Air Force for transmission of weather maps throughout the Dominion and and its territories.

Television Factories Shift Work Load

SEASONAL business conditions are continuing to shape tv receiver production trends but some progress has been made in leveling output, as is shown in the chart.

Summer months are still the production low point for the industry, with the month of July representing the lowest point for most years. But there has been some shift in the heavy output load of the last quarter to earlier months of the year. In 1950, 55 percent of total production was completed in the first 8 months of the year and in 1951, for the same period, 67 percent was produced. Last year the lifting of the freeze altered the trend but so far this year, if production estimates of 6.6 million sets hold true, over 72 percent of 1953 production was completed by the end of last August.

▶ **Changes**—The gradual shift of heavy production away from the last quarter of the year is seen by some manufacturers as being due to efforts of the industry to introduce new tv models in earlier summer months. The fact that some manufacturers are following the one-line-a-year policy is also having an effect.



Despite the trend, however, few

(Continued on page 20)

for you

100% Microscopic Inspection
Lowest Vibrational Noise Output
Higher Plate Voltage Ratings
Higher Bulb Temperature Ratings . . . 265°C.
More Uniform Low Heater Voltage Performance
Higher Heater Cycle Life Test Voltage

Each tube meets the latest military requirements for RELIABILITY — based on field and production tests for Shock, Vibration, 5000 Hour Life, Centrifugal Acceleration, Heater Cycle Life, High Temperature Life, Lead Fatigue.

All these Raytheon Reliable Subminiature Tubes must pass microscopic inspection

TYPE	DESCRIPTION	MAX. RATINGS			TYPICAL CHARACTERISTICS								
		Vibration Output mVac	Bulb Temp. °C	Plate Volts	Heater Volts	Heater Ma.	Plate Volts	Plate Ma.	Grid Volts or Rk	Screen Volts	Screen Ma.	Amp. Factor	Mut. Cond.
CK5702WA	RF Amplifier Pentode	**50**	**265**	**200**	6.3	200	120	7.5	200 ohms	120	2.6	—	5000
CK5703WA	High Frequency Triode	**10**	**265**	**275**	6.3	200	120	9.4	220 ohms	—	—	25.5	5000
CK5744WA	High Mu Triode	25	**265**	**275**	6.3	200	250	4.2	500 ohms	—	—	70	4000
CK5783WA	Voltage Reference	50	**175**	—		Operating voltage approximately 86 volts between 1.5 and 3.5 ma.							
CK5784WA	RF Mixer Pentode	100	**265**	**200**	6.3	200	120	5.2	-2	120	3.5	—	3200
CK5787WA	Voltage Regulator	—	220	—		Operating voltage approximately 100 volts between 1 and 25 ma.							
CK5829WA	Dual Diode	—	220	360*	6.3	150			Max. I_o = 5.5 ma. per plate				
CK6021	Medium Mu Dual Triode	50	250	165	6.3	300	100	6.5	150 ohms	—	—	35	5400
CK6111	Medium Mu Dual Triode	50	250	165	6.3	300	100	8.5	220 ohms	—	—	20	5000
CK6112	High Mu Dual Triode	25	250	165	6.3	300	100	0.8	1500 ohms	—	—	70	1800
CK6152	Low Mu Triode	**25**	**265**	**250**	6.3	200	100	10.0	270 ohms	—	—	17.5	5100
CK6247	Low Microphonic Triode	**1.0**	**250**	**275**	6.3	200	250	4.2	500 ohms	—	—	60	2650

*Peak inverse voltage   Note: All dual section tube ratings (except heater) are for each section.

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RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES manufacturers have any hope that the summer dip in production will ever be entirely eliminated. They point out that because summer months are vacation months for both consumers and tv production workers, mid-year periods will continue to be low points in both tv production and sales.

Financial Roundup

REPORTS to shareholders by companies in the electronics field continue to show increases in profits over 1952. The following firms issued profit statements for the first six months of 1953:

Company	1953 Net Profit	1952
Bendix Av. (9m)	12,618,552	10,338,784
Bulova Watch (3m)	1,769,391	1,337,279
El. Engineering (6m)	14,517	17,156
Emerson Radio (39w)	2,333,227	1,005,359
Garrett Corp. (12m)	3,084,984	2,699,900
Indiana Steel (6m)	209,601	145,164
I-T-E Circ. Breaker (6m)	1,237,255	1,332,418
Magnavox (12m)	2,238,337	1,343,760
Olympic Radio (6m)	21,115	*36,511
Oxford Electric (6m)	57,000	6,886
Westinghouse (6m)	35,660,000	31,507,000

*Loss.

▶ **Securities** — Clary Multiplier offered 29,090 shares of common stock (par $1) at 62½ a share. Net proceeds will be added to working capital.

Raytheon stockholders approved an increase in authorized common stock to four million shares. The proceeds, when it is sold, will be used for working capital for future requirements.

Texas Instruments merged with Intercontinental Rubber. Stockholders of Intercontinental can exchange one share of their stock for one share of Texas Instruments.

IT&T withdrew its SEC registration for a $35.8 million offering of 20-year convertible debentures.

General Fuse, with stockholders approval, will increase its capital stock so that it can accept an offer to combine operations with another company with established earnings. Proceeds of a stock sale, if approved, will be used for working capital and for debts.

Business Is Good For Radio-TV Dealers

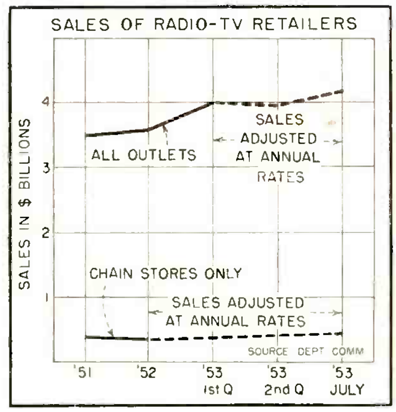
Independent and chain stores in the field are doing well but competition is increasing

ACCORDING to the latest RETMA survey, there are over 105,000 radio-tv dealers in the U.S., an increase of 9,750 in a ten-month period. At the present rate of business, according to the Commerce Department, total sales of radio-tv household-appliance stores, including chains, are seen reaching $4.2 billion this year, an increase of $0.6 billion over 1952 sales. Over half of this volume will be accounted for by radio and tv set sales, according to past ratios.

▶ **Income**—Basic factor accounting for the healthy trend in retail trade has been a growing volume of disposable consumer income, according to the Department of Commerce. It has been large enough so that increased radio-tv sales, as a percentage of disposable consumer income, have varied only slightly from past years. In 1951, 1952 and in the second quarter of this year, such sales took 1.6 percent of disposable consumer income.

All durable goods sales will take 25 percent of such income this year, at present rates. Automotive sales alone are taking 14 percent, an increase of 1.7 percent over last year. Radio-tv outlets may find that their biggest competition is coming from the automotive field.

▶ **Chains**—Sales by radio-tv-appliance chains of 11 or more stores are up so far this year. At annual rates, chain sales for the first seven months jumped to $427 million from $383 million last year and $392 million in 1951. As a percentage of total radio-tv retail outlet sales, however, the picture does not look far different. For the period from January to July of this year, chain sales accounted for 11 percent of total retail sales in the field, an 0.6 percent increase over last year. In 1951 the percentage was 11.2 percent.



Chain stores in the radio-tv field still account for a larger share of sales than do chains in any in the other durable goods classifications.

FCC Approves Interim TV Station Operation

NEW WRINKLE in tv station applications bids to speed up television service to areas where station applications are in contest before FCC. Three competing applicants for channel 12 in Shreveport, La. formed the Interim Television Corp. which, as its name implies, will construct and operate a tv station jointly while they await the outcome of hearings.

▶ **Setup**—The three competitors each own equal shares of stock in the interim corporation and have equal director representation. They will equally share the cost of constructing and operating the station. They have agreed that the petitioner who is successful in the hearing will purchase, at cost, the interests of the losing parties and will repay them for their actual expenses in connection with interim operation.

▶ **Results**—Since the case was the first of its kind to be approved and required a waiver of the rules, FCC has retained the right to cancel the authorization at any time. The Commission also ruled

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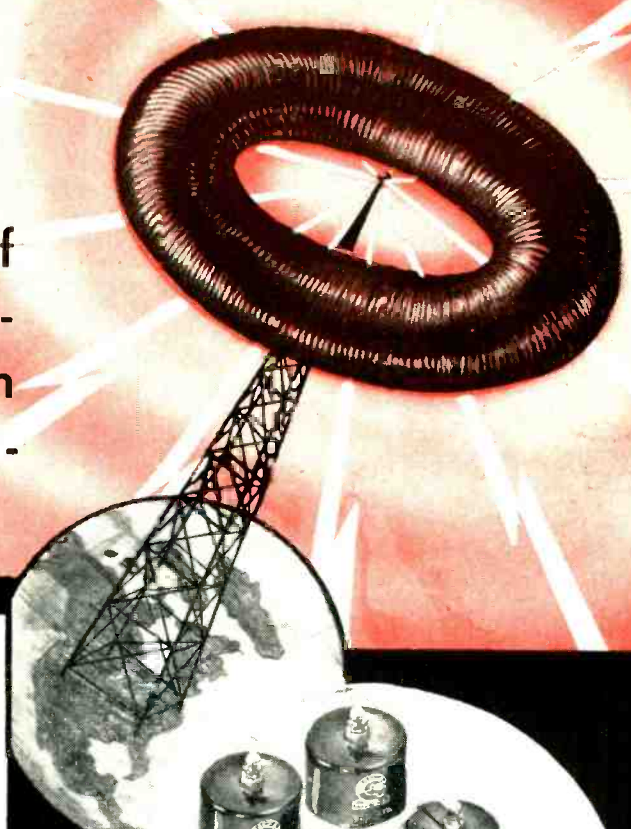
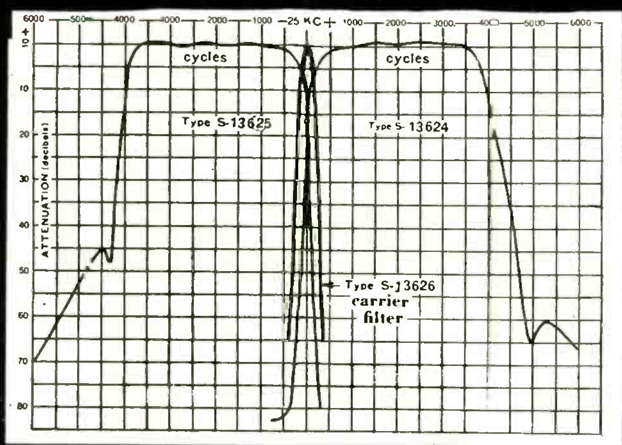
RIGHT ON TOP

Burnell records a few of it's most recent engineering achievements in Toroids and Filter Networks.

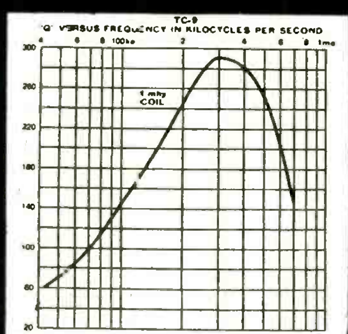


SIDE BAND FILTERS



Our most recent engineering achievement in communications filters has already stirred the interest of the leading receiver manufacturers in the country.

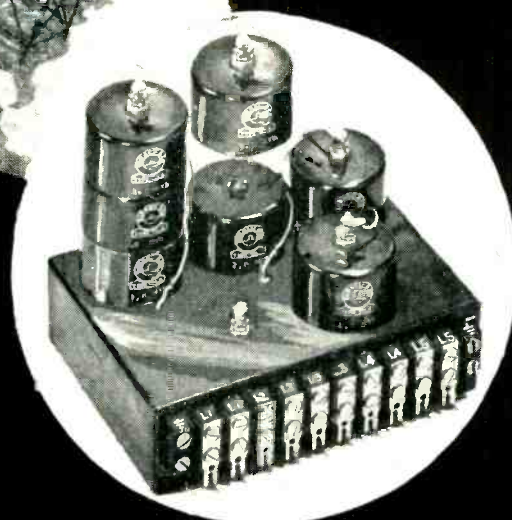
Our new side band filters which eliminate, for most applications, the necessity for expensive crystal filters are expected to accelerate the advancement of single side band communications.



SUB MINIATURE TOROIDS

Toroids for intermediate frequencies of 100KC to 1 megacycle. A wide variety of coils ranging in size from ½ inch provides high Q in the frequency range between audio and RF.

The tiny toroid about the size of a dime has been welcomed by designers of sub miniature electronic equipment for the transistor, guided missile and printed circuit field.



PLUG IN DECADES

An entirely new development in inductance decades eliminating disadvantages of switch boxes. Inductance units plugged together in various combinations providing decade steps of inductance with minimum number of units required.

MINIATURE TELEMETERING FILTERS

In recognizing the need for miniaturization of the presently bulky telemetering equipment, our engineering staff has succeeded in reducing the size of telemetering filters to as little as 25 to 50% of the original volume.

BURNELL & COMPANY is very pleased to announce that it now has available a 12 page catalog which includes valuable and complete information on toroids, high quality coils, and various audio filter networks.

The catalog includes complete descriptions, attenuation and Q curves that will prove valuable for equipment design engineers.

Write for Catalog 101-A.

Burnell & Company
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

Exclusive Manufacturers of Communications Network Components

that, in no event, will it extend the interim authorization beyond 10 days after the date a regular construction permit for channel 12 has been granted.

Armstrong Shows Binaural Multiplex

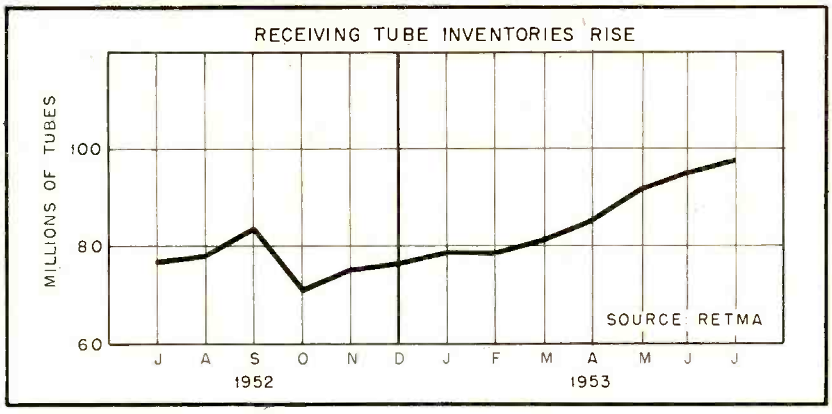
LATEST version of multichannel broadcasting first introduced in 1934 was recently demonstrated by Edwin H. Armstrong and John Bose at Columbia University. The new system, which has been undergoing secret field trials for several years, has the advantage of being compatible with existing f-m broadcasting techniques. Listeners will still be able to receive regular programs on existing receivers. Only those who wish to receive the side channel will require new receivers.

▶ **Binaural Reception**—Presently, radio station WQXR in New York is broadcasting all its live programs binaurally using both its a-m and its f-m transmitters for the two pickups. If Armstrong's multiplex were used, quality would be improved for those interested enough to purchase a new binaural f-m receiver.

During a part of the broadcast day, such a station could transmit a sponsored popular program, such as a ball game, on the side channel while a musical program is in progress on the main channel.

It would be easy, according to Major Armstrong, to substitute a communications channel (which uses a narrow band) for the additional broadcast channel. In fact, two communications channels might be squeezed in for taxi, police or other base station service.

▶ **Mobile Radio**—In conversations with an NARTB committee recently, Commissioner Sterling referred to the possibility of increasing f-m revenues by adding a multiplexed subscription-music channel. But his real shocker was the suggestion that f-m broadcasters supply the function of a base station for mobile communications systems. This would free the assigned base-station frequency for mobile use.



Receiving Tube Stocks Are Up

INDICATION of the state of business in the electronics industry as a whole is seen in the receiving tube inventories of leading tube manufacturers.

As shown in the chart, receiving tube inventories at the end of each month for the past year have steadily risen. Compared to July of 1952, inventories in July of this year were 20 million units higher. During the period, however, receiving tube sales rose nearly 50 percent.

▶ **Types**—Bulk of the receiving tubes on tube manufacturers shelves in July were of the type used in radio and tv receivers. In July, out of a 97.5 million tube total, 89.3 million tubes were of this type, enough to fully equip over 3 million tv receivers. The remaining 8.3 million were allied receiving types used in other commercial equipment.

▶ **In Sets**—Radio-tv receiver manufacturers also carry substantial tube inventories. Dollar value of receiving tube inventories in set manufacturers warehouses stood at $15,092,839 in April of this year, a slight increase over the $15,014,298 value computed for March. Tubes on hand are estimated to be enough to take care of two months of tv set production.

New Agency to Aid Business

Electronic manufacturers to be represented by two of 25 industry divisions

PROMOTION of business stability and growth are the dual aims of the Department of Commerce's newly established Business and Defense Services Administration.

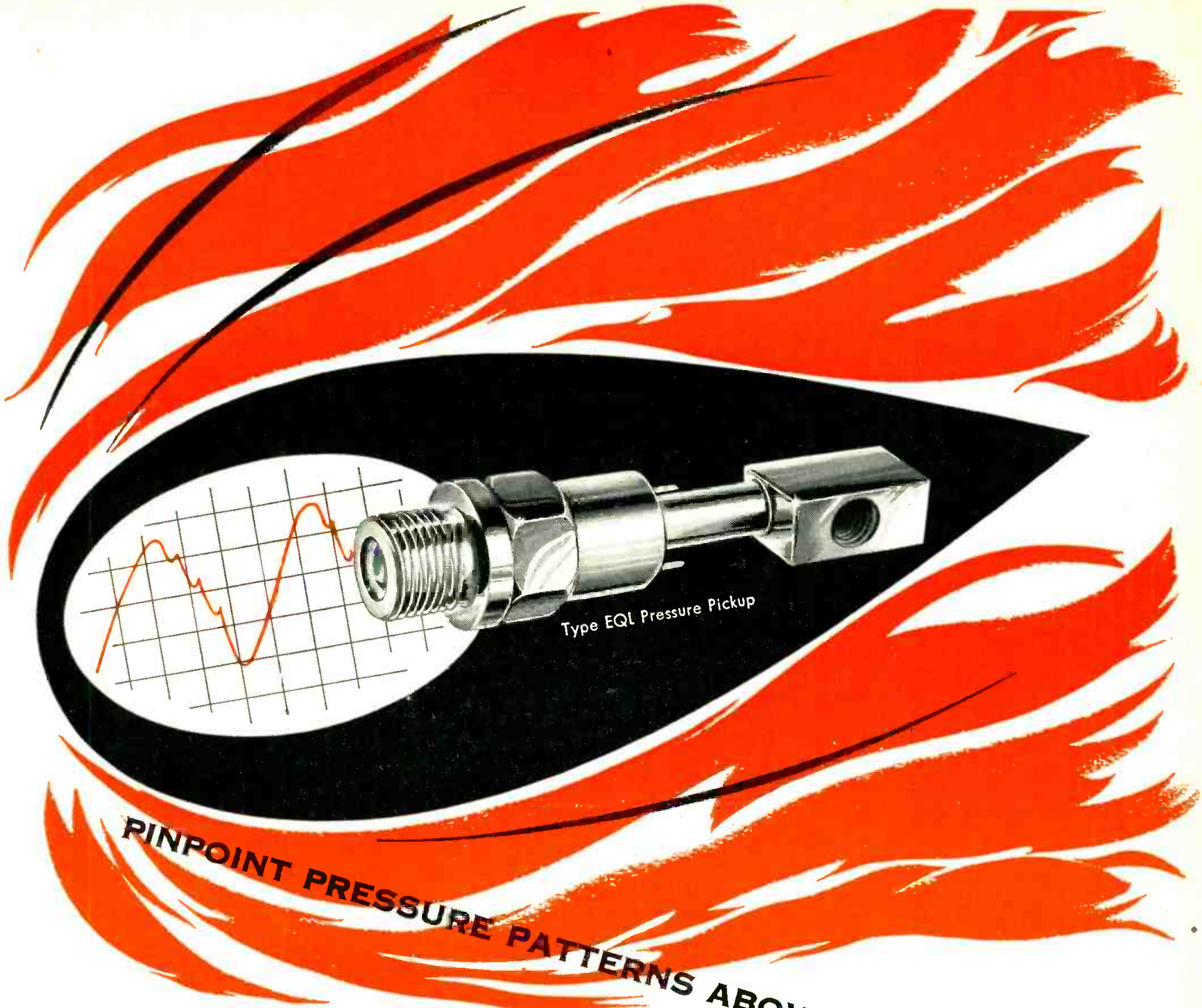
The agency is intended to foster government-industry cooperation through the exchange of information, ideas and services. It takes over some of the defense and mobilization functions of the now defunct National Production Board.

▶ **Three Heads**—The BDSA will comprise three offices: the Office of Technical Services, a clearing house for technological information, the Office of Small Business, providing liaison with the Small Business Administration and the Office of Distribution that will be concerned largely with the wholesale, retail and marketing trades.

▶ **Divisions**—Industry advisory councils made up of representatives from government and private industry will be named for the twenty-five industry divisions within the agency. There will be additional product divisions within the industry divisions.

The electronics industry will be

(Continued on page 24)



PINPOINT PRESSURE PATTERNS ABOVE 5000°F

Proven Design — new, high temperature pressure pickup uses same catenary diaphragm and tubular strain gage as NORWOOD CONTROLS' highly successful EP model. Immune to external vibration; mounts flush with negligible change in volume of pressure chamber; extremely high frequency response, flat to 10,000 cps, resonant frequency above 15,000 cps.

Withstands ultra-high temperatures — designed for use in rocket and jet engines, high temperature chemical reactions, etc. Efficient water-cooling system enables diaphragm to withstand gas temperatures above 5000°F. Heat transfer rate 11 BTU/sq. in./sec. with 85°F temperature rise of cooling water.

Corrosion resistant — All exposed parts of stainless steel, can safely be exposed to highly oxidizing conditions.

Full Scale Pressures — 500 and 1000 psi ranges down to 0 absolute with 1% of full scale accuracy and excellent temperature compensation. (Other ranges available on special order.)

A word about NORWOOD CONTROLS — *This name stands for an expanding line of commercial instruments for the measurement of pressure, flow, temperature and weight. It represents a fresh concept of creative engineering which, combined with New England manufacturing skill, is establishing new frontiers in the field of instrumentation.*

NORWOOD CONTROLS

CONTROL ENGINEERING CORPORATION
564 Providence Highway, Norwood, Massachusetts

Norwood Controls representatives are located in principal cities.
Complete technical information will be supplied upon request.

Want more information? Use post card on last page

represented in two divisions: communications equipment and electronics.

Donald Parris, former chief of NPA's electronics division, is acting director of the new electronics division. He is assisted now by a staff of six, including William Dulin, Edward Glacy and Charles Fess, all from NPA.

The electronics division will continue to review and make recommendations to the Office of Defense Mobilization on expansion goals, tax amortization and domestic loan applications. It will make recommendations on stockpiling or disposal of stockpiled strategic materials. It will collect, analyze and disseminate information on business activity as it affects the industry and will be the point of contact for the electronics industry in foreign trade.

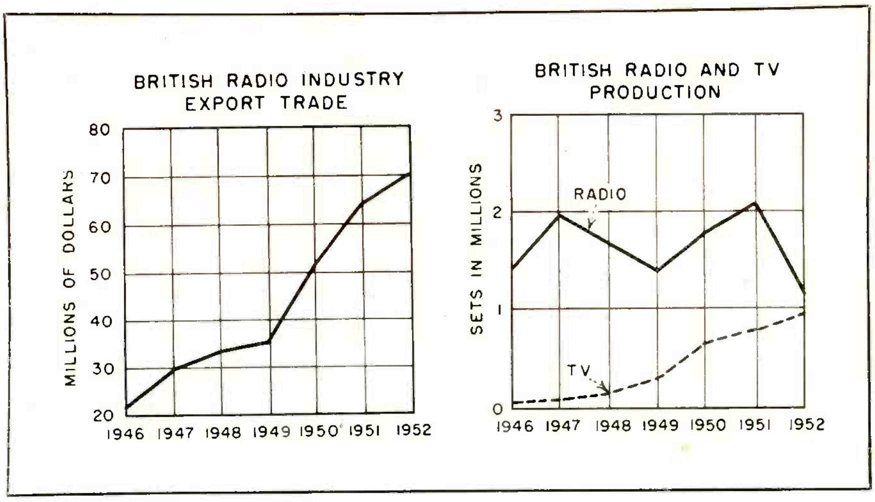
Crystal Sets Are Still Selling

ONLY a handful of companies in the U. S. specialize in crystal-set manufacture, but the market for such sets is still active and sales so far this year have increased over last year for the same period.

One manufacturer in the field estimates that a total of 150,000 sets were sold in 1952. The handful of companies accounted for a retail sales volume of approximately a half-million dollars. Prices range from $1.15 to $5.00 each. Over the past 30 years, about 8 million crystal sets have been sold.

▶ **Markets** — Manufacturers find their biggest sales in schools, hospitals and the youth market. Hospitals use crystal sets because head-phone operation prevents disturbance to other patients and because power is not needed. In the youth market, as in schools, many organizations find the sets an ideal and inexpensive way of keeping members interested. Other important markets are premium houses and nonelectrified areas.

Galena and catwhisker sets are still popular but two companies now supply germanium diodes in five-dollar models.



Britain's Electronics Industry Changes

PRODUCT structure of the radio and electronics industry in the United Kingdom has undergone a marked change since 1935, according to the *London Times Review Of Industry*. Companies and their products are far different now from prewar days.

▶ **Past**—England's 1935 Census of Production shows that only six percent of the total radio equipment produced that year could be classified as industrial, as opposed to domestic. Domestic radio and sound reproduction apparatus accounted for the remaining 93 percent. Nearly 100 radio firms employing over 35,000 people turned out equipment valued at $49.5 million. At that time, 80 percent of the output came from the 20 largest firms and almost 90 percent of total output was from companies in the greater London area.

▶ **Present**—Composition of Britain's electronic products output in 1952 shows that of an estimated total sales volume of $343 million, domestic radio accounted for only 25 percent, television took 30 percent and industrial apparatus, mainly defense items, 45 percent.

About 125,000 people are now employed by the industry and output is concentrated in the hands of a few large firms. Due to movement to suburbs, firms in the London area now account for about 65 percent of total sales.

▶ **Radio-tv**—*The Financial Times*, reporting on the radio and television segments of the industry, charts the total production and export figures shown in the graphs.

The trend in radio set production has been down, with 1952 output lower than any year since before 1935. Television production has been on an upswing with an estimated demand for a million sets a year for the next five years.

A breakdown of the export figures for 1952 shows sales of about $21.8 million in components, $22.4 million in transmitters, $14.1 million in receivers and $10 million in tubes. Two-third to a half of these exports went to countries in the British Commonwealth and about a third went to Europe.

FCC Gets New Member

PRESIDENT EISENHOWER has appointed Robert E. Lee as a member of the Federal Communications Commission for a seven-year term subject to Senate confirmation. He succeeds Paul A. Walker, whose term expired last June, and brings Commission membership to its full complement.

Commissioner Lee was formerly director of surveys and investiga-

(Continued on page 26)

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tions for the House Committee on Appropriations where he has served since 1946. He entered Federal service in 1938 as a special agent for the FBI and in 1941 was made administrative assistant to J. Edgar Hoover. He was assigned to build the FBI staff for new responsibilities under the threat of war. Later he was made chief clerk of the FBI and was in charge of all fiscal matters.

SMPTE Convention Stresses Electronics

INCREASING influence of electronics on the motion picture industry was pointed up at the recent convention of the Society Of Motion Picture and Television Engineers in New York City.

It was stated that technological improvements and changes in motion pictures and tv which may add up to half a billion dollars or more were on the agenda of the meeting. About 40 or 50 percent of this cost figure applies to new techniques such as 3-D and stereophonic sound apparatus for motion pictures. The rest applied to color tv, theater tv, subscription tv and a few other new communications developments. One estimate puts sales of stereophonic sound equipment for theaters at $15 million for 1954.

▶ **Theater TV**—Although the matter of theater tv network facilities has already been handled by the FCC, the subject was widely discussed at the convention. In a paper, the members were told that if theater tv was to have simultaneous presentation and spontaneity it would require networks similar to those now furnished tv broadcasters.

▶ **Technical**—Other subjects discussed at the convention ranged from a new tv film scanner which is said to offer better reproduction of both black-and-white and color motion pictures on home tv sets to the latest information on 4-track magnetic stripping production. Because of the great interest in sterephonic sound, a special all-day session was added to the convention schedule.

MEETINGS

OCT. 26–28: Radio Fall Meeting, RETMA, RTMA of Canada and IRE, King Edward Hotel, Toronto, Ontario, Canada.

OCT. 30–31: Third Meeting Of The Industrial Council, Rensselaer Polytechnic Institute, Troy, N. Y.

NOV. 2–6: AIEE Fall General Meeting, Hotel Muehlebach, Kansas City, Mo.

NOV. 9–12: National Electrical Manufacturers Association, Haddon Hall Hotel, Atlantic City, N. J.

NOV. 9–12: Conference on Radio Meteorology, Austin, Texas.

NOV. 12–13: IRE Fourth Annual Meeting of Professional Group On Vehicular Communications, Hotel Somerset, Boston, Mass.

NOV. 13–14: Annual Electronics Conference, Hotel President, Kansas City, Missouri.

NOV. 19–20: Sixth Annual Conference On Electronic Instrumentation And Nucleonics In Medicine, IRE, AIEE and ISA joint sponsorship, Hotel New Yorker, New York, N. Y.

DEC. 1–2: Frequency Response Symposium, ASME, Hotel Statler, New York, N. Y.

DEC. 8–10: Joint AIEE-IRE-ACM Computer Conference and Exhibition, Statler Hotel, Washington, D. C.

DEC. 14–16: Second Annual Wire And Cable Symposium, sponsored by Signal Corps Labs and the wire and cable industry, Berkeley Carteret Hotel, Asbury Park, N. J.

JAN. 18–22, 1954: Winter Meeting of AIEE, Hotel Statler, New York, N. Y.

JAN. 26, 27, 1954: AIEE Scintillation Counters Conference, Washington, D. C.

JAN., 1954: Conference on Radio Astronomy, Carnegie Institute of Washington, California Institute of Technology and National Science Foundation, Washington, D. C.

FEB. 4–6, 1954: Sixth Annual IRE Conference And Electronics Show, Hotel Tulsa, Tulsa, Oklahoma.

FEB. 11–12, 1954: Joint IRE, AIEE, ACM West Coast Computer Conference, Ambassador Hotel, Los Angeles, Calif.

MAR. 22–25: IRE National Convention, Waldorf-Astoria Hotel and Kingsbridge Armory, New York, N. Y.

APRIL 22–23, 1954: AIEE Conference On Feedback Control, Claridge Hotel, Atlantic City, N. J.

APRIL 24, 1954: Eighth Annual Spring Technical Conference, Cincinnati IRE, Cincinnati, Ohio.

APRIL 27–29: AIEE Electronic Components Conference, Washington, D. C.

MAY 5–7, 1954: Third International Aviation Trade Show, 71st. Regiment Armory, New York, N. Y.

MAY 24–26, 1954: AIEE Conference On Telemetering, Morrison Hotel, Chicago, Ill.

JULY 6–9, 1954: International Conference On Electron Microscopy, Joint Commission on Electron Microscopy of International Council of Scientific Unions, London, England.

SEPT. 13–24, 1954: First International Instrument Congress And Exposition, Commercial Museum and Convention Hall, Philadelphia, Pa.

SEPT. 1954: International Scientific Radio Union, Amsterdam, Netherlands.

SEPT. 30–OCT 2, 1954: Second Annual International Sight and Sound Exposition, Palmer House Hotel, Chicago, Ill.

Industry Shorts

▶ **Figures** for the National Electronics Conference show that 6,880 visitors, 1,500 more than last year, attended exhibits of 114 manufacturers and listened to 98 technical papers.

▶ **Telecommunications** Planning Committee has been reestablished by the U. S. to provide immediate attention for telecommunications matters necessary to national defense.

▶ **Nippon** Television Network's first tv station JOAX-TV, took to the air on August 28 in Tokyo.

▶ **Work** will begin shortly on the construction of a $1 million Central Electronics Engineering Research Institute in Pilani, Central India, that will undertake research and development work in all aspects of electronics.

▶ **Television** broadcasting has not yet been approved in Australia by the government but nearly 120 preliminary tv station license applications have been made.

▶ **Hi-Fi** sales may reach between $200 and $300 million in 1954, according to RCA Victor.

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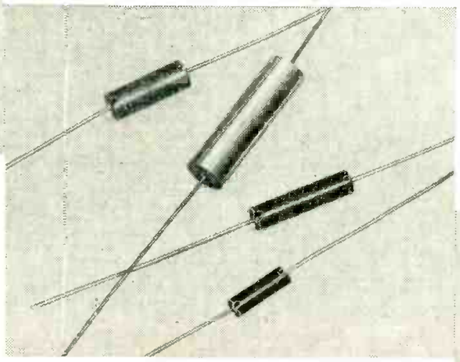
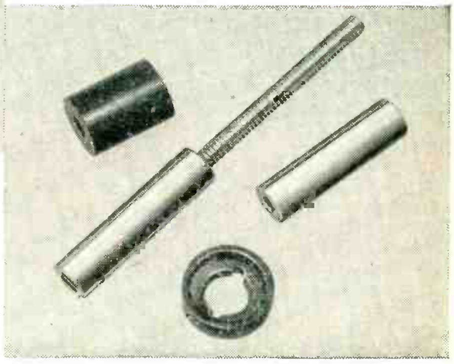
Moldite Dependability
in all 3!

FERRICORES



MOLDED COIL FORMS



MAGNETIC IRON CORES

Moldite's famed precision production facilities are now devoted to 3 major types of electronic components—to give the industry a superlative core or coil form for every electronic application.

Through years of continued engineering and research Moldite has produced cores of guaranteed dependability, economy, quality and uniformity. Our customers' smooth running production lines tell the story best.

Specify a Moldite core specially designed and precision made for you, with absolute uniformity from first to last.

FERRITE CORES
MOLDED COIL FORMS
(iron and phenolic)
MAGNETIC IRON CORES
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Samples promptly submitted upon request for design, pre-production, and test purposes

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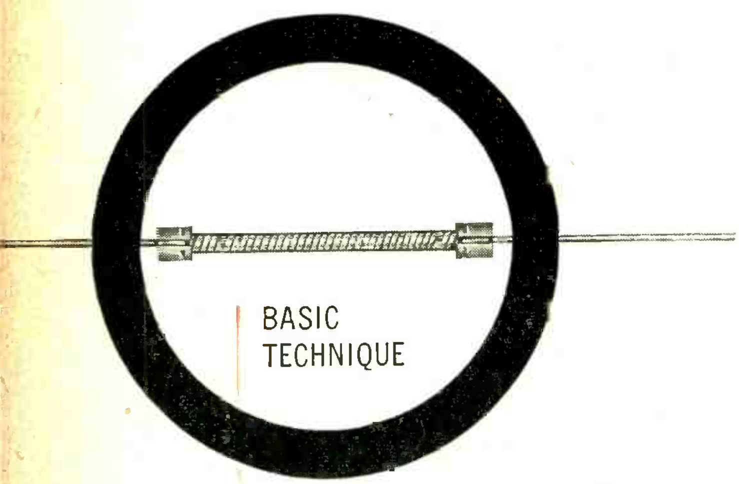
Precision, high-speed winding equipment for IRC elements

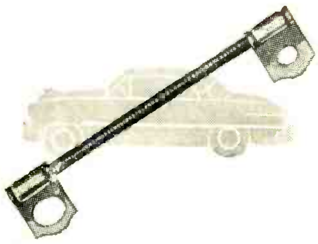
ONLY IRC WINDING SKILL OFFERS



BASIC TECHNIQUE

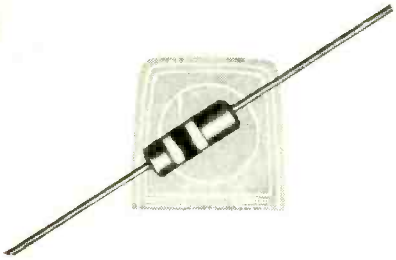
Wire element is uniformly and tightly wound on an insulated core. Axial leads or other terminations are secured to element by automatic machinery. Insulated housing may be used or omitted.

If you seek savings in component costs,
IRC's winding skill may serve your need.
IRC's mastery of winding wire elements
dates back more than 25 years. Today,
it provides a wide variety of unique units
that offer realistic possibilities for
savings. Cost-conscious IRC engineers
will glady analyze your requirements.



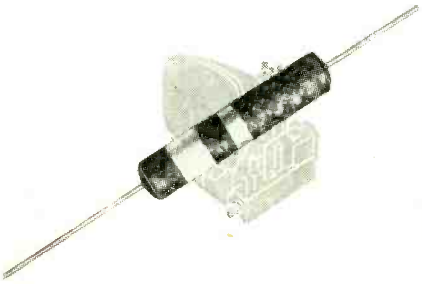
14c savings per car

Type AW Wire Wound resistors save automobile manufacturers an average of 14c per car. For quantity requirements, these low-cost windings can be made specially to suit individual designs. This adaptability has proved profitable to numerous appliance manufacturers.



low cost—low wattage

Type BW insulated wire wounds offer excellent stability in low ranges—at low prices. Leading instrument manufacturers attest to their superiority. ½, 1 and 2 watt sizes are equivalent to Jan types RU-3, RU-4 and RU-6.



50% savings

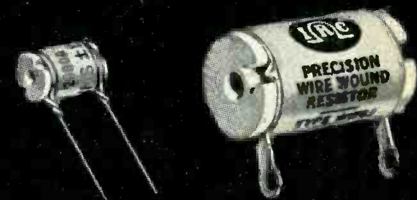
IRC Insulated Chokes offer savings up to 50% over ordinary types. Available in two sizes, they are fully protected against humidity, abrasion, assembly damage and danger of shorting to chassis. A favorite source of savings for TV and radio set manufacturers.

THESE SAVINGS

inexpensive solution

4-watt Insulated Power Wire Wounds with axial leads can save several cents over conventional power resistors. Inorganic core and high-temperature plastic housing allow safe operation up to 165° C. Widely used in toys, juke boxes and amusement devices.

NEW specifications



MIL-R-93A AMENDMENT 1

Government specifications for precision wire wound resistors have been revised. MIL-R-93A Amendment 1 is the new rigid standard.

IRC PRECISION WIRE WOUNDS

meet and beat these new specifications. They are equivalent to Mil types RB-15 through 19.

MAXIMUM STABILITY

Temperature cycling even beyond Mil requirements has only negligible effect. Send for new technical bulletin.

Boron & Deposited Carbon Precistors • Power Resistors • Voltmeter Multipliers • Low Wattage Wire Wounds • Insulated Composition Resistors • Volume Controls •

Wherever the Circuit Says

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Precision Wire Wounds • Ultra HF and Hi-Voltage Resistors • Low Value Capacitors • Selenium Rectifiers • Insulated Chokes • Hermetic Sealing Terminals •

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403 N. Broad St., Philadelphia 8, Pa.

In Canada: International Resistance Co., Ltd., Toronto, Licensee

Send me technical data on: ☐ Precision Wire Wounds; ☐ Insulated Chokes; ☐ BW Resistors; ☐ 4-Watt Power Resistors

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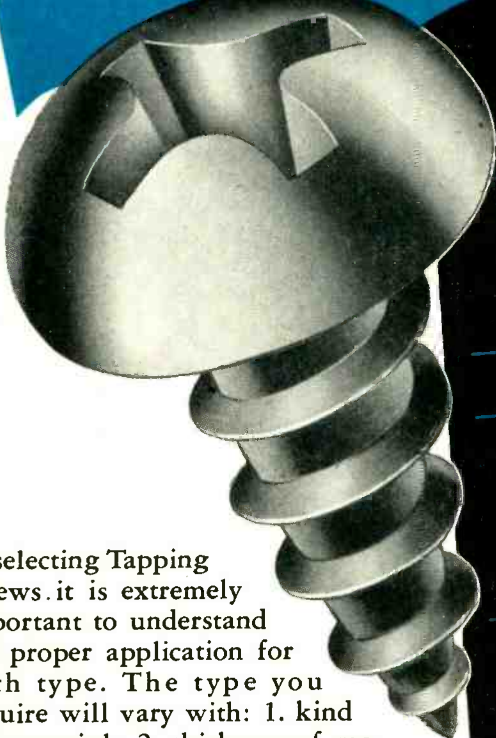
Title____________________

Company____________________

Address____________________

City__________State__________

HOW TO SELECT TAPPING SCREWS

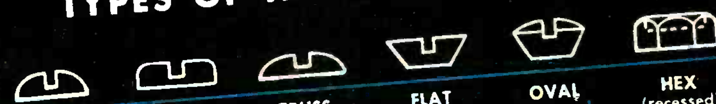


In selecting Tapping Screws it is extremely important to understand the proper application for each type. The type you require will vary with: 1. kind of material; 2. thickness of material; 3. the method used for making the hole.*

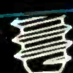
Lamson Tapping Screws are precision made to insure maximum holding even in thin material, fully hardened to permit the thread crests to form clean threads without stripping hole. They are available in a wide range of head and point combinations. A "special" Tapping Screw to many . . . is a "stock" item at Lamson.

*This information is available in tabular form for easy reference. Write for as many copies as you need.

TYPES OF TAPPING SCREWS



AVAILABLE WITH SLOTTED, CLUTCH OR PHILLIPS HEAD RECESSES

POINTS AND THREADS		METAL THICKNESS	HOLE DIAM.	POINT DIAM.
 TYPE "A"	Spaced thread with gimlet point. Use in light sheet metal, resin impregnated plywood, asbestos compositions etc.	From .018" To .048"	.128" To .149"	Sharp (for easy starting)
 TYPE "B"	Spaced thread with pitches finer than type "A" but with same general uses. Blunt point for better appearance. Point requires less space.	From .018" To ⅜"	.144" To .173"	.130/.125
 TYPE "C" COARSE OR FINE THREAD	Thread similar to machine screw threads. Used where a machine thread is preferable. May be used with machine nut for extra strength. Requires higher driving torques than "A" or "B".	From .037" To 5/16"	.154" To .177"	.147/.133

*These specs. apply only to #10 tapping screw in sheet steel

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PLUG NUTS
Ideal for blind or hard-to-reach places.

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Forged steel, heat-treated.

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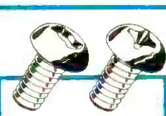
Cup point type, hardened and heat-treated.

PLACE BOLTS
With "Built-in" spring action for positive locking.

LOCK NUTS
Economical, vibration proof. Can be used repeatedly.

"BENT BOLTS"
Including U bolts, eye bolts, hook bolts, etc.



MACHINE SCREWS
Clutch and Phillips recessed head screws.

SEMS
Pre-assembled lockwashers on tapping and machine screws.

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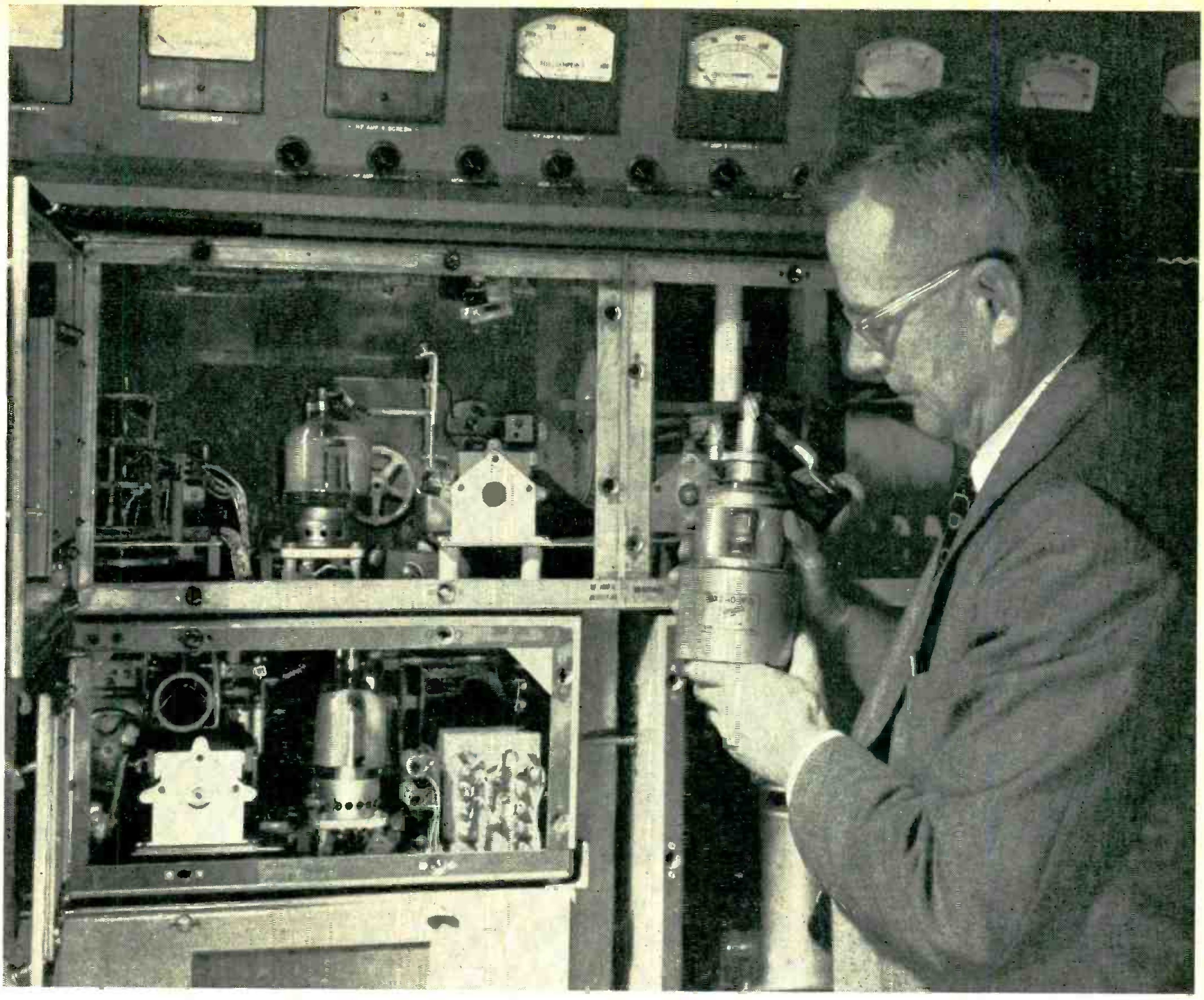


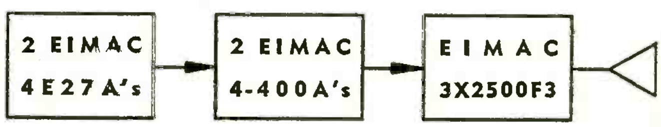
L. G. Young, Bell Telephone Laboratories, Inc., inspects Eimac tubes in LD-T2 transmitter.

Western Electric multi-channel, single side band Transmitters use Eimac tubes in final RF stages

LD-T2 transmitters designed by Bell Telephone Laboratories, for overseas multi-channel communications, are another example of Bell System equipment that meets severe performance requirements. Manufactured by Western Electric, type LD-T2 single sideband suppressed carrier transmitters operating between 4 and 28 mc., handle numerous channels simultaneously with outstanding dependability and performance. Naturally, electron power vacuum tubes in the LD-T2 must meet exacting specifications.

Eimac 4E27A radial-beam power pentodes, 4-400A radial-beam power tetrodes and 3X2500F3 power triodes fill sockets in the final three stages of the RF sections in Western Electric LD-T2 transmitters.

Final Three RF Stages



For information about Eimac electron power tube write our application engineering department.

Eimac TUBES

EITEL-McCULLOUGH, INC.
San Bruno, California

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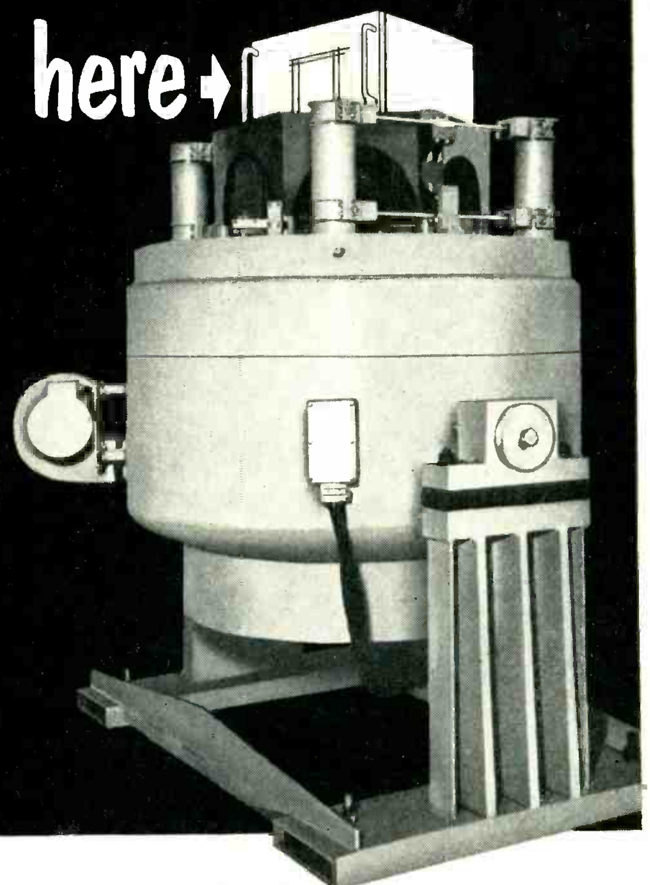
Put *your* product here→ to shake-test it with 10,000 lbs force



MB produces the largest exciter ever built to meet heavy duty vibration test specifications

THERE'S nothing like a good shaking to test out structural designs, electronic equipment, instruments or complete assemblies for faults or flaws. In fact, for many products put to military use, such tests are *specified.* However, since *all* products encounter some vibration or shock in service, many engineering departments use an MB Exciter to test all designs. By so doing, the "bugs" are discovered in the test laboratory instead of out in the field, at cost of good will.

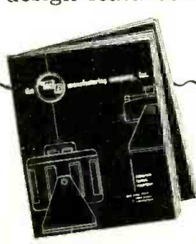
Largest in the line of MB electromagnetic shakers, the Model C-100 shown delivers at least 5 tons continuous force. Its performance permits heavy duty vibration testing to MIL-E-5272 and other specifications. It incorporates a number of unusual design features for easy, quick, convenient operation—including interlocking controls for complete safety and provisions for cycling tests.

HOW TO HANDLE LARGE MASSES

MB can show you a setup of vibration exciter and resonating beam that multiplies the capacity of versatile MB Exciters many fold.

Shaker being used in this fatigue strength test of aircraft engine mounts is the model S-3 rated at 200 lbs. Others available down to 10 lbs. force output.

Vibration is MB's specialty. You're invited to draw on the benefits of this specialization—and get highly qualified products for testing and control, and technical help on your problem.



Valuable bulletins for test engineers
Calibrating vibration pickups to 2000 cps is comprehensively covered in MB Bulletin No. C-11-1. Bulletin No. 1-VE-1 describes vibration exciters and details their specifications. Write today.

THE MB MANUFACTURING COMPANY, INC.
1060 State Street, New Haven 11, Conn.

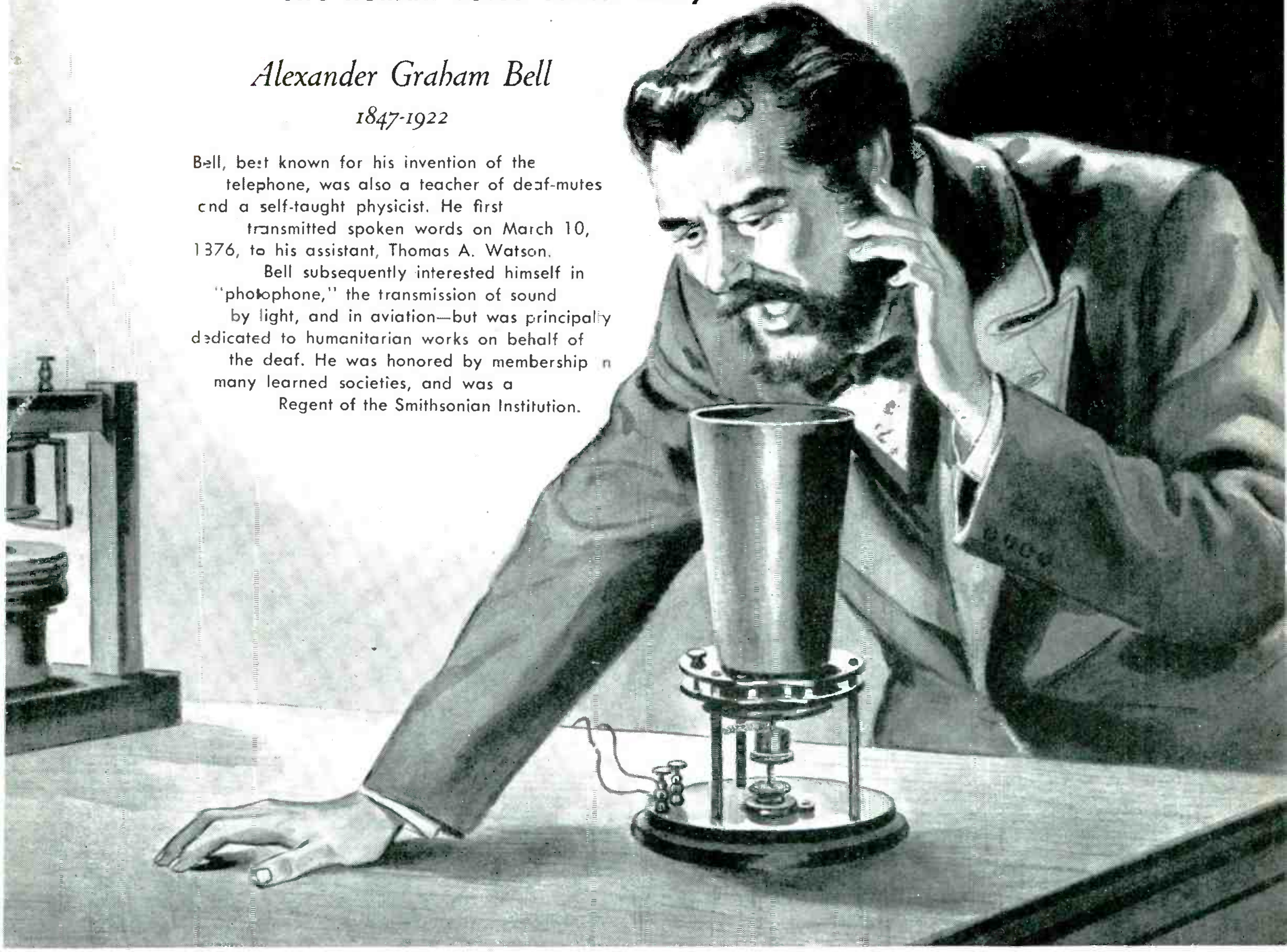
HEADQUARTERS FOR PRODUCTS TO INDUCE VIBRATION . . . TO MEASURE IT . . . TO ISOLATE IT

Bell ...First to transmit the human voice electrically

Alexander Graham Bell

1847-1922

Bell, best known for his invention of the telephone, was also a teacher of deaf-mutes and a self-taught physicist. He first transmitted spoken words on March 10, 1876, to his assistant, Thomas A. Watson. Bell subsequently interested himself in "photophone," the transmission of sound by light, and in aviation—but was principally dedicated to humanitarian works on behalf of the deaf. He was honored by membership in many learned societies, and was a Regent of the Smithsonian Institution.



From an original drawing made for Ohmite

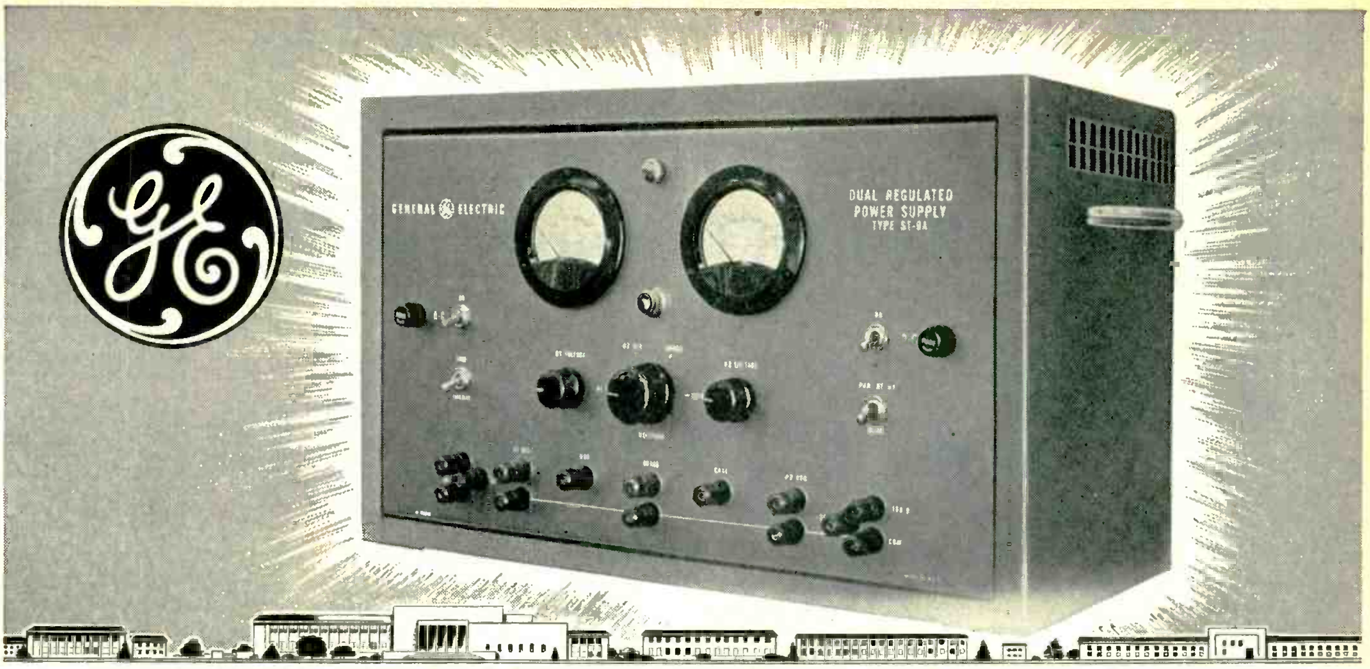
OHMITE®

...First in resistors—today

For the resistors *preferred* by industry everywhere, look no further than Ohmite! Dependability and long, trouble-free life have made Ohmite resistors the favorite in their field. Moreover, they are available in an unusually wide range of sizes and types—which means you can select a resistor *precisely* suited to your needs. Don't just specify resistors . . . specify Ohmite!

Be Right with OHMITE

RHEOSTATS • RESISTORS • TAP SWITCHES



ELECTRONICS PARK—G-E HEADQUARTERS FOR ELECTRONICS RESEARCH

Need a DUAL Regulated Power Supply?

Get the G-E ST-9A with *twin outputs* and featuring . . .
ELECTRONIC OVERLOAD PROTECTION *plus* BUILT-IN MODULATOR

No power supply on the market today can match this new G-E unit for general laboratory purposes. Routine bench casualties are no problem for the ST-9A: the instruments cannot be harmed by short circuits on the regulated outputs. And—with the built-in modulator you can now observe hum and noise tolerances by actually duplicating them on the equipment. This saves you time by establishing final power supply design specifications quickly.

TYPE ST-9A ELECTRICAL SPECIFICATIONS

OUTPUT VOLTAGES

#1 Regulated—Continuously variable, 0-500 volts, maximum current 100 ma
#2 Regulated—Same as #1
Parallel #1 and #2—Continuously variable, 0-500 volts, maximum current 150 ma
Unregulated—Approximately 650 volts no load, maximum current 200 ma
—75 Volts—VR tube regulation, 0-2 ma
—150 Volts—VR tube regulation, 0-4 ma
Filament Supply—6.3 volts a-c at 10 amps

REGULATION

Better than ½% + ½ volt

RIPPLE AND NOISE

Less than 3.5 mv (10 mv peak-to-peak) on all regulated outputs

INSTRUMENTS

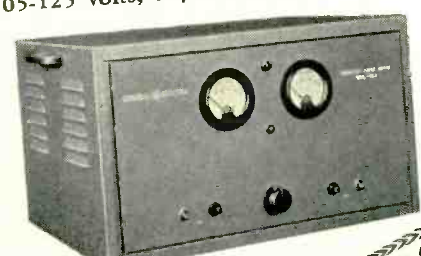
Milliameter 0-300 ma d-c; voltmeter 0-500 volts d-c; voltage and current can be metered at #1 and #2 Regulated and Unregulated outputs; total current drawn from all outputs can be metered and it should not exceed 200 ma

OVERLOAD PROTECTION

3 amp fuse in the a-c line; ⅜ amp fuse in the d-c line; overload of any degree on the regulated outputs will harm neither the supply itself nor the instruments.

G-E POWER SUPPLY YPD-2

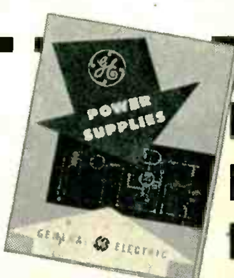
Excellent for many laboratory applications. DC Voltage Output: 250-450 volts, (positive or negative may be grounded to chassis). DC Current Output: 0-300 milliamperes. AC Output: 6.3 volts 10 amperes unregulated. Regulation: Less than 1% of output voltage from minimum to maximum current. Ripple: Less than 5 mv peak to peak. Output Impedance: Approximately 2 ohms at 30 cycles, decreases with increasing frequency. Power Requirements: 105-125 volts, 50/60 cycle, 350 watts maximum.



General Electric Company, Section 4113
Electronics Park, Syracuse, N. Y.

Please send me a copy of your G-E POWER SUPPLY CATALOG (ECB-6A).

NAME..
COMPANY.......................................
ADDRESS.......................................
CITY.......................STATE..............



1878 75 1953 YEARS OF ELECTRICAL PROGRESS

GENERAL ELECTRIC

DX

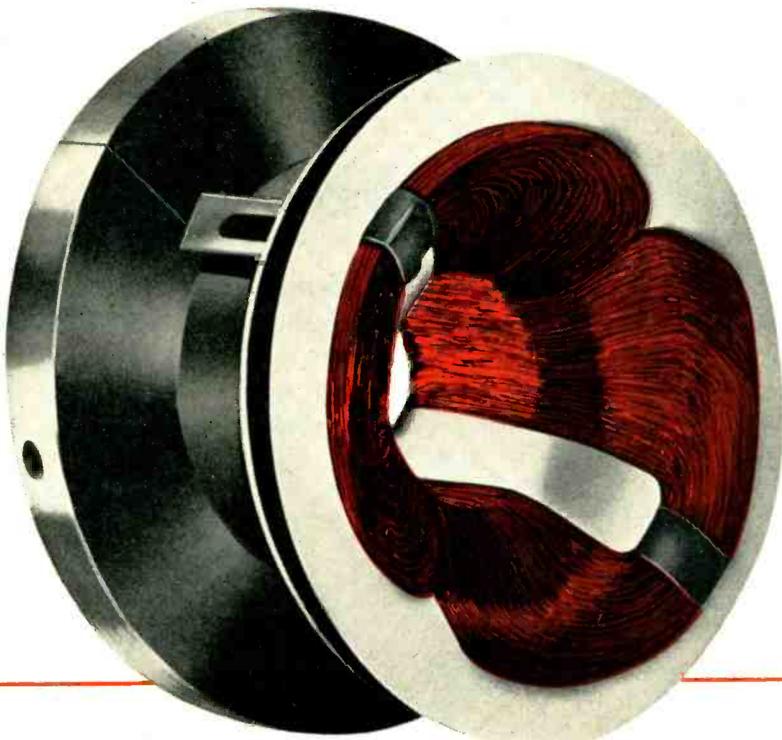
COMPONENTS

"the heart of a good television receiver"

TRADE MARK

DX RADIO PRODUCTS COMPANY

PRODUCTS *wired for life* with WARREN WIRE



The new DX 90° Deflection Yoke for 27" tubes is especially designed for television receiver manufacturers who want a sharp full-screen focus with a minimum of pincushioning. This compact component blends advanced engineering skills with the finest materials to assure top performance and economy. Here, as in the manufacture of many other fine electric and electronic products, Warren Wire is used for its easy handling, efficiency and dependability. There's a Warren Wire Engineer near you trained to help you solve your wire problems right in your own plant. There is no obligation, of course.

NEW! Send for our new "Magnet Wire Reference Tables" Chart

WW

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Manufacturers of Plain Enamel, Nylon, Formvar, Teflon and Served Magnet Wires . . . Teflon Hook-up and Lead Wire . . . Tinned and Bare Copper Wire.

*Office and Warehouse

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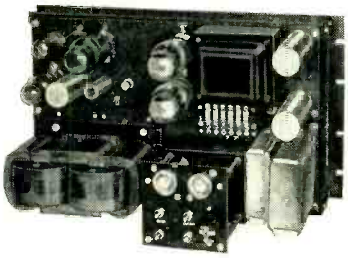
TO MAINTAIN CONSTANT OUTPUT VOLTAGES
STABILINE *Automatic* VOLTAGE REGULATORS
are available in 2 DISTINCT TYPES

TYPE IE INSTANTANEOUS ELECTRONIC



For the most exacting control

featuring:

INSTANTANEOUS CORRECTION — as compared with any other type. Operation is entirely electronic without moving parts. Complete correction is effected in 3 to 10 cycles depending on variations in line voltage, load current, load power factor and other conditions.

EXCELLENT STABILIZATION AND REGULATION — The maximum change in output voltage will not exceed: ±0.25 per cent for any or all changes or variations in operating conditions — ±0.1 per cent for input voltage changes — ±0.15 per cent for load current or power factor changes from lagging 0.5 to leading 0.9.

MINIMUM WAVEFORM DISTORTION — Except under the most adverse conditions, distortion is usually under 2 per cent.

MUCH WIDER INPUT RANGE — than most competitive types. Ranges are 95-135 volts for a nominal output of 115 volts and 195-255 volts for a nominal output of 230 volts.

ADJUSTABLE OUTPUT VOLTAGE — Output from a nominally 115 volt unit is adjustable from 110 to 120 volts and from 220 to 240 volts on a nominally 230 volt unit.

INSENSITIVITY TO FREQUENCY CHANGES — but to maintain optimum correction characteristics, tolerances should not exceed ±10 per cent of the specified frequency.

STANDARD MODELS — are available in numerous ratings in capacities up to 5.0 KVA.

TYPE EM ELECTRO MECHANICAL

to control industrial loads — offer zero waveform distortion

featuring:

UNUSUALLY HIGH EFFICIENCY — is an outstanding feature of the Type EM. It is comparable to that of the most conservatively designed fixed-ratio transformers.

ZERO WAVEFORM DISTORTION — is a primary requirement for many electronic applications. Type EM provides a constant output voltage which is a faithful and distortionless reproduction of the applied input waveform.

RAPID CORRECTION — Type EM is an electro mechanical device. While it does not correct instantaneously, it provides faster correction than most other automatic voltage regulators.

WIDE INPUT RANGE — is another important feature. Range is 95-135 volts for a nominally 115 volt unit; 195-255 volts for a 230 volt unit; 400-520 volts for the 460 volt units.

ADJUSTABLE OUTPUT VOLTAGE — Output from a 115 volt unit is adjustable from 110 to 120 volts; output from a 230 volt unit is adjustable from 220 to 240 volts; output from a 460 volt unit is adjustable from 420 to 460 volts.

INSENSITIVE TO FREQUENCY AND SYSTEM POWER FACTOR — Designed for 50/60 cycle power lines, all of the Type EM will perform satisfactorily at any frequency from 45 to 65 cycles. In addition, Type EM is insensitive to the magnitude and power factor of the load and has no effect on the system power factor.

STANDARD MODELS — are available for 115, 230 or 460 volt, 50/60 cycle, single and three phase operation in capacities up to 100 KVA.

. . . AND SPECIAL TYPES

application engineered to meet individual requirements

Specializing in the design, development and manufacture of Voltage Control Apparatus, The Superior Electric Company offers its experience to help in solving any voltage control problem. The Superior Electric Company is pleased to analyze your individual needs and will recommend the STABILINE Automatic Voltage Regulator best suited to your application.

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

Manufacturers of

- POWERSTAT VARIABLE TRANSFORMERS
- STABILINE AUTOMATIC VOLTAGE REGULATORS
- VOLTBOX A-C POWER SUPPLIES
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SEND COUPON TODAY FOR BULLETIN S351 featuring engineering and application data on STABILINE Types IE and EM.

THE SUPERIOR ELECTRIC CO.
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Please send my copy of Bulletin S351.

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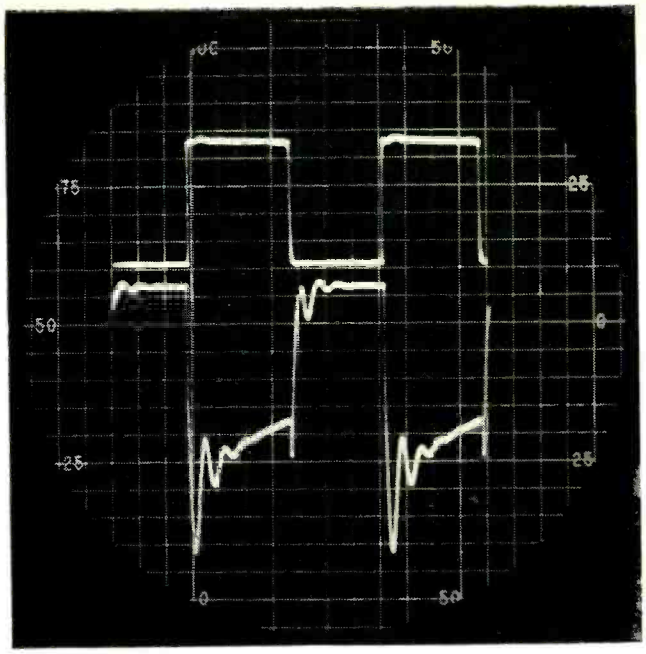
Observe and Measure...

Grid and plate waveforms of amplifier are displayed on common time base for accurate comparison. Grid waveform (top) observed on 100 millivolts full scale; plate waveform (bottom) observed on 100 volts full scale. Illuminated calibrated scale facilitates both visual observation and analysis of oscillogram.



...with the new

DU MONT TYPE 322-A

Dual-Beam Cathode-ray Oscillograph

PRICE $895

Observe and *accurately measure* two signals simultaneously on a single cathode-ray tube screen with the new Du Mont Type 322-A Cathode-ray Oscillograph.

In addition to the well-known advantages of observing the true relationship between two signals on the same screen, Du Mont offers built-in, accurate amplitude calibration of each of the two channels in the new Type 322-A. Push-button calibration, plus an illuminated scale permit rapid, convenient, wide-range voltage readings of signals.

The accuracy achieved in the new calibration system of the Type 322-A results from the use of the newly developed Du Mont Type 5AFP- tight tolerance cathode-ray tube.

FEATURES

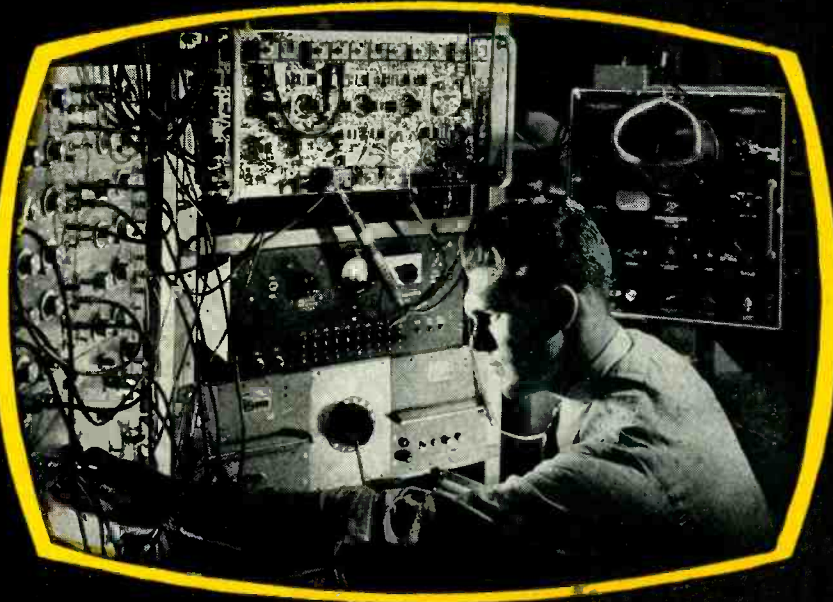
- High-accuracy, dual-beam Type 5AFP- Cathode-Ray Tube.
- Essentially two complete time-tested Type 304-A cathode-ray voltmeters in one cabinet. Ranges of measurement from 100 millivolts full scale to 1000 volts full scale.
- Expansion to 5 times full scale vertically and 6 times full scale horizontally.
- Sweep ranges from 2 cps to 30 KC compatible with frequency range of d.c. to 10% down at 100 KC.
- New concentric knobs for easy manipulation and accurate resetting.
- Illumination of special calibrated scale can be varied for viewing and photography.

DU MONT

for Oscillography

WRITE FOR 322-A BROCHURE

INSTRUMENT DIVISION • ALLEN B. DU MONT LABORATORIES, INC. • 760 BLOOMFIELD AVENUE, CLIFTON, N. J.



MEPCO'S NEW SEALED Precision Resistors STOP Humidity Failures

Over 2 years of laboratory development and testing were required to achieve a sealed resistor design up to Mepco's standard of quality. No sacrifice of our standard time-proven features have been made in order to perfect this sealed resistor.

SPECIFICATIONS: Meets all requirements of MIL-R-93A and JAN-R-93.

SEALING: Completely encapsulated and bonded.

OPERATING TEMPERATURE: −65°C. to +125°C.

WINDINGS: Reversed and balanced PI-windings for low inductance with use of only the finest "certified" resistance alloys.

EXCLUSIVE INTERNAL FEATURES: Internal section's cross-over wire insulated from winding by 2000 v. insulation (patented). Special metal molded connecting feature, which bonds end of winding and terminal in a non-corrosive and mechanically secure manner — no solder or flux used.

TERMINALS: Rigid hot solder coated brass terminals for easier and more secure soldering.

TYPE	NOMINAL WATTAGE RATING	RESISTANCE		NO. SECTIONS	SUPERSEDES JAN-R-93 TYPE
		MIN.	MAX.		
RB15 (M15)	.25 .50	0.1 ohm 0.1 ohm	.185 meg. .6 meg.	2	RB10
RB16 (M16)	.35 1.00	0.1 ohm 0.1 ohm	.3 meg. 1.5 meg.	2	RB11
RB17 (M17)	.50 1.00	0.1 ohm 0.1 ohm	.3 meg. 2.0 meg.	4	RB12
RB18 (M18)	.50 1.00	0.1 ohm 0.1 ohm	.75 meg. 4.0 meg.	4	RB13
RB19 (M19)	1.00 2.00	0.1 ohm 0.1 ohm	4.0 meg. 15.0 meg.	8	RB14
RB52 (M52)	.25 .50	0.1 ohm 0.1 ohm	.1 meg. .5 meg.	2	RB51

MIL - R - 93A
WATTAGE & RESISTANCE TOLERANCE

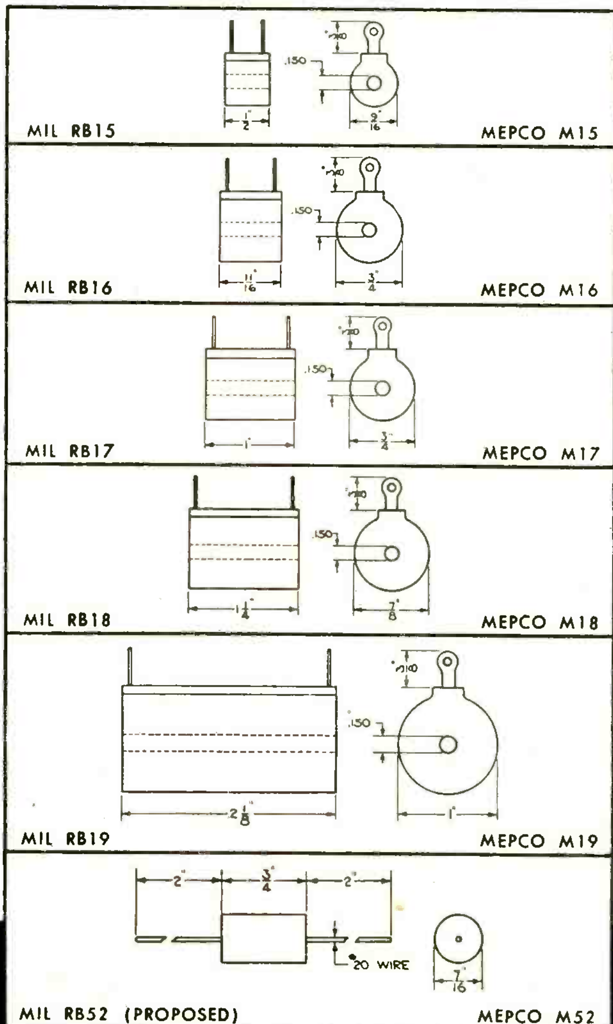
TOLERANCE SYMBOL	RESISTANCE TOLERANCE	PERCENT OF NOMINAL WATTAGE
B	0.10 %	50 %
C	0.25 %	50 %
D	0.50 %	75 %
F	1.00 %	100 %

MIL - R - 93A
TEMPERATURE COEFFICIENT
(REFERRED TO 25°C)

SYMBOL	EXPRESSED IN PERCENT PER DEGREE C.	
	NEGATIVE, MAX.	POSITIVE, MAX.
E	0.0022	0.0022
J	0.0040	0.0155
K	0.0050	0.0255

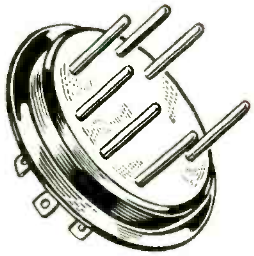
SPECIAL REQUIREMENTS

Variations of the above ratings, tolerances, temperature coefficient, etc. can be supplied to special order.



MEPCO, INC. MORRISTOWN, NEW JERSEY

In Addition to Its Regular Line of Compression Seals
With Individually Glassed Terminals...



Hermetic

Offers a Complete Line of

MULTI-TERMINAL

HEADERS & PLUGS

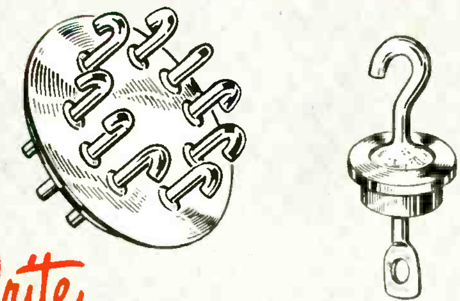
In "All-Glass" Compression CONSTRUCTION

"All-Glass" Compression HERMETIC Seals offer many advantages for components which require headers of unusual ruggedness because of adverse design, assembly or shop handling conditions.

- The greater strength of these "all-glass" units is due to the controlled, compression-type construction.
- They offer greater economies over headers constructed with individual glass beads.
- The improved glass construction of the "all-glass" units prevents the formation of moisture pockets.
- There is also greater insulation resistance and voltage breakdown inherent in the longer leakage path of the "all-glass" construction.

Because there is infinite application for these new units, they are available in a wide variety of mounting flange arrangements to fit existing or new designs.

And, of course, HERMETIC also offers its complete regular line of individually glassed multi-headers and plugs, plus single terminals, feed-throughs and stand-offs.



Write for complete information on how HERMETIC engineers can apply "All-Glass" Compression Seals to your regular or special applications. Available, too, is HERMETIC's Brochure CS on compression seals, as well as a 32-page catalog on its standard line.

Hermetic Seal Products Co.
31 South Sixth Street
Newark 7, New Jersey

SEALED IN by HERMETIC HEADERS

FIRST AND FOREMOST IN MINIATURIZATION

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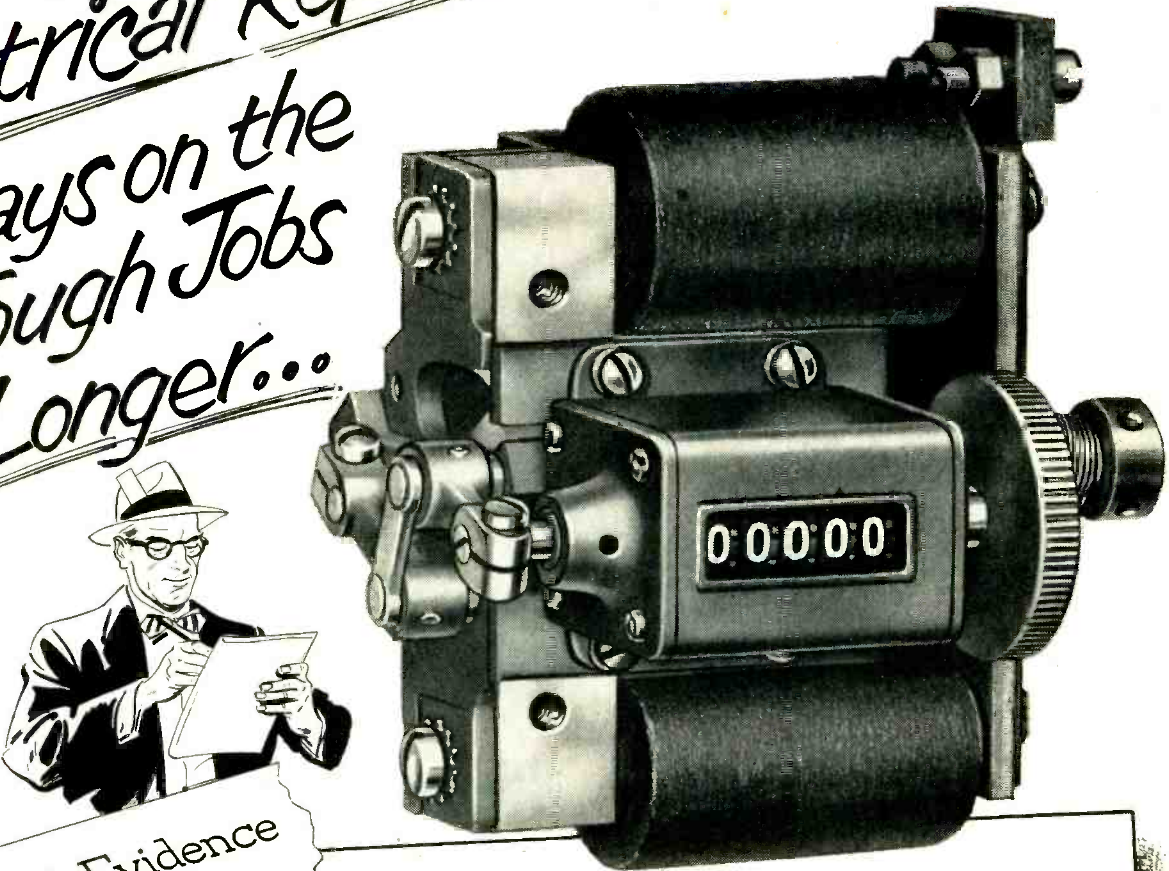
This Electrical Reporter Stays on the Tough Jobs Longer...



Added Evidence that

Everyone Can Count on VEEDER-ROOT

Compact and rugged . . . this electrically operated reset counter is specially designed for tough jobs that demand longer counter life.

Here's another instance of the *infinite applicability* of Veeder-Root *Count*rol — electrical, mechanical or manual. And here's another instance, too, of the endless resourcefulness of Veeder-Root engineering, and the ability to design a *complete counting package* that fits the job fully and exactly. Now . . . what's *your* problem?

VEEDER-ROOT INCORPORATED

"The Name That Counts"

HARTFORD 2, CONNECTICUT

Chicago 6, Ill. • New York 19, N.Y. • Greenville, S.C.
Montreal 2, Canada • Dundee, Scotland
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ERIE

Complete line of

DISC CERAMICONS®

HIGH VOLTAGE

HIGH VOLTAGE DISC CERAMICONS employ the same basic diameters that have been standardized in 500 volt Ceramic capacitors. Careful and detailed life testing has been accomplished over a long period of time to establish required dielectric thicknesses to assure conservative ratings in the high voltage line. Standard voltage ratings range from 1,000 through 6,000 Volts, D.C., Working.

TEMPERATURE COMPENSATING

TEMPERATURE COMPENSATING DISC CERAMICONS, in four sizes, offer all standard combinations of temperature coefficient and capacitance value. They are tested for conformance to Erie specifications for Tubular Ceramicons and meet all requirements for RTMA REC-107A Class 1 ceramic capacitors. They are available in capacity ranges up to 725 mmf.

GENERAL PURPOSE

GENERAL PURPOSE DISC CERAMICONS have low series inductance which assures efficient high frequency operation. They are made in sizes from 5/16" to 3/4" diameter, and in capacitance values ranging from 10 mmf to .02 mfd.

ERIE DISC CERAMICONS are available in three styles, each having a wide range of capacitance values for the basic applications. These capacitors consist of flat ceramic dielectrics with fired silver electrodes. Lead wires are firmly soldered to the electrodes, and completed units are given a protective coating of wax impregnated phenolic. For complete description and specifications, write for catalogs and samples.

ERIE components are stocked by leading electronic distributors everywhere.

25th Anniversary

TRADE ERIE MARK

RESISTOR CORP.

ERIE RESISTOR CORPORATION . . . ELECTRONICS DIVISION

Main Offices: **ERIE, PA.**

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Factories: **ERIE, PA. • LONDON, ENGLAND • TORONTO, CANADA**

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For *Critical* Applications

Triplett 630-A Has No Counterpart

Accuracy
to 1½%

Readability
with a Mirror-Scale

Adaptability
with ½% resistors

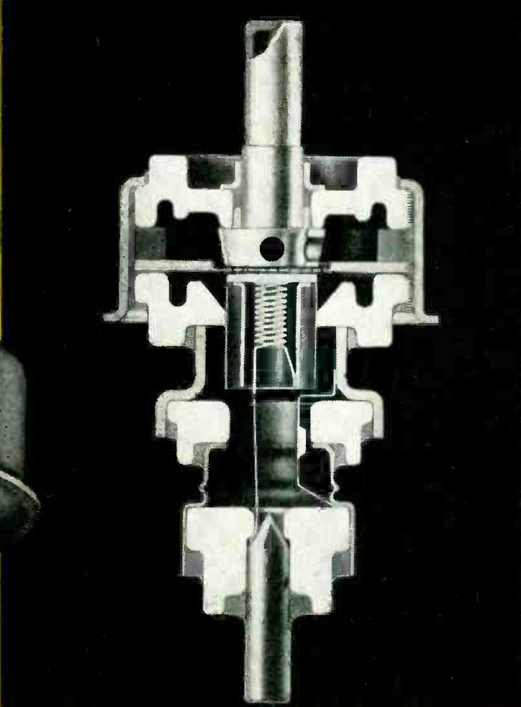
Try This Volt-Ohm-Mil-Ammeter at your distributor's

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON— OHIO

New G-E LOW-NOISE U-H-F AMPLIFIER TRIODE

Only 8.5 decibels at 1200 megacycles!

GL-6299

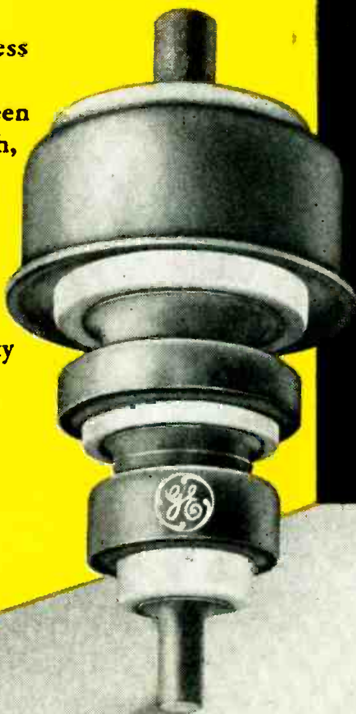


Greatly Improves Reception!

EQUIPMENT DESIGNERS! In G. E.'s new GL-6299, you have a low-level Class A amplifier for frequencies up to 3,000 mc, with an exceptionally low noise figure—8.5 db or better at 1,200 mc; under 14 db at 3,000 mc.

RESULT: better all-around reception. In radar, less "grass." To make this possible, the highest standards of tube precision workmanship have been observed. Grid-cathode spacing is only .0004 inch, or less than 1/10 the diameter of a human hair. Similar close tolerances and exact measurements mark the rest of this tiny, finely-engineered triode.

At the same time, the GL-6299 is sturdy—shock-resistant—mounts coaxially with large contact areas. An electrical plus is the tube's ability to (1) withstand spike voltages, (2) reduce their overloading effect on later circuit stages. Means stepped-up reliability of equipment! . . . Write for Booklet ETD-810, with full tube description, ratings and performance curves. *Tube Department, General Electric Company, Schenectady 5, N. Y.*



Actual Size

1 inch high.
Gold-plated.
Made like
a fine watch.

APPLICATIONS INCLUDE:

- Military radar and communications equipment.
- Commercial microwave communications and relay systems.
- Aircraft communications equipment.
- Electronic navigation aids.
- Signal generators.

1878 75 1953 YEARS OF ELECTRICAL PROGRESS
Diamond Anniversary

GENERAL ELECTRIC

163-1A9

LITTON ENGINEERING NEWS

NOW! Dependable pressure monitoring of high vacuum systems during processing

The new Litton Ionization Gauge is a rugged and completely dependable production tool for monitoring pressures from 10^{-4} to 10^{-7} mm Hg. The instrument is a Philips-type gauge*, specifically engineered for constant production monitoring of high vacuum pressures. It eliminates annoyance and costs of burned-out gauges, activation of poisoned cathodes, heating of grids, etc. Even in steady, day-after-day use, it requires no attention other than a chemical cleaning about twice a year.

Cold Cathode Emitter

The Type L-3032 gauge was developed within Litton Engineering Laboratories to facilitate our own manufacturing of vacuum tubes. It utilizes crossed electric and magnetic fields which enhance collision probability in a small volume so that a cold cathode emitter can be used. Thus operation, even at atmospheric pressure, will not damage the tube. (In normal use, the tube is not operated until black-out of the vacuum system is reached. Good relative pressure readings are available throughout the range of 10^{-4} to 10^{-7} mm Hg.) Type L-3032 tubes have been tested during the past two years on Litton vacuum tube production lines. They are now installed on every exhaust station in our plant.

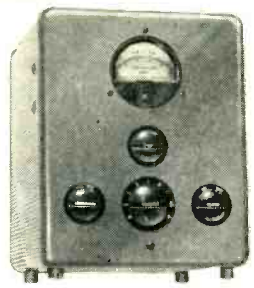
Type L-3032 Ionization Gauge (above) with adapter for glass systems

Monel-Encased

The Ion Gauge Tube is composed of a monel-encased interaction space with the case near ground potential. A nichrome wire anode at 2,500 volts is centered within the case. An outgassing 6.3 volt heater is mounted near the monel case, but insulated from it. A ¾″ diameter kovar tube, insulated from the monel case by a glass seal, is supplied for connection to the vacuum line. The magnetic field is provided by permanent magnets mounted in a sheet steel shell. This shell also serves as a return magnetic path, connection block, package envelope and oven for the outgassing heater. Electrical connections are made to binding posts on the steel case. The tube weighs but 22 oz. and measures 7″ x 5″ x 3½″. \$60.00.

Model 4301 Ionization Gauge Amplifier

This amplifier is a companion instrument for Type L-3032 Ionization Gauge Tube. It includes a range switch for measuring from 10^{-4} to 10^{-8} mm Hg., a special leak-check control providing full scale deflection at any pressure, a zero adjustment control, and a gauge heater supply switch.



Model 4301 Amplifier

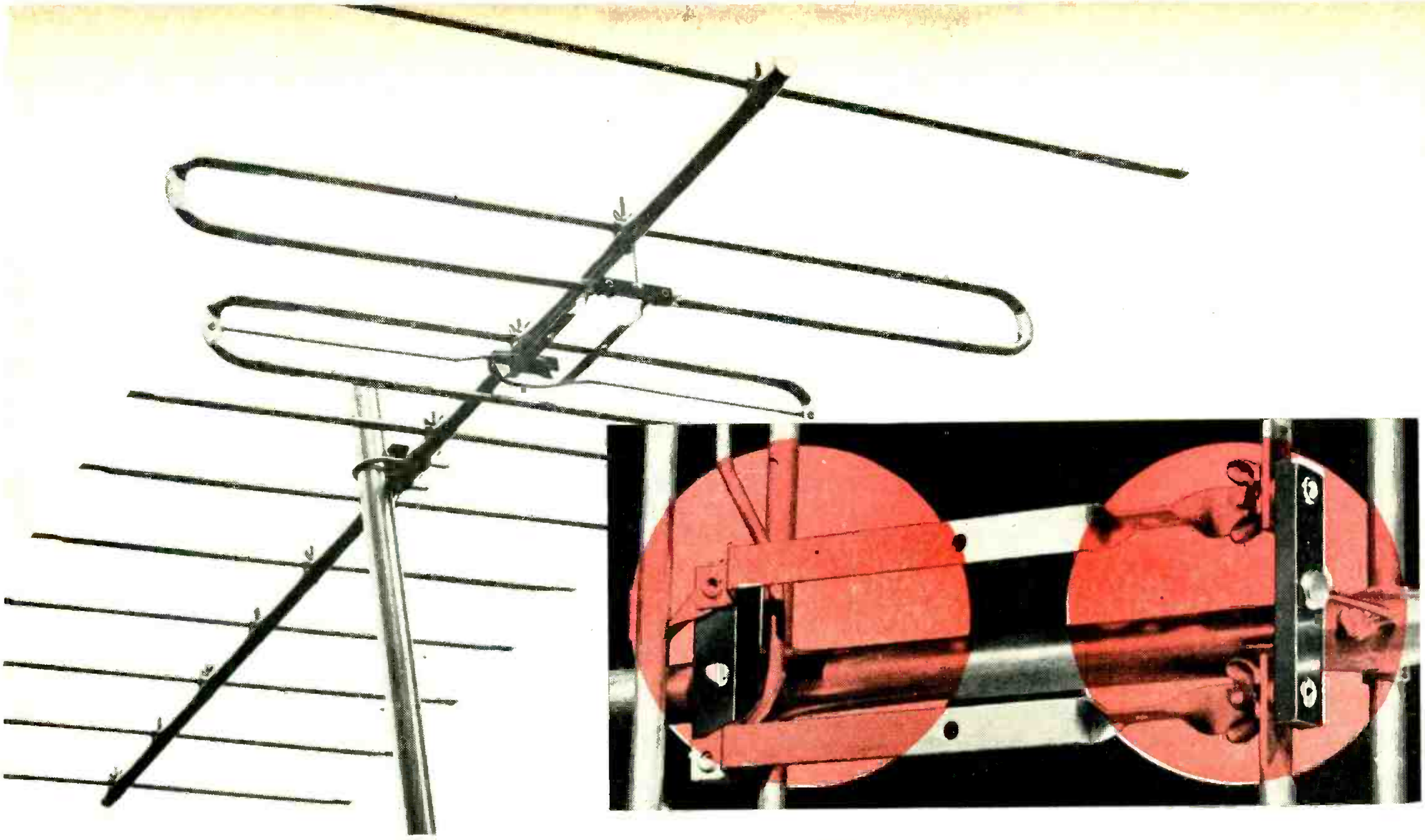
It consists of a high voltage rf power supply, a vacuum tube voltmeter circuit with current-sampling resistors, a 6.3-volt transformer (to provide current for the outgassing heater in Type L-3032 Ionization Gauge Tube) and a self-regulating low voltage power supply providing wide input voltage variation without affecting performance. Electrical connection is by cable with banana plugs to Type L-3032 Ion Gauge. Power supply requirements are 110 volts, 60 cps. The instrument measures 10″ x 8″ x 8″. Weight is 17½ lbs. \$255.00.

**Licensed under Philips Laboratories, Inc. Patent No. 2197079 Data subject to change without notice. Prices f.o.b. factory.* 2743

LITTON ENGINEERING LABORATORIES

1049 BRITTAN AVENUE • SAN CARLOS 2, CALIFORNIA • U. S. A.

Manufacturers of glassworking lathes and attachments, vertical sealing machines, pumps, spotwelders and timers, burners, Molube, bell jars, hydrogen furnaces, thermopiles, ion gauges and amplifiers, U-lines, water loads, dielectric stubs, phase changers.



economical PHENOLITE low-loss block insulators . . . on famous *CHANNEL MASTER* TV antenna

Channel Master's famous Futuramic antenna combines Broad Band TV coverage with the high gain and directivity of the Yagi. Utilizing Phenolite low-loss block insulators—the Futuramic is the one antenna that solves *today's* reception problem, yet will also receive *tomorrow's* VHF channels.

This use of Phenolite is typical of its countless applications in the electrical field. Phenolite, about one-half the weight of aluminum, is the perfect insulating material for high and low voltage applications.

It possesses an unusual combination of properties. Phenolite has great mechanical strength and high resistance to moisture; ready machinability; is unaffected by solvents and oils. It can be easily punched, sawed and sheared. Tough and with high impact strength, Phenolite is one of the strongest materials per unit weight known.

Available in various grades and colors; in sheets, rods, tubes, and special shapes. Write for literature and engineering information—

Channel Master's two dipole system—connected by Phenolite low-loss block insulated harness—makes possible the high gain and directivity of the Futuramic broad band Yagi antennas.

Illustrated: Futuramic Model 1173 broad band Yagi antenna covering channels 7-13, Channel Master Corporation, Ellenville, New York.

NATIONAL VULCANIZED FIBRE CO.

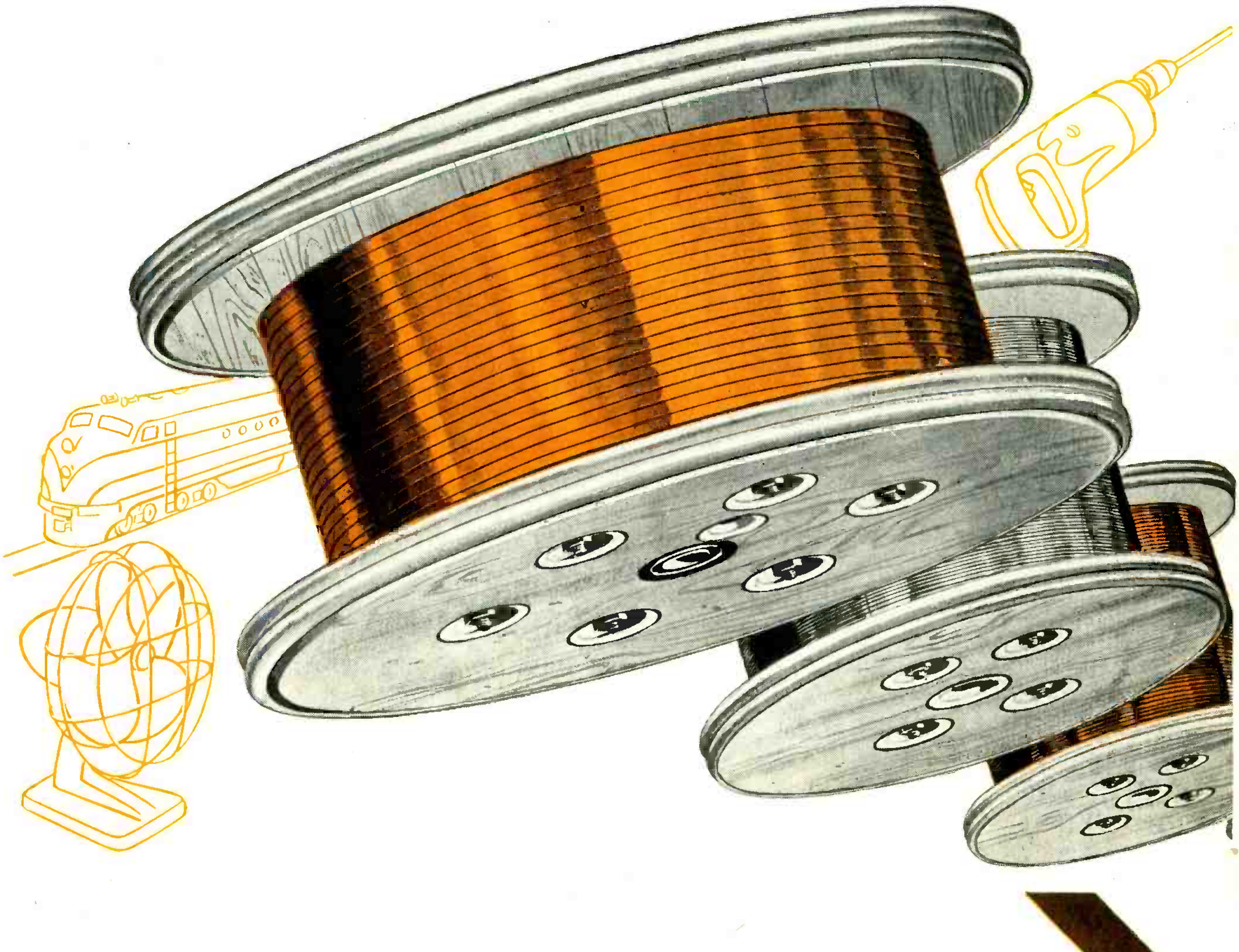
Wilmington Delaware

Offices in Principal Cities

Since 1873

Rely on **PHELPS DODGE** *for Magnet Wire and*

THE RIGHT WIRE TRANSFORMER,



First for Lasting Quality—from Mine to Market!

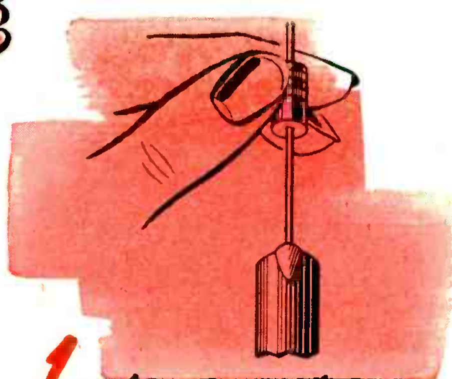
"Drop that Soldering"

Revolutionary new method wraps connections so tightly that soldering is unnecessary

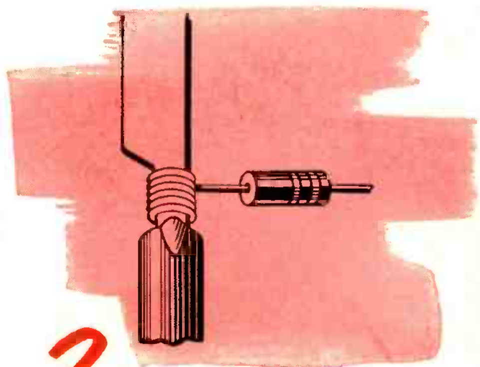
Here is a method that produces electrical connections more reliable than the most skillfully soldered connections . . . in a fraction of the time . . . at a fraction of the cost. Operator training takes only minutes instead of days.

By replacing hand operations with pneumatic or electric Wire-Wrap Tools, you get consistently uniform connections all through the day. Rejects are greatly reduced . . . inspection becomes simple . . . production costs are cut.

Investigate this revolutionary new process—write for Bulletin No. 11, today.



1 INSERT WIRE



2 ZIP... AND

Wire-Wrap Tools

are now available from Keller—the original manufacturer

KELLER TOOLS

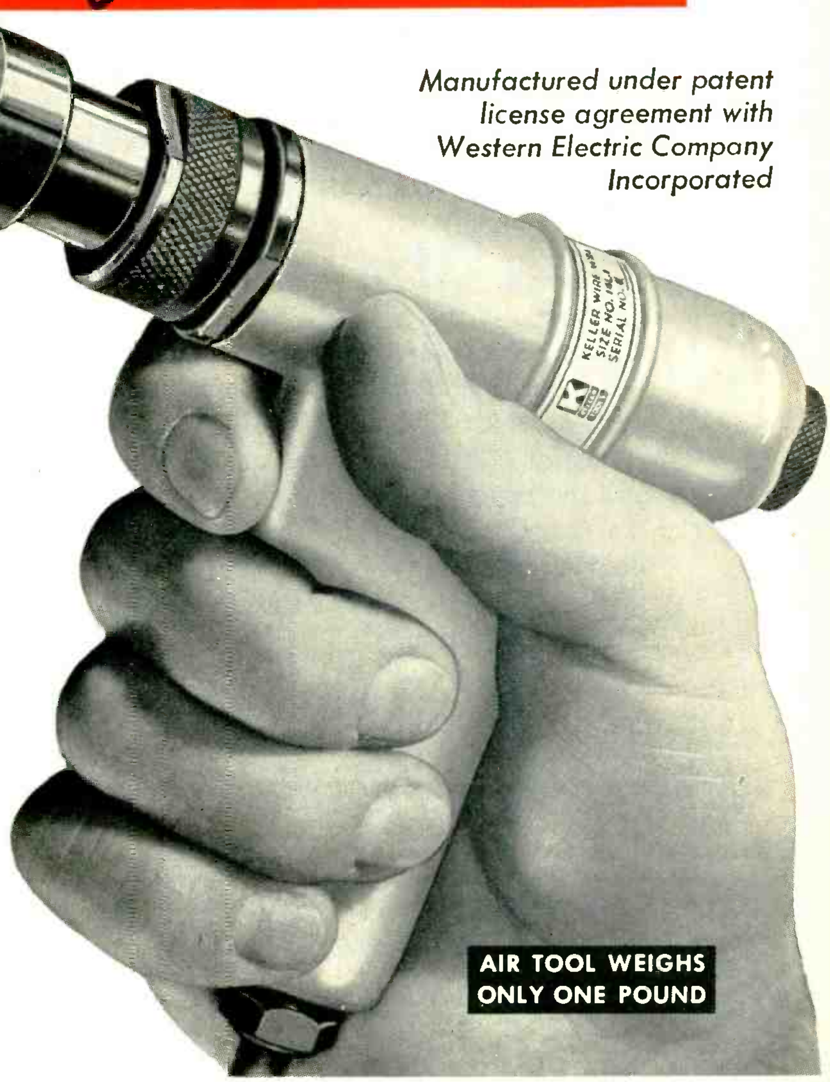
Iron, Sister!...

THIS **NEW**

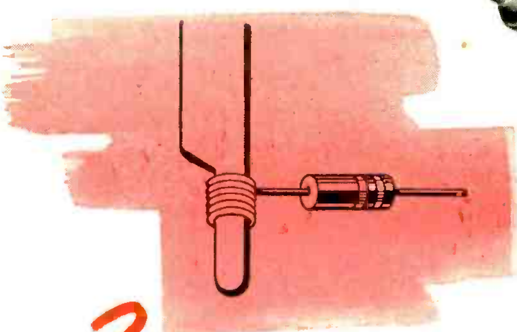
Wire-Wrap Tool

MAKES SOLDERLESS CONNECTIONS

...in half the time!



Manufactured under patent license agreement with Western Electric Company Incorporated



3 *IT'S FASTENED*

KELLER

Wire-Wrap

TOOLS

Wire-Wrap Division

KELLER TOOL CO.
Grand Haven, Michigan

"SPECIAL transformers?

. . . Oh, they're no problem with us. We let Electronic Transformer Company worry about 'em."

That's right. When we tackle those tricky special transformer jobs we relieve our customers of the complete headache. We're prepared to do *your* worrying, too, because custom-designing, custom-building transformers is our sole business. Government and industrial companies throughout the country have depended upon us since 1938.

Behind ETC transformer quality are a thoroughly trained engineering staff and the resources of our fully equipped laboratory and production department. We carry the ball from the circuitry stage right down the line to pilot and production runs.

What have *you* on the board or in your mind? Please telephone or write us without obligation.

ELECTRONIC TRANSFORMER COMPANY

Transformers, Reactors and Filters Engineered to your Needs

209 WEST 25th STREET • NEW YORK 1, N. Y.

Telephone: WAtkins 4-0880

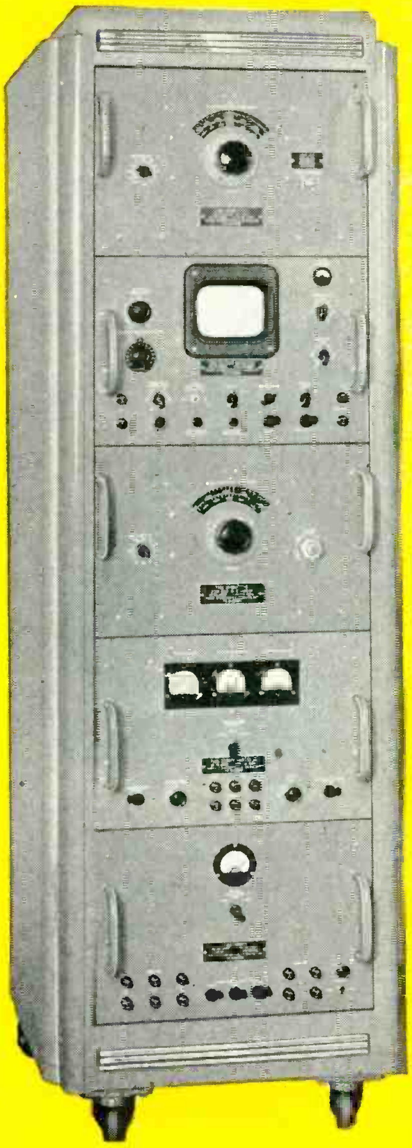
ETC SINCE 1938

The Only
All Band

10 mc
to
21,000 mc

Direct Reading
Single Control

SPECTRUM ANALYZER
Model LSA



The Model LSA provides direct means of rapid, accurate measurement of spectral display of r. f. signals from 10 to 21,000 MCS

Saves Engineering Manhours

The Model LSA Spectrum Analyzer is Polarad's answer to rising engineering costs when high performance and economy are essential.

This unique engineering tool helps get results faster with fewer personnel and in less space. Because of its ultra simplicity, tremendous frequency coverage and remarkable instrumentation the Model LSA can handle almost any problem in the radio spectrum (10 mc to 21,000 mc) with the greatest of ease, reliability and accuracy.

How The Model LSA Cuts Production Costs

In the factory, Model LSA's simplicity of operation, direct reading and "GO-NO-GO" electronic display speeds production and cuts costs. Uniform quality and high performance of your complete equipment is assured by checking it with a Polarad Spectrum Analyzer.

Expensive personnel training programs are eliminated by the Model LSA, which often actually takes the place of the microwave specialist and frees engineers for other work. For further details contact your nearest Polarad representative or write direct to us.

FEATURES:

Frequency Range 10 mc-21,000 mc; 4 tuning heads
Accuracy Frequency Calibration—1%
Spectrum Display variable from 250 kc to 25 mc
Frequency Marker for measuring frequency differences of 0-25 mc
Broad Band R.F. Attenuators 10 mc-12,000 mc
Automatic Voltage selector for each tuning head
Single Dial Control
Direct Frequency Reading
Spectrum Displayed on 5" cathode ray tube

USES:

Examine pulse spectrum of magnetrons and klystrons
Measure noise and interference spectrum
Act as broad band receiver from 10 mc to 21,000 mc
Observe and measure harmonic frequency differences
Measure band width of microwave cavities
Calibrate microwave oscillators and preselectors

More Megacycles Per Dollar Than Any Other Instrument

Polarad Electronics Corporation

Polarad Electronics Corporation
100 Metropolitan Avenue, Brooklyn 11, N. Y.

REPRESENTATIVES: Albuquerque • Atlanta • Boston • Chicago • Cleveland • Fort Worth • Kansas City • Los Angeles • New York • Ontario • Philadelphia • San Francisco • Seattle • Syracuse
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ALLIED CONTROL'S NE

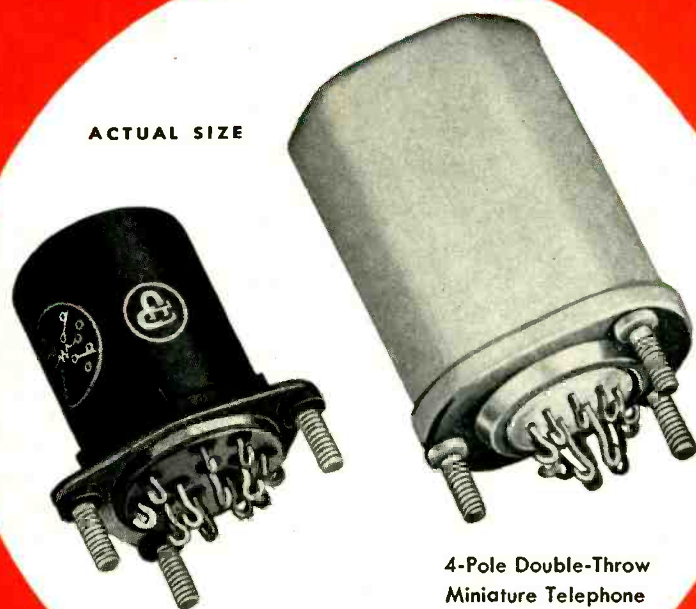
✓ SIZE CUT 66%

✓ WEIGHT CUT 48%

✓ RELIABILITY DOUBLED

✓ WRIGHT FIELD APPROVED

ACTUAL SIZE



New MH-12 with Interchangeable Mounting

4-Pole Double-Throw Miniature Telephone Relay

Designed to withstand a shock of 50G, these new Allied Control double-throw miniature relays were developed to meet the rigid requirements of U.S.A.F. Specifications MIL-R-5757A.

Known as the Allied MH series, this new line of relays consists of the 6-pole MH-18, the 4-pole MH-12, and the 2-pole MH-6. Contacts are rated at 2 amps resistive or 1 amp inductive at 28 volts D. C.

The high performance of these relays has been achieved in an extremely compact, unitized construction and parallels the most recent advances in airborne equipment design. The "actual size" photographs shown above highlight the 66% savings in overall size, the 48% savings in weight and the 30% reduction in chassis area.

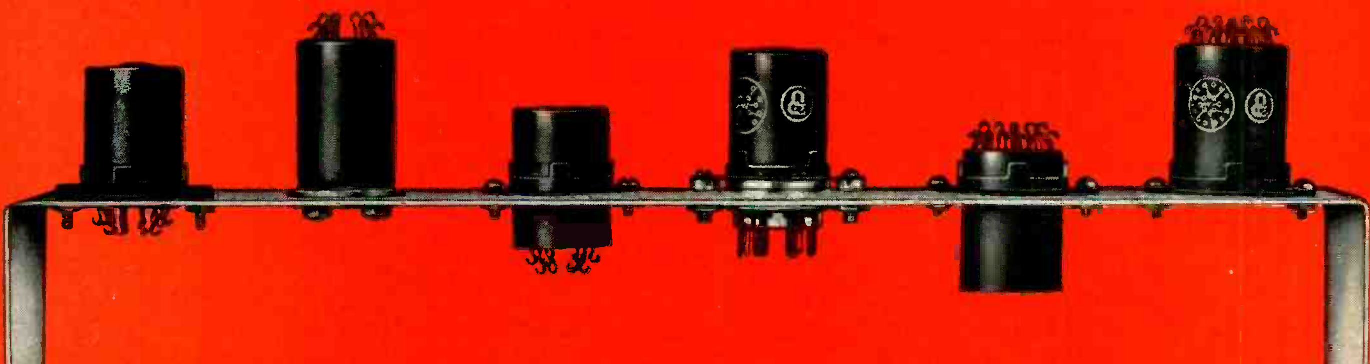
For detailed specifications and drawings of these new relays, contact your local Allied Control Representative or write us for **Bulletin 1002.**

Want more information? Use post card on last page.

50 G MINIATURE RELAY

APPROVED MIL-R-5757A

SIX DIFFERENT MOUNTINGS



1. Standard Mounting
2. Flush Mounting—2 Studs at 5/8 ′ Centers
3. Thru-Chassis Mounting—Terminols Down
4. Plug-In Mounting With Socket
5. Thru-Chassis Mounting—Terminal Up
6. Flush Ring Mounting

FEATURES

Wide Ambient Temperature Range: *55°C to 85°C standard—65°C to 125°C MHB-type*

Vibration Resistant: *15G's vibration to 500 cycles* • **Operating Shock:** *no contact chatter to over 50G's*

High Altitude: *seal-tested to 70,000 feet*

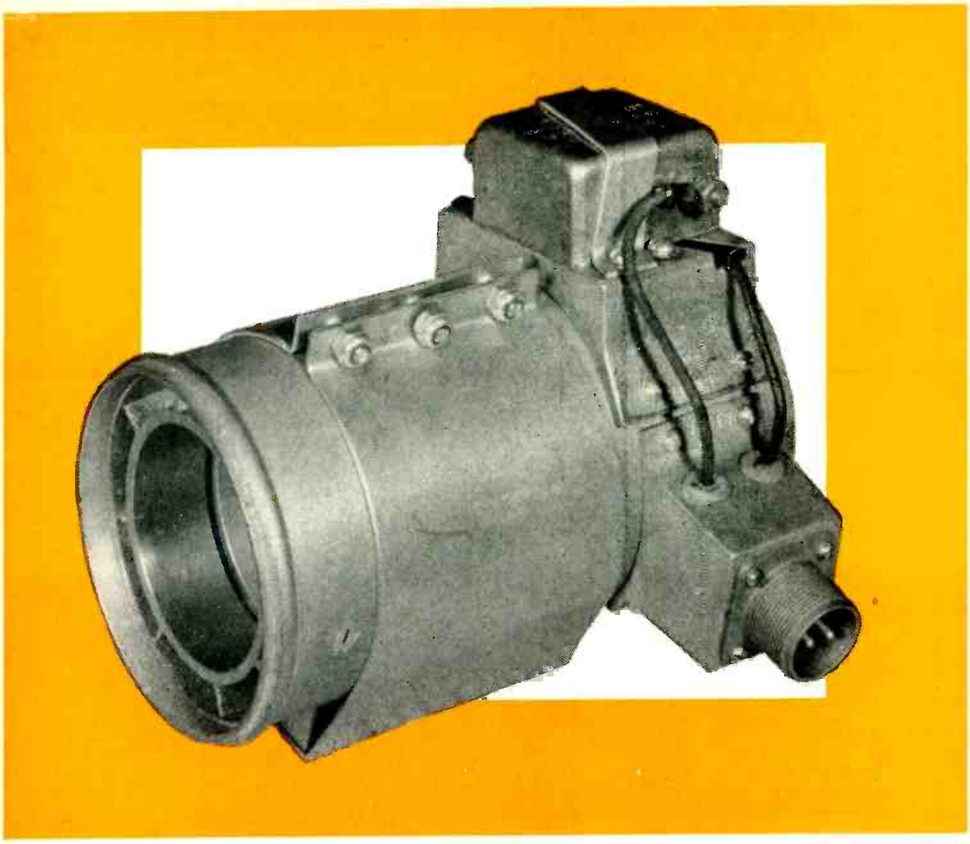
Dependable Operation: *life expectancy of over 1 million operations at rated load*

High Speed: *operate-to-make time under 8 ms.*
release-to-make time under 4 ms.
release-to-break time under 2 ms.

ALLIED CONTROL COMPANY, INC.

2 EAST END AVENUE, NEW YORK 21, N. Y.

Want more information? Use post card on last page.



SPECIFICATIONS

Tubes Cooled
4X150A, 4X150G
5508 and 6161

Altitude
Up to 50,000′

Fan Model
Joy Axivane
AV-3.5-2.75-120D

Size
3½″ diameter

Weight
5 lbs.

Duty
60 CFM @ 5″ WG

Motor
27V DC—4.7 Amps.

Only a JOY AXIVANE® FAN can handle this Electronic Tube cooling job at altitudes up to 50,000 feet

Cooling the above-specified tubes in airborne applications is a critical problem because of the extremely light air. The difficulty is particularly severe at elevations of 40,000 or 50,000 feet.

An extensive series of tests were recently initiated in an attempt to determine an effective cooling process. The tubes and sockets were mounted in pairs in a special cabinet designed to equalize the air distribution for each tube. The problem was to discover a method of heat dissipation that would hold the temperature of the glass-to-metal seals below the design operating level.

Of all the blowers tested, only this Joy AXIVANE fan was able to meet the rigid specifications. The tubes were cooled with 25°C air at an elevation of 50,000 feet, easily surpassing all requirements.

This is just one of an extensive line of AXIVANE fans specially designed for economical efficiency in cooling electronic equipment. All are built of aluminum and magnesium for light weight, sturdily constructed for maximum resistance to shock and vibration, and feature the space-saving compactness inherent in vaneaxial design.

Each fan can be modified to fit individual requirements for cooling all types of electronic equipment under any conditions. Let us help solve *your* problem. ● *Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.* In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

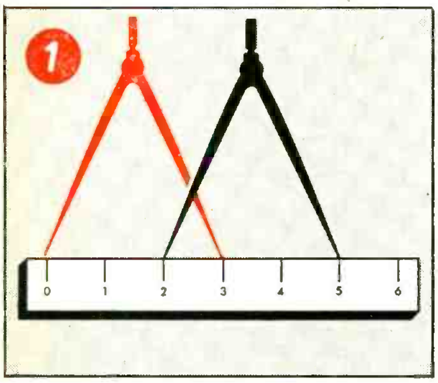
Consult a Joy Engineer

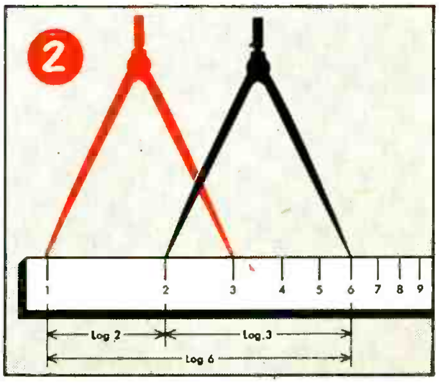
JOY

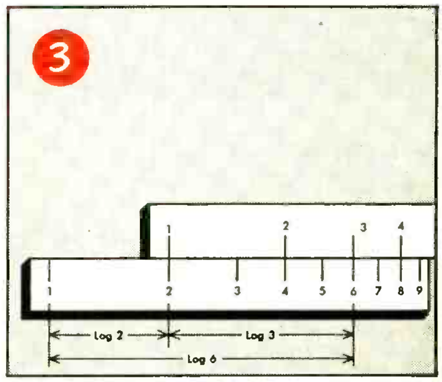
WORLD'S LARGEST MANUFACTURER OF VANE-AXIAL TYPE FANS

W&D I-4840

Why a Slide Rule Adds



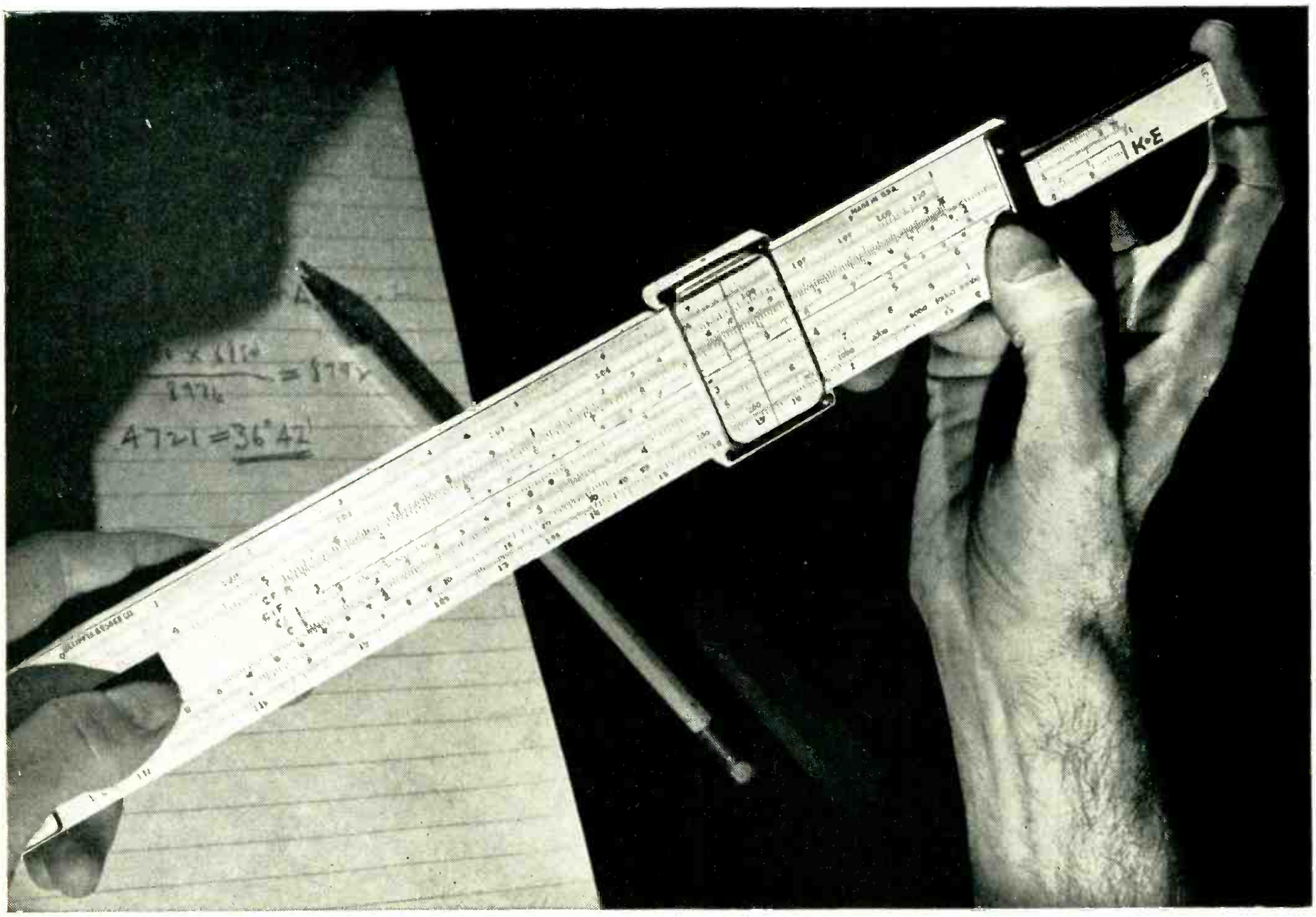




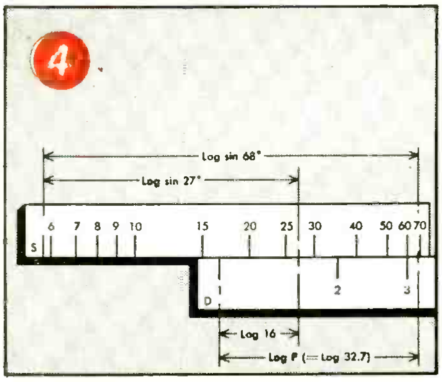
In a mechanical sense, the slide rule merely adds and subtracts quantities. How these simple operations can be performed mechanically may be seen from the illustration above, which shows the addition of 2 and 3 by means of a pair of dividers applied to an ordinary 6-inch rule. Even many electronic calculators work basically on this principle.

With a different system of calibrations on the scale, if appropriate meanings are assigned to them, more difficult problems may be solved in the same way. An example of this is seen above where a pair of dividers is shown adding 2 and 3 on a logarithmic scale and obtaining the answer 6. Advantage is taken of the fact that the multiplication of numbers may be accomplished by the addition of their logarithms.

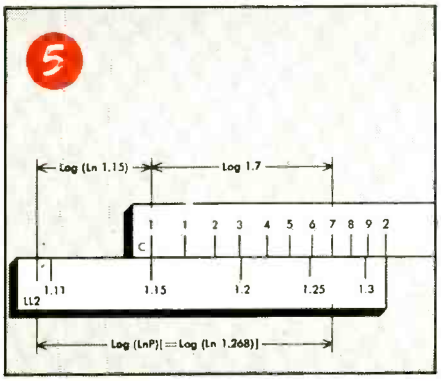
A handier method, which begins to approach the usefulness of a slide rule, is to place two similar logarithmic scales together. Seen above is the simple setting in which 2 is shown being multiplied by 3. Observing the illustration it can be seen that the same setting also multiplies 2 by 2 and 4. Without changing the setting, the device shows the corresponding operations in division.



to Multiply



Problems in plane trigonometry require only appropriate logarithmic scales, calibrated to read in degrees so that operations can be performed on the functions of angles. Two scales of this kind are generally used: one for the sines of angles and the other for tangents. Above is seen a setting for finding $P = \frac{16 \text{ Sin } 68°}{\text{Sin } 27°}$.



Problems of greater complexity, involving higher powers and roots of numbers, including fractional and negative powers and roots, can also be made as easy as 2 + 3 by means of appropriate logarithmic scales. Known as log log scales, they are calibrated to read in logarithms of logarithms. Above is seen a setting for finding $P = 1.15^{1.7}$.

The slide rule has been called the symbol of the engineer. The symbol that distinguishes the slide rule itself for leadership in design and workmanship is the K&E trade mark or the name KEUFFEL & ESSER CO.

Pioneers in the manufacture of slide rules in America, K&E have always been in the forefront with new ideas and improvements. The most recent example is the slide rule of today, the K&E Log Log Duplex Decitrig*, designed on the fundamental and simple principle of referring all its scales to the basic C-D scales. This enables problems involving arithmetic, trigonometric and exponential functions to be readily solved without reading any but the final answer.

Ask your K&E Distributor or Branch for full information about K&E Slide Rules.

The Right Angle

If you'd like l-o-n-g mileage without re-sharpening, get a PARAGON* RED TIP ruling pen. They are tipped with tungsten carbide alloy butt-welded to stainless steel blades. Ideal for use on aluminum, glass cloth and other abrasive surfaces as well as on regular paper or cloth. Identify it by the red tip at the end of the handle.

A good way to make life easier is to give your drawing board a glass-smooth, non-glare working surface with a covering of LAMINENE†. This drawing board backing material is washable, hard enough to minimize pencil scoring, but yielding enough for pencil lines to take well. Comes either white or green, in rolls.

*Trade Mark ®
†Trade Mark

K+E

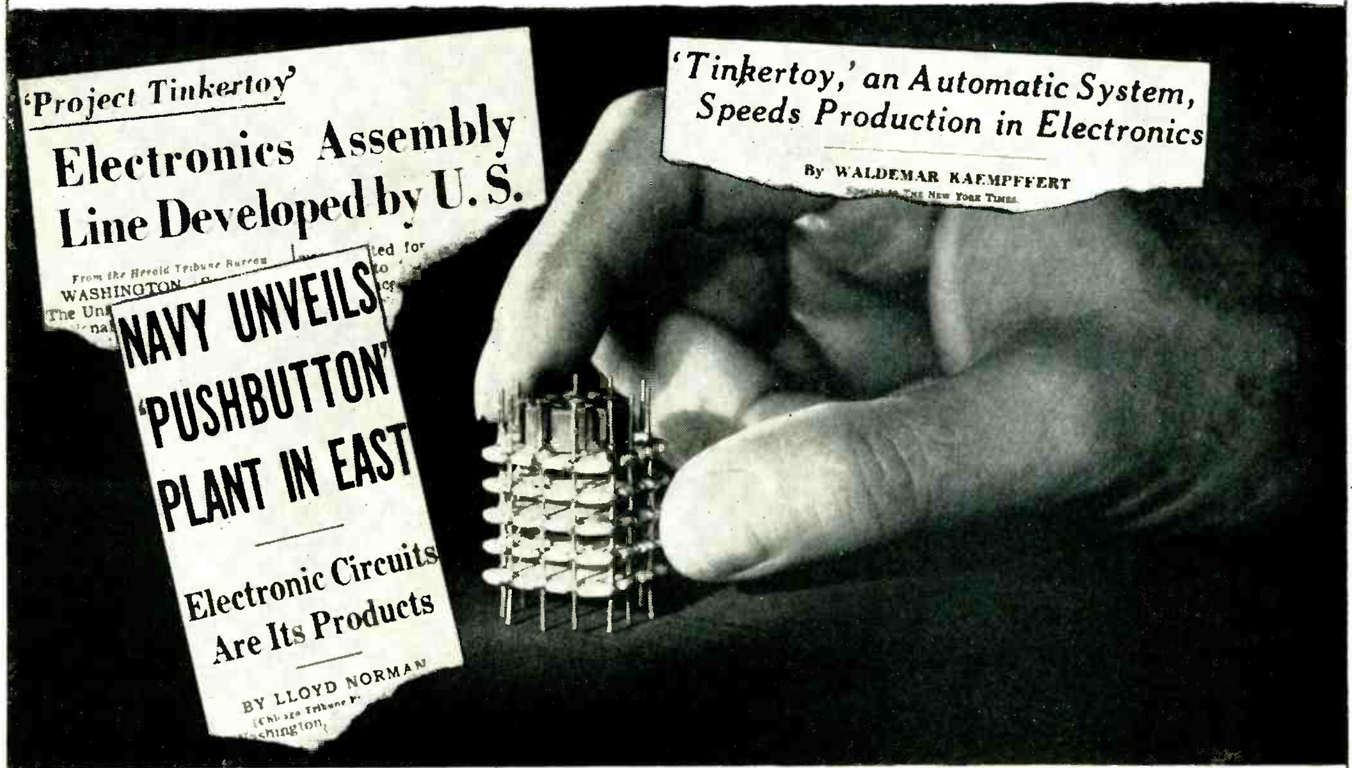
PARTNERS IN CREATING

KEUFFEL & ESSER CO.
EST. 1867
Drafting, Reproduction, Surveying Equipment and Materials, Slide Rules, Measuring Tapes.
NEW YORK • HOBOKEN, N. J.
CHICAGO • ST. LOUIS • DETROIT
SAN FRANCISCO • LOS ANGELES • MONTREAL

Want more information? Use post card on last page.

Meet the mechanical marvel behind

"PROJECT TINKERTOY"



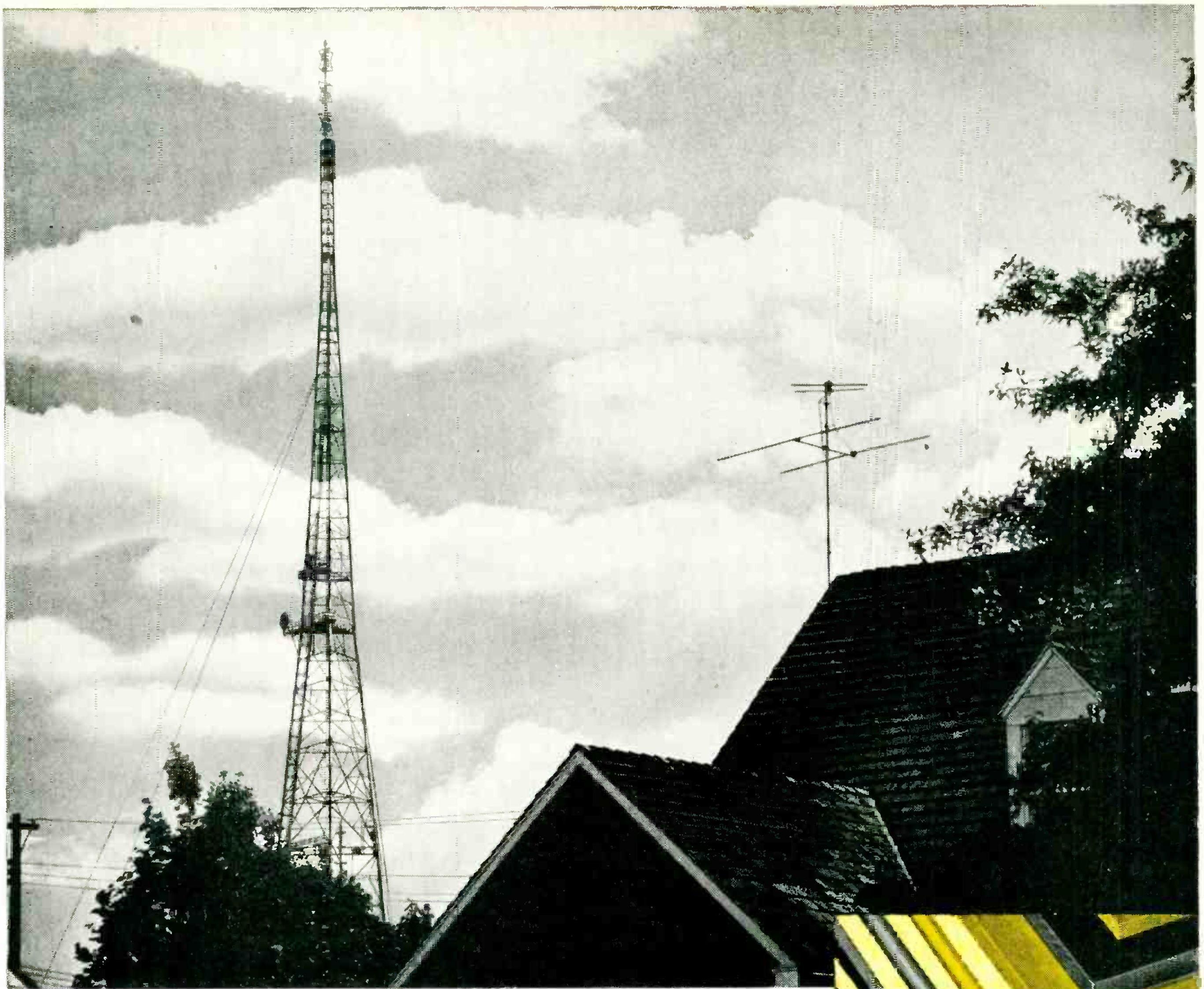
This tiny electronic device is the secret behind that amazing U. S. Navy and National Bureau of Standards development you've been reading about . . .

Hush-hush for many months, "Project Tinkertoy" can now be revealed as one of the most remarkable developments in modern electronics . . . a Technique that will very probably revolutionize manufacturing methods in the electronics and allied fields. Radio, television, aviation, computing, and communications are five of the fields where it is immediately applicable . . . where its ability to produce a wide variety of electronic circuit combinations will produce tremendous savings in materials, time and labor. For further information on its possibilities, applications . . .

Contact Engineering Department

WILLYS ELECTRONICS DIVISION

OF WILLYS MOTORS, INC.
Toledo, Ohio   Arlington, Va.



SYNTHANE —out of sight, but in the picture

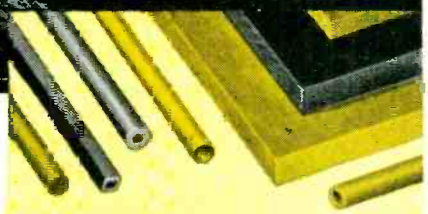
Whenever you turn on television you are using a little-seen, but essential, material called Synthane.

Synthane is a laminated plastic of multiple virtues, which recommend it for many jobs in television.

Synthane is an excellent insulator, laminable with metal, hence, a good base for space-reducing "printed" circuits. Synthane is notable for low power factor, low moisture absorption, and ease of fabrication, three properties desirable for radio and television insulation. Synthane plays a supporting part in many behind-the-screen and behind-the-camera applications.

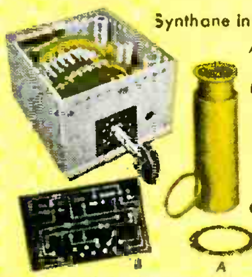
Synthane is also light in weight, strong, vibration absorbing, chemically resistant, high in dielectric strength, dimensionally stable, heat resistant to about 300°F.

There may be a place for Synthane in your product. To find out more about the possibilities of Synthane for your purpose, write for the complete Synthane Catalog. Synthane Corporation, 17 River Road, Oaks, Pennsylvania.



Synthane laminated plastics are produced under heat and pressure from laminations of resin-impregnated materials such as paper, fabric, glass cloth, asbestos, etc. Synthane plastics are available in sheets, rods, tubes, and fabricated or molded parts. Each of the many Synthane grades has a combination of useful properties.

Synthane in Television . . .



A–Television camera parts
B–Television receiver printed circuits — metal foil on Synthane sheets
C–Channel selector switch insulation

Synthane–one of industry's unseen essentials

SYNTHANE

LAMINATED PLASTICS

Want more information? Use post card on last page.

Why do so companies make

FOR one thing, it's *easy* to make an ordinary relay. Requirements are not rigid. Little equipment is needed. You can even *buy* the component parts in a pinch. Dozens of companies do a good job of making these relays, as long as the service requirements are not too severe.

But when you need top reliability, when you need relays that will withstand temperature extremes, tremendous shock loads, moisture, continuous service—come to an expert to get the kind of relay performance you need.

Union Switch & Signal has been making relays for over 70 years, most of them in vital railroad signaling service. Many of them operate continuously, yet remain unattended for years. In fact, we regularly encounter "Union" relays that have been in service for over 40 years. And they are still in good operating condition.

This vast relay engineering skill has been used to produce the "Union" type M miniature relay. Hermetically sealed, weighing only 3½ ounces, this 26.5 v.d.c. relay meets all requirements of Military Specifications MIL-R-5757 A & B.

"Union" type M relays are available in quantity *now*—in either 6-pole or 4-pole doublethrow models. Write for more information.

GENERAL APPARATUS SALES

UNION SWITCH & SIGNAL

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18 PENNSYLVANIA

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

many relays?

TYPICAL PERFORMANCE DATA

Service Temperature	-65°C to 125°C	-55°C to 85°C
Style FM (6-pole)	303125	303085
Coil Resistance	325 ohms	325 ohms
Nominal Voltage	26.5	26.5
Max. Pull-In Voltage at Max. Rated Temperature	18	18
Max. Drop-Out Voltage at Max. Rated Temperature	13	13

Service	Continuous
Shock	40 G's for 10 milliseconds
Vibration	10 to 55 cycles per sec.—0.060 total excursion
Life Expectancy	1,000,000 operations minimum
Contact Rating	2 amps. at 26.5 Volts—Resistive Load
Breakdown Voltage at Sea Level	1000 volts a.c. between case and contacts or coil

General Apparatus Sales
Union Switch & Signal Division
Westinghouse Air Brake Company
Pittsburgh 18, Pa.

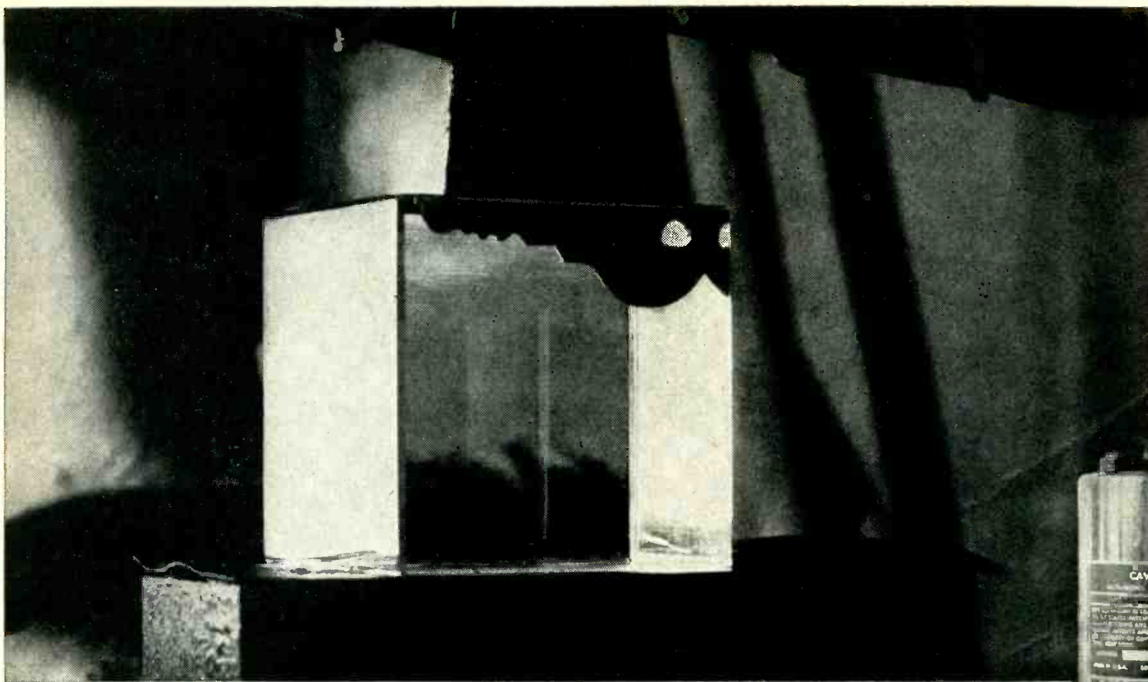
Please send additional information on "Union" type M relays.

Name .... Title ....

Company ....

Address ....

City, Zone & State ....



An ordinary house key, brazed to the tool holder of the Cavitron, cuts quickly and easily into a glass paperweight. The tool vibrates 1,620,000 times a minute and uses a boron carbide abrasive in solution to remove the particles of glass without cracking it.

How Magnetostriction was harnessed

...to give industry a new tool

Remember those magnetostriction experiments in the physics lab?

You learned what happened when a ferro-magnetic material was placed in a magnetic field.

But what good was it?

Your instructor probably told you it was pretty much a laboratory curiosity.

And except for use in undersea sounding devices, it remained so until recent years.

Now scientists are harnessing it in many ways. One of the most interesting applications is in this ultrasonic machine tool.

Called the Cavitron, this tool vibrates 1,620,000 times a minute and, with the help of an abrasive solution, easily machines materials as hard as tungsten carbide.

The vibrations drive the abrasive against the material which is to be cut and form the desired shape in it.

Putting magnetostriction to work in this way wasn't easy. Before the inventor perfected a commercial model, he experimented for twelve years.

He worked with a number of materials, searching for the magnetostrictive qualities he needed for the transducer. He found them in "A" Nickel.

Then he had to find an alloy for the tool holder with suitable high strength and acoustical properties. Most materials he tried heated up rapidly and cracked at stress points. Again, he discovered the very qualities he needed in another Inco Nickel Alloy — Monel®.

The inventor of the Cavitron found Inco ready to help in supplying information on magnetostriction, fabrication and metal stress at all times.

That same service is available to you. Call on us for help in solving your problems. And write for your revised copy of "Magnetostriction" and the booklet "Inco Nickel Alloys for Electronic Uses."

Consult your regular supplier of Inco Nickel Alloy forms for latest information regarding their availability. Remember, too — it always helps to anticipate your requirements well in advance.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Inco Nickel Alloys

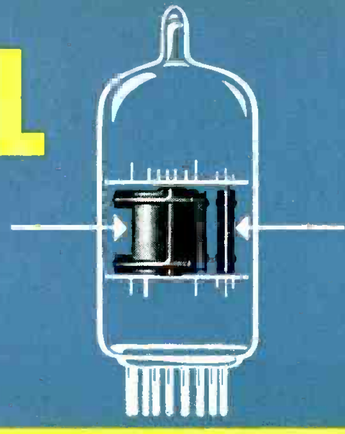
INCO TRADE MARK

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
INCONEL® • INCONEL "X"® • INCONEL "W"® • INCOLOY®
NIMONIC® ALLOYS • NICKEL • LOW CARBON NICKEL • DURANICKEL®

TUNG-SOL


6U8
miniature
triode-
pentode
PROVIDES
NEW FLEXIBILITY
IN TV RECEIVER
CIRCUIT
DESIGN
see other side for additional information

TUNG-SOL



6U8

miniature triode-pentode

Tung-Sol Designed and Developed

- ✓ ***Completely independent sections***
- ✓ ***Versatility in circuit application***
- ✓ ***Improved circuit performance***

This tube has two electrically independent sections—a triode and a pentode and is intended as a local oscillator mixer for FM and TV receivers. Each section is adequately shielded, and both are capable of exceptionally good performance at the higher frequencies.

Because the two sections are completely independent, a high degree of flexibility of circuit design is available—especially valuable in TV tuner oscillator use. Performance of the 6U8 triode at low voltages is superior to that of many types previously used for this service. It has sufficient reserve emission to operate efficiently under widely varying supply voltage conditions.

The pentode provides excellent gain with low local oscillator voltage injection resulting in low oscillator radiation from TV receivers. Use of the pentode section as the mixer permits the high (40 m. c.) I. F. so desirable to reduce interference and increase stability.

The construction and characteristics of the 6U8 provide designers with extremely desirable flexibility in combining circuit functions. The pentode section of the tube may be used as an I. F. amplifier, video amplifier, sound limiter or synchronizing separator. The triode performs satisfactorily as a horizontal or vertical oscillator, or sync clipper.

Wherever there is need for a triode and a pentode in a receiver, they can be combined in the 6U8.

MECHANICAL DATA

Coated unipotential cathodes—2			
Outline drawing	RTMA 6—2	Bulb	T—6-1/2
Base	RTMA E9—1	Miniature button	9-pin
Maximum diameter			7/8"
Maximum overall length			2-3/16"
Maximum seated height			1-15/16"
Base pin connections		RTMA basing	9 AE
Pin 1—triode plate		Pin 6—pentode plate	
Pin 2—pentode grid #1		Pin 7—pentode cathode grid #3, shield	
Pin 3—pentode grid #2		Pin 8—triode cathode	
Pin 4—heater		Pin 9—triode grid	
Pin 5—heater			
Mounting position			Any

ELECTRICAL DATA

Interelectrode Capacitances	With Shield #315	Without Shield	
Pentode grid #1 to pentode plate	0.006	0.010 max.	µµf.
Pentode input	5.0	5.0	µµf.
Pentode output	3.5	2.6	µµf.
Triode grid to triode plate	1.8	1.8	µµf.
Triode grid to cathode	2.5	2.5	µµf.
Triode plate to cathode	1.0	0.4	µµf.
Cathode to heater (either section) approx.	3.0	3.0	µµf.

ELECTRICAL DATA

Ratings

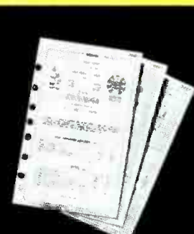
Heater voltage (ac or dc)	6.3	VOLTS
Maximum heater-cathode voltage	90.0	VOLTS
Maximum plate voltage (pentode)	300.0	VOLTS
Maximum plate voltage (triode)	300.0	VOLTS
Maximum grid #2 supply voltage	300.0	VOLTS
Maximum plate dissipation (pentode)	2.8	WATTS
Maximum grid #2 dissipation	0.5	WATTS
Maximum positive dc grid #1 voltage	0	VOLTS
Maximum positive dc grid voltage (triode)	0	VOLTS
Maximum plate dissipation (triode)	2.5	WATTS

Typical Operating Conditions and Characteristics

	Triode		Pentode	
Heater voltage		6.3		VOLTS
Heater current		450		MA.
Plate voltage	150		250	VOLTS
Grid #2 voltage	...		110	VOLTS
Cathode resistor	56		68	OHMS
Transconductance	8500		5200	µMHOS
Grid #1 voltage (approx.) for Ib=10 ua.	-12		-10	VOLTS
Plate current	18		10	MA.
Grid #2 current	...		3.5	MA.
Plate resistance (approx.)	.005		0.40	MEG.
Amplification factor	40		..	

TUNG-SOL ELECTRON TUBES

The TUNG-SOL engineering which has produced the 6U8 is constantly at work on a multitude of special electron tube developments for industry. Many exceptionally efficient general and special purpose tubes have resulted. Information about these and other types is available on request to TUNG-SOL Commercial Engineering Department.



TUNG-SOL ELECTRIC INC., NEWARK 4, NEW JERSEY

SALES OFFICES: ATLANTA, CHICAGO, COLUMBUS, CULVER CITY (LOS ANGELES), DALLAS, DENVER, DETROIT, NEWARK, SEATTLE

TUNG-SOL MAKES ALL-GLASS SEALED BEAM LAMPS, MINIATURE LAMPS, SIGNAL FLASHERS, PICTURE TUBES, RADIO, TV AND SPECIAL PURPOSE ELECTRON TUBES AND SEMICONDUCTOR PRODUCTS.

NOVEMBER, 1953

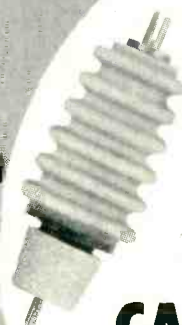
it makes **SENSE** to

SAVE DOLLARS

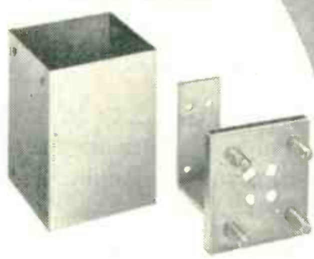
with

Heldor

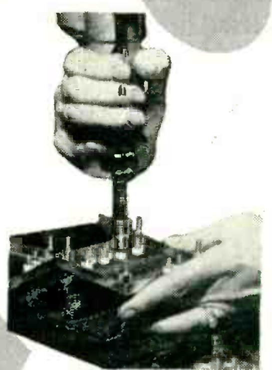
HERMETIC SEAL BUSHINGS



CANS & COVERS



COMPLETE ASSEMBLY SERVICE



IF YOU manufacture electronic or nuclear components requiring the use of hermetic-seal terminals and cans, Heldor's *proven* quality-control volume production methods makes possible substantial dollar savings for you.

It will pay you to get the facts about Heldor's cans, hermetic-seal bushings and complete assemblies made to meet MIL-T-27 or commercial specifications. Send your specifications or prints today for a "quote" that tells its own money-saving story.

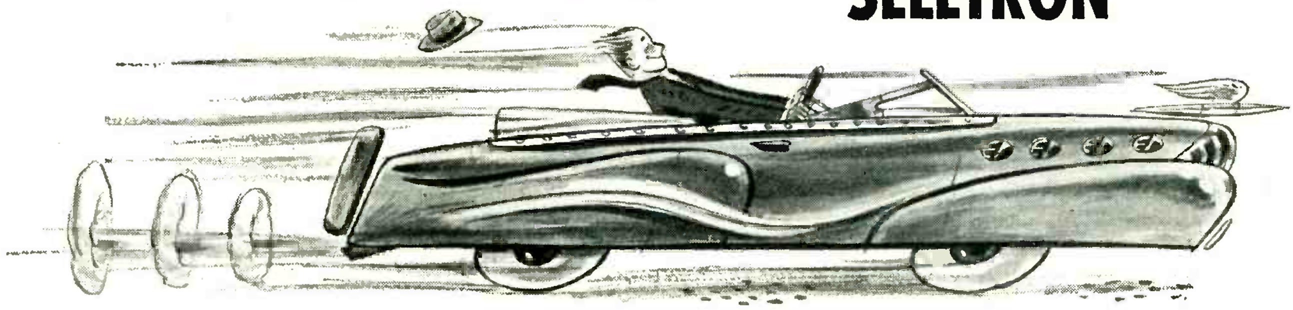
HELDOR MANUFACTURING CORPORATION

HELDOR BUSHING & TERMINAL CO., INC.

238 Lewis Street • Paterson, N. J.

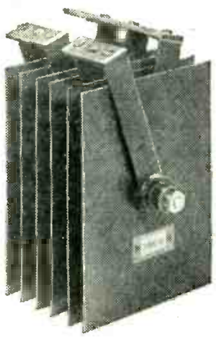
Want more information? Use post card on last page.

fast starts! with an assist from SELETRON



Seletron
SELENIUM RECTIFIERS

Here's why Heyer Industries chose and *reorders* SELETRON for their new portable fast chargers



There's nothing like a good charge to wake up your car battery and Heyer Industries, Inc., Belleville, N.J., find SELETRON Selenium Rectifiers assure efficient and certain action in their "Safe-Fast" portable battery chargers.

Purchasing Agent Walter Mack says, "The selenium rectifier is a major component in our product, and extensive field tests show we are safe on all counts with SELETRON. Your rectifiers give excellent performance under heavy current load."

Arduous duty in fast chargers is only one of many uses for versatile SELETRON Selenium Rectifiers. There are innumerable applications. Besides radio, TV and other audio-visual equipment normally requiring miniatures, they are components in industrial electronic circuits calling for big power stacks of all sizes.

Our engineers can guide you to a solution of your problem in rectification. Why not outline it to us today, and study our catalog in Sweet's Product Design File. *We also manufacture germanium diodes and transistors.*

For complete dependability Heyer's fast charger utilizes one Model 6T0730 SELETRON Selenium rectifier.

Seletron and Germanium Division

RADIO RECEPTOR COMPANY, Inc.

Since 1922 in Radio and Electronics

SALES OFFICE: 251 WEST 19th STREET, NEW YORK 11 • FACTORIES IN BROOKLYN, N. Y.

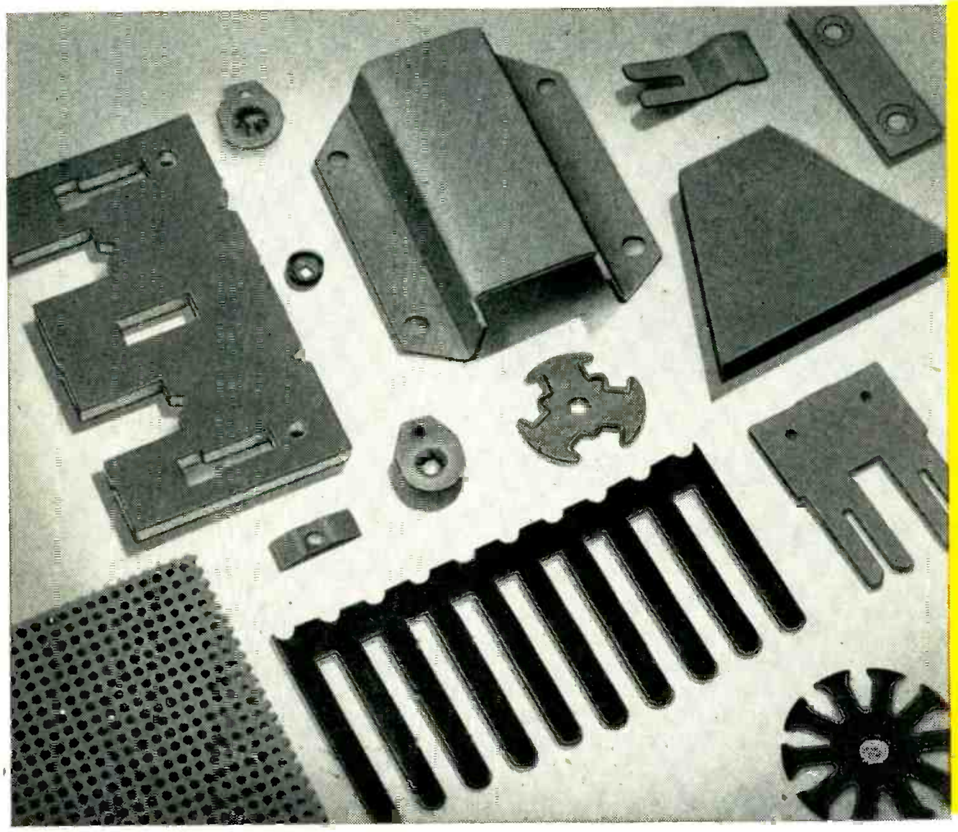
TAYLOR ***Commercial Grade Vulcanized Fibre***
is tough, lightweight, abrasion resistant . . .
excellent for bending, punching, stamping and forming . . .
resistant to organic solvents, oil and gasoline . . .
has excellent electrical characteristics.

Want to make something of it?

Make it into insulating plates, upset washers, arc barriers, terminal blocks, switch and appliance insulation, cases, face plates for golf clubs . . . or any other electrical or mechanical component that can benefit from the unique properties of this versatile material.

Make it in red, gray, black, or special colors.

Make it from sheets or rolls with these specifications:



SPECIFICATIONS

Thickness Range:	.005″ to 1″
Finish:	Pressed and calendered
Punching:	To 3/16″ thick
Sheet Size:	56″ x 90″
Roll Width:	56″ for thicknesses of .005″ through .060″. Coils to 3/16″ for thicknesses of .005″ through .090″.

PROPERTIES

Mechanical

Flexural Strength	
(Lengthwise)	14000 psi min.
(Crosswise)	12000 psi min.
Tensile Strength	
(Lengthwise)	7500 psi min.
(Crosswise)	5500 psi min.
Compressive Strength	
(Flatwise)	20000 psi min.
Izod Impact Strength	
(Lengthwise)	3.5 Ft.-Lbs./inch
(Crosswise)	2.9 Ft.-Lbs./inch

Electrical

Dielectric Strength	
(1/32″ thick)	250 min.
Short Time Test	
(1/8″ thick)	175 min.
Arc resistance, seconds	100

Make it from turned rods. Diameters from 1/8″ to 1″ with ground or buffed finish.

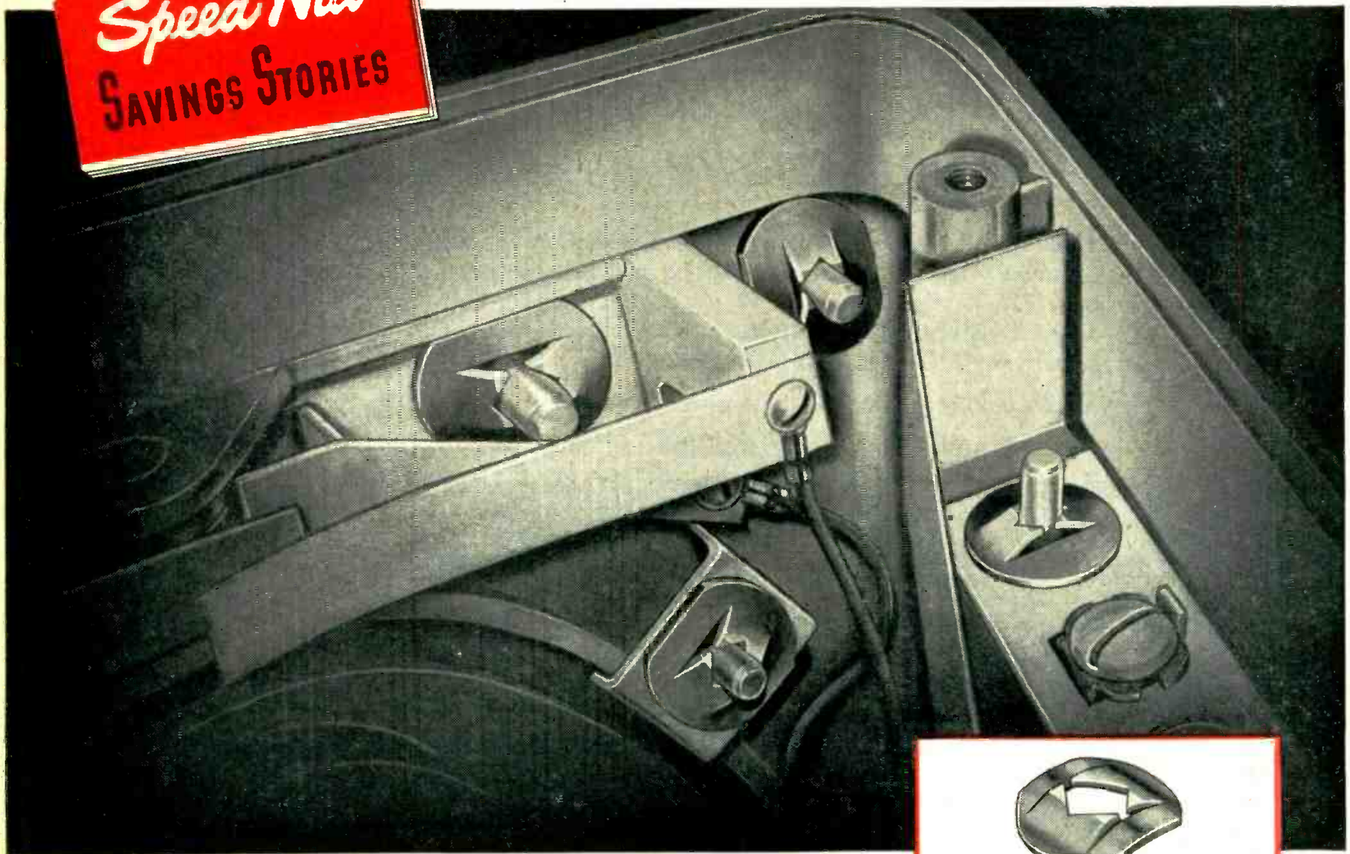
Make it easy for yourself when you're buying vulcanized fibre. Call your Taylor engineer . . . he will be glad to work with you . . . help select the correct grades to fit your needs —Commercial, Bone, Super White, Abrasive and Built-up. Also ask him for samples of Taylor Laminated Plastics . . . *Phenol, Silicone and Melamine Laminates* . . . suited for a variety of your product requirements.

Taylor Fibre Company, Norristown, Pennsylvania—La Verne, Calif.

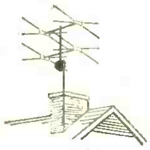
TAYLOR
Laminated Plastics
Vulcanized Fibre

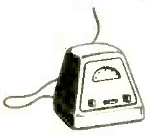
TINNERMAN *Speed Nut* SAVINGS STORIES

FASTEST THING IN FASTENINGS®



alliance TENNA·ROTOR "TURNS" TO TINNERMAN ...BEAMS-IN 50% ASSEMBLY SAVINGS!





Engineers at Alliance Manufacturing Company, Alliance, Ohio, knew from experience how SPEED NUT brand fasteners change fastening problems into production savings. That's why they "turned" to Tinnerman for a clear savings picture in designing the Tenna-Rotor! Push-On SPEED NUTS were selected right from the Tinnerman catalog for tremendous time and engineering savings at the design stage! 16 Push-Ons, zipped over integrally molded studs, attach the electronic mechanism to the plastic control panel and box! They eliminated metal inserts, nuts, and lockwashers — reduced materials handling — stepped-up production, and netted a 50% savings in assembly costs.

A call will bring your Tinnerman representative with complete, detailed information to help solve your fastening problems . . . and maybe find savings like this!

PUSH-ON SPEED NUTS®

Start by hand

. . . zip over integral studs, rivets, tubing, or other unthreaded parts; bite into smoothest, hardest surfaces — lock with firm spring tension on metal, plastic or wood. Eliminate costly inserts in plastics; save machining of die castings!

Write today for your copy of SPEED NUT "Savings Stories" a booklet of amazing examples of Tinnerman savings to industry:

TINNERMAN PRODUCTS, INC., Dept. 12, Box 6688, Cleveland 1, Ohio. *In Canada:* Dominion Fasteners, Ltd., Hamilton, Ontario. *In Great Britain:* Simmonds Aerocessories, Ltd., Treforest, Wales. *In France:* Aerocessoires Simmonds, S. A. — 7 rue Henri Barbusse, Levallois (Seine).

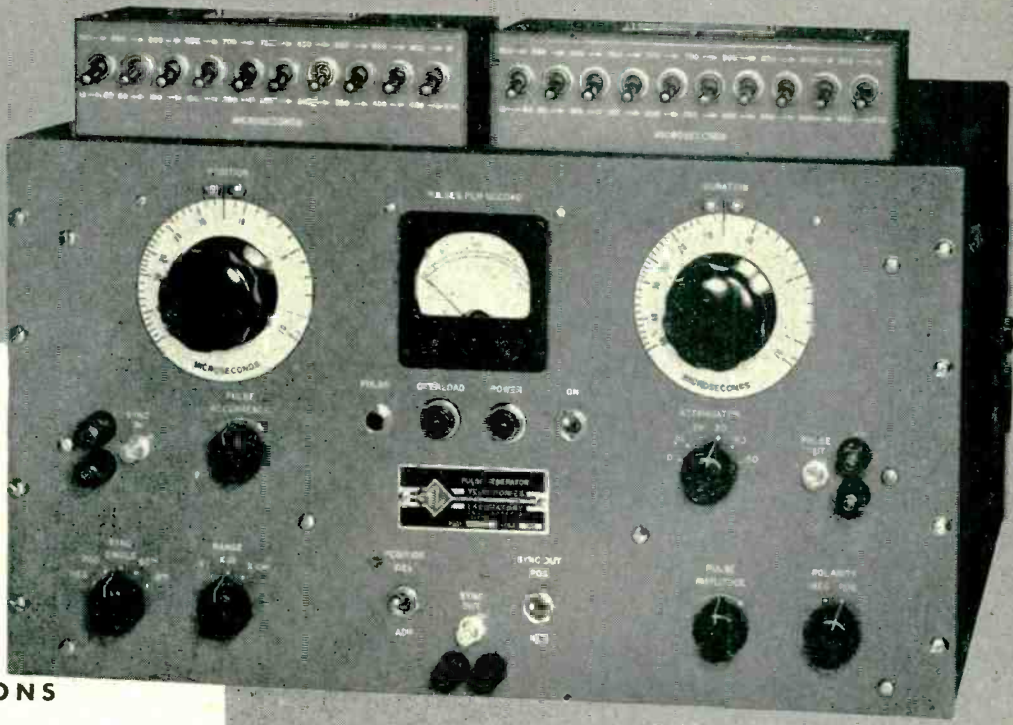
TINNERMAN *Speed Nuts*®

MORE THAN 8000 SHAPES AND SIZES

WIDE RANGE

FAST-PULSE GENERATOR

PG-200A
Pulse Generator
PGA-210
Range Extenders



SPECIFICATIONS

PULSE POWER

- Amplitude 100 volts open circuit
- Continuously variable over a range of -10 db
- 50 db attenuation in steps of approx. 10 db
- Driving impedance 50 ohms or less
- Max. average current (50 ohms load) 0.1 amp. for pos. pulses, 0.07 amp. for neg. pulses
- Max. recurrence rate at least 20,000 pps
- Max. duty cycle 50%, min. pulse interval (trailing edge to leading edge) approx. 40 µs

PULSE WAVEFORM

- Rise and decay times 0.03 µs or less (10% to 90% amplitude)
- Crest and base line overshoots and ripple less than 5% of average pulse amplitude
- Duration calibrated 0.1 to 50 µs, accuracy below 5000 pps within 5% or 0.1 µs whichever is greater, accuracy above 5000 pps subject to additional 0.3 µs error, min. pulse width less than 0.05 µs (50% amplitude)

PULSE POSITION

- Delay after external sync signal fixed at approx. 10 µs or adjustable from approx. 20 to 70 µs
- Advance or delay with respect to sync out trigger calibrated 0.1 to 50 µs, accuracy below 5000 pps within 5% or 0.1 µs whichever is greater, accuracy above 5000 pps subject to additional 0.3 µs error

features

- **DURATION AND POSITION .05 TO 1000 µs**
- **RISE AND DECAY TIMES CONSTANT .03 µs**
- **SINGLE PULSES TO 20,000 PER SECOND**
- **100 VOLTS, 50 OHMS DRIVING IMPEDANCE**
- **CALIBRATED WIDTH, POSITION AND RATE**
- **TRIGGER OR SINE WAVE SYNCHRONIZATION**
- **NEGLIGIBLE INTERACTION OF CONTROLS**

RANGE EXTENDER

- 19 additional time increments of 50 µs each
- Continuous calibrated coverage from 0.1 to 1000 µs, accuracy within 5%
- Plugs into top of Pulse Generator directly above position or duration control

SYNCHRONIZATION

- Externally by almost any 5 volt waveform from essentially 0 to 20,000 per sec.
- Internal single pulses, power line freq. or adjustable from 20 to 20,000 pps
- Recurrence rate meter, accuracy within 5%
- Sync out trigger 50 volts, 1 µs duration

TELETRONICS LABORATORY INC.

54 KINKEL STREET, WESTBURY, LONG ISLAND, NEW YORK

Want more information? Use post card on last page.

"O.K. But what's your price for performance?"

Here's a purchasing agent buying resistors on a price basis. But doing it the *right* way.

Some day we may even be able to quote resistor prices in terms of performance—so many cents per thousand hours of trouble-free operation. Then we'll be able to tell you exactly how much *less* Ward Leonard resistors really cost than the so-called "bargain" resistors now on the market.

But until then, remember, it's *performance* you pay for when you're buying resistors. There's a lot more than just a few cents difference in the performance you'll get from the two resistors above.

The one made by Ward Leonard will perform at its rated value for the life of the product it goes into. There's a chance the so-called "bargain" resistor will too. But you can't afford to take *any* chances on your product's failure—even once out of a hundred times. Not when you consider the actual cost of such failure, figured in terms of returned merchandise, replacement cost, customer and dealer dissatisfaction.

That's why, even on a price basis, the accuracy, dependability and uniformity of Ward Leonard resistors make them far better buys than any of the questionable bargains you'll find on the market. Send for *new* Resistor Catalog No. 15. Ward Leonard Electric Co., 31 South Street, Mount Vernon, N. Y.

3•18

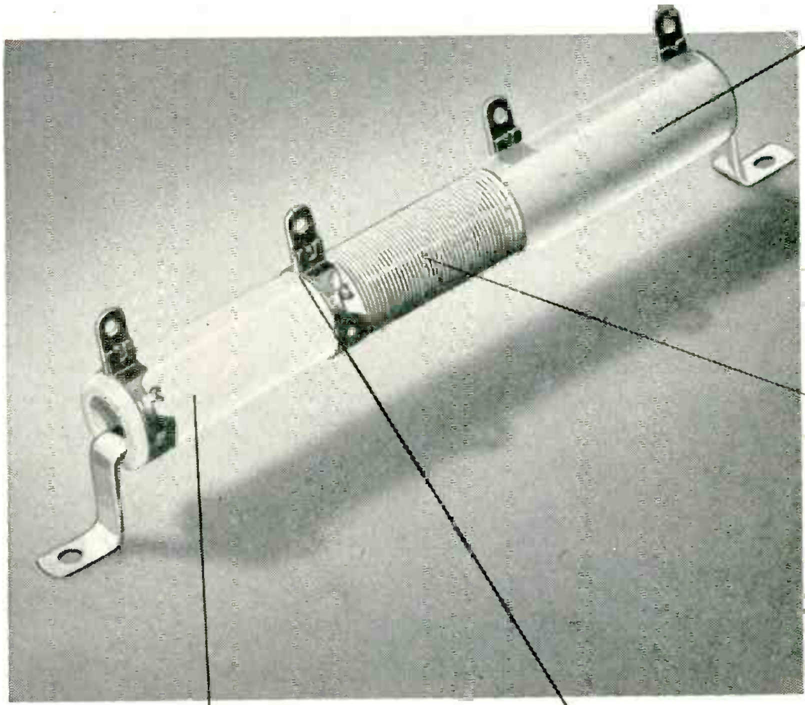
WARD LEONARD

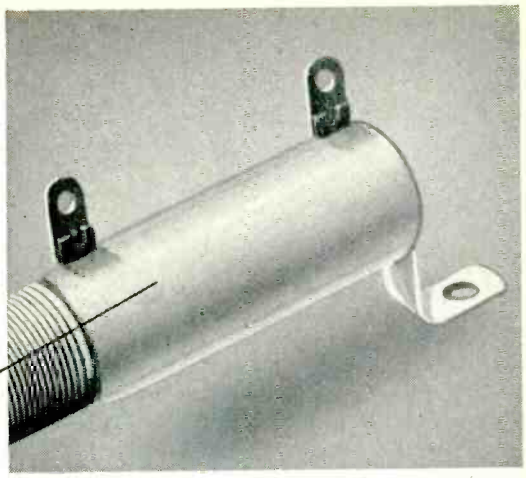
WARD LEONARD ELECTRIC COMPANY

MOUNT VERNON, NEW YORK

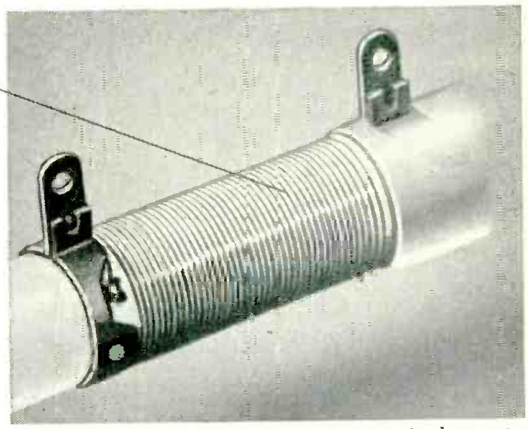
Result-Engineered Controls Since 1892

This check list shows you how to get the most for your money in terms of resistor performance

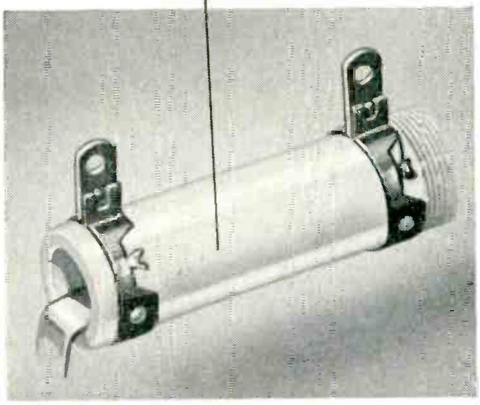




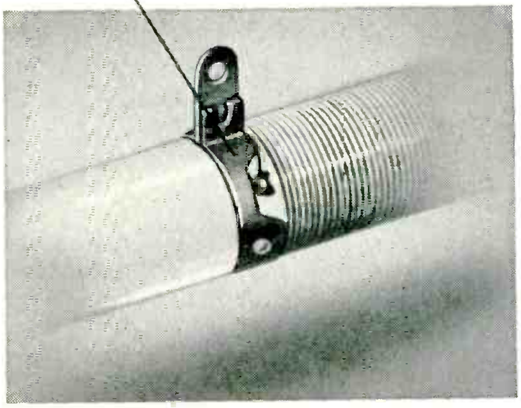
COATING. Vitrohm enamel coating of all Ward Leonard resistors provides a complete hermetic seal highly resistant to shock, high humidity, extreme temperatures, acids, alkalies, and electrolysis. Unlike most resistor manufacturers, we manufacture our own vitreous enamel.



RESISTANCE WIRE. The resistance wire is drawn to Ward Leonard's own specifications for each particular resistor type. It is capable of withstanding heavy overloads, has a uniformly low coefficient of resistivity. Many of the "bargain" resistors are wound with resistance wire of ordinary grade.



RESISTOR CORE. Ward Leonard's own manufactured cores upon which the resistance elements are wound consist of a perfectly cylindrical ceramic body of high density, low porosity, and high dielectric strength, with a thermal coefficient of expansion correlated to the expansion of the enamel.



TERMINALS. In Ward Leonard resistors, special alloy terminals insure proper expansion and adherence to the enamel, are designed to provide strong anchorage. Every wire-to-terminal junction is joined mechanically first, then specially silver-brazed for lasting contact.

Want more information? Use post card on last page.

Type U70, 3/4" diameter *miniaturized* variable composition resistor with special printed circuit terminals. Wattage rating: .3 watt for resistances through 10,000 ohms, .2 watt with 350 volts maximum across end terminals for resistances over 10,000 ohms.

Type U45, 15/16" diameter, variable composition resistor with blade-type printed circuit terminals. Wattage rating: 1/2 watt for resistances through 10,000 ohms, 1/3 watt for resistances over 10,000 ohms through 100,000 ohms and 1/4 watt with 500 volts maximum across end terminals for resistances over 100,000 ohms.

Type GC-U45, 15/16" diameter, variable composition resistor with blade-type printed circuit terminals same as U45 except with attached SPST, 3 ampere, 125 volt "GC" type switch. Also available with type "WF", DPST, 3 ampere, 125 volt switch. (Variable resistor type WF-U45.)

CTS

CHICAGO TELEPHONE SUPPLY
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ELKHART • INDIANA

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Henry E. Sanders, McClatchy Bldg.
69th & Market St., Upper Darby, Penna.
Phone: Flanders 2-4420

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Los Angeles 35, California • Phone: Bradshaw 2-3321

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8 West 40th Street, New York 18, N. Y.

Specialists in Precision Mass Production of Variable Resistors

Need ceramic coil forms? *Look to* CTC!

Nine different types to choose from — each meeting strict government specifications.

Wind these CTC ceramic coil forms to your specifications — then let us make them up for you in quantity. Forms are made of grade L-5 silicone impregnated ceramic varying in winding diameters from .205″ to ½″ and in mounted heights from 19/32″ to 1 11/16″ (see table below). Forms LST, LS5, LS6 and LS7 are also available with silicone fibreglas terminal retaining collars permitting 2 to 4 terminals. Designated as Type C, these latter forms are excellent for bifilar windings and are advantageous for single pie windings, permitting terminals to be located above or below winding thus shortening wiring to circuit elements. These forms also afford twice as many soldering spaces.

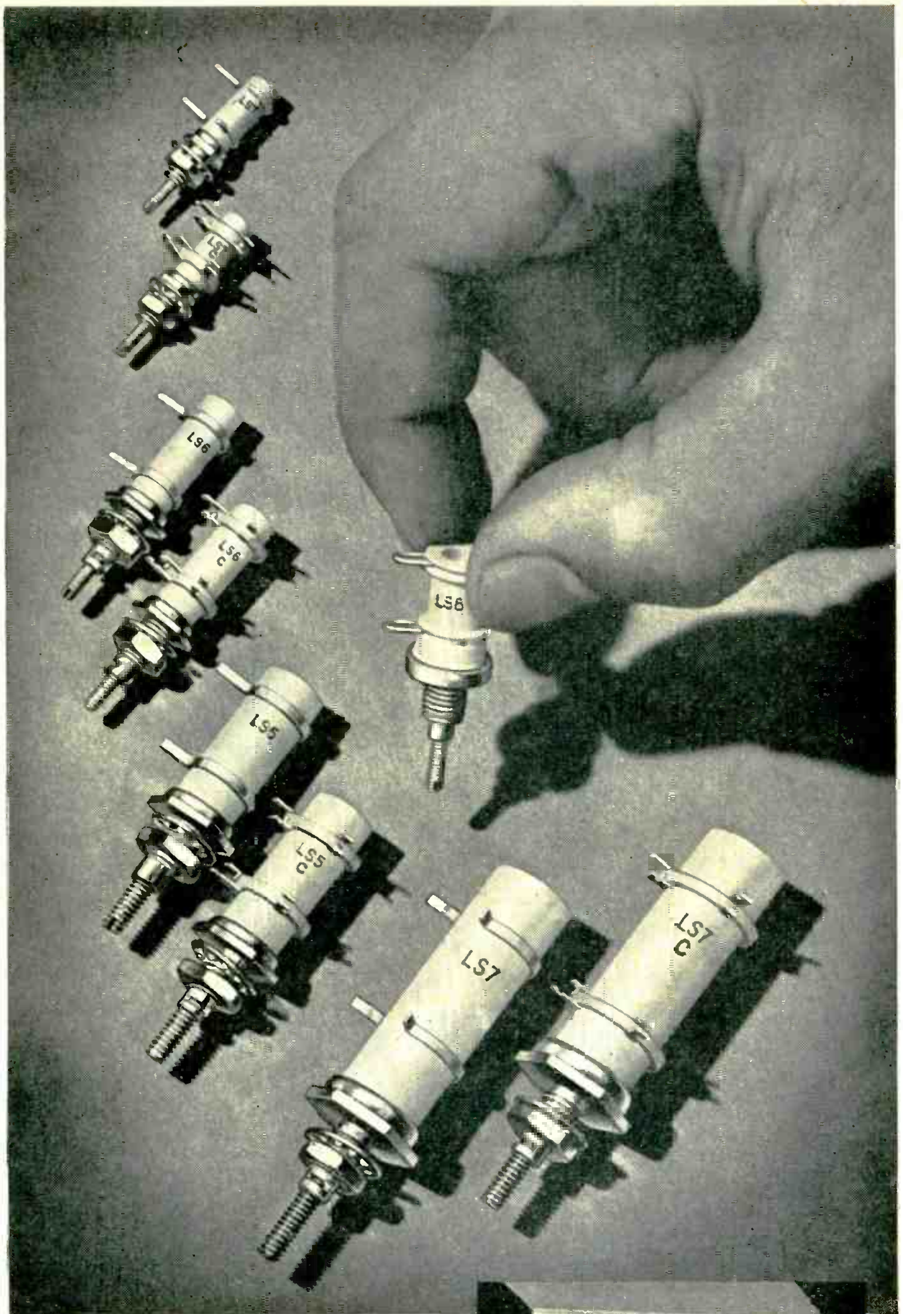
CERAMIC COIL FORM SPECIFICATIONS

Coil Form	Mounting Stud Thread Size	Form O.D.	Mounted O.A. Height
*LST	8-32	.205″	19/32″
*LS6	10-32	¼″	27/32″
*LS5	¼-28	⅜″	1 1/16″
LS8	¼-28	25/64″	23/32″
*LS7	¼-28	½″	1 11/16″

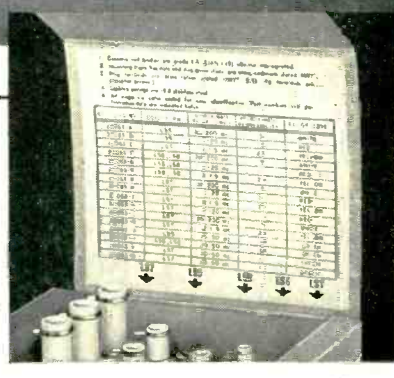
*ALSO AVAILABLE as Type C, described above.

For your convenience, a kit (X1897) containing 3 each of the forms listed above is available for developing prototypes and pilot models. Also, a new Coil Kit (X2060) containing 10 slug-tuned LS6 Type C coils is available — ranging from 2 Microhenries to 800 Microhenries.

Ceramic coils wound to your specifications can be furnished in quantity. Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Mass. West coast manufacturers contact E. V. Roberts, 5068 West Washington Blvd., Los Angeles, and 988 Market Street, San Francisco, California.



Shown approximately full size.

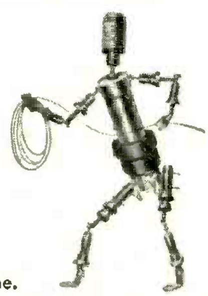


Color-Coded Chart on inside cover of the CTC Ceramic Coil Form Kit lists data of interest to designer and enables designer to order in quantity after specifications are determined.

CAMBRIDGE THERMIONIC CORPORATION

CTC

custom or standard . . . the guaranteed components



Write for Free Catalog #400 containing complete data on the entire CTC line.

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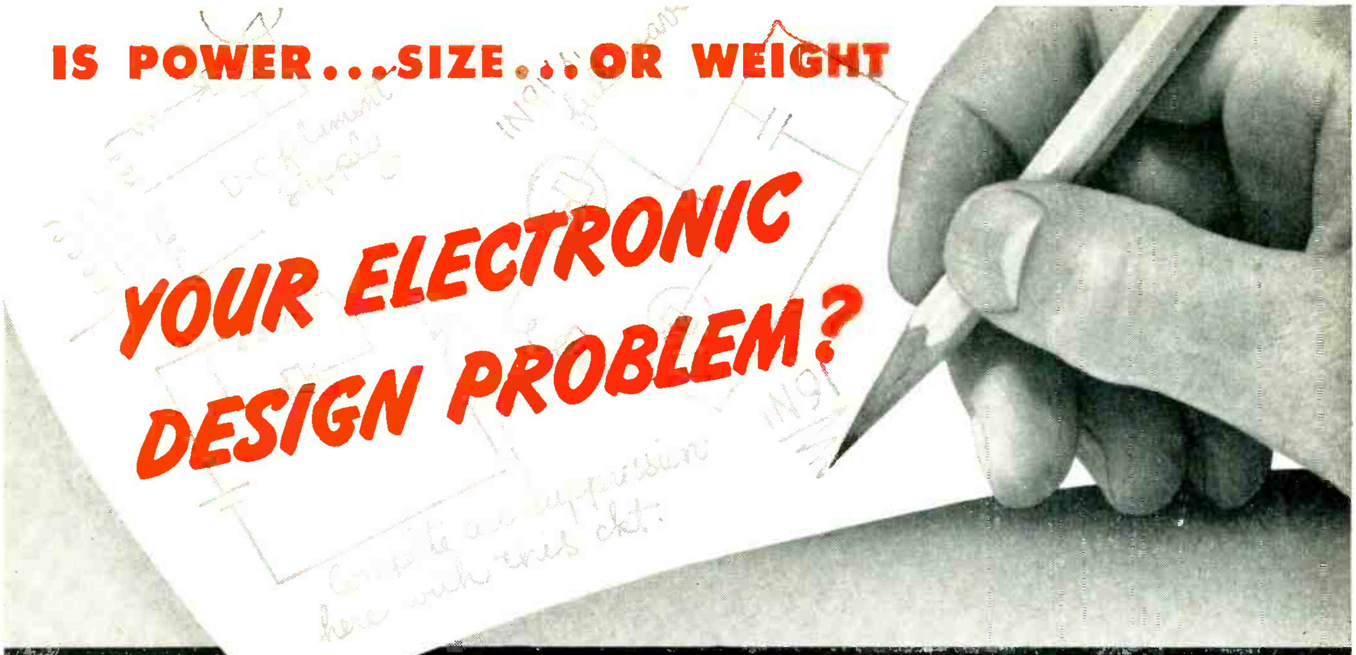
IS POWER...SIZE...OR WEIGHT

YOUR ELECTRONIC DESIGN PROBLEM?



DIFFUSED JUNCTION GERMANIUM RECTIFIERS

NOT only is the complete G-E rectifier line an umbrella which covers virtually every power requirement imaginable but individual types also apply to a broad base of power circuit functions. The 1N91 is an excellent example. Utilizing its low voltage...high current characteristics our engineers pin point new applications every day. A machine involving small dc relays...a calculator...model train control...appliances...a pinball machine are typical discoveries. Quite possibly the equipment design you are presently at work on will be the next addition to this list.

Why not send your specifications to General Electric application engineers for a complete recommendation!

G-E HAS A COMPLETE LINE

Type	Peak Inverse	D.C. Output
1N91	100 v	150 ma
1N92	200 v	100 ma
1N93	300 v	75 ma
1N151	100 v	500 ma
1N152	200 v	500 ma
1N153	300 v	500 ma
1N158	380 v	500 ma

DESIGN FEATURES

- VERY LOW LOSSES.
- HERMETICALLY SEALED against deteriorating elements.
- MINIATURE SIZE made possible by low internal losses.
- DESIGNED to meet all military humidity tests and shock and vibration requirements.
- MULTIPLE ARRANGEMENTS for full wave or bridge circuits up to tens of amperes.

LET G-E APPLICATION ENGINEERS ADVISE YOU!

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

General Electric Company, Section 4113
Electronics Park, Syracuse, N. Y.
Here are my circuit requirements. Please send me your recommendation.

NAME...

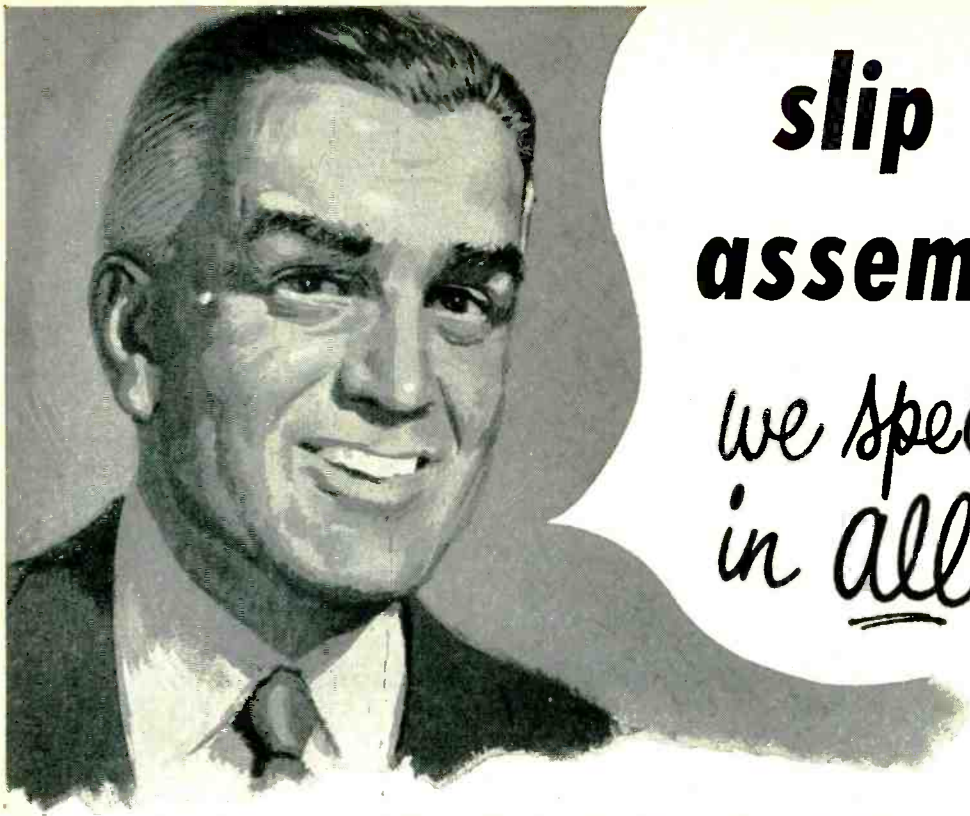
COMPANY...

ADDRESS...

CITY...STATE.................................

GENERAL ELECTRIC

Want more information? Use post card on last page.

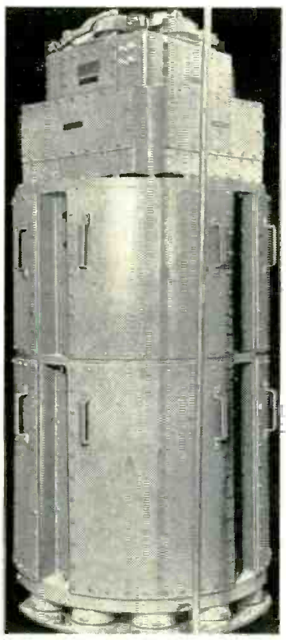


slip ring assemblies-

we specialize in all sizes

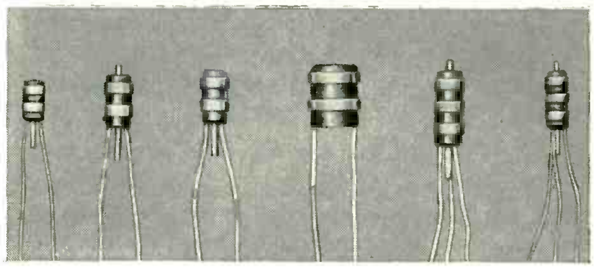
Your slip ring requirements may necessitate a very large assembly, equipped to carry 500 or more circuits, and operable for long periods of time under severe conditions. Or you may require a miniature unit which can be produced inexpensively in high volume and still function to precision specifications. . . . PM Industries can fulfill either type of requirement because we are experienced in designing, developing, and producing Slip Ring Assemblies at both ends of the scale.

FOR EXAMPLE —



REQUIREMENT: S. R. A. for gun fire control. **CUSTOMER:** U. S. Navy, Bureau of Ordnance. The specifications on this unit called for 531 circuits, including high voltage and RF. Also included in the specifications were easy servicing, long operating life, and ability to withstand vibration and severe shock.

The completed assembly, which met all specifications, was 8′ 1″ high, 40″ in diam., and weighed 4300 lbs. Subsequently the customer specified greatly reduced weight, increased electrical capabilities from fewer rings, additional RF circuits, and decreased space allotment. These have been achieved in a unit 9″ x 12″ x 59″ weighing 450 lbs.



REQUIREMENT: S. R. A. for selsyn motors. **CUSTOMER:** Bendix Aviation Corp. This unit, which is being produced to meet special military specifications, is .450″ long, with rings .250″ in diam. The rings are silver alloy not less than #70 Vickers in hardness, and are molded in mineral filled Melamine with a central mounting shaft of stainless steel. The molded units are 100% tested at 900 volts RMS, 60 cycles. Production rates, even though high initially, have recently had to be increased in order to meet Bendix Aviation's demand for this PMI assembly.

For further information on how PMI might be of assistance to you, write for our Facilities Report and our new brochure "Slip Ring Assemblies to Your Specs."

DESIGN • DEVELOPMENT • PRODUCTION

PMIndustries Inc., Stamford, Conn.

Electro-mechanical devices • Engineered plastic-metal assemblies

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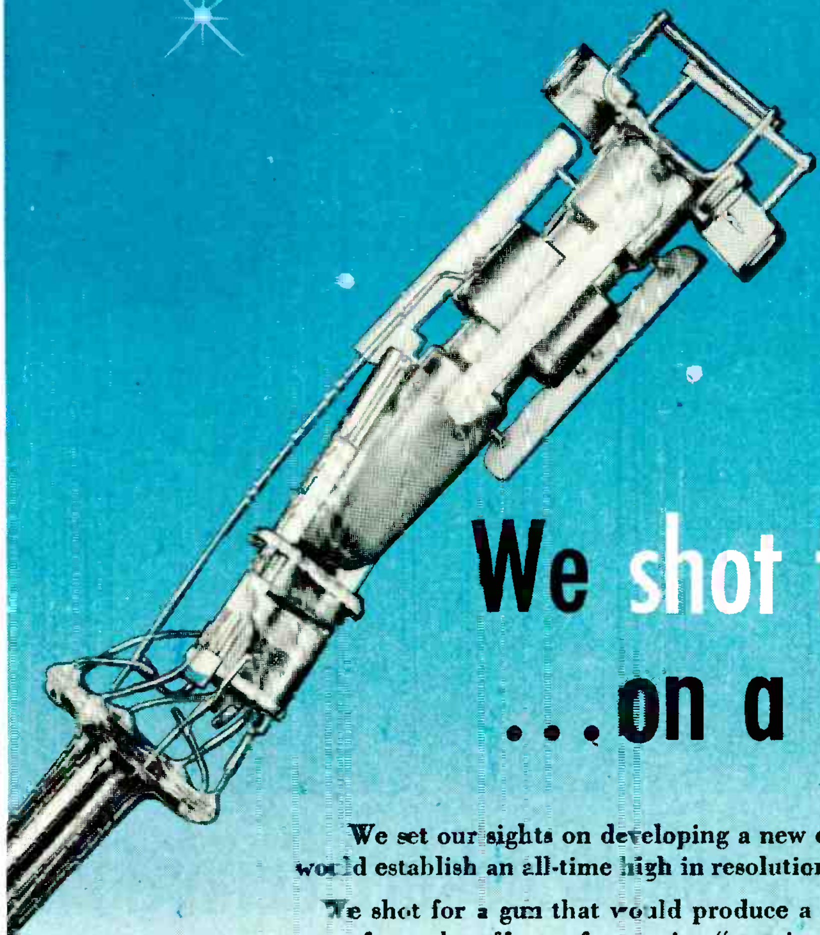

We shot for the moon ...on a clear night

We set our sights on developing a new electron gun . . . one whose finer beam would establish an all-time high in resolution for electrostatic-focus picture tubes.

We shot for a gun that would produce a smaller, sharper spot . . . a spot free from the effects of excessive "starring" which causes an outline blur similar to the haze around the moon on a cloudy night.

Smaller spot size, and cleaner, more uniform spot shape are the secrets of the Du Mont Hi-R Teletron. These are the features which have made possible a more vivid presentation of the television picture.

They are the reasons why, in just a few months, the Hi-R Teletron has become the performance standard of the television industry.

DUMONT® *Teletrons**

Hi-R — A new high in resolution — now being incorporated in all DuMont Electrostatic Focus Teletrons

*TRADE MARK

CATHODE-RAY TUBE DIVISION • ALLEN B. DU MONT LABORATORIES INC., CLIFTON, N. J.

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TV PURCHASING AGENTS:

Cut Production Line Rejects

with *Federal* "BEST-IN-SIGHT" PICTURE TUBES

OVER 99%* hit the bull's-eye for quality

Thousands of famous-name TV picture tubes were quality-tested by a famous-name manufacturer* of sets. When the scoring was over, Federal led all the brands tested . . . with an O. K. on over 99% of its tubes!

Here's proof of picture performance, Mr. Purchasing Agent . . . proof that you can cut your production line rejects with "Best-in-Sight" picture tubes.

Federal dependability is based on Federal's years of experience in producing *power* tubes . . . up to 500 KW . . . for hundreds of broadcast stations . . . for rectifying, industrial, military and general purpose applications.

Talk over *your* TV tube requirements with Federal . . . get the facts about the tube with *picture* quality to match the finest *chassis* quality.

For full information on types and sizes, write today to Dept. N-413.

FEDERAL TELEPHONE & RADIO FTR DIVISION OF IT&T

Federal Telephone and Radio Company

VACUUM TUBE DEPARTMENT 100 KINGSLAND ROAD, CLIFTON, N. J.

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

"Federal always has made better tubes"

Want more information? Use post card on last page.

DIRECT READING, MULTI-PURPOSE

SIGNAL GENERATORS

new!

-hp- 620A

SHF SIGNAL GENERATOR

7,000 to 11,000 mc

Now *-hp-* offers precisely accurate, easily obtained, *direct reading* test signals at any frequency from 10 to 11,000 mc!

New Model 620A SHF Signal Generator extends coverage of the *-hp-* generator group through the 7,000 to 11,000 mc range. Like other *-hp-* VHF, UHF and SHF Signal Generators, Model 620A provides the utmost in accuracy, pulsing capabilities, wide range, broad usefulness, and convenience. Frequency and output are directly set and read—no charts or interpolation are necessary.

Within its range, this new instrument simplifies all types of measurements including sensitivity, selectivity and rejection, signal-to-noise ratio, conversion gain, SWR, antenna gain and transmission line characteristics. It is also highly useful for slotted lines or waveguide networks, filter networks, etc.

Versatile *-hp-* 620A provides internal or external pulse modulation, internal square wave modulation, FM or CW output. On internal FM, the instrument provides a sawtooth sweep variable between 40 and 4,000 cps (deviation variable to ±3 mc). For external frequency modulation, capacitive coupling is provided to the repeller of the klystron oscillator. Repeller voltage is tracked automatically, and no adjustment is needed to select the correct frequency.

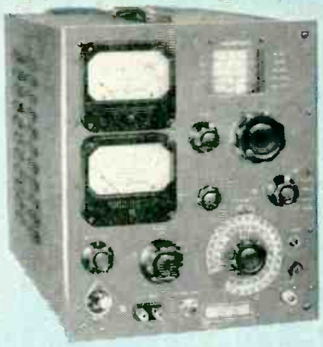
Output of the instrument is 0.1 mw or 0.071 v to 0.1 μv (—10 dbm to —127 dbm) into 50 ohms. Frequency calibration accuracy is better than 1%, and attenuator accuracy is within ±2 db.

Repetition rate is 40 to 4,000 pps, and pulse width is variable from 0.5 to 10 μsec. Sync-out signals may be simultaneous with the rf pulse, or in advance by any period from 3 to 300 μsec. Model 620A may be synchronized with external sine waves, or with positive or negative pulse signals. The instrument is compactly and sturdily constructed of highest quality components, weighs 90 pounds, and measures approximately 17″ wide x 14″ high by 16″ deep. Power source is 115 v ±10%, 50/60 cps, 250 watts. Price: $2,250.00.

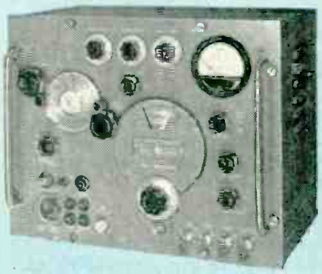
COMPLETE COVERAGE | **HEWLETT-PACKARD**

FOR ALL FREQUENCIES

10 to 11,000 mc



-hp- 608A VHF SIGNAL GENERATOR



-hp- 614A UHF SIGNAL GENERATOR

Only Hewlett-Packard offers this broad selection of direct-reading signal generators

Instrument	Frequency Range	Characteristics	Price
-hp- 608A	10 to 500 mc	Output 0.1 µv to 1 v into 50 ohm load. Pulse or CW modulation. Direct calibration.	$ 850.00
-hp- 612A	450 to 1,200 mc	Output 0.1 µv to 0.5 v into 50 ohm load. Pulse, CW or amplitude modulation to 5 mc. Direct calibration.	1,200.00
-hp- 614A	800 to 2,100 mc	Output 0.1 µv to 0.223 v into 50 ohm load. Pulse, CW or FM modulation. Direct calibration.	1,950.00
-hp- 616A	1,800 to 4,000 mc	Output 0.1 µv to 0.223 v into 50 ohm load. Pulse, CW or FM modulation. Direct calibration.	1,950.00
-hp- 618B	3,800 to 7,600 mc	Output 0.1 µv to 0.223 v into 50 ohm load. Pulse, CW, FM or Square wave modulation. Direct calibration.	2,250.00
-hp- 620A	7,000 to 11,000 mc	Output 0.1 µv to 0.071 v into 50 ohm load. Pulse, CW, FM or Square wave modulation. Direct calibration.	2,250.00

-hp- 612A UHF-TV SIGNAL GENERATOR

Model 612A is a new master oscillator—power amplifier generator especially designed for TV measurements including receiver and amplifier gain, selectivity, sensitivity and image rejection. Like other *-hp-* generators, it is also a convenient *direct-reading* power source for driving bridges, slotted lines, antennas and filter networks.

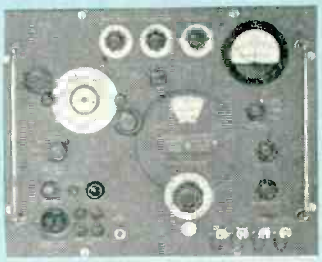
-hp- 612A covers all frequencies from 450 to 1,200 mc, and provides 0.5 volt output into 50 ohms throughout range. It has low incidental FM and broad band video modulation to 5 mc. It may be modulated internally or externally, amplitude modulated, or pulse modulated (good rf pulses 0.2 µsec or longer). Pulse modulation may be applied to the amplifier, or direct to the oscillator for high on-off signal ratios. Price: $1,200.00.

Data subject to change without notice. Prices f.o.b. factory.
For complete details, see your -hp- field representative or write direct

HEWLETT-PACKARD COMPANY

2853-A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.

SALES REPRESENTATIVES IN PRINCIPAL CITIES



-hp- 616A UHF SIGNAL GENERATOR

-hp- 618B SHF SIGNAL GENERATOR

hp INSTRUMENTS | COMPLETE COVERAGE

Want more information? Use post card on last page.

The most versatile test data recorder you've ever seen!

Check these features:

SPAN:
adjustable from 1 to 50 millivolts. Arbitrary dial markings, readily converted to millivolt range by means of calibration supplied with recorder.

ZERO SUPPRESSION:
coarse and fine dials permit movement of zero by ±100% of max. span.

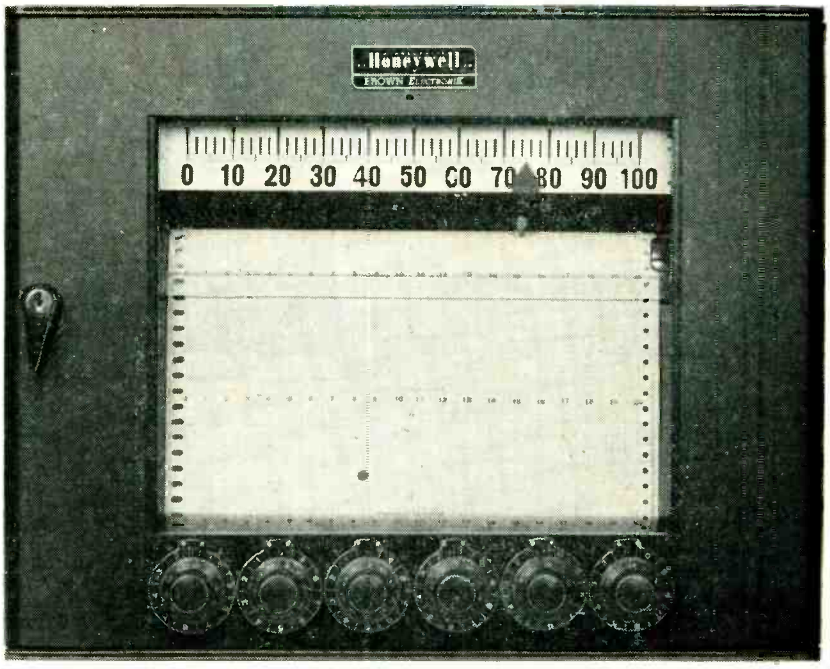
DAMPING:
adjustable to obtain optimum balancing action for almost any span or source impedance.

SENSITIVITY:
automatically adjusts measuring circuit response as span is changed.

SPEED:
full scale pen travel as fast as one second.

WIDE CHART:
11-inch calibrated width gives high resolution.

STANDARDIZING:
manual.



If you need to record results of a variety of tests, this new *ElectroniK* instrument is just what you've been looking for. A simple turn of its dials converts it to practically any range your tests require.

Especially useful with strain gauges, accelerometers, tachometers, differential thermocouples—or any other voltage-producing transducer—it is like having a hundred instruments in one. You can vary its full scale span over a wide range, to spread out test curves in exceptionally readable form. You can move its zero point up and down at will, until the portion of the test curve in which you're most interested is spread across the recorder chart. And you can change its sensitivity and damping to give the recording characteristics that best fit your test. Span and zero adjustments are completely independent.

Our local engineering representative will be glad to discuss how this new instrument can bring new convenience to your test work. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4428 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA:**
Write for Data Sheet No. 10.0-10 "Adjustable Span *ElectroniK* Recorder."

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

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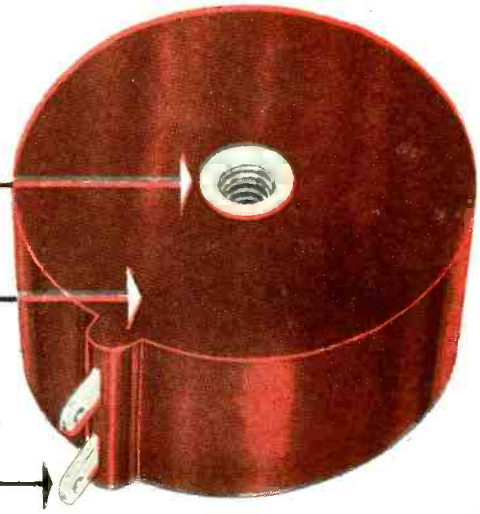
You Can Depend on COMMUNICATION ACCESSORIES for

ADVANCED DESIGN



THROW AWAY the special washers and tubings used in your present mechanical mountings of toroids. C-A-C Advanced Design provides a molded-in brass bushing with center hole sizes to clear (type A) or tapped (type B) for a 6/32 screw.

PRESSURE ENCAPSULATION in low loss plastic provides a dense molding of extremely uniform dimension. We've cycled them from —73° C to 150° C—boiled them for hours in salt water—without any significant change.

TERMINALS are brass, silver-plated. Located for ease of connection. Any reasonable number of terminals may be provided. Units may be stacked and mounted with a single screw.

AN EXCLUSIVE **C-A-C** DEVELOPMENT

Compression MOLDED PLASTIC TOROIDS

THE C-A-C MP (molded plastic) Toroid is the result of years of development and exhaustive tests to determine the most suitable materials and method of manufacture. The small, extra cost of the molded unit is more than justified by the superior protection of the unit from damage in assembly and operation—and the elimination of complicated mounting arrangements. The assemblies are compact (see table for dimensions). Complete data available on request; samples will be furnished for your evaluation.

TOROIDAL INDUCTORS
Data For Standard Types

	Type	Normal Lmax.	Appr. Size O.D. x H	Useful Freq. Range	Qmax @ Freq.	T.C.	Iac. ma
*	206	3.0 Hy	.90x .40	Up to 15 KC	140 @ 9 KC	1	23
**	930	17.5 Hy	1.20x .60	Up to 15 KC	170 @ 7.5 KC	1	42
	254	35 Hy	1.85x .85	Up to 15 KC	220 @ 5 KC	1	67
	466	60 Hy	2.15x1.00	Up to 15 KC	260 @ 5 KC	3	95
*	848	1.4 Hy	.90x .40	10- 50 KC	170 @ 20 KC	1	33
**	395	8.0 Hy	1.20x .60	10- 50 KC	220 @ 20 KC	1	61
	381	17.0 Hy	1.55x .65	10- 50 KC	250 @ 17.5 KC	3	71
*	608	600 Mh	.90x .40	30- 75 KC	165 @ 60 KC	3	50
	579	7.5 Hy	1.55x .65	30- 75 KC	185 @ 30 KC	2	110
*	041	320 Mh	.90x .40	50-200 KC	115 @ 120 KC	3	68
	013	4.0 Hy	1.55x .65	50-200 KC	145 @ 70 KC	3	150

REMARKS

Qmax—Values taken at approx. .01 Iac. Q decreases with increasing current to about .50 Qmax at 1.0 Iac—higher inductance values have lower Qmax at lower frequency due to dielectric losses of winding distributed capacity. All values are for inductors wound with Heavy Formex wire.

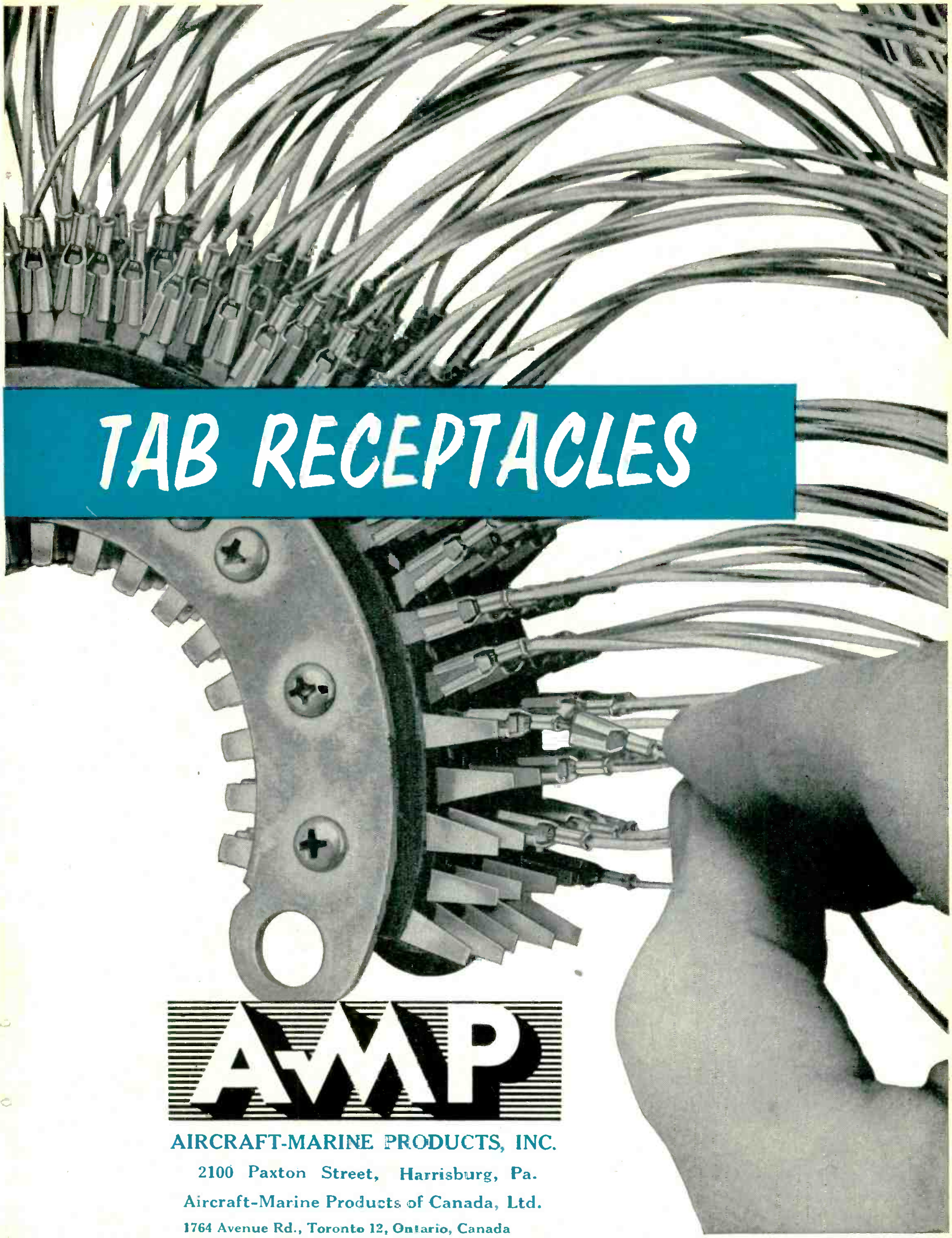
T.C.—Temperature characteristics as follows:
1—approx. 100 ppm/°F
2— = .1% 55 to 90°F
3— = .1% 30 to 130°F
(most types with temp. characteristic 1 are available with characteristic 3 at no sacrifice in performance)

Iac—r.m.s. current which raises 0.1 Hy inductor to max. (2% above initial) inductance — (1% increase occurs at approx 0.35 Iac.

* FINISHED SIZE — 1-1/16" O. D. x 1/2" THICK
** FINISHED SIZE — 1-5/16" O. D. x 11/16" THICK

Via C.A.C. Beechcraft, we are only hours away from you—we solicit the invitation to discuss your problems across your own desk.

COMMUNICATION ACCESSORIES *Company*
HICKMAN MILLS, MISSOURI



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For a complete range of compositions solving every important design problem

Specify **GENERAL CERAMICS**

ELECTRICAL CERAMICS

including

- TEMPERATURE EXTREMES
- SHOCK AND VIBRATION
- LOW ELECTRICAL LOSS
- HIGH DIELECTRIC STRENGTH
- MECHANICAL ADAPTABILITY

- **STEATITE**
  For low power loss at high frequency. High dielectric strength through wide temperature range. Low thermal expansion.
- **PORCELAINS**
  An economical high voltage material of great hardness. Low thermal expansion. Wet or dry processing.
- **ALUMINA**
  Characterized by great hardness and chip resistance. Will withstand very high temperatures.
- **ZIRCON**
  Has low loss properties that vary inversely with frequency. An excellent high frequency material having good thermal shock resistance.

General Ceramics has specialized in the manufacture of high quality technical ceramic materials for the electrical and electronic industries for over 25 years. The many compositions now supplied were developed over the years to solve specific problems of these industries. Most of these compositions have been standardized by General Ceramics and are available to solve your problems quickly and economically. Why not call, wire or write today for information.

GENERAL CERAMICS and STEATITE CORPORATION — STEATITE INSULATORS

General CERAMICS and STEATITE CORP.

General Offices and Plant: KEASBEY, NEW JERSEY

MAKERS OF STEATITE, ALUMINA, ZIRCON, PORCELAIN, SOLDER-SEAL TERMINALS, LIGHT DUTY REFRACTORIES, CHEMICAL STONEWARE, IMPERVIOUS GRAPHITE & FERRAMIC MAGNETIC CORES

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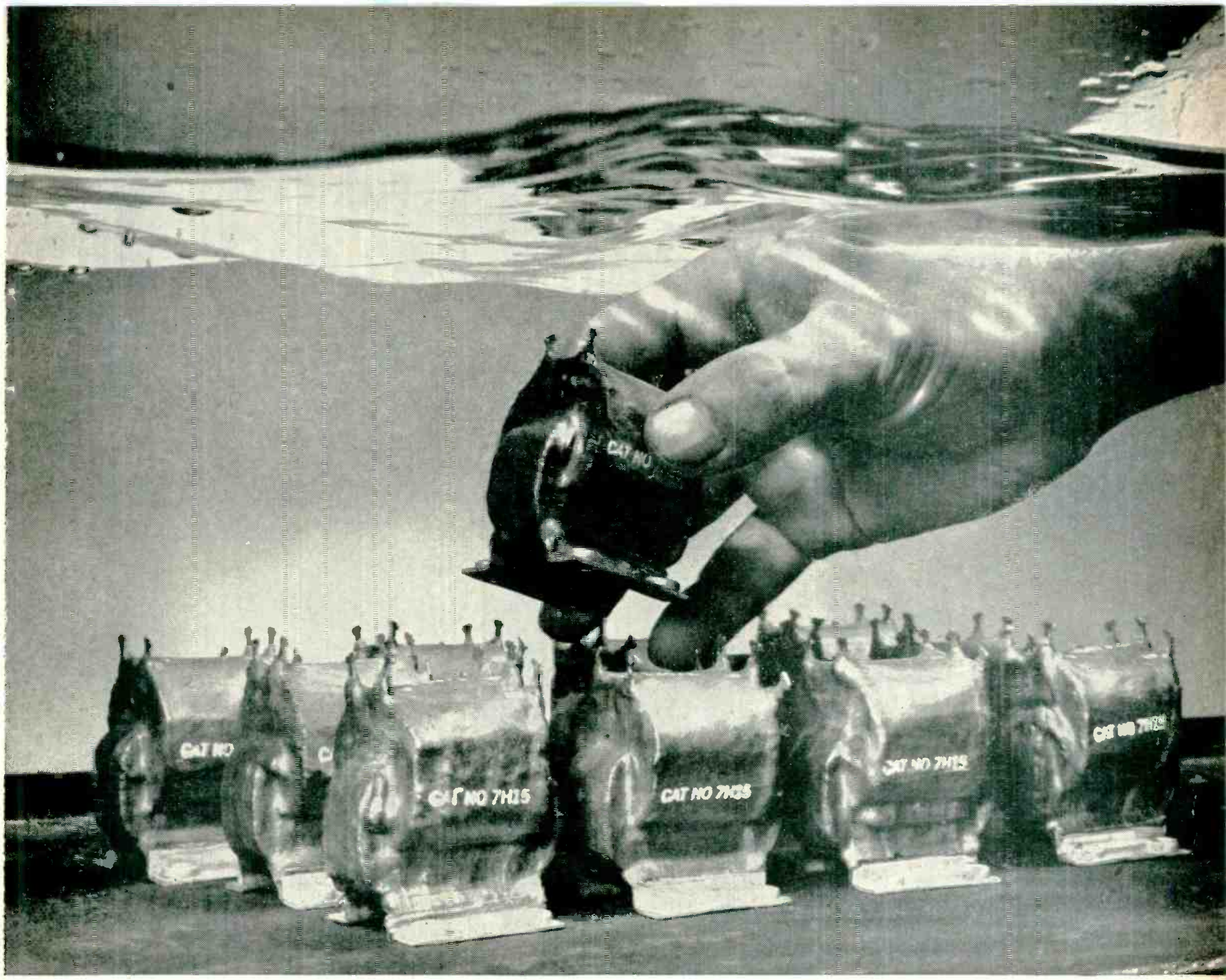


Westinghouse Fosterite® Transformers must pass this 4-hour underwater test

If you're looking for a small, open-type transformer, fully protected against moisture, check the line of Westinghouse Fosterite impregnated transformers. This four-hour underwater test proves the point:

All Fosterite-treated transformers are completely submerged in hot water at 60° Centigrade for two hours, after which they are "thermal-shocked" in cold tap water, and soaked there for an additional two hours. An electrical test is then applied, in which each transformer must show an insulation resistance reading of at least 2000 megohms. Fosterite has to be good!

This is just one of many severe tests to which Westinghouse specialty transformers are subjected. They assure you of quality that will meet your requirements exactly . . . quality that stands up under extreme conditions.

Fosterite impregnated and coated transformers can be made available to meet your most stringent specifications. In addition to moisture protection, Fosterite makes drastic weight reductions possible . . . as much as 30 to 50%, when compared to enclosed types.

Call your Westinghouse representative for further information, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-70678

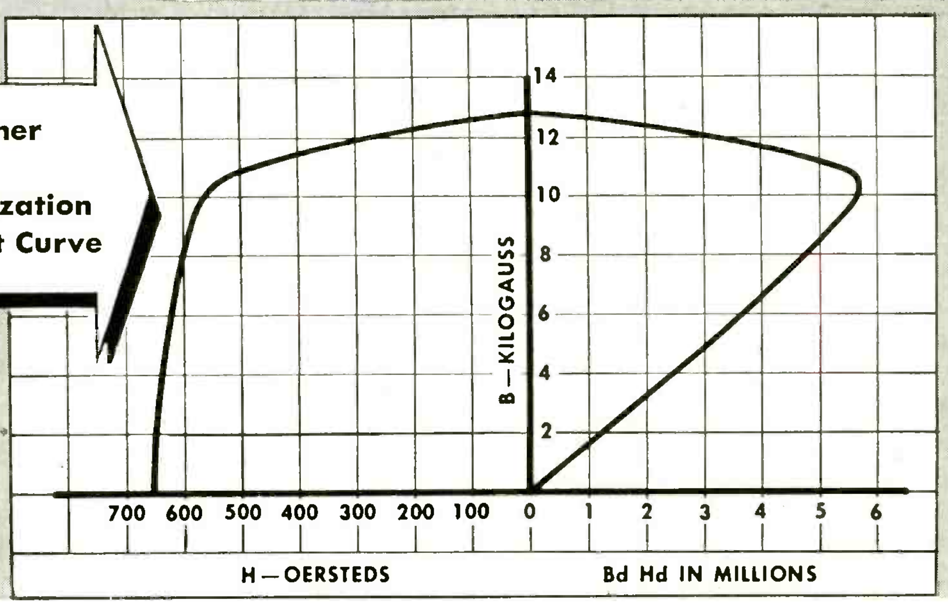
YOU CAN BE *SURE*... IF IT'S

Westinghouse

5.70 x 10^6 Bd Hd energy product nominal

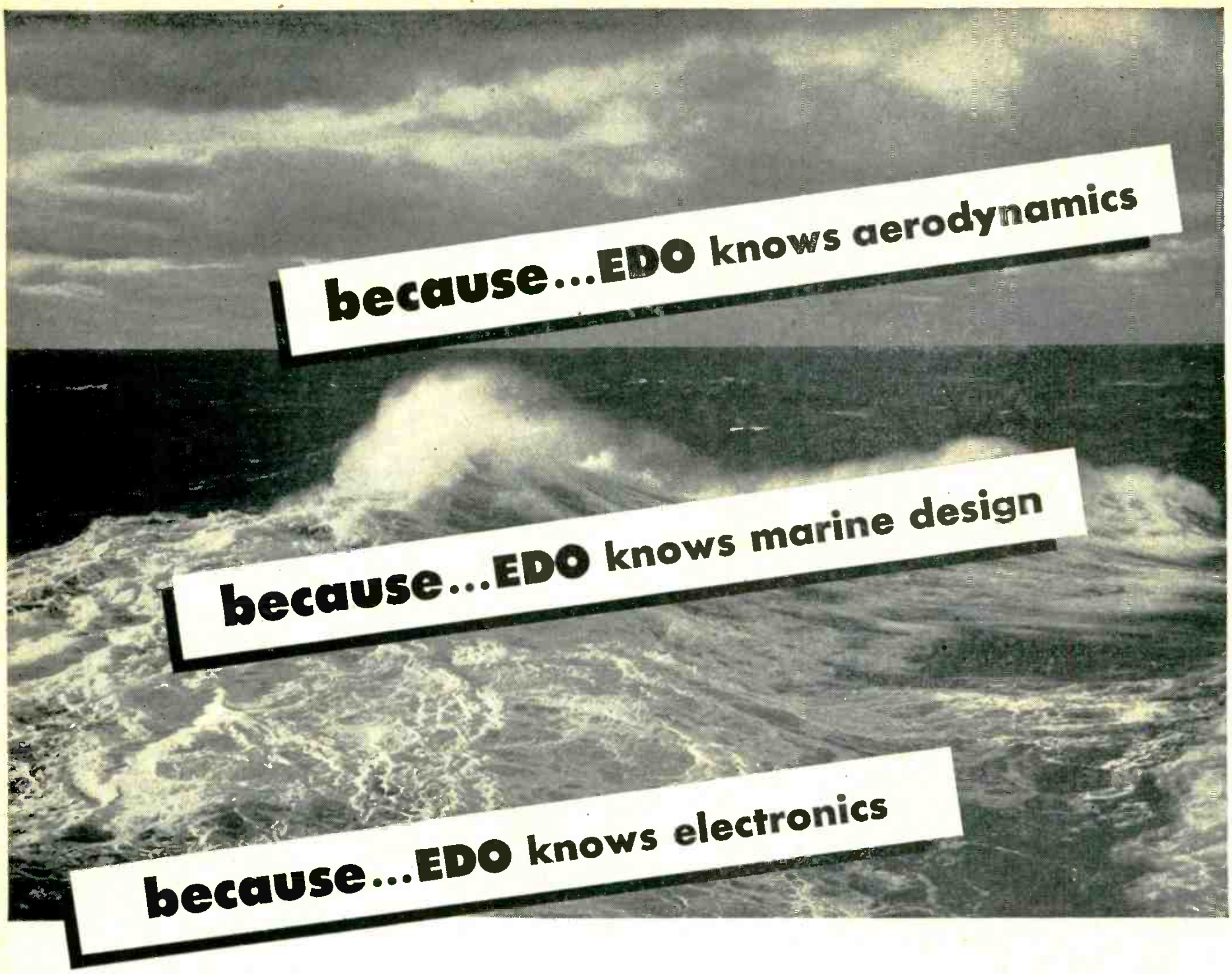
NEW ALNI

Thomas & Skinner
Alnico 5Cb
Typical Demagnetization
and Energy Product Curve



SPECIALISTS IN MAGNETIC MATERIALS . . .

Permanent Magnets Laminations and Wound Cores



let **EDO** house your electronic equipment

Housing intricate electronic equipment for airborne or shipboard use to withstand shocks and forces which might cause malfunction often presents problems as difficult as the design of electronic systems themselves.

Tackling such problems for electronic manufacturers, ship and aircraft builders is a specialty of the Edo Corporation. Whether your equipment must operate properly on jet aircraft or on board ship under battle conditions, its reliability is improved if mounted in Edo-designed and built cabinets or housings.

If you have a housing problem, why not talk it over with our versatile engineering staff whose three-fold experience in the marine, aviation and electronics fields is unique *and at your disposal.*

to withstand . . .

SHOCK
MACH 1 SPEED
VIBRATION
CONCUSSION
SPRAY
ENVIRONMENTAL

TWO TYPICAL HOUSING PROBLEMS SOLVED BY EDO

1. AIRBORNE HOUSING. A volume producer of airborne radar nacelles, Edo was asked to design a pressurized external store housing capable of being flown in the trans-sonic speed range. From wind tunnel tests to completed tooling and production, Edo relieved the electronics manufacturer and the aircraft builder of these design problems.

2. SEABORNE INSTALLATIONS. To house its own electronic equipment developed and manufactured for the Navy, Edo engineers have perfected a series of *standard* electronic cabinets admirably suited to naval electronic equipment. Capable of housing all standard electronic units, the Edo cabinets are vibration-proof and spray-proof.

Edo CORPORATION College Point, L. I., N. Y. SINCE 1925

NEW GUN

Tests made under standard conditions in fringe areas and in laboratories show better definition in Westinghouse picture tubes

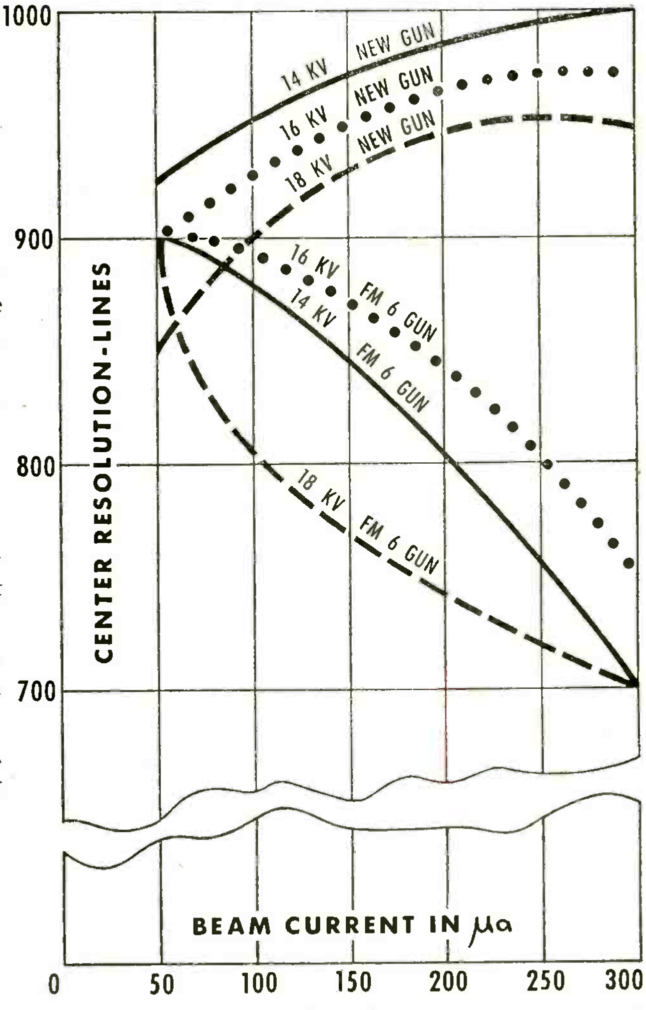
In the Westinghouse engineering laboratories, tests were made of the performance of the new Westinghouse electrostatic gun in a 21-inch tube. Comparable tests were made on the Westinghouse FM-6 gun—which has been recognized as being among the best in the industry. The results of these tests show that the new gun gives a decidedly superior performance.

To substantiate this laboratory data a series of field tests was made in a residence in Bath, New York. A Westinghouse 21YP4 electrostatic focus picture tube was selected at random from cartoned stock. The 21YP4's of three other leading manufacturers were purchased from distributor stock. Identical test conditions were maintained.

The results of these tests:

1. The smaller spot size produced in the Westinghouse tube gave greater picture resolution, finer definition, than that of any other tube tested.
2. The Westinghouse tube showed more detail in highlights and smaller snow particles than any other tubes tested.
3. Subsequent laboratory tests showed that the Westinghouse tube maintained far better focus over a wide range of focus voltage than any other tubes tested, as follows:

Westinghouse:	Sharp focus from —50 V to +150 V.
Brand "X":	Sharp focus from —30 V to —60 V only.
Brand "Y":	Sharp focus from —80 V to —100 V only.
Brand "Z":	Sharp focus from +160 V to +200 V only.

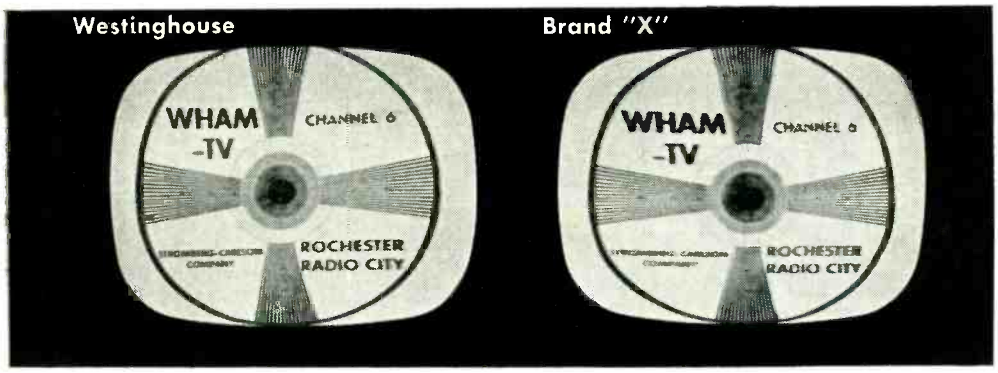


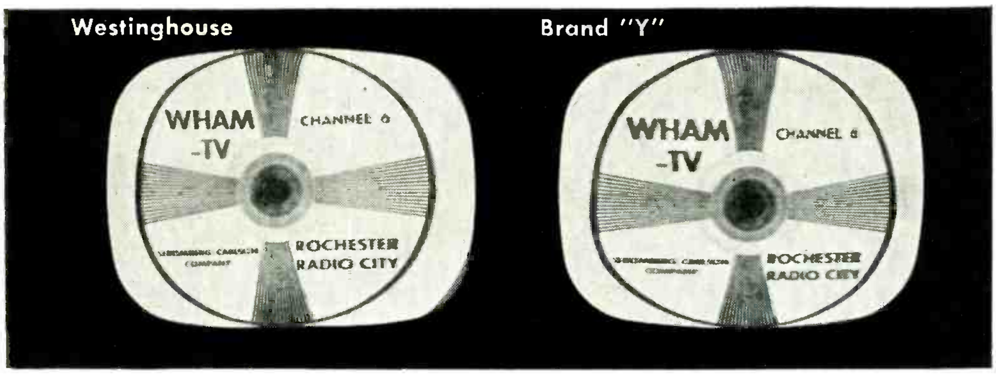
This curve relates center resolution to beam current over a range of anode voltages — depicting the ability of the gun to maintain sharp definition despite changes in current.

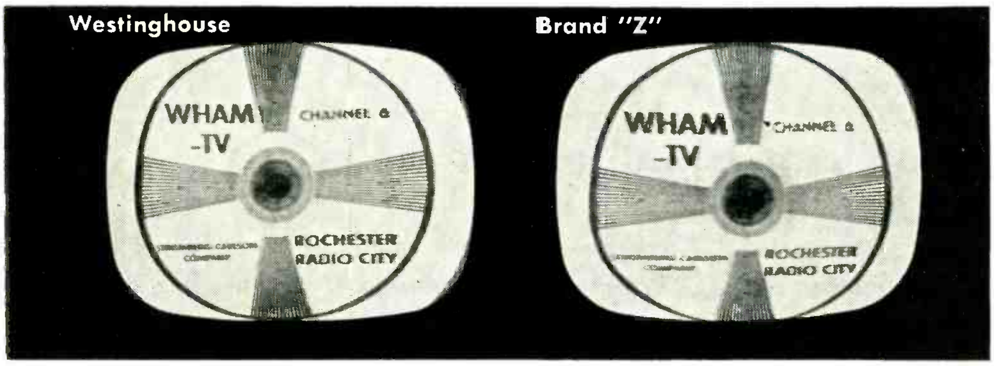
YOU CAN BE SURE... IF IT'S **Westinghouse**

WESTINGHOUSE ELECTRIC

In Westinghouse Electrostatic Picture Tube Gives Better Resolution in Fringe Areas







Check Comparative Resolutions Shown in These Photographs

The greater resolution, finer definition, and better contrast of the Westinghouse tube is obvious on the unretouched photographs on the left. Each photograph shows a Westinghouse tube operating next to a competitive tube in an adjacent chassis. Each pair of pictures is the result of a single photograph with each tube operating under identical conditions.

Westinghouse invites you to perform this or similar tests in any chassis you may choose. Complete data resulting from the Bath, New York, tests on Aug. 15, and Westinghouse laboratory tests is available upon request to Dept. A-211, Westinghouse Electric Corp., Elmira, N. Y.

The following test conditions were maintained throughout all field tests:

Date: August 15, 1953
Location: Bath, New York
Signal: Test pattern from station WHAM-TV, Rochester, N. Y., 70 miles distant.

Tubes Tested: Westinghouse 21YP4 with new electrostatic focus gun and 21YP4's of three other leading manufacturers. All tubes selected at random.

Beam Current: 200 μa
Anode Voltage: 13.5 KV
Screen Voltage: 400 V

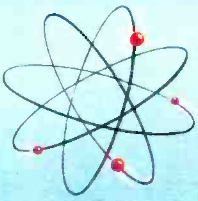
ET-95039

RELIATRON TUBES
TM

CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

Want more information? Use post card on last page.

GOLD PLATED CONTACTS



NOW STANDARD ON ALL

AMPHENOL

A N CONNECTORS

AMPHENOL's recent conversion to gold plated contacts on all A N connectors gives every user of quality A N connectors three important advantages:

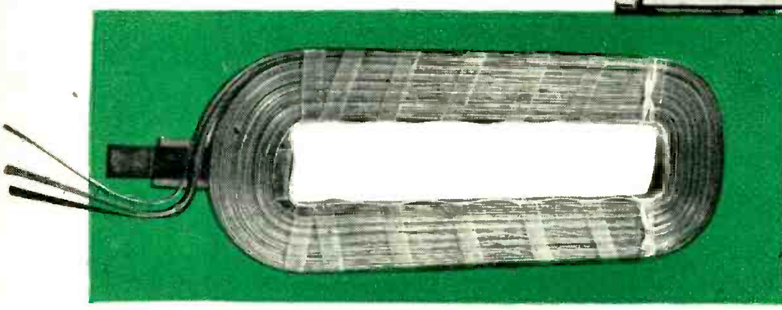
GOLD PLATED CONTACTS mean each AMPHENOL A N connector has a superior contact surface, electrically and mechanically, and provides more efficient performance.

GOLD PLATED CONTACTS end forever the problem of oxidation, as with ordinary silver-plated contacts. Results: like-new appearance and indefinite stock life.

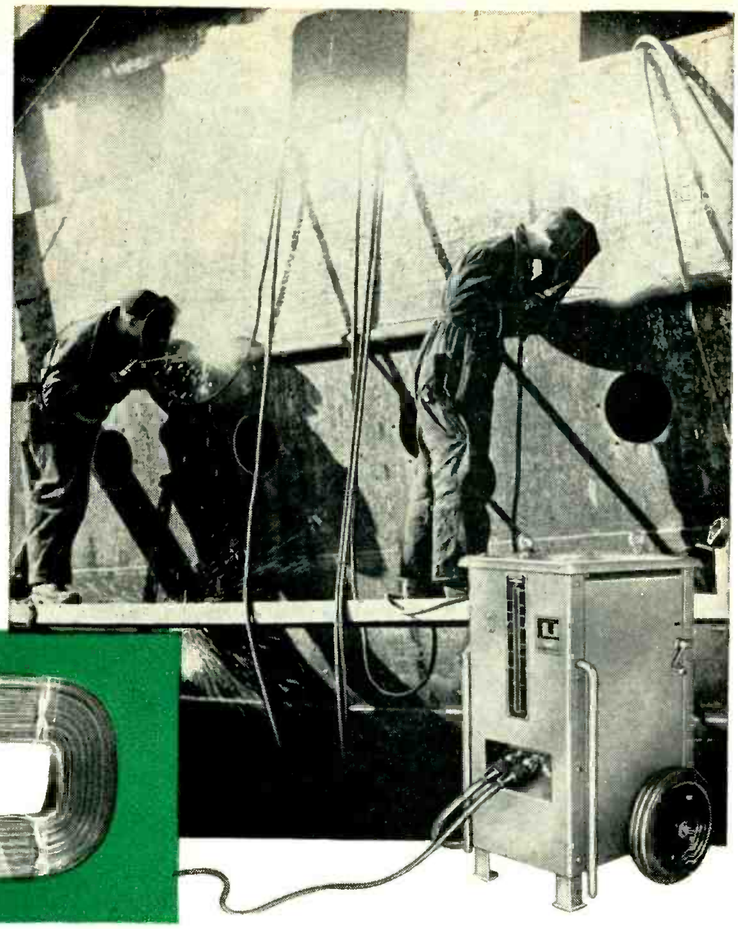
GOLD PLATED CONTACTS make soldering easier and faster than with silver—no pre-tinning of solder cups is required.

Write for your copy of Catalog A-3, a new and complete listing of all AMPHENOL A N and special connectors. It provides electrical, mechanical and dimensional data on each connector as well as illustrations of all insert arrangements.

NATVAR *in* NORWAY



This secondary coil shows the rugged construction used to insure proper operation under all service conditions. Natvar Varnished Fiberglas Tape and Sleeving are used to insulate and protect coils and leads from moisture and heat.



This UNITOR AC Arcwelder provides a welding current of 600 amperes at 40 volts load voltage on a 50% duty cycle. Heat range can be controlled either at the unit or from the operator's stand, from maximum down to 100 amperes at 25 volts. The unit can be moved close to the job so that long ground and electrode cables are not required.

UNITOR A. S., Oslo, Norway, manufactures a complete line of AC Arcwelders which can be easily moved from job to job. Since service conditions vary widely, these units are designed and built to operate in spite of severe moisture, corrosion, heat, and vibration.

Transformer coils and leads are insulated and protected with Natvar Varnished Fiberglas Tape and Sleeving because of its uniformly high performance under adverse conditions. Natvar agent and distributor for Norway is C. Bagges Asbestkompani A.S., Radhusgt 6, Oslo.

If you need insulating materials with good physical and electrical properties, and exceptional uniformity, it will pay you to get in touch with your distributor, or with us direct.

Natvar

Natvar Products

- Varnished cambric—cloth and tape
- Varnished canvas and duck
- Varnished silk and special rayon
- Varnished—Silicone coated Fiberglas
- Varnished papers—rope and kraft
- Slot cell combinations, Aboglas®
- Varnished-lacquered tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

Ask for Catalog No. 22

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

TELEPHONE RAHWAY 7-8800

CABLE ADDRESS NATVAR: RAHWAY, N. J.

201 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

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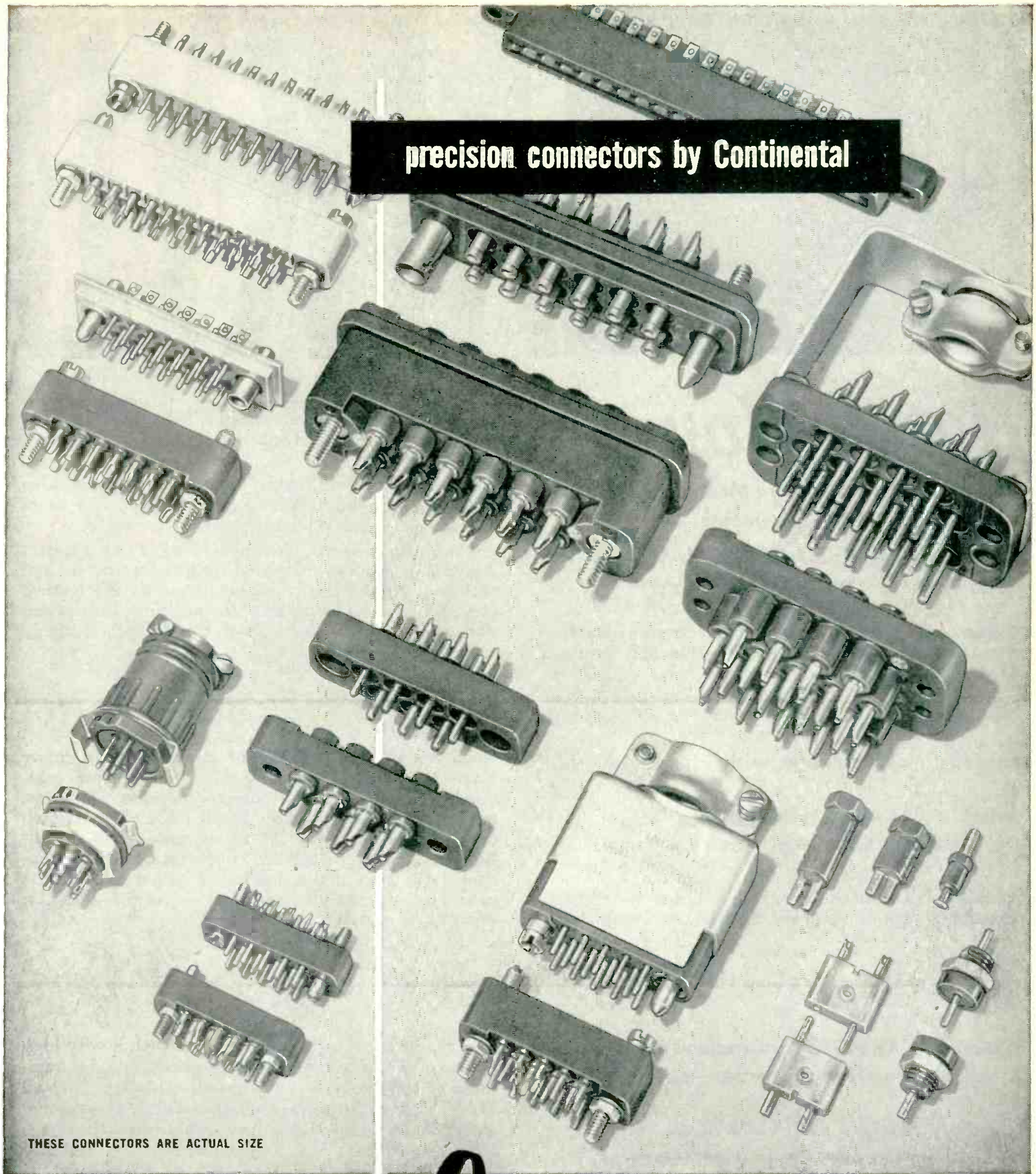

Series SM-20......Sub-Miniature Rectangular Connectors
Series 20..................Miniature Rectangular Connectors
Series H-20 ....Hermetical Seal Miniature Rectangular Connectors
Series C-20..................Miniature Hexagonal Connectors (Vibration Proof)
Series EZ-16.................Easy Release Power Connectors (Spring Loaded contacts)
Series 16.........................Rectangular Power Connectors
Series 14.........................Rectangular Power Connectors
Series PC...............................Printed Circuit Connectors
Miniature Precision Stand-offs
SPECIAL DESIGNS—submit your connector problems to our engineering department.

Continental Connectors

ELECTRONIC SALES DIVISION DeJUR-AMSCO CORPORATION

Write Dept. EC-11, DeJur-Amsco Corporation
45-01 Northern Blvd., Long Island City 1, N. Y.

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PLASKON ALKYD

Here's How...

Plaskon Fiber Glass Alkyd Meets Specific Electronic Equipment Requirements

—*says* DEJUR-AMSCO CORPORATION,

Exclusive Sales Agents for Continental Connectors,
45-01 Northern Blvd., Long Island City 1, N. Y.

Continental has kept pace with the electronics industry in miniaturization, sub-miniaturization and printed circuit connector development. The DeJur-Amsco Corporation's "Continental Precision Connectors" catalog says:—

"We have introduced new molding materials, such as Plaskon Fiber Glass Reinforced Alkyd . . . to meet specific electronic equipment requirements."

Among the reasons Continental went to Plaskon Alkyd are—customer demand for greater dimensional stability; greater arc resistance; superior mechanical strength; greater resistance to moisture absorption; and products with clean, sharp-molded edges, highly resistant to chipping.

Virtually No Shrinkage with Plaskon Alkyd,

—*says* CAL-CONNECTOR,

7414 Varna Avenue, North Hollywood, California:

"Shrinkage of insulating inserts in electrical connectors presents a serious problem to the user—especially when a *pressurized* connector is required. In many plastics used for inserts, after-shrinkage from cold-molded dimensions continues for months. However, parts molded with Plaskon Alkyd 422 display no such effect. Quick to recognize the advantages of dimensional stability in electrical connectors, the Cal-Connector Co. now molds inserts of Alkyd 422 for the products it manufactures. As a result—*Cal-Con inserts have virtually no shrinkage!*"

Miniature VARICONS are molded of Plaskon Alkyd for dielectric properties—*plus.*

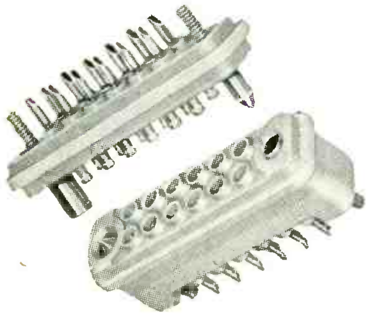
ELCO CORPORATION,

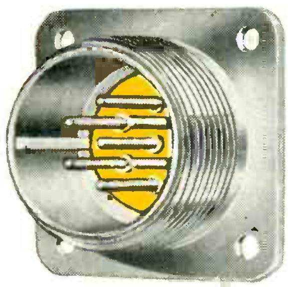
190 W. Glenwood Avenue, Philadelphia, Pa.

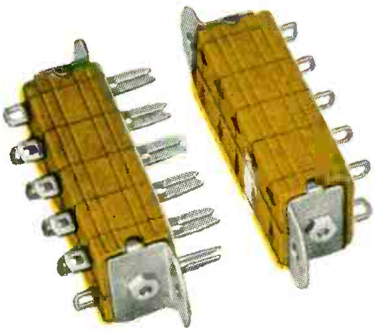
These pygmy parts are miniature connectors that do the work of giants and now, utilizing Plaskon Alkyd, carry even heavier loads. Elco Varicons have a wide acceptance in the electrical and electronics fields. They require electrical insulating material with a very high degree of arc resistance, to assure withstanding a maximum of 4000 volts between closest terminals. Like all Plaskon Alkyd parts, they possess superior dimensional stability, so there is no measurable after-shrinkage from cold-molded dimensions. Dimensional stability is highly important to Varicons, for there must be perfect fit between these miniature matched pairs. And the high-speed, low-pressure molding characteristics of Plaskon Alkyd contribute to Elco's production speed and low costs.

You can give your product superior arc resistance; make it stronger, more compact; assure its freedom from after-shrinkage; mold it faster—by using either Plaskon Alkyd or Plaskon Fiber Glass Reinforced Alkyd.

Solves Vital Problems for Electronics Manufacturers







Here's Why...

- **High dimensional stability (low after-shrinkage)**
- **Superior mechanical strength**
- **Fast, clean-edge moldings**
- **Extremely high arc resistance**
- **High heat resistance**
- **Greater compactness with safety**

—Because of their superior dielectric properties, Plaskon Alkyd parts can provide greater safety, with reduced over-all dimensions.

- **Molds easily, cleanly and rapidly, at low pressures**

Plaskon Mineral Filled and Plaskon Fiber Glass Reinforced Alkyd possess similar characteristics. In addition, Plaskon Fiber Glass Reinforced Alkyd has exceptionally high impact strength. Tough and rugged, it has three times the resistance of commonly used impact molding materials.

Write today!

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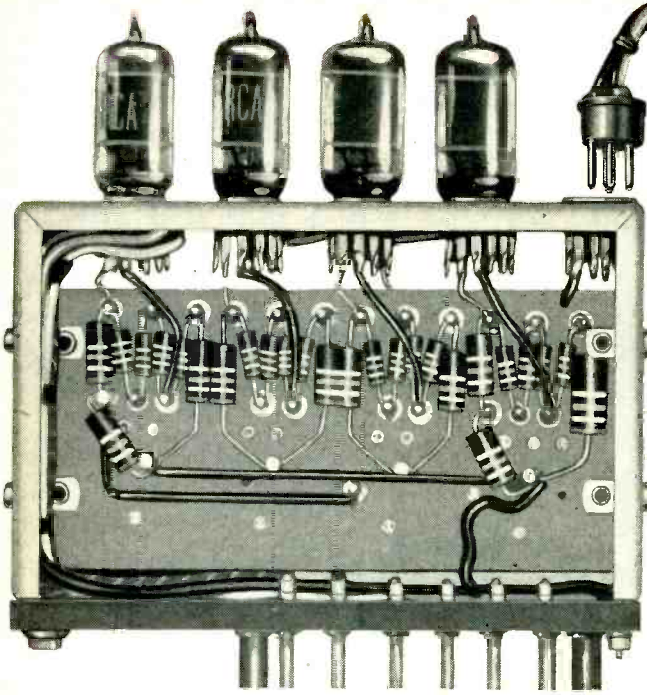
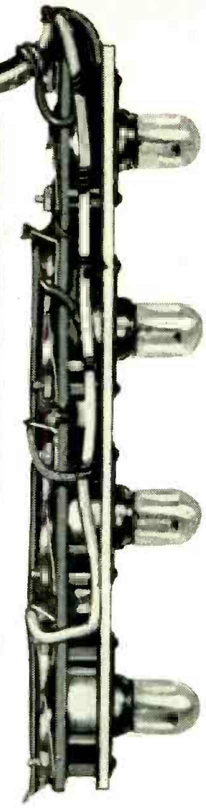
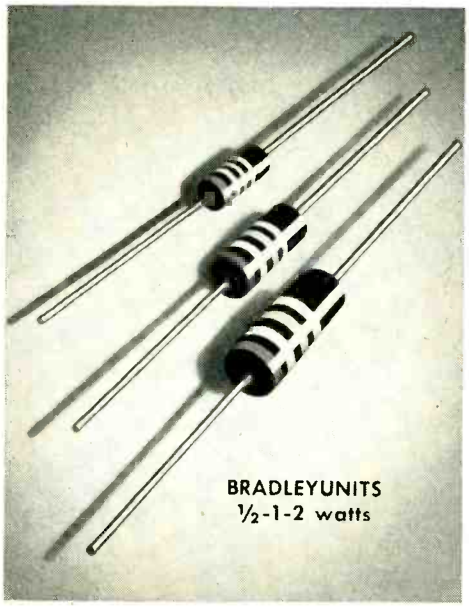
ALKYD

FOR SUPERIOR ELECTRICAL PARTS





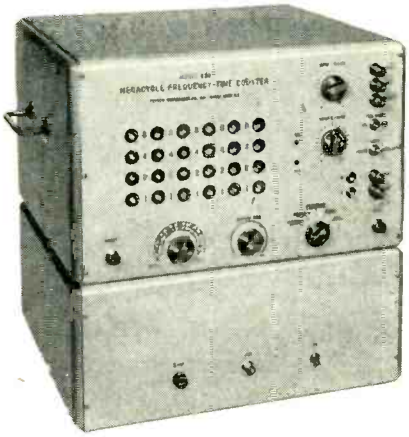


BRADLEYUNITS
½-1-2 watts

POTTER DECADE AND GLOW LAMPS—One of six decade units used in Potter Model 850 Megacycle Frequency-Time Counter shown below. Twenty-five Bradleyunits are used in each decade.

POTTER ELECTRONIC PLUG-IN COUNTER DECADES

are equipped with ½-1-2 watts BRADLEYUNITS



Model 850 Frequency-Time Counter
A versatile production counter for handling very short or rapidly recurring count pulses as in package conveyor applications. Also used for rapid inventory counts.

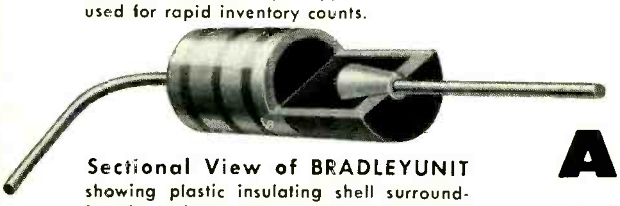
Electronic counters . . . like this Potter unit which has a counting speed up to 1,600,000 counts per second . . . are used for controlling manufacturing processes with high precision. Therefore their component parts must be stable in characteristics and accurate in rating.

The fixed resistors selected for this Potter precision counter are Bradleyunits in the ½, 1, and 2 watt ratings. Being conservatively rated at 70C instead of 40C, Bradleyunits have stable resistance values. Under continuous full load for 1000 hours, their resistance change is less than 5 per cent.

The leads of Bradleyunits are differentially tempered. This graduated softness of the leads near the resistor body prevents sharp bends and avoids damage to the resistor.

Bradleyunits are encased in a plastic insulating shell. Hence, they need no wax impregnation to pass salt water immersion tests. They are available in three tolerances—plus or minus 5%, 10%, and 20%. Let us send the Allen-Bradley resistor chart.

Allen-Bradley Co., 110 W. Greenfield Ave., Milwaukee 4, Wis.



Sectional View of BRADLEYUNIT
showing plastic insulating shell surrounding the resistor unit, permitting these units to be closely grouped with safety. Available up to 22 megohms in all ratings.

ALLEN-BRADLEY

FIXED & ADJUSTABLE RADIO RESISTORS

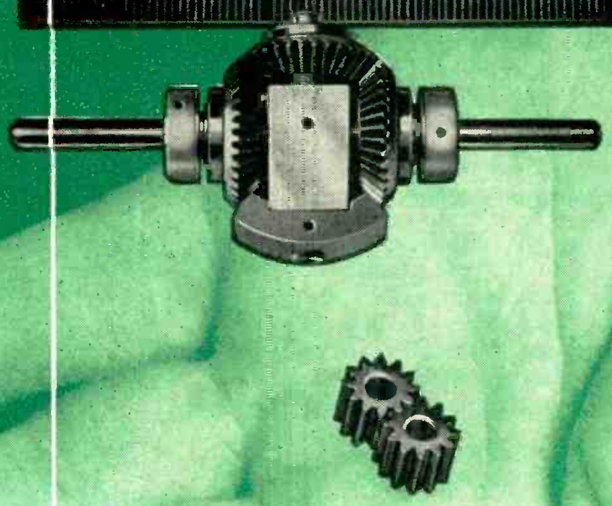
QUALITY

Sold exclusively to manufacturers of radio and electronic equipment

Electronic Gears and Gear Drives by WESTERN GEAR WORKS

Do you have a problem involving the design of gears or gear drives for electronic application? For operation of servo-mechanisms, computers, adjustment of radar or other antenna systems, for auto-tune transmitters? Do you require "just ordinary" gearing or extremely accurate "precision class" gears?

Whatever your need, whatever the type gear or gear train, you will find the engineering assistance and complete facilities available at Western Gear Works. Specialists who know and understand your problems are ready to go to work for you. Your inquiries are invited; write, wire or telephone us now, at Western Gear Works, Executive Offices, Post Office Box 182, Lynwood (Los Angeles County), California, Telephone NEvada 6-2161



Illustrated are a few typical examples of electronic gearing designed for customer requirements.

Plants—417 Ninth Ave. S., Seattle 4, Washington
2600 E. Imperial Highway, Lynwood (Los Angeles County), California
1035 Folsom St., San Francisco 3, California
Belmont (San Francisco Peninsula), California
117 N. Palmer St., Houston 3, Texas

Representatives—N. 2605 Division St., Spokane, Washington
930 S. E. Oak St., Portland 14, Oregon
Room 212, Ross Bldg., Denver 2, Colorado
500 South Ervay Street, Dallas, Texas
Engineering & Machinery Ltd., 1366 W. Broadway, Vancouver, B. C.

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Manufacturers of PACIFIC-WESTERN Gear Products
Pacific Gear & Tool Works

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SLANT your requirements to INSTRUMENT CORP. OF AMERICA for miniature

SLIP RING AND COMMUTATOR ASSEMBLIES

This Instrument Corporation of America plant contains the most modern and complete facilities available anywhere in the world for the exclusive production of Miniature Slip-Ring and Commutator Assemblies to precision standards. It is now in full scale production to meet your requirements in the fastest possible time at the lowest possible cost.

COMPLETE ENGINEERING AND PRODUCTION FACILITIES AVAILABLE

Our assemblies can be supplied at low cost. Quality is the highest in the industry. Dimensional accuracy and other characteristics are excellent and these units are highly recommended for instruments such as synchros, etc.

ONE PIECE ELECTRO-PLATED TYPES FOR EXTREME ACCURACY

Wherever extreme dimensional precision, accurate concentricity and high dielectric qualities are required, the electro-deposition method is recommended . . . the production of which is licensed under an exclusive arrangement with the Electro Tec Corporation.

TYPICAL SPECIFICATIONS:

Sizes: .035" to 24" Cylindrical or Flat

Cross-sections: .005 to .060" or more

Finish: Polish to 4 Micro-Inches or Better

Breakdown: 1000 V or More Hi-Pot Inter-Circuit

Ring Hardness: 75 to 90 Brinell

Rotation Speeds: To Over 12000 RPM

Surface Protection: Palladium and Rhodium or Gold Prevent Tarnish, Minimize Wear

Our engineering staff is at your service at all times for consultation

INSTRUMENT CORPORATION OF AMERICA
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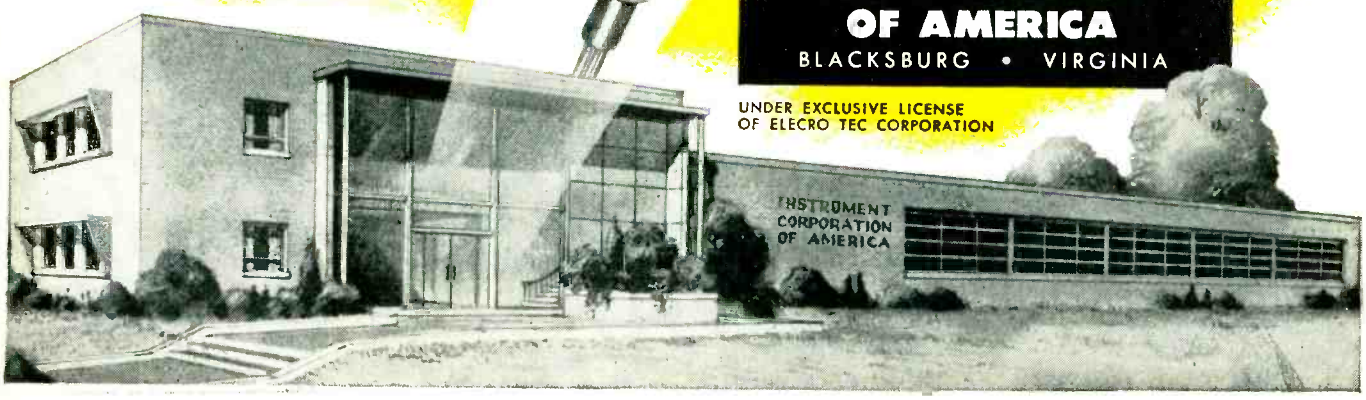
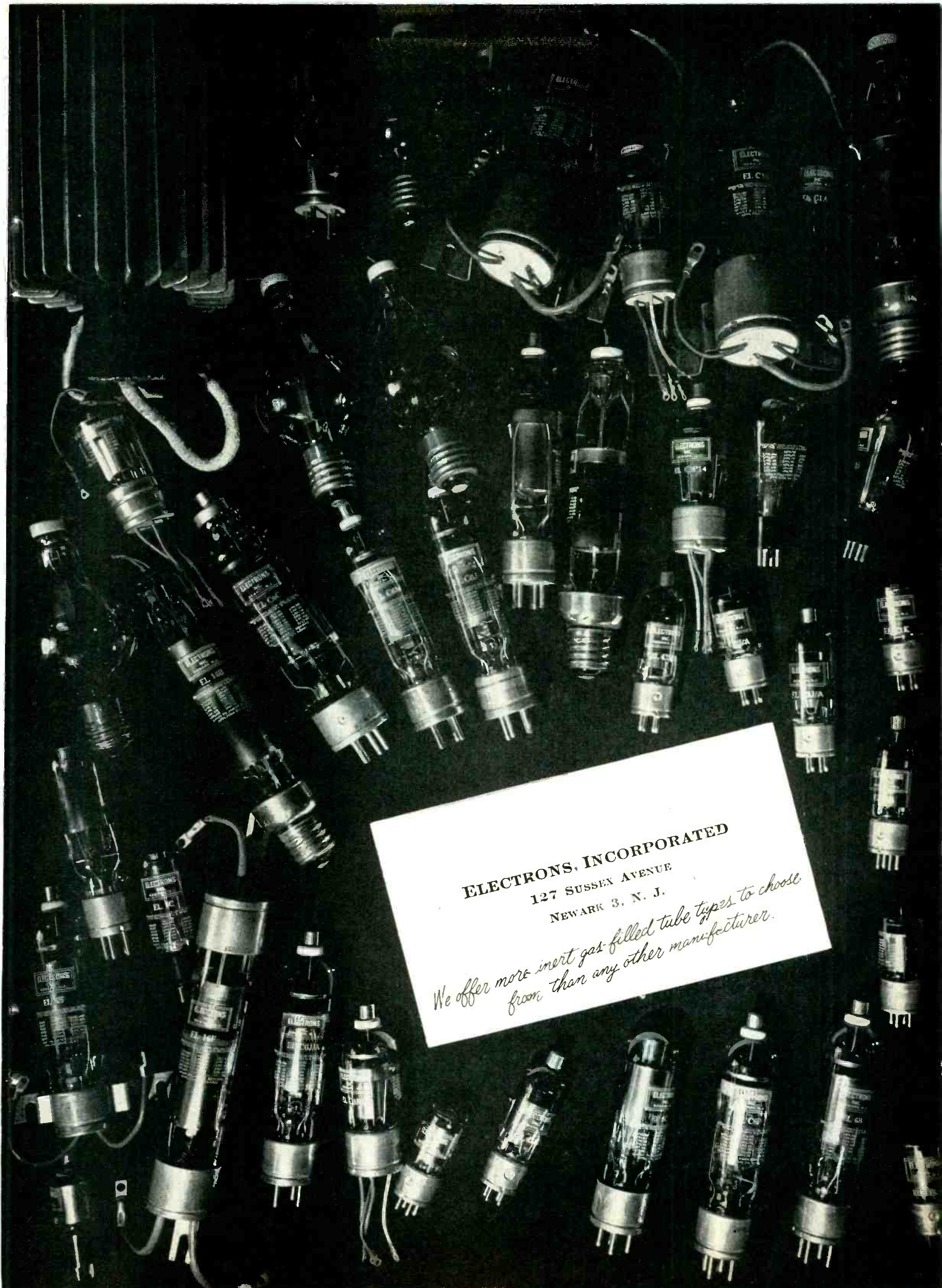
UNDER EXCLUSIVE LICENSE OF ELECRO TEC CORPORATION

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127 SUSSEX AVENUE
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We offer more inert gas-filled tube types to choose from than any other manufacturer.

—spelt backwards is just another name for quality

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PRECISION DRAWN CLOSURES AND QUALITY METAL STAMPINGS—Designers and production engineers can draw on the Hudson line of standard cases and covers to solve "hurry up" closure problems. Several hundred stock shapes and sizes, with numerous variations possible due to optional features available, assure prompt service at mass-production prices. Hudson stock parts can usually meet all but the most unusual requirements.

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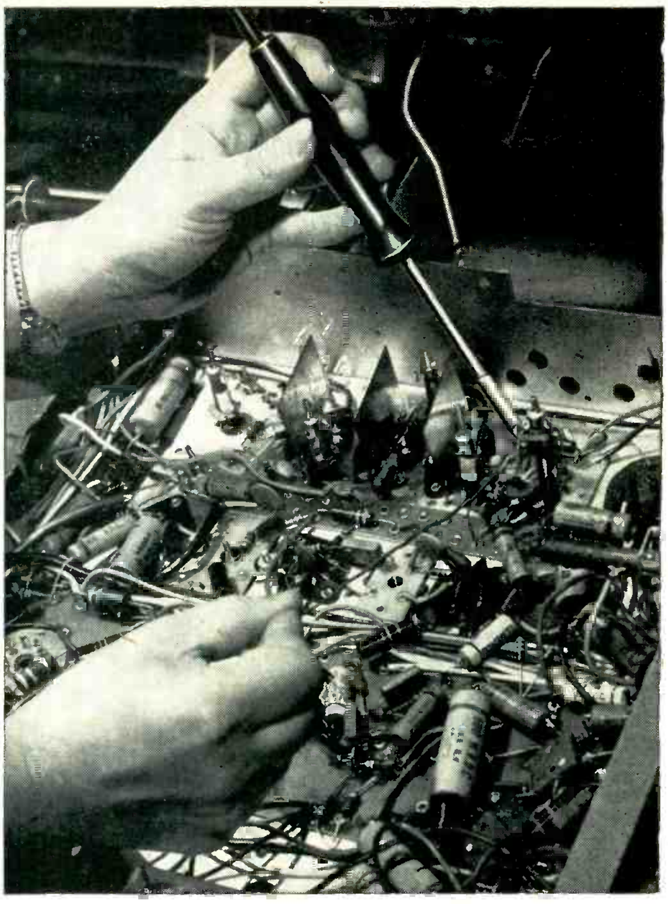
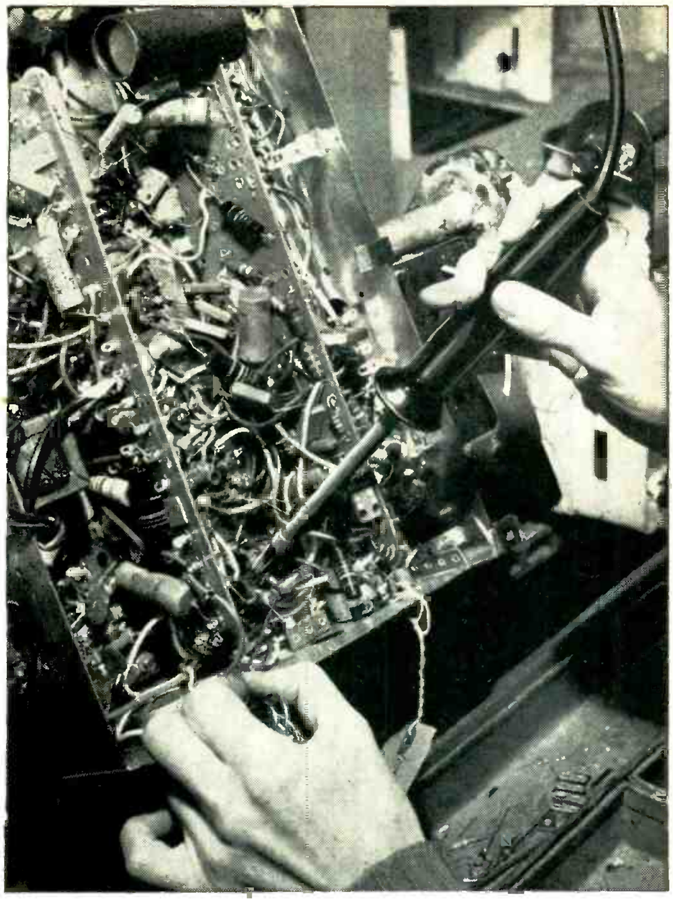
HUNDREDS OF STANDARDIZED DESIGN ASSURE FASTEST POSSIBLE DELIVERY! When time is short, consult the Hudson Catalog of stock shapes and sizes. If you have not yet received your copy of this file folder, request yours, today. Keep a copy handy in engineering, production and purchasing departments. Just call or write.





G-E MIDGET AND G-E LIGHTWEIGHT IMPROVE SOLDERING EFFICIENCY AND SPEED IN TIGHT PLACES.

Now—2 G-E Irons for Hard-to-solder Places

FAST PRODUCTION WITH THE G-E LIGHTWEIGHT

Quick heat recovery and easy handling combine to give you quality production at high speed. The thin, $\frac{5}{16}$-inch diameter shank allows easy soldering where a bulkier iron can't reach or would cause damage to insulation and surrounding parts.

PINPOINT ACCURACY WITH THE G-E MIDGET

Soldering difficult joints is as easy as writing with a pencil when you use the slender, 1¾-ounce, 6-volt midget iron. Power costs are cut to one-fourth those of a regular iron, and tip heat can be closely controlled with the optional four-tap transformer.

BOTH LIGHTWEIGHT AND MIDGET IRONS OFFER YOU:

Longer Service, Lower Maintenance—Extra long wearing Ironclad tips resist pitting and corrosion, giving you longer service for both high-speed repetitive production line soldering and intermittent work. General Electric Calrod* heaters provide dependable, efficient operation throughout their long life. The tip and heater unit is easily replaced by unscrewing it from the handle.

Reduced Operator Fatigue—Both irons are light in weight, well balanced, and have comfortable handles. Easy handling helps cut rejects and increase operator speed and efficiency.

SOLVE YOUR SOLDERING PROBLEMS TODAY

For the complete story on the G-E Lightweight and Midget soldering irons contact your G-E Apparatus Sales Office or Distributor. Additional information is yours by mailing the coupon below.

*Reg. Trade-mark of General Electric Company

Section D720-115
General Electric Co.
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Please send me the following bulletins:

☐ For immediate project ☐ For reference

☐ GED-1583, G-E Lightweight Soldering Iron.

☐ GEA-4519D, G-E Industrial Soldering Irons.

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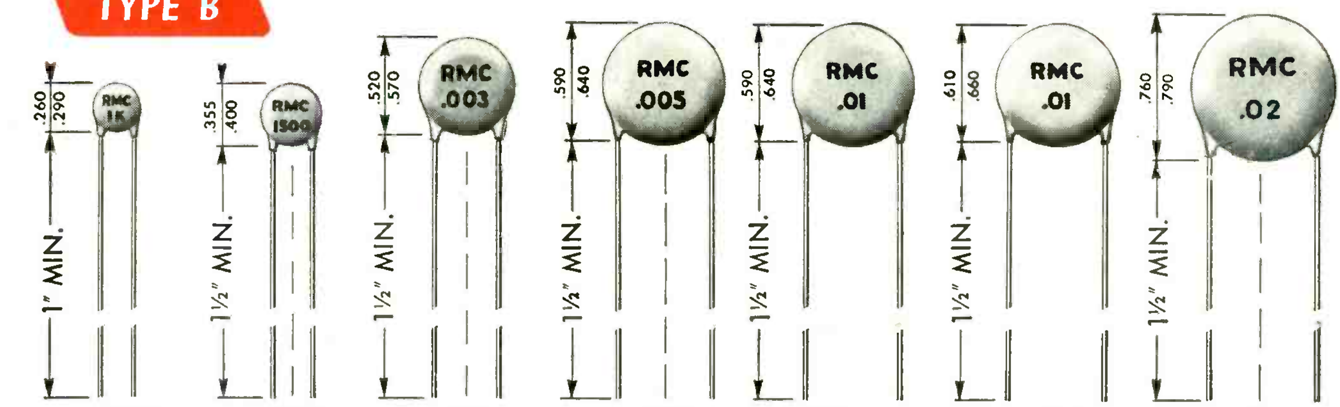
RMC DISCAPS®

APPROVED AND USED BY LEADING MANUFACTURERS

"Heavy Duty" By-Pass *DISCAPS*

TYPE B



.00047	.0015	.003	.0047	.01*	.01*	.01
.00068	.002	.004*	.005	±20%	.02*	.02
.0008	2x.001	.005*	2x.002	.02*		2x.004
.001		2x.0015		+80% −20%		
		2x.002*				

*Rated 600 V.D.C.W. Flash test 1200 V.D.C.

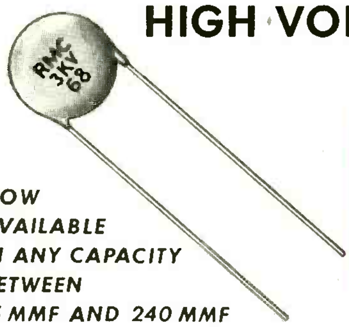
SPECIFICATIONS

TYPE B BY-PASS SERIES—GUARANTEED MINIMUM VALUE

POWER FACTOR: 1.5% Max. @ 1 KC (initial)
POWER FACTOR: 2.5% Max. @ 1 KC (after humidity)
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
LEADS: No. 22 tinned copper (.026 dia.)

INSULATION: Durez phenolic—vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms

HIGH VOLTAGE DISCAPS—*Designed for Deflection Yokes*



NOW AVAILABLE IN ANY CAPACITY BETWEEN 15 MMF AND 240 MMF

SPECIFICATIONS

POWER FACTOR: .1% Max. @ 1 M C (initial)
POWER FACTOR: 2.5% Max. @ 1 M C, after humidity
WORKING VOLTAGE: 2000, 3000, 4000, 5000 V.D.C.
TEST VOLTAGE: 4000, 6000, 8000, 10,000 V.D.C.

LEADS: No. 22 tinned copper (.026 dia.)
INSULATION: Durez phenolic—vacuum waxed
INITIAL RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms
AVAILABLE TOLERANCE: ±5% ±10% ±20%

SEND FOR SAMPLES AND TECHNICAL DATA

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IRVINGTON
INSULATING VARNISH DIGEST

Finishing Enamel Oilproofs Windings Quickly and Easily

The insulation on electrical windings exposed to contact with oil can easily be given an added degree of protection by application of a coating of Irvington No. 32 Red Enamel over the previous insulation treatment.

This enamel can be readily applied by brushing and air dries to the point where the parts can be handled within half an hour at room temperature. Additional baking and long drying periods are eliminated.

In addition to oilproofing windings, No. 32 Red Enamel protects them against moisture, chemicals, dust and water. It forms a very tough, adhesive film on most surfaces. The enamel is low in initial cost and has the advantage of long storage life.

No. 32 Red Enamel is brushed on windings to protect them from oil

Preheating of Parts Improves Impregnation

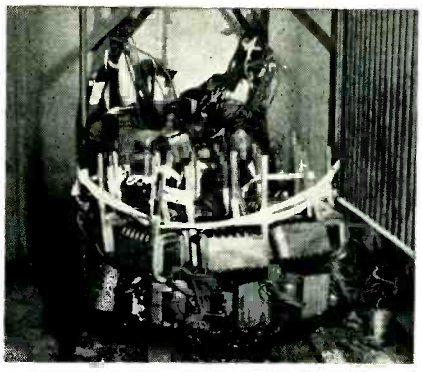
Units that are to be impregnated with insulating varnish by dipping should be preheated before being placed in the dip tank.

The preheating aids in expelling any moisture from the parts and also causes the surrounding varnish to decrease in viscosity. This results in more thorough penetration of the windings.

Correct Baking Procedures Essential In Performance of Insulating Varnishes

Design of Ovens and Control of Baking Cycles Play Major Part in Satisfactory Curing

It is generally accepted that baking varnishes provide greater all-around qualities than air drying varnishes. Air drying varnishes are used mainly for maintenance purposes or where baking facilities are unavailable.



After vacuum impregnation with a clear baking varnish, heavy transformer coils are baked in an oven like the one shown

Spray Method Can Be Used on Large Pieces

While the two recommended methods of applying insulating varnish are dipping and vacuum-and-pressure impregnation, there are instances where the unit is too large for the capacity of existing shop equipment.

In such cases, the varnish may be applied by spraying. It is usually necessary to apply the varnish at a lower viscosity than is customary with other methods. Air pressure and consistency of varnish should be adjusted to produce a smooth, uniform coating.

When baking varnishes are applied by spraying, the standard baking schedules should be followed to assure a complete cure. Spray application is also frequently used for Irvington air drying varnishes, which are recommended chiefly for emergency repair and maintenance work.

Baking varnishes are made in a variety of types specially formulated to provide high dielectric strength, resistance to high temperatures, vibration, moisture, oils, chemicals, dust and fumes. These qualities can be achieved only by proper varnish curing.

Design of Oven

A well-designed baking oven should provide dry heat at controlled temperatures which are uniform throughout the entire oven. Any variations between the temperatures in different parts of the oven may result in faster curing of the varnish on some insulated windings than on others. Service performance of the varnish will then tend to be non-uniform.

The oven should be provided with a ventilating system to remove solvent fumes released from the varnish. Otherwise the solvent fumes continue to circulate through the oven, washing over the windings that are being baked and preventing them from drying thoroughly.

Baking Schedules

Baking temperatures and times should conform to the recommendations of the varnish manufacturer. In any cases where unusual conditions are involved — such as in the case of deep-seated windings or multiple coats of varnish — it is desirable to consult a representative of the varnish manufacturer on the specific procedures that will give most effective results.

For further information, write the Sales Manager, Varnish Department, Irvington Varnish & Insulator, Division Minnesota Mining & Manufacturing Company, 11 Argyle Terrace, Irvington, New Jersey

Look closely at the picture below. This spotlessly clean and orderly paint spray room is but one of the outstanding facilities available to you at Karp. And this "good housekeeping" is reflected by the gleaming hammertone enamel finish of the marine radio cabinet at left—typical of the uniformly high quality finish we give your cabinets, chassis, housings and enclosures.

Another Karp facility: Where our finish is the beginning of lower enclosure costs for you.

Because this entire spray room is air conditioned—completely dirt and dust free, and because it is manned with specialists in surface preparation and finishing who work with the most modern equipment, we are able to assure you of the finest quality finish for any type service or exposure.

And to make sure that the finish lasts for the life of your enclosure it is carefully baked in our electro-mechanically timed ovens. Result: your perfect finish is a lasting finish. Attractive but tough—and always economical.

Like the Finishing Department, our entire plant is dedicated to the principle of producing the finest sheet metal cabinets, chassis, housings and enclosures *at the lowest possible price*. How well we live up to this principle is easily proved: simply send us your prints. We'll promptly quote prices and delivery.

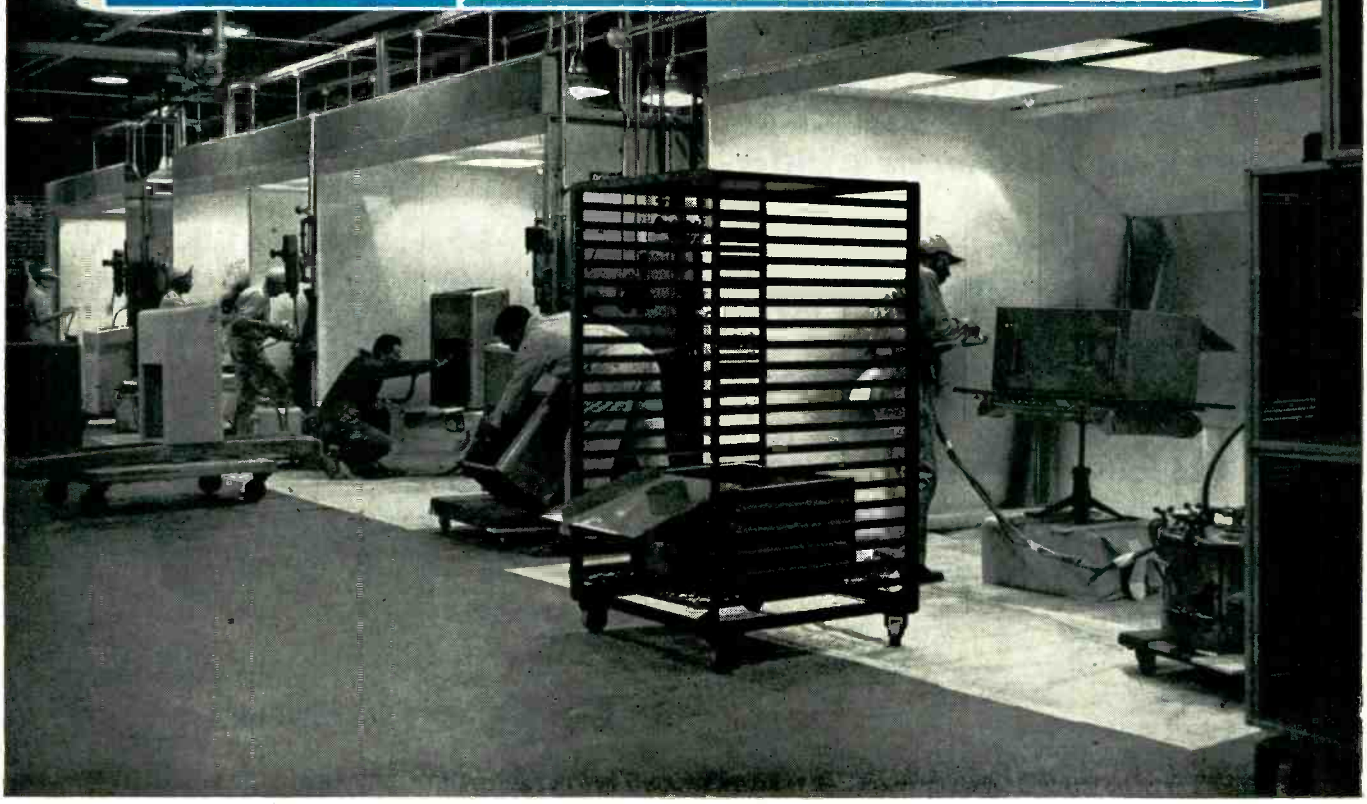
KARP

MOST COMPLETE FACILITIES FOR ENGINEERED SHEET METAL FABRICATION

KARP METAL PRODUCTS CO. Division of H & B American Machine Company
215 63RD STREET, BROOKLYN 20, N. Y.

FACILITIES FOR ENGINEERED SHEET METAL FABRICATIONS: in aluminum or steel • long run or short • spot, arc, gas or heliarc welding • any type finish.

- Modern plant—3 city blocks long
- Thousands of dies available
- Most modern of sheet metal fabricating equipment
- U. S. Air Force Certified Welding Facilities
- Air-conditioned spray room ... complete baking facilities
- Complete sub-assembly facilities



Want more information? Use post card on last page.

Can you see the BIG difference?

On the face of it, Avien's Two-Unit Fuel Gage looks like previous systems, but there's a big and important difference behind it all.

Behind this Avien dial face (shown here three times actual size) is Avien's brand-new concept of fuel gage system "packaging."

Previously, you'd find these units behind a dial: an indicator case, motor and balancing potentiometer; and elsewhere a bridge-amplifier, a shockmount and a tank unit.

Now, in the Avien Two-Unit Gage, the necessary components for the bridge and amplifier functions have been built right into the indicator case.

The result: a fuel gage system of "plug-in, plug-out" simplicity, which weighs 50% less and eliminates the need for any field calibration.

What a BIG difference this makes in money!

First of all, the basic system costs less. Less time is spent in installation. Less wiring and connectors are needed. Less maintenance is required, because there are fewer components to maintain. Trouble-shooting time is cut for the same reason. And fewer parts must be stocked for maintenance and repairs.

Because of this new package, Avien gages are now "shelf items." They're completely interchangeable in the aircraft for which they are designed.

Additional functions for fuel management can be easily integrated into the basic Two-Unit system.

The Avien Two-Unit Fuel Gage is now available to meet your production programs. The indicator is available in either large or small sizes, with all varieties of dial configurations.

Every month, Avien produces over ten thousand major instrument components for the aviation industry.

The Avien Two-Unit Fuel Gage will make such a BIG difference in your cost sheet, we suggest that you write or call for more information today.

Avien

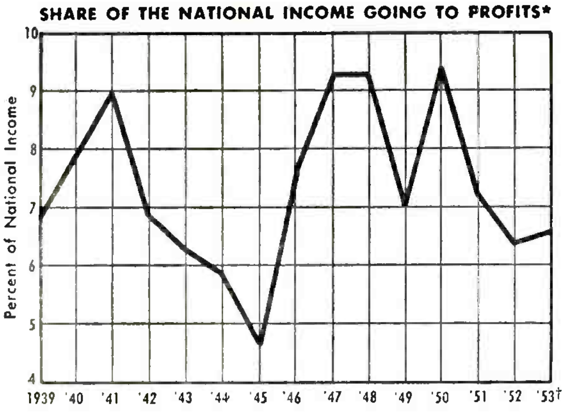
AVIATION ENGINEERING DIVISION

AVIEN-KNICKERBOCKER, INC.

58-15 NORTHERN BOULEVARD, WOODSIDE, L. I., N. Y.

The first of two articles on profits

PROFITS...How High Are They?



*Net Profits After All Federal and State Taxes Source: U.S. Dept. of Commerce
†Annual Rate in First 6 Months

How high are profits? What is being done with them? This is the first of two articles designed solely to throw some factual light on these key economic questions.

One of the important economic developments of 1953 has been a substantial increase in the dollar volume of corporation profits from the level of 1952. But to answer the question "How high are profits?" we must also measure them: 1) by comparison with the record of previous years, and 2) as a share of the total national income. The term "profits," as used here, refers to profits *after taxes*. These are the only profits that can be paid to stockholders or retained for use in the business.

In the first six months of 1953, corporate profits *after taxes* were at an annual rate of $20.4 billion. This was higher than in the first half of 1952, but lower than in the full years 1948 or 1950, or in the first half of 1951. If allowance is made for the declining value of the dollar, this year's net profits for all corporations represent less purchasing power than those made five or six years ago.

Here is the record of profits over the years:

	Net Profits After Taxes of All U. S. Corporations	
	Billions of Dollars	
	Actual	In 1953 Prices
1929	8.4	14.6
1939	5.0	9.8
1947	18.5	22.1
1948	20.7	22.7
1949	16.3	18.3
1950	22.7	24.6
1951	20.1	19.7
1952	18.6	18.7
1953*	20.4	20.4

*Annual rate, first six months

The record shows that real profits have a little more than doubled since 1939. This increase, however, does not mean that corporations are doing exceptionally well. The entire national income has doubled since 1939. And our industrial plant is more than twice as large as it was in 1939. Therefore, profits have just about kept pace with industrial growth.

Return on Investment

How high are profits compared with sales, or compared with the stockholders' investment?

What is the rate of return to the people who have invested their savings in corporate business?

The table below shows that for the past three years the rate of return on both sales and investment has been substantially below the return achieved in earlier postwar years. The rate of return on stockholders' investment is higher now than it was in 1939. But this is primarily because today's profits are reported in terms of today's prices, whereas much of the investment in plant facilities is still carried on the books at prewar prices, which are substantially below the cost of replacement. The current rate of return, measured as a percentage of total corporate sales, is below prewar levels.

	Corporate Profits After Taxes	
	Per Cent of Total Sales	Per Cent of Stockholders' Equity *
1929	6.1	NA
1939	4.1	4.0
1947	5.3	
1948	5.3	14.8 average
1949	4.4	
1950	5.3	
1951	4.1	11.8
1952	3.6	10.3
1953 #	3.7	10.8

* Manufacturing corporations only
NA Not available
Annual rate, first six months

In considering these figures, it should be remembered that they are averages for all corporations. Some companies make more than the average, and many make no profit at all. In every year since 1915 at least 25% of all corporations have operated at a loss. In 1939, 58% of all corporations were losing money. This year the figure will probably be at least 30%. The improvement since 1939 shows a much healthier economy. But it does not indicate that profits are easy to make.

How Big a Share of the Pie?

The most important single fact about profits is that they now represent a *smaller* share of national income than they have in past years of normal prosperity. For the past three years, profits have taken a smaller share of the pie than in 1939, and considerably smaller than in the early postwar years. Here, as the chart at the beginning shows, is the record:

	Corporate Profits After Taxes as a Percentage of National Income
1929	9.6
1939	6.9
1947	9.3
1948	9.3
1949	7.5
1950	9.4
1951	7.2
1952	6.4
1953*	6.6

*Annual rate, first six months

The main reason for the declining corporate share of national income is, of course, the increasing share taken by the federal government in the form of taxes. The wage earners' share is also higher than in 1939. But the really startling increase is in federal taxes. Taxes on profits now equal almost 8% of the national income, compared to only 2% in 1939.

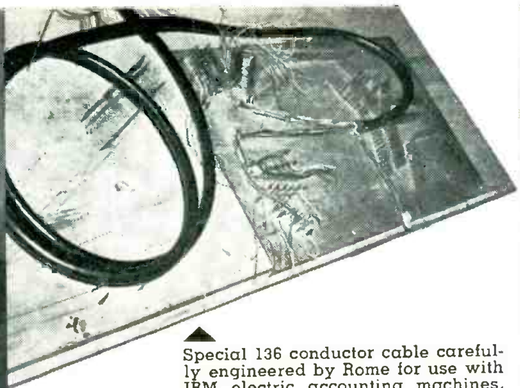
Why This Is Important

It is important that these facts about profits and taxes be widely understood. At its next session, Congress must consider what to do about the emergency taxes on profits enacted after the outbreak of the Korean War. The so-called excess profits tax is scheduled to die on January 1, 1954. In the absence of new legislation, the rate of the corporate income tax will drop from 52% to 47% on April 1. Many factors, including the revenue needs of the government, must enter into the decision whether or not to reduce taxes. But one fact stands out clearly: By comparison either with past years or with the total national income, corporate profits today are relatively low.

* * *

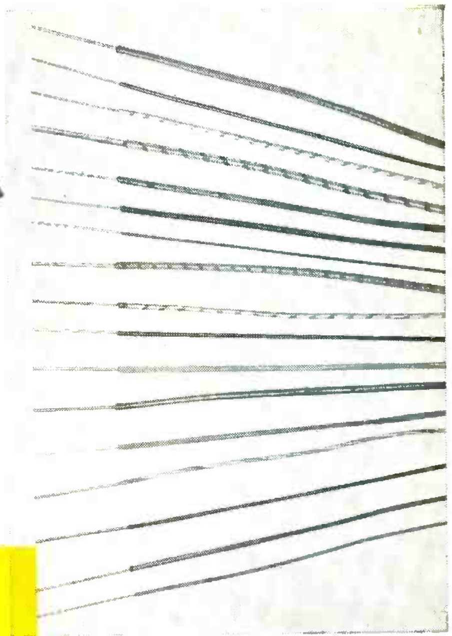
The second article in this series will discuss what corporations do with their profits.

McGraw-Hill Publishing Company, Inc.



Special 136 conductor cable carefully engineered by Rome for use with IBM electric accounting machines, Types 402 and 403; IBM Reproducing Punch, Type 514; IBM Summary Punch, Type 523; and IBM Accumulating Reproducer, Type 528.

Spools of Rome hook-up wire set up on multiple spool racks used in making cables for practically all IBM electric accounting machines.



Carefully engineered wires and cables help keep IBM equipment "on the beam"

Equipment manufactured by International Business Machines Corporation has established a record for accuracy and service that's hard to beat.

Much of the reason for this record is the fact that IBM uses only the finest components in their equipment.

This is one of the reasons IBM often comes to Rome Cable for top quality, specially engineered wires and cables. One of these is the 136 conductor cable (pictured top center) which is used in several IBM machines.

Others are various types of hook-up wire, a few of which are shown on the multiple spool rack (top left). Millions of feet of this Rome hook-up wire, manufactured to exacting specifications, are used by IBM every year.

In addition to the constructions shown, Rome manufactures a wide range of military and commercial type hook-up wires, intercommunication cables, coaxial cables, R. F. transmission line, television camera cables and other special constructions, engineered to the application involved.

Commercial type HOOK-UP WIRES

Rome offers commercial hook-up wires with three standard insulations.

Rome Hi-Temp—a rubber insulation with exceptionally high resistance to heat. Underwriters' approved for 75° C.

Rome Synthinol—a polyvinyl chloride thermoplastic compound, highly resistant to acids, oils, alkalies, moisture and flame. Underwriters' approved for 80° C.

Rome Synthinol 901—offers all the advantages of Synthinol plus higher resistance to heat deformation, shrinkage and cracking, also improved solderability. Underwriters' approved up to 105° C.

MILITARY HOOK-UP WIRES

Rome manufactures military type SRIR, SRHV and WL, complying with Army-Navy Joint Specification JAN-C-76, as well as shipboard types SRI and SRIB conforming to Specification MIL-C-915. Insulated with Rome Synthinol, these wires are made in a complete range of specification sizes.

ROME CABLE Corporation
ROME • NEW YORK
and
TORRANCE • CALIFORNIA

ROME CABLE CORPORATION, Dept. EL-11, Rome, N. Y.
Please send me information on Electronic Wiring

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Company..........

Address..........

City.......... Zone........ State..........

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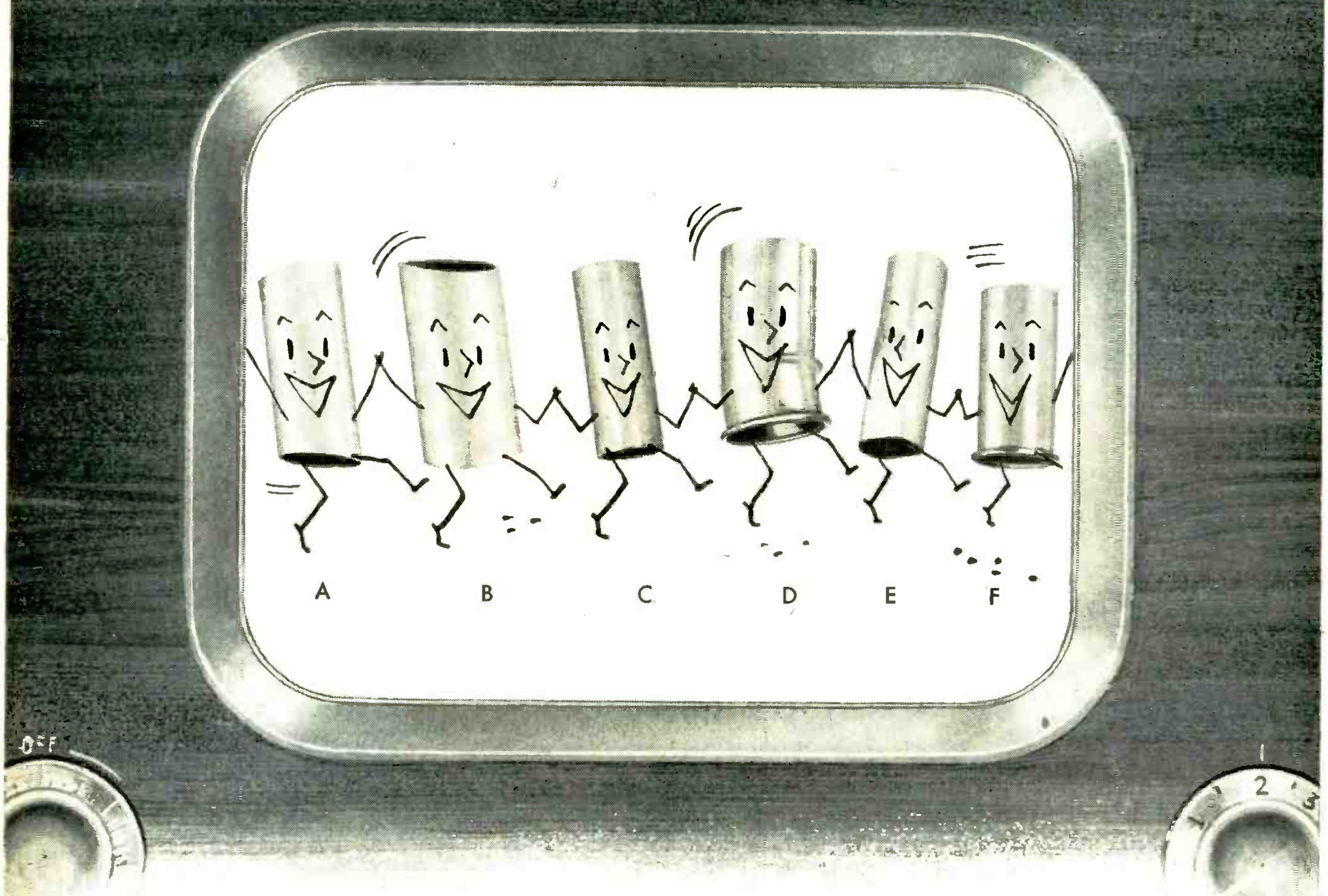
The Superior anode family is on the air



When you meet anyone in radio or television circles named Anode, the chances are favorable that he was born in Norristown, Pa., at Superior Tube Company.

Millions of Anodes have started life at Superior—all types and sizes—stainless steel, nickel, Monel*, Inconel*, straight cut, angle cut, rolled—one or both ends, flattened, bent—and for all types of vacuum tubes.

If the anode you want isn't pictured, tell us about it.

A—Weldrawn†, 304 Stainless Steel, Double angle cut. .520" O.D. x .500" I.D. x 1.321" long.

B—Weldrawn, 305 Stainless Steel, Single angle cut. .520" O.D. x .500" I.D. x 1.102" long.

C—Weldrawn, 305 Stainless Steel, Straight cut. .520" O.D. x .500" I.D. x 1.750" long.

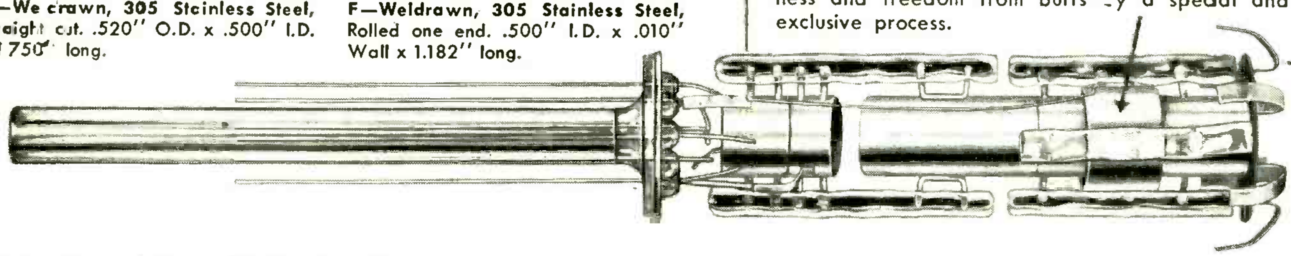
D—Weldrawn, 305 Stainless Steel, Rolled and bent 10°. .449" I.D. x .010" Wall x 1.050" long.

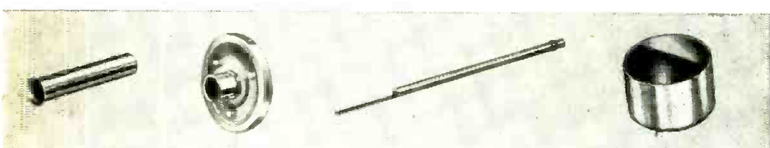
E—Seamless Nickel, Flattened one end. .500" O.D. x .025" Wall x 1.625" long.

F—Weldrawn, 305 Stainless Steel, Rolled one end. .500" I.D. x .010" Wall x 1.182" long.

GUN ASSEMBLY FOR ELECTRO-STATIC TYPE TELEVISION PICTURE TUBE

All of the anode elements (as well as the disc cathode) are fabricated from Superior Tubing. A critical part of this assembly is the "focusing anode" or "focusing ring", produced from Superior Stainless Steel ⅝" O.D. x .028" wall, cut to ½" lengths. It is of extreme importance that the finish of the focusing ring be smooth, and that the I.D. be burr-free else corona would occur and the flow of electrons to screen would be distorted. Superior achieves its degree of smoothness and freedom from burrs by a special and exclusive process.





Seamless Nickel Cathode. Round, flanged one end, .070", .072" I.D. x .0025" Wall. .295" long.

Disc Cathode .121" O.D., .312" long.

Lockseam†† Nickel Cathode Round, tabbed, single bead, .045" O.D. x .0021" Wall. 27 mm long.

No. 1 Grid Cup, 305 Stainless Steel. .499" I.D. x .010" Wall x .438" long.

Superior

THE BIG NAME IN SMALL TUBING

SUPERIOR TUBE COMPANY

Electronics Division

2500 Germantown Ave., Norristown, Pa.

All analyses .010" to ⅝" O.D. Certain Analyses (.035" max. wall up to 1⅜" O.D.)

*Registered U. S. Trademark, International Nickel Company

†Manufactured under U. S. Patents

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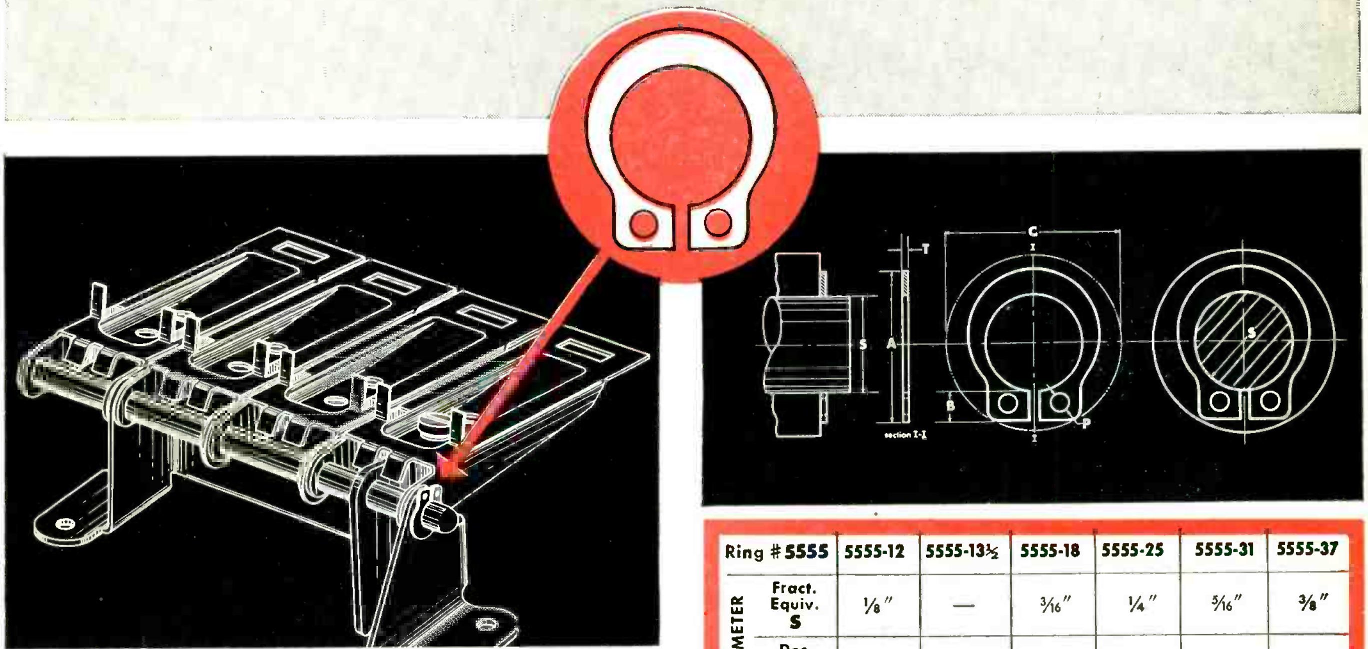
New Waldes Truarc GRIP Ring requires no groove, holds fast by friction, can be used over and over again



		Ring # 5555	5555-12	5555-13½	5555-18	5555-25	5555-31	5555-37
SHAFT DIAMETER		Fract. Equiv. S	⅛″	—	3/16″	¼″	5/16″	⅜″
		Dec. Equiv. S	.125	.136	.187	.250	.312	.375
		TOL.	±.002	±.002	±.002	±.002	±.003	±.003
RING DIMENSIONS	Thickness	T	.025	.025	.035	.035	.042	.042
		TOL.	±.0015	±.0015	±.002	±.002	±.002	±.002
		Length A	.268	.285	.364	.437	.553	.626
		Lug B	.078	.078	.097	.097	.141	.141
		Hole P	.042	.042	.042	.042	.078	.078
		Min. Ring Clear C	.33	.34	.44	.50	.67	.73
Approx. Ultim. Thrust Load (Lbs)			20	20	25	35	50	60

The Waldes Truarc Grip Ring is a new, low cost fastener that provides a positioning shoulder secure against moderate thrusts or vibration. Installed on a straight ungrooved shaft, the Truarc Grip Ring can be assembled and disassembled in either direction with Truarc pliers.

The Grip Ring can be installed tightly against a machine part in order to take up end-play. The basic Truarc design principle assuring complete circularity around periphery of the shaft and the ring's unusually large radial width combine to exert considerable frictional hold against axial displacement. The ring can be used again and again.

Find out what Waldes Truarc Retaining Rings can do for you. Send us your drawings. Waldes Truarc engineers will give your problems individual attention without obligation.

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WALDES

TRUARC

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RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING.

Waldes Kohinoor, Inc.,
47-16 Austel Place, L.I.C. 1, N. Y.

E 115

☐ Please send me sample Grip-Rings (please specify shaft size ______________)

☐ Please send me the complete Waldes Truarc catalog.

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Name ______________

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Company ______________

Business Address ______________

City ______________ Zone ______ State ______

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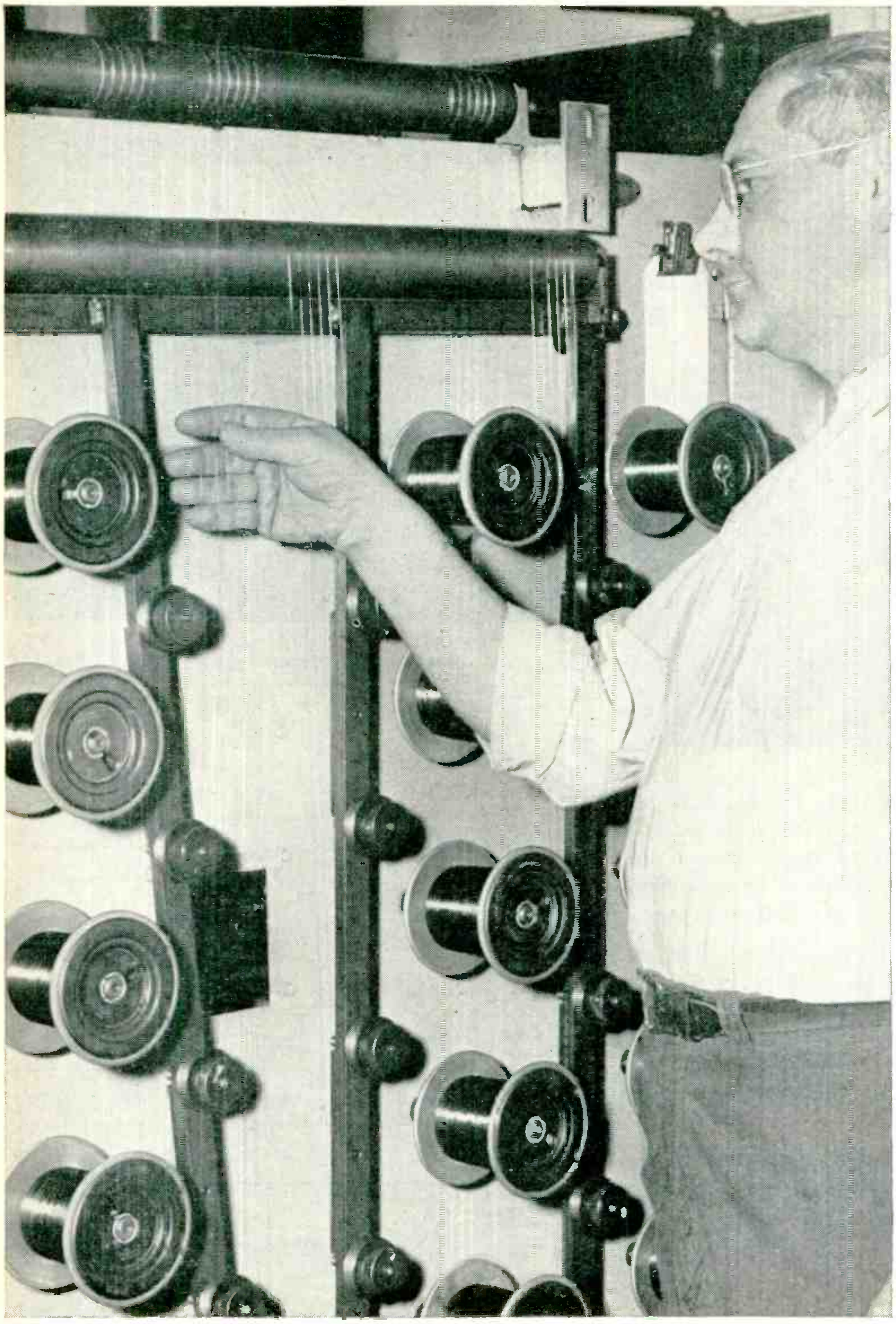


MAGNET WIRE

ED SCHWERSKE, skilled inspector at Anaconda, checks enamel magnet wire for surface quality. This wire will be used in automatic multiple-head coil-winding machines where high quality, uniformity, greater spool lengths are important.

He keeps harping . . . on quality

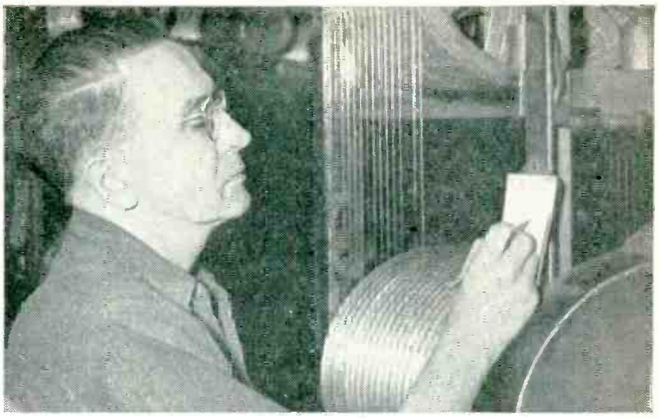
LET'S START by being frank. Today the only practical way to make magnet wire that is perfect for commercial applications is under strict quality-control procedures.

At Anaconda, quality is determined by statistical limits—or fences—beyond which no phase of production may stray. Charts of each process are kept to guide machine operators and foremen on their road to higher quality. The narrower the control limits, the better the wire. These limits—at Anaconda—are the most exacting in the industry today.

MANY TESTS ARE MADE

Ed Schwerske's sensitive fingers check wire smoothness. But—thorough as Ed's inspection is—it is only one of 30 tests the wire must pass.

DRAWING FINE WIRE demands close tolerances. Wire is "miked" in the process to make sure it's within acceptable limits. If not, the reel is rejected. Anaconda's reject rate is low—all the more impressive because of rigid standards—the most exacting in the industry.



REGULAR AS CLOCKWORK. This inspector thoroughly checks wire on large enameling machines. Every 1½ hours he makes a record of his inspections on the card which hangs beside each machine. This card becomes part of the permanent quality-control record.

Each test is recorded. And in that complete record is the final proof of the quality of ANACONDA Wire.

TYPICAL CUSTOMER EXPERIENCE

Listen to Head Inspector, Merrill Bailey: "When I hear how one customer now winds 11 sticks of 20 coils with ANACONDA Wire where he could wind only 7 sticks before, I know our painstaking inspection pays off. His coil-winders say our wire winds faster, easier, and longer without breaks."

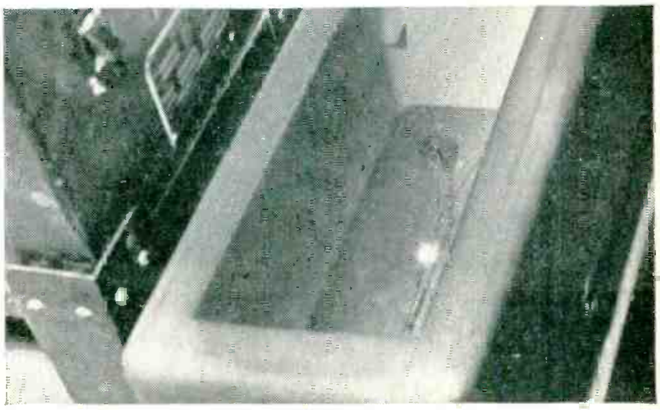
ANOTHER PROOF OF QUALITY

The list of customers who have depended on ANACONDA Magnet Wire for 25 years or more is long . . . and many buy 80-90% of their wire from Anaconda. Many have further expressed their confidence by eliminating incoming inspection of the wire . . . at considerable savings.

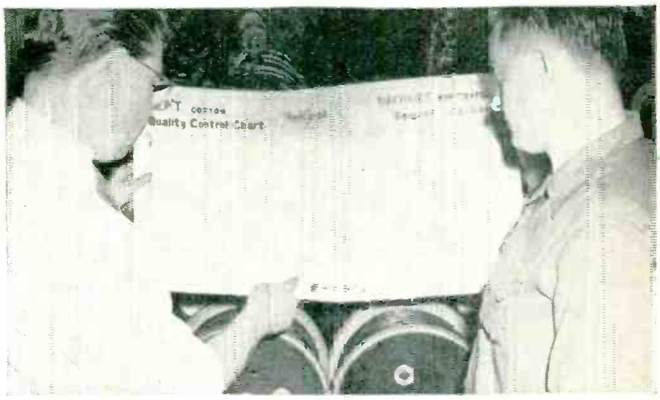
Would you like to see how Anaconda Quality Control actually works? Ask your Anaconda Representative to arrange for a plant visit. There you will see typical Anaconda thoroughness at work—the legacy of over a half century of experience and leadership. *Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.* 53360

ANACONDA®

TODAY'S HEADQUARTERS FOR MAGNET WIRE



BREAKDOWN TEST FOR FORMVAR. A sample from every reel is given this test. The wire is first put under tension by twisting. Then a gradually built up potential is applied until the wire breaks down. This makes sure that the dielectric strength is ample.



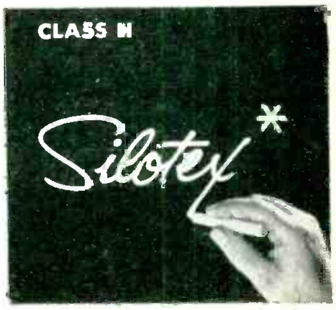
FINGER ON QUALITY CONTROL. Every Anaconda Operator is concerned with the performance of his machine. Here foreman and operator go over control chart which graphs reject rate—in this case close to nominal. If it should stray, machine is shut down.

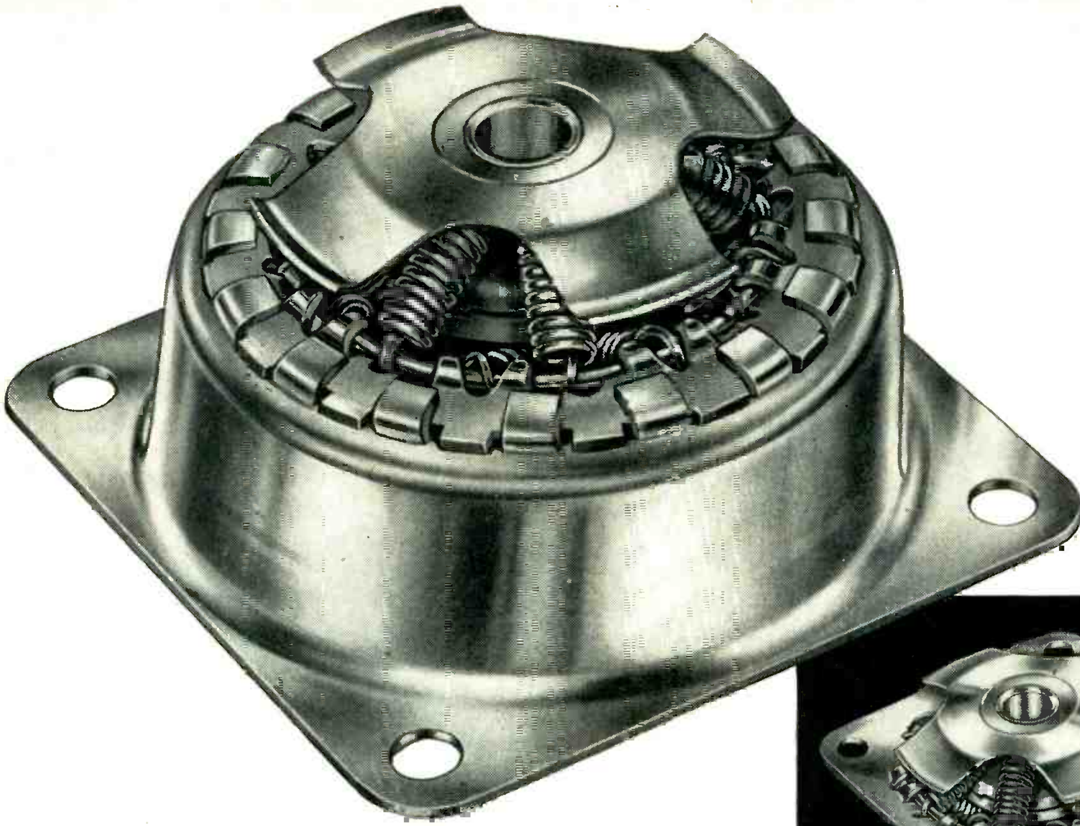
*Reg. U.S. Pat. Off.

A COMPLETE LINE: ANY TYPE, SIZE OR SHAPE
—round, square, rectangular—

Your *special* needs will be given *special* attention.

Write for complete pocketsize catalog C69A and handy reference wall chart for shop use (gives dimensions of popular wire sizes).





EQUIFLEX

metal Vibration Isolators...

. . . ensure long life, resistance to temperature extremes and absence of drift or permanent set.

Each unit consists of a tubular core attached by springs either to a square mounting plate or to a circular mounting cup. The springs are arranged to form two opposed cones. Within these cones of springs, are two floating metal stampings held apart by an internal compression spring. This damper keeps amplitude within safe limits at resonant frequencies. Overload and shock conditions are met by heavy, rebound washers securely fastened to each end of the tubular core.

The mountings withstand 100 hour salt spray tests, take 15G shocks without damage and will keep equipment captive up to 30G's.

Extra-damped mountings are available in which each multiple coil spring is shrouded with polyethylene tubing.

For further details, write for illustrated, descriptive folder.

ELECTRICAL ASSEMBLIES
Ucinite
RADIO AND AUTOMOTIVE

The UCINITE CO.
Newtonville 60, Mass.
Division of United-Carr Fastener Corp.

Specialists in
ELECTRICAL ASSEMBLIES,
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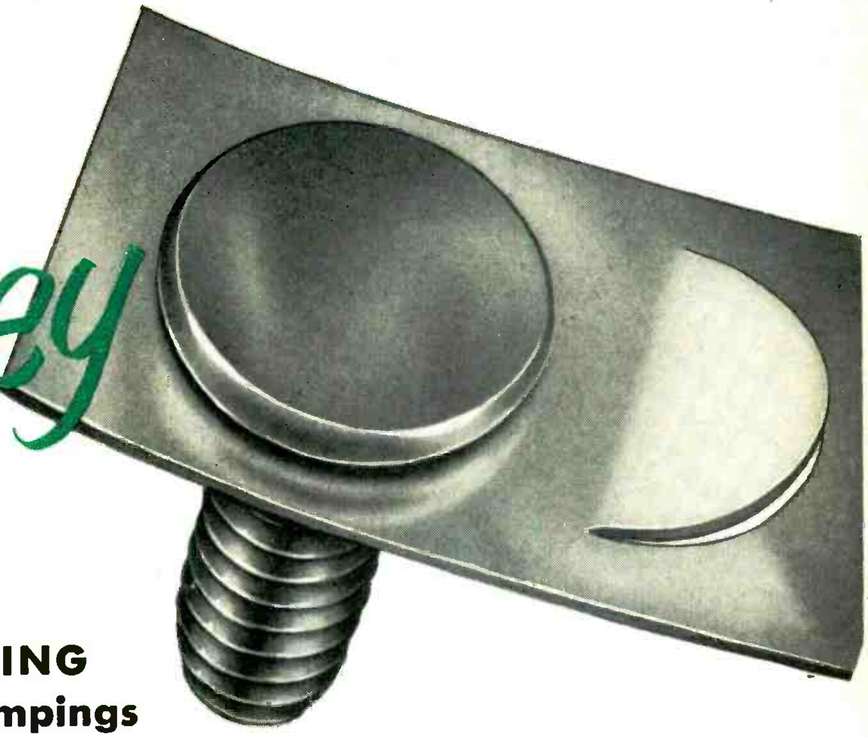
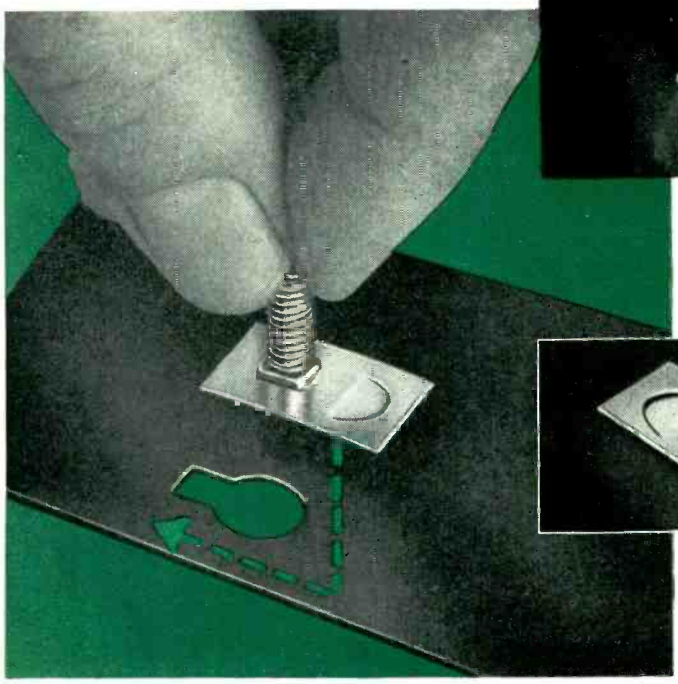
NEW

Quickey

FASTENER



- **FACILITATES NESTING** of sheet metal stampings
- **ELIMINATES DAMAGE** due to welded or staked studs



Not this

Welded or staked studs are easily damaged in transit from one department to the next or during processing, painting, polishing, etc. The bolts themselves can cause serious damage, denting, scratching or chipping painted or polished surfaces.

But this

QUICKEY SNAPS IN just before final assembly . . . allows finished parts to be nested for economical transportation *without* protruding studs of any kind. Installed at the last moment, every Quickey is perfect. If damaged during later assembly operations, any Quickey can be removed and replaced easily and quickly, even in blind assemblies.

Like thousands of other fasteners and allied devices, designed and manufactured by United-Carr, Quickey helps speed assembly and cut costs. Available in a complete range of sizes and in volume quantities; further details on request.

UNITED-CARR

MAKERS OF **DOT** FASTENERS

UNITED-CARR FASTENER CORPORATION, CAMBRIDGE 42, MASSACHUSETTS

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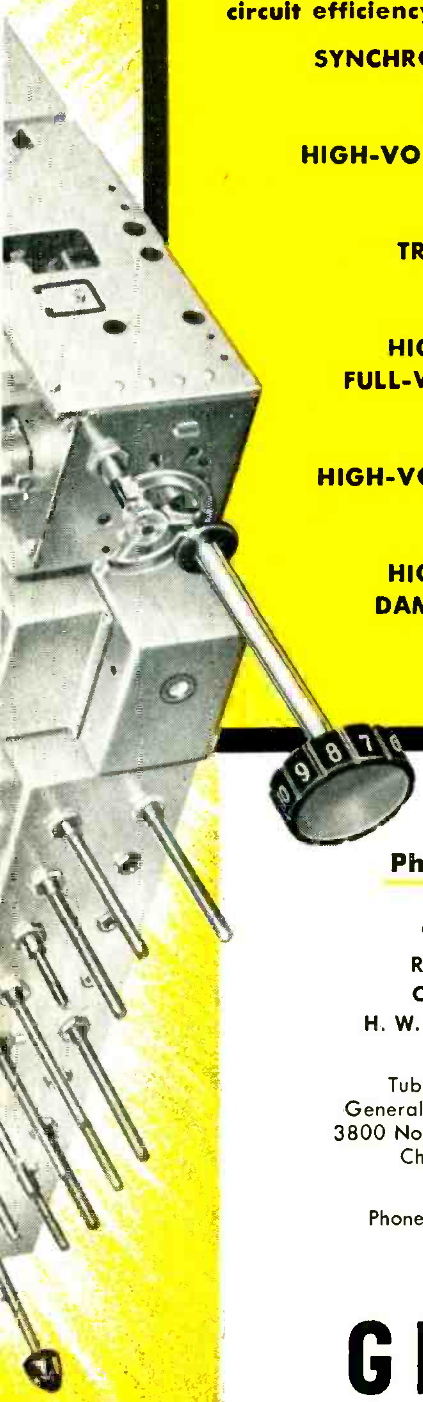
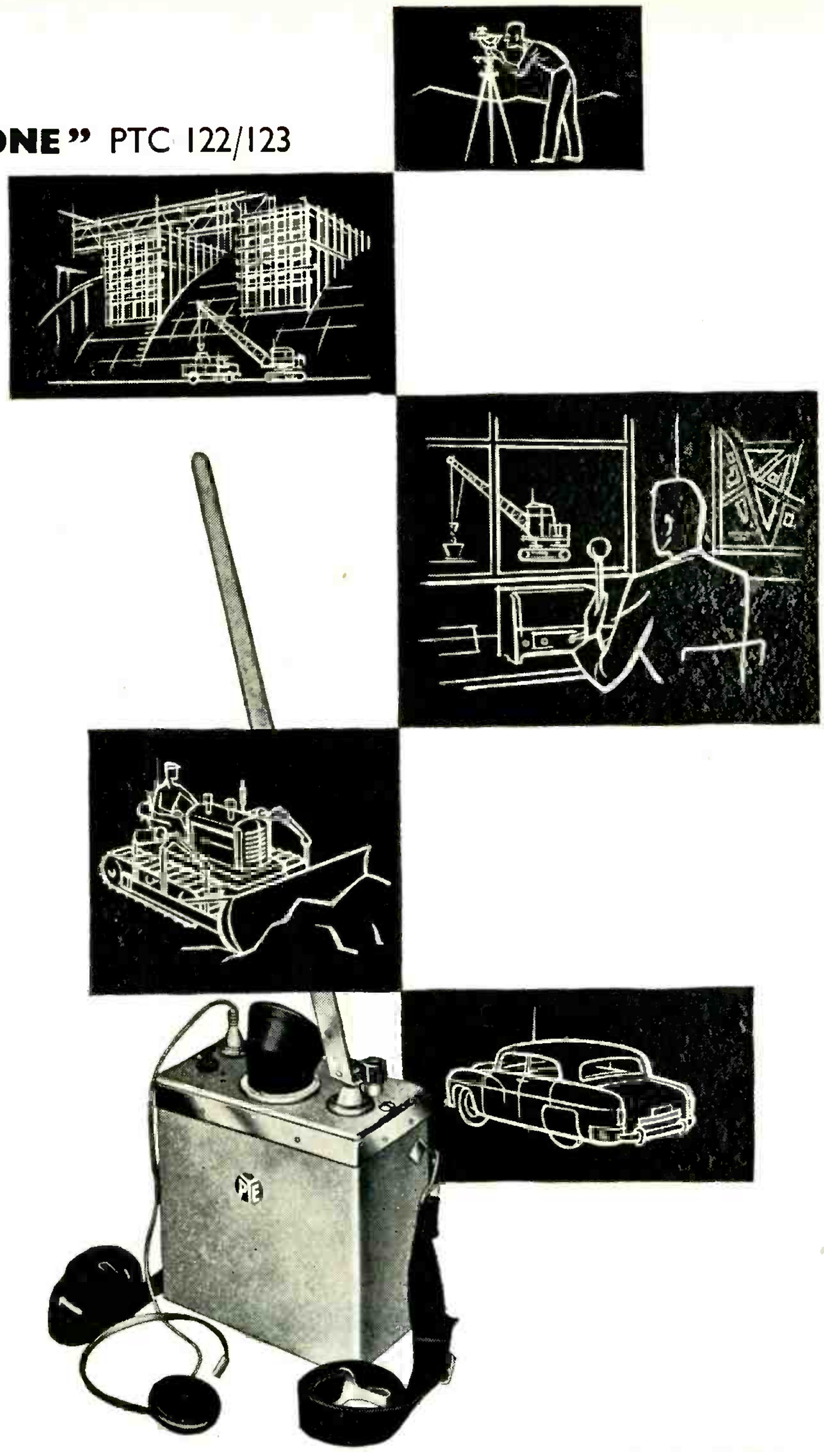
BRAND-NEW TUBES FOR COLOR TV....

Developmental color-TV chassis



9
8
7

"WALKIEPHONE" PTC 122/123

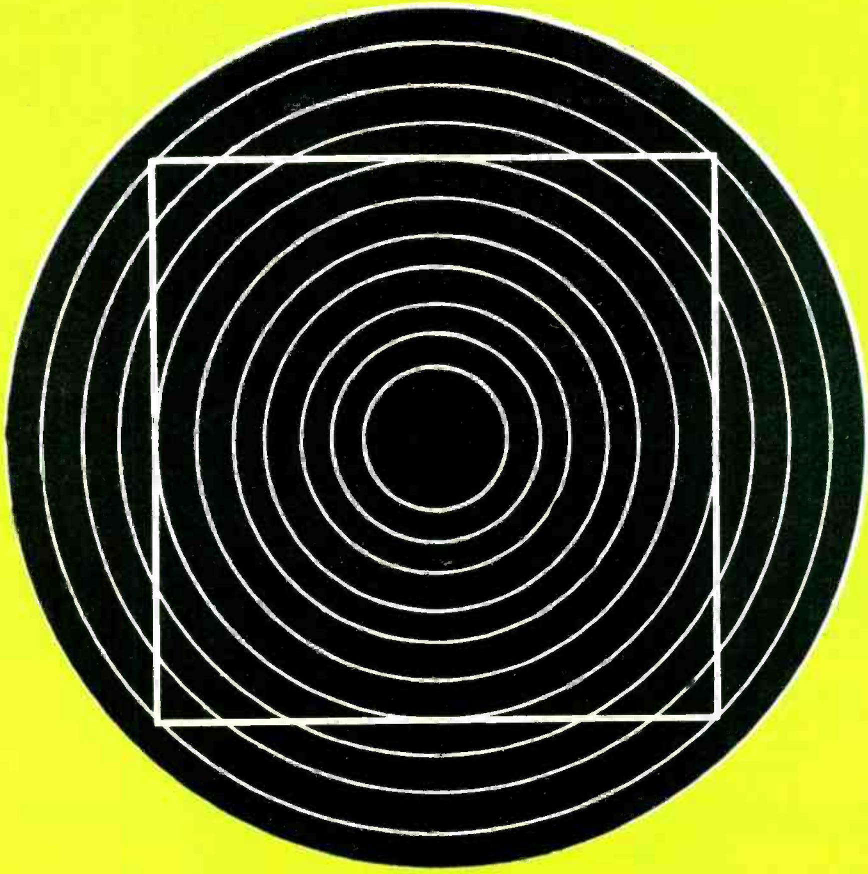


PORTABLE RADIO-TELEPHONE
FOR CIVIL ENGINEERING
COMMUNICATIONS

For purposes of routine inspection and maintenance the Pye V.H.F. Walkiephone makes a valuable but inexpensive addition to any V.H.F. Scheme. Armed with this lightweight equipment one man becomes, unimpeded, a source of information and when required, a centre of control. In places both unexpected and inaccessible the Pye "Walkiephone" ensures the smooth control of emergency operations. Robust, reliable, and economical in use, the complete equipment weighs only 10½ lbs with batteries.

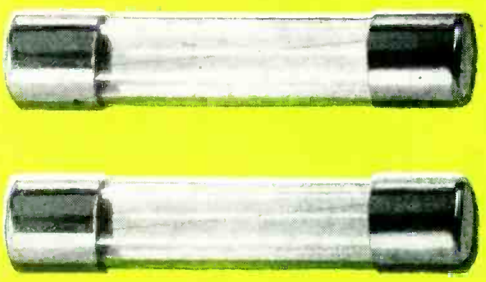
Telecommunications

PYE LIMITED CAMBRIDGE ENGLAND



things are NOT as they seem . . .

This is a perfect square within the circle — it is an optical illusion that the sides bend.



Things are not as they seem . . .
These two fuses look alike . . .
But they are not.

This fuse may burn out anywhere along the length of the filament even in the cap—this blown fuse is impossible to detect visually.

This Littelfuse has a controlled blowing point—the filament is plated throughout its length except in the very center—the fuse will always blow here. A blown Littelfuse can be detected immediately—a Littelfuse feature.

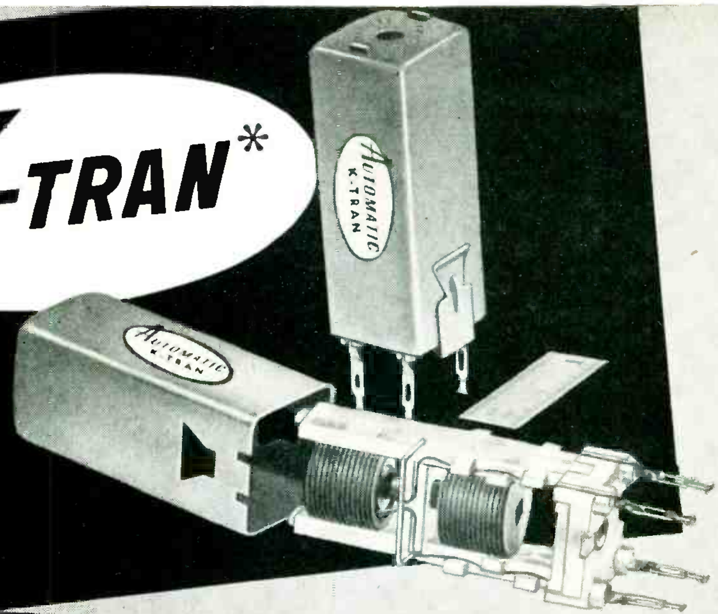
Littelfuse holds more design patents on fuses than all other manufacturers combined.

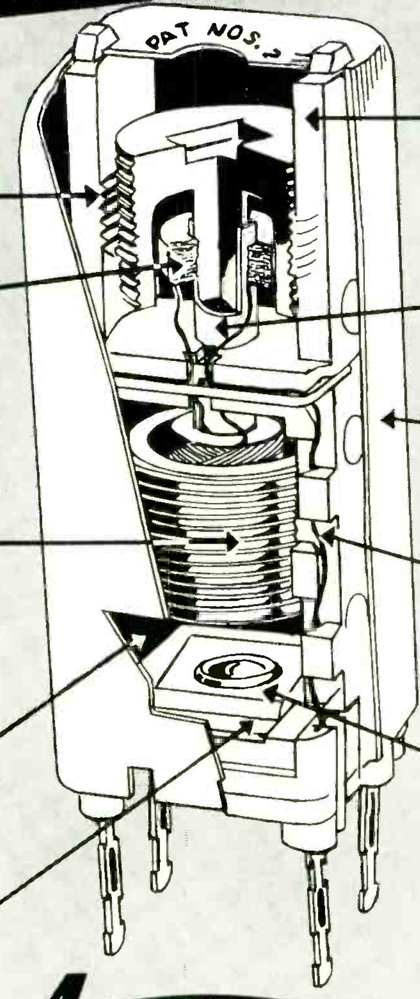
LITTELFUSE

DES PLAINES, ILLINOIS

This is the . . . K-TRAN*

. . . the original permeability tuned ¾" I.F. transformer introduced by Automatic in 1945. Since then, many have tried to imitate and copy it, but failed, due to Automatic's patents and manufacturing know-how.





Many long threads under steel spring tension maintain core torque accurately. Core is not supported by coil form.

High temperature plastic supports. Safe for use up to 90°C. Made in Automatic's molding plant.

Iron cores supported by side frames. Coils supported by core. Differing thermal expansion rates of coil form and side frames give thermal stability correction. *Only* K-TRANS have this feature.

Special *thin* wall coil form manufactured by Automatic.

Shield manufactured in Automatic's aluminum department.

Powdered iron core designed and manufactured by Automatic has center tongue for permanent adjustment and an integral shell giving complete magnetic shielding except for coupling flux.

All leads located exactly by threading into side frames. Capacity coupling is absolutely uniform.

Holes to seat the patented K-TRAN mounting clip, which assures perfect grounding.

Heavy spring pressure plate guarantees capacitor stability.

Silvered mica capacitors manufactured entirely by Automatic.

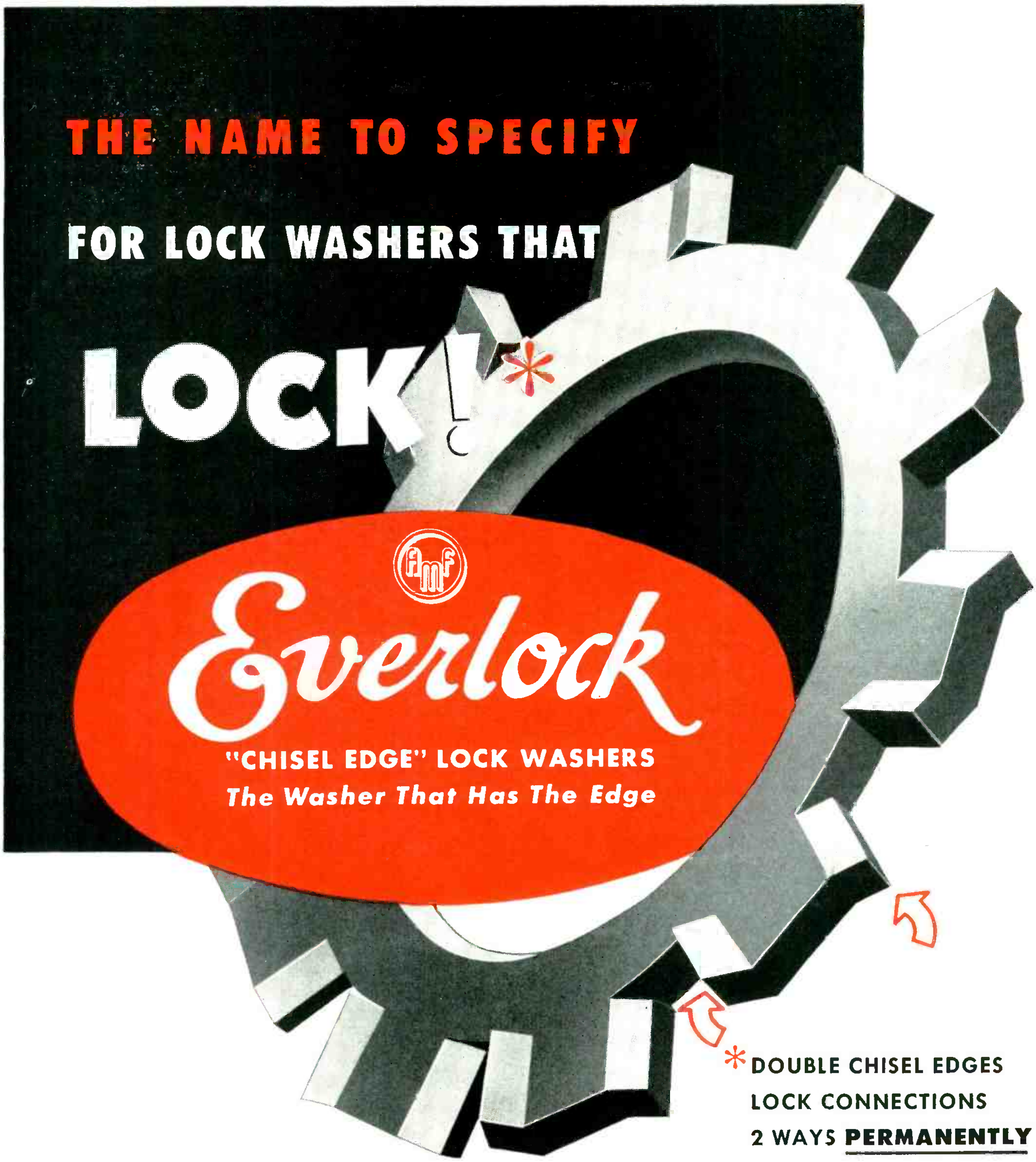
Automatic also manufactures the K-CAP the finest ceramic capacitor available.

AUTOMATIC MANUFACTURING CORPORATION

MASS PRODUCERS OF ELECTRONIC COMPONENTS

65 GOUVERNEUR ST. NEWARK 4, N. J.

*Manufactured under U. S. Patents 2429468, 2547085, 2435630, 2483919



Everlock's alternating chisel edges actually BITE into both surfaces—into the face of the work and the nut—and are held in place permanently by powerful spring tension.

Available in four standard types or special to your exact specifications.

When ordering screw-washer assemblies from screw manufacturers specify EVERLOCK washers for quality and fast service.

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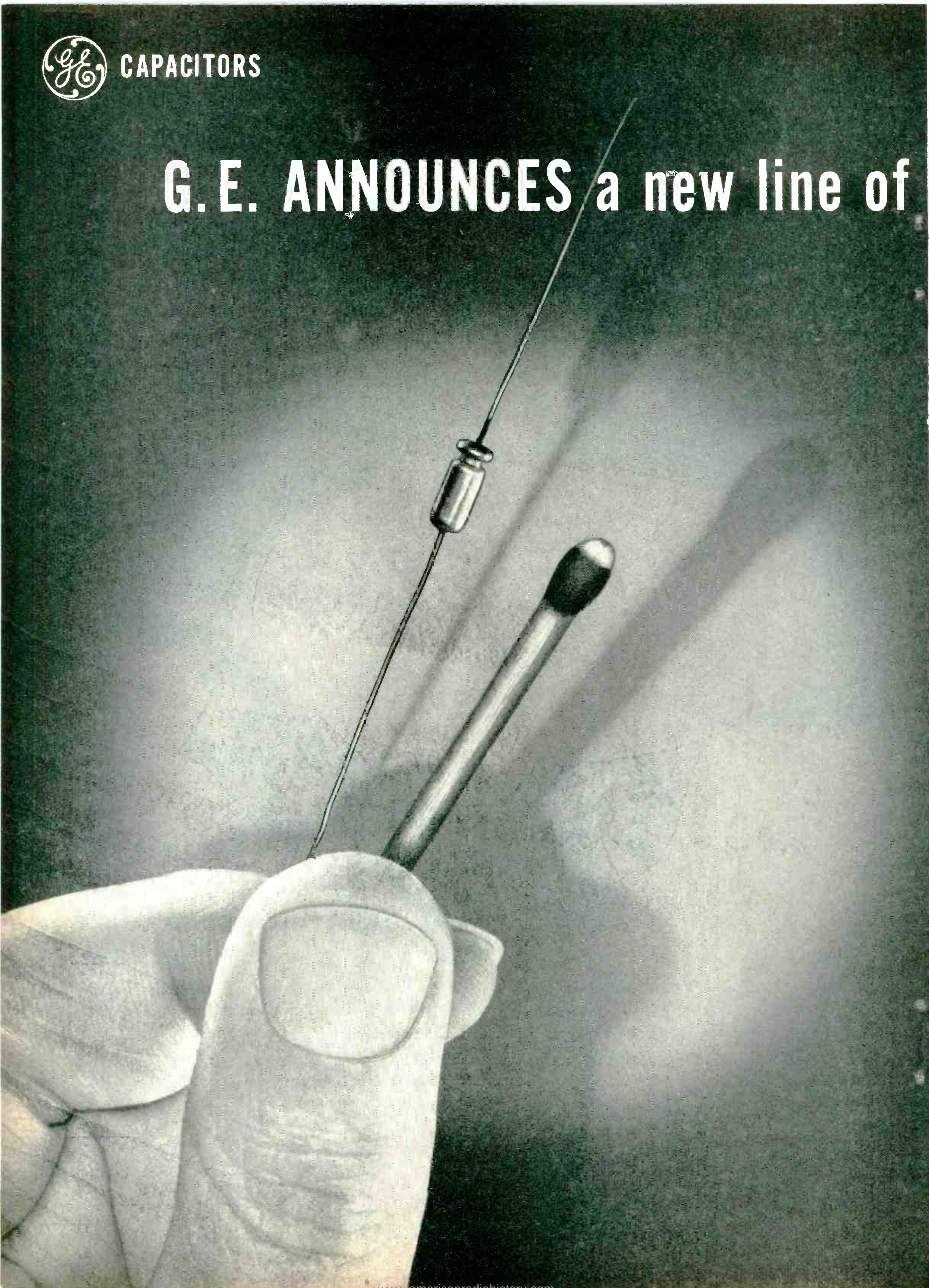
THOMPSON-BREMER & COMPANY • 520 N. DEARBORN STREET, CHICAGO 10, ILLINOIS

SUBSIDIARY OF AMERICAN MACHINE AND FOUNDRY COMPANY • NEW YORK, N. Y.


CAPACITORS
G.E. ANNOUNCES a new line of

Micro-miniature Tantalytic Capacitors

Smallest electrolytic capacitors commercially available— permit new design flexibility for low-voltage d-c applications

General Electric's new *Micro-miniature* Tantalytic capacitors combine *smaller-than-subminiature* size, large capacitance and low leakage current. They permit new design flexibility in low-voltage, d-c circuits . : : particularly transistorized subminiature assemblies where space is at a premium, such as hearing aids.

SUPERIOR PERFORMANCE. *Micro-miniature* Tantalytic capacitors outperform aluminum electrolytics in electrical stability, operating and shelf life, because of the inert characteristics of tantalum metal and the stability of its oxide. They gain added reliability from the use of silver cases, a non-acid electrolyte, and complete sealing that prevents leaking and contamination of the interior.

WIDE TEMPERATURE RANGE. *Micro-miniature* Tantalytics can operate over a −20 C to +50 C range—may be stored at −65 C. With some capacitance derating, they can operate well below −20 C. At −55 C, units rated 10 volts and above will maintain at least 65% of their 25 C value. They also perform satisfactorily above +50 C with some life limitations.

AVAILABILITY. Designed especially for non-resonant, non-critical applications such as coupling, by-pass and filtering, *Micro-miniature* Tantalytics can be obtained in sample lots 2 to 3 weeks after your order is received at the factory. Production lots can be shipped 6 to 8 weeks after your order is received. For more information, see your G-E Apparatus Sales Representative or write for bulletin GEA-6065 to General Electric Company, Section 442-13, Schenectady 5, N. Y.

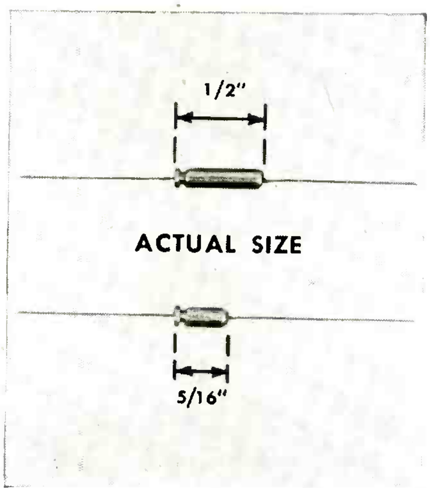
Progress is our most important product

GENERAL ELECTRIC

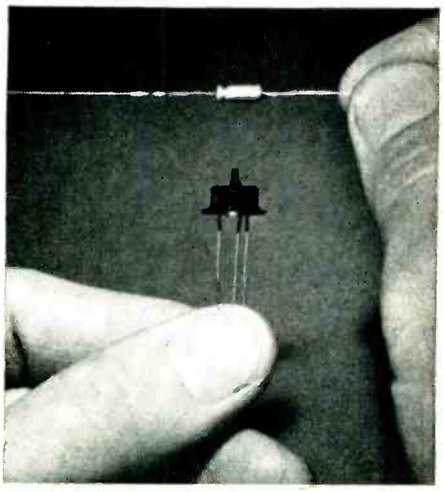
AVAILABLE RATINGS

Working volts d-c	Maximum muf 5/16" Length	Maximum muf 1/2" Length
2	3.0	6.0
4	2.0	4.0
6	1.5	3.0
8	1.2	2.5
10	1.0	2.0
16	.7	1.5

These ratings are based on known muf X volt capabilities. They meet the −15% to +75% capacitance tolerance. Other ratings, particularly whole muf values, can be supplied if the muf X volt rating is not exceeded for the voltage involved.



LARGE CAPACITANCE and small size make Micro-miniature Tantalytics valuable where space is at a premium. Diameters are .125 in.



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electronics

W. W. MacDONALD, Editor

NOVEMBER • 1953

CROSS TALK

▶ **BUSINESS** . . . Conversations with men in many fields during the past month reflect a rather widespread belief that American business may drop as much as 10 percent in 1954. It is not seriously expected to dip lower than that because people have money in the bank and jobs. McGraw-Hill's economist describes the prospect as a not unhealthy decline "from super-boom to prosperity."

In our travels it seems that pessimism is found largely in businesses not accustomed to frequent introduction of new products. Optimism, on the other hand, is found in businesses that expect to grow with new products. Electronics is one such business, and this is why so many people look to us for compensating increases.

Electronics could go up in 1954, might hold level. If it drops the drop will be less than in most other businesses.

▶ **MECHANIZATION** . . . In June we said "this might be the first commercially significant year for circuit mechanization." Several things have happened since to strengthen that conviction.

More small radios utilizing machine-made wiring have come on the market. Many television sets now utilize subassemblies employing such wiring. We've heard about an experimental tv set in which not only wiring but virtually all interconnection of component parts is accomplished without the aid of human hands. A system of complete military circuit mechanization, including automatic testing, has been demonstrated. Top management in many companies has issued what amounts to an edict that engineers down the line must develop still better labor-saving systems, and do it soon. An active industry engineering committee studying mechanization methods is becoming even more active, now with an eye on the calender.

Mechanized wiring is well along, although many engineers think ideal materials and methods are just barely within sight. Mechanization of complete circuits, on the other hand, is still in the early experimental stage; machine inflexibility continues to be a problem but it is one that will eventually be solved.

▶ **MANPOWER** . . . The technical-personnel market is still tight, but not as tight as it was six months ago. The cost of finding men nevertheless remains high. A chief engineer of our acquaintance has kept score on help-wanted-ad costs over the years. He tells us that it cost him $700 to find a man he wanted back in 1951. Now it costs $1,100.

▶ **SCANNER** . . . In July we put in a personal, boat-owner's plea for a depth finder that would tell us what was *ahead* rather than under. On the market today is a unit that not only does this but scans and also tracks if you want it to.

▶ **TRANSISTOR** . . . Don't sell glass, vacuum pumps or rare gases short. There are signs that all three may be very useful in the manufacture of transistors. For special applications, at least, it is now known that germanium dislikes contact with most solids and liquids; put it in a bottle, pump the air out and admit the right kind of gas, and temperature and humidity as well as mechanical troubles decline.

▶ **TRANSITOR** . . . Proofreaders will please curb an understandable urge to put another S in this word, because we do mean transitor. It is a word used by some tv-station engineers to describe the devices upon which the camera is focused when making transitions between scenes. A whirling spiral disc may be used, for example, to denote shifting of action to the thought, dream or spirit world.

▶ **COVER** . . . Several contemporary magazines have used 3-D front-cover pictures, supplying subscribers with the necessary glasses. Not to be outdone, it seems, ELECTRONICS mailed out a couple of copies last month with faulty front-cover registry. One of them just bounced back from the field along with a kidding letter and a pair of plastic specs. Darned if it doesn't look like deliberate 3-D!

By J. E. BINNS
Associate Engineer
Brookhaven National Laboratory
Upton, N. Y.

West face of reactor at Brookhaven, N. Y. Research workers on balcony are performing experiments with neutron beams emerging from the reactor

Electronic Control

Safe operation of Brookhaven's nuclear reactor requires use of several types of electronic instruments for neutron sensing over the wide range of levels encountered. Servo system is provided for automatic operation of the reactor at constant level

BROOKHAVEN'S NUCLEAR reactor consists of a 25-ft cube of graphite that contains rods of uranium, the fuel, and rods of boron steel for control. Although this reactor was designed to afford a maximum of experimental facilities and is quite different from the power-producing and fuel-breeding reactors of the future, it presents many of the same instrumentation problems.

The major problem is control of neutron production in the reactor. Neutron production ranges between 10^{8} and 10^{18} neutrons per second. A neutron is commonly detected by allowing it to be absorbed by some nucleus that then becomes unstable and splits into charged fragments that produce copious ionization in passing through a gas. These gas ions are collected on a charged electrode and cause a current to flow in the external signal circuit.

At high neutron levels the average signal current is great enough to provide a usable d-c signal; at low neutron levels this d-c component is below the noise level, and it becomes necessary to count individual pulses of current.

Starting Up

When the reactor is shut down, all the neutron-absorbing control rods are in the reactor and the neutron level is so low that it has to be observed by an ion chamber that utilizes the fission of U^{235}. The signal consists of discrete pulses that average about one per second. The circuit rejects low-energy noise pulses, equalizes the signal pulses as to energy content and takes a time average, which is proportional to the average pulse rate. The counting rate meter is illustrated in Fig. 1A.

The operator now withdraws one of the boron-steel control rods. Since fewer neutrons are being absorbed, the reactor is now a better multiplier of neutrons and the counting rate rises on an exponential curve, leveling off at a slightly higher value.

Withdrawal of each successive rod causes an increase in counting rate, the increments becoming larger and larger. These are analogous to the output increments obtained from an amplifier with some positive feedback and a constant small input signal when the gain is increased in equal steps. These phases of the reactor startup are shown in Fig. 2.

By the time the counting rate meter goes off scale with an increase in level of a factor of 104, the next instrument begins to respond. This is the period meter. See Fig. 1B. It uses a boron-lined ion chamber to sense neutrons. Here the d-c level is high enough to be used as the signal for a d-c amplifier whose output is proportional to the time derivative of the logarithm of the input, that is, to

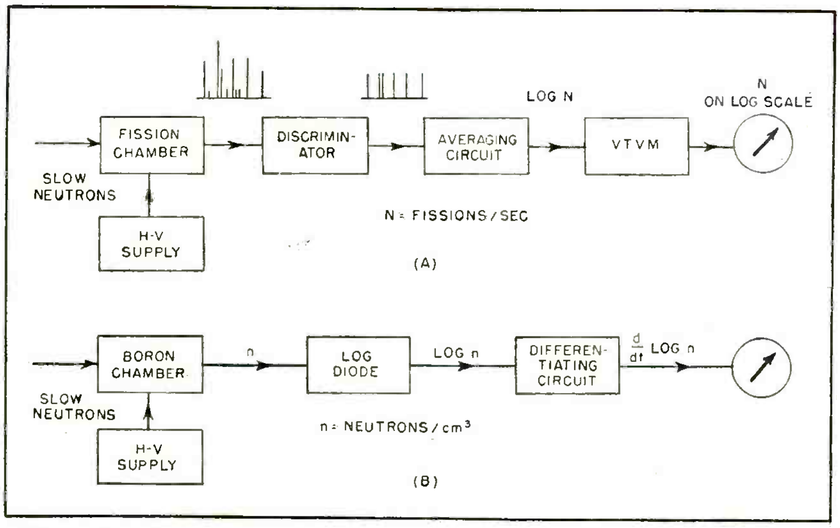

FIG. 1—Counting rate meter used to measure low neutron levels (A) and period meter used to measure higher levels (B)

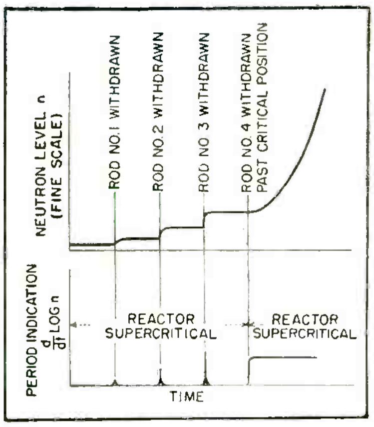

FIG. 2—Phases in starting up a nuclear reactor

# of a Nuclear Reactor

the percentage rate of rise of the neutron level or to the reciprocal of the reactor period. At this stage of startup the response is in the form of a transient deflection that becomes larger with each successive rod withdrawal.

The reactor is still subcritical, that is, the neutron level is a function of control-rod positions. Eventually the reactor becomes supercritical, which means that the neutron level rises exponentially without apparent limit. This is analogous to the building up of amplitude of self-sustained oscillation in an amplifier after critical gain has been exceeded.

The farther the rod has been pulled past the critical position the greater is the rate of rise of the neutron level. The period meter now shows a steady reading. The operator adjusts the rod to give a safe rate of rise. If he brought up the neutron level on too short a period there would be danger of overshooting the safe maximum level and damaging the fuel assemblies by excessive temperature.

At some time during the exponential rise of neutron level the d-c signal from another boron-lined chamber becomes large enough to deflect a sensitive galvanometer. The operator can follow the rise by means of the galvanometer.

As the desired level is approached, the operator slows down the rise by inserting a control rod. The trick is to bring the rod to such a position that the reactor is just critical at the desired level, that is, so that the level neither rises nor falls.

Operation at Constant Level

In practice the reactor is always either slightly subcritical or slightly supercritical, so that the level is either slowly falling or slowly rising. To maintain a constant average level it is necessary to keep moving the rod slightly about the critical position. This may be done by the operator or by a servo that uses a boron-lined chamber to sense neutron level.

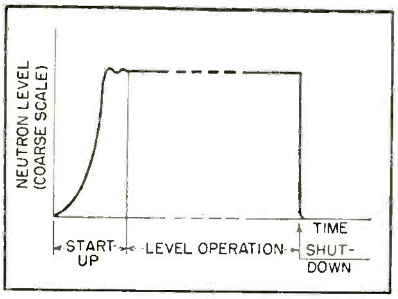

FIG. 3—Typical operating cycle of a nuclear reactor

Safety Provisions

During high-level operation. the plant is constantly monitored to detect excessive neutron level or temperature inside the reactor, excessive gamma radiation or the presence of radioactive dust in personnel areas, excessive output of radioactive cooling air from the stack or failure of the cooling system. Certain of these conditions will cause immediate shutdown of the reactor, while others will sound an alarm.

Shutting Down

The reactor may be shut down in a few seconds by inserting all control rods simultaneously, either by the operator or by an instrument. When all control rods are in, the reactor is highly subcritical and the neutron level decays with a short time constant. Figure 3 shows typical operation of a nuclear reactor.

Design and construction of the Brookhaven reactor was carried out under the auspices of the Atomic Energy Commission.

Color-Television Converter

Chrominance detail is heterodyned into the pass band of transmission medium to produce good color reception, since programs sent via coaxial circuits with 2.7-mc bandwidth would otherwise drop out color information from television signal. Technique produces results comparable to those encountered in cable-carried monochrome

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AN IMPORTANT requirement to be met by any color television standards proposed for commercial adoption is that the signal be capable of satisfactory transmission over intercity network facilities.

This article describes a method of passing NTSC color signals over existing facilities that do not pass the full range of frequencies of the proposed specifications.

Two principal types of facilities are currently available for long distance transmission of monochrome television programs. One is a radio relay designated by the Bell System as TD-2, capable of passing the full video range. The other is a coaxial cable system designated L-1, capable of passing video frequencies up to about 2.7 megacycles.

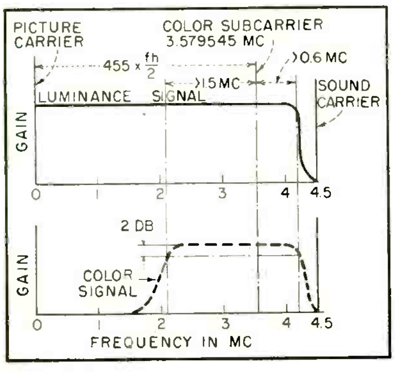


FIG. 1—Video spectrum of the NTSC field-test signal, showing band-sharing obtained by chrominance subcarrier

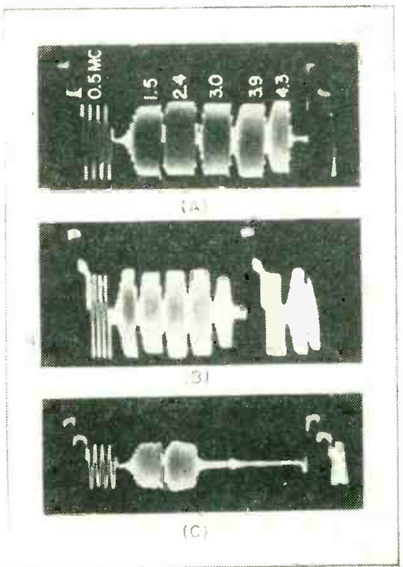


FIG. 2—Typical signal from burst-frequency generator (A), frequency response over a microwave transmission system (B) and frequency limitation imposed by coaxial-cable transmission (C)

In monochrome television transmission, the energy content of the higher-frequency components of the picture signal is relatively small compared to that of the lower-frequency components. A loss of the higher-frequency components results in a picture of reduced detail, but the picture is generally considered acceptable. However, a color television signal made up of a luminance portion and a color subcarrier has all the chrominance information at the high end of the video spectrum.

A loss of these components results in a picture with little or no color information.

Thus, transmission of the high-frequency end of the video band becomes a matter of major importance.

Figure 1 shows the video spectrum of the NTSC field-test signal. Band sharing is accomplished by adding to the luminance information a subcarrier that is modulated by chrominance information. The subcarrier frequency is chosen to be an odd multiple of half the line frequency (and consequently an odd multiple of half the frame frequency) for frequency interleaving of luminance and chrominance information. In practice, the subcarrier frequency is determined by a crystal and the line-sync generator is locked to this crystal by frequency divider and multiplier circuits.

The following description assumes a subcarrier frequency of 3.579545 mc. What follows would generally apply to any subcarrier frequency chosen.

for Cable Networks

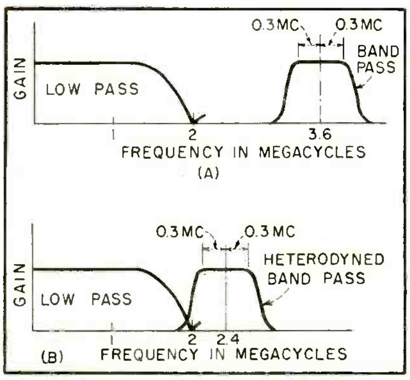


FIG. 3—Composite signal separated (A); heterodyning upper band down (B)

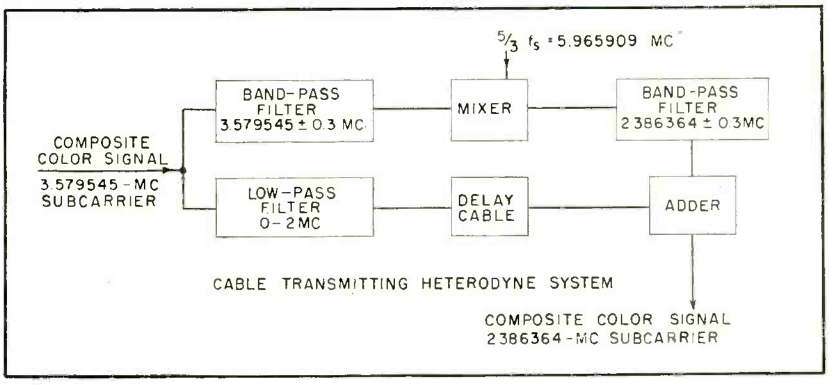


FIG. 4—Transmitter terminal equipment alters NTSC color signal for narrow-band transmission

The bandwidth of the common-carrier microwave system, as used for television transmission, extends beyond 4 mc; the color signal represented by Fig. 1 may be transmitted without modification. Because color reception depends critically on the frequency response of the transmission path, it is essential that the microwave circuits give a flat frequency response up to 4 mc.

The pass band of the coaxial-cable system limits the total spectrum of the signal to about 2.7 mc. Transmission of the signal of Fig. 1 results in complete loss of the chrominance information.

Facilities Tests

Late in 1951, color demonstrations were given in Washington, D. C. Color signals originating in New York, were sent over both the microwave and the coaxial-cable systems. To check the performance of the network paths, extensive use was made of a burst-frequency generator.[1]

Figure 2A shows a photograph of the signal obtained from this generator. The simulated composite video signal is made up of horizontal sync and blanking pulses, with discrete bursts of various frequencies during picture time. This unit was initially designed to provide a quick check of terminal and interconnecting facilities for monochrome television. Its use is equally applicable to color transmission.

A frequency-response over the microwave system and associated local channels is shown in Fig. 2B. Such a test must be made using

Although at the present time the use of the heterodyne conversion equipment is necessary when using the L-1 cable carrier system, the Bell System has recently developed a new wide-band cable system known as the L-3. This system is nominally 8-mc wide, of which about 4 mc may be used for television and the remainder for other services. At present one of these new L-3 systems is in operation between New York and Philadelphia with telephone circuits operating over it. Tests of the system have included transmission of the proposed compatible color tv signal.

It is the hope of the broadcasting networks that certain sections of the country now served only by the L-1 systems will be the first to be benefited by L-3 installations, although the Bell System has made no announcement of its plans in this regard. Wherever this is done, the use of conversion equipment for color will no longer be necessary.

The foregoing does not imply that good compatible color pictures will not be available by network except where the L-3 system is available. Color pictures transmitted over the L-1 coaxial cable system using the telephone company's heterodyne conversion equipment compare favorably with the transmission afforded by the newly developed L-3 system and with that of radio relay facilities.

The Editors

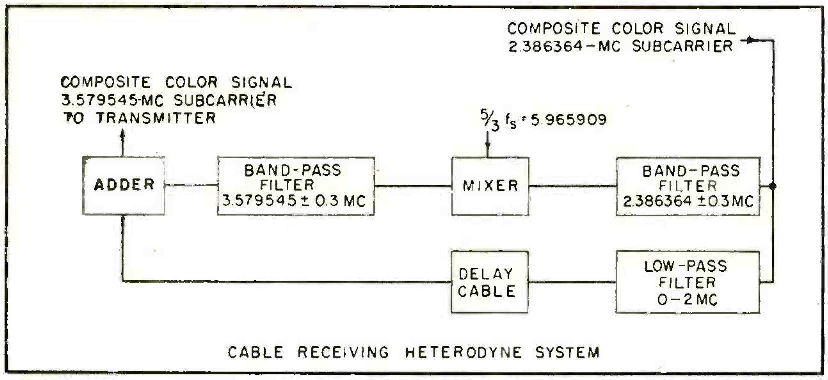


FIG. 5—Receiver terminal equipment translates 2.4-mc subcarrier back to 3.6 mc using filters and heterodyne principle

oscilloscopes of bandwidth greater than that of the circuit being tested. The response is fairly well down at 4.3 mc, as shown by the last burst.

Figure 2C shows a frequency-response check made over the coaxial-cable system including associated facilities. Amplitude of the last burst indicates that the response is still good at 2.4 mc.

Color Conversions

When narrow-band coaxial-cable transmission is used, retention of much of the chrominance information in the NTSC color signal may be accomplished by suitable conversion equipment at the transmitting and receiving cable terminals. This equipment operates on the composite color signal so that frequency components around the subcarrier frequency are translated into the pass band of the coaxial-cable system.

As an alternative method[2], the color studio can employ an encoder operating at 2.4 mc, which receives information from the color cameras directly. The advantage of the conversion method to be described lies in its flexibility. Circuit complexities of a color encoder are avoided. Also, the conversion equipment can be remote from the studio, allowing full-band transmission to a point such as Toledo, with restricted-band transmission over coaxial cable to some other point, such as Dayton.

The translating equipment is designed to provide approximately 2 mc of luminance detail, and 0.3 mc of chrominance detail. By means of filters the transmitting terminal equipment divides the composite color signal into two bands of frequencies as indicated in Fig. 3A. The first band contains frequency components of the signal extending from 0 to 2 mc. The second band contains components whose frequencies extend 0.3 mc on each side of the subcarrier frequency f_s, 3.579545 mc.

This second band is moved down in frequency by heterodyning so that it is adjacent to the 0-to-2 mc band. The new spectrum of the signal is thus limited to 2.7 mc, as shown in Fig. 3B. This signal is sent over the coaxial cable to the receiving terminal equipment. Here the two bands are separated and the upper band moved back to its original position by heterodyning.

The transmitter terminal equipment that alters the NTSC color signal for narrow-band transmission is indicated in the block diagram of Fig. 4. First, a linear-phase-shift low-pass filter selects the luminance components extending out to 2 mc. An m-derived band-pass filter selects the components that extend 0.3 mc on each side of the subcarrier frequency f_s, 3.579-545 mc. This band is then lowered by heterodyning in a mixer with a sine-wave voltage whose frequency is 5/3 times the color subcarrier frequency, or 5.965909 mc.

A second m-derived band-pass filter follows the mixer. This filter selects only the difference frequency components that extend 0.3 mc on each side of $\frac{2}{3} f_s$, or 2.386364 mc. This band around 2.4 mc is then added to the low-pass band to give a spectrum shown in Fig. 3B. All components originally near 3.6 mc are now near 2.4 mc. In effect, the subcarrier has been lowered. The synchronizing burst is now a burst of 2.386364 mc. This new spectrum can now be transmitted over a system limited to about 2.7 mc.

Terminal Inverter

The receiver terminal equipment to translate the 2.4-mc subcarrier back to 3.6 mc is shown in Fig. 6. Another linear-phase-shift low-pass filter selects the luminance components extending out to 2 mc. An m-derived band-pass filter selects the components extending 0.3 mc on each side of 2.386364 mc. This band is then heterodyned in a mixer with a signal whose frequency is again 5/3 f_s, as in the transmitting terminal.

Another m-derived band-pass filter following the mixer selects only the difference-frequency components, which extend 0.3 mc on each side of f_s. Thus the color subcarrier is moved back to its original value. The band around 3.579545 mc is added to the low-pass band. The spectrum of Fig. 3A is recovered and the signal is ready for transmission as an NTSC color signal of reduced detail.

It is noteworthy that the heterodyning signals at both the transmitting and receiving ends of the terminals must be locked to the original subcarrier, f_s, in order to maintain the 455/2 ratio between the subcarrier and line frequency. This condition is established by automatic-frequency-control circuits in both the transmitter and receiver terminal equipment.

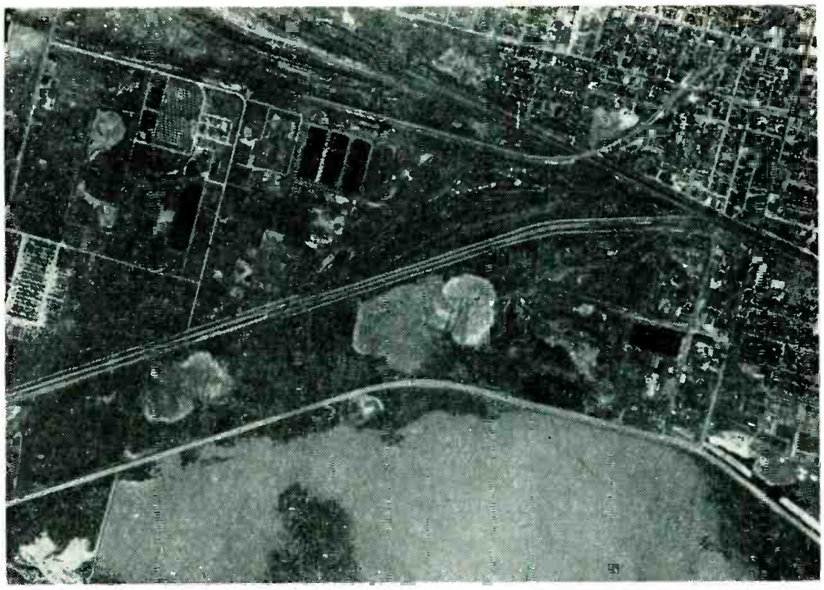
An oscillator in each is locked to the color synchronizing burst of its input signal. Thus the heterodyning signals and the lower subcarrier are locked to the original subcarrier f_s. The final subcarrier is thus identical in frequency to the original subcarrier. Band-pass filters at both terminals must be carefully designed to eliminate any undesired components introduced by the mixers.

References

(1) H. Borkan, W. C. Morrison and J. G. Reddeck, Video Test Signal Generator, Electronics, p 139, Sept. 1953.

(2) An Analysis of the Sampling Principles of the Dot-Sequential Color Television System, *RCA Review*, Sept. 1950.

Air photo taken with camera controlled by automatic film-speed synchronizer. Sharp, detailed photographs require that film and projected ground image move through camera at same speed



By HERBERT E. MEINEMA
Lake Forest, Ill.

Film Synchronizer for Aerial Cameras

Phototube-controlled servo system measures aircraft ground speed and adjusts camera film transport to keep film and image moving at same rate, regardless of speed and altitude changes. Controls compensate for camera angle and focal length of lenses

SHARPNESS of the photographic image obtained with moving-filmstrip aerial cameras is largely dependent on accurate correlation between the ground speed of the plane and the speed of the film moving past the lens. Ground speed data obtained from usual aircraft indicators, although accurate over longer periods, are not sufficiently accurate for short-time variation.

To provide a means of continuously measuring ground speed, and use this information to maintain proper film speed, the instrument shown in the block diagram, Fig. 1, was developed.

The system uses a phototube scanning unit to measure the angular ground speed by reflected light. A limiting amplifier and a frequency-responsive detector put the phototube output into a square-wave form for controlling a servo system that adjusts the film speed to follow a function of the signal voltage.

Scanner Unit

Operation of the scanning head is shown in Fig. 2. Two parallel gratings are mounted one above the other. Each grating is composed of alternate transparent and opaque bands lying in a direction across the line of flight of the aircraft. A ray of light reflected from a single point on the ground will be alternately transmitted or cut off, as the point moves through positions A, B and C. The light transmitted through the grating will be pulsating in character; its frequency will depend upon the pitch of the grating and the ratio of the grating separation to the altitude and ground speed of the plane. This frequency will be $f = sd/ap$ where f is the frequency in cycles per second, s is the ground speed in feet per second, a is the altitude of the plane in feet, d is the grating separation in inches and p is the pitch of grating lines in inches. The light pulsations are converted into electrical pulsations by phototubes above the top grating.

The surface of the earth is not uniform in appearance, but consists generally of terrain having many light and dark areas of varying size and shape. Light pulses transmitted through the gratings from light reflecting points on the ground will be identical in frequency at any given instant since all points are moving at the same speed relative to the plane. The relative phase of the pulses, however, will be purely random.

Since the total amount of light received by the gratings is directly proportional to the number of re-

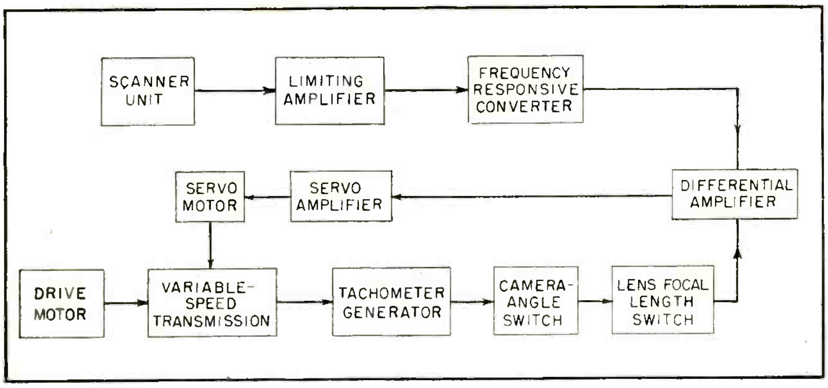


FIG. 1—Block diagram of film-speed synchronizer. Error signal from differential amplifier operates variable-speed transmission to balance error

flecting points in the field of view, percentage modulation of the light received will be proportional to $1/\sqrt{n}$, where n is the number of light-reflecting points. The magnitude of the pulsating component of the modulated light will also be directly proportional to the brightness of ground illumination and the average degree of contrast between light and dark areas. Also, if we assume a constant size for the reflecting areas on the ground, the amplitude of the modulated component of light will be inversely proportional to altitude.

Design Factor

In the practical design of the scanner, several factors had to be taken into account. Grating area had to be kept reasonably small because of restrictions on the size of the hole in the fuselage of the aircraft. Included angle of view had to be as large as possible to include the greatest number of reflecting points, and the frequency generated by the gratings had to be kept within reasonable limits for convenience in amplifying and converting.

A single slit instead of a grating would not have been suitable. When flying over a row of regularly spaced reflections, such as waves, the frequency of the signal would be a function of the number of such reflections passed over per second, rather than their angular velocity. As many lines as possible should be provided in the gratings, but due to diffraction and the difficulty of aligning the gratings the minimum practical spacing is about 0.020 inch, with a separation of 3 inches between the gratings. With flight limits of 600 mph at 100 ft altitude and 250 mph at 3,000 ft, the signal frequency covers a range from 1,320 to 18 cycles per second.

The top grating is separated into two equal areas in which the pattern in one is displaced from the other by the width of one opaque line. A lens assembly above each area concentrates most of the light passing through the gratings on the cathode surfaces of the phototubes. The two phototubes are connected in series, the signal voltage being taken from the common junction. The phototubes thus receive the same amount of ambient light, but a reflecting point on the ground will cause light to fall first on one tube and then on the other. Ambient light is, therefore, balanced out and only the modulated light component generates a signal.

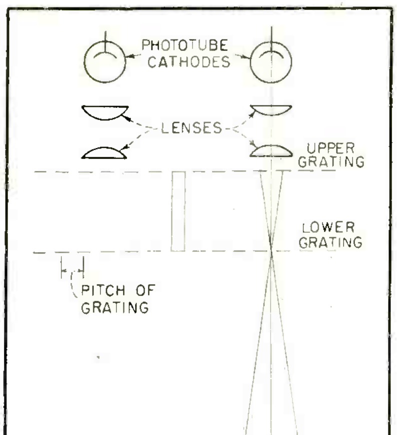


FIG. 2—Gratings of scanner unit modulate reflected light to produce frequency variations in phototube output

The phototubes used are sensitive in the red region as it has been found that the greatest terrain contrast lies in this band. The phototubes must be well matched in current for identical light values and must remain thus, irrespective of light level, temperature and aging. They must also be rigidly constructed, otherwise vibration will cause the generation of spurious frequencies.

Because the modulated light is very low in level it is important that the phototube output be as high as possible for a given light input. The impedance of the tubes is on the order of 1,000 megohms so the input impedance of the amplifier must be at least this high. This is accomplished by feeding the phototube signal into a cathode-follower circuit, Fig. 3.

When operated at high speeds and low altitudes the large areas of reflection on the ground produce a low-frequency component which will blanket the signal unless removed. The constants of the cathode-follower input are proportioned to attenuate these low-frequency signals and an additional two-section high-pass filter network provides additional attenuation. A high-gain amplifier stage and a cathode follower to drive a shielded line complete the unit. The complete scanner is shock mounted with the mounts in the same horizontal plane as the center of mass to prevent rotational vibration.

Main Control Unit

In the main control unit, Fig. 4, the signal from the scanner is clipped in several stages to produce a constant amplitude square wave of the same fundamental frequency as the original. The square wave is then used to trigger a multivibrator. The multivibrator output is rectified to obtain a d-c potential directly proportional to the original scanner-signal frequency.

The signals from the scanner are usually intermittent, arriving in bursts and disappearing when over low-contrast areas such as freshly plowed fields or still water. The d-c output from the rectifier is used as the reference voltage for the

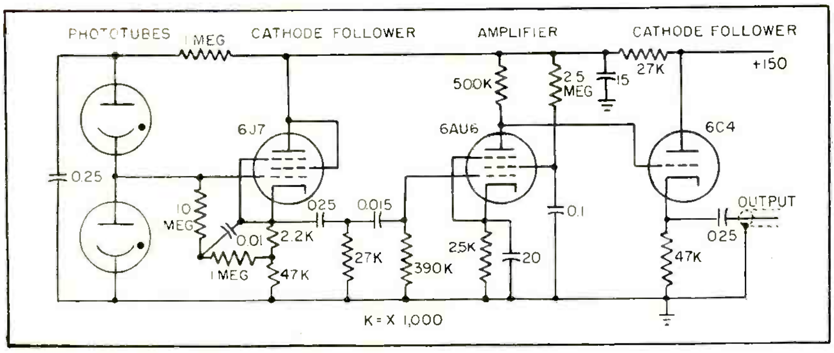


FIG. 3—Scanner-unit circuit has cathode-follower input to provide high impedance for phototubes. Amplified signal is fed to main control unit through shielded line

servo system, and therefore, must remain steady, changing only as the frequency of the signal varies. To provide this constant reference, the d-c current from the rectifier charges a capacitor, and the voltage across this capacitor is used as the reference. When the scanner signal drops below a threshold value a relay drops out, disconnecting the charging circuit from the capacitor. Because no energy is removed from the capacitor, other than by stray insulation leakage, the voltage across it remains steady until the subsequent signal burst arrives. The servo system during the no signal interval, continues to act as though the last signal were still present.

The reference signal is a function of the relative angular velocity of the ground image with respect to the aircraft, whereas the actual speed of the moving film in the camera is a function of the focal length of the lens system and the angle at which the camera points toward the ground. To correlate the relative speeds of the scanner ground image and the lens ground image a d-c tachometer is mechanically coupled to the film drive roller. The tachometer output, which is directly proportional to film speed, is modified by means of attenuator switches so that for a particular focal-length lens and camera angle, the film speed and ground-image speed are the same. One attenuator switch is set up so that each step represents a lens focal length, and the other attenuator is calibrated for various camera angles.

The d-c signal after passing through the lens and camera-angle attenuators is compared to the scanner signal. The differential or error signal, is applied to a phase-sensing modulator having an output frequency of four-hundred cycles. This output is amplified and used to energize one phase of the two-phase servo motor. The servo motor drives the speed-control shaft of the variable-speed transmission until the reference and tachometer signals are in balance, at which time the film velocity is synchronized with the ground-image velocity.

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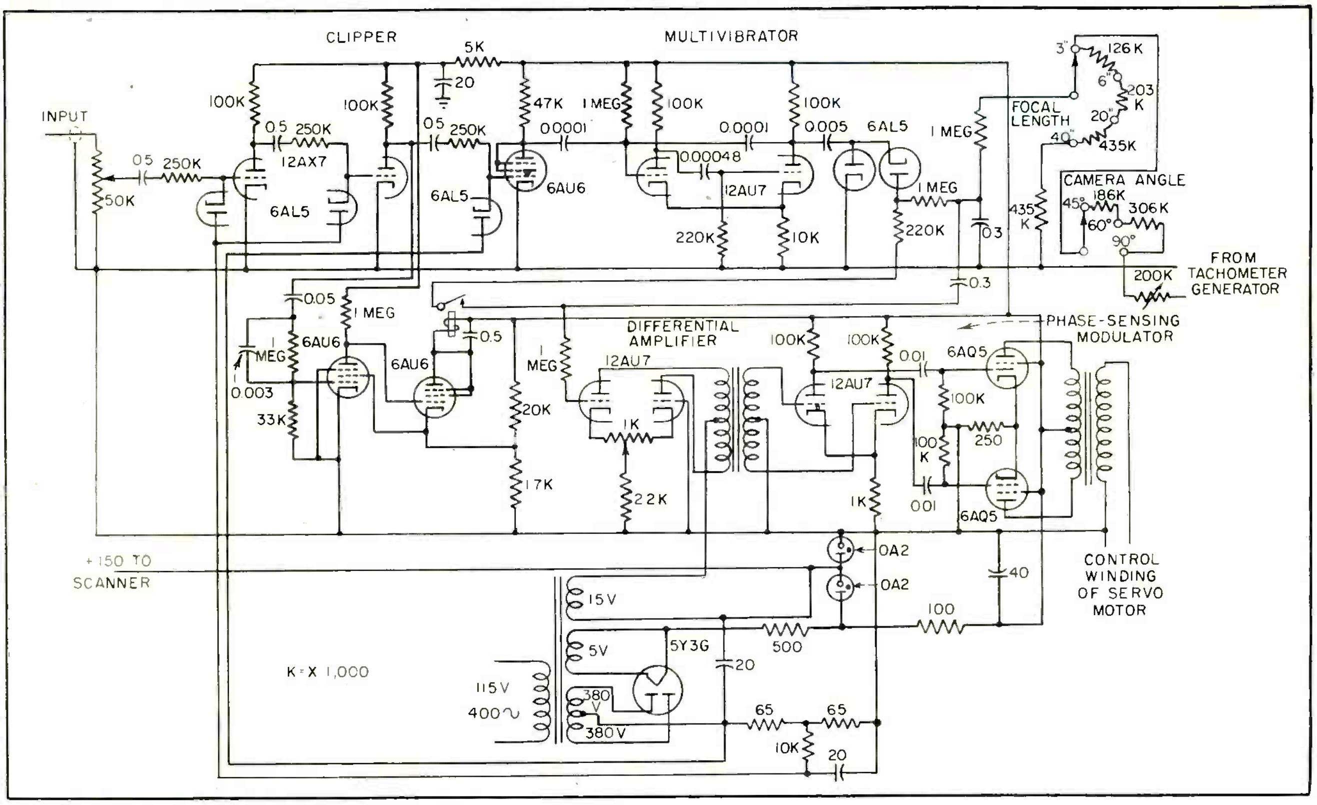

FIG. 4—Circuit of main control unit. Relay opens differential amplifier input when scanner signal drops below specified level. Charged capacitor maintains previous signal on grid, holding film speed constant while passing over nonreflecting areas

Polycathode Counter

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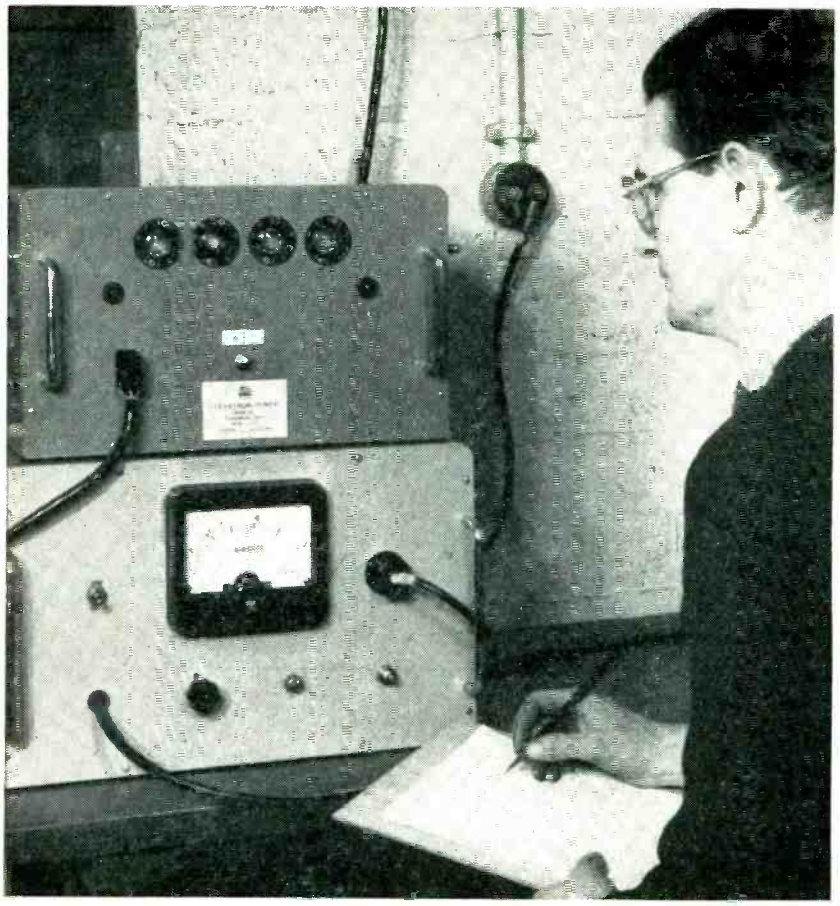
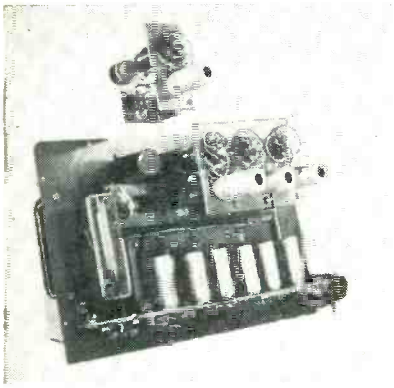
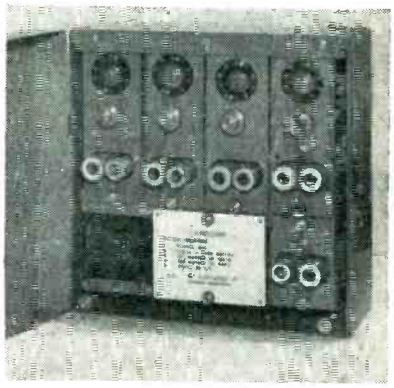


Millisecond timer (top unit) being used with regulated current source to measure delay time of blasting caps. Count is started by application of firing voltage and ended by sound of explosion picked up by microphone



Internal arrangement of millisecond timer. Plug-in unit at upper left contains counter and driver tubes



Batching counter with cover open. Position of glow on counter tubes at top indicate number being set

TECHNIQUES using tubes to count and indicate by the successive movement of a localized glow between a number of cathodes in a gas-filled multi-electrode cold-cathode tube have been described at various times[1,2,3,4]. Such tubes can greatly simplify existing methods of scaling and indicating pulses, permitting digital methods to be applied in fields where such methods would normally be too expensive or insufficiently reliable.

A single decade scaler using these tubes involves one counter tube and one coupling tube. These scalers cost less than conventional circuits using neon indicators. Besides being simpler, less critical of adjustment and more reliable, they are more economical in power consumption and require less space.

The fastest Ericsson Dekatron tube[1] is the GC10/D which will count up to 20 kc. Another model, the GC10/B, will count reliably up to 2 kc.

Operating Principle

The counter tubes operate on the principle that the ionization of the gas around the cathode of a gas-discharge tube will lower the striking potential to an adjacent cathode.

The counter tube has a central anode connected through a load resistor to B+, with ten counter cathodes arranged symmetrically around it as in Fig. 1 and connected independently to ground. Between counter cathodes are two guide electrodes, $1G_1$ and $2G_1$. Since the ten cathodes have similar characteristics, the burning potential to a glowing cathode will be lower than the striking potential to any other cathode.

Because of the partially ionized gas in the region, the striking potential from the anode to the two

Tube Applications

Millisecond timer, batching counter and oscilloscope time marker use polycathode counter tubes in low-cost, dependable circuits. The basic decade scaler units used in these instruments are capable of counting at rates up to 20,000 per second

cathodes adjacent to the glowing one will be less than to the more distant ones. In Fig. 1, if the glow is on K_1 and the 1G rail is negative relative to ground by an amount greater than the burning-striking differential of 1G_1, the glow will move to 1G_1 since it has the smallest burning-striking differential because of the glow on K_1. While 1G is negative, the tube current will rise, causing the anode potential to fall by an amount approximately equal to this negative swing. This extinguishes the glow on K_1. If the

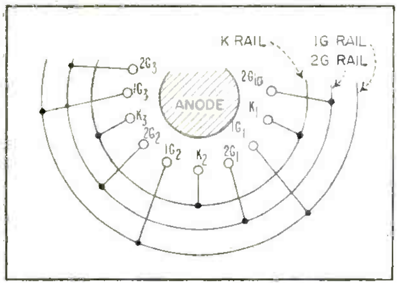


FIG. 1—Arrangement of cathodes around anode of counter tube. Guide cathodes 2G and 1G are used to transfer glow in proper direction from counting cathodes K_1 and K_2

driving potential to the 1G rail is removed, the glow will remain on 1G_1 since the striking potential to any other cathode must be greater than the burning potential to 1G_1. Similar manipulation of the 2G rail and the K rail will put the glow on K_2.

In practice it is not necessary to manipulate all three rails. The K-cathodes are kept at ground potential and the guide electrodes are biased relative to ground, so when there is no signal the glow is stable only on one of the K-rail cathodes.

Basic Counter-Unit

In the basic counter unit a pulse shaper in the form of a trigger circuit is used to supply the counter tube with a standard negative signal having uniform amplitude and good edges.

With this method of operation, bias rails for the guides can be eliminated, providing the coupling time constant is reduced so that when 1G draws current, the self-bias produced on the coupling capacitor extinguishes the glow on the guides after the integrating capacitor has been charged through 2G. Bias for the output cathode can also be dispensed with if the resistance in the guide circuits is kept high enough to prevent guide current from lowering the output current to a point where insufficient output is available to drive the next stage. This presents little difficulty since resistances of 100 to 200K can be used in the guide returns, and 10K is the minimum output-cathode load resistor needed to drive the coupling trigger circuit.

The trigger circuit is a variation of the Schmitt circuit, modified to operate from positive signals and give good negative signals. This circuit is straightforward, designed to operate from a minimum input of 5 volts positive and give a uniform output of 100 volts and about 0.3-millisecond duration. Repetition rate is limited by grid-current paralysis of the coupling capacitor. For high repetition rates diode clamping can be used to eliminate paralysis.

Millisecond Timer

The driver and counter stage is designed as a unit to plug into a plug-panel, with the end of the tube showing through a front panel. A timer built up from these units is

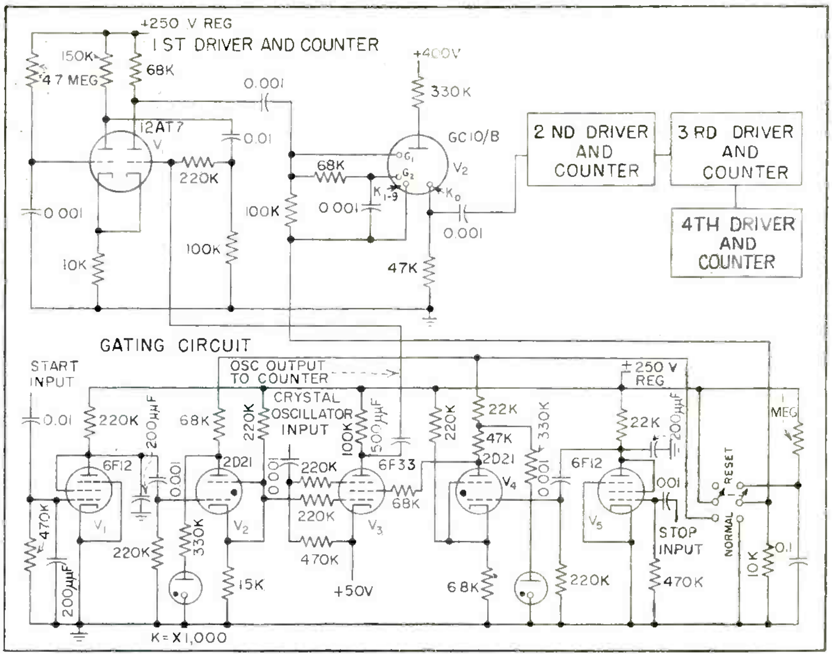


FIG. 2—Millisecond timer circuit. Thyratron gating circuit is used to connect crystal oscillator to counter units. Basic driver and counter unit, at top left, is repeated in other two counting stages

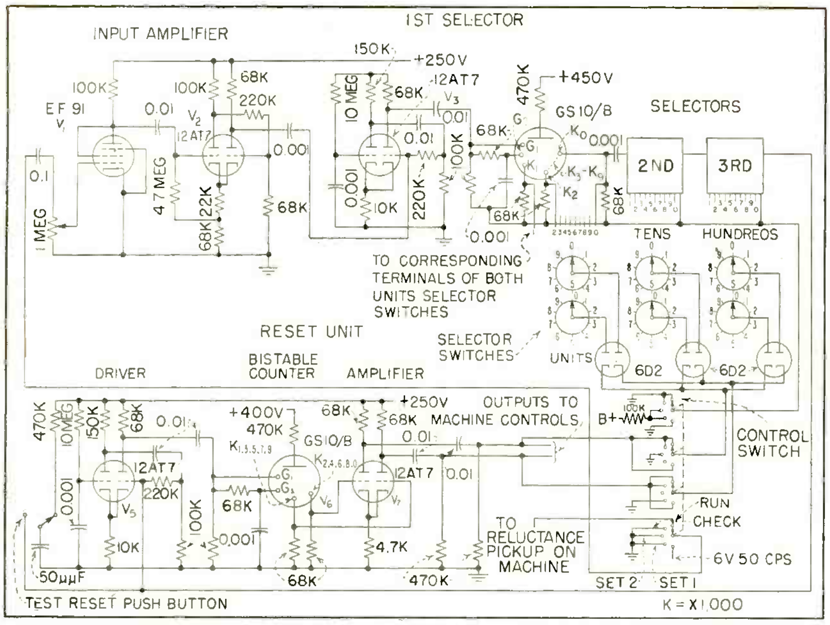


FIG. 3—Batching counter circuit. Counter tube V_6 is used as flip-flop switching unit. Concentric dials in each selector stage are used for setting up the two numbers for count

shown in Fig. 2 and the photo.

The circuit is straightforward, using a 1-kc crystal gated by a conventional gating circuit and triggered from lock-on 2D21 gas-tetrode trigger tubes.

The instrument is used for routine determination of delay times of electric-delay blasting caps and has also been adapted to operate as a Geiger scaler by substituting a suitable pulse shaper for the oscillator unit.

Batching Counter

Application of polycathode counter tubes has been made to the alternate batching of two three-digit numbers. The specification for the unit described here was that the machine should be engaged for a preselected number of revolutions and disengaged for a second preselected number.

To avoid the use of triple gates to indicate when counting of a three-digit number has been completed, the number is subtracted from 1,000 and this complementary number is set up on the counter tubes. The count is then completed to 1,000, with the output pulse from the last stage indicating the end of count. This pulse operates a bistable circuit in the reset unit which sets up the new number for the second counting cycle.

A number is set up by forcing the glow to the selected cathode with a 100-volt negative pulse applied to that cathode through a ten-position selector switch. A separate switch is used for setting up each of the two numbers. The two switches for each counter are mounted concentrically beneath the visible end of the counter tube. When the numbers are being set up, the glow moves to the cathode corresponding to the position of the switch to give a visual indication of the number selected.

The input amplifier stage of the batcher, shown in Fig. 3, amplifies and shapes the signal from a reluctance pick-up attached to a moving member of the machine being controlled. The output is differentiated and the positive pulse used to drive V_3 of the first selector unit.

Selector Units

Three selector units are connected in series. Tube V_3 is a driver stage like that used in the millisecond timer and V_4 is a GS10/B counter tube. Each cathode of the counter tube has its own resistor and is also connected to the appropriate position on each of the two concentric selector switches. These switches, set to the preselected numbers, receive the resetting pulse through blocking diodes as shown.

Reset Unit

The reset unit consists of driver V_5, bistable counter V_6, and reset-pulse amplifier V_7. The unit is fed from the output of the third counter.

Bistable counter V_6 is a counter-tube with alternate cathodes joined. As the glow moves from cathode to cathode the tube acts as a flip-flop, providing positive signals alternately to the two grids of dual-triode amplifier V_7. These amplified signals are a-c coupled to the counter units via stopping-diodes 6D2 and the selector switches. The diodes only pass the negative resetting pulses and prevent feedback in the resetting chain when the two numbers have a common digit in the same position.

Each position of the flip-flop corresponds to one position of the two-position control coupling to the machine. On the completion of the preset number of revolutions the

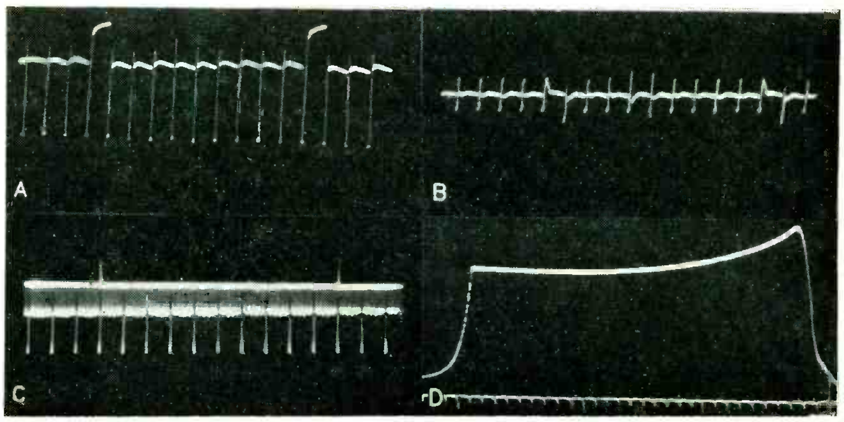


FIG. 4—Oscillograms of cro timing marks produced by counter-tube marker. Output from counter tube (A) is clipped and differentiated (B). With a superimposed one-second pulse (C) the wave is integrated to obtain output (D)

flip-flop operates and the machine is switched to its alternative position. At the same time, the second preset number is set up.

Control Switch

The control switch has five positions. In the RUN position the machine is coupled to the input and the batching action is as described.

In the CHECK position, repeated operation of the TEST-RESET pushbutton operates the flip-flop and resetting circuits by injecting pulses into V_5, causing the two preset numbers to appear alternately.

The SET positions, one for each number to be set, operate as described above. Rotation of the switch to the selected number is indicated by rotation of the glow to the cathode corresponding to the number set.

The 50-CPS position of the control switch allows the whole instrument to be tested, without running the controlled machine, by injecting a power-line signal to simulate pulses from the pickup unit.

The clutch controlling the batching operation of the machine is operated by signals from the plates of V_7.

Although V_6 has been coupled as a bistable stage to cover two required conditions of the machine to be controlled, the use of the 12-cathode GS12/B would allow multistable circuits to cover 2, 3, 4, 6 or more different conditions.

CRO Time Marker

A further application of counter tubes utilizes the waveform appearing at the anode to provide timing marks on oscilloscope traces, as shown in Fig. 4. In the circuit of Fig. 5, the output of a 1-kc crystal oscillator is stepped down to 100 cps by the first counter stage. This output is used to drive the second counter stage through an amplifying and inverting triode.

The output from the anode of the second counter is shown in Fig. 4A. The large positive square pulses correspond to the tenth counts and the thickening of the trailing edges of the other pulses correspond to the movement of the glow from a cathode to the following guide electrodes.

By cutting off the negative part of the pulses just above where this thickening occurs, the effect can be eliminated. This clipping is carried out by diode V_7, bias being obtained through a 20K potentiometer. When this waveform is differentiated by the *R-C* circuit in the output of V_7, it appears as in Fig. 4B. The tenth pulse corresponds to the trailing edge of the large positive pulse of Fig. 4A, and is consequently larger than the other nine, the relative sizes being dependent on the bias setting of the 20K potentiometer.

To provide a straight base line from which measurements of displacement might be made, this output is passed through diode V_8 which has its anode biased positively. The diode cuts off the erratic base line of Fig. 4B and refers the pulses to a potential determined by the 330K and 5K divider.

The third counter unit is driven through triode V_{11} from the output cathode of the second counter. The output from this counter consists of a 100-millisecond positive square wave with a repetition rate of one per second. As this pulse is too long for the purpose of time marking, it is differentiated and the negative pulse from the trailing edge rejected by V_9. The 220K and 68K divider control the size of this positive pulse, so as to reject the small variations due to the intervening nine counts of the second counter.

This pulse, recurring at intervals of one second, is superimposed on the signal output from V_8 by feeding it to the common 150K load resistor. The resultant waveform is shown in Fig. 4C. This photograph was obtained by brightening the beam with the differential of this signal. Without brightening, the pulses are too sharp to register without over-exposing the base line. For practical purposes this is not convenient. Instead, the output is integrated; the result being as shown in Fig. 4D. This was obtained by using a drum camera having a time sweep of approximately 6 inches per second, and using a steady beam brightness.

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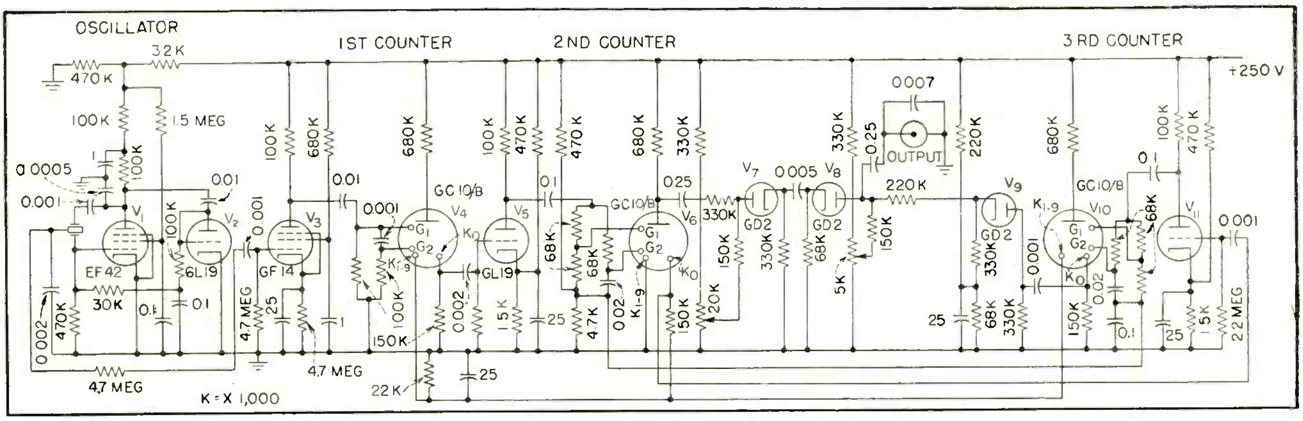

FIG. 5—Time marker circuit for cathode-ray oscilloscope. Crystal-controlled oscillator supplies 1,000-cycle signal to three counter stages and variations of voltage at anode of counter tube are used to indicate tenth and hundredth second marks

Antenna-Matching

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FREQUENTLY it is necessary to estimate the transfer efficiencies of networks used to match arbitrary load impedances to feed cables or transmission lines.

Such a problem arises when making a choice between two possible antennas for use in a particular application.

The approach to be described is to calculate the matching efficiency for all possible antenna impedances based upon some idealized network capable of matching all impedances likely to be encountered.

Equivalent Circuits

The basic circuits of Fig. 1 permit an infinite variety of impedance transformations. Each particular combination yields a different value of efficiency. If the combination yielding the highest efficiency is chosen, the circuits reduce to the simple L-type networks shown in Fig. 2. These circuits are the idealized networks on which the matching efficiency will be based. The region of the impedance plane that each of the circuits matches is also shown.

Calculations

Using the circuits of Fig. 2 and assigning specific loss values to the elements, it is possible to calculate matching efficiency for every value of R and X and to present the information as contours of constant efficiency in the R-X plane. Nor-

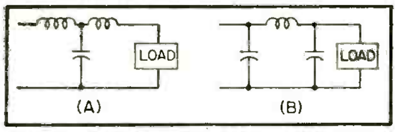

FIG. 1—Basic ladder-type matching networks

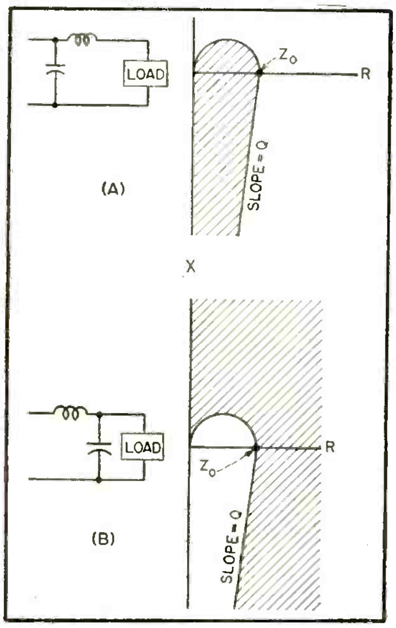

FIG. 2—Two L-type matching networks. Shaded areas show region in impedance plane matched by network

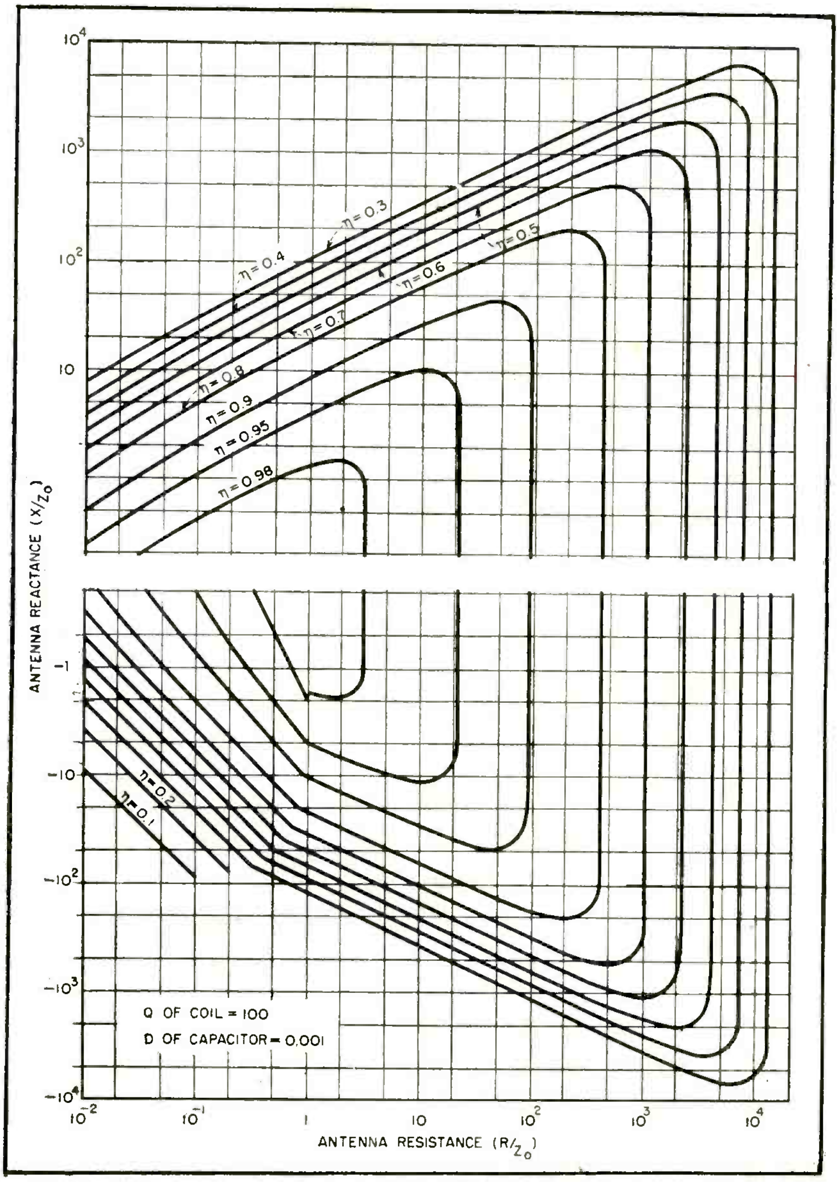

FIG. 3—Antenna-matching-efficiency chart for coil Q equal to 100

Network Efficiency

Charts used to estimate transfer efficiencies of networks matching load impedances to transmission lines and feed cables. Typical use is in choosing between two possible types of liaison antennas for installation in a particular aircraft

malized antenna reactance $X = X_a/Z_o$ as a function of normalized antenna resistance $R = R_a/Z_o$ for a certain matching efficiency is given by the expression

$$X = -[QR(1-\eta)/\eta] \pm \sqrt{R/\eta - (R^2/\eta^2)} \quad (1)$$

and

$$X = \rho R/(\rho^2 - \eta\alpha^2 R)\left(1 \pm \sqrt{\eta\alpha^2 R\,[1+(1-\eta\alpha^2 R)/\rho^2]}\right) \quad (2)$$

where Q = Q of the network inductors, D = dissipation factor of the network capacitor, η = efficiency, $\rho = D\eta/(1-\eta)$ and $\alpha = [(1/Q) + D]/(1-\eta)$.

Equation 1 applies to the region in the impedance plane matched by the circuit of Fig. 2A, while Eq. 2 applies to the region matched by the circuit of Fig. 2B. For the circuit of Fig. 2A the loss in the capacitor is almost always negligible compared to the loss in the inductor. Thus D does not appear in Eq. 1. For the circuit of Fig. 2B it is not possible to ignore the loss in the capacitor.

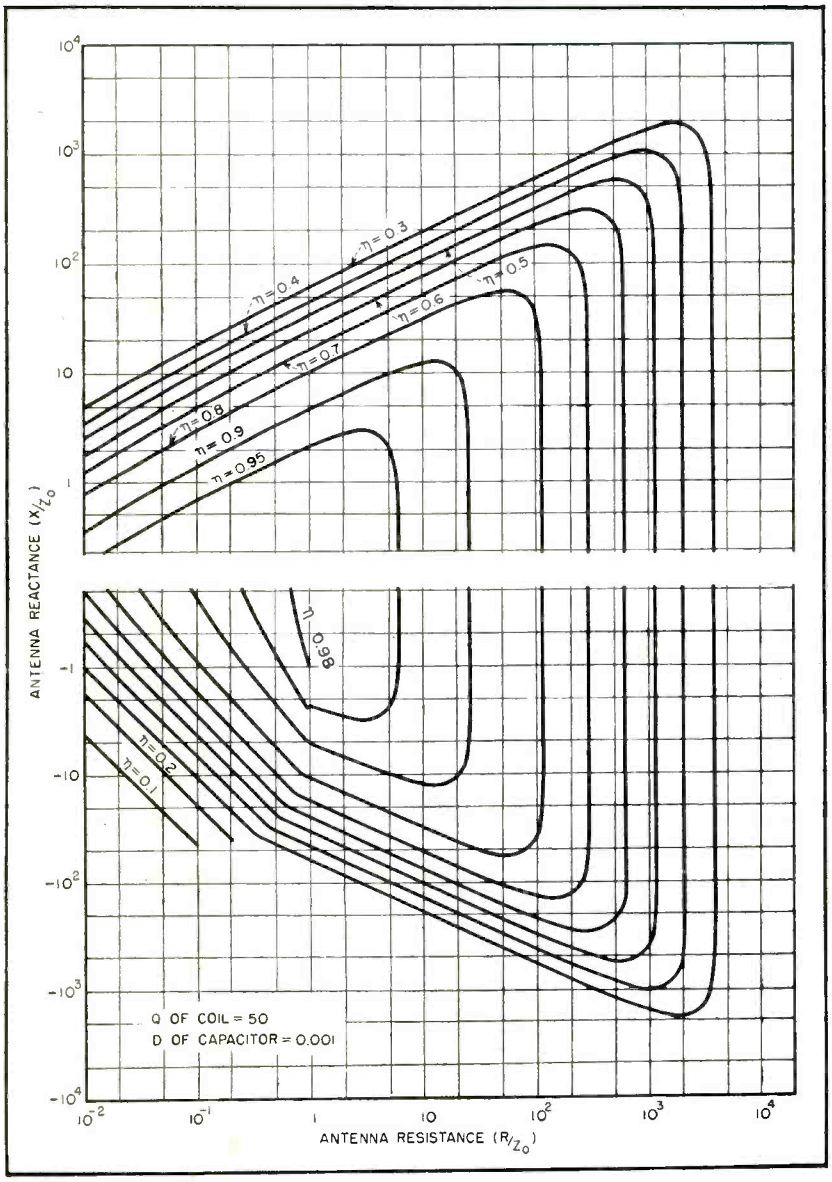

FIG. 4—Antenna-matching-efficiency chart for coil Q equal to 50

Efficiency Charts

The charts show contours of constant efficiency in the R-X plane. Logarithmic impedance scales are used. The slight discontinuities that appear in two of the higher-efficiency contours result from an approximation made in deriving Eq. 2. Maximum error occurs at the boundary between the domain of Eq. 1 and that of Eq. 2. This error is not large, however.

Use of Charts

To use the chart, the impedance to be matched is first normalized with respect to the feed-cable impedance. The normalized impedance is then found on the chart and the efficiency of match determined by interpolation between the two contours enclosing the point. It has been found that for a coil Q equal to 100 the chart gives a good approximation for frequencies below 15 mc, while for a coil Q equal to 50 the chart gives a better approximation at frequencies between 15 and 24 megacycles.

Bridges Measure

Junction transistors operating at moderately high frequencies possess many of the complexities of vacuum tubes operating at very high frequencies. Special bridge circuits measure admittance parameters to specify transistor small-signal operation

SMALL-SIGNAL operation of a transistor is accurately specified by means of four complex parameters having both real and reactive components. Eight quantities must be measured, and since these quantities in a fixed environment are potentially a function of operating voltage, current and frequency, the measurement equipment must have considerable flexibility.

The bridge equipments to be described operate in the frequency range of approximately one kilocycle to one megacycle although by suitable modifications the range can be extended. These bridges use a multifrequency test signal such as a square-wave, pulse, or swept-frequency test signal. Multielement equivalent circuit representations can thus be obtained which are valid over a wide range of frequencies so that an ordinarily complex measurement task is considerably simplified.

Small-Signal Operation

The small-signal, and therefore linear, operation of a transistor is accurately determined by means of four independent parameters. These are generally chosen as the coefficients in equations associated with the input and output terminals. These terminal equations may be written in either a loop or nodal form; the resulting independent parameters are impedances or admittances respectively.

The bridges described here have been designed to measure the admittance parameters. This choice of admittance rather than impedance parameters was dictated by several factors;[1] the most important of these factors is the greater ease with which the admittance parameters can be measured as compared with the impedance parameters.

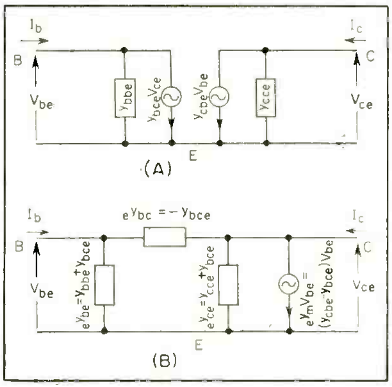

FIG. 1—Two-generator (A) and one-generator (B) equivalent transistor circuits

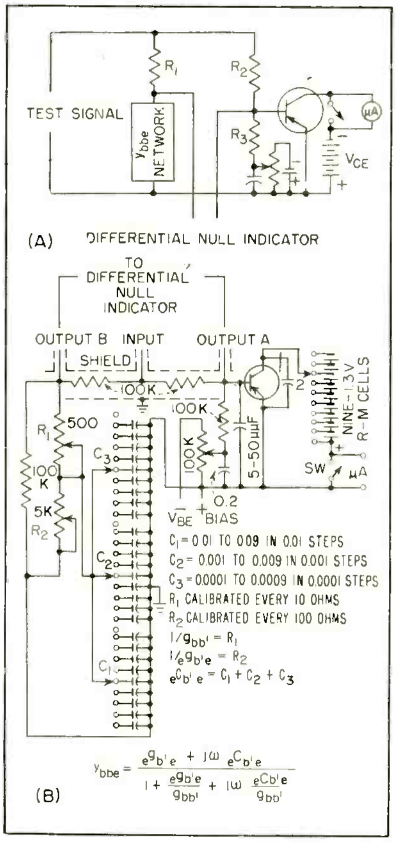

FIG. 2—Block form (A) and detailed circuit (B) of y_{bbe} admittance bridge

Since many circuit applications for a junction transistor will use a common-emitter connection (emitter element common to both input and output circuits), this paper will consider the measurement of the admittance parameters associated with a common-emitter circuit. The appropriate nodal or loop parameters associated with other circuits can be obtained by suitable transformations.[2]

The four admittance parameters are indicated in Eq. 1 and 2.[3] These equations are Kirchhoff's nodal equations for the base and collector respectively when the a-c base-to-emitter voltage and a-c collector-to-emitter voltage are V_{be} and V_{ce} respectively and the a-c base current and a-c collector current are I_b and I_c respectively. The admittance parameters are further defined by means of Eq. 3, 4, 5 and 6, which equations also serve as a basis for the admittance measurements to be described

$$I_b = y_{bbe} V_{be} + y_{bce} V_{ce} \quad (1)$$

$$I_c = y_{cbe} V_{be} + y_{cce} V_{ce} \quad (2)$$

$y_{bbe} = g_{bbe} + jb_{bbe}$
= input admittance with output short-circuited (3)

$y_{bce} = g_{bce} + jb_{bce}$
= reverse transfer (feedback) admittance with input short-circuited (4)

$y_{cbe} = g_{cbe} + jb_{cbe}$
= forward transfer admittance with output short-circuited. (5)

$y_{cce} = g_{cce} + jb_{cce}$
= output admittance with input short-circuited. (6)

The nodal equations 1 and 2 can be depicted most directly by means of the two-generator equivalent

Transistor Parameters

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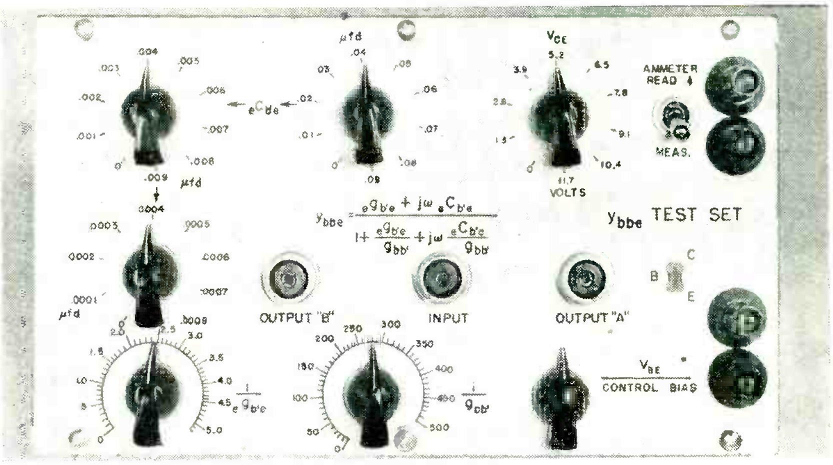
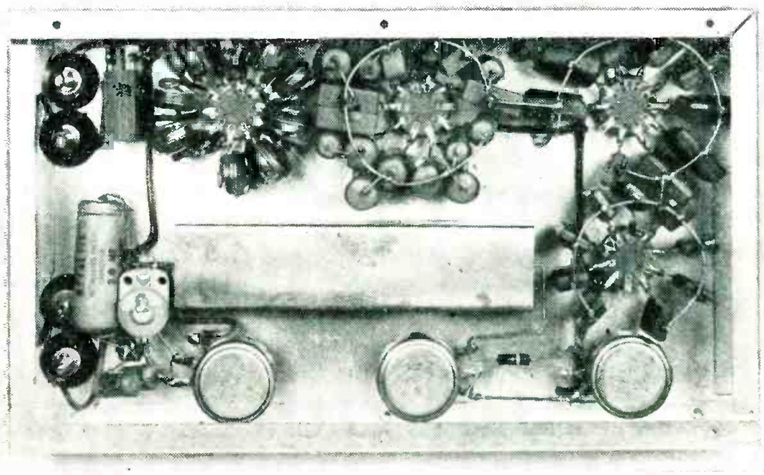


Photograph of y_{bbe} bridge panel is typical of other test sets described



Under chassis view shows arrangement of components and generous use of shielding

circuit shown in Fig. 1A. The more familiar one-generator π equivalent circuit is shown in Fig. 1B.

The small-signal circuit operation of a transistor can be completely determined after the admittance parameters have been measured.[2]

If the measurement frequency is low enough, the admittance parameters are essentially conductance parameters. These conductance parameters are very useful throughout the audio frequencies and can be measured on a General Radio Type 561 vacuum-tube bridge. This bridge is useful because g_{cbe}, $1/g_{cce}$ and μ_{cb} for a transistor are the same as g_m, r_p and μ for a vacuum tube and g_{bce}, $1/g_{bbe}$ and μ_{bc} are the same quantities measured on the grid side of the vacuum tube. The bridge balances out reactive effects.

The vacuum-tube bridge can be used to measure d-c conductance coefficients[3] of junction transistors. The method of measurement is the same as for small-signal parameters, but the d-c terminal voltages and currents are zero. The bridge can also be used to measure open-circuited self-impedance loop parameters by using a current bias rather than the usual voltage bias.

Since the bridge balances out the reactive component, measurement of either reactive or susceptive parameters at 1,000 cps can be made. The simplest method of doing this is by substitution. First, balance the bridge with the transistor; second, remove the transistor and connect an adjustable passive network between appropriate terminals of the bridge; third, rebalance the bridge by adjustment of the passive network. The value of the passive network is the desired result.

To determine performance of a transistor as a function of frequency, both conductance and susceptance components of the admittance parameters must be known. These parameters can be measured using the four admittance bridges to be described, at any frequency desired from approximately 1 kc to 1 mc. These admittance bridges are for measuring *pnp* junction transistors. It is only necessary to reverse the various voltage polarities to measure *npn* junction transistors.

The y_{bbe} admittance bridge is shown in block form in Fig. 2A. A test signal of suitable amplitude and frequency is connected to a bridge arrangement of R_1-y_{bbe} network and R_2-transistor. It is usually convenient to make $R_1 = R_2$ in which case the bridge will be balanced when the y_{bbe} network has the same admittance as is present between the transistor base and emitter.

The presence of R_3 can be compensated for by connecting an identical resistor across the y_{bbe} network. A detailed circuit of the y_{bbe} test set is shown in Fig. 2B.

Battery Operation

Consider first the d-c operation of the transistor. The collector-to-emitter voltage is supplied by means of a 10-position selector switch and nine R-M cells. This arrangement permits nominal 1.3-volt steps in V_{CE}. The base-to-emitter voltage is established with

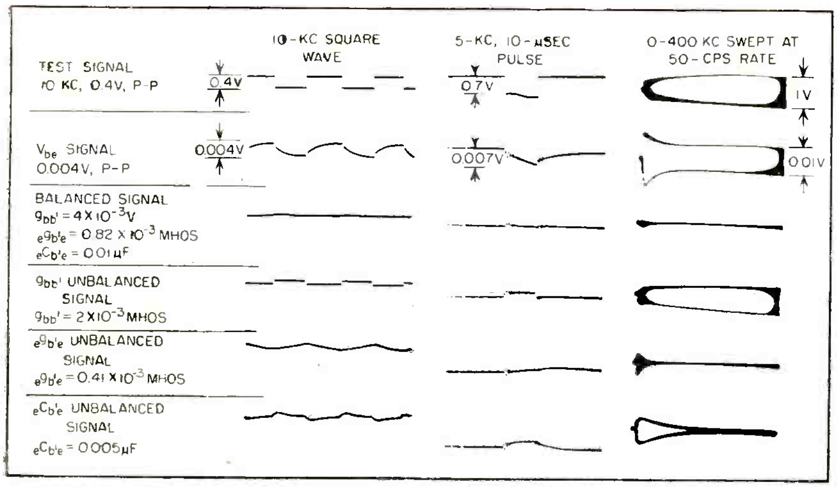


FIG. 3—Operation of y_{bbe} test set using square-wave, pulse and swept-frequency test signals

the aid of a potentiometer and an external V_{BB} bias battery.

Normally, only two elements are required in the y_{bbe} network for point-by-point measurements. Experience has indicated that if $_ey_{bc}$ is small, to a fairly good approximation y_{bbe} can be represented as a pure conductor $g_{bb'}$, associated with base lead conductance in series with a parallel conductor, $_eg_{b'e}$, and capacitor $_eC_{b'e}$. Here, b' denotes an internal base point connected to the external base b through an ohmic resistor $1/g_{bb'}$.

This network arrangement of y_{bbe} is very useful since it yields directly elements of some physical importance and elements that are to a good approximation independent of frequency. However, since there are three elements to be balanced, the correct balance can be obtained only by multifrequency testing. Multifrequency testing is achieved by using a square-wave, pulse, or a swept-frequency test signal that contains multiple frequencies. The bridge equipment and null indicator must be wide band in its frequency response. The operation of the y_{bbe} test set for the three types of multifrequency test signals mentioned is indicated in Fig. 3.

The top tracing is the input test signal. The second tracing is the test signal applied to the transistor. The third tracing indicates the null (zero) signal when all three elements of the y_{bbe} network are properly adjusted.

The fourth tracing indicates the null signal when $g_{bb'}$ is unbalanced. The fifth tracing indicates the null signal when $_eg_{b'e}$ is unbalanced. The sixth tracing indicates the null signal when $_eC_{b'e}$ is unbalanced. From the shape of the null signal the cause of the unbalance is ascertainable so that a complete balance can be easily and rapidly obtained.

A multifrequency test signal has considerable merit over a single-frequency test signal even when only a resistive and reactive element are to be balanced because the cumulative effect of small phase shifts of individual component frequencies provides a comparatively large net unbalanced null signal.

Output Admittance

The y_{cce} test set is similar to the y_{bbe} test set and is shown in block form in Fig. 4A. Assuming $R_1 = R_2$ when the bridge is balanced, the admittance of the y_{cce} network is equal to the y_{cce} admittance of the transistor shunted by R_3.

It is not possible to make R_3 large enough to be negligible. Accordingly R_3 is made as large as possible and then compensated for by connecting a resistor of equal value across the y_{cce} network. The detailed circuit arrangement for the y_{cce} test set is shown in Fig. 4B. A variable (0 to 300 volt) regulated power supply can be used to provide collector bias.

The arrangement of the nine 1.3-volt R-M cells together with the selector switch and pushbutton switch is essentially an infinite resistance voltmeter for setting V_{CE}. A vacuum-tube voltmeter may be used instead.

Transfer Admittance

The y_{cbe} test set is somewhat different from the preceding two tests since it measures transfer admittance rather than self admittance. The block diagram for the bridge arrangement of the y_{cbe} test set is shown in Fig. 5A. The operation of this bridge circuit[4] can be better understood by referring to Fig. 1A and Fig. 6A.

When the bridge is balanced, y_{cbe} is given by the value of the y_{cbe} network elements. Also, when the bridge is balanced, the collector is short-circuited to the emitter as is required for the measurement of y_{cbe}. A null balance can be obtained with the circuit of Fig. 5A only because of the phase reversal that takes place in the transistor.

Measurements of junction transistors have indicated that the y_{cbe} network can be constructed most simply by means of a conductor g in series with an inductor L. It is difficult to make a continuously variable inductor, and the inductors invariably have appreciable

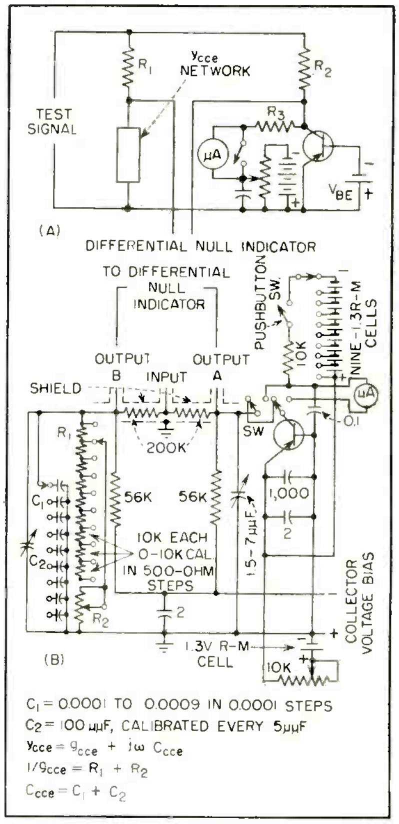


FIG. 4—Block form (A) and detailed circuit (B) of y_{cce} admittance bridge

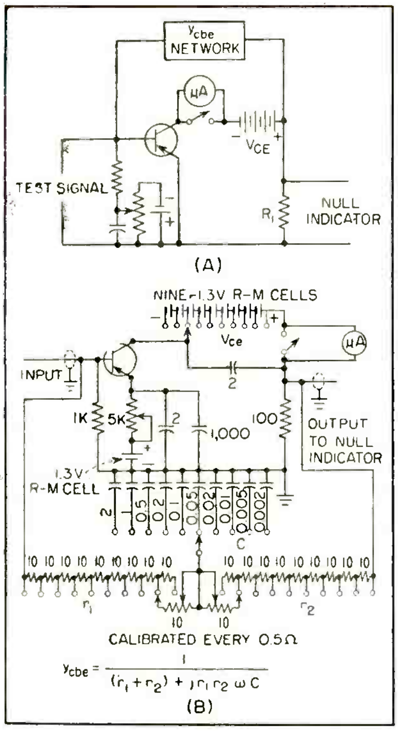


FIG. 5—Block form (A) and detailed circuit (B) of y_{cbe} admittance bridge

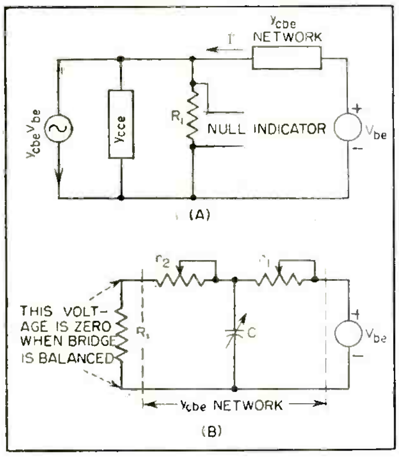


FIG. 6—Equivalent circuit of y_{cbe} bridge and arrangement of y_{cbe} network

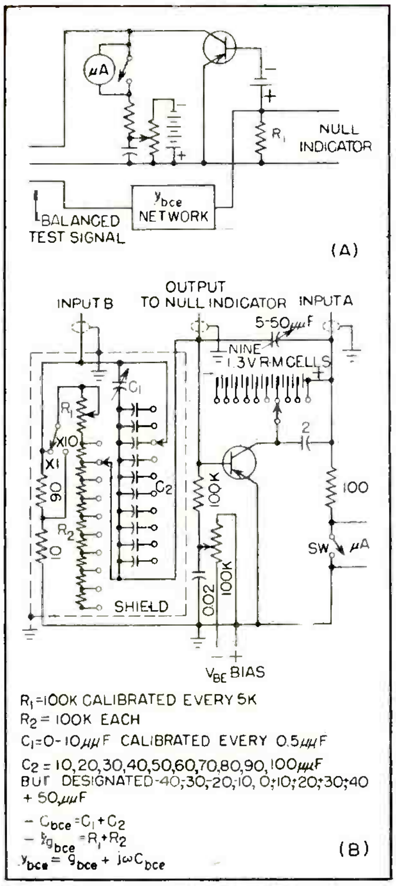


FIG. 7—Block form (A) and detailed circuit (B) of y_{bce} admittance bridge

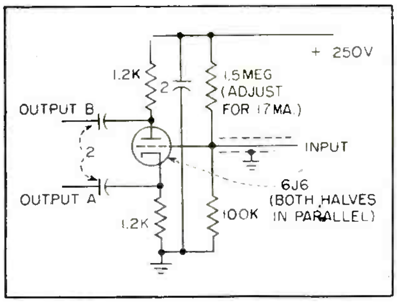


FIG. 8—Vacuum tube provides balanced signal from unbalanced source

resistance. To circumvent these difficulties, a y_{cbe} network of resistors and capacitors was devised as shown in Fig. 6B. Although the y_{cbe} network now contains three elements, single-frequency measurements are possible since r_1 and r_2 are not independent elements. However null adjustment is more difficult than with a two-element network.

The detailed circuit of the y_{cbe} test set using the y_{cbe} network of Fig. 6B is shown in Fig. 5B.

The operation of the y_{bce} test set shown in block form in Fig. 7A is similar to the operation of the y_{cbe} test set. The important difference is that there is no phase reversal associated with y_{bce}. Consequently, an accurately-balanced test signal is necessary to produce a null across R_1. The detailed circuit of the y_{bce} test set is shown in Fig. 7B.

A switch is used to multiply the $-1/g_{bce}$ values in the $-y_{bce}$ network by 10. This was done to accommodate the large range of values encountered in this parameter. Since $-C_{bce}$ does not vary over as large a range as $-1/g_{bce}$, the multiplier has been wired to be effective only for $-1/g_{bce}$.

The circuit used to provide a balanced signal from an unbalanced source is shown in Fig. 8. Although simple, its operation should be carefully checked to insure that the two outputs are accurately balanced at all frequencies used.

Associated Equipment

A suitable null indicator is required for the operation of the four admittance test sets. A wide-band untuned null indicator simplifies measurement work considerably. A Tektronix type 512 cathode-ray oscilloscope has been found generally suitable as either a balanced or unbalanced null indicator. The oscilloscope is normally operated with maximum gain. Somewhat greater gain may be desirable particularly for the y_{bbe} and y_{bce} test sets.

The network component values used in the four test sets were chosen to cover a range of typical transistor parameters. For measurements beyond the range provided, or for special transistors, it will be necessary to change the network component values. Another method of providing a larger range of values is to switch in different values of R_1 and R_2 in the y_{bbe} and y_{cce} test sets or to divide the test signal as was done in the y_{bce} test set. By careful design a large range of values may be measured.

The accuracy of a bridge is dependent to a considerable degree upon the extent and effectiveness of shielding. The shielding indicated should be considered as a minimum requirement.

The apparatus may be used for measuring point-contact transistors provided the point-contact transistor is short-circuit stable. The y_{bbe} and y_{cce} test sets may also be used for measurement of junction diodes in either the forward or reverse direction.

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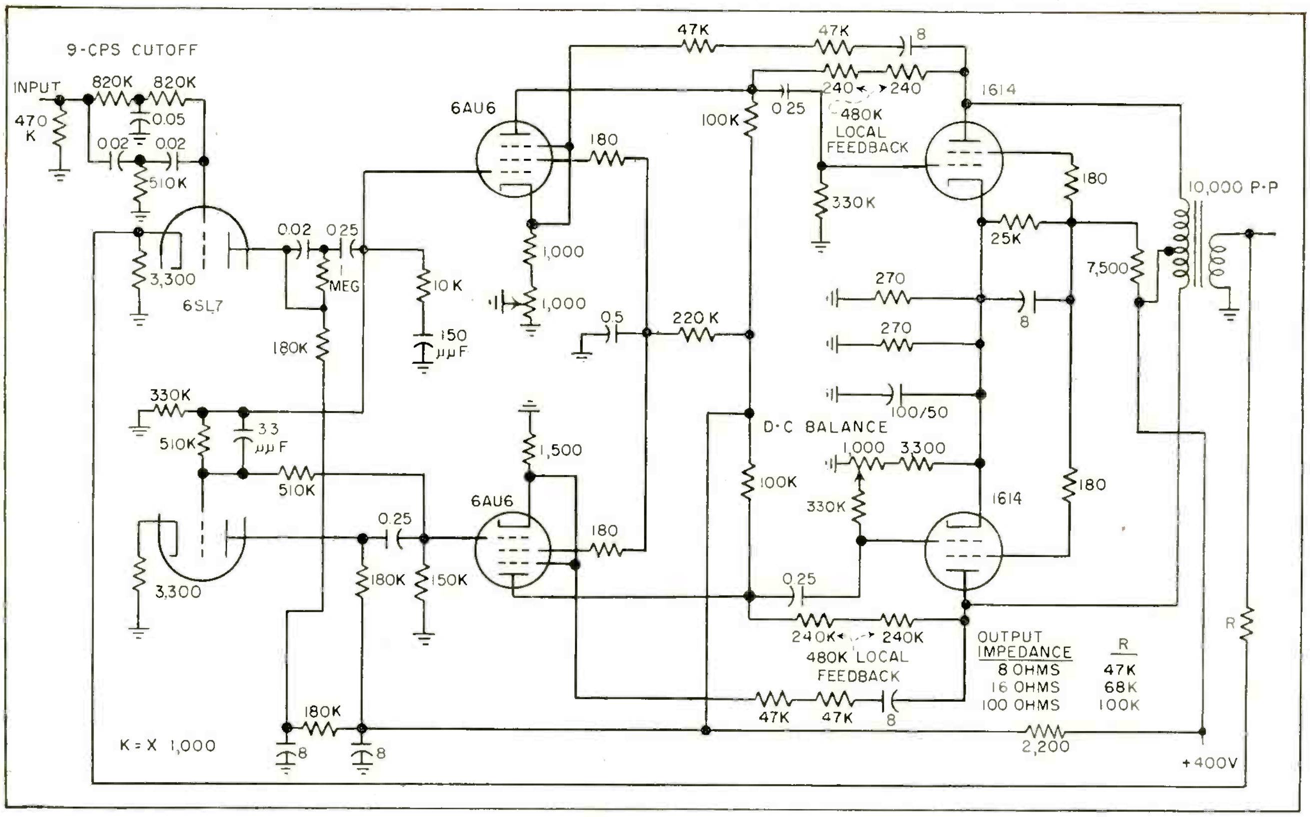

FIG. 1—Circuit of complete amplifier. Value of feedback resistor *R* depends on impedance of speaker used. Output tubes can be 1614, 6L6, 5881 or KT66

Multiple-Feedback

Plate-to-grid feedback in tetrode output stage of amplifier gives double the power output of triode Williamson circuit. Low distortion and high stability characteristics of triode stage are retained with reduced power supply requirements

IMPROVING the power output and stability of the Williamson amplifier circuit without increasing distortion and plate-power consumption involves special design considerations.

Obtaining 15 to 20 watts output without using four output tubes and a large power supply, and without operating the power tubes beyond ratings, rules out a triode output stage. A tetrode output stage, besides requiring considerably more feedback to equal the distortion performance of a triode stage, raises a stability problem that has not been discussed before. The voltage gain of a tetrode output stage is proportional to its load impedance, and this load impedance is highly variable with frequency in the case of a speaker load.

Since the voltage gain of the output stage is part of the gain of the overall feedback loop (whether taken from the primary or secondary of the output transformer), stabilization of the feedback loop is made more difficult. It is therefore necessary to obtain a low output impedance in the output stage itself, before overall feedback is applied, to make the gain of this stage relatively independent of loading. This may be done in only three ways: by using triodes, with their numerous disadvantages; by loading the stage with resistance in addition to the speaker, and thus wasting a good part of the increased power output obtained from tetrodes; and finally by using local feedback in the amplifier output stage.

An example of 100-percent local feedback is found in the cathode-follower output stage. An extremely low output impedance is realized in this way, but the driving requirements are severe, and high plate-supply voltages are required in the

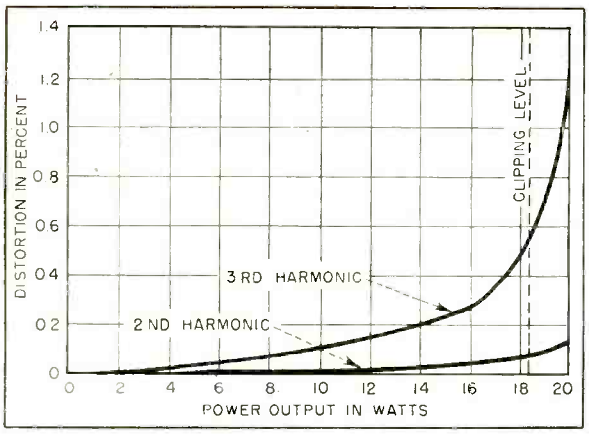

FIG. 2—Distortion compared to power output at 1,000 cps. Curve is substantially the same at 50 cps

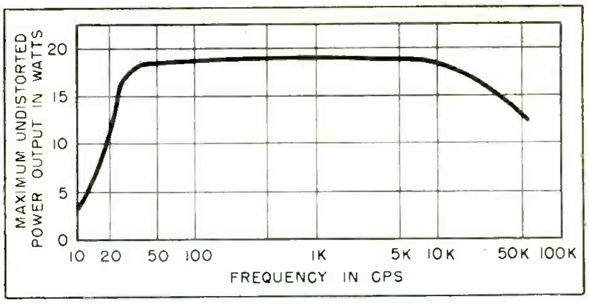

FIG. 3—Maximum undistorted power output over frequency range of amplifiers

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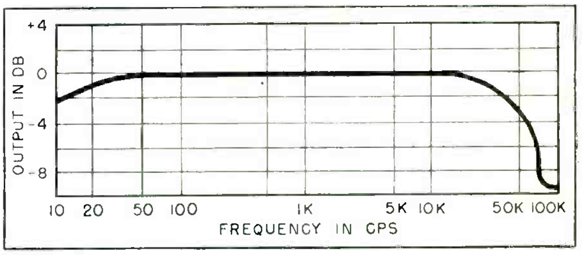

FIG. 4—Variation of response with frequency at 1-watt output with 8-ohm load

Audio Amplifier

drivers. A more practical device is plate-grid feedback, since any degree of feedback may be selected.

Local feedback may also be obtained by driving the screens with a fraction of output voltage, but since the relationship between control grid and screen grid is not linear, it is preferable to feed back to the control grids[1].

Local Feedback

In this case the 480,000-ohm local-feedback resistors, together with the 100,000-ohm 6AU6 plate loads, provide about 12 db of local feedback, and make the output impedance of the power stage in itself about 1,200 ohms at each plate. This figure compares favorably with the 1,700-ohm plate resistance of the 6L6 as a triode.

This driver and power stage combination is similar to the triode equivalent in both output impedance and distortion, but power output is doubled and the B+ requirement is somewhat reduced. It only remains to add a phase inverter, a gain stage and the overall feedback.

The phase inverter used is of the paraphase or anode follower type, and is difficult to surpass. For high frequency applications this circuit has given excellent balance to 1 mc.

The other half of the 6SL7 functions as a voltage amplifier. Overall feedback, as seen from Fig. 1, is split into push-pull feedback from the output-transformer primary, and a single-ended feedback loop from the secondary which encloses the first loop. Each of these loops contributes about 12 db, making the total feedback around the output stage 36 db, including local feedback. This procedure avoids using a very large amount of push-pull feedback, requiring critical control of balance[2], and also avoids using 20 db or more of feedback from the secondary with the questionable stability that often results.

With the present design, including the 10,000 ohm — 150 $\mu\mu$f and 1 meg — 0.02 μf phase-control networks, complete stability is obtained on open circuit, speaker load, or with any degree of capacitive loading. There is no tendency toward oscillation under conditions of heavy overload and recovery from such overload is immediate. The resultant freedom from instability under all dynamic conditions is of far greater practical interest than a perfectly flat frequency response beyond the audible range.

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Radiation Monitor

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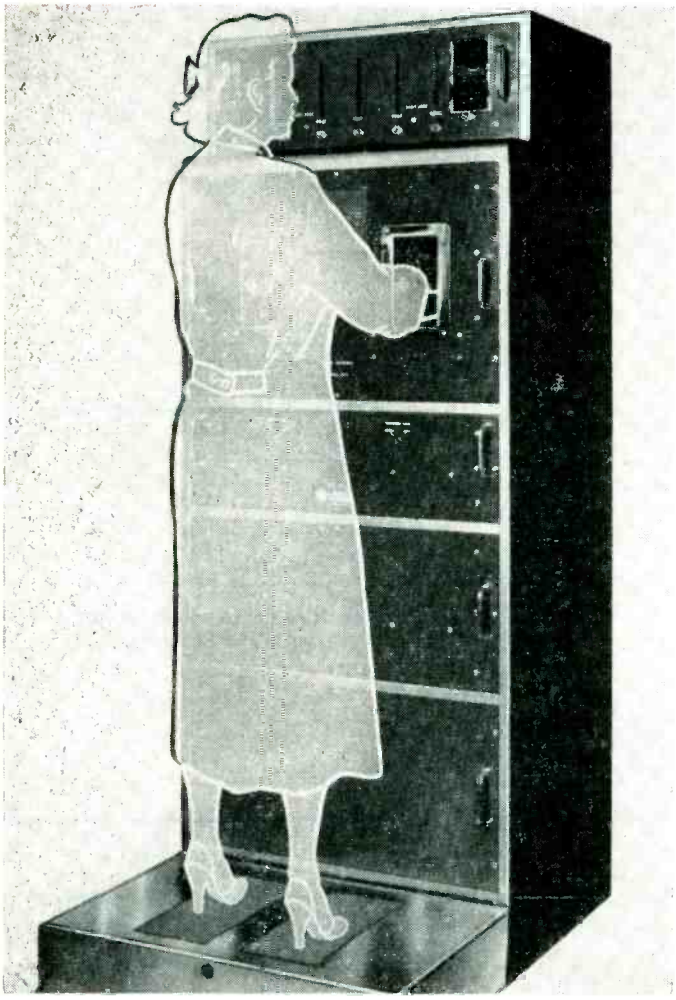

Monitor checks contamination on soles of feet, backs and palms of hands. Operation is simple and fail safe

SAFETY OF PERSONNEL in radioisotope laboratories is enhanced by a completely automatic radiation monitor that measures, evaluates and indicates the amount of beta and gamma radioactive contamination on the worker's hand surfaces and the soles of his shoes. Called the hand-and-foot monitor, the device combines laboratory precision with the operational simplicity of a pinball machine.

The instrument is normally in ready condition and an illuminated green legend says READY FOR USE. Meanwhile the counting channels are pulsed from an internal signal generator and the contamination indicators cycle continuously to indicate that the counting channels are operating properly.

Operation

The worker stands on the platform with feet on paper-covered grills. Radiation detectors for the shoe soles are under the grills. When the hands are inserted in the counting chambers, where another set of radiation detectors is located, switches are operated to start automatic operation.

The indicators are reset and the legend changes to a white COUNTER-IN-OPERATION sign. If either or both hands are withdrawn before the predetermined monitoring time has elapsed, the indication changes to a yellow CHECK-INCOMPLETE, RESET-AND-REPEAT warning. At the end of the monitoring time an illuminated legend either reads CHECK OK or DECONTAMINATION REQUIRED.

Each counting channel provides a single illuminated number proportional to the amount of radioactivity measured by that channel. If decontamination is required, an additional set of indicators shows in which channel or channels the tolerance has been exceeded.

System

Figure 1 is a block diagram of the instrument. It consists of five detecting and counting channels, a regulated low-voltage power supply for the electronic circuits, a regulated high-voltage power supply for the radiation detectors and an automatic control circuit that programs and times the operations.

The trigger circuits, binary scaling stage and decade scaling stages are all plug-in units. This simplifies servicing and permits easy change of the scaling factor of any or all channels. To convert a unit from beta and gamma monitoring to alpha monitoring it is only necessary to replace the detectors and use appropriate scaling factors in the counting channels.

G-M Counters

The radiation detectors are thin-wall (30 to 40 mg per square cen-

Protects Lab Workers

Automatic fail-safe radiation counter measures radioactive contamination on workers' hands and feet. Changeable scaling factor permits conversion from beta and gamma to alpha monitoring. Plug-in units facilitate rapid servicing

timeter), stainless-steel, halogen-quenched Geiger-Mueller counters. This counter combines long life, ruggedness and high output with good sensitivity. The inorganic, halogen-quenching vapor does not gradually decompose with use as do organic vapors. Guaranteed minimum life of the counter is greater than 10^{10} counts. This allows the counters to be left connected to their rated operating voltages with no worry about their life. The walls of the counter are thin enough to allow beta particles with energies as low as 200,000 electron volts to be detected. The counters develop pulses of approximately 18 volts.

In the hand-monitoring section two counters are connected in parallel in each channel and the output is fed through RG-11/U coaxial cable to the trigger circuits on the scaler chassis. In the foot monitoring platform eight counters are connected in parallel to a single output. The counters are shielded individually by a minimum of ½ in. of lead around back and sides to reduce background from stray and natural radiation.

Trigger Pairs

The trigger circuit shown in Fig. 2 is built as a plug-in unit and is complete except for the grid-bias potentiometer on the scaler chassis. The diode in parallel with the nonconducting tube's grid resistor sharpens the pulse and helps restore the grid quickly. Thus, even if the bias of the first section is adjusted for high sensitivity, long pulses will not cause the circuit to double pulse.

The 6BK7 dual triode gives the large output pulses required to drive the scaling stages while retaining good resolution. The input sensitivity can be set between 0.2 and 2 volts for negative pulses. However, the permissible range of input pulse is better than 0.2 to 20 volts. Output is a 100-volt negative-going pulse with a 90-percent duration of 2 μsec with the circuit

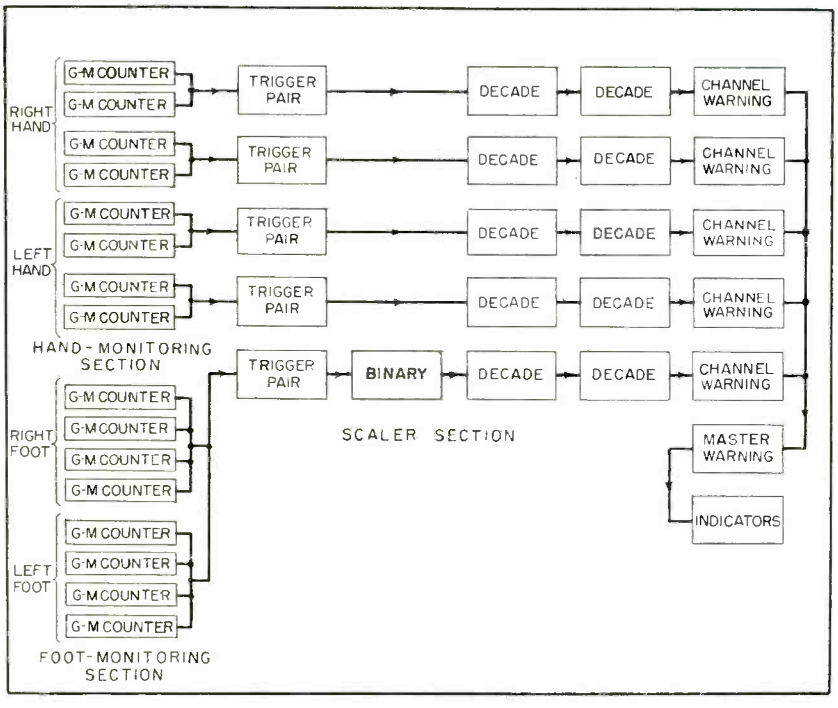

FIG. 1—Complete monitor comprises five detecting and monitoring channels employing 16 G-M counters, single-channel and overall warning indicators

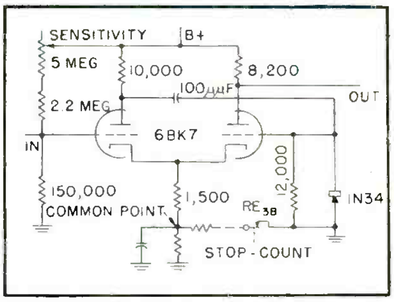

FIG. 2—Trigger circuit includes crystal diode to sharpen pulse

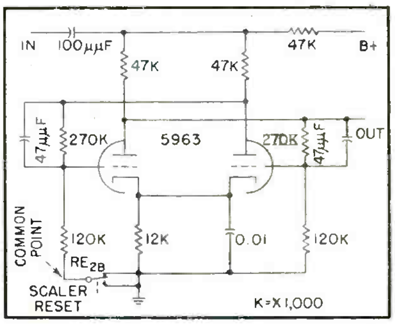

FIG. 3—Scaling stage uses computer-type dual triode to enhance reliability

constants shown. Output pulses of better than 150 volts can easily be obtained.

Scalers

The binary scaling stage shown in Fig. 3 is conventional. The 5963 dual triode is used for high reliability although any stock 12AU7 will work satisfactorily. The 5963 is a computer-type tube in which the emissions of the two sections are matched and the cathode specially designed to avoid the sleeping sickness that occurs when tubes are cut off for long periods.

The decade scaling stages are of the scale-of-sixteen-minus-six variety. The binary stages making up the scale of sixteen are the same as those shown in Fig. 3. This circuit also uses 5963 dual triodes. However tests have been made using 12AU7's too mismatched for use even in ring-type scalers. The scaling action was perfect over a B+ range of over 80 volts. Figure 4 shows the feedback loops for adding six pulses per cycle to provide decade operation with a scale of sixteen counter.

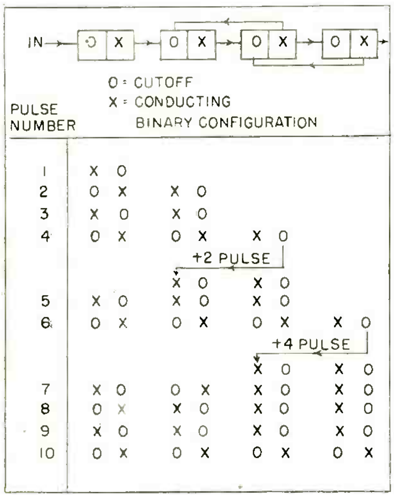

FIG. 4—Feedback loops produce decade counting by adding six counts per cycle to scale-of-sixteen binary scaler

Warning Circuits

Each scaling channel terminates in a thyratron circuit operated from the carry pulse of the last decade. The five thyratrons operate from a common plate load and a signal from any or all of the circuits is fed to a common thyratron circuit. The individual circuits provide single-channel indications while the common circuit operates relay RE_5 that changes the final indication from CHECK OK to DECONTAMINATION REQUIRED. Figure 5 shows these circuits.

Thyratrons are preferred for this application because once a thyratron has fired it will continue to conduct and does not depend on any critical design as would be encountered in special flip-flops; also, if there is the slightest possibility of spurious operation, the circuit will fail safe. It is better to say that decontamination is necessary than take the chance of missing a person with radioactive material on his body.

Control Section

The control circuit is shown in Fig. 6. There are actually two hand switches, one for each hand.

With the power turned on, the READY-FOR-USE lamp is lit and the scaler-reset line is closed so the decades can scale. The trigger-circuit stop-count line is grounded so they can operate and the stop-test line is ungrounded so pulses from the test signal generator will drive the trigger circuits. The thyratron-reset line is held open so the decontaminate-signal circuits will not function.

When hand switch S_1 is operated, a circuit is completed to the COUNTER-IN-OPERATION light and counting timer TI_1 which determines the monitoring time. Another circuit is completed to RE_1, which then operates and locks.

Relay RE_1 turns off the READY-FOR-USE light and prepares a circuit to be used if the hands are removed too soon. The stop-test line is now grounded through RE_{1d} to shunt out the pulses from the test signal generator. Relay RE_1 also operates RE_2.

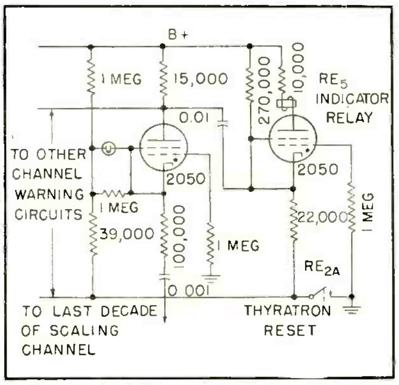

FIG. 5—Thyratron warning circuits are fail safe to prevent incorrect indication

Relay RE_2 resets all of the scaling stages by momentarily opening the reset line through RE_{2B}. This relay also grounds the thyratron-reset line so the individual channel warning circuits can operate.

At the end of the monitoring time counting timer TI_1 turns off the COUNTER-IN-OPERATION lamp, energizes RE_3 and turns on either the CHECK-OK or DECONTAMINATION-REQUIRED lamp. This choice is determined by RE_5 (Fig. 5), which is operated by the master warning circuit.

When RE_3 operates it locks and breaks the partial circuit to the CHECK-INCOMPLETE lamp so that it will not light when the hands are removed. The trigger-circuit stop-count line is now opened so that no further counts from the Geiger counters will be registered until the monitor is reset.

When the hands are removed, the hand switches restore and complete a circuit through contacts of RE_1 to operate the reset timer TI_2 and energize RE_4. Relay RE_4 locks itself and the reset timer while opening the circuit, already broken by the hand switches, to counting timer TI_1. This prevents the counting timer from restarting until the monitor has been reset. The display remains on the counting channels until the reset timer operates or until the reset button S_2 is pushed. Resetting opens one side of the 115-volt line. This restores relays 1 to 4 and the reset timer TI_2, returning the monitor to the ready-for-use condition.

Interlock

The under-voltage interlock system, shown in Fig. 7, consists of a thermal time-delay switch S_3 and high-resistance relay RE_6. If the high voltage falls below a predetermined value, the contact-type meter applies 150 volts through its contacts and locking coil and S_5 to RE_6. When the relay operates, it opens one side of the 115-volt line to the control section turning off the READY-FOR-USE light. This interlock prevents use of the radiation monitor if the voltage on the detectors has fallen below their operating point.

The BACKGROUND switch in parallel with contacts RE_{1D} of relay RE_1 is key operated and can be used to shunt out the pulses from the test signal generator to allow service personnel to check the radiation background while the monitor is in the ready-for-use condition without running through the timed cycle. Shielded hermetically-sealed relays are used along with 0.01-μf disc-ceramic capacitors placed directly at the coil terminals, to eliminate a-c pickup in the counting circuits.

Tolerance and Background

In body monitoring, it is desirable that the personnel have no radioactive contamination on their person. If the monitor were set to signal for decontamination when it detected the slightest amount of radioactivity, the signal would operate every time a person was checked since radioactivity is present to some extent all of the time, from cosmic rays, minute amounts of natural radioactivity and the radioactive materials used in the lab.

The radioactive background or noise level for the monitor must be determined for the specific location in which it is to be used. This can be done by taking a long measurement or a number of short ones and taking the average. However, since the background fluctuates in a random manner it is necessary to apply statistical methods to determine the maximum probable amount of background activity that will be measured per unit time.

The counting timer TI_1 is adjustable from 5 to 60 seconds. With a scaling factor of 100, tolerance can be adjusted anywhere between 100 and 1,200 counts per minute. If the background is extremely low, the first decade can be replaced with a binary stage or even bypassed completely to give a tolerance as low as 10 counts per minute.

Power Supplies

The power supply for the electronic circuits employs a 5U4G rectifier, capacitor input filter,

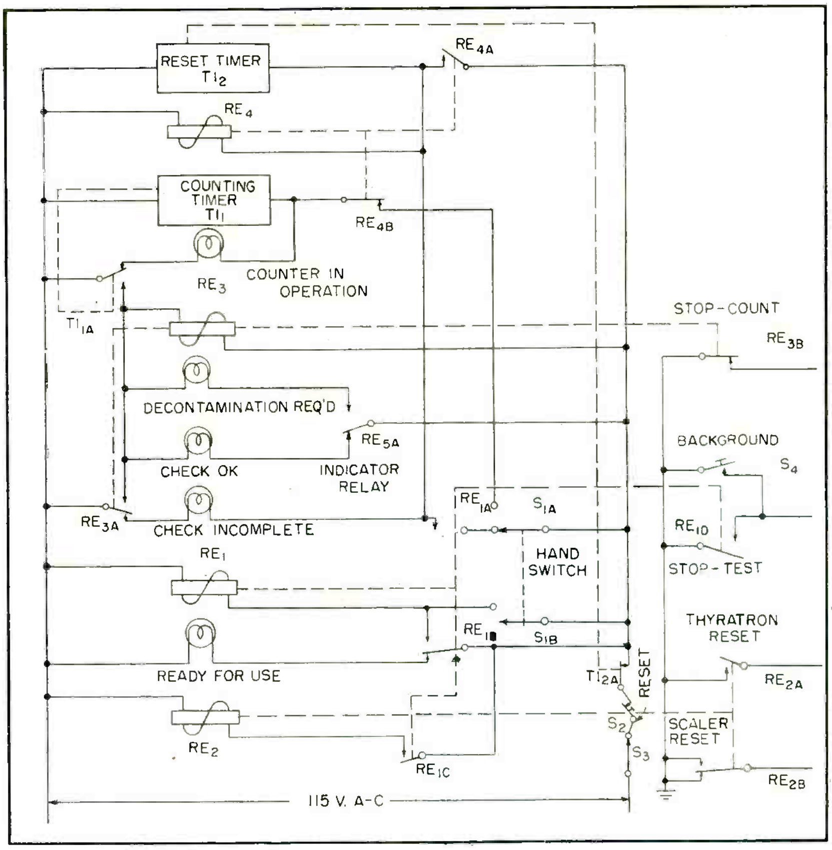

FIG. 6—Automatic control circuit simplifies monitoring operation. Warning lamp signals if worker withdraws hand before check is complete

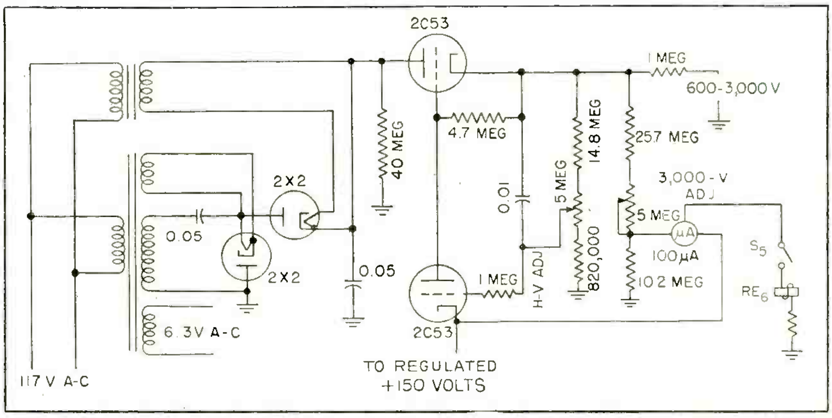

FIG. 7—High-voltage supply for Geiger-Muller tubes incorporates under-voltage interlock as additional safety feature

6AS7G regulator and 6SJ7 difference amplifier. A single OD3/VR-150 serves as voltage standard for both the high- and low-voltage power supplies.

The high-voltage supply must provide voltage continuously adjustable between 600 and 3,000 volts at 1 ma with 0.5-percent stabilization over a line voltage range of 95 to 135 volts. In addition, the supply must have very low noise. The supply has been designed not only to operate Geiger counters, but also air-proportional counters or scintillation detectors employing multiplier phototubes.

The high-voltage supply uses a transformer having a 2,800-volt secondary in a voltage doubler circuit. This provides adequate voltage for a series-shunt regulator and permits operating the regulator tubes in more favorable regions than is usually possible. The high voltage supply is shown in Fig. 7. The high-voltage metering system uses electronic depression to provide a meter scale of 600 to 3,000 volts.

Universal Medical Timer

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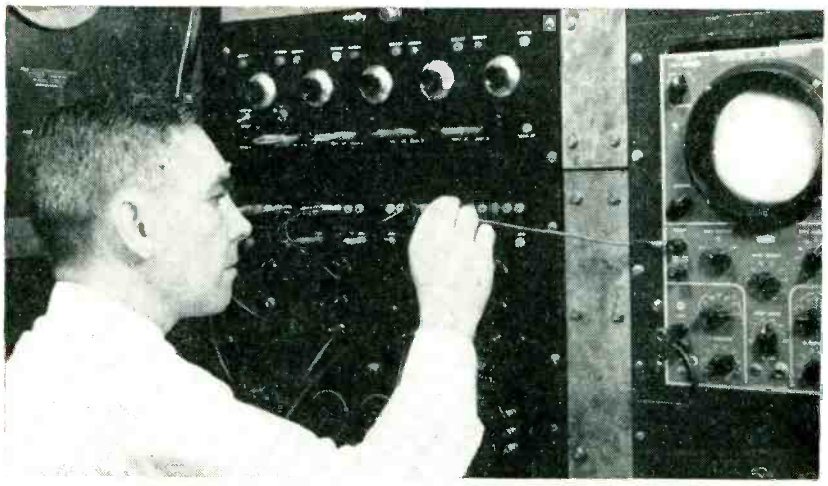


Timing units above researcher's hand give start and stop signals to stimulus units below. Cross connections are made on jack field

PULSE-TYPE electronic stimulators described in the literature have varied little in principle, differing mainly in the type and number of output circuits required for aural, visual and electrical stimuli. Despite basic similarities, these devices have been restricted in application.

In the equipment to be described, the design has been directed towards simple and reliable circuits that can be easily adapted to virtually any stimulation problem in the fields of psychological and medical research.

Basic Considerations

The factors by which one stimuli-generating equipment differs from another are essentially two: the type and number of stimulus output circuits and the timing patterns associated with these outputs. The most flexible stimulator design should therefore consist of an adequate number of standardized timing subassemblies and a sufficiently large variety of stimulus output subassemblies to meet the requirements of most of the stimulation problems encountered. The processes of timing and stimulus generation can therefore be functionally separated and all interconnections between these two functions made available to the experimenter in a patch panel arrangement. The conversion of the equipment from one problem to another can then simply consist of an exchange of stimulus-generating subassemblies and a reconnection of the timing subassemblies to provide the required display patterns.

Unit Assemblies

The photograph shows an equipment based upon these considerations. The upper chassis is the timing unit. It has five plug-in subassemblies. Four of these are delay circuits. The fifth is an astable circuit that can also function as a fifth delay unit if required. In general, the delay circuits are of the monostable variety, although in some applications—for example, flicker-fusion frequency studies—a pick-off type of delay unit is desirable in order that adjustable duty ratios may be provided.

Each monostable delay unit has been provided with a trigger-input and a delayed-trigger-output pin-jack. By interconnecting the output and input jacks of successive units in the desired manner, delay periods can be added in any sequence. Two or more delay units can be cross-coupled to establish a second or even a third pulse recurrence frequency if required.

The lower chassis has four plug-in stimulus subassemblies, although for most problems no more than two are required. Each of these units possesses two trigger input jacks; one to initiate the stimulus and the other to terminate it. A row of five pin jacks is located in the main panel directly above each of these units. The pin jacks are connected internally to the respective trigger-output lines of the units in the timing chassis.

A choice of any two of five trigger pulses to start and stop each stimulus can therefore be made at each stimulus subassembly location. The temporal relationships of these pulses is determined by the delay unit interconnections and, by the respective delay adjustments. This arrangement permits almost any conceivable timing pattern for two stimuli to be arranged quickly by the experimenter. The interconnections required for a specific problem are shown in Fig. 1, which illustrates the flexibility of this system.

The circuit of the monostable delay unit designed for the timing section is shown in Fig. 2. Tubes V_1 and V_2 and associated com-

and Pulse Stimulator

Flexible control of timing intervals from two or more units using phantastron circuits is basis of equipment for medical and psychological research. Several types of stimulus generators driven by the timers produce audible, visual or electrical signals as desired

ponents constitute a conventional screen-coupled phantastron circuit that can be triggered into its quasistable condition by applying a positive pulse to the input of trigger-injection amplifier V_{4B}.

Delay Circuit

A delayed positive pulse is obtained at the termination of the quasistable period of the circuit in the following manner: the positive excursion of the suppressor-grid potential of V_1 during the interval is limited to a few volts above ground potential by positive grid current flow in V_{3B}. The termination of the period is regenerative and the circuit has been designed so the plate currents of both V_1 and V_{3B} are interrupted at this instant.

The resulting negative step function of current in R_3 is shaped into a positive pulse at the grid of cathode follower V_{4A} by the R-C peaker action of R_3, C_3 and R_4. An additional output voltage useful for gating or monitoring is obtained from the suppressor grid of V_1 through buffer cathode follower V_{3A}. The output is a rectangular waveform having an upper level slightly above ground potential and a duration equal to that of the quasistable interval of the circuit.

This interval is adjustable from approximately 150 microseconds to 3 seconds by controls S_1 and R_2. Adjustment is accomplished by increasing the value of the timing capacitor in the second position of S_1 and lowering the positive grid-return potential of V_1 in the third position of this switch. The ten-turn helical potentiometer R_2 gives essentially linear control of delay over each of these ranges.

Pattern recurrence frequencies are established by a circuit identical to the delay circuit, except for the addition of switches S_{1C}, S_2 and S_3 and associated components shown by dashed lines in Fig. 2. With these switches in the position shown, the circuit will function as a delay unit. When S_2 is thrown to the opposite position, the screen is capacitively coupled to the suppressor grid, and the normal quasistable interval of the circuit is followed by a second such period during which multivibrator action between the screen and suppressor grids takes place.

Grid Cutoff

This period of grid cutoff is established by the capacitance values selected by S_{1C}. They have been chosen to permit the charge recovery period of C_1 or C_2 to be complete before permitting the normal action of the circuit again to take place. The recovery period has been made small by using a

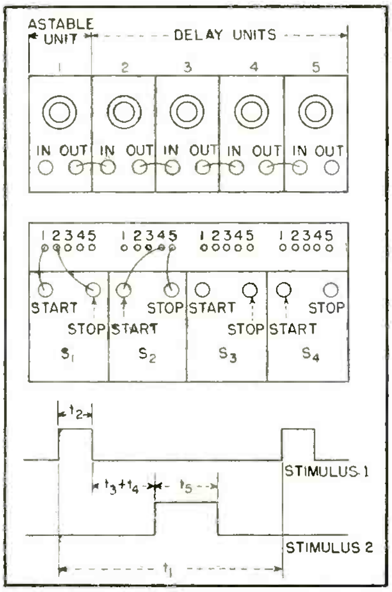


FIG. 1—Interconnections of timers and stimulus generators for a problem

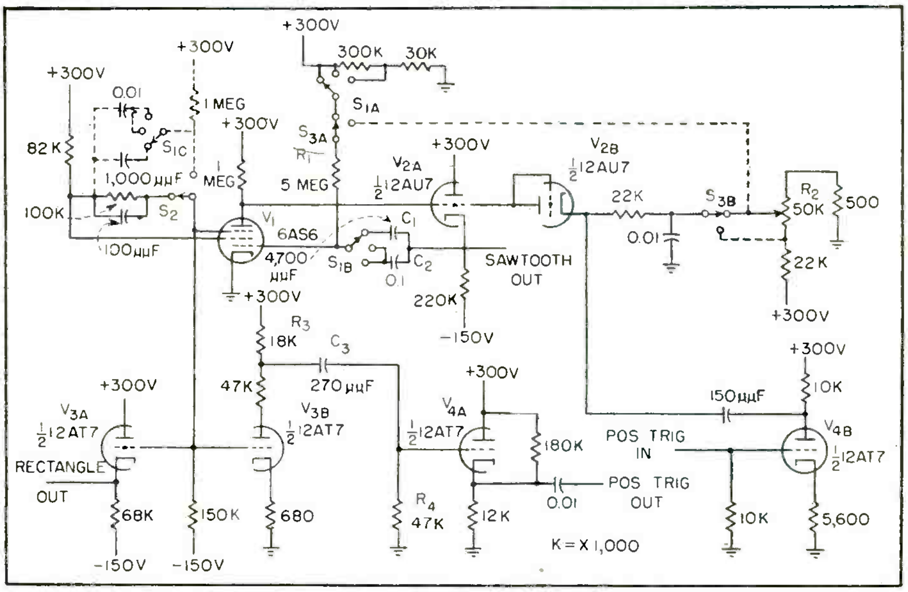


FIG. 2—Monostable delay unit used in timing section of the universal stimulus generator

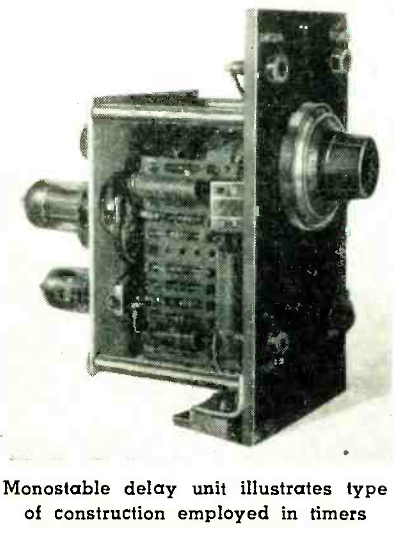
large value of R_1 and correspondingly low values of C_1 and C_2. Switch S_2 therefore functions to give monostable or astable operation of the circuit.

Sawtooth Voltage

When S_3 is in the position shown in Fig. 2, the quasistable interval of the circuit and the amplitude of the sawtooth voltage output are both linearly dependent upon the setting of R_2. In the opposite position, the initial plate voltage of V_1 is fixed and its grid-return voltage controlled by R_2. Consequently, this position of S_3 provides a fixed amplitude sawtooth voltage that has a period inversely proportional to the setting of R_2.

The first position of S_3 is employed in monostable applications where linear control of delay is most often required and also for the linear control of recurrence period in astable operation. The latter position of S_3 gives linear frequency control in the astable position of S_2 over a wide range, although a control ratio of greater than 10 to 1 on a given range setting is not recommended if good timing stability is desired.

The modified phantastron delay unit was chosen instead of the astable multivibrator not from any consideration of linearity of control or stability but because of the additional output that is available. The constant-amplitude variable-frequency sawtooth of voltage can be used as a time base for displaying all the equipment waveforms on a cathode-ray oscilloscope. It can also be utilized when the duty ratio of the stimulus is to be controlled in preference to its duration.



Monostable delay unit illustrates type of construction employed in timers

The simple multivibrator amplitude comparator shown in Fig. 3 will produce trigger output pulse delayed from the start of the negative-going waveform by an interval, $t_d = \alpha\ t_R$, where t_R is the repetition period of the sawtooth, and α an adjustable factor controlled by R_1. This pulse is produced by differentiating the positive jump in the plate potential of V_{1A} that occurs at the instant of conduction of V_{1B}. Range switch S_1 has no control over this delayed pulse, but does permit a sufficient amount of control of the multivibrator period to prevent the occurrence of additional pulses due to the restoration of the grid potential of V_{1B} before the input waveform has crossed the grid base of V_{1A}. This switch setting corresponds to the range-switch setting of the astable circuit if the multiple burst is to be prevented.

Actually, the delayed pulse is usually employed to turn off a stimulus, so in this case the multiple burst would be of no consequence. The constant-current cathode load V_{2A} has been provided to insure a constant trigger-pulse amplitude over the range of control of R_1. This control range will provide a duty ratio α of from 0.05 to approximately 0.95.

Stimulator Circuit

At present, only three basic stimulus subassemblies have been designed. Each of these is a bistable system having two trigger-pulse input circuits; one for initiating and the other for terminating the stimulus.

One unit for the production of auditory tone bursts is shown in Fig. 4. In this circuit, amplifier V_{3A} is keyed on, and V_{3B} is keyed off for the period between start and stop pulses. The keying voltages are obtained from the bistable multivibrator V_{2A}, and are applied to V_3 through buffer cathode followers V_1.

An audio signal applied to the input of V_{3A} will appear in the output circuit for the period between

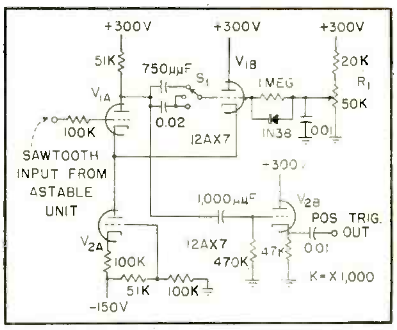


FIG. 3—Multivibrator amplitude comparator produces delayed output pulse

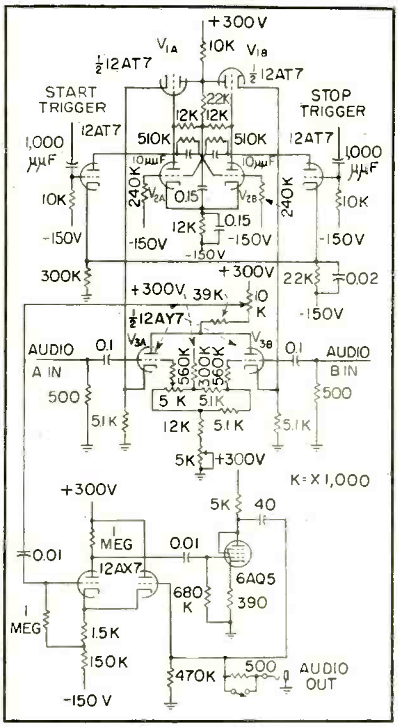


FIG. 4—Tone-burst stimulus generator

timing pulses to provide a tone burst. Conversely, a signal applied to V_{3B} will provide a tone blank for this same period. By connecting the same trigger pulse to both pulse-input circuits, the on-off periods will be equal and the circuit can then be used as a conventional electronic switch if desired.

A portion of the voltage appearing across the common load impedance V_{3A} and V_{3B} is transferred to the output circuit through a two-stage resistance-capacitance coupled feedback amplifier. A feedback factor of approximately unity is employed in this circuit to give a midfrequency gain of one and an output impedance of 15 ohms. This circuit will deliver approximately 5 volts to a 500-ohm resistive load with negligible distortion over a

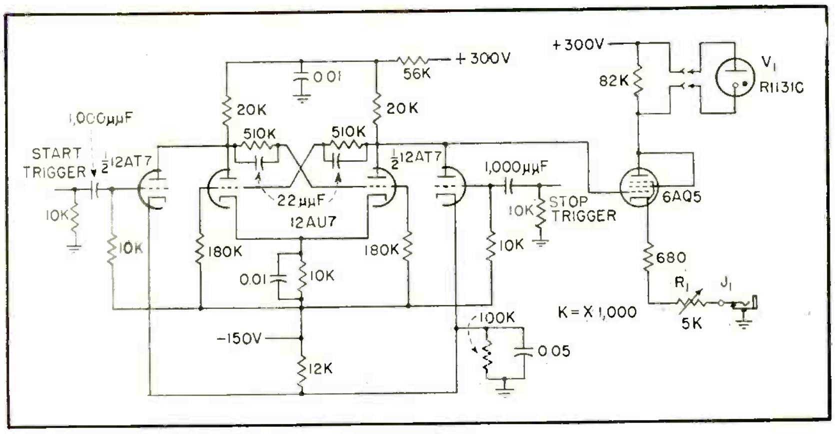


FIG. 5—Visual-stimulus generator turns on preset current in glow-modulator tube. Light intensity is function of tube current. Circuit can also be used to operate solenoid

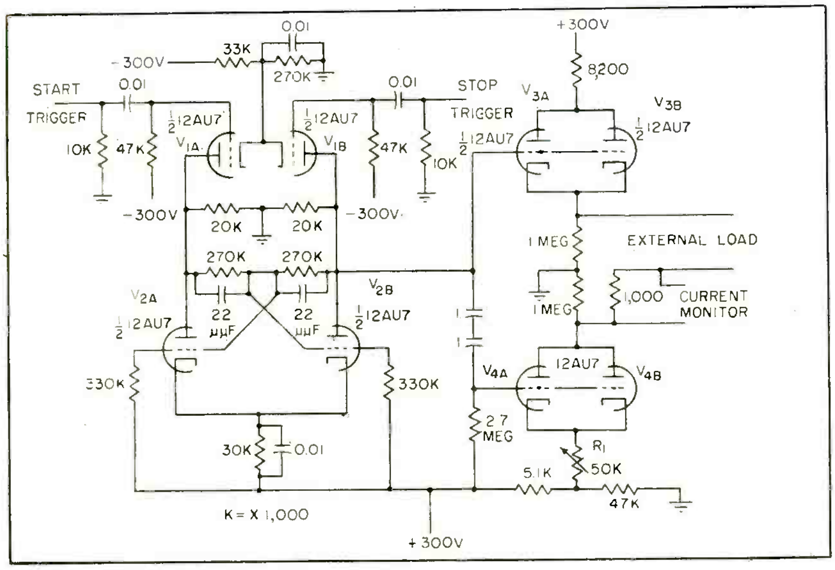


FIG. 6—Current stimuli adjustable from 2 to 20 ma are keyed on and off by triggers

wide frequency range. Series resistance may be added between the output and the load if load-impedance matching is required.

Another type of subassembly used for the production of visual stimuli is shown in Fig. 5. Here the rectangular output of the bistable circuit is employed to turn on a preset current in a Sylvania R1131C glow-modulator tube V_1. The intensity of the light pulse obtained from this tube is essentially a function of the current through it and thus a reasonably large amount of degeneration in the gating tube circuit is desirable for stabilizing this current. The flash intensity can be preset by simply triggering the circuit with a start pulse and adjusting R_1 until the current measured at J_1 has the desired value. This circuit can also function to operate a relay or a solenoid in lieu of the glow-modulator tube for problems requiring an electromechanical operation to take place at some instant during the stimuli pattern.

Current Stimulus

The circuit of a third unit tentatively designed for the production of current stimuli, adjustable from 2 to 20 milliamperes, is shown in Fig. 6. The load impedance through which this current must flow is connected by a suitable electrode system in series with two cathode followers V_3 and V_4. These tubes are biased beyond plate-current cutoff at all times, except during the stimulation period. The lower cathode follower serves as an adjustable constant-current load in series with the external load. The upper circuit provides a low-impedance path to chassis ground only during the stimulation period.

The bistable multivibrator V_1 is employed here to apply a constant-voltage rectangle to V_3 and to the resistance-capacitance network in the grid circuit of the lower cathode follower. If the external load impedance is low enough to prevent grid-current flow in V_4 owing to reduced plate voltage on this tube, the current in the load circuit will be determined almost entirely by the setting of R_1. The resistive component of this impedance must be 6 kilohms or less, and any reactive component must be capacitive for this condition to be realized.

The impedances generally realized with a suitable electrode system will easily meet these requirements.

Dual capacitive coupling in the grid circuit of V_4 provides an additional measure of safety. The substitution of beam power tubes for V_3 and V_4 with attendant circuit modifications will permit constant-current pulses up to 0.1 ampere to be obtained from this unit. A further modification may be made by utilizing the gating pulse from the monostable delay units to key V_3 and V_4 directly in lieu of bistable multivibrator V_1. This may be done in any stimulus subunit that is to be used only for short-duration stimuli.

Auxiliary Circuits

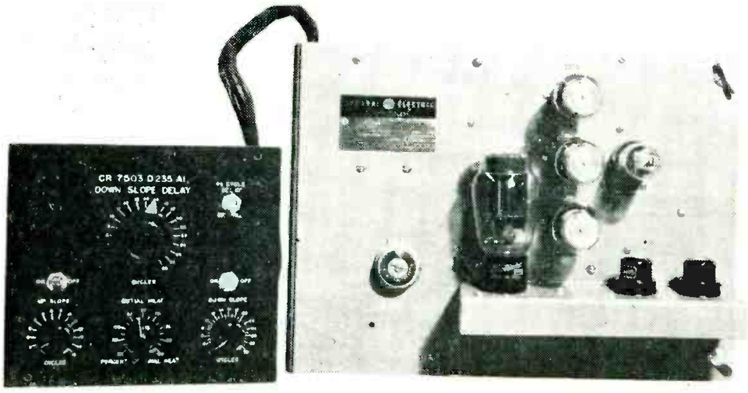
The excellent stability of the phantastron circuit in the presence of supply-voltage variations has eliminated the necessity for using regulated voltages for the timing chassis. The positive 300-volt supply for this chassis has been obtained from a simple full-wave rectifier circuit with L-section filtering.

The power supplies provide regulated supply voltages of +300, −300 and −150 volts.

The development described is an outgrowth of Contract N5ori-166, Task Order I between the Office of Naval Research and The Johns Hopkins University for Cooperative Research.

Current-Slope Control

Simple six-tube control circuit for resistance welders permits independent control of buildup and decay rates of welding current. Gives longer electrode tip life and more uniform welds on aluminum and magnesium



Up-down slope control unit with separate control station

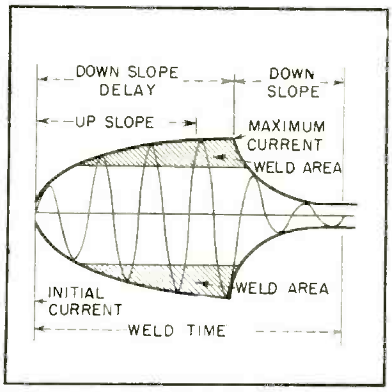


FIG. 1—Welding-current waveform

CONTROL of rise and fall of the current envelope in resistance welding is of aid in increasing weld quality and uniformity.

A gradual rate of increase is helpful in reducing sticking in spot welding of aluminum materials, magnesium and their alloys. From a production point of view this means fewer interruptions for dressing electrode tips. Tests show that the number of welds made before sticking occurred could be increased 20 to 25 times by controlling the up slope of the welding current envelope.

Control of the down slope, or rate of decay of welding current, has an annealing effect that helps to relieve stresses, reducing the possibility of shrinking, cracks and porosity in the welding of temper types of aluminum. Also, the application of forging pressures is less critical when controlled down slope is used.

To assist in obtaining and maintaining high-quality welds, the combination up-down slope control shown in the photograph has been developed.

The control unit employs a relatively simple electronic circuit having a short reset time, capable of resetting in one cycle when interconnected to a seam-welding control. The unit is completely electronic in operation, with no relays or moving parts requiring maintenance.

Welding-Current Waveform

When connected in the welder circuit, the up-down slope control produces the welding-current waveform shown in Fig. 1. The up and down slope adjustments control the rate of current increase and decrease. Control of initial and maximum current is provided to establish the current range through which the slope will operate.

The down-slope delay determines the point where the down slope will start. This delay requires a precision timing circuit since it effectively determines the end of actual weld time. If this timing is not accurate, the amount of heat energy supplied to the weld will vary, causing inconsistent results. This is one of the main features of this control, from a welding viewpoint.

Basically the control may be considered as a variable resistance inserted in the phase-shift circuit of the main welding control as shown in Fig. 2. The phase of the voltage developed across the output transformer is used to control the point on the supply-voltage wave at which the welding ignitron tubes fire.

Circuits

In this phase-shift circuit, increasing the resistance will decrease welding current. An increase in resistance shifts the phase of the voltage across T_4, making it more lagging, and retarding the firing point of the welding ignitron tubes.

The two sections of the low-mu twin-triode V_6 are connected to present a variable resistance across the secondary of T_3. This resistance is reflected to the primary, which is connected in the phase-shift circuit. This reflected resistance will control the welding current.

The variable resistance is controlled by the current conducted by V_6, which will be dependent on the grid bias values. During standby, bias is supplied by V_4 which charges capacitor C_1 during each

for Resistance Welders

By R. O. JOHNSEN

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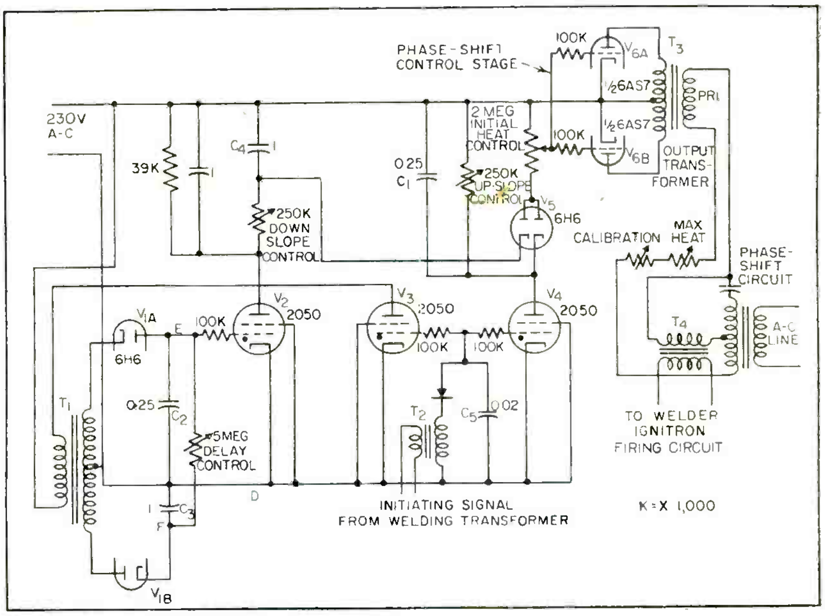


FIG. 2—Circuit of current-slope control unit

half-cycle of supply voltage. The voltage across the capacitor is applied through half of V_6 to the initial-heat potentiometer. A portion of this voltage is applied to the control grids of V_6, setting the initial current.

Up-Slope Control

Tube V_5 isolates the up-slope timing circuit from the down-slope circuit. The up-slope control determines the rate at which C_1 discharges after V_4 stops conducting. The bias voltage for V_6 will then vary from the initial bias value, as selected by the up-slope control potentiometer, to zero. Zero bias is reached in the time it takes C_1 to discharge through the control potentiometer.

The voltage developed across the secondary of transformer T_2 at the beginning of each weld is rectified and the resulting negative d-c voltage is used as a bias to turn tubes V_3 and V_4 off, thus initiating the up-slope time by allowing C_1 to discharge.

Down-Slope Control

The down-slope starts at the instant V_2 begins to conduct. Tube V_2 is normally held off by the precision timing circuit consisting of tube V_1, capacitors C_2 and C_3, the down-slope delay control and the secondary of T_1. During standby, C_2 and C_3 are charged to equal d-c voltages by T_1 through each section of twin-diode V_1. At the instant that welding current starts to flow, V_3 is cut off by the same negative d-c voltage that cuts off V_4. This removes the supply voltage of T_1 from the timing circuit and permits C_2 and C_3 to discharge through the down-slope delay control. The manner in which these capacitors discharge, including the bias voltage for V_2, is shown in Fig. 3.

This timing circuit is self-regulating. With a 60-cycle line frequency, timing will not vary over the range of 1 to 15 cycles.

In the 16-to-30-cycle range, variation will be ±1 cycle or less. These values will hold true with a ±10 percent supply voltage regulation.

In Fig. 3, the bias voltage for V_2 (between circuit points D and E in Fig. 2) crosses the value of D at Y, reducing the bias voltage to zero and permitting V_2 to conduct. Should the supply voltage decrease, as indicated by dotted line in Fig. 3, the discharge rate will decrease because of the lower differential in the d-c charge on C_2 and C_3. Because of this lower discharge rate, E will again cross D at Y, permitting the down-slope delay time to remain constant.

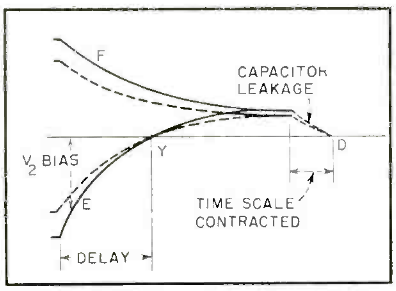


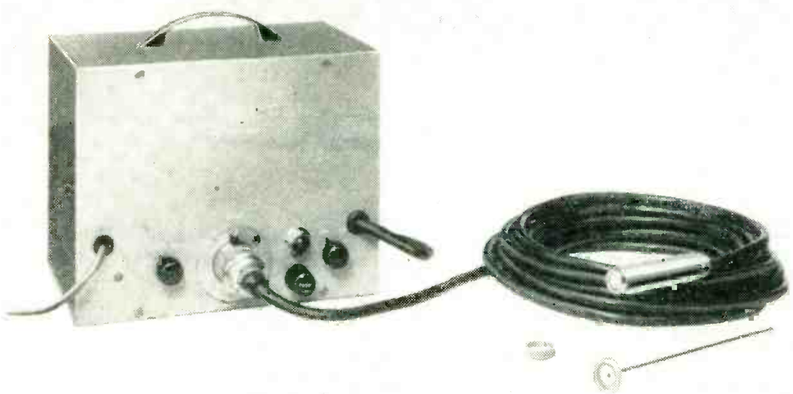
FIG. 3—Effect of voltage change on bias level

The down-slope begins when V_2 starts conducting. The down-slope is determined by the rate at which C_4 charges through the down-slope control. The voltage developed across C_4 is applied through V_5 to the initial-heat potentiometer. A portion of this voltage is once again applied to the grid of V_6. Thus, the bias voltage on V_6 is increased from zero to the bias originally selected by the potentiometer, at a rate determined by C_4 and the down-slope potentiometer.

To reset the control at the end of each weld, tubes V_3 and V_4 must refire. These tubes will refire in the time it takes C_5 to discharge, removing the hold-off bias. This reset time is about 8 cycles. In control combinations where a sine-wave voltage appears at the start of each weld, it is possible to obtain a one-cycle reset time. This available voltage could then be applied to T_2 in such a way that the plate voltage of tubes V_3 and V_4 would be 180 degrees out of phase with the grid voltage obtained from T_2. With this sine-wave hold-off during the weld, and with C_5 removed, the reset time can be reduced to one cycle.

Microphones Measure

Designed for measurement of sound pressure level in the range 40 to 220 db referred to 0.0002 dyne per square centimeter, three different types of microphones are used to cover the frequency range from 3 to 30,000 cps required to record industrial noise, explosions and jet or rocket noise



High-intensity microphone is mounted on base containing cathode follower. Power supply and output circuits are contained in remote case. Probe is at right

RESEARCH in medicine requires microphones capable of reproducing low-intensity sound, whereas modern aircraft and new industrial apparatus produce sounds different in range and intensity from those encountered in speech and music. The condenser microphone is adaptable to the needs of each of these fields, embodying sturdiness and stability as well as least phase shift over a wide range of levels and frequencies.

This paper describes microphone systems designed for measurement of sounds in the range 40 to 220 db referred to 0.0002 dyne per square centimeter. The frequency range encountered in these measurements is so great that it is necessary to use several types of sound generators as calibration source. From 3 to 300 cps the pistonphone produces good-waveform sound pressure levels in small cavities and provides levels up to approximately 130 db.

In the range from 50 to 2,000 cps loudspeakers of the cone type are used. From 500 to 10,000 cps, loudspeakers with a thin metallic or plastic diaphragm provide good sources. From 5,000 up to 30,000 or more cps, a microphone of the Altec 633 type is used as a loudspeaker. It produces sound pressure levels on the order of 120 db at a distance of 12 inches, with an electrical input of approximately 10 watts.

Microphones encountered in speech and music work have a noise floor of 20 to 30 db and a maximum undistorted range of approximately 140 db. For abnormally high sound-intensity ranges microphones having a noise floor of approximately 65 db are used in the range from 140 to 200 db. Recording of acoustic shock waves and explosions require a usable range from 160 up to 220 db or more. Suitable modifications of a small condenser type microphone can provide the core of a measurement system that meets all of the requirements outlined above.

Microphone Construction

The shock-wave microphones are in principle and size the same as certain standard microphones. A diaphragm of increased stiffness is used, depending upon the sound pressure levels encountered. The diaphragm is clamped tightly around the edges. It is laminated with a molecular coating of gold on the exposed surface to make the conductor. This structure allows full excursion of the diaphragm without possibility of shorting or arc-over since the dielectric material that forms the diaphragm insulates the conducting surface from the back plate even when large amplitudes cause the diaphragm to touch the back plate.

Figure 1 is a schematic of the cathode follower and its associated power supply, as used with type 21BR microphones. The base housing the cathode follower is connected to the power supply with a five-conductor shielded cable. The cathode follower uses a type 5840 subminiature pentode having a shock rating of 500 g. A switch on the output provides either direct cathode-follower output or transformer coupling. The transformer is uniform to 5 cps.

High-Intensity Sound

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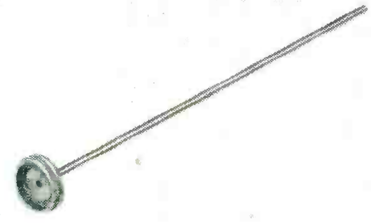
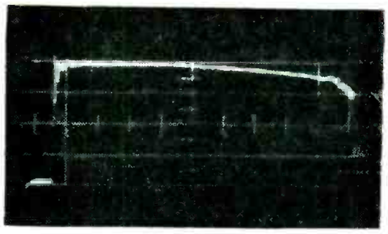


Probe that can be attached to high-intensity microphone creates little disturbance in cavity and allows use at temperatures above 700 F



Recorded shock wave corresponds to pressure change of 27 psi or sound pressure level of 200 db above 0.0002 dyne per sq cm

The microphone diaphragm may be exposed directly to the shock wave or where desirable a probe may be attached. A probe tube, shown in the illustration, is available for sampling minute sound-pressure fields without upsetting the physical dimensions of the cavity.

Pistonphone Calibration

A pistonphone is used for the calibration of pressure microphones in the region where there is no deviation between the free field and pressure calibration. It consists essentially of the dynamic system having a 2-in. voice coil, mounted on a metal V cone diaphragm, a cloth spider and permanent magnet. A small piston 5 millimeters in diameter is attached to the apex of the cone. This piston operates into an entirely enclosed pressure chamber.

The chamber has a removable cover with provision for the insertion of a microphone. A microscope with an eyepiece micrometer, graduated in tenths of millimeters is mounted between the voice coil and the pressure chamber. It permits the measurement of the piston stroke in the range from 0.02 to 0.8 mm.

The pressure chamber proper is bounded by a laminated plastic cup that has a cylindrical bore of 90 mm and a depth of 75 mm. The rubber sealed piston assembly extends into this bore. Various insert cylinders are used to reduce the cavity, depending upon the types of microphones to be calibrated and the special range of frequencies to be used.

The largest chamber is approximately 475 cubic centimeters and shows no measurable standing waves up to approximately 300 cycles. A smaller chamber of approximately 18 cubic centimeters is used for higher frequencies and to develop higher sound pressure levels. The maximum sound pressure that can be developed with 475 cubic centimeters is approximately 16 dynes per square centimeter. With the 18 cubic centimeter chamber a sound pressure level of 124 dynes is available.

The pressure developed in the cylinder is a function of the piston diameter, the barometric pressure, the piston stroke and the pressure chamber volume. Sound pressure level is computed according to the following equation:

$$P = 0.52 \frac{D^2 H B}{V}$$

Where P = effective sound pressure in μb
D = piston diameter in mm
B = barometric pressure in mm of Hg
H = piston stroke in mm
V = pressure chamber volume in cc

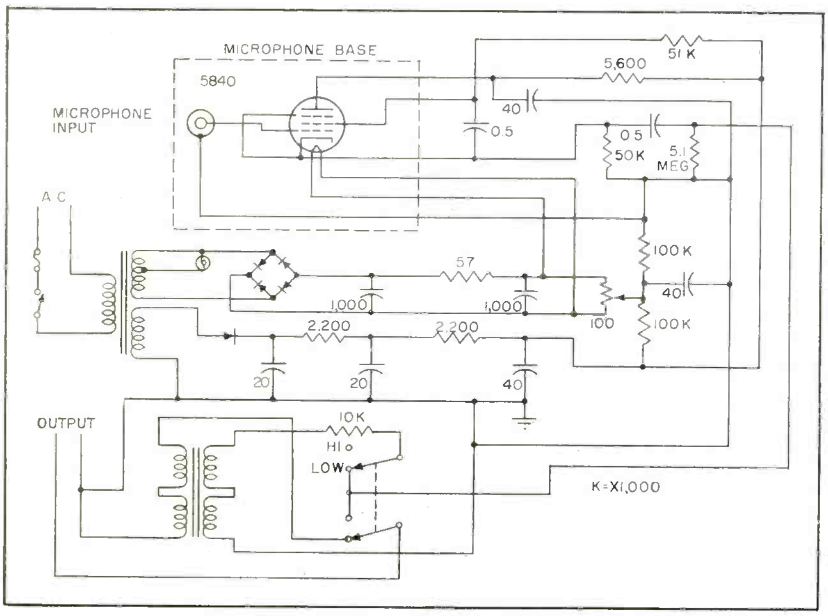


FIG. 1—Cathode follower and power supply used with sound pressure level microphones

Jet Noise Levels

Aircraft propulsion systems presently used, and those planned for the future include turbojet engines, rockets, supersonic propellers and ram jets. Presently the turbojet engine is the most common and potent source of noise. It is anticipated that unless quieter engines can be designed, the radius of disturbance from an airport may be as great as 30 miles.

The origin of the noise in jet engines is probably due to the formation of eddy currents at the nozzle, irregularities of fuel combustion and to some extent intake noise. Since these sources are not accurately defined, progress in providing a muffler to reduce this noise has been delayed and it is not expected that within the immediate future these sounds can be attenuated at a rate sufficiently fast to cope with the increase in power.

The noise of jet engines is a more continuous spectrum than that of propeller-driven aircraft. In the latter case the noise is concentrated in the lower frequencies having a maximum amplitude at the propeller blade frequency, which is in the range of 75 to 150 cps. The energy falls off rapidly at the harmonic frequencies. The jet engine, however, has almost a uniform spectrum up to 1,000 cps and above 4,000 cps appreciable energy is radiated. Since a propeller is principally a low-frequency generator, the noise is nondirectional and is at a maximum near the pilot's position. For this reason the rear part of the cabin is considerably quieter than the forward part.

Jet Noise

In a jet plane the source of noise is well to the rear. However, since the jet spectrum is extended, the noise-distribution pattern varies with frequency. In the first octave the noise is nondirectional. The sound radiator is a dipole antenna and the pattern shifts progressively so that the radiation at medium and higher frequencies is at right angles to the airplane. At very high frequencies the radiation is directed forward.

Attenuation of low frequencies by the wall of the plane requires increased thickness or mass, but the high frequencies are easily attenuated by present-day construction. Because of the varying directions of the noise, passengers in such planes as the English Comet are seated as far forward as practical.

Table I—Microphone Characteristics

Type	Open-circuit sensitivity in db ref to 1 volt	Maximum sound pressure level (spl)	Frequency range in kc
21C	− 46	140	0.005-17
21BR-180	− 66 ± 5	180	0.005-17
21BR-200	− 86 ± 5	200	0.005-17
21BR-220	− 106 ± 4	220	0.005-17

The manufacture, testing and use of turbojet and ram jet engines have created many problems in connection with the intense noise produced by the operation. The present-day turbojet engine burns approximately 5,000 to 8,000 pounds of fuel an hour. The acoustic power increase is approximately proportional to the fourth power of the fuel consumption, and this corresponds to approximately 70 kw at its highest speed. The sound pressure level is approximately 160 db at a distance of 1 nozzle diameter from the engine.

The spl developed by an engine is a precise value depending upon the fuel consumption. Measurements on a number of engine test cells have shown that the sound output is within a few tenths of a decibel when the fuel is correctly metered. There are three noise-level situations that cause concern with operation of jets:

(1) A short full-power check of the engine before taking off.

(2) Adjustments in plane after installations.

(3) Finally, what is probably the most potent source of interference, factory testing of jet engines.

At the present time objections come principally from adjustments in the plane and factory testing. The latter represents the major source of annoyance to nearby office workers and residential areas. This testing also constitutes a hazard in that a certain partial or permanent impairment of hearing can be produced by operations' personnel being exposed to this noise.

In the research and design on engines, high ambient pressures and temperatures are involved when a microphone is used to obtain data within or near the combustion chamber. Types of burner instabilities occur and the role of flame-driven standing waves in burners is being studied. The names given to these instabilities are: (in rockets) "chugging" and "screaming;" (in afterburners) "rumbling" and "queaking;" (in ram jets) "resonance", "rough burning," "pulsing" and "whistling."

High Temperatures

The condenser microphone can be operated at higher temperatures than conventional microphones, since the materials used are Mycalex, glass and stainless steel. The Mycalex becomes unstable above 1,000 degrees F and other parts are stable up to 1,600 degrees F. For short periods of time, such as an interval of less than one minute, the microphone can be directly exposed to 1,600 F.

Where continued temperatures above 700 degrees are encountered in the measurements, the microphone is used with a probe tube. The probe tube usually has a bore of 1 to 3 mm and a length to provide the necessary temperature gradient. The probe tube also provides more of a point-source pickup and reduces diffraction of sound around it allowing end of the tube to be mounted in a wall of a pipe or engine. The length of the probe tube varies from 3 in. up to experimental units measuring 14 in. in length.

The walls of the probe can be cooled by liquid, air or covered with heat resistant insulation so that the temperature at the microphone end is within accepted limits. Usually stainless steel is used to resist the corrosive action of heat and the various types of liquid fuels and propellants. The wall of the probe tube is sufficiently thick so that an attenuation of at least 50 db is provided.

Where the ambient barometric pressure exceeds 30 psi, it may be necessary to provide a bypass from the front of the diaphragm or the chamber to the housing at the rear of the microphone to equalize the static pressure. When the temperature at the diaphragm is elevated beyond 200 degrees, the voltage between cathode and ground drops, and it is advisable to provide means for maintaining a constant potential of 200 volts.

Plant Noise Control

Noise control of jet engine testing cells has become compulsory. Factories are usually located in areas somewhat remote from residential sections, but progressively these areas are built up and complaints by the residents bring preventive measures. Present acceptable daytime sound levels can approach a value of 72 to 75 db and nighttime levels, a value of 60 to 65 db before complaints will be received.

An engine at 5 feet will develop approximately 160 db spl at full power. Some engine plants have as many as 50 individual testing cells in operation simultaneously and the spl is raised to 177 db. Exhaust stack treatment, tunnels, ducts and resonators are used to provide various degrees of attenuation. The cost of providing the attenuation is between \$500 and \$1,000 per db. At least 50 db of attenuation at 100 cycles is required. Higher powered engines are being developed and it is anticipated that in the near future the initial noise will be increased by a factor of 5 to 10 db.

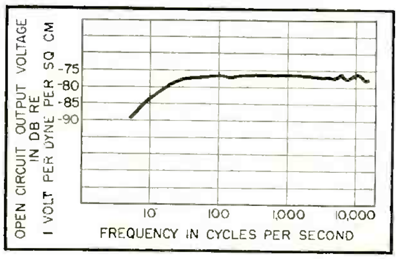
Noise Monitoring

The management of factories must provide means of continuously monitoring the noise interference in a neighborhood and take appropriate measures to keep it within acceptable limits to avoid legal action. Facilities for this monitoring are now in use experimentally and are also being planned for several areas that include office and residential areas.

The procedure consists in mounting microphones in an open structure such as a tower, church or school belfry in the residential area. The output of the microphone is amplified to a level of approximately + 10 vu and transmitted over private or leased telephone circuits to the plant receiving terminal. The telephone circuits are equalized for uniform response up to 8,000 cycles and selection of cable pairs can provide a signal-to-noise ratio of 50 db. The threshhold of residential ambient noise is seldom less than 40 db, and this allows a range up to 90 db.

At the receiving terminal, line amplifiers provide sufficient gain to compensate for the loss in the telephone cable. (The equalized 1,000-cycle gain is equivalent to the loss of 4 db per circuit mile.) In addition to monitoring the noise, equipment is available to operate a warning light when the sound pressure level in the region of this microphone exceeds the specified interference level and to record noise on tape or sound-level recorders.

Equipment used at the pickup point is the type 21 condenser microphone, having a dynamic range of 30 to 140 db spl and a 100-db gain amplifier capable of + 10 vu output. The gain of the system is adjusted so that the maximum expected level in the area will develop + 10 vu and maintain the highest possible signal-to-noise ratio without producing crosstalk in adjacent cable circuits.



Calibration chart for representative microphone at 124 db spl input

Calibration of the microphone, amplifiers, telephone cables, line terminal equipment and recording facilities may be provided by mounting a small stable loudspeaker near the microphone. This loudspeaker is energized by a calibrated reference tone transmitted over a separate outgoing telephone line.

The monitoring at the exhaust stack or within a few diameters of the engine is accomplished with the 21BR-200 microphone. Experimental tests over a period of several months in a midwestern jet-engine factory indicate that the microphone system can be exposed to conditions of weather, including 100-percent humidity and temperature ranges from −20 F to 100 F. Overall change in sensitivity of microphone, amplifier and telephone cables was less than 2 db over a period of one month.

When the aircraft engine noise exceeds the predetermined complaint level in the residential areas, the procedure is to reduce the fuel consumption temporarily or shut down the required number of engines to keep within the specified level.

Hearing Loss

Loss of hearing to personnel operating and testing equipment in factories today is a factor that management must evaluate to protect the worker. It is estimated that a large sum is involved in legal action today resulting from claims on loss of hearing. Drop forges, trip hammers, riveting and the like develop peak sound pressure levels in excess of 150 db. Employees working in these high noise fields without ear protectors may suffer permanent loss of hearing at frequencies above 1,000 cycles.

Other Applications

Condenser microphones are being used to determine the vibration of fuel lines, tanks and other parts in rockets. Safe-risk distances for operating personnel adjacent to rocket launching apparatus is determined by measuring the spl at the launching platform.

Motor car engine timing chain noise is measured by mounting a probe tube close to the individual links of the chain around the sprockets.

In the medical field, small animals are used for experimental purposes to study the effects of exposure to blast. By inserting a probe tube in the animal at the point of interest, the internal pressure can be accurately measured.

In the field of vibration, the microphone may be used to trace the nodal pattern of vibrating turbine buckets, as well as recording the axial modes of a vibrating turbine wheel.

Step-Switch Converter

Amplifier-controlled telephone-type stepping switches convert analog voltage to digital information. Converter is particularly useful when results of engineering computations performed on analog computers must be analyzed statistically

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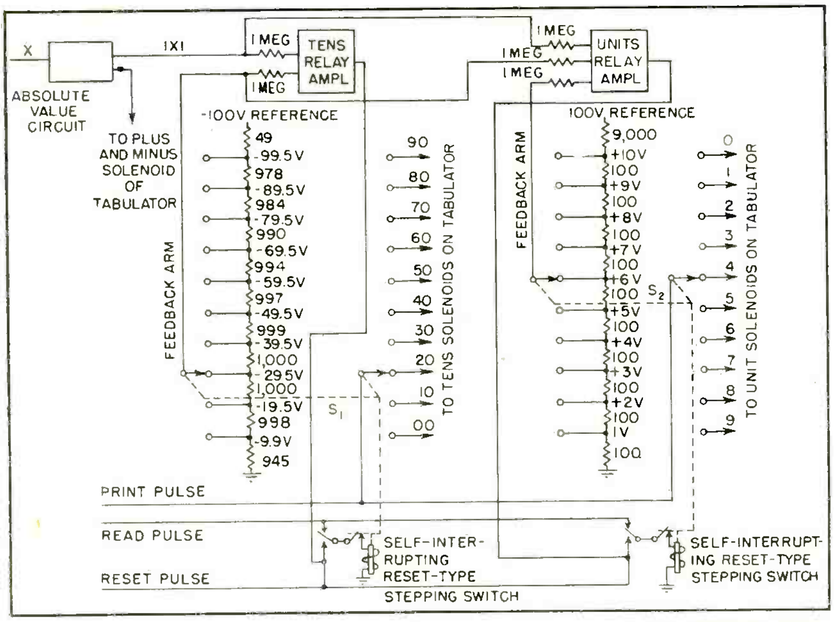


FIG. 1—Principal features of analog-to-digital converter; standard telephone-type stepping switches are used

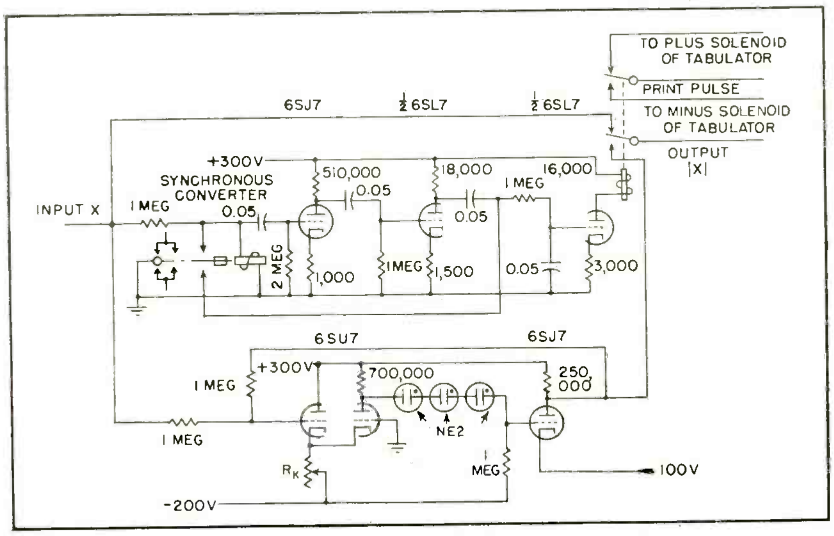


FIG. 2—Amplifiers used in absolute-value circuit

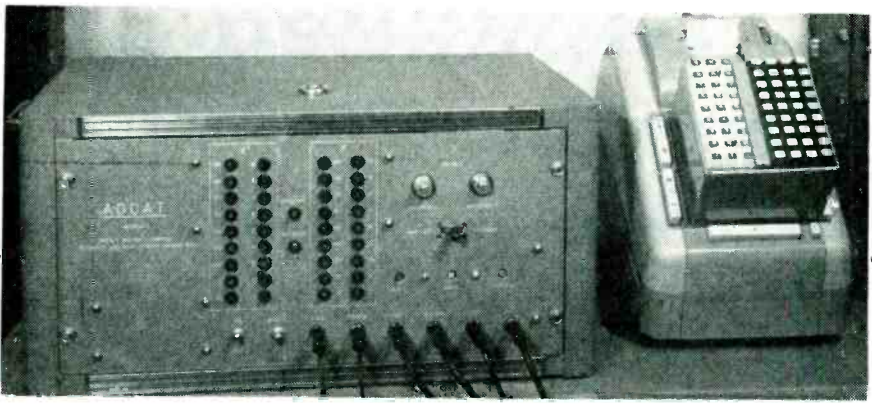
APPLICATION of analog computers to statistical studies[1] requires gathering numerous discrete statistical results and reducing them to useful engineering data. Output devices generally associated with analog computers present the desired results as curves. Measuring discrete points from these curves introduces human error and time lag. The device to be described automatically converts an analog voltage into digital form. Figure 1 illustrates its operation.

Voltage X in the range of $\pm$ 100 volts is connected to the input of the absolute-value circuit. The output of the absolute-value circuit, $|X|$, then becomes an input to the summing networks of the tens and units relay amplifiers.

The tens relay amplifier energizes the tens-digit stepping switch S_1 as long as the sum of its inputs is positive while the units relay amplifier energizes the units-digit stepping switch S_2 as long as the sum of its inputs is negative. Hence, S_1 operates as long as the absolute voltage on its feedback arm is less than $|X|$.

While S_1 operates, the sum of the inputs to the units amplifier is positive and S_2 does not operate. As soon as S_1 feeds back the appropriate voltage to the tens amplifier and stops, S_2 steps until a voltage is fed back sufficient to make the sum of the inputs to the units amplifier positive, at which time S_2

Digitizes Analog Data



Analog-to-digital converter with associated tabulator. Keys are operated by solenoids energized by converter

stops. The shaft position of the two stepping switches represents the two-digit answer. Additional banks of contacts are used to energize keyboard solenoids on a tabulator and to light the visual indicators shown in the photograph.

The conversion and tabulation operation takes place in less than one second and is actuated by either a pushbutton on the unit or automatically by an external switch.

The same shaft position may be used to obtain any function of X by adding enough banks to the stepping switches, essentially providing a table of values of $f(X)$ for each X. The function $f(X) = X^2$ is of particular value in statistical studies. The mean square of the variable X is obtained by recording X^2 and computing the sum of the X^2's at the end of a sample of runs. The addition of the X^2's may be accomplished within the accompanying tabulator.

More Digits

The system can be extended to more than two digits by adding one more relay amplifier and stepping switch for each additional digit. The limitation to the number of digits depends upon the accuracy of the reference voltages, the accuracy of the feedback divider resistors and the resolution of the relay amplifiers.

The two-digit system converts an analog voltage to the nearest unit. Figure 1 shows the position of the stepping switches for $24.5 > |X| \geqq 23.5$ volts. The tabulator would record 24 for this value of X. The statistical problems for which the converter was built did not warrant greater accuracies. The divider resistors for S_1 and S_2 are $\pm$ 0.1-percent and $\pm$ 1.0-percent wire-wound resistors, respectively.

Absolute-Value Circuit

Figure 2 shows a relay amplifier and an inverting amplifier connected to form an output that is equal to the absolute value of the input. The relay selects the input if the input is positive or the negative of the input if the input is negative. A second pair of contacts provides the contact closure to energize appropriately the plus or minus solenoid of the tabulator. The relay amplifier is a conventional chopper amplifier using a 60-cps synchronous converter. It energizes its relay on a negative 10-millivolt input and has inherently negligible drift.

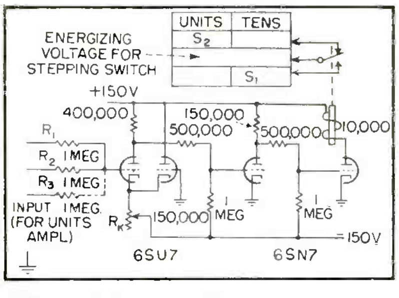


FIG. 3—Relay amplifier used to position stepping switch

The inverting amplifier is a high-gain d-c feedback amplifier connected to give an overall gain of minus one. It is linear over the range of $\pm$ 120 volts. Cathode resistor R_k is for zero balancing the amplifier.

Figure 3 is a schematic of a stepping-switch actuating amplifier. The slight differences between the tens and units amplifiers are indicated on the schematic. Balancing an amplifier consists of adjusting cathode resistor R_k to give the proper relay-contact closure with all inputs grounded. Two neon lights on the front panel indicate the desired relay-contact position.

Amplifier Drift

Direct-current amplifier drift in the inverting amplifier and the two stepping-switch actuating amplifiers is reduced to a negligible amount by using regulated power supplies, differential-amplifier input stages[2] and deposited-carbon resistors throughout. The amplifiers would be chopper stabilized in applications where more accuracy is required from the converter.

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(1) R. R. Bennett and A. S. Fulton, Automatic REAC Operation for Statistical Studies, Symposium II on Simulation and Computing Techniques, Reeves Inst. Corp., Apr.-May 1952.

(2) G. E. Valley, Jr. and Henry Wallman, "Vacuum Tube Amplifiers", p 441, MIT Rad. Lab. Series, McGraw-Hill Book Co., Inc., N. Y., 1948.

TRANSISTORS: Theory and Application

Grounded Emitter

Part IX

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IN PREVIOUS ARTICLES of this series, discussions have been restricted to the grounded-base connection for transistors. One of the main reasons for introduction of the grounded-base connection first is because it appears that in the testing and evaluation of transistors, this connection will be used. In general, the values of parameters obtained and the interpretation to be placed on the measurements depend on the method of connection.

Grounded emitter and collector circuits have advantages over the grounded-base circuit in certain applications. The significance of the method of connection will become apparent in the ensuing discussion.

Grounded-Emitter Connection

The parameters which describe the grounded-emitter connection most adequately for design and analysis purposes are the input and output resistances, and the voltage and power gains. To find these, it is necessary to obtain the loop currents.

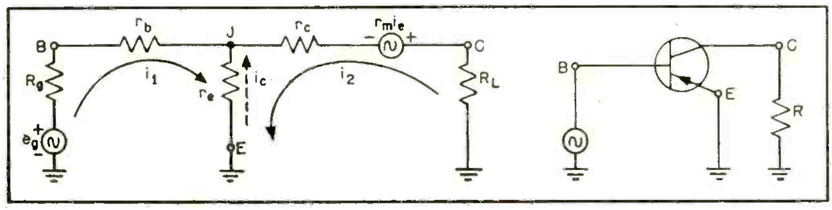

FIG. 1—Equivalent and schematic circuit diagrams for grounded-emitter connection

Table I—Typical Values of Transistor Parameters

	Point Contact	Junction
r_e	150 ohms	25 ohms
r_b	120 ohms	500 ohms
r_m	35 kilohms	0.96 meg
r_c	15 kilohms	1.0 meg
R_g	500 ohms	500 ohms
R_L	20 kilohms	0.1 meg
alpha	2.3	0.96
e_g	0.01 volt	0.001 volt

Following the rules in the previous article, Kirchhoff law equations for the two loops in Fig. 1 will be set up to find these currents as a function of known transistor parameters.

Figure 1 shows the essentials of the grounded-emitter connection. Note that d-c biases are omitted, the r's are shown instead of Z's for simplicity, and that arbitrary current directions, toward the imaginary junction point J, are assumed.[1]

Following the rules in Part VII the loop equations are

$$(R_g + r_b + r_e)\, i_1 + r_e\, i_2 = e_g \tag{1}$$

$$-r_m (i_1 + i_2) + r_e\, i_1 + (R_L + r_c + r_e)\, i_2 = 0 \tag{2}$$

Note that $(i_1 + i_2) = -i_e$ and that i_e = current through r_e toward J. Ordinarily, with the direction of currents as selected, $r_m i_e$ would have a minus sign since it is a generator; since i_2 flows from plus to minus with respect to it, it requires another minus sign, so that $r_m i_e$ is now plus. However, $i_e = -(i_1 + i_2)$, and therefore the term appears as $-r_m\ (i_1 + i_2)$ in the equation. Rewritten in standard form, Eq. 1 and 2 become

$$(R_g + r_b + r_e)\, i_1 + r_e i_2 = e_g \tag{3}$$

$$(r_e - r_m)\, i_1 + (R_L + r_e + r_c - r_m)\, i_2 = 0 \tag{4}$$

Solving for i_1

$$i_1 = \frac{e_g\,(R_L + r_c - r_m + r_e)}{[(R_g + r_e + r_b)\,(R_L + r_e + r_c - r_m) + r_e\,(r_m - r_e)]} \tag{5}$$

Input Resistance

The input resistance for the rounded-emitter connection is

$$R_{ie} = \frac{e_g}{i_1} - R_g$$

$$= r_e + r_b + \frac{r_e\,(r_m - r_e)}{R_L + r_e + r_c - r_m} \tag{6}$$

Since one can normally neglect r_e compared to r_m

$$R_{ie} = r_e + r_b + \frac{r_e\, r_m}{R_L + r_e + r_c - r_m} \tag{7}$$

For comparison, the equivalent relation for the grounded-base connection is

$$R_i = r_e + r_b - \frac{r_b\, r_m}{R_L + r_c} \tag{8}$$

A study of these equations reveals the following:

(1) The subscript convention adopted is as follows: If only one subscript is used (for example, R_i), the value refers to the grounded-base connection; R_{ie} re-

and Collector Circuits

Design equations for additional transistor circuit configurations are derived and average values inserted to show typical performance. Relative advantages of various circuits for both junction and point-contact transistors are discussed in detail

Table II—Formulas and Typical Values for Transistor Circuit Parameters

		Grounded Base	Grounded Emitter	Grounded Collector
Input Resistance		$r_b + r_e - \frac{r_b (r_b + r_m)}{R_L + r_b + r_c}$	$r_b + r_e + \frac{r_e (r_m - r_e)}{R_L + r_e + r_c - r_m}$	$r_b + r_c - \frac{r_c (r_c - r_m)}{R_L + r_e + r_c - r_m}$
	P.C.	$\approx$ 150 ohms**	$\approx$ 35,000 ohms	$\approx$ 2,000,000 ohms
	Junction	$\approx$ 90 ohms	$\approx$ 700 ohms	$\approx$ 700,000 ohms
Output Resistance		$r_b + r_c - \frac{r_b (r_b + r_m)}{R_g + r_b + r_e}$	$r_c + r_e - r_m + \frac{r_e (r_m - r_e)}{R_g + r_e + r_b}$	$r_c + r_e - r_m - \frac{r_c (r_c - r_m)}{R_g + r_c + r_b}$
	P.C.	$\approx$ 9,500 ohms	$\approx$ −13,000 ohms	$\approx$ −650 ohms
	Junction	$\approx$ 530,000 ohms	$\approx$ 63,000 ohms	$\approx$ 25 ohms
Voltage Gain		$\frac{(r_b + r_m) R_L}{(R_g+r_b+r_e)(R_L+r_b+r_c) - r_b (r_b+r_m)}$	$\frac{(r_e - r_m) R_L}{(R_g+r_b+r_e)(R_L+r_e+r_c-r_m) + r_e (r_m-r_e)}$	$\frac{r_c R_L}{(R_g+r_b+r_c)(R_L+r_e+r_c-r_m) + r_c (r_m-r_c)}$
	P.C.	$\approx$ 30	$\approx$ −130	<1
	Junction	$\approx$ 150**	$\approx$ −575	<1
Power Gain		$\frac{4R_L R_g (r_b + r_m)^2}{[(R_g+r_b+r_e)(R_L+r_b+r_c) - r_b (r_b+r_m)]^2}$	$\frac{4R_L R_g (r_m - r_e)^2}{[(R_g+r_b+r_e)(R_L+r_e+r_c-r_m) + r_e (r_m-r_e)]^2}$	$\frac{4R_g R_L r_c^2}{[(R_g+r_b+r_c)(R_L+r_e+r_c-r_m) + r_c (r_m-r_c)]^2}$
	P.C.	$\approx$ 100 (20 db)	$\approx$ 1700 (32 db)	$\approx$ 0.1
	Junction	$\approx$ 440 (26 db)	$\approx$ 6600 (38 db)	$\approx$ 0.02
Current Gain		$\alpha_{ce} = \frac{i_2}{c_1}$	$\alpha_{cb} = \frac{\alpha_{ce}}{1 - \alpha_{ce}}$	$\alpha_{eb} = \frac{-1}{1 - \alpha_{ce}}$
	P.C.	$\approx$ 2.3	$\approx$ −1.66	$\approx$ 0.77
	Junction	$\approx$ 0.96	$\approx$ 24	$\approx$ −25
Stability	P.C.	Stable unless $R_L = 0$*	Unstable	Unstable
	Junction	Stable	Stable	Stable
Phase	P.C.	No reversal unless R_L low or α high	Voltage and current phase reversal	No phase reversal usually
	Junction	No phase reversal	Voltage phase reversal	Current phase reversal
Advantages		High R_o	High R_i and gain; single voltage supply; high Z levels for junc.	Cathode follower action; high current gain; good freq. resp.
Disadvantages		Low R_i; low gain for point-contact types	Unstable	Voltage and power gain poor; may be unstable

* Point-contact transistors are available which are short-circuit stable.
** These are revised values, slightly higher then were given in Part VII.

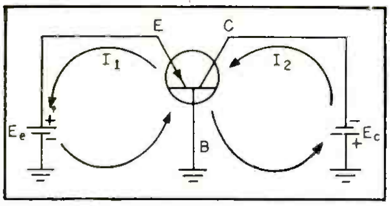

FIG. 2—Biasing connections for grounded-base connection

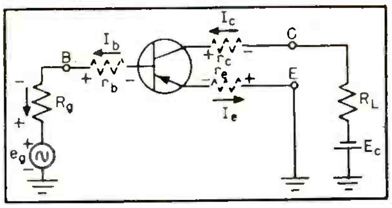

FIG. 3—Grounded-emitter circuit for pnp and point-contact transistors

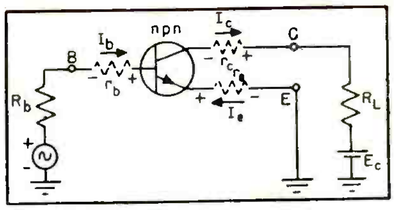

FIG. 4—Same as Fig. 3 except for npn transistor instead of pnp

fers to grounded-emitter connection, and similarly R_{ic} refers to the grounded-collector connection.

(2) In Eq. 8, since r_b, r_m, r_c and R_L are in general positive numbers, R_i will always be less than $r_e + r_b$ by the quantity $r_b r_m/(R_L + r_c)$.

(3) In contrast, in Eq. 7, the input resistance will in general be greater than $r_e + r_b$, by the quantity $r_e r_m/(R_L + r_c + r_e - r_m)$. As this latter quantity may be negative, two possibilities occur: (a) Junction transistors: As alpha is less than unity, and as alpha $= r_m/r_c$, $(r_c - r_m)$ is always positive. Hence, $r_e r_m/(R_L + r_e + r_c - r_m)$ is always positive and R_{ie} is always greater than $r_e + r_b$. (b) Point-contact transistors: In this case alpha is greater than 1; therefore, r_m is greater than r_c and $r_c - r_m$ is negative. However, by making R_L greater than $r_c - r_m$, $r_e r_m/(R_L + r_e + r_c - r_m)$ can still be made positive and an input resistance greater than $r_e + r_b$ obtained.

Typical Values

Using the typical values from Table I, $R_{ie} = 35{,}000$ ohms for the point-contact transistor and 700 ohms for the junction unit. These values should be compared with 150 ohms and 90 ohms respectively, obtained for the grounded-base connection.

High Input Resistance

As can be seen from Eq. 6, it is possible, in the grounded-emitter circuit, to make the input resistance quite high by proper choice of R_L. This is not, in general, possible with the grounded-base connection (see Eq. 8). When $R_L + r_e + r_c = r_m$, the denominator of the second term right-hand side, Eq. 6, becomes infinite, and the input resistance becomes, theoretically, also infinite. It is profitable to consider two cases:

(a) Junction: As alpha is less than 1, and r_c is greater than r_m, the second term right-hand side can be made very large only if R_L is very small, and alpha is very near unity, say 0.997. Further, if R_L is made small, the possible voltage and power gain will be small.

(b) Point contact: Making $R_L + r_e + r_c = r_m$ is entirely feasible, and high input resistances are readily achievable in practice.

In Eq. 6 it is very possible that r_m is greater than $(R_L + r_e + r_c)$ if R_L is sufficiently small, and this may easily lead to a negative value of R_{ie}. This leads to a condition of instability wherein the circuit sings or oscillates parasitically. The subject of instability will be treated later in this series.

Voltage Gain

Returning to Eq. 3 and 4, and solving for i_2

$$i_2 = \frac{e_g\,(r_m - r_e)}{[(R_g + r_e + r_b)(R_L + r_e + r_c - r_m) + r_e\,(r_m - r_e)]} \qquad (9)$$

The voltage gain VG_e is then given by

$$VG_e = \frac{-i_2 R_L}{e_g} = \frac{-(r_m - r_e)\,R_L}{[(R_g + r_e + r_b)(R_L + r_e + r_c - r_m) + r_e\,(r_m - r_e)]} \qquad (10)$$

Using typical values, $VG_e = -130$ for point-contact units, and $VG_e = -575$ for junction units.

These values should be compared with 30 and 150 respectively for the grounded-base connection. The negative sign shows that the voltage across R_L and the input voltage e_g are 180 degrees out of phase. Thus it is seen that the grounded-emitter connection produces a phase change of 180 degrees. It will be recalled that the grounded-base connection does not produce phase inversion.

To find the theoretically maximum value of VG_e, one assumes, as was done for the grounded-base connection, that $R_L = \infty$, and $R_g = 0$. Numerator and denominator of Eq. 10 are divided by R_L. Multiplying and dividing numerator by r_c

$$VG_e\,(\max) = -\left[\alpha - \frac{r_e}{r_c}\right]\frac{r_{22}}{r_{11}} \qquad (11)$$

Equation 11 should be compared with Eq. 12 below, which is the corresponding expression for the grounded-base connection of a transistor.

$$VG\,(\max) = \alpha\,\frac{r_{22}}{r_{11}} \qquad (12)$$

The maximum theoretical voltage gain for the grounded-emitter connection is somewhat less than that for the grounded-base connection; however, since for most transistors r_e/r_c is negligible compared to alpha, there is in practice no appreciable difference between these two gains. As the numerical values obtained indicate for specific values of transistor and circuit parameters, the grounded-emitter connection need not always show a smaller gain than the grounded-base connection. The reason follows from the difference in the way the voltage gain varies with R_L and r_c in the two expressions for voltage gain.

Power Gain

Power gain is obtained from the formula

$$PG_e = \frac{I_2^2 R_L}{\dfrac{e_g^2}{4R_g}} = \frac{4R_g R_L i_2^2}{e_g^2} \qquad (13)$$

$$= \frac{4R_g\,R_L\,(r_m - r_e)^2}{[(R_g + r_e + r_b)(R_L + r_e + r_c - r_m) + r_e\,(r_m - r_e)]^2} \qquad (14)$$

Using typical values, $PG_e = 1{,}700$ for point-contact units and 6,600

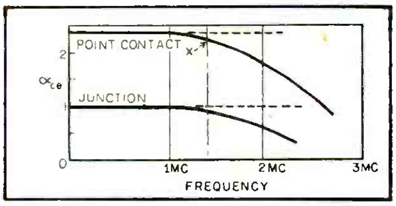

FIG. 5—Curves of α_{ce} vs frequency for grounded-base connection

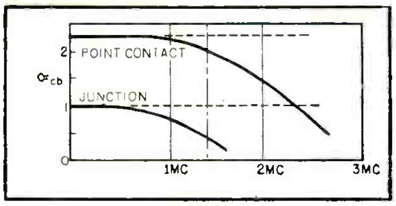

FIG. 6—Curves of α_{cb} vs frequency for grounded-emitter connection

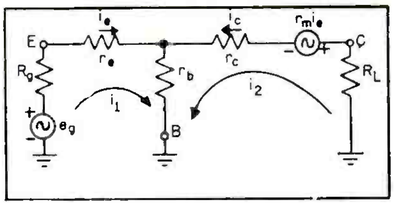

FIG. 7—Equivalent circuit of grounded-base circuit shows loop currents

for junction transistors.

By comparison, for the grounded-base connection, corresponding values are 100 and 440 respectively. The grounded-emitter connection is inherently capable of power gains greater than those for the grounded-base connection.

Output Impedance

To find the output impedance, e_g is set equal to 0 in Eq. 3, and Eq. 4 is set equal to e_g instead of to 0. This is equivalent to removing the signal from loop 1 of Fig. 1, and inserting it in loop 2.

The resulting equations are

$$(R_g + r_b + r_e)\, i_1' + r_e i_2' = 0 \qquad (15)$$

$$(r_e - r_m)\, i_1' + (R_L + r_e + r_c - r_m)\, i_2' = e_g \qquad (16)$$

Solving for i_2'

$$i_2' = \frac{(R_g + r_b + r_e)\, e_g}{[(R_g + r_b + r_e)\,(R_L + r_e + r_c - r_m) - r_e\,(r_e - r_m)]} \qquad (17)$$

$$R_{oe} = \frac{e_g}{i_2'} - R_L$$

$$= r_c + r_e - r_m + \frac{r_e\, r_m - r_e^2}{R_g + r_e + r_b} \qquad (18)$$

Using typical values $R_{oe} = -13{,}000$ ohms for point-contact units and 63,000 ohms for junction units.

The fact that the output resistance is negative for the point-contact transistor indicates that, under average operating conditions, the point-contact transistor tends to be unstable when used in the grounded-emitter connection. Because this type of connection has some very worthwhile features, however, it is sometimes profitable to alter the circuit slightly to make it stable. For a given transistor, r_m, r_c, r_b and r_e are fixed. Adding series resistance to r_e will bring the output resistance into the range of positive values. A resistance of approximately 750 ohms placed in series with the emitter will make R_o plus for the point contact. This is a common artifice to stabilize a transistor circuit.

Because r_c is greater than r_m for junction types, the output resistance is always positive for the junction transistor and it may be inferred that, collating Eq. 18 with Eq. 7, the grounded-emitter connection is unconditionally stable for this type of transistor.

Regarding magnitudes, an inspection of Eq. 18 will show that the very high values of resistance possible for R_i, Eq. 7, are, even theoretically, not feasible for R_o. Since adding a high resistance to r_e to make R_o positive introduces prohibitive losses, just enough resistance is usually added to make R_o slightly positive, for the point-contact unit. Accordingly, the grounded-emitter connection for this type usually results in a high-input, low-output impedance arrangement. For the junction transistors, low-input, high-output impedance arrangements are possible; but, with the proper α_{ce} and R_L, both high input and output impedances are attainable.

Other Advantages

From a biasing standpoint, the grounded emitter has a particular advantage over the grounded base. Figure 2 shows the elementary biasing arrangement for the grounded-base connection.

Speaking generally, since the emitter and collector currents in the base are in opposite directions, it would be difficult to use a single battery, in the base, to bias emitter and collector simultaneously. The directions of current shown in Fig. 2 are electronic; those in Fig. 1 are arbitrary.

In Fig. 3 a possible biasing arrangement for the grounded-emitter connection is shown. Note the use of a single battery for the bias supply. The d-c collector-to-emitter path biases the emitter with respect to the junction point by an amount $I_e r_e$. Point B is negative with respect to point E by an amount $I_b R_g$, and the correct bias polarities are achieved using only one power supply. The polarity in Fig. 3 is for point-contact and *pnp* transistors.

The sketch in Fig. 4 shows the same type of connection for the *npn* transistor. Here, point B is positive with respect to E by an amount $I_b R_b$, and the correct polarities are observed.

One interesting but unfortunate aspect of the grounded-emitter connection is its poor frequency response compared to the grounded-base connection. In transistor work, frequency response usually means α versus frequency. Figure 5 shows two typical curves for α versus frequency for a point-contact unit and the junction unit, both measurements having been made using a grounded-base connection. Figure 6 shows frequency response curves for the same units in the grounded-emitter connection.

Current Gain

In general, alpha is a measure of the current gain in the transistor, and is defined as $-i_c/i_e$. For the grounded-base connection, it can be verified from Fig. 7 that $i_c = i_2$ and $i_e = i_1$, and that for this connection only

$$\alpha = -\frac{i_c}{i_e} = -\frac{i_2}{i_1} \qquad (19)$$

A notation frequently used in the literature is to use the small letter a for the ratio of output to input current, that is

$$a = \frac{i_2}{i_1} \qquad (20)$$

and from Eq. 19, for the grounded-base connection

$$\alpha = -a \qquad (21)$$

In the case of the grounded-emitter connection, it is not so much the ratio of collector current to emitter current that is of interest, as the ratio of output to input current, a. The ratio of collector to emitter current is invariant with the method of connection. Except for stray capacitance, the transistor does not know how it is hooked up; but the ratio of output to input current differs quite widely for the three possible connections. The grounded emitter current gain varies with α_{ce}. In practical transistor measurements it is common to measure the grounded-base alpha, α_{ce}, and to compute from this data the grounded-emitter current gain.

In specifying alpha, it is convenient to use the letters c, b, and e as subscripts and by their sequence to indicate the method of connection. In practice, the letters in the subscript state first the output current terminal, and then the input current terminal—the letter omitted implies the common or grounded terminal. Thus, α_{ce} is the grounded-base α, α_{cb} the grounded-emitter α, and α_{eb} the grounded-collector α. When speaking of the frequency response curves, the ratio of output to input current versus frequency is taken, not the ratio of collector current to emitter current.

From Eq. 5 and 9, the value of a for the grounded-emitter connection is

$$\frac{i_2}{i_1} = \alpha_{cb} = \frac{r_m - r_e}{R_L + r_e + r_c - r_m} \qquad (22)$$

While this is true mathematically, from the physical standpoint this relation has limited use as a comparison number for transistors because the gain shown may differ over a very wide range depending on the value selected for R_L. It will be recalled that alpha for the grounded-base connection is measured with the collector shorted. Consider the equations of the grounded-base connection:

$$v_1 = (R_g + r_{11})\, i_1 + r_{12} i_2 \qquad (23)$$

$$v_2 = r_{21} i_1 + i_2\,(R_L + r_{22}) \qquad (24)$$

If v_2 is set equal to 0, (short-circuit the collector and put R_L equal to 0)

$$-\frac{i_2}{i_1} = \frac{r_{21}}{r_{22}} \qquad (25)$$

which is α_{ce} by definition.

Hence, to get a comparable figure of merit, and render the result independent of R_L, α_{cb}, the current gain for the grounded-emitter connection, is defined by putting $R_L = 0$ in Eq. 22.

$$\alpha_{cb} = \frac{r_m - r_e}{r_e + r_c - r_m} = \frac{\dfrac{r_m}{r_c} - \dfrac{r_e}{r_c}}{\dfrac{r_e}{r_c} + 1 - \dfrac{r_m}{r_c}} \qquad (26)$$

Neglecting r_e/r_c compared to r_m/r_c and to unity and using the grounded-base alpha definition, $\alpha_{ce} = r_{21}/r_{22} \approx r_m/r_c$

$$\alpha_{cb} = \frac{\alpha_{ce}}{1 - \alpha_{ce}} \qquad (27)$$

Equation 27 does not depend on the load resistance, and shows how the current gain for the grounded-emitter connection varies with the grounded-base current gain, α_{ce}. A significant aspect of the grounded-emitter connection is that current gains greater than unity are entirely possible, using junction transistors. Typical values are

$\alpha_{cb} = -1.66$ for point-contact unit (28)
(the minus sign indicates phase reversal)

and $\alpha_{cb} = 24$ for junction units. (29)

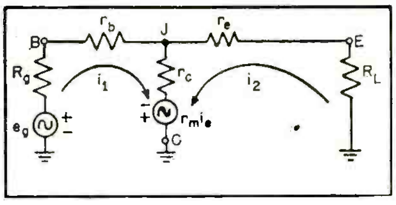

FIG. 8—Equivalent circuit of grounded-collector connection

Frequency Response

The ordinate in Fig. 6 is α_{cb} of Eq. 27. The reason for the relatively poor frequency response of the grounded-emitter connection compared to the grounded-base arrangement may be seen.

Due to the capacitance, both stray and internal, and to the transient time dispersion effects[8], at some frequency below cutoff, α_{ce} falls off by 10 percent. This would be point X of Fig. 5. When α_{ce}' is 0.9 α_{ce}

$$\alpha_{cb}' = \frac{0.9\,\alpha_{ce}}{1 - 0.9\,\alpha_{ce}}$$

(using Eq. 27) and for the junction type $\alpha_{cb}' = 6.34$.

Comparing this value with $\alpha_{cb} = 24$ (Eq. 29) when α_{ce} was 0.96, it is seen that, due to the nature of the $\alpha_{ce}/(1 - \alpha_{ce})$ function, when α_{ce} falls off by 10 percent, the grounded-emitter alpha, α_{cb}, falls off by almost 75 percent. The frequency response of the grounded-emitter connection falls off much more rapidly than the inherent frequency response of the transistor as measured by α_{ce}.

These effects are illustrated by Fig. 5 and 6. Both curves are for the same transistors, but Fig. 5 was obtained using the grounded-base arrangement, and Fig. 6 using the grounded-emitter arrangement. A rule of thumb sometimes useful is to consider that the frequency of alpha cutoff, using the grounded-emitter connection, may be a fifth or less of the response using the grounded-base arrangement.

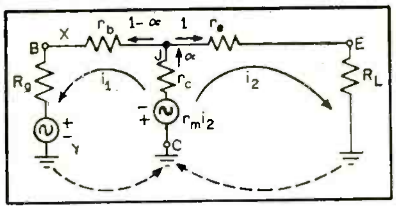

FIG. 9—Grounded-collector connection using electron flow

As the numerical example shows (see Eq. 28) for point-contact transistors the grounded-emitter current gain will usually be negative. From Eq. 27, if α_{ce} is greater than unity, as in the case of point-contact units, α_{cb} is negative, representing an 180-degree phase reversal in current.

It is desirable to bear in mind that:

(1) When the signal is fed into the emitter, and the output taken from the collector, the transistor will introduce no significant phase change, regardless of the method of connection. Under special conditions of loading and frequency dependence of parameters, changes in phase may be observed, but these will in general be less than 180 degrees. The significant point is that phase change is essentially associated with the method of feeding the signal into the transistor;

the method of connection introduces a phase change only because it determines the method of feeding the signal. The grounded-base connection is an illustration of feeding the signal into the emitter and taking the output from the collector—no significant phase change is observed.

(2) A phase change is usually observed in the grounded-emitter connection because the signal is fed into the base. A similar effect will be observed for the grounded-collector connection, where the signal is also fed into the base.

Unlike the vacuum tube, which is usually considered to be essentially a voltage amplifier, the transistor usually amplifies both voltage and current concomitantly. For the grounded-emitter connection, where both current gain and voltage gain are usually greater than unity for both point-contact and junction units, the transistor is a power amplifying device. As an illustration, in transistor equipments using several stages in cascade, or in a typical superheterodyne arrangement beginning with the very first r-f stage, one computes power gain stage by stage, so that there is a successive power build-up. This method of computation should be compared with the vacuum-tube analog, where voltage gains only are normally computed, up to the one or two last power gain stages.

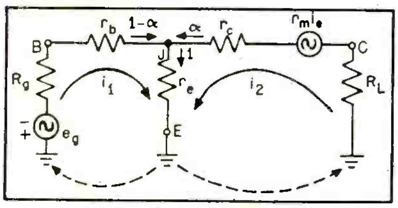

FIG. 10—Grounded-emitter connection using electron flow

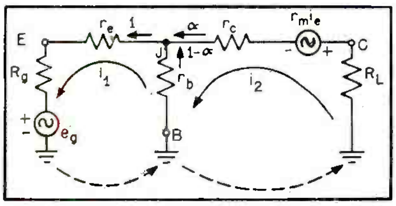

FIG. 11—Grounded-base connection using electron flow

Grounded Collector

The third principal method of connection of transistors is in the grounded-collector or common-collector connection. An equivalent circuit diagram is given in Fig. 8.

In writing the circuit equations, bearing in mind the rules previously laid down in Part VII of this series[1], the following must be considered for the grounded-collector equivalent circuit:

(1) Current i_e = current through r_e which flows toward junction J, and is in this case given by i_2, that is $i_2 = i_e$.

(2) The polarity of $r_m i_e$, consistent with the usage for the grounded-emitter and grounded-base connections, is chosen minus toward junction J, and plus toward the collector terminal.

(3) For the grounded-collector connection, i_c = current through $r_c = i_1 + i_2$.

The current-determining equations are

$$(R_g + r_b + r_c)\, i_1 + (r_c - r_m)\, i_2 = e_g \qquad (30)$$

$$r_c\, i_1 + (R_L + r_e + r_c - r_m)\, i_2 = 0 \qquad (31)$$

$$i_1 = \frac{e_g\,(R_L + r_e + r_c - r_m)}{[(R_g + r_b + r_c)\,(R_L + r_e + r_c - r_m) - r_c\,(r_c - r_m)]} \qquad (32)$$

$$i_2 = \frac{-e_g\, r_c}{[(R_g + r_b + r_c)\,(R_L + r_e + r_c - r_m) - r_c\,(r_c - r_m)]} \qquad (33)$$

The value of i_2 when e_g is considered to be in series with R_L is

$$i_2' = \frac{+\,e_g\,(R_g + r_b + r_c)}{[(R_g + r_b + r_c)\,(R_L + r_e + r_c - r_m) - r_c\,(r_c - r_m)]} \qquad (34)$$

Input Resistance

The input resistance of the grounded-collector circuit is

$$R_{ic} = \frac{e_g}{i_1} - R_g$$

$$= r_b + r_c - \frac{r_c\,(r_c - r_m)}{R_L + r_e + r_c - r_m} \qquad (35)$$

Typical values are R_{ic} = 2 megohms for point-contact units and + 0.7 megohm for junction units.

The high input resistance obtainable from the grounded-collector connection is in sharp contrast to the input resistance of a few hundred ohms for the grounded-base connection.

Thus it is seen that the grounded-base connection exhibits a low input resistance, while the grounded-emitter and grounded-collector connections show quite a high input resistance. Redrawing Fig. 8, using this time instantaneous electron current flow paths, instead of the arbitrarily-selected current directions, Fig. 9 is obtained.

R_L Equals Zero

If a unit change of current occurs through r_e, since the current gain is α_{ce}, a current change of $\alpha_{ce} \times 1$ will occur through r_c. At the junction point J, since the sum of the currents at a junction must be zero, a current of $1 - \alpha_{ce}$ units will flow through r_b. This is the condition for $R_L = 0$, that is, output shorted, for the current through r_c is not exactly α_{ce} times the current in r_e unless $R_L = 0$, by definition. When α_{ce} is very near unity, $1 - \alpha_{ce}$ is very near zero, and therefore a very small current flows in loop 1, and the circuit to the right of points X-Y (Fig. 9) presents a high impedance to generator. The current gain for the grounded-collector connection is given by the equation

$$\alpha_{eb} = \frac{i_2}{i_1} = \frac{-1}{1 - \alpha_{ce}} \qquad (36)$$

Typical values are 0.77 for point-contact units and −25 for junction units.[8]

In Fig. 10 for the grounded-emitter case, a unit change in current through r_e results in α_{ce} times that change in current through r_c, for $R_L = 0$. The net current change through r_b is $1 - \alpha_{ce}$ and tends to make i_1 very nearly equal to 0 and the input impedance high, as alpha approaches unity. Note also how the current gain is now $i_2/i_1 = \alpha_{ce}/(1 - \alpha_{ce})$ in agreement with Eq. 27.

In Fig. 11 for the grounded-base connection, unit current change through r_e produces $\alpha_{ce} \times 1$ current change through r_c, and therefore $1 - \alpha_{ce}$ current change in r_b. Hence the input current through r_e does not approach 0 as α_{ce} approaches 1. Thus the input resistance for the grounded-base connection will never become very high.

R_L Not Zero

When R_L is not zero, a slightly different approach will provide the physical interpretation for the high input resistance. In Fig. 9 for the grounded-collector connection when

R_L and i_2 have values such that

$$e_g \cong i_2 (r_e + R_L) \quad (37)$$

or when

$$e_g \cong i_2 (r_m - r_c) \quad (37')$$

a very small drop in $r_b + R_g$ only is involved, that is $i_1 = 0$, and the input impedance is high. If Eq. 37 and 37′ are valid, then

$$r_e + R_L = r_m - r_c \quad (38)$$

The significance of Eq. 38 can be seen by considering Eq. 32. Since none of the terms in the denominator can ever be infinite for finite values of load resistance, the only way for i_1 to be close to zero is for the numerator to be very nearly zero, that is

$$R_L + r_e + r_c - r_m \cong 0 \quad (39)$$

When a value of R_L is used which makes Eq. 39 true, then R_i may become very high, see Eq. 35, and the physical interpretation is that an insignificant amount of current is drawn from the source generator e_g. The condition expressed by Eq. 39 is identical to that in Eq. 38, verifying the conditions for high input resistance.

Similar remarks apply to the grounded-emitter connection. (See Fig. 10). When

$$e_g \cong (i_2+i_1)\, r_e = (R_L+r_c-r_m)\, i_2 \quad (40)$$

i_1 is approximately zero, and the drop across $R_g + r_b$ is negligible. When $i_1 \cong 0$, from Eq. 40

$$i_2 r_e \cong (R_L + r_c - r_m)\, i_2 \quad (41)$$

Transposing Eq. 41, R_L must be selected so that

$$R_L + r_e + r_c - r_m = 0 \quad (42)$$

exactly as in Eq. 39. This is confirmed by Eq. 5, where it may be seen that if Eq. 42 is true, loop 1 current is negligible. From Eq. 6 one can then observe that if Eq. 42 is valid, the input resistance may be quite high.

But these remarks do not apply to the grounded-base connection. For the grounded base case,

$$i_1 = \frac{e_g\,(R_L + r_b + r_c)}{[(R_g+r_b+r_e)\,(R_L+r_b+r_c) - r_b\,(r_b+r_m)]}$$

and by inspection this cannot be made to approach 0 by any choice of R_g and R_L, and therefore a high input resistance is impossible.

Returning now to the analysis of the grounded-collector connection,

$$VG = \frac{-i_2 R_L}{e_g}$$

and, using Eq. 33

$$VG = \frac{r_e\, R_L}{[(R_g+r_b+r_e)(R_L+r_e+r_c-r_m) - r_e\,(r_c-r_m)]} \quad (43)$$

Typical values for VG are slightly less than unity, but positive, for point-contact and junction transistors.

Output Resistance

Since $R_o = (e_g/i_2') - R_L$, using Eq. 34

$$R_o = r_e + r_c - r_m - \frac{r_e\,(r_c-r_m)}{R_g+r_b+r_e} \quad (44)$$

Typical values for R_o are −650 for point-contact units and 65 for junction units.

The grounded-collector connection is a low-resistance output connection. While the negative sign of R_o for the point-contact connection is generally undesirable, producing an unstable condition, nonetheless, proper operation is possible. If a stabilizing resistance of about 1,000 ohms is added in series with the output, (in series with r_e at the emitter) the net output resistance becomes positive.

Cathode Follower

Considering the high input resistance and low output resistance levels of the grounded-collector connection, and bearing in mind the low voltage gain figures obtained, a close analogy between this method of connection and the cathode follower of vacuum tube practice is observed. The current gain for the junction type (Eq. 36) is 25, further improving the analogy.

For the point-contact type, the current gain is rather poor, + 0.768, and combined with the negative output indicates that, in general, the applications of point-contact transistors connected in this way are rather limited. For the junction transistors, both input and output resistances are positive, and the relative magnitudes suggest strongly the transformer step-down effect obtainable in the cathode follower.

A disadvantage of the grounded-collector connection arises from the fact that the output is taken from the emitter terminal, see Fig. 8. Because the output is taken from the emitter terminal, large output voltage swings are not feasible. In general, emitter biases are of the order of 1 volt, and collector biases up to 50 volts. Excessive voltage swings in the emitter will move it into regions where the transistor is either entirely inoperative as a transistor, or has reached saturation as evidenced by clipping.

Regarding the power capabilities, using Eq. 33

$$PG = \frac{4R_g R_L i_2^2}{e_g^2} = \frac{4R_g R_L r_e^2}{[(R_g+r_b+r_e)(R_L+r_e+r_c-r_m) - r_e\,(r_c-r_m)]^2}$$

Typical values for power gain in the grounded-collector connection are 0.1 for point contact units and 0.02 for junction units.

The power gain of the grounded-collector connection may be made somewhat higher by suitable choice of R_L and R_g, but in general tends to be unimpressive. In practice, the grounded-collector connection is used principally as a coupling device for impedance matching and, using the junction transistor, for current gain. It is clearly not suited for voltage or power amplification. There is experimental evidence that the frequency response of this connection holds some promise.

Summary

This article has pointed out the pertinent operating characteristics of transistors in grounded-emitter and grounded-collector connections, as compared to the grounded-base connection explained in the previous part of this series.

These characteristics are summarized in Table II, which appears on page 167 of this issue.

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(1) Abraham Coblenz and Harry L. Owens, Equivalent Transistor Circuits and Equations, ELECTRONICS, p 156, Sept. 1953.

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(3) R. L. Wallace and W. J. Pietenpol, Some Circuit Properties and Applications of npn Transistors, *BSTJ*, p 530, July 1951.

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PCM Coding System Uses Special Tubes

Multielectrode selector and coding tubes translate voltages sampled from signal into pulse-code impulses. Circuit is more simple and compact than present pulse-code modulators. Basic system can be used for analog-to-digital data conversion, speech scrambling, statistical tabulation and pulse-height analysis

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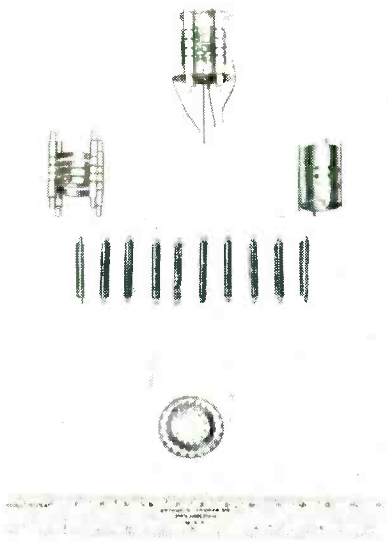
USE OF PULSE-CODE modulation has been restricted, especially in airborne telemetering, by the weight, size and complexity of the modulating equipment.

The basic pulse-coding system to be described achieves a reduction in weight, size, complexity and power consumption over present pulse-code modulation methods. Two special tube types, incorporated in a circuit requiring a minimum of additional components, perform the functions of sampling, quantizing and coding. Sampling is achieved in the selector tube, a ribbon-beam cathode-ray tube having ten separate targets. Quantizing and coding are done in the coding tube, which has ten stable electron-beam positions produced by crossed electric and magnetic fields. In addition to simplifying pcm circuits, the method described may be useful in related techniques such as analog-to-digital data conversion, statistical tabulation and pulse-height analysis.

The Selector Tube

The beam-deflection selector tube is shown in cross section in Fig. 1A. The electron gun produces an efficient ribbon beam that comprises over 90 percent of the cathode current. The tube delivers high beam current at low accelerating voltage, 1 ma at 250 volts. This low voltage permits a deflection sensitivity of 12 volts per target.

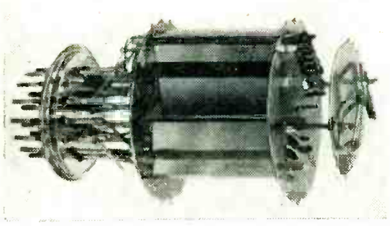
Use of a ribbon beam allows short, sharp focusing in a small bulb size. The tube fits in a bulb $1\frac{1}{2}$ in. in diameter and $1\frac{3}{4}$ in. high. The ten targets are 0.060-in. wires with suitable suppressors. Each target is brought out individually through the stem. The electrical characteristics of the gun and three targets are given in Fig. 2. Reliability is provided by a low-power heater (2 watts), low cathode-current density, absence of critical element spacing and simple construction requiring a minimum of control elements and external circuits.



Exploded view of coding tube shows four stacked collector rings that surround anode. Apertures in anode determine which ring receives current

The Coding Tube

The coding tube is shown in cross section in Fig. 1B. An electric field and an axial magnetic field within the tube produce ten stable beam positions of which no more than one is possible at a given time. While the beam is holding in any position, portions of it are permitted to pass through coded apertures in the anode to the four rings comprising the parallel binary digits; 300-400 microamperes may pass through each aperture. The tube and its associated permanent magnet occupy a space $1\frac{3}{4}$ in. in



Basic elements of selector tube. Ribbon-shaped electron beam strikes one of ten targets as determined by deflection voltage derived from signal source. All connections are brought through the base of the tube

diameter and 1¼ in. high.

With a uniform magnetic field of 300 to 350 gausses within the tube and all electrodes 100 volts positive with respect to the cathode few electrons leaving the cathode reach any of the positive electrodes. However, if the potential of one of the spades is lowered and the current to this spade monitored, the characteristic of Fig. 3 will result. If a 100,000-ohm load resistor is placed in this circuit, two stable operating points will be produced: one near +100 volts and the other near cathode potential

With resistors in all the spades, and a spade and anode supply of 100 volts, assume the tube to be initially cut off. If the potential of one of the spades is lowered beyond the point of unstable equilibrium, usually 40 volts positive with respect to cathode, that spade will operate at its lower stable point, 1 ma, with the anode and collector rings receiving a total of 8 ma. Holding action will continue until operating conditions are changed externally, thus providing a simple memory device.

Circuit Operation

A partial coding circuit is shown in Fig. 4. Only three of the ten connections are completed. Assume that the coding tube is cut off and the selector-tube beam is cut off by bias on its focus electrode. If the deflection-plate voltage is of the proper amplitude and the beam is turned on for a short time, the beam will fall on one of the targets, thus lowering its potential. As this potential passes the point of unstable equilibrium on the spade characteristic, the spade will take over and assume its stable position near cathode potential. It will make no difference if the selector-tube beam is turned off; the coding tube will remember the selected target.

Only one spade will assume its low operating potential when the beam falls equally on two targets. The spade that holds is determined by the direction of the magnetic field applied to the coding tube. This choice remains constant once the apparatus is set up. The coding tube is cleared before each sample is taken; thus only the new level will be stored.

A complete pcm circuit is shown in Fig. 5. If one of the spades in the coding tube is holding, the cathode current for the tube is approximately 9 ma. The cathode resistor for the triode control tube is adjusted until the voltage at its plate is about 100 volts below the coding tube spade-anode supply, about 150 volts above ground.

Next, the voltage on the selector-tube focus electrode is made sufficiently negative with respect to ground and its own cathode that the selector beam is cut off and no current reaches the targets. Any voltage applied to the deflection plates produces no output. However, if the beam is turned on momentarily, current will strike a target corresponding to the amplitude of the deflection voltage at the instant of sampling.

The signal to be sampled and coded is applied to the selector-tube deflection plates. If a negative sampling pulse is applied to the input the control triode and coding tube will be cut off. Simultaneously, the same sampling pulse turns the selector-tube beam on and the beam falls on a target corresponding to the instantaneous deflection-plate voltage.

During the sampling pulse the R-C network comprising the load resistance and stray capacitance of the previously-holding spade discharges and the R-C network in the new position charges through the selector-tube beam. The sampling pulse must be long enough for both these actions to be completed, approximately 3 microseconds. Since 1 ma of beam current is available, the final potential across the new R-C combination will be close to 100 volts.

At the end of the sampling pulse, the selector tube is turned off and the coding tube turned on with the selected spade held at or near coding-tube cathode potential as a

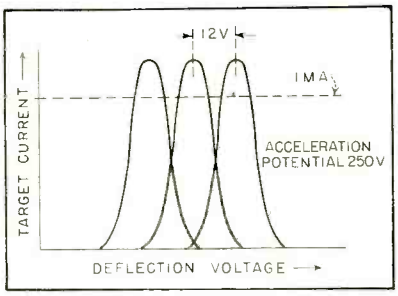


FIG. 2—Selector-tube deflection characteristics of three adjacent targets

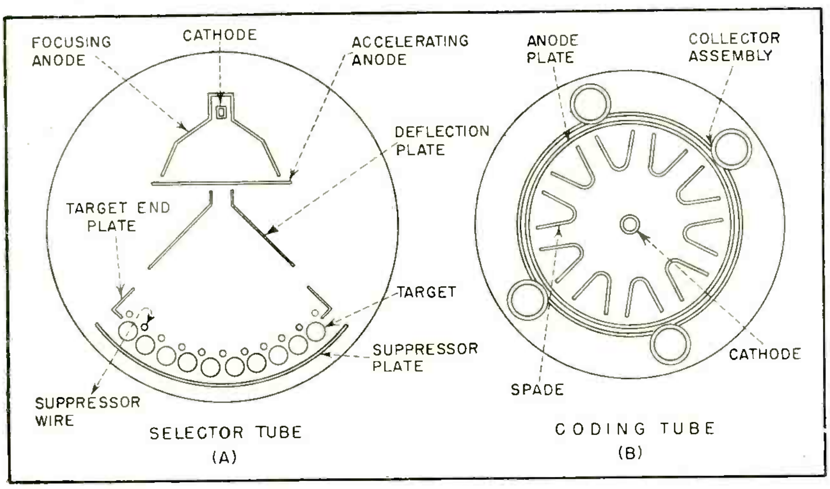


FIG. 1—Cross-section views of special tubes used in pulse-code modulation system

result of charge stored in its stray capacitance. With low potential on one spade, the coding tube locks on it. Coding-tube current goes to this electrode and to the anode and proper collector-ring outputs. This condition will be maintained until the next sampling pulse causes the action to be repeated.

Outputs

The output of the coding tube is determined by monitoring the current to the four collector rings. Each ring either receives current or does not, depending upon the relative location of the beam and the coding of the anode apertures.

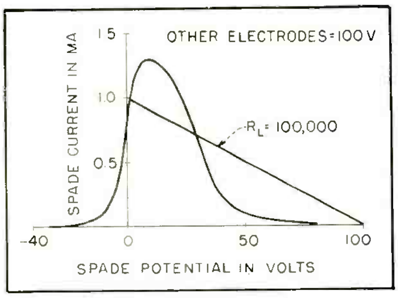


FIG. 3—Spade characteristic for coding tube

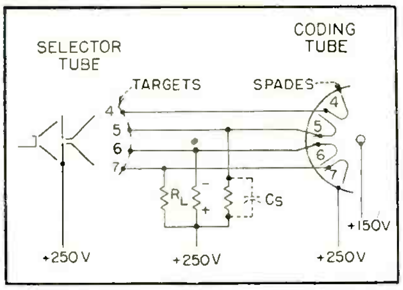


FIG. 4—Basic coding circuit for pulse-code modulation

The output is in straight decimal-to-binary notation. Use of the rings as output permits a wide range of voltage and impedance levels to be delivered to the load.

The output may be derived alternatively from the spades, with a low potential indicating the presence of the beam at that level. However, this method is limited by loading effects on the spades, and does not provide the desired binary-coded output.

Increasing Sampling Levels

Where greater definition is required, the use of these tubes may be extended by interconnecting two systems of the type described. As many as twenty levels may be obtained.

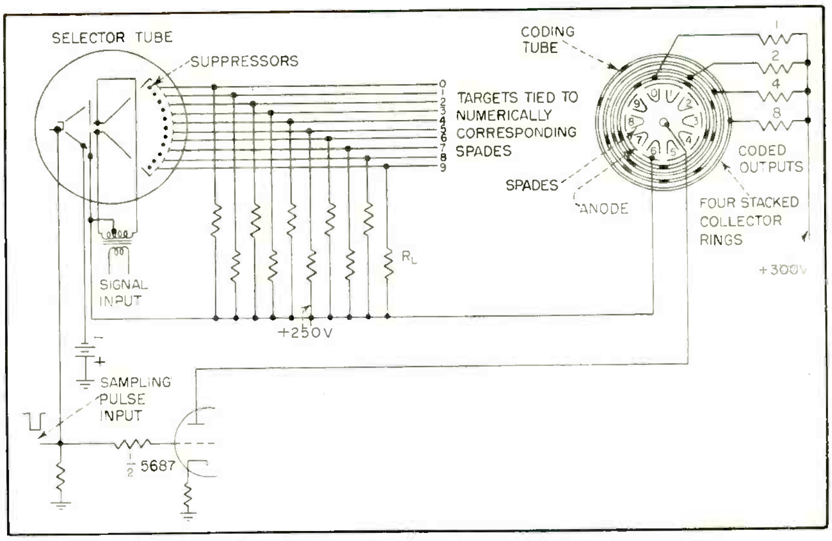


FIG. 5—Coding system for pulse-code modulation

To specify completely the increased number of sampling levels, a fifth binary digit is necessary that is obtained from one of the spades, selected so that its output is high when the positive half of the input signal is sampled and low when the negative part of the signal is sampled. The coded output then consists of a four-digit binary code representing signal amplitudes from 0 to 9, with the fifth digit indicating plus or minus.

One hundred levels may be obtained by arranging one pair of tubes to read the tens digit, with a feedback network to the second pair where the units digit can be read.

Other Applications

In an analog-to-digital converter, the analog voltage to be converted can be applied to the selector-tube deflection plates, with the digital output taken in decimal form from the coding-tube spades or in binary form from the collector rings. The required output accuracy determines whether 10, 20 or 100 levels are to be sampled.

The tubes may also be used in enciphering or speech scrambling. Instead of wiring a 1-to-1 correspondence between targets and spades, the leads from both targets and spades are brought to a plug-board, and the relationships changed by rearranging the wiring.

This pcm system may also be adapted for use in statistical tabulation. A multi-output tube has been developed for this purpose. Instead of coded holes and collector rings, the anode has a slot in each of ten possible positions with an individual target outside each slot. These targets receive appreciable currents, and are electrically isolated from the spades and anode. If a voltage proportional to the data to be tabulated is applied to the deflection plates, a single output is created that operates the counter to tabulate the data.

Another possible application is that of a pulse-height analyzer. Pulses, the height of which are to be analyzed, are applied to the selector-tube deflection plates. Turning the beam on at the peak amplitude of the pulse initiates the sampling and quantizing action.

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Wide-Range Vacuum Gage

Linear cold-cathode radium-type gage measures gas pressures from 1,000 to 0.0001 millimeters of mercury absolute with consistent accuracy. Collection of ions is made in a low-voltage field to minimize contamination of electrodes

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AN OUTGROWTH of the radium-type vacuum gage invented by Downing and described by Mellen[1], the gage to be described has six linear ranges to cover pressure measurements from 1,000 to 0.0001 millimeters of mercury.

The response of the gage is practically instantaneous, and the output signal to the meter is linear and proportional to the gas pressure. The signal is determined by the collection of gas ions produced by a constant flux of alpha particles emitted from a small nonhazardous sealed radium source. Essentially, all of the ions produced are collected in either of the two ionization chambers, one for the high ranges: 1,000, 100 and 10 mm, and one for the low ranges: 1, 0.1 and 0.01 mm. The ion current is amplified by a factor of 10^7 and is indicated by a panel meter or a recorder. A low-voltage collection field is used, thereby eliminating the problems of contamination of the electrodes.

The use of a special small chamber built into the measuring head excludes the possibility of nonlinearity due to recombination of the ions in the high-pressure ranges, a factor which limited the use of the previous gage. This has been done without sacrificing any of the inherent advantages of the previous gage, which included rugged construction, no filament, operation at the temperature of the gas being measured and the absence of mercury introduced into the system. The gage is normally calibrated for air but may recalibrated for other gases.

The volume of the sensing element has been kept small so that the pressure in the element will follow more closely sudden pressure changes in small-vacuum systems. The entire sensing element, including the radium source, range resistors, thermal relays, preamplifier and collector electrodes is mounted in a shell similar to that of a metal 6L6, which has a volume of about 50 cc as compared with 450 cc for the previous gage.

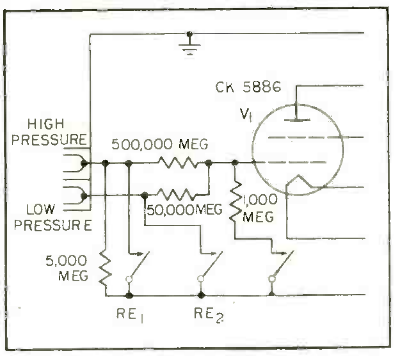


FIG. 1—Input circuit of vacuum gage. Relay RE_1 is closed for low-pressure-chamber operation. For high-pressure operation, RE_2 is closed

Sensing Element

As shown in the photograph, the sensing element consists of the ionization chamber and the preamplifier enclosed in a metal envelope. Separating them is a thin brass disk that is used to mount the radium source and the special small high-pressure chamber.

Below the disk is mounted the electrometer tube, the various input resistors and the range-changing relays. Since these components are located in the vacuum to be meas-

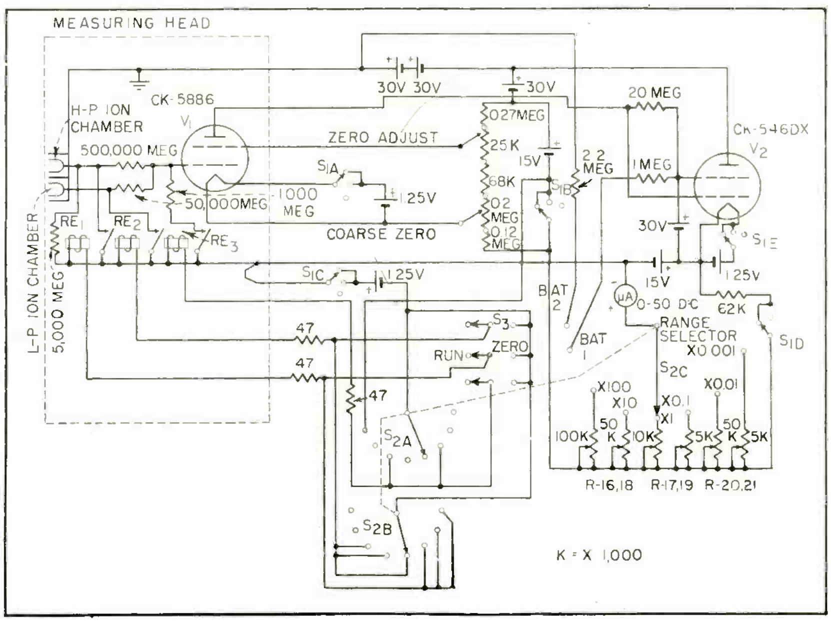
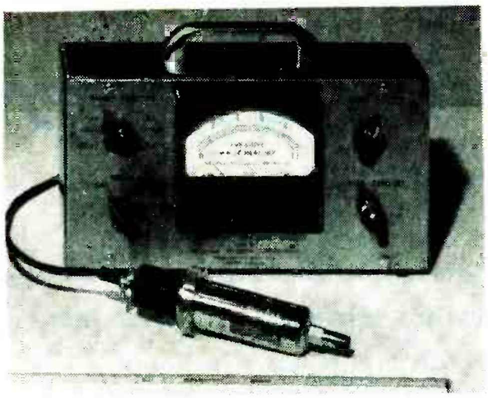
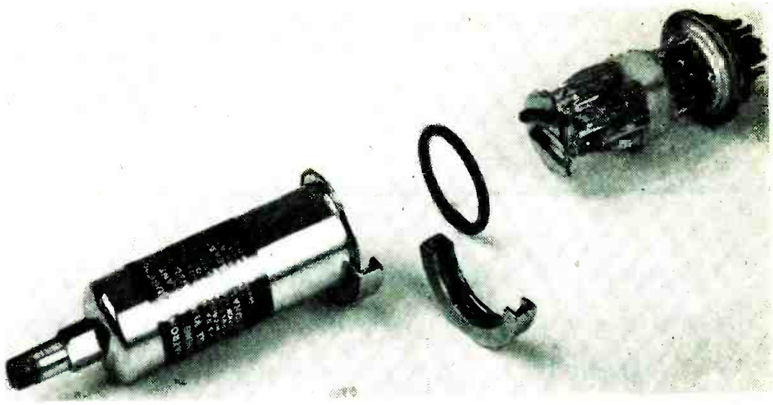


FIG. 2—Complete circuit of wide-range vacuum gage



Chamber volume of present vacuum gage is 50 cc against previous model's 450 cc



Exploded sensing element shows radium source, high-pressure chamber, collector electrode, electrometer tube, range relays, resistors and vacuum seal

ured, no special feedthrough insulators are necessary. The positive-ion collectors are merely the resistor leads extending into the ionization chambers. A Neoprene O ring seals the tube-envelope flange to the header flange and is compressed with a ring clamp around the flanges. For special applications, this joint may be made using solder.

D-C Amplifier

The Roberts[3] d-c amplifier circuit with the improvements developed by N. F. Moody[4] is essentially the basic circuit. A CK-571AX (5886) electrometer pentode is used in the input stage and a CK-546DX pentode in the cathode follower.

The low filament currents assure a long life for the filament batteries. Since the input resistor to the amplifier is 100,000 megohms on the lowest pressure range, it is necessary to connect the amplifier directly to the chamber. Therefore, the sensing element includes the first stage of the two-stage amplifier as well as the input switching circuits for range changing.

The six ranges are selected by means of three thermal relays. These relays are made specifically for switching very-high-impedance circuits and are available only in a single-pole, single-throw arrangement in which the arm of the relay is directly connected to one heater lead. Switching of the two high-impedance collector electrodes with one relay is impossible. To provide six ranges, it is necessary to connect the large chamber for the three low-pressure ranges and the small chamber for three high-pressure ranges to the electrometer grid.

The input circuit shown in Fig. 1 was developed to provide the necessary switching with the relays available. In each case the relay connects the unused collector to the feedback line. In order to zero set, both relays are closed, thereby simulating zero pressure in the ionization chamber. A third relay changes the input resistance to give two ranges for each chamber.

The remainder of the circuit is similar to that developed by Moody with the addition of the switching circuits. In the original Roberts circuit, the order of stability achieved was dependent on the gain of the feedback loop. Vacuum-tube electrometers are inherently low-gain tubes due to the low plate voltages and currents required for minimum grid current. To improve the loop gain and zero stability, positive feedback is added around the cathode-follower stage from the cathode to the plate of the electrometer tube.

In the previous gage, the ionization chamber produced a constant output current at all pressures below one micron. The current was the equivalent of that produced by 4.5 microns of air pressure. This dark current was found to be caused by the direct collection of alpha particles (positively charged He atoms) that hit the collector.

To balance out this current, the zero of the amplifier was displaced downscale so that at zero pressure the meter read zero. However, when the range was extended to 10 microns full scale, this dark current zero correction amounted to 45 percent of full scale and would have required a meter-reversing switch. In the new gage a shield prevents the alpha particles from striking the collector, eliminates the dark current and allows the sensitivity to be increased even further into the low-pressure range.

The minimum pressure that can be measured is limited by several factors. Among these are the grid current of the electrometer tube, the response time constant and the permissible contamination without loss of accuracy. The grid current of the electrometer tube sets an ultimate limit of about 10^{-6} mm as the lowest measurable pressure. This would require an input resistor of ten-million megohms giving a response time constant of well over one minute.

With an input resistor of only 100,000 megohms the input time constant is about 5 seconds and the negative feedback of the amplifier reduces the meter response to less than one second. Contamination that causes shunting of the input resistor also becomes a real problem if the resistor is increased above this value. These practical considerations limit the input resistance to 100,000 megohms, which corresponds to a minimum pressure reading of 10^{-4} mm.

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Zero-Intercept

Phase meter uses new comparator circuits to determine zero-axis intercept of waveforms. Measures phase angle between two symmetrical or unsymmetrical waves at frequencies from 100 kc down to practically zero. Phase lead or lag is also indicated

By Y. P. YU *Chief Engineer, Advance Electronics Co., Passaic, N. J.*

INSTRUMENTS for measuring phase angle usually require the generation of two square waves from two input signals by successive processes of amplifying and clipping. The square waves are fed to a summing amplifier. The plate current of the sum amplifier is directly proportional to the phase angle between the two alternating voltages.

A direct current meter measuring the plate current can be used to indicate the phase angle between the two signals. However, phase lead or lag cannot be identified when this method is used.

Another method employs two differentiating circuits and a bistable multivibrator. The two square waves are fed to separate differentiating circuits, and the output pulses of both circuits are used to trigger the bistable multivibrator.

Averaging Effect

The chief difficulty of these methods lies in making the phase angles of the resultant square waves equal to those of the applied signal. Any variation in supply voltages, or in the d-c potentials across various coupling capacitors due to the harmonic contents of the applied signals, may change the levels at which clipping takes place. As a result the period of the positive loops of the resultant square waves will no longer equal that of the negative loops.

Since the zero axis of an alternating waveform moves to the line representing the average value of the waveform after an R-C coupling network, the phase angle of the resultant square wave would be very different from that of the original signal wave if a slightly

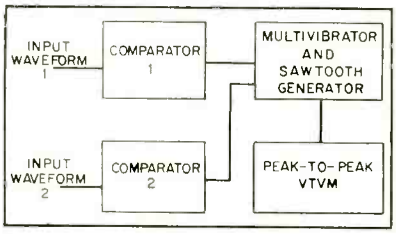

FIG. 1—Block diagram of phase meter. Peak to peak voltmeter measures amplitude of sawtooth wave generated between pulses from comparator circuits

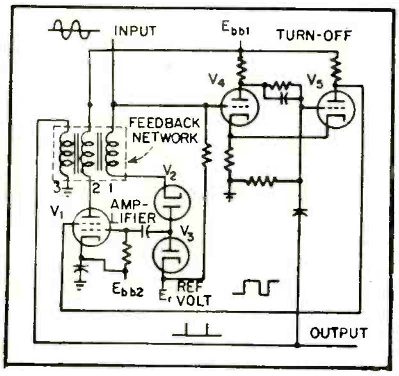

FIG. 2—Basic comparator circuit uses amplifier with regenerative feedback to control flip-flop turn-off stage

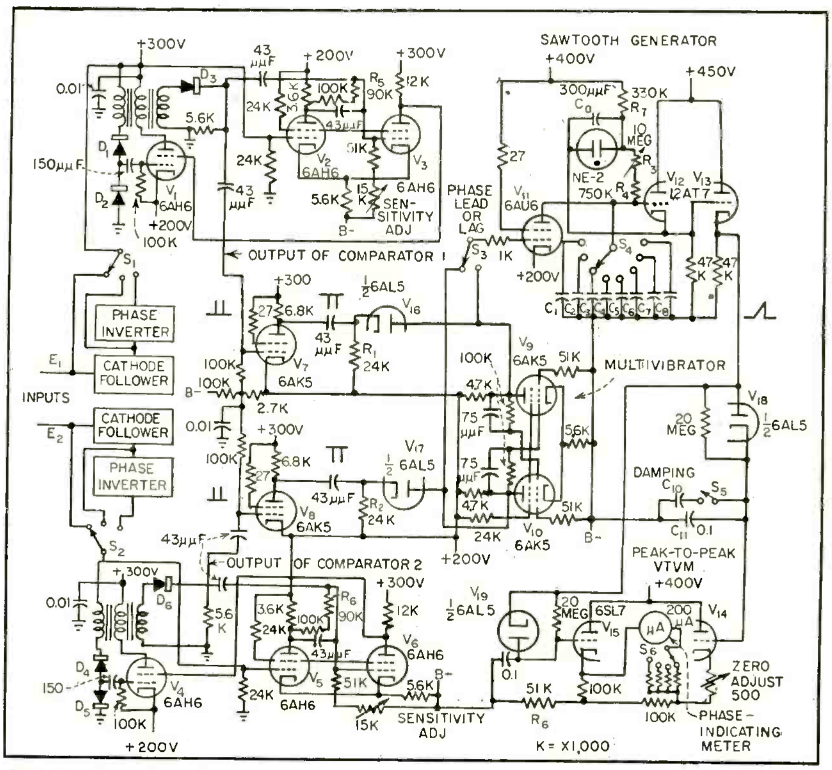

FIG. 3—Complete phase meter circuit uses cathode follower inputs with or without phase inverters. Pulses from comparators control operation of sawtooth generator through multivibrator

Phase Comparison Meter

Front panel of type 404A Advancetron phase meter. Input jacks for waveforms being compared are at either end of panel. Controls next to each input provide for inserting 20-db attenuation and 180-degree phase shift. Indicator is 200-μa meter movement with 0-36, 0-90, 0-180 and 0-360 deg ranges

unequal change in clipping level occurs at an early stage.

The phase meter to be described here is shown in Fig. 1. Two comparator circuits are used, each producing a pulse when its input wave crosses the zero axis. The first pulse initiates generation of a sawtooth pulse, and the second pulse cuts off the sawtooth generator. The amplitude of the sawtooth wave generator varies with the time between the two pulses. This peak amplitude is measured with a vacuum-tube voltmeter calibrated to indicate phase angle directly. This method overcomes the previously mentioned difficulties, and has the additional advantage of allowing phase angle to be determined within one period of the waveform.

Comparator Circuit

The pulse-producing comparator circuit defines the instant when a given voltage or current waveform passes through a certain critical point on its negative or positive slope by the stable and sharp break characteristic of a nonlinear element, such as a germanium diode. This circuit will generate a narrow pulse, or a definite number of pulses, when a given voltage or current waveform reaches a critical point, then return immediately to its normal quiescent state.

The circuit diagram of the comparator circuit is shown in Fig. 2. The feedback network consists of a three-winding transformer. The amplifier is a single pentode V_1. Windings 1 and 2 are arranged so that mutual coupling between these two windings will produce regenerative feedback for the amplifier. Diodes V_2 and V_3 are connected so the first is cut off and the latter is conducting when the potential of the input waveform is above reference potential, and the condition will be reversed when the potential of the input waveform is below the reference potential.

The turn-off unit consists of triodes V_4 and V_5 connected as a bistable multivibrator. When the input is above the reference potential diode V_2 is cut off, diode V_3 is conducting and the loop gain of the amplifier and feedback network is less than one. Thus no oscillation can take place. As soon as the negative slope of the input waveform reaches a potential E_r, diode V_2 conducts, the regenerative feedback loop closes, and a positive pulse is produced at the output terminal.

This positive pulse also causes triode V_5 of the turn-off unit to conduct. The potential at the plate of V_5 drops, and a switching action occurs. At the end of the switching action, V_4 is cut off and V_5 conducts. Thus a positive step voltage appears at the plate of V_4 and a negative step voltage appears at the plate of V_5. This negative step voltage decreases the screen potential of V_1 and terminates the oscillation of the amplifier and feedback transformer.

As soon as the potential of the input waveform rises above the reference potential E_r, V_4 conducts and V_5 is cut off, and the screen potential of V_1 becomes high enough to allow the amplifier to function. However, since diode V_2 is cut off and the regenerative feedback is opened no oscillation can take place.

As soon as the input waveform decreases to a potential equal to that of the reference voltage, V_2 again conducts, oscillation takes place, and the switching action is repeated again. In this way the circuit will produce one pulse each time the waveform crosses the reference potential level.

Since no coupling capacitor is needed in the input, the low end of frequency response can be extended to less than one cycle per second without relaxation oscillation or bouncing, and the high end is limited only by the stray capacitances of the tubes employed.

Another advantage resulting from the absence of coupling capacitors is that the accuracy and function of the circuit are not affected by the harmonic contents, shape or the degree of symmetry of the input signal.

Complete Phase Meter Circuit

In Fig. 3, diodes D_1 to D_3 and tubes V_1 to V_3 are connected as an amplitude comparator circuit for input signal E_1. As soon as E_1 intersects with the zero axis, diode D_1 conducts and V_1 oscillates through grid-plate coupling of the transformer. One positive pulse is delivered to V_7 when E_1 intersects with the zero axis.

In a similar manner, diodes D_4 to D_6 and tubes V_4 to V_6 deliver one positive pulse to V_8 whenever input signal E_2 intersects with the zero axis. Carbon-film ceramic resistors R_5 and R_6 serve for temperature compensation in turn-off units V_2 to V_3 and V_5 to V_6 respectively.

Pentodes V_7 and V_8 are used as amplifiers to isolate the comparator circuits. Tubes V_9 and V_{10} are arranged as a bistable multivibrator. Diode V_{16} feeds the trigger pulse through the plate of V_9 to the grid of V_{10} from amplifier V_7 only when V_9 is cut off, because the cathode of V_{16} is biased through R_1 with a positive potential of 200 volts.

Similarly, diode V_{17} feeds the trigger pulse through the plate of V_{10} to the grid of V_9 from amplifier V_8 only when V_{10} is cut off. Therefore, the operation of the instrument is not affected when signals E_1 and E_2 are in phase.

Action With Distorted Waveforms

Diodes V_{16} and V_{17} also serve to prevent the bistable multivibrator from switching to the reverse direction on arrival of the following pulse from the same channel, without awaiting for completion of the switching action initiated by the next pulse from the other channel. This feature is very desirable when one of the input signals contains so much distortion that its waveform intersects with the zero axis more than once during a half-cycle. For example, in Fig. 4, signal E_2 has so much distortion that its waveform intersects with its zero axis within a half-cycle. The comparator circuit would then generate an additional undesirable pulse b_1' after the desired pulse b_1 within the same half-cycle. Pulse a_1 of the E_1 channel passes through amplifier V_7 and diode V_{16} to the plate of V_9 and the grid of V_{10}, after which a switching action takes place with the result that V_{10} cuts off and V_9 conducts.

As soon as pulse b_1 of the E_2 channel reaches the plate of V_{10} and the grid of V_9 through diode V_{17}, a reverse switching action takes place with the result that V_9 cuts off and V_{10} conducts. Since the potential at the plate of V_{10} is below 200 volts, V_{17} cuts off because its cathode is biased at + 200 volts through R_2. Thus pulse b_1 cannot pass through V_{17}. Therefore, no switching action will take place in multivibrator tubes V_9 and V_{10} until the arrival of pulse a_2. As a result, the phase angle reading will be confined in the interval between pulses a_1 and b_1 and not be affected by the undesirable pulse b_1'.

In a case where the distortion occurs during the interval between a_1 and b_1, phase measurement has to be transferred to the interval between b_1 and a_2 in order to avoid errors due to undesirable pulses such as b_1'.

Sawtooth Generator

Tubes V_{11}, V_{12} and the NE-2 neon diode are connected as a direct-

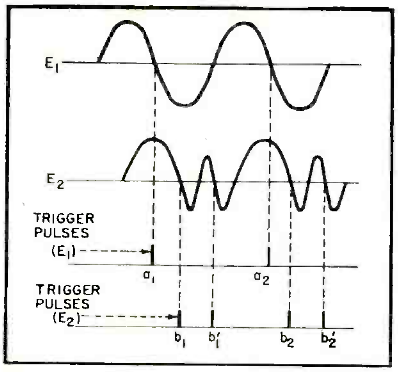

FIG. 4—Trigger pulses that could be developed when comparing sine wave with wave that intersects zero axis four times in every period

coupled sawtooth generator. Its operating principle is somewhat similar to a boostrap sawtooth generator. Pentode V_{11} is used as a clamp tube for terminating the sawtooth waves. When V_{11} is cut off by the negative pulse of the multivibrator, C_3 charges through variable resistor R_3 and fixed resistor R_4. Since R_3 is isolated from +400 volts by R_7 and coupled to the cathode of cathode follower V_{12} through capacitor C_a and the constant-voltage-drop neon diode, the charging current to C_3 is constant. Thus the grid of cathode follower V_{12} rises linearly with a slope equal to the time constant of C_3 and the series resistors R_3 and R_4.

As soon as the negative pulse at the grid of V_{11} passes, the bias potential returns to zero, the plate current begins to flow, and C_3 discharges immediately. By careful arrangement of the values of R_3, R_4 and the values of the capacitors on switch S_4, it is possible to set the peak amplitude of the sawtooth wave to a predetermined value with S_4 and variable resistor R_3 when both input signals E_1 and E_2 are 360 deg apart throughout a wide frequency range, probably from 100 kc down to 0.001 cps with commercially available components.

Cathode follower V_{13} isolates the sawtooth generator from the peak-reading voltmeter. Diode V_{18} is used in order that C_{10} and C_{11} can be charged by V_{13} through a low-impedance path. The capacitors are charged to the positive peak amplitude of the sawtooth wave, and store the charge for a long period because diode V_{18} is cut off during discharge. Capacitor C_{10} can be switched in or out of the circuit by switch S_5 so that a longer or shorter period of discharge can be chosen to suit the frequency of applied signals. Diode V_{19} is used in a similar manner to couple the negative peak amplitude of the sawtooth wave to the grid of V_{15}. A peak-to-peak voltmeter is used instead of a simple peak voltmeter to obtain higher accuracy when the phase angle to be measured is near 360 deg.

Tubes V_{14} and V_{15} are arranged as a balanced cathode follower. High stability can be obtained in this circuit since it is essentially a balanced bridge and a large amount of degeneration against common-mode fluctuation is established by R_6. Good accuracy can also be obtained because the output meter current can be made independent of tube factors by increasing the load resistance connected between the two cathodes. Switch S_6 is used to select the various ranges on the output meter.

Accuracy

The accuracy of this instrument is within 1 percent from zero to 10 kc. The error then increases slowly to 4 percent at 100 kc. These values are with an external indicator; an additional error of 1.5 percent is added when the panel meter is used.

Readings can be reproduced with a deviation of less than 0.5 percent after 500 hours of operation.

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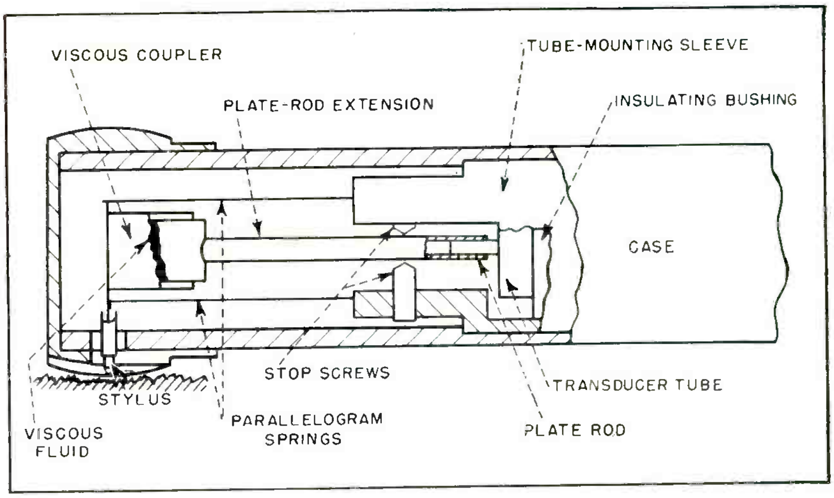


Cross-section of pickup head showing suspension of parts

Movable-Anode Tube Gages Surface Roughness

Pickup stylus coupled to movable plate of transducer tube measures roughness on a wide range of surface shapes. High electrical output of tube reduces complexity of amplifying and indicating circuits

MEASUREMENT of roughness requires a means of comparing minute surface deviations with the nominal surface of the material being measured. In the unit to be described, a pickup head incorporating a movable-anode tube and a diamond stylus is used to measure the deviations. The movable-anode tube feeds a highly stable vacuum-tube voltmeter through a two-stage triode amplifier.

Stylus

As a means of sensing the irregularities, a diamond stylus with a 0.0005-inch tip radius is used. This stylus radius permits greatest penetration of fine irregularities without scratching the surface being measured.

The reference surface from which stylus deflections are measured is established by two large-radius skids arranged in line with, and at either side of the stylus. These skids ride over fine scratches following the nominal surface contour. The skids are mounted on a tubular case that houses the pickup element. A transducer is attached to the housing and the stylus is fastened to its input thus producing a mechanical displacement which is the deviation of the actual surface from the nominal.

Pickup

Mechanical displacement is converted into electrical signal by an RCA 5734 electro-mechanical transducer. This device is a three element, all-metal vacuum tube constructed as shown in Fig. 1. The plate rod can be moved with respect to other tube elements by an extension through a thin metal diaphragm that seals one end of the tube. This relative motion changes the tube characteristics so that variation of output voltage can be used to indicate mechanical displacements. Average mechanical-electrical conversion characteristics for a circuit having a 75,000-ohm load resistance and a 250-volt plate supply are shown in Fig. 2. The relation between displacement and voltage is not linear and the electrical output for a given dynamic displacement range is greater if the mean deflection is positive rather than negative.

Several features make this transducer useful for measuring surface roughness and other small displacements. It has a high ratio of electrical output to mechanical input, reducing the complexity of the indicating circuits. The size and weight of the tube are small and the force required to deflect the plate rod from its neutral position is moderate. The principal drawback is the limited allowable movement of the plate rod. Movement of more than ½ deg. either side of neutral may result in permanent deformation of

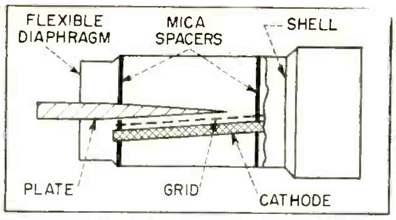


FIG. 1—Type 5734 tube used as transducer

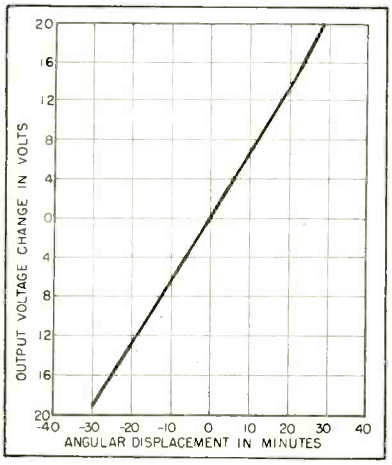


FIG. 2—Variation in movable-anode tube output voltage with displacement of anode

the diaphragm or in damage to tube elements. This angular restriction amounts to ± 0.008-inch movement on the end of a 1-inch extension to the plate rod.

To permit use of the pickup on a wide variety of surface shapes a total allowable stylus travel of about 0.040 inch is provided. The need for this range of travel can be seen from Fig. 3A, which shows the relative positions of the stylus and skid on different surfaces. Although the nominal extension of the stylus from the housing varies considerably, the motion required after engagement with the surface ranges from only a few microinches to 0.001 inch. The use of a long extension of the plate rod to provide for sufficient travel is undesirable since the sensitivity would be reduced and the high-frequency response of the assembly impaired.

Viscous Coupling

The nonlinear response of the tube requires that some means be provided so that dynamic deflections always take place about its undeflected neutral position regardless of the nominal stylus position.

A viscous coupling was developed to limit anode movement without restricting position of the stylus. The construction of this device is shown in Fig. 3B. A plate attached to the stylus is suspended within a U-shaped driven plate. Space between plates is filled with a viscous fluid. Displacement of the driving plate transmits force through the viscous material to the driven plate. The spacing of the plates is such that the fluid is kept in the clearance space by capillary attraction eliminating the need for seals and permitting use of the coupling in any position without loss of fluid. It is essential that the material used between the plates be a true liquid and not a grease, in order that the plate rod may always return to its neutral position.

The viscous coupler performs in a manner analogous to an electrical filter. The force between the plates is proportional to their relative velocity. The movement of the elastically-restrained output plate for a sinusoidal displacement of the stylus can be shown to be

$$\delta_{out} = \delta_{in} \frac{k}{\sqrt{k^2+1}} \text{ where } k = \frac{\mu A \omega}{Ch}$$

δ_{out} is the output displacement amplitude, δ_{in} the input displacement amplitude, μ the absolute fluid viscosity, A the total shear area of plates, ω the frequency of displacement, C the spring rate of driven plates and h the separation of plates.

Phase angle can be determined to be: $\beta = \tan^{-1} 1/k$

The performance of the coupler can then be described in terms of k. Figure 4 shows percent transmission and phase angle as a function of k. For values of k less than about 0.1 the coupler acts as a differentiator and the output is proportional to the derivative of the input. For values of k greater than 5, transmission is greater than 98 percent and the coupler serves essentially as a solid connection.

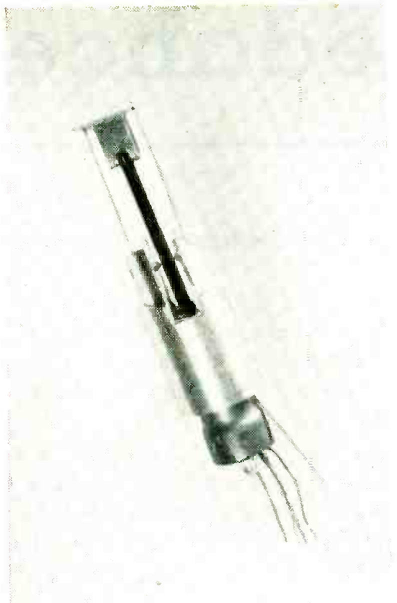
As utilized in the surface-roughness gage, the cutoff of the coupler is well below that of the amplifier so as not to influence the performance of the overall instrument. The particular geometry and viscosity used in this pickup results in $k=5$ at a frequency of 3 cps.

Since k is affected by temperature, a silicone fluid having a small change in viscosity with temperature is used in the coupler. This is especially important in this pickup since the tube heater raises the ambient temperature of the coupler.

Suspension System

The stylus and driving vane mounting are shown in Fig. 5. A parallelogram spring suspension locates the stylus rigidly along the pickup axis eliminating the need for sliding bearings that might intro-

Roughness gage provides five roughness ranges and three cutoff frequencies



Pickup head with cover removed to show arrangement of parts

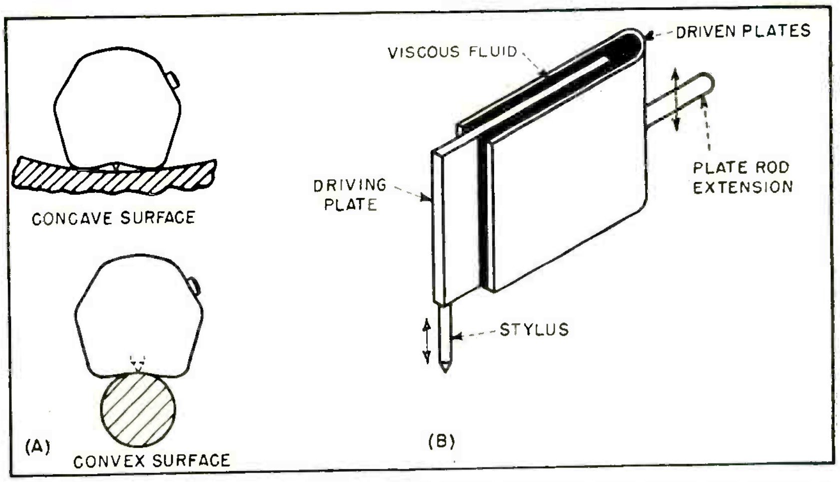


FIG. 3—Range of surface contours (A) requires variable stylus position. Viscous coupling (B) permits this variation while limiting travel of plate rod

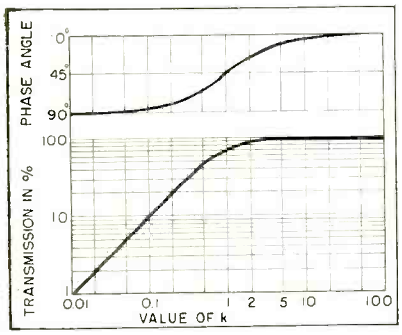


FIG. 4—Characteristics of viscous coupler. For k less than 0.1 coupler acts as a differentiator

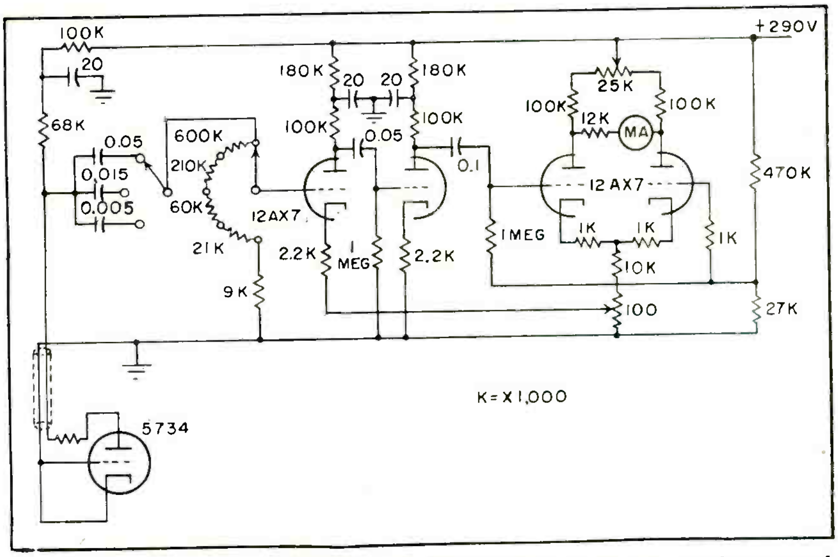


FIG. 5—Circuit of surface-roughness gage. Signal from movable-anode tube mounted in probe, is measured by a-c VTVM

duce friction. The driving plate is also located in its properly spaced relationship to the driven plate by these spring supports. Positive stops on the plate rod prevent mechanical displacements that would damage the tube.

As the stylus is deflected when the pickup first engages a surface, the plate rod is restrained by the stop screw and the coupling slips until the riders contact the surface. The elastic force of the tube diaphragm then causes additional slip in the coupling bringing the plate rod to its neutral position. Traversing the pickup over the surface, the high-frequency displacements of the stylus are transmitted undiminished through the coupling to the transducer tube.

The static force of the stylus on the surface is reduced since it is determined by the stylus suspension which has a spring rate of only 30 milligrams per 0.001-inch deflection as compared to 300 milligrams per 0.001 inch for the tube diaphragm itself with a one-inch extension.

Measuring Circuit

The electronic circuit used with the pickup described above for measurement of surface roughness is shown schematically in Fig. 5. It is essentially a stable a-c vacuum-tube voltmeter with provision for selecting low-frequency response characteristics. A three-position switch allows a choice of 5, 15, or 50 cps cutoff frequency by switching a single R-C filter circuit. This provision permits separation of short wave-length roughness from the longer-wavelength characteristics of the surface. The above frequencies correspond to wavelength cutoffs of 0.030, 0.010, and 0.003 inch respectively at the recommended traversing speed of 0.150 inch per second. The most generally used wavelength cutoff is 0.030 inch. Shorter wavelengths are called roughness and longer are called waviness.

The remainder of the circuit consists of two triode amplifier stages and a bridge output. Negative feedback is used to stabilize the gain. The power supply is well filtered and voltage stabilized to permit operation from a-c lines varying widely in voltage. The meter is a rectifier type with relatively long period and large damping to permit easier reading of average current. This is necessary since the input is not periodic but consists of a series of irregular fluctuations that may occur at relatively low frequency.

High Input Impedance

By E. W. HOGUE

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HIGH INPUT impedance amplifier circuits are of extreme importance to engineers faced with the problem of coupling signal-generating transducers to control circuits.

One technique widely used in the past for providing high input impedance to a vacuum-tube amplifier (the order of several hundreds of megohms) is the cathode-follower with cathode-connected shield[1,2] illustrated in Fig. 1A. This setup suffers from several disadvantages, in particular, the double-shielded wire with its attendant mechanical, electrical and economic drawbacks.

Figure 1B shows an improved circuit offering several unique and important features. By grounding the cathode and using the shielding arrangement illustrated, all the disadvantages of the cathode-connected shield circuit are overcome, and the new circuit presents to the transducer an impedance whose value is not limited by stray capacitive and resistive leakage[3].

In the circuit of Fig. 1A it was necessary to shield a set of conductors from ground by means of an off-ground shield. In the new circuit it is necessary to shield one set of conductors from another set of conductors by means of a grounded shield.

In the new circuit grounded shields S_1 and S_2 perform the double function of impedance raising and electrostatic interference prevention.

In the removal of strays directly shunting the source, the shielding in the new circuit can easily be made almost perfect, raising Z_s to an enormous value. The impedance presented to the transducer then becomes

$$Z_{in} = (M + 1)Z_g$$

where Z_g is the parallel resultant of R_g and z_s which includes the entire capacitance and resistance to ground of the shielded cable connecting transducer to grid; and where M is the undegenerated voltage gain of the tube. In the new circuit a multistage amplifier can be used instead of the single tube to give very large values of M. This permits the use of large lengths of shielded cable between transducer and input stage because, in effect, the cable capacitance is divided by M.

As a result of the impedance-raising shield in the new circuit, the impedance presented to the transducer in practical circuits becomes many thousands of megohms. Paradoxically, while feedback serves to raise the impedance presented to the transducer terminals, it serves at the same time to lower the impedance from each of these terminals to ground in the new circuit. Both of these effects are brought about by feedback through the internal impedance Z_t of the transducer.

Other properties resulting from the highly degenerative nature of the circuit are low microphonism, reduced sensitivity to magnetic hum, high linearity, and low voltage gain. As in the cathode-follower, the voltage gain of the new circuit is very nearly equal to unity, its upper limit.

Practical Circuits

Figure 2 shows a practical high-input-impedance preamplifier in which a constant-current tube serves as the plate load for a 6J7 pentode to provide a voltage loop-gain approaching that of the pen-

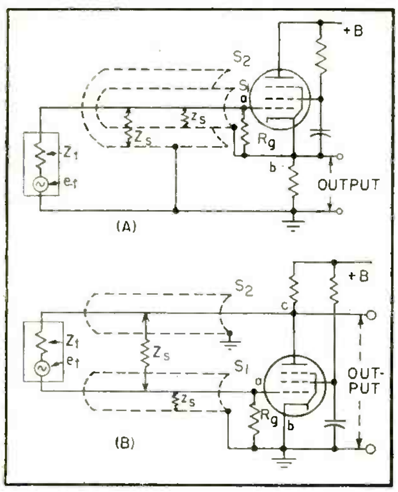


FIG. 1—Basic circuits of double-shield (A) and new (B) preamplifier circuits

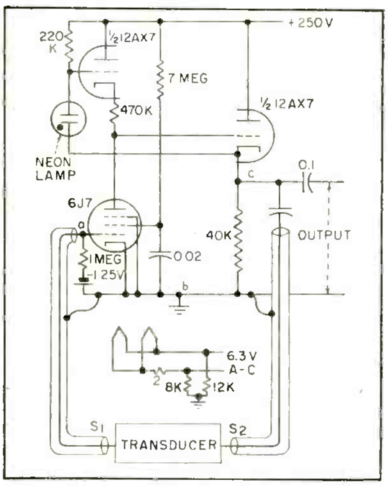


FIG. 2—Circuit having input of impedance 1,500 meg shunted by 0.005 $\mu\mu f$

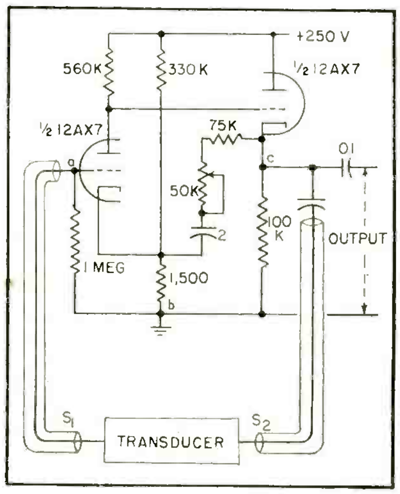


FIG. 3—Single-tube version of preamplifier has shunt capacitance of 2 $\mu\mu f$

Preamplifier Circuit

Reduced noise level and distortion are fortunate byproducts of raising amplifier input impedance to several thousand megohms by connecting transducer in feedback loop of a two-stage preamplifier. Circuit has numerous industrial applications and makes possible the use of charged parallel-plate capacitors as transducers

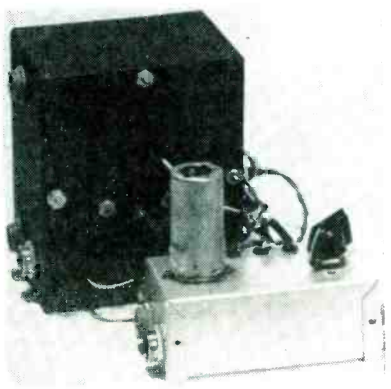
tode amplification factor.[4] A cathode-follower serves to couple the high-impedance plate to the output load. The input impedance of this circuit is 1,500 megohms paralleled by the gride-plate capacitance of the 6J7—approximately 0.005 $\mu\mu$f.

If shielded cable having a total capacitance C is used to connect the grid to the signal source, and the voltage gain of the amplifier is 1,500, an additional capacitance $C/1{,}500$ will then parallel the grid-plate capacitance.

The second preamplifier in Fig. 3 uses a double triode (12AX7) of which the first half is a voltage amplifier and the second half is a cathode follower. Positive feedback between the cathode-follower and the cathode of the voltage amplifier can be adjusted to give stable gains of up to 3,000 in accordance with the relation

$$M' = \frac{M}{1 - \beta M}$$

where M is the normal voltage gain of the first stage without feedback, and where β is the fraction of the output voltage impressed on the input cathode. Since β is positive, as βM approaches unity, M approaches infinity. For $\beta M > 1$ the amplifier is unstable. With an input grid resistor of several megohms this preamplifier presents an input impedance of many thousands of megohms in parallel with the grid-plate capacitance of a triode—approximately 2 $\mu\mu$f for the 12AX7. A pentode would give a much lower input capacitance, but because its gain depends upon g_m, which is highly variable, rather than on μ, which is reasonably constant, the pentode is unsuitable for use with positive feedback. As βM approaches 1 both β and M must be highly stable to avoid self-oscillation.



Two versions of preamplifiers that present input impedance of several thousand megohms to the transducer

The ideal tube for use in this application would be a triode-tetrode. The tetrode half, used as the voltage amplifier, would be provided with a grounded screen-grid carefully aligned behind the control-grid wires to provide good screening of the grid from the plate to give low grid-plate capacitance, but poor screening of the cathode from the plate to retain the stable gain characteristic of the triode.

Transducers

The circuit makes the use of tiny electrostatic mechanoelectrical transducers practical. The inherent virtues of the polarized variable capacitor as a transducer have long been known, but its one defect, an extremely high internal impedance at audio and subaudio frequencies, has restricted its use to a few laboratory and professional applications.

In all these applications the transducer is kept close to the input stage, and in most cases its capacitance is kept above 50 $\mu\mu$f. Using the new circuit, an electrostatic phonograph pickup having a total internal capacitance of 5 $\mu\mu$f has been operated with complete success when connected to the preamplifier by three feet of ordinary fine shielded wire running from each terminal. Full output of several volts was obtained over the range from 40 cps to over 10,000 cps.

The charged parallel-plate variable capacitor comes close to being the ideal mechanoelectrical transducer when operating into the new circuit. It then behaves as a voltage source whose output is a linear function of the capacitor plate separation. Using a typical closely spaced parallel-plate capacitor the total noise level of the input stage can easily be held to 14 millivolts rms for a 140-volt signal. Since the transducer itself generates no noise, the linear dynamic range of this transducer when coupled to the new circuit is around 10,000 to 1 in voltage, or 80 decibels.

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(3) E. W. Hogue, United States Patent 2,598,259, May 27, 1952.

(4) Valley & Wallman et al., "Vacuum Tube Amplifiers", p 439, 18, M.I.T. Radiation Laboratory Series, McGraw-Hill Book Co., New York, 1948.

Switching System Speeds

Punch-card controlled bridge being used to measure interelectrode capacitances in subminiature tubes. Variety of adapter units permit measurements on all types of tubes

ACCURATE MEASUREMENT of interelectrode capacitance becomes increasingly important as tubes are used at higher frequencies.

Conventional methods of measuring tube capacitances, although accurate, require time-consuming changes in coaxial cable connections for each capacitance measured. Grounded-sheath coaxial cables are necessary for connections to tube elements because of the stringent limitations placed on the amount of stray capacitance that can be tolerated. In testing the eight different capacitance values of a dual-triode tube, nine coaxial cables must be rearranged eight times.

Where large groups of a single tube type are to be tested, it is possible to decrease set-up time by connecting the adapter only once for each desired capacitance measurement, and running all tubes through before changing to the next set-up. Although this reduces the number of connector changes, it requires that each tube be inserted into the adapter once for each measurement.

Multiple tube insertion is undesirable, particularly for subminiature tubes where long flexible leads are used. It was this problem that was largely responsible for the development of the new automatic switching equipment described here.

Automatic System

In the equipment shown in the photograph, the coaxial cables have been replaced by relays actuated from a punched card. This change has resulted in simplification of operation with increased speed of testing. The possibility of incorrect cable arrangement is completely eliminated. The switching relays are housed in shielded compartments and are connected so that the stray capacitance paralleling the tube under test is negligible.

A large-diameter cylinder on top of the bridge contains the relays used to make proper tube connections. A smaller cylinder is one of a set of adapters used to make connection from the switching unit to the tube under test. An adapter for any type of tube base may be plugged into the front of the switching unit.

A punched card is run through the control box at the right of the bridge, making connections for the series of capacitance measurements. Switches on the front of the box may be used for experimental measurements or for tube types for which no card is available.

The direct-capacitance measuring bridge permits measurement of capacitance between any two elements or groups of elements of an electron tube independently of other capacitances within the tube.

The bridge circuit may be represented by the three-terminal network shown in Fig. 1A. Points *B* and *C* are the terminals between which the desired capacitance is placed for measurement, and *G* is the shield or ground terminal. The bridge is designed so that the indicated capacitance value is proportional to C_1, and is independent of C_2 and C_3. If terminals *B* and *C* are connected to the tube elements under test by means of individual, grounded-sheath coaxial-cable connections, only capacitances from *B* and *C* to *G* (ground) are added to the bridge.

Tube connections can be ar-

Tube Capacitance Tests

Interelectrode capacitance measurements are simplified by punch-card controlled switching system that permits checking tube capacitances without manual changing of tube connections. Stray capacitances are eliminated by relay grounding system

By R. E. GRAHAM

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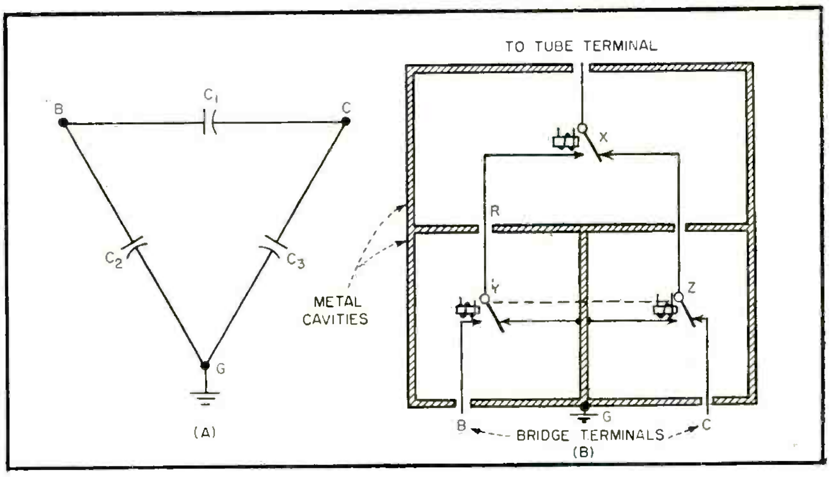

FIG. 1—Capacitances existing in three-terminal bridge circuit (A). Relay switching system (B) grounds all capacitance except that between terminals being measured

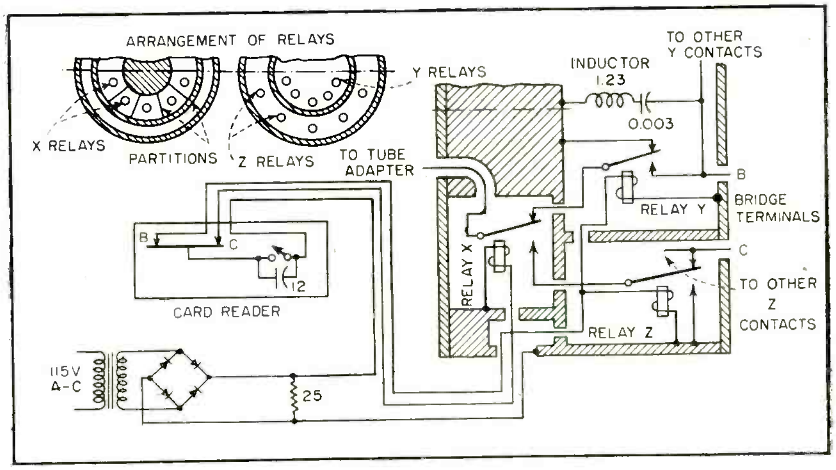

FIG. 2—Card reader unit and relay arrangement for one tube terminal. Relay group XYZ is repeated in each section of switching unit. Power supply, capacitor in card reader and inductor serve the entire device. Cross-section shows placement of relays within circular housing

ranged to place the desired capacitance between *B* and *C*, and all other capacitances between *B* and *G* or *C* and *G*. Since the bridge is insensitive to capacitances from *B* and *C* to ground, it is possible to obtain a direct interelectrode-capacitance measurement between the elements connected to *B* and *C*. For example the grid-to-plate capacitance of a triode may be measured independently of the grid-to-cathode or plate-to-cathode capacitances simply by connecting the grid to terminal *B*, the plate to terminal *C*, and the cathode to to terminal *G*. In this manner, grid-to-cathode and plate-to-cathode capacitances will be applied from *B* to *G* and from *C* to *G*, respectively, and will have no effect on the measurement of the grid-to-plate capacitance from *B* to *C*. It is for this reason that the resulting measured value is termed the direct grid-to-plate capacitance.

Switching Unit

The principle of operation of the automatic relay system is illustrated in Fig. 1B for one tube terminal. The entire system consists of a repetition of this arrangement for each tube terminal. The letters *B*, *C* and *G* refer to bridge terminal connections, as in Fig. 1A. Three relays are used for each tube terminal. Relays *Y* and *Z* are ganged, and *X* is a single relay.

With the contacts in the position shown in the diagram, the tube terminal is connected to bridge terminal *C*. The stray capacitance across *Y* is from *B* to ground, and that across *X* and *Z* is from *C* to ground. These capacitances are not objectionable from the standpoint of accurate measurement.

The only opportunity for stray capacitance between *B* and *C* is from the *B* wiring in the *Y* cavity to the *C* wiring in the *X* cavity by way of the connecting wiring hole *R*. This undesirable capacitance can be held to an acceptable minimum provided the hole is effectively plugged by the grounded conductor running through it. To attain maximum shielding between cavities the hole must be small, the conductor must be almost as large as the hole and the insulation on the conductor must be thin. These conditions are met by using plastic-covered radio hook-up wire of a diameter equal to that of the hole.

When relay X is changed from the position shown in Fig. 1B the tube terminal is connected to ground. This can also be accomplished by throwing Y and Z without changing X. When all the contacts are changed from the positions shown, the tube terminal is connected to bridge terminal B. In no case is there a possibility for stray capacitance to occur between terminals B and C.

Figure 2 shows the cross-section of the switching unit with its arrangement of miniature relays and associated equipment. The three relays are arranged similar to Fig. 1B and perform the switching function for one tube terminal. This relay arrangement is repeated ten times making it possible to measure the capacitance of tubes with up to nine terminals, with one set of relays connected to an external shield.

The switching unit uses thirty relays operating electrically as ten sets of three relays each. The three relay categories are labeled X, Y and Z as in Fig. 1B. One terminal of each Y and Z relay is connected to the B and C terminals of the bridge, respectively. It is not necessary for X and Y relays to be shielded from other relays in the same category since all contacts in each instance are connected either to ground or to their respective bridge terminals. In category X, however, different relays may be connected to different bridge terminals, and therefore, the relays are shielded from each other in ten pie-shaped cavities. The switching unit can thus be pictured as ten relays in ten cavities, and two groups of ten relays each in two separate cavities.

Stray Capacitances

It was mentioned earlier that a direct-capacitance bridge measures the capacitance between terminals B and C and is insensitive to capacitances from B and C to ground. There are, however, practical limitations on the values of these grounded capacitances. For the direct-capacitance bridge, used here, capacitances from B to ground should be kept below 25 $\mu\mu$f. Capacitance from C to ground should be less than 300 $\mu\mu$f for accurate measurements in the order of thousandths of a micromicrofarad, such as grid-to-plate values. However, the total capacitance from C to ground may be considerably higher when the values to be measured are greater.

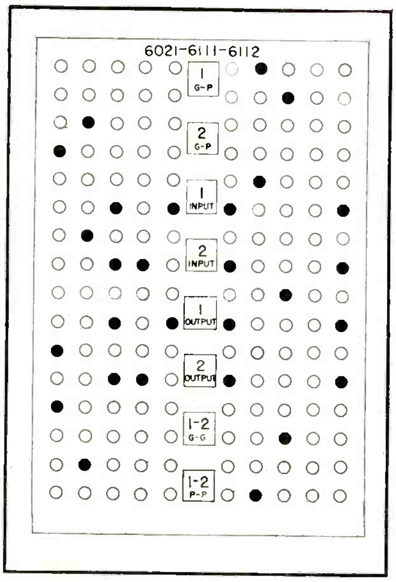

FIG. 3—Punch card for 6021, 6111 and 6112 tube types. Boxes at center indicate capacitance being measured

If the limitations of total capacitance to ground are exceeded, the bridge-balance null will become too broad to permit accurate readings, and the bridge zero-balance point (no capacitance between terminals B and C) will be shifted away from the zero calibration on the dial.

Measurements on the switching unit determined that the capacitance from B to ground is $(61 + 12\ t)$ $\mu\mu$f, where t equals the total number of connections made from terminal B to the front of the unit. The capacitance from C to ground is $(165 + 4\ t_C - 8\ t_B)$ where t_C and t_B represent the total number of terminals connected to C and B respectively.

The adapter for connecting subminiature tube leads to the switching system adds about 5 $\mu\mu$f to ground per terminal. Thus, in connecting one tube terminal to the B bridge terminal, a total capacitance to ground of 78 $\mu\mu$f is encountered in the switching unit and adapter. In connecting one tube terminal to the C bridge terminal and one to the B bridge terminal, as is done for the measurement of grid-to-plate capacitance, a capacitance of 166 $\mu\mu$f from C to ground is encountered. If seven tube terminals are connected to the C bridge terminal, and one is connected to the B bridge terminal there is a total capacitance of 220 $\mu\mu$f from C to ground. Since the capacitance from B to ground is too high, a 1.23-mh inductance is used to resonate out part of it. Thus, bridge accuracy is not impaired and the null balance remains sharp. The value of the inductance is picked to resonate with 95 $\mu\mu$f at 465 kc.

The 0.003-μf capacitor in series with the inductance provides 60-cycle isolation necessary for correct operation of a continuity checker used for relay maintenance. A switch in the card reader prevents over-heating of the switching unit when no card is in the reader.

Measurements indicate that the residual capacitance between the circuits of any two adjacent output terminals of the switching unit is less than 0.00005 $\mu\mu$f.

Control Box

The control box consists of a card reader and a set of manual switches, either of which may be used to control the switching unit. When using the card reader, correct connnections are made automatically. Contacts are made through the holes of a card moved through the reader. Each position corresponds to a desired capacitance measurement. The card, shown in Fig. 3, may be punched for as many as eight different measurement positions, the number depending upon the tube type. Symbols indicating the capacitances to be measured are written on the card in boxes, each in turn being visible through a window in the card reader as the card is moved to the next position.

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Transient Analysis of Transistor Amplifiers

Response of junction-transistor amplifiers to steep-front pulses can be calculated using equivalent circuit described. Grounded-base circuits with *npn* junctions are seen to give best transient performance. Response times of 0.5 μsec have been observed

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APPLICATION of transistors to pulse amplifiers, computers and servo amplifiers requires an understanding of transient behavior. All physically-realizeable mechanisms, whether electrical, mechanical or acoustical, are subject to energy-storage effects. Thus, the response of a physical system to a suddenly applied force will never be instantaneous.

Transient behavior of lumped-parameter R-L-C networks is well known.[1] Whenever lumped-parameter electrical analogies are possible, the study of transient and frequency response is comparatively simple. Even when the analogies lead to highly complex circuits, a solution of transient response problems may still be attained by use of an analog computer. For example, in vacuum tubes, the interelectrode energy-storage properties are dealt with in design problems by assuming physical capacitors to exist between the electrodes.

When more complex phenomena are involved, such as electron bunching due to space charge, the lumped-parameter equivalent circuit becomes inadequate as a representation of the physical case. This does not invalidate the use of the simple equivalent circuit, providing its limitations are kept in mind.

Theory Review

To understand better the basis for a transient study of transistors, consideration of the physical phenomena involved in transistor action is helpful. Figure 1A illustrates the potential energy profile of a *pnp* junction transistor biased in the usual manner.

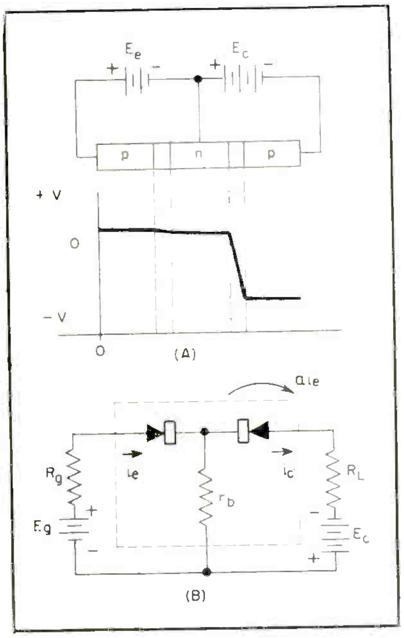

FIG. 1—Potential profile for *pnp* junction transistor is shown in A. Low-frequency diode equivalent circuit of a grounded-base amplifier is shown in B. Emitter and collector resistances are included in the diode symbols

The low-frequency diode-equivalent circuit of a *pnp* junction-transistor amplifier is shown in Fig. 1B.

There is very little potential drop across the emitter-base barrier of the transistor, and current will flow freely from the emitter to the base. Practically no potential gradient exists in the base region. The base-collector barrier is biased in the inverse diode direction, and practically all of the potential drop between the external base and collector leads occurs across the base-collector barrier.

A positive signal current, applied to the emitter of a *pnp* transistor, will cause holes to migrate from the emitter to the base. For an *npn* transistor, a negative current applied to the emitter will cause electrons to migrate from the emitter to the base. In order that the emitter signal may cause a change in collector current, holes that have migrated from the emitter to the base must traverse the base region and appear at the base-collector barrier. Since there is virtually no electric potential gradient in the base region, the process of hole travel through the base is essentially one of diffusion. This diffusion is motivated by a concentration gradient rather than an electric-field gradient, the concentration of holes being much higher in the base region near the emitter than in the base region near the collector.

If all the holes that enter the base from the emitter due to a signal current in the emitter were to do so with equal momentum vectors and if, in the process of traveling through the base region from the emitter to the collector, the holes were to experience no collisions or nonuniform field effects, the only re-

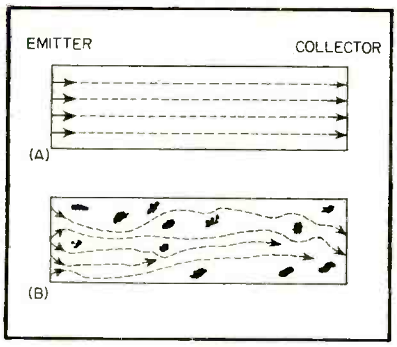

FIG. 2—Drawing shows ideal (A) and actual (B) movement of carriers across base region. Due to dispersion effect, carriers leaving emitter junction at same time arrive at collector junction at slightly different times

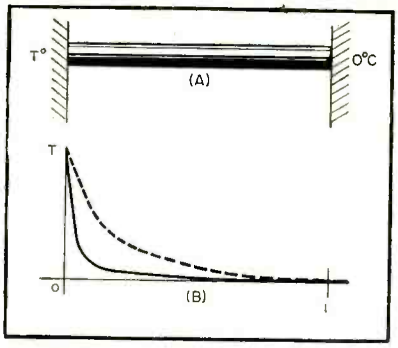

FIG. 3—Thermal analogy of diffusion of holes or electrons in base region of a junction transistor. A thermal conducting rod is placed between points of fixed temperature. Resulting distribution of temperature is shown in (B)

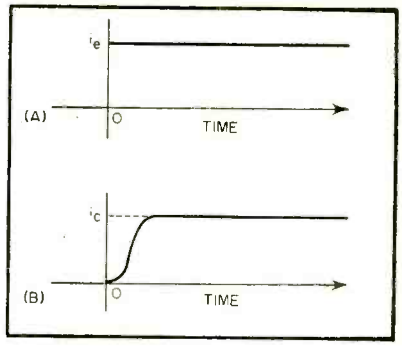

FIG. 4—Dispersion and time-delay effects are clearly evident from curves showing collector current (B) resulting from steep-front emitter current rise. Best transient response is obtained with shortest base region

sult of hole diffusion through the base region would be a time delay between collector and emitter signals. Such a hypothetical diffusion is illustrated in Fig. 2A.

In practice, carriers moving through the base region of a transistor are subject to many effects that cause individual carrier paths to differ greatly. The initial carrier momentum vectors are randomly distributed; this alone would cause path variations in the diffusion of the carriers through the base. Furthermore, the carriers are subject to collision among themselves as well as to collision with fixed atoms, and are also subject to nonuniform space-charge forces.

A more realistic picture of carrier diffusion would therefore look like that illustrated in Fig. 2B. A current pulse at the emitter gives rise to an instantaneous influx of carriers in the base region, but the arrival of these carriers at the collector is spread out over a period of time.

This dispersion effect in the transistor is analogous to the dispersion of a pulse as it is propagated along a transmission line. In the transmission line, the dispersion effect is treated by considering the line to have distributed capacitance, inductance and resistance.

Thermal Analogy

The diffusion of holes or electrons in the base region of a junction transistor bears a striking physical analogy to the diffusion of heat in a thermal conductor. For example, consider the phenomena involved if a massive hot plate were suddenly applied to the end of a metal rod with the other end maintained at 0 C as illustrated in Fig. 3A. The transition of the temperature distribution along the rod from a short time (solid line) after the hot plate is applied to a time when a steady-state distribution of temperature has been reached is illustrated in Fig. 3B.

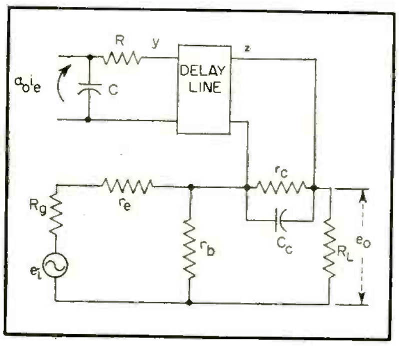

FIG. 5—Equivalent circuit used to calculate transient response

The fundamental physical conditions of the thermal problem are: (a) A constant temperature T is suddenly applied to one end of the metal rod, (b) heat diffusion through the length of the rod occurs as a result of the temperature gradient, (c) a uniform radiation of heat, proportional to the temperature, accounts for some heat loss from the rod to the surrounding medium, and (d) zero temperature is maintained at the far end of the rod.

For the base region of the *pnp* junction transistor, the corresponding physical conditions are: (a) a sudden excess concentration (concentration above the thermal equilibrium value) of carriers is injected into the base region at the base-emitter barrier, (b) carrier diffusion through the length of the base region occurs as a result of the carrier concentration gradient, (c) a uniform loss of carriers exists, due to the recombination of holes with electrons, and the loss is proportional to the carrier concentration, and (d) zero excess concentration of carriers at the base-collector barrier is maintained, implying that all carriers which arrive at the base-collector barrier are immediately swept into the collector.

Transient response of the collector current to a step in emitter current can be shown[3] to be of the form illustrated in Fig. 4. Both the dispersion and time-delay effects are clearly evident. In terms of the transistor construction, the time delay may be related to the length of the base region; the dispersion is related to the length of the base region and the collector-base barrier thickness. Other effects, such as surface phenomena and barrier-thickness modulation by applied voltages[4] also affect the transient response of transistors, but these may often be neglected in transient considerations, especially for small-signal analysis.

A simple small-signal equivalent circuit of a grounded-base junction-transistor amplifier, which has been found useful in transient analysis calculations, is illustrated in Fig. 5. The delay line is assumed to have the current transfer characteristic given by

$$\frac{i_z}{i_y} = \epsilon^{-Kj\omega}$$

The time constant RC is adjusted so that it corresponds to the α cutoff frequency $f_{\alpha o}$ of the transistor. Thus

$$\frac{i_y}{i_e} = \frac{\alpha_o}{1+j\omega RC} = \frac{\alpha_o}{1+j\dfrac{\omega}{2\pi f_{\alpha o}}}$$

where α_o is the low-frequency current amplification factor of the transistor and $f_{\alpha o}$ is the α cutoff (3 db down) frequency of the transistor. In Fig. 5, the signal source e_i is assumed to have an internal impedance of R_g. Resistances r_e, r_b, r_c and R_L are, respectively, the a-c emitter resistance, base resistance, collector resistance and load resistance. The collector capacitance of the transistor is represented by C_c.

Comparison of the experimental and theoretical frequency-response characteristics for a *pnp* junction transistor amplifier is illustrated in Fig. 6. The circuit parameters for the transistor used in the experiment are listed on the diagram.

Knowing the frequency response characteristics of the transistor network, and restricting the input signal to a magnitude sufficiently small so that the equivalent circuit may be assumed linear, transient-response calculations may be made.[1] Calculations based upon the equivalent circuit of Fig. 5 are found to be in good agreement with results obtained experimentally.

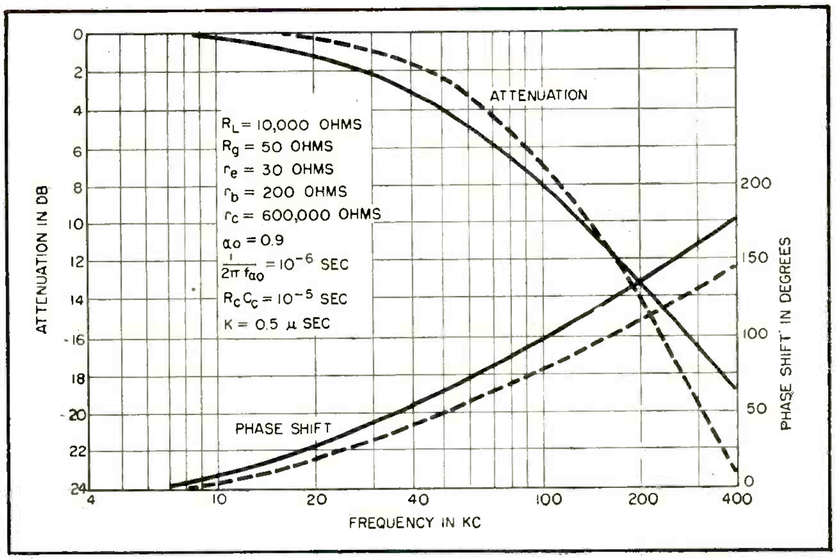

FIG. 6—Comparison of experimental and theoretical phase and attenuation characteristics for transistor amplifier show close correlation

Contributing Factors

The transient response of transistor amplifiers depends upon essentially three factors: the connection of the transistor (grounded-base, grounded-emitter or grounded-collector), the operating point of the transistor emitter and collector biases, and the circuits external to the transistor.

Figures 7A and 7B illustrate the transient response of two grounded-base *npn* junction transistor amplifiers. In each case the input signal was a square-wave of 10 μsec duration, 0.05 μsec rise and decay times and 60 mv magnitude (positive). The circuit of Fig. 7A exhibited a response time of 2 μsec. Maintaining the bias currents of the circuit constant, but reducing the load resistance by a factor of two, caused a 100-percent improvement in response time, but at the expense of a voltage amplification reduction of 43 percent as illustrated in Fig. 7B.

Grounded-emitter amplifiers were (Fig. 7C) found to have somewhat poorer response times, in general, than the grounded-base circuits. Figure 7D illustrates a grounded-collector stage with a load resistance of 500 ohms. The grounded-collector amplifier has no voltage amplification, but nevertheless exhibits power gain. The apparent rapid transient response of the grounded-collector circuit (0.07 μsec) is due to the direct transmission of the input signal through the low-resistance path between the base input and emitter output leads ($r_b + r_e$). However, it should be remembered that this rapid response is only apparent, and that the actual power response is approximately similar to that of the grounded-emitter circuit.

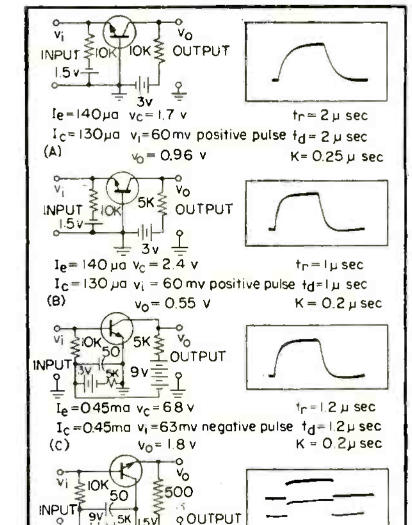

FIG. 7—Circuits, parameters and curves showing transient response of different transistor amplifier circuits

In conclusion, it has been shown that the frequency and transient response of junction transistor amplifiers may be calculated with good accuracy from the equivalent circuit of Fig. 5. Experimental tests indicate that the grounded-base amplifier gives the fastest transient responses, but in general, this is dependent upon the external circuit connections. For *pnp* junction transistors presently available, response times of the order of 1 μsec have been obtained, whereas for *npn* junction types, responses ranging from 0.5 to 1 μsec have been observed.

This work has been supported, wholly or in part, under Contract AF 33 (600)-17793, which is sponsored jointly by the U. S. Air Force, U. S. Army and U. S. Navy.

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(3) R. F. Shea, *et. al*, "Principles of Transistor Circuits", to be published by John Wiley & Sons Inc., N. Y., 1953.

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Matching Nonstandard

Experimental procedure determines matching parameters for junctions between standard waveguide and guide having constant but unusual cross section. Method is applicable to dielectric-filled guides and junction of waveguide and traveling-wave-tube helix

By A. CHLAVIN

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Hughes Research and Development Laboratories
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MATCHING A JUNCTION between standard guide and nonstandard guide is a problem often encountered in waveguide circuits. Nonstandard guides may be thought of as guides of constant but unusual cross sectional characteristics such as elliptical, triangular or ridged guides. They may also be more conventionally shaped guides carrying higher-order modes. Standard guides may be thought of as the rectangular or coaxial guides for which slotted sections, detectors and loads may readily be obtained. Since most junctions of the type considered here present complicated boundary conditions, mathematical analysis is tedious and often impossible.

A well known experimental method for determination of junction-matching parameters is the moving-short method.[1] However, this method is limited in that it is often not possible to move a short-circuit plunger in the nonstandard guide. For example, a moving-short method could not be easily applied to a dielectric-filled guide or a junction between the helix of a traveling-wave tube and a guide. The method suggested here is an experimental procedure that does not involve moving terminations in the nonstandard guide.

Procedure for Matching

The first problem encountered in matching the junction between standard and nonstandard guide is that of terminating the nonstandard guide. Since no loads or detectors are available and moving terminations are not to be used, it is necessary to make an additional junction back to the standard line for a termination. This arrangement is shown schematically in Fig. 1: Y_i is the admittance looking into the entire test section; Y_y is the admittance just to the right of junction 1 and Y_x is the admittance just to the left of junction 2. The distance between Y_x and Y_y is ψ, the length of nonstandard guide; Y_L is the load admittance transformed to the output of junction 2.

Three test sections like those shown in Fig. 1 must be fabricated. The nonstandard waveguide in each test section should differ in electrical length by an amount $\Delta\psi$, which is not 180 degrees. The dimensions of the junctions should be held closely from one test section to the next. One end of a test section is attached to a microwave test-bench setup consisting of an oscillator, pad and slotted section. To the other end of the test section a variable susceptance unit such as a single-post tuner is fastened, together with a flat termination. The test setup is shown in Fig. 2.

If the depth and position of the probe in the tuner are adjusted to arbitrary values b and θ an admittance looking into the test piece can be measured with the slotted section. If depth b is kept fixed and the position of the post in the line changed by increments in θ, the admittance at each of these incremental points can be determined with the slotted section. The locus of such points when plotted on an admittance chart will be a circle. The diameter of this circle is a function of the junction involved, the length of nonstandard guide ψ and the depth b of the post in the tuner.

For a particular test piece, the length of nonstandard guide is fixed and the diameter of the circle is directly a function of the depth of the post in the tuner. If the second and third test pieces are substituted for the first, keeping the same b in the post tuner and repeating the impedance measurements for incremental values of post position θ, a second and third circle will be obtained on the admittance chart. Because the length of guide ψ of the second and third test pieces is different from that of the first, the resulting circles will be of different diameters and not concentric with each other. Since the diameters of these circles depend upon b, the depth of post, they may or may not intersect depending upon how deep the post was initially placed

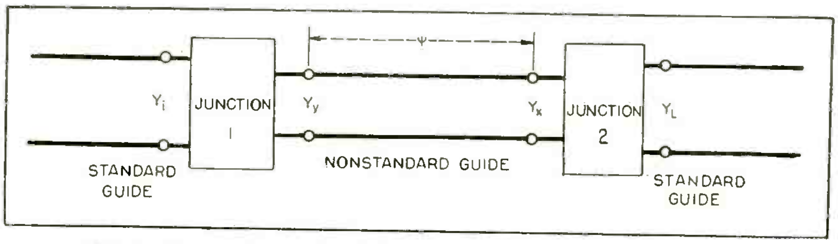

FIG. 1—Test section used to determine waveguide-junction parameters

Waveguide Sections

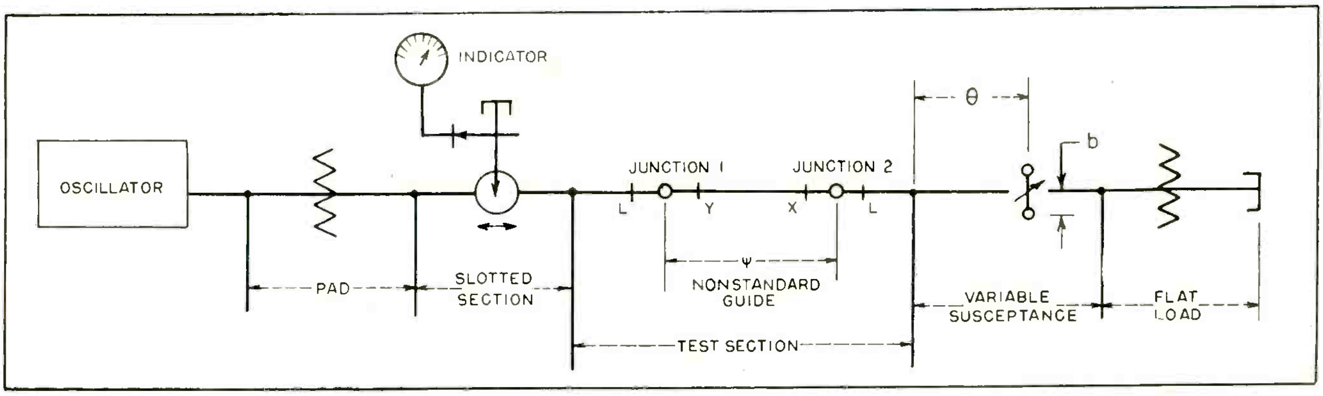

FIG. 2—Microwave test-bench setup used to make impedance measurements

in the guide. A single point of intersection of the three circles is desired. This is illustrated in Fig. 3.

When the post depth b_0 and its position θ_0 are found that give a single admittance point at the input independent of the length of nonstandard guide ψ, the second junction has been matched with the tuner.

Validity of Procedure

Moving a fixed susceptance along an otherwise matched transmission line causes the input admittance at a fixed reference plane to move along a circle in the G-B plane.[2] The horizontal diameter of this circle coincides with the G-axis. For a different susceptance a different circle is obtained that does not cross any other circle so generated. The whole right-hand plane can, in principle, be filled with such circles: that is, to any point in the right-hand half plane there corresponds a value of susceptance and its position along the matched line. The post tuner and flat load described in the experimental procedure represent just such a variable susceptance and matched line and are capable of filling nearly all of the righthand plane with circles.

The test piece can be thought of as three transducers: junction 1, the length of nonstandard guide and junction 2. Each transducer may be represented by a linear fractional transformation.[3] Since repeated transformations still result in a linear fractional transformation the entire test piece may be thought of as the transducer. The circles generated by the variable susceptance at the output are transformed through the transducer and appear as circles at the input since circles transform into circles. These circles may be magnified, rotated and translated by the transformation but still do not cross each other, since the transformations are conformal.

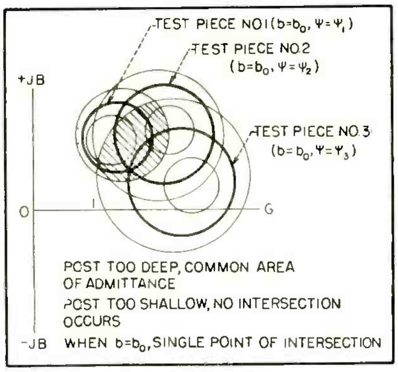

FIG. 3—Junction measurements plotted on admittance chart

Graphic Solution

If the length of nonstandard guide is changed, the whole family of circles shifts position, since the transformation parameters are different. However, they still remain a family of nonintersecting circles. Each of these transformed families of circles corresponding to a particular value of ψ will cover the right-hand plane since the transducer is considered lossless.[4] One circle in each family therefore, passes through an admittance point that will make Y_x in Fig. 1 equal to Y_0. Since there is only one value of Y_L that when transformed can make $Y_x = Y_0$, there is a definite value for the post depth and post position. If $Y_x = Y_0$ the length of nonstandard guide will have no effect on the input admittance since Y_0 always transforms into Y_0. The point of intersection of the three circles at the input represents a point where the admittance does not vary with the length of nonstandard guide. This indicates that the post tuner has matched junction 2 and $Y_x = Y_0$. The point of intersection is therefore the admittance of junction 1.

It is clear that junction 2 need not be constructed identical to junction 1. The only requirement is that junction 2 be matched by the tuner so that the input admittance be independent of ψ. By measuring the admittance of the tuner, the complex conjugate of junction 2 is obtained and the admittance of the intersection point is the admittance of junction 1. This property may be useful in speeding up measurements of complicated junctions.

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(1) John C. Slater, "Microwave Electronics", p 109, D. Van Nostrand Co. Inc., New York, 1950.

(2) Theodore Moreno, "Microwave Transmission Design Data", p 41, McGraw-Hill Book Co. Inc., New York, 1948.

(3) W. H. Watson, Matrix Methods in Transmission-Line and Impedance Calculations, *Journ IEE*, p 737, 1946.

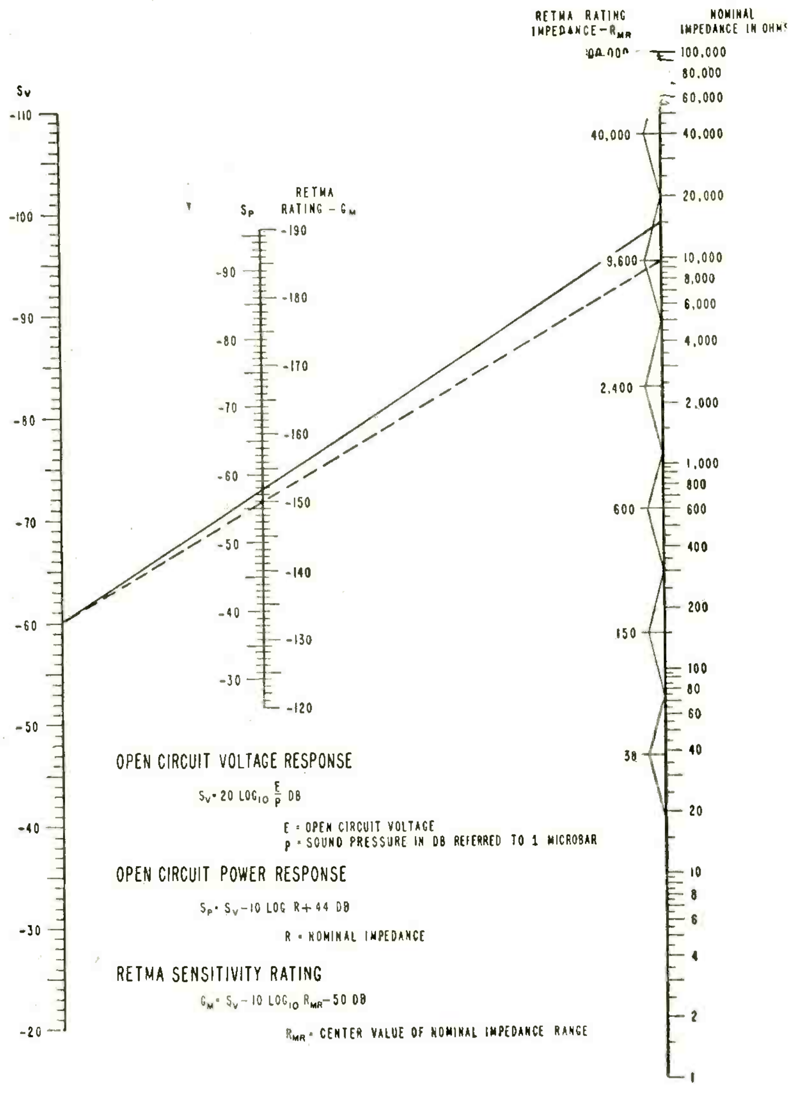
(4) Reference (1), p 104.

Microphone Sensitivity Conversion

Chart gives quick interchange of values for three common systems of rating microphone sensitivity. Change in open-circuit voltage sensitivity during impedance transformation can also be determined

By **LEO ROSENMAN**

Shure Brothers, Inc.
Chicago, Ill.



MICROPHONE sensitivities are often specified in different systems, making comparison difficult. The accompanying nomograph gives the relationship between open-circuit voltage response, open-circuit power response, and the RETMA sensitivity rating.

The voltage response value, S_v, is in db referred to 1 volt per microbar, and the power response, S_p, is in db referred to 1 milliwatt for 10 microbars sound pressure. A microbar is 1 dyne per sq cm.

The RETMA sensitivity rating is the power available in db relative to 1 milliwatt for 0.0002 dyne per sq cm. It is not defined for values below 19 ohms. For a given nominal impedance, R_{MR}, the microphone rating impedance, is the center value of the range of impedance values covered by the triangular sections on the nomograph.

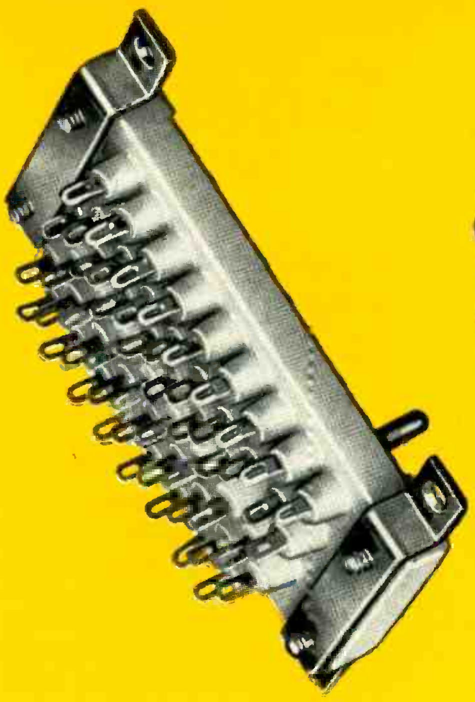
Use of the nomograph to convert sensitivities is illustrated for a microphone having an open-circuit voltage sensitivity of -60 db and a nominal impedance of 15,000 ohms. Connecting these points as indicated by the solid line gives a power sensitivity of -58 db.

In finding the RETMA rating the microphone rating impedance of 9,600 ohms is used, since 15,000 ohms falls within that area on the R_{MR} scale. The dashed line indicates that the rating is -150 db.

Open-circuit voltage sensitivity of microphones undergoing impedance transformation can be found by determining the power sensitivity for the original impedance and then pivoting about this point until aligned with the new impedance. The new open-circuit voltage may then be read on the S_v scale.

REFERENCES

RETMA Standard SE-105, "Microphones for Sound Equipment".
ASA Standard 224.1, "Acoustical Terminology".



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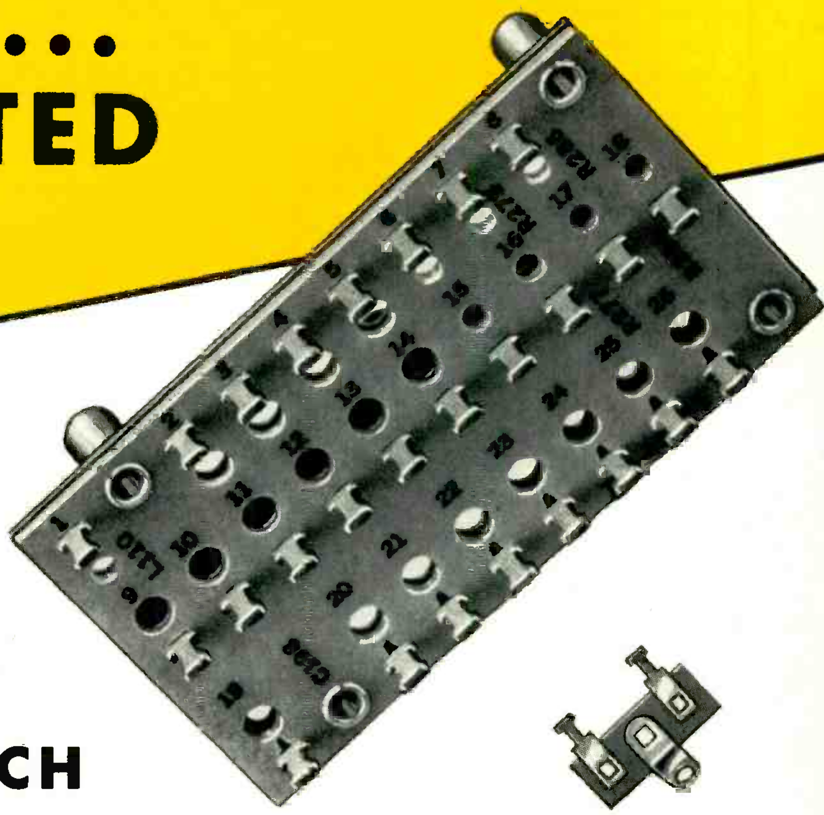

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Magnetic Drum Design

Nomograph relates drum diameter, spot density, frequency, angular velocity, access time and number of spots stored, to speed determination of design having optimum compromise of cost, storage volume and access time for modern computing machines

By D. G. O'CONNOR

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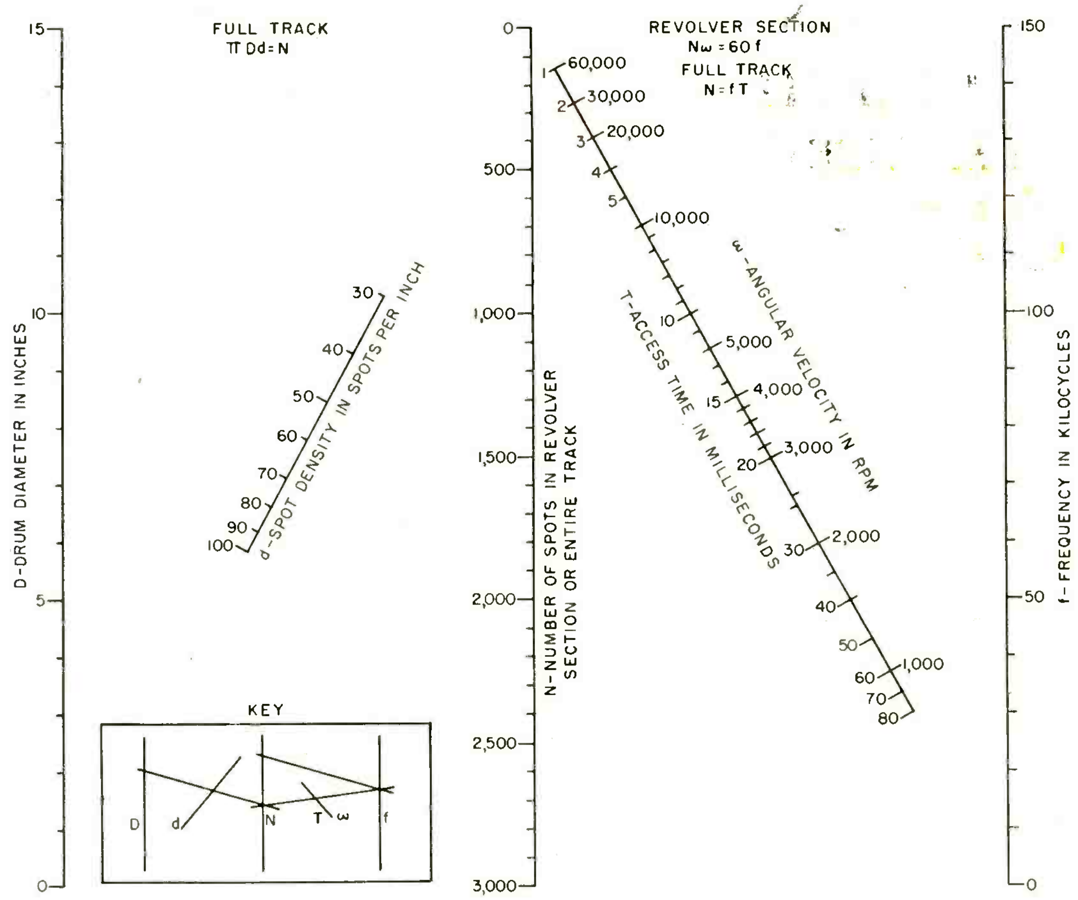
International Business Machines Corp.
Endicott, N. Y.

THE SINGLE NOMOGRAPH below suffices for all quantities involved in the design of magnetic drums.

Example 1. It is required that 1,200 spots be stored on the full track. Assuming an operating frequency of 70 kc, a straight line through $N = 1{,}200$ and $f = 70$ kc gives $\omega = 3{,}500$ rpm and access time $T = 17$ milliseconds. Next, assume a reasonable value for spot density such as $d = 50$ and project from $N = 1{,}200$ through this to read $D = 7.6$ inches for required drum diameter.

Example 2. An access time of $T = 8$ milliseconds is required when using a revolver section having $N = 720$ spots. Extending a line through these values gives $f = 90$ kc. Assuming 4,000 rpm as a reasonable angular velocity for a revolver, a line through this value and $f = 90$ kc gives $N = 1{,}350$ spots. This means that 720/1,350 or 8/15 of the complete track is used for the revolved information. Assuming $d = 40$ for spot density, project through this value from $N = 1{,}350$ to read $D = 10.7$ inches as drum diameter.



Nomograph for parameter relations on magnetic information-storing drums. In revolver-type drum applications, each bit of information is read by one head, erased by the next head, and rerecorded by the third head a short distance ahead. The recorded information thus revolves around the drum concurrently with rotation of the drum to reduce access time to a fraction of a revolution

Stop Vibrator Power Supply Troubles Before They Start

The best time to do this is while your equipment is still on the drawing board. Each element . . . the vibrator, transformer and buffer capacitor . . . must be carefully selected for balanced electrical characteristics if your power supply unit is going to do the right job when it gets in service.

The best way to avoid vibrator power supply trouble is to call on the specialized knowledge and experience of Mallory engineers. Let us analyze the power requirements of your equipment and help you translate them into a power circuit that will give the performance you need.

Why call on Mallory? There are a lot of reasons . . . good ones. In the first place our experience in this field is backed by an unmatched fund of engineering knowledge that started over 20 years ago . . . when we produced the first commercial vibrator. Our experience includes supplying more vibrators for original equipment than all other makes combined.

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ELECTRONS AT WORK

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Edited by ALEXANDER A. McKENZIE

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Thyratron-Vacuum Tube Counter

By Richard W. Hofheimer

Staff Member
Lincoln Lab., M. I. T.
Cambridge, Mass.

Low-frequency counting operations in which low-impedance output is required can be accomplished in a circuit derived from a thyratron counter described in the MIT Radiation Laboratory book, "Waveforms". This circuit is reproduced in Fig. 1.

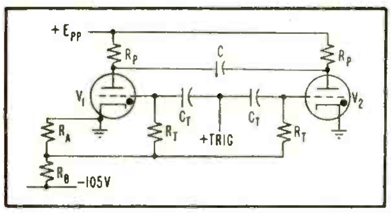


FIG. 1—Thyratron counter circuit

If it is assumed that V_1 is conducting and V_2 is off, a positive pulse of suitable amplitude, applied at + TRIG will cause V_2 to conduct. The plate voltage of V_2 decreases rapidly and because of the capacitor C the plate voltage of V_1 is decreased by an approximately equal amount causing it to fall substantially below ground. This extinguishes V_1. Another pulse will cause the counter to assume its original state.

Within its frequency limits this counter operates reliably unless something happens to cause the two thyratrons to conduct simultaneously. If this occurs the circuit ceases to function, and additional measures must be taken to extinguish one of the thyratrons.

This difficulty can be avoided by making V_1 a vacuum tube instead of a thyratron. In this case, if it is assumed that V_2 is off, a positive pulse will cause V_2 to conduct and to remain in conduction. Another applied pulse will cause the plate voltage of V_1 to decrease. As in the original circuit, this will cause the plate voltage of V_2 to decrease, extinguishing the tube.

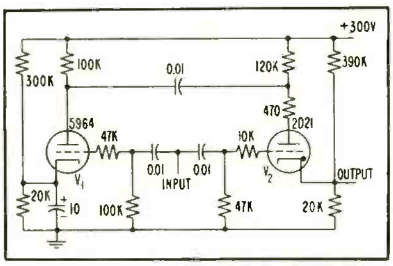


FIG. 2—Modified counter circuit

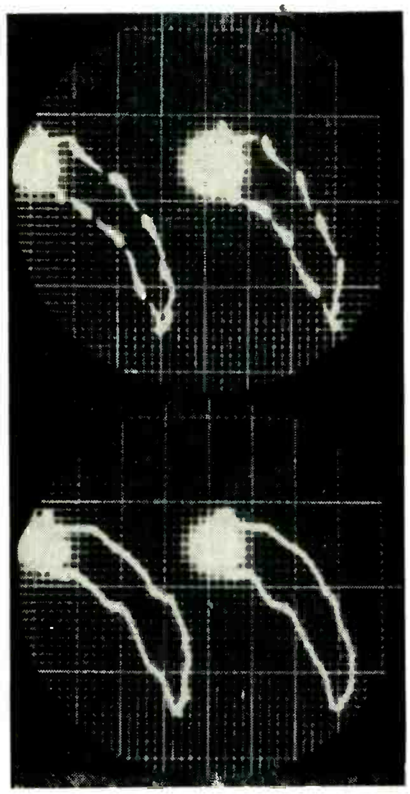
A practical form of this circuit is shown in Figure 2.

Research described in this document was supported jointly by the Army, Navy, and Air Force under contract with the Massachusetts Institute of Technology.

Stereovectorcardiograph

Uniplane vectorcardiograms showing current distribution around the heart have been used during the last 15 years. For more detailed studies three-dimensional wire models have been constructed from photographs of two plane vectorcardiograms displayed on a c-r tube screen. Three or more electrocardiograph leads are appropriately connected to the deflection plates for this purpose.

Recently, two-gun c-r tubes have been employed for simultaneous display of information that can be re-



Two stereovectorcardiograms recorded from a normal individual. A third-dimensional effect is obtained by fusing each pair of images at a distance of 6 inches from the eyes. Older viewers may require corrective lenses of plus 3 to 5 diopters. Practice in fusing images may require as much as 15 minutes initially

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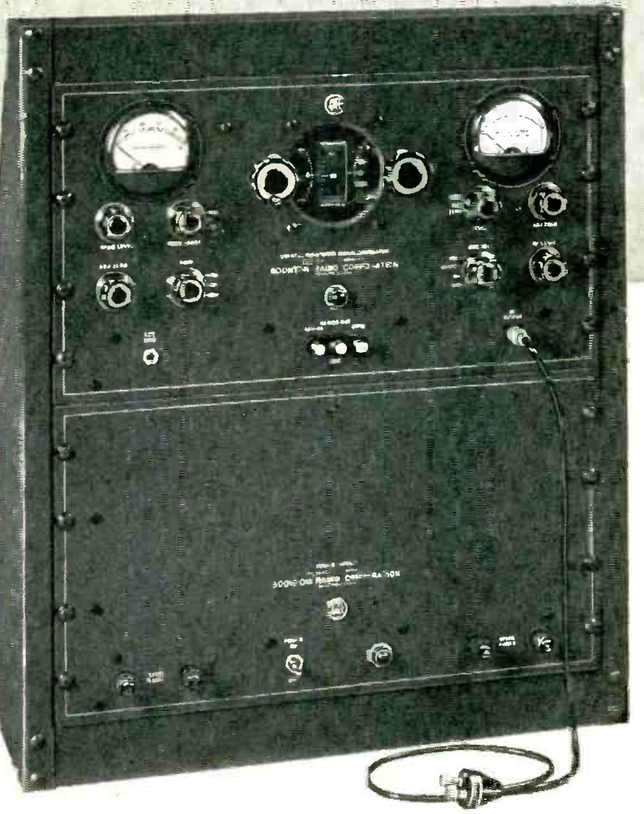

SIGNAL GENERATOR

Type 211-A

Frequency Range 88-140 mc.

Output Frequency Crystal Monitored
Amplitude Modulation 0-100%
Modulation Fidelity ±0.5 db
30 cycles to 11 kilocycles
Negligible Spurious FM

The Type 211-A Signal Generator was designed by Boonton Radio Corporation in cooperation with the CAA and leading manufacturers of aircraft navigation and landing receivers. It was designed for specific application to the calibration of these receivers to the high accuracy characteristics required. The CAA system requiring these receivers guides aircraft from one location to another and assists in landing under marginal weather conditions. The Signal Generator is also useful in testing accurately tuned communications receivers.

SPECIFICATIONS

FREQUENCY RANGE: 88 to 140 mc. in one Range. Vernier Dial marked to 10 Kc. division. Accuracy ± 0.25%.

R. F. OUTPUT: 0.1 to 200,000 microvolts. Output resistance looking into output terminals 26.5 ohms.

AMPLITUDE MODULATION: AM 0-30% and 0-100% with internal or external oscillator. Distortion below 5% at 95% modulation.

INTERNAL AUDIO OSCILLATOR: 400 and 1000 cps.

MODULATION AMPLIFIER: Uniform response within ± 0.1 db 90 to 150 cps. and 9.5 to 10.5 Kc. within ± 0.5 db 30 cps. to 11 Kc.

PHASE DISTORTION: Up to 60% modulation less than 0.25 degrees at 30 cps and 10 degrees at 11 Kc.

SPURIOUS FM: Less than 1 Kc. at 60% FM.

CRYSTAL CALIBRATING FREQUENCIES: 110.100 and 114.900 mc. ± 0.0035%. Calibrations can be made at these and other frequencies by slipping dial vs condenser shaft position.

PRICE: $1800.00 FOB Boonton, N. J. (Relay Rack not included).

Glide Slope Signal Generator

Type 232-A

Frequency Range 329-335 mc.

The 232-A Glide Slope Signal Generator provides 20 crystal controlled frequencies between 329 and 335 mc for testing aircraft landing receivers. One crystal controlled frequency is provided for the IF amplifier of the receiver.

The 232-A is a completely self-contained signal generator including its own power supply and synchronous motor driven modulator. It is a complete test equipment for Glide Slope Receivers.

SPECIFICATIONS

FREQUENCY RANGE: 329 to 335 mc (20 crystal controlled frequencies).

FREQUENCY ACCURACY: ± 0.0065%.

OUTPUT LEVEL: 1 to 200,000 microvolts.

OUTPUT IMPEDANCE: 53 ohms unbalanced.

IF FREQUENCY: 18.9 mc (By changing crystal 15 to 30 mc).

MODULATION: 90-150 cps, 1000 cps, external.

PRICE: $1500.00 FOB Factory.

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corded or directly viewed to give a three-dimensional pattern of electrocardiograph currents.

The displays in Fig. 1 were made using five pickups. A 300-cycle sawtooth time signal was applied to the Z-axis of both beams. Because the time signal turns the beam on slowly and then cuts it off rapidly, each pip of the vectorcardiogram takes on a comet-like appearance, the impulse traveling towards the head of the comet.

With a little practice, each pair of photographs in Fig. 1 can be fused to produce a third-dimensional picture. The electrodes used in this recording were placed so that the planes observed deviate from each other by 10 to 15 degrees.

This material has been abstracted from information furnished by Arthur C. Guyton, M. D., Chairman of the Department of Physiology and Biophysics, University of Mississippi School of Medicine in University, Miss.

Pentode Gain Stabilizing Circuit

By J. G. Haydock, Jr.
Asst. Manager, Sales Engineering Globar Division The Carborundum Co. Niagara Falls. N. Y.

Effects of supply-voltage fluctuations on the performance of amplifiers in gain and signal-measuring equipment and sweep-voltage amplifiers for cathode-ray oscilloscopes and tv receivers can be virtually eliminated by use of a circuit employing voltage-sensitive resistors.

Gain of pentode amplifiers is dependent to some extent on supply voltage, because of the effect that screen voltage value has on the mutual conductance of such tubes.

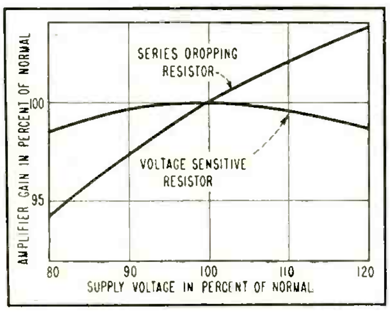

FIG. 1—Variation of gain with supply voltage for 12SK7 pentode in circuit using regular resistors and voltage sensitive resistors

The variation of gain with supply voltage in conventional r-f pentode circuits when a series dropping resistor is used to obtain screen voltage, is shown in Fig. 1. This curve was obtained for a 12SK7 with 250 volts on the plate, 100 volts on the screen and normal grid bias by means of a cathode resistor. A rise or fall of 10 percent in supply voltage caused a corresponding 2 to 2.5-percent increase or decrease in the gain.

The second curve in Fig. 1 was obtained with the circuit of Fig. 2

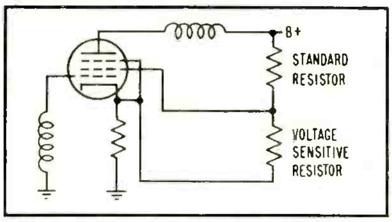

FIG. 2—Circuit using voltage-sensitive resistors has voltage divider returned to ground through cathode resistor

using the same tube and supply voltages. This circuit confines the fluctuation of gain within a range of approximately $\pm$ 0.2 percent of a mean value over the range from -10 percent to $+10$ percent of normal supply voltage.

Screen voltage is supplied by the voltage-divider method. The low-potential section of the divider is a voltage-sensitive resistor whose value decreases sharply as the voltage drop through it increases. The current drawn by the voltage divider is returned to ground through the cathode resistor rather than directly.

Because of the increase in current drawn by the voltage-sensitive resistor caused by a relatively small increase of supply voltage, the bias on the stage increases with supply voltage. This increase is at a rate that opposes the tendency for the stage gain to increase with supply voltage.

In the curve obtained with this circuit, values of the various resistors have been proportioned to cause the stage gain to reach a maximum at the nominal supply voltage of the tube. By using other resistor proportions this type of curve can be obtained with practically all r-f pentodes. This method of gain stabilization is effective also with some beam pentodes.

The stabilized circuit has been evaluated in a preliminary way for reducing the variations in the width of pictures on the television-receiver picture tube. Tests indicate that up to a 4-to-1 reduction in picture-width variation with line voltage is possible. This would minimize present service adjustment problems related to horizontal-sweep voltage. It also presents the possibility of making television receivers self-regulating in this respect.

Diode-Capacitor Memory

Electronic computers are handicapped by inability of the memory to attain speeds matching practical arithmetic units. The diode-capacitor memory, developed by A. W. Holt of National Bureau of Standards, can be designed to present more than 100,000 randomly located 50-digit words per second to SEAC computer, decreasing machine computation time for mathematical problems. In contrast, SEAC's acoustic memory has a random access of 6,000 words per second while the Williams memory has an access rate of up to 60,000 words per second.

Basic circuit (Fig. 1) for the storage element consists of two di-

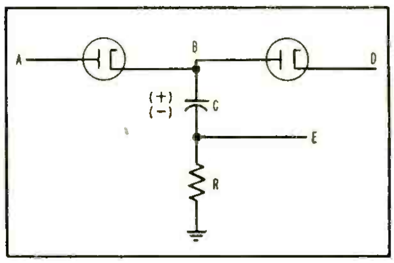

FIG. 1—Basic storage element in diode-capacitor memory

odes in series, with the anode of one connected to the cathode of the other, one side of a capacitor tied to their midpoint, and the other side of the capacitor returned to ground through a resistor. The point between the capacitor and resistor, denoted by E, is used for both reading and writing, while the two diodes are used as a squeezer to connect the capacitor to the read-write circuits.

During holding, both diodes are

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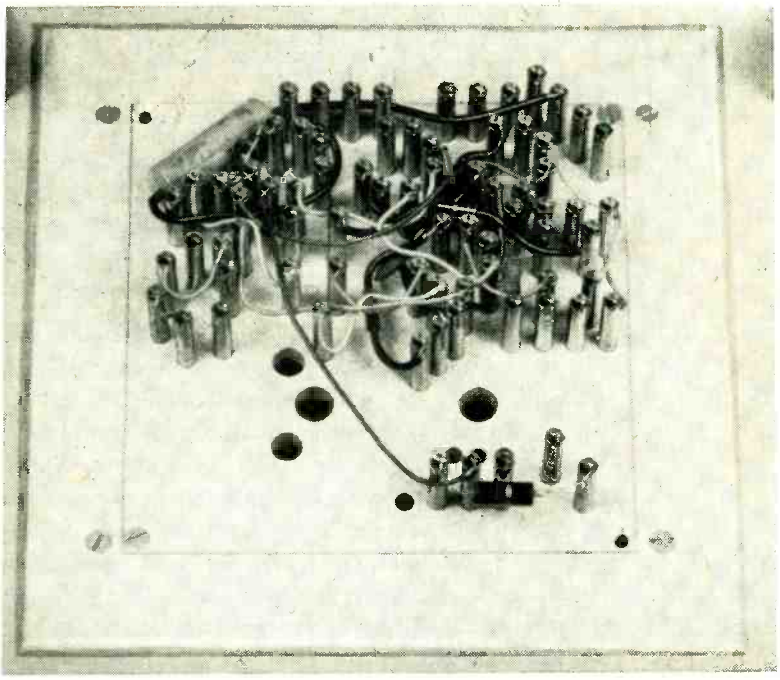

SOLDERLESS multiple-spindle wiring is done with rotating spindles within stationary sleeves. As described in ELECTRONICS, p 272, June 1953, each spindle has two longitudinal holes, one near the edge and the other at the center. Wire is inserted in the outer hole and the terminal placed in the center. When the spindle rotates, wire is wrapped under tension.

A semiautomatic machine that makes many solderless connections simultaneously is now being used experimentally by Bell Telephone Laboratories. Basis for this method of mechanized wiring is the single-wrapped solderless connection (as shown in insert on cover) developed jointly by Bell Labs and Western Electric Co. and now being introduced into Bell telephone equipment.

Terminals of a commercial a-m receiver were modified to have the proper edged cross-section in approach to automation.

Semiautomatic wiring is done in four steps: inserting leads and wires in the spindles; placing the chassis terminals on the spindles; wrapping; removing the chassis. The last three steps are performed simultaneously for all connections.

The multiple-spindle head is aligned with the chassis, which is lowered onto it. To adapt the machine for a new placement of parts, a new spindle-holding plate is set into the assembly bench. Spindles and sleeves are merely relocated.

A 35-mm slide projector indicates successive steps to be taken by the operator. Wiring path and component number are projected for each component.

Correspondingly numbered components are removed from convenient storage bins and dropped into place.

Servicing of equipment wired in this manner is easy. Connections can be unwrapped from either end and replaced with a single-spindle tool that duplicates the original action.

biased in their back direction. For example, the anode of one diode might be held at -4 volts while the cathode of the other is held at $+4$ volts. Then, if the capacitor has a charge of 2 volts both diodes will be biased in their back direction, and only small currents will flow into or out of the capacitor.

When the ends of the diodes are both forced to ground potential (squeezed), one diode or the other will conduct, and a voltage will appear across the resistor. If the capacitor has been charged with 2 volts of such polarity as to make its lower terminal more negative than its upper terminal, there will appear at output E a pulse of -2 volts, which dies out with the time constant RC. This negative pulse is recognized by the reading circuits at the output as binary zero.

If the polarity on the capacitor had been in the opposite direction, the squeeze would have produced a positive pulse that would be recognized as the binary one. Thus, the content of the storage element has been read; but in the process it has been at least partially discharged, and the information has been lost from the storage element. The information must be rewritten.

Rewriting

To rewrite information it is only necessary to force point E to the desired state and hold it there until the squeeze is over. While the ends of the diodes are at zero voltage, assume that E is forced to $+2$ volts and held there until the diodes are returned to their normal voltages of -4 and $+4$ volts. Then the capacitor is left with a charge of 2 volts and upon the next squeeze will produce a positive pulse at E—a one is written.

The opposite is equally possible. Forcing E negative until the end of the squeeze will write a zero. Once the diodes have been returned to their normal voltages, the charge on the capacitor will be undisturbed by later changes at E, provided the magnitude of the voltage at E never exceeds 2 volts. Thus E can have other pulses on it, either positive or negative, and the charge stored on the capacitor will remain unaffected because both diodes will remain with backward bias. This is important for organizing many basic storage elements into an efficient memory assembly and is the reason for charging the capacitor to only ± 2 volts while biasing the diodes twice as much.

The effect of finite forward conductance will reduce output pulse amplitude, and determine how long a writing pulse must last to charge the capacitor adequately. The effect of finite backward resistance is

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critical. During the holding operation relatively long times will elapse, and even minute currents through the diodes disturb capacitor charge.

Arbitrarily long periods of information storage are achieved by regeneration; before the capacitor charge can change to a point where there is danger of losing the information, memory control circuits read the content of each cell and rewrite it.

An amplifier is required at point E to sense the polarity of E during the early part of the squeeze period, together with a gate structure that will force E to the desired polarity during the latter part of the squeeze period. For reading or regeneration E is forced to the same polarity that was read. For writing new information the polarity to which E is forced is independent of what was read, but is determined by the new information being written.

Gating Amplifier

For efficiency, it is essential the gating amplifier serve many basic storage elements. Buses to the diodes are made common to all digits of a particular computer word, and a particular gating amplifier serves the same digit on each of many words. Thus for 256 words of 50 binary digits each there would be 256 pairs of leads to the diodes and 50 gating amplifiers. For reference to a particular word, the proper pair of buses are squeezed to zero voltage, while all the other pairs are held at their normal value of -4 and $+4$ volts.

In this way each gating amplifier receives a pulse from its particular digit of the selected word so that the word is available in parallel at the gating amplifiers. They can then write into this word or rewrite it without affecting the other words in the memory since all diodes in other words remain with backward bias. Regeneration is handled by having the memory control intersperse regeneration cycles, in which the words are read one after the other and rewritten into their former state, between the computer access cycles.

A selection matrix consisting of transformers and diodes is used that has no standby power require-

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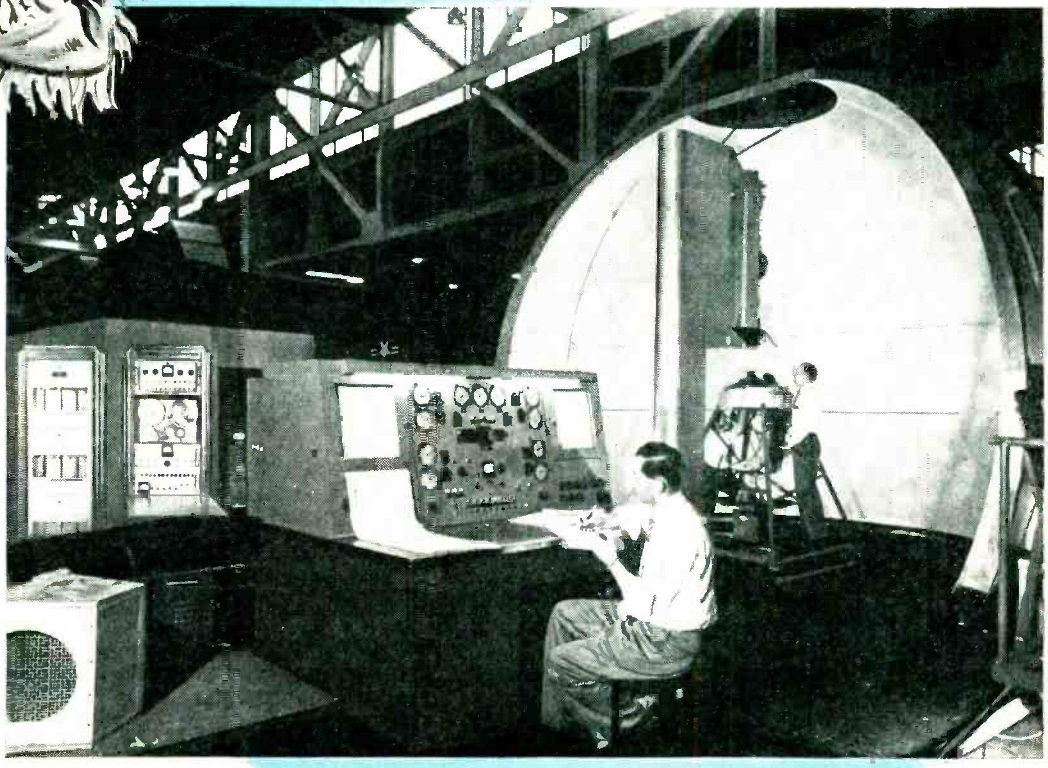

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ment, although it does require more input drivers than would be necessary with a multidimensional diode matrix. For the transformer and-gate matrix, $2n$ inputs are required to select from n^2 words. The matrix

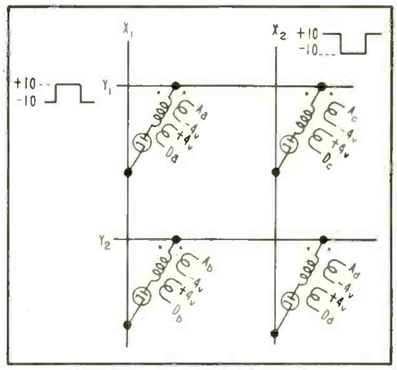

FIG. 2—Word selection matrix using transformer and-gates is described in text

is made up of two sets of crossing buses, X and Y; at each crossing a diode and transformer primary are connected in series, with the cathode of the diode tied to the X bus as shown in Fig. 2.

Normally all the X buses are held at +10 and all the Y buses at —10 volts. This puts backward bias on the diodes associated with each transformer, so normally no current flows through any transformer. If one X bus is dropped to —10 volts, still no current flows; but if simultaneously one Y bus is raised to +10 volts, then just one transformer at the crossing of these two buses will receive a signal, the transformer secondaries connected to the diode-capacitor will squeeze the buses together, and the desired word will be selected.

Microwave Absorption Mats

MICROWAVE ABSORBERS in the form of fibrous mats impregnated with pigmented rubber solutions have been developed at Naval Research Laboratory. These materials have given efficient broadband absorption over the range from 2,500 to 35,000 megacycles, reflecting less than 5 percent of the energy returned by a smooth metal plate.

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"Real-life stars create plenty of excitement when they appear at famous stores," says B. F. Michtom. "But to cash in, we have to get the dolls on the counter *on time.* We call Air Express. Frantic telegrams come in: 'Sold out. 1,000 kids in store. Send more dolls!' We keep both kids and stores happy — we call Air Express again!

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GETS THERE FIRST via U.S. Scheduled Airlines ever, has proved the best combination. This combination is flexibile, resilient and resists mechanical abuse and normal weathering conditions. It uses relatively inexpensive materials that are available commercially in large quantities.

Chief present disadvantages of this absorber, which the scientists have named Darkflex, are it's flammability and variations in thickness and density. Curled animal hair sheets are not subject to close control, in normal production, with considerable variation possible even in a single small sheet. Bulkiness is another disadvantage for broadband application, since the minimum thickness is about a quarter of the longest wavelength to be absorbed. Less bulky types have been developed, however, that are applicable to particular bands, such as the K-band, and the K— and X-bands.

Bulb Puncture In Gas Tubes

By V. L. Holdaway
Bell Telephone Labs.
Murray Hill, N. J.

Electrical puncture of an electron tube bulb results in abrupt failure of the device. The user may fail to identify this type of failure as it may occur at any time during normal life, depending upon the operating conditions. Often the only physical evidence is merely a small pinhole in the envelope.

Bulb puncture is caused by an electrical stress through the envelope. The stress may be produced by the potential of a contacting conductor, or in high voltage circuits by the proximity of a conductor. The condition may be intentional, resulting, for example, from the use of shields or supporting devices or may be accidental, resulting from poorly arranged wiring.

For the higher voltage tubes, the published information gives sufficient warning against operating conditions conducive to bulb puncture. Precautionary information along this line for the lower voltage tubes is generally lacking.

Damaging potential gradients are more likely to be produced through the bulb of a gas tube than the high-vacuum type. In the gas tube the inside bulb sur-

face, in general, assumes a potential approximately equal to that of the plasma. In most types this will be near cathode potential. The wall potential of the high-vacuum tube is more uncertain and also there is a dearth of charge carriers in the tube to complete the circuit to a tube element.

Bulb puncture is aggravated by high temperatures. The operating temperature of the glass bulb results from a heat balance between the power dissipated within the bulb plus radiant heat from surrounding components and heat energy leaving the bulb by convection, conduction and radiation. The effectiveness of these cooling processes will depend upon ambient temperature and the rate of air circulation for the convection process, conductivity of the heat-conducting path and temperature of the sink for conduction cooling and the black-body constants and temperature of the tube or radiator for radiation cooling.

The prevailing trend toward space and weight saving often results in crowding and poor ventilation with attending high temperatures. Close-fitting shields often used on miniature and subminiature tubes to reduce bulb temperature by heat conduction may produce bulb-puncture conditions.

Under a particular set of operating conditions there will be a difference between bulb temperature and the environment generally referred to as bulb temperature rise above ambient. The bulb temperature of cold-cathode tubes used at low currents or operated intermittently may not have an appreciable rise above ambient. Certain types, however, such as gas-

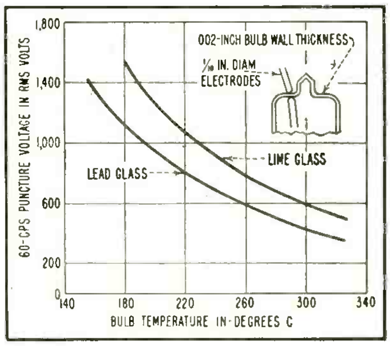

FIG. 1—Puncture voltage versus temperature. Test voltage raised at rate of 1,000 v per minute

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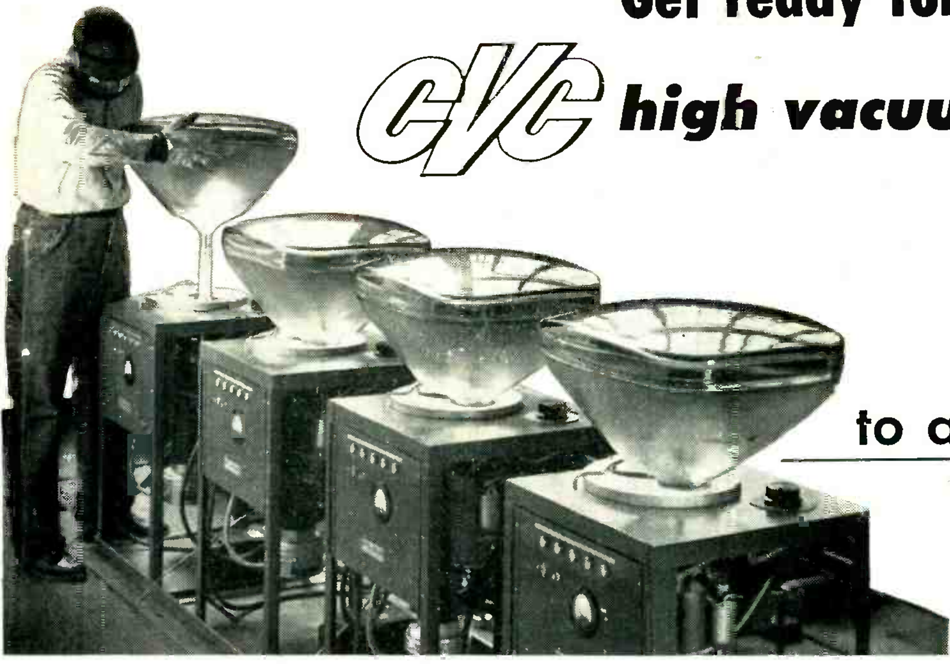

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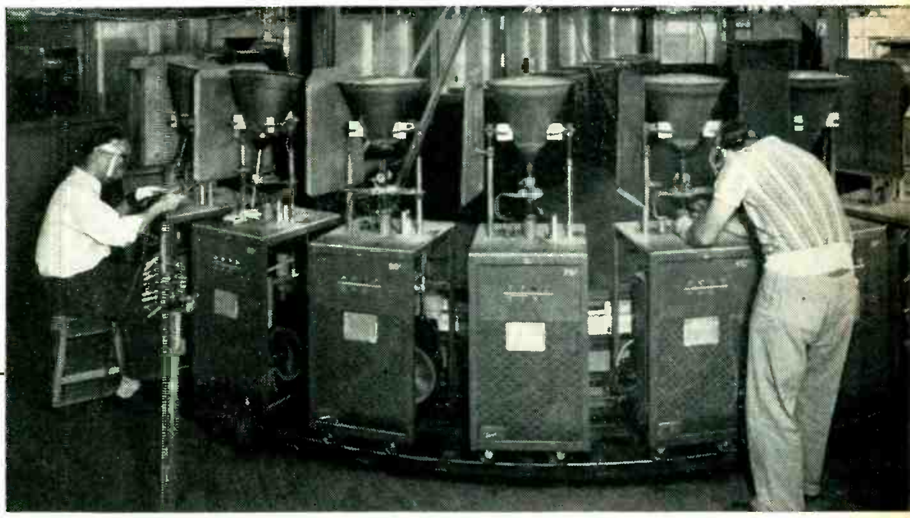

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tube voltage regulators, may exhibit a considerable temperature rise.

Operating conditions likely to produce bulb puncture are more likely to be unwittingly set up in the use of the lower voltage gas tubes that are generally in soft glass.

The dielectric strength of lime and lead bulbs is not high and decreases markedly with increased temperature. Figure 1 shows typical puncture voltages for lime and lead glass bulbs of 0.02-inch wall thickness as a function of temperature These curves are for short-time voltage application. The puncture voltage for sustained application will be somewhat lower. In continuous use a safety factor of at least two is suggested.

The dielectric strength of the bulb will be approximately proportional to the wall thickness. The wall thickness will vary from some 0.02 inch for the smaller bulbs such as the T5-½ to 0.06 inch or more for the larger transmitting types. The larger tubes, however, are generally in hard glass, which has several times the dielectric strength of the soft glasses.

The tube operating conditions should be scrutinized carefully in any application of a gas tube where contact is made with the bulb at any location by a conductor such as a shield, hold-down or clamping device, or where contact may be made accidently. The factors that should be considered are:

(1) Kind of glass in the bulb and wall thickness.

(2) Temperature of the bulb at the contact area under maximum power and ambient temperature.

(3) Maximum voltage that may appear between the external contact and any tube element, notably the filament or cathode. Abnormal conditions such as transients and oscillations, overload conditions, high line voltage or similar adverse factors should be considered. One condition often overlooked is where the bulb contact is at ground potential and the tube elements are raised considerably off ground by the voltage of a coupled circuit. This is often the case in cascaded circuits.

Aside from bulb puncture, the

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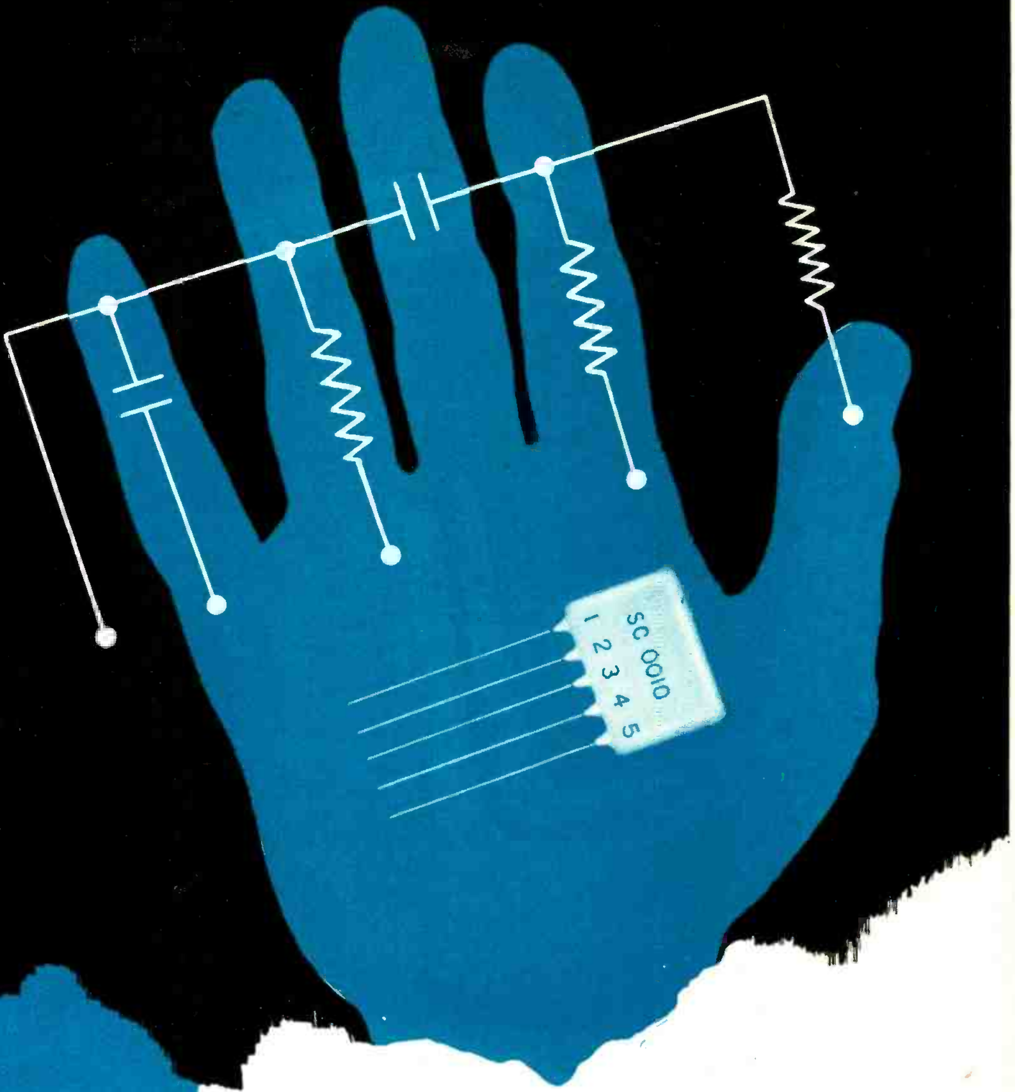

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operation of a tube at high bulb temperatures produces a second damaging effect, that of foreign gas liberation. Gases liberated from the inside bulb walls impair tube performance and reduce tube life. The amount liberated depends on the temperature and time. For a conventionally designed and properly processed lime-bulb tube, 175 C is considered a maximum safe limit of bulb temperature.

TV Field-Strength Indicator

By JOHN B. LEDBETTER
Pomona, Calif.

A SIMPLE INSTRUMENT for checking tv signal strength is useful in setting up a monitor receiver for tv remote cues, checking reception, orienting receiver antennas and in adjusting the studio master antenna. Such a device is shown in Fig. 1.

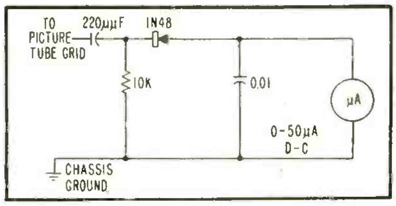


FIG. 1—Circuit of tv field-strength indicator. Values of parts used are not especially critical

In use the test circuit is connected to the tv-receiver chassis and to the picture-tube grid. A needle-point clip will allow easy connection through the picture-tube grid lead without disturbing circuit connections. For distances up to 50 feet ordinary lamp cord or unshielded wire can be used between the 1N48 and the indicating meter. If used as a remote indicating device in conjunction with a calibrated video monitor, the meter can be used to show relative or average video level and saturation of the signal.

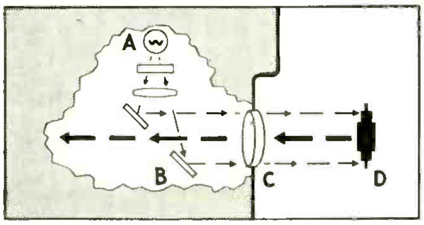
Low-Distortion Detector

A DETECTOR for amplitude-modulation receivers having 0.3 percent total harmonic distortion at 100-percent modulation for a modulation frequency or 420 cycles is described by F. Langford-Smith in

Plain Pointers on Projection

ONE of the basic precepts of the study of geometrical optics is that the angle of incidence equals the angle of reflection. This law, recognized by the Greek philosophers and refined by later investigators, has an important bearing on modern optical gaging by projection. In numerous instances it is desirable to project the surface of a part on the screen to check the position and size of recesses or to measure features which may not permit conventional profile shadow images. The ease and success with which this is done depend not so much on how much light is thrown on the part as on how much of this light is reflected back into the instrument's lens.

Traditionally, surface illuminators used with contour projectors have been placed at an angle on each side of the lens or optical axis. This was true of the pilot model of the Kodak Contour Projector and we frankly admit it proved somewhat less than perfect. Since the light struck the part at an acute angle, it was reflected from the surface at a similar angle—reflected away from the lens, as it were, when the part was normal to the lens for a distortion-free image.



However, between design of this pilot model and our production models, our optical engineers devised a radically different system. As shown here schematically, this consists of a 1000-watt lamp (A) so mounted that its light is reflected by a mirror (B) through the front lens (C) of the instrument. Since the light from this surface illuminator travels along the axis of the lens, it is reflected from a part (D) back through the lens with negligible loss. By staging the part to be measured perpendicular to the optical axis, the angles of incidence and reflection approach zero degrees. Light is reflected from the part back on its own path.

This permits inspection of deep recesses and results in a screen image of unusual brilliance when projecting surfaces. The latter we have frequently demonstrated by placing the works of a small watch on our contour projector. Spectators are generally impressed to see the wheels and gears in motion, and on at least one occasion we've had a watch brought to us for repair. While this was perhaps somewhat embarassing, we're reconciled by the thought that users of our projectors are saved embarrassment daily because of the accuracy with which they can gage parts to "tenths."

Radiotronics. The circuit developed at Radiation Laboratory of the University of California has only 0.8 percent distortion at 100-percent modulation for a frequency of 4 kc.

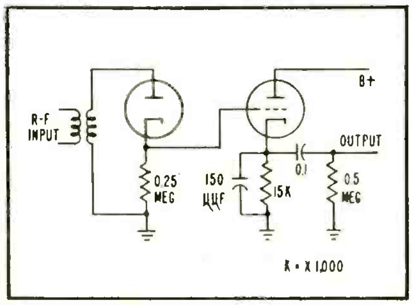


FIG. 1—Low-distortion a-m detector

As shown in Fig. 1, the detector is a conventional diode rectifier directly coupled to a cathode follower in whose output an r-f filter reduces carrier-signal output. Because load on the diode for normal a-m carrier frequencies is essentially resistive, normal effects of excessive shunting capacitance are eliminated.

There is no effect from bias currents normally developed in a diode-loading circuit using coupling capacitors because the cathode follower is directly coupled.

PERTINENT PATENTS

From 1950 to 1952, new applications for patents received by the U. S. Patent Office declined from 69,294 to 60,386. The National Patent Council, viewing this situation with alarm urges increased incentives to keep up the American leadership in invention so long held.

Cathode-Ray Numerals

Titles of some patents become unwieldy. This is true of a "Device of the Kind Comprising an Electronic Tube, Having a Ribbon-Shaped Beam Which is Deflected and Held in Different Positions", invented by Klaas Rodenhuis, of Eindhoven, Netherlands. The U. S. patent number is 2,642,547 and it is assigned to the Hartford National Bank of Hartford, Conn. as trustee.

From the diagrams of Fig. 1 it is seen that the device is an indicating tube operating on the prin-

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ciple of electrostatic deflection cathode-ray indicators in cooperation with a system of electrodes that provide operating conditions similar to a sharp-cutoff pentode.

Indicating tubes of this general type have been seen on counting instruments. The problem of the earlier devices has been a lack of definition of the beam clearly to indicate its position. This deficiency results from peripheral electrons, due to secondary emission, that are caused to bounce from electrode structures. They create a glow on the fluorescent indicating surface where none is intended. Additionally, shadows of the grid structures fall upon the indicating screen.

It is the purpose of the Rodenhuis invention to eliminate this condition by generating a ribbon-shaped beam. This beam is made to pass wholly or in part through a deflection system and a system of electrodes so positioned that the beam is focused directly in the plane of a slotted screen. It produces thereon a sharply defined image of the beam position.

In Fig. 1 the arrangement of the suppressor and slotted screen

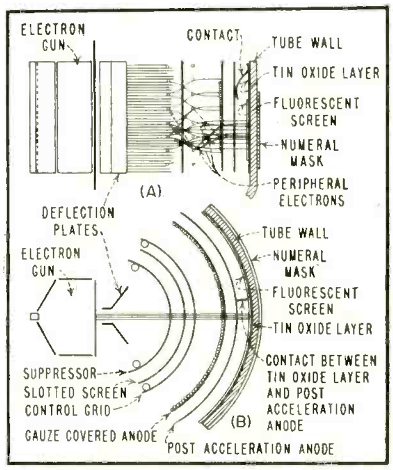


FIG. 1—Side view (A) and cross-section (B) of ribbon-beam c-r tube

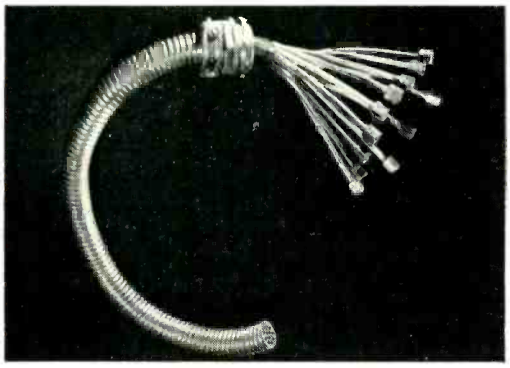
is such that the suppressor grid is held at a potential to collect secondary electrons emitted from the slotted screen. The control grid is similar in construction to the suppressor and is arranged so that its wires are located in the shadow of those of the suppressor grid.

The anode structure is perfo-

For the new pneumatic instrumentation

Cabled Tube

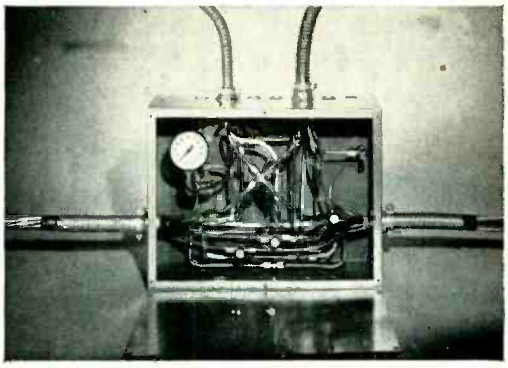
The recent tremendous increase in the use of tube instead of wires for instrumentation and control purposes has led to an important new development—cabled tube. This is an armored group of long tubes twisted together to permit bending without distortion. An insulating tape is wrapped over the bundle of tubes to prevent electrolytic action. Then interlocking, flexible galvanized steel armor is applied, like BX. This protects the tubes from injury during shipment, storage, installation, and in service. Standard fittings, boxes and cabinets can be used for junction boxes and terminations. To make it possible to readily identify each tube, one tube in each layer is colored; the position of each tube in each layer in relation to the coded tube



remains the same throughout the length of the cable.

The tubes usually are copper, but aluminum tubes can be used for special purposes. For unusually corrosive situations, a plastic outer sheath can be applied. As many as 19 tubes, ¼" OD, can be cabled, and supplied in lengths up to 1,000 ft.

Since the tubes carry not electricity but air, nitrogen, helium, or a fluid, they are especially attractive in potentially explosive locations, as in refineries and chemical plants. Utilities are also turning decisively to this new cable, while automatic process control (automation) is a rising application.



Revere, as a supplier of tube for this purpose, calls this cabled tube development to your attention as a matter of general and perhaps specific interest. See Revere for copper, aluminum and brass tube and pipe, electric welded steel tube, and lockseam tube. Call the nearest Sales Office.

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Showing the construction of Crescent Armored Multitube, made by Crescent Insulated Wire and Cable Co., Trenton 5, N. J., which will supply further information on request.

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rated and the perforations are covered with a gauze. Only 8 to 10 percent of the beam current passes through the gauze to the fluorescent screen past the post-acceleration electrode. The transparent tin-oxide coated layer on the screen is at the same potential as the post-acceleration electrode.

External tube masks are provided with numeral cutouts. The tube may be operated with deflection and control signals to position the beam at any instant for a numeral correspondence with the control signal. The luminescence of the screen is maintained optically uniform as a result of the positioning of the control-grid structure.

Magnetic-Field Detector

A "Device for Detecting or Measuring Magnetic Fields" is the subject of U. S. patent 2,642,479 granted Jack Weir Jones of Chester, Pa., and assigned to the Sun Oil Co., of Philadelphia, Pa. The invention is designed to detect extremely small magnetic leakage fields.

In oil pipelines magnetized scrapers and other devices are

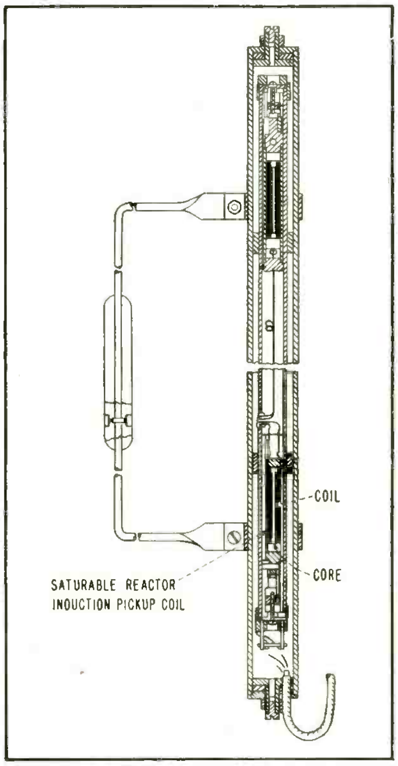
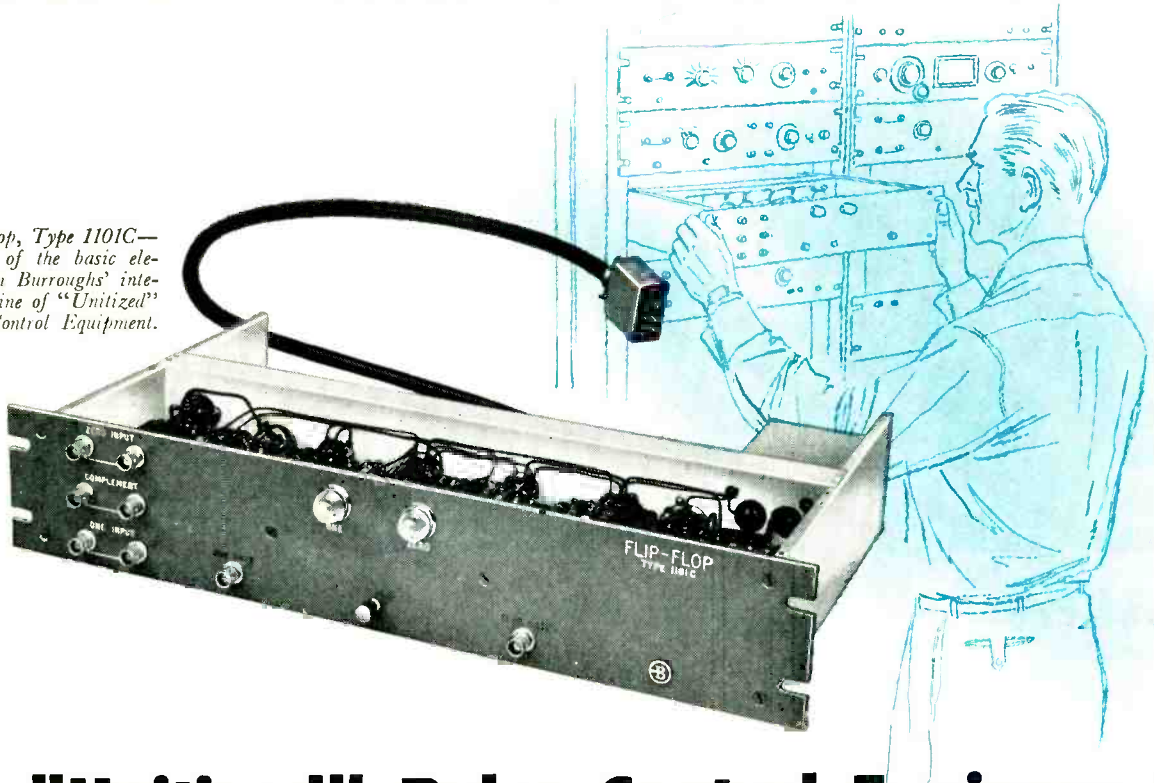


FIG. 2—Saturable reactor pickup device used in pipe-line maintenance

Flip-Flop, Type 1101C—another of the basic elements in Burroughs' integrated line of "Unitized" Pulse Control Equipment.



"Unitized" Pulse Control Equipment

saves time and money in electronic engineering

There's no longer any need to tie up engineering personnel with the time-consuming work of developing and "breadboarding" electronic test circuits. Burroughs, a leader in the office machine industry, now offers an integrated line of "Unitized" Pulse Control equipment covering all the basic functions in pulse circuit engineering. These one-basic-function units are designed with a maximum of flexibility to be used as building blocks for test systems ranging from the very simple to the most complex. Engineers need only make a block diagram of the apparatus needed, assemble the necessary Burroughs units in the plug-in rack, and interconnect them with the various standard coaxial cables and accessories. It's really that easy! It's equally easy to reassemble your units for a different project when your present tests are completed.

YOU SIMPLY "PLUG IN" BURROUGHS FLIP-FLOPS

Burroughs Flip-Flop, Type 1101C, demonstrates the one-basic-function principle that makes Burroughs "Unitized" Equipment so suitable for your needs.

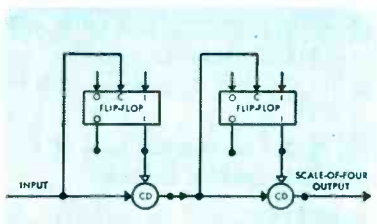
This flip-flop is a bistable circuit designed specifically to provide an output gating voltage to be used in coincidence circuits. The unit contains a pentode Eccles-Jordan circuit capable of being switched at rates up to 2.5 megacycles per second, with 0.1 microsecond pulses.

There are three inputs—Zero, One and Complement—operating from pulse amplitudes of 12 volts or more. Coaxial output jacks marked "Zero Gate" and "One Gate" supply either 0 volts or -23 volts at an impedence level of approximately 680 ohms.

Two neon lights on the front of the panel indicate the position of the flip-flop. A terminal block on the rear of the unit can be used to operate indicator lights installed at a remote point for visual monitoring.

Proved by more than two years of constant use, Burroughs "Unitized" Pulse Control equipment has been purchased by many leading electronic research organizations. Some of the users are: Massachusetts Institute of Technology, University of Michigan, Stanford Research Institute and National Union Radio Corporation.

Scale-of-Four Binary Counter Using Burroughs "Unitized" Equipment



The left flip-flop, Type 1101C, changes state with each input pulse, so that the left coincidence detector (CD) or gate, Type 1201B, is alternately opened and closed with succeeding input pulses, with the result that every other input pulse passes through the left coincidence detector, giving a count of 2. A similar flip-flop and gate combination cascaded to the first combination gives a total scale of 2 x 2 = 4. The number of flip-flop and coincidence detector combinations that can be cascaded is unlimited.

For full information on Burroughs "Unitized" Pulse Control Equipment, write or call Department 12E. Electronic Instruments Division, Burroughs Corporation, 511 N. Broad St., Philadelphia 23, Pa.

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allowed to move through the lines with oil flow. Pipelines are steel and only a very small magnetic field can leak to the outside. The magnetometer, or gradiometer of this invention includes the induction pickup shown in Fig. 2. The arrangement of the two coils is such that a pipe inspector can carry the assembly over the pipe line. When one of the magnetized devices passes through the pipe line the faint magnetic field induces a potential in the saturable reactor coils.

The circuit of the magnetometer is shown in Fig. 3. An oscillator

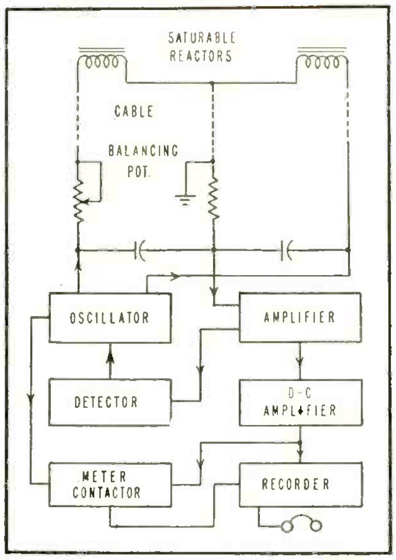


FIG. 3—Combined diagram of oil-pipe-line scraper magnetic detector

applies potential at some predetermined frequency to the saturable reactors mounted in the pickup assembly. Both reactors are saturated. Assuming a zero gradient of the external magnetic field, the output wave of the reactors to a detector will be as

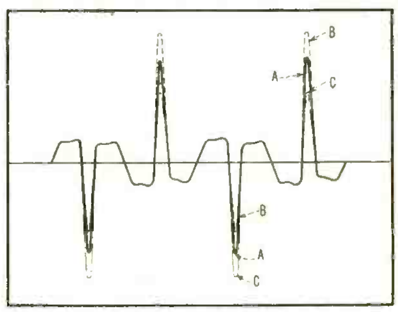
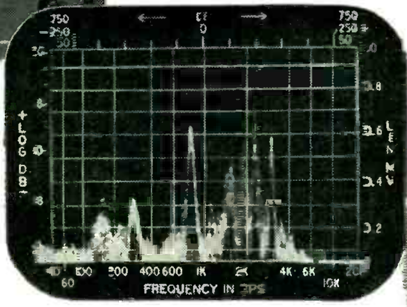


FIG. 4—Output wave of saturable reactors to a detector

WITH

PANORAMIC SONIC ANALYZER LP-1



Engaged in operations which demand maximum efficiency, Pratt & Whitney Aircraft has chosen the Panoramic Sonic Analyzer LP-1 to speed up and simplify sound and vibration analysis. The results of this careful selection are outlined in the Pratt & Whitney Aircraft report. The facts presented there speak for themselves.

In only one second, the LP-1 automatically visualizes on a Cathode Ray Tube the frequency and magnitude of sound and vibration components between 40 and 20,000 cps. The LP-1 is therefore an invaluable tool for analyzing random as well as steady phenomena. Special control features allow selection and magnification of narrow bands for detailed examination. Panoramic presentations are simple. They are readily interpreted by technical and non-technical personnel.

Whatever your problem ... sound, vibration, or general spectrum analysis in the laboratory or on the production line, join the many top-flight manufacturing, research, and development activities which have increased their efficiency through the use of instruments made by Panoramic, the leader.

- Operate with microphones, vibration pickups and other transducers.
- Presents data graphically permitting rapid, direct readings of frequency and voltage.
- Data can be easily photographed or recorded.
- Linear and log voltage calibrations.
- Simple operation.

Report from
PRATT & WHITNEY AIRCRAFT

The Panoramic Sonic Analyzer Model LP-1 is being used by Pratt & Whitney Aircraft for analyzing spectra of pressure, vibration and noise measurements. It is found that records can be obtained in one minute that would take six hours by previously used methods. It is possible, therefore, to evaluate developmental changes more rapidly and to make more thorough analyses of available data.

The instrument is usually used with a Polaroid Land Camera for analyzing data recorded on tape recorders. For more immediate results visual analysis is used while the engine is operating and the more interesting points are then photographed.

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shown in curve *A* of Fig. 4. The peaks are odd harmonics due to unbalance of the coils and their saturated condition. A true balance would give zero output.

The existence of a magnetic field in the vicinity of the reactors induces even harmonics that appear at the peaks. Curve *B* shows this condition as a result of a positive gradient in the magnetic field. Positive peaks are increased and negative peaks are reduced. A negative gradient results in curve *C*, in which positive peaks are reduced and negative peaks increased. The remainder of the circuit is essentially a peak voltmeter serving as a measuring device for the gradient. The meter is calibrated by measure of known gradients.

Variations in the oscillator are prevented from affecting the system by an interconnection of the grid leaks of the oscillator tubes and the detector. A change in oscillator amplitude is accompanied by a bias change that adjusts the sensitivity of the detector in a compensatory fashion.

The detector output operates a meter device so arranged that at certain amplitudes of the meter movement, in response to the gradient detected, there is provided an audible output signal while lower levels are disregarded.

A recorder may be included in the circuit when actual levels are to be recorded.

Control Bridge

Patent 2,642,228 was recently granted to George A. F. Machlet of Elizabeth, N. J., for "Pulsing Electronic Measuring and Control Apparatus."

The patent discloses several circuits for use in control equipment where the element of control is some variation in the operating conditions. Changes in magnitude, pressure, temperature, current or voltage are among those shown as useful for the circuits of the invention.

The circuit of Fig. 5 is one of those for electronic measurement and proportioning control. The initial balance condition of the bridge circuit is set by a control factor as it varies above and below

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For maximum precision—Corning Type N Resistors—Where accuracy is important, Corning Type N Resistors have a resistance tolerance of 1%—are ideal for use in critical, low tolerance circuits and high frequency applications. Can be operated at ambient temperatures up to 140° C.

Specifications—Corning Type N Resistors

Power Rating	SIZE *Length*	*Diameter*	RESISTANCE *Min. (ohms)*	*Max. (ohms)*
½ Watt	19/32"	11/64"	10	10,000
1	15/16"	19/64"	10	40,000
2	2 1/16"	19/64"	20	100,000

For high temperature operation—Corning Type S Resistors

Capable of operating at ambient temperatures up to 200° C., Corning Type S Resistors have an unusually low temperature coefficient of resistance. They operate at higher power levels—afford important space savings. Thin film construction and inherent stability provide excellent high frequency characteristics. Normal resistance tolerance is 2%.

Specifications—Corning Type S Resistors

Power Rating	SIZE *Length*	*Diameter*	RESISTANCE *Min. (ohms)*	*Max. (ohms)*
1 Watt	19/32"	11/64"	10	10,000
2	15/16"	19/64"	10	40,000
4	2 1/16"	19/64"	20	100,000

Corning Load Resistors

These RF and high frequency load resistors combine high power dissipation with exceptional stability and low inductance. For dummy loads, they can be used with forced air or water cooling. Corning Load Resistors can be furnished with resistive coatings either inside or outside the heat-resistant glass tubing.

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a desired value. The primary control here is in the illumination of the photocells by the light from the mirror galvanometer. The galvanometer is actuated by the output current from a thermocouple that is inserted into a crucible whose operating temperature is to be controlled.

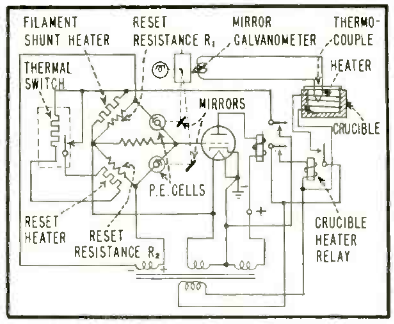
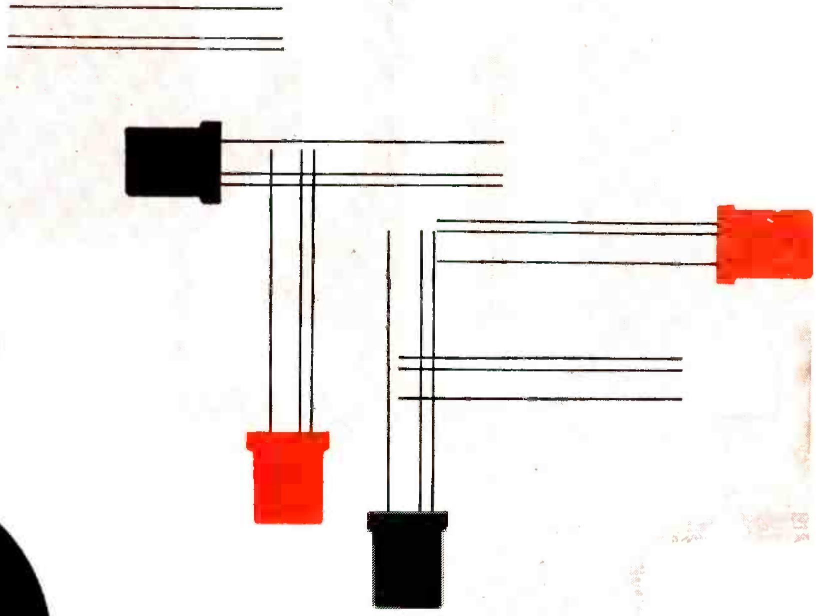


FIG. 5—Primary control depends upon illumination of photocells by galvonometer mirror

Two arms of the bridge are photocells. The other two are heater resistances. The diagonal resistance biases the triode grid negatively by the drop in the heater voltage during balance. With this bias the triode plate relay is not energized sufficiently to close the contacts, which in turn control the crucible heater relay.

Unbalance of the bridge by change in temperature in the crucible, resulting in movement of the galvanometer mirror to change the illumination of the photocells, increases triode plate current, closing the plate relay, which applies current to the crucible heater. The inventor claims his control system is fail-safe because current will not be supplied to the crucible heater by failure of the light source or other elements of the control system. Unbalance of the bridge makes the grid bias on the triode less negative.

A thermal switch is also energized when the triode plate relay is energized. The thermal switch energizes the network that heats the bridge arm resistors and the thermal-switch-controlled heaters. The crucible heats up very slowly and the rebalancing resistors arrive at maximum temperature long before the crucible reaches



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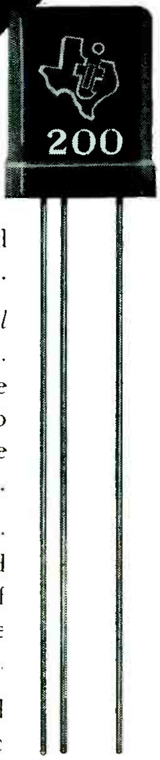

EVERY Texas Instruments grown junction and point contact transistor must pass more than 20 tests—in addition to continual visual checks—before it is granted the TI trademark and shipped to the user.

Texas Instruments inspects *all* transistors *all along* the manufacturing process. This 100% inspection insures that the completed product will adhere closely to published specifications (see distribution curves at lower right).

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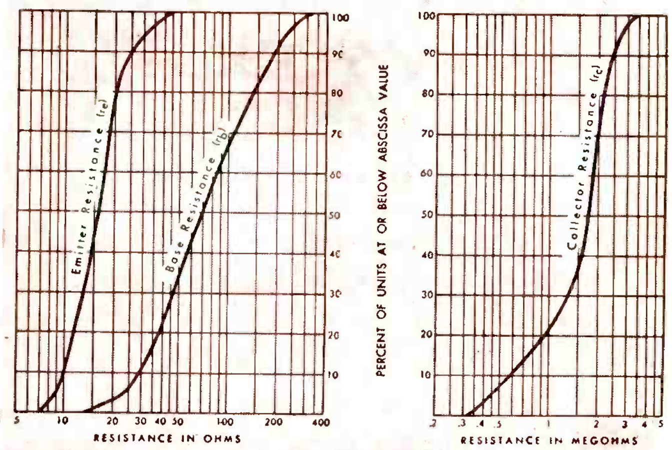
ELECTRICAL DATA

	n-p-n Junction	
RATINGS, RECOMMENDED MAXIMUM:	**Type 200**	**Type 201**
Collector Voltage	30 volts	30 volts
Collector Current	5 ma.	5 ma.
Collector Dissipation (at 30°C)	50 mw.	50 mw.
Ambient Temperature	50°C	50°C
AVERAGE CHARACTERISTICS (at 30°C):		
Collector Voltage	5 volts	5 volts
Emitter Current	−1 ma.	−1 ma.
Collector Resistance (minimum)	0.2 megohms	0.4 megohms
Base Resistance	150 ohms	150 ohms
Emitter Resistance	30 ohms	30 ohms
Current Amplification Factor (minimum)	0.90	0.95
Collector Cut-Off Current	10μa	10μa
Collector Capacitance	12$\mu\mu$fd.	12$\mu\mu$fd.
Noise Factor (average value)	22 db.	22 db.

STATISTICAL DISTRIBUTION CURVES

Based on 250 Type 200 Transistors



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the required temperature. The resistance of the heated resistor will not rebalance the bridge so far from balance because the photocell illumination is widely off balance.

For all practical purposes the reset resistance (R_1) on the upper left of the bridge is inoperative during the heating of the crucible because the thermal switch contacts are initially open. Transitory closing of the switch merely increases the unbalance when it occurs before the thermal switch is saturated—at a time when there is illumination unbalance of the bridge, at low crucible temperature. The contacts are opened again when the thermal switch is saturated and the reset arm cools down to room temperature before the desired crucible temperature is reached.

At the desired temperature the bridge is balanced. In this condition the lower reset resistance (R_2) is heated to maximum and the upper reset resistance (R_1) is cool. The plate current of the tube drops below relay pull-in value and the system remains in equilibrium as long as the temperature is that desired.

In other circuits shown in the invention disclosure the thermal switch and galvanometer bridge

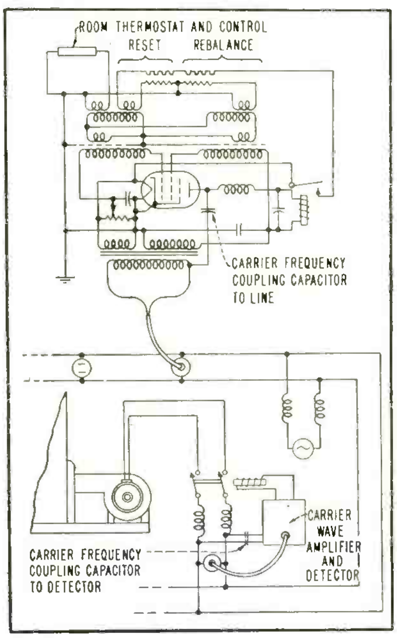

FIG. 6—Remote oil-burner control uses r-f carrier on power line

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Naturally, we take particular pride in our trademark: Nichrome—granted solely and wholly to us by the United States Patent Office forty-five years ago. Representing a series of superb heating and resistance alloys, developed and produced *only* by Driver-Harris, this trademark symbolizes *long life* and *trouble-free* operation to manufacturers everywhere.

Sole producer of Nichrome®, Advance®, Karma® and over 80 other alloys for the electrical, electronic and heat-treating industries.

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arrangement are replaced with a cold resistance balanced bridge. The triode is replaced with a multigrid tube like the 6L7 with the bridge in one control grid and a control pulse input to another control grid to reset the crucible heater.

In one embodiment the control pulse is derived from an r-f signal impressed on the power line to control the operation of an oil burner heating system some distance away. This is shown in Fig. 6. The control pulse is transmitted when a predetermined coupling between two coils during the oscillation of the r-f circuit results in a plate current in the bridge circuit oscillator. The setting of the coupling is accomplished by a room temperature thermostat.

Testing Bits

R. S. Segsworth of Toronto, Ontario, Canada has been granted U. S. patent 2,642,482 for an "Electronic Bit Tester."

The circuit of the bit tester is

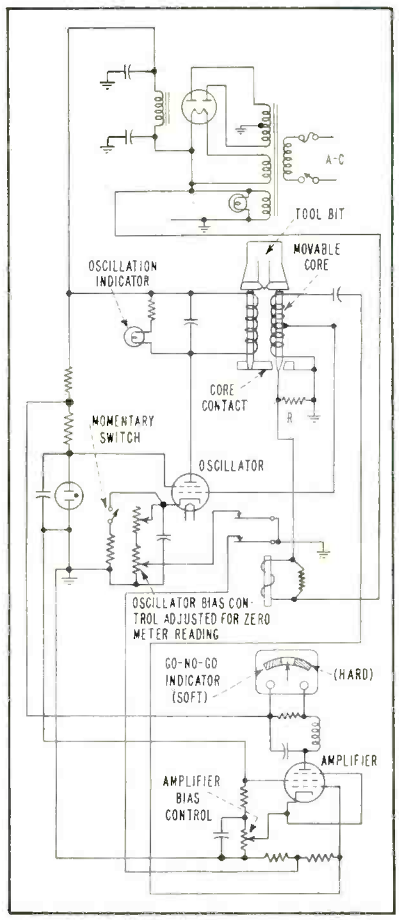

FIG. 7—Bit tester circuit depends upon magnetic loop

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shown in Fig. 7. Figure 8 illustrates the principle of the oscillating circuit that is the basis of the invention.

The oscillator operating at relatively low frequency to avoid skin effects is energized and the meter

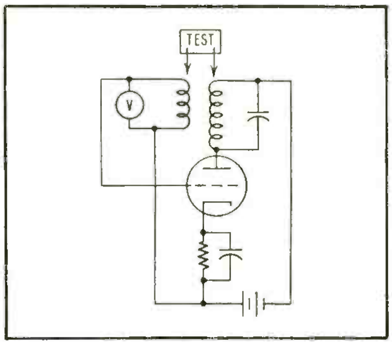
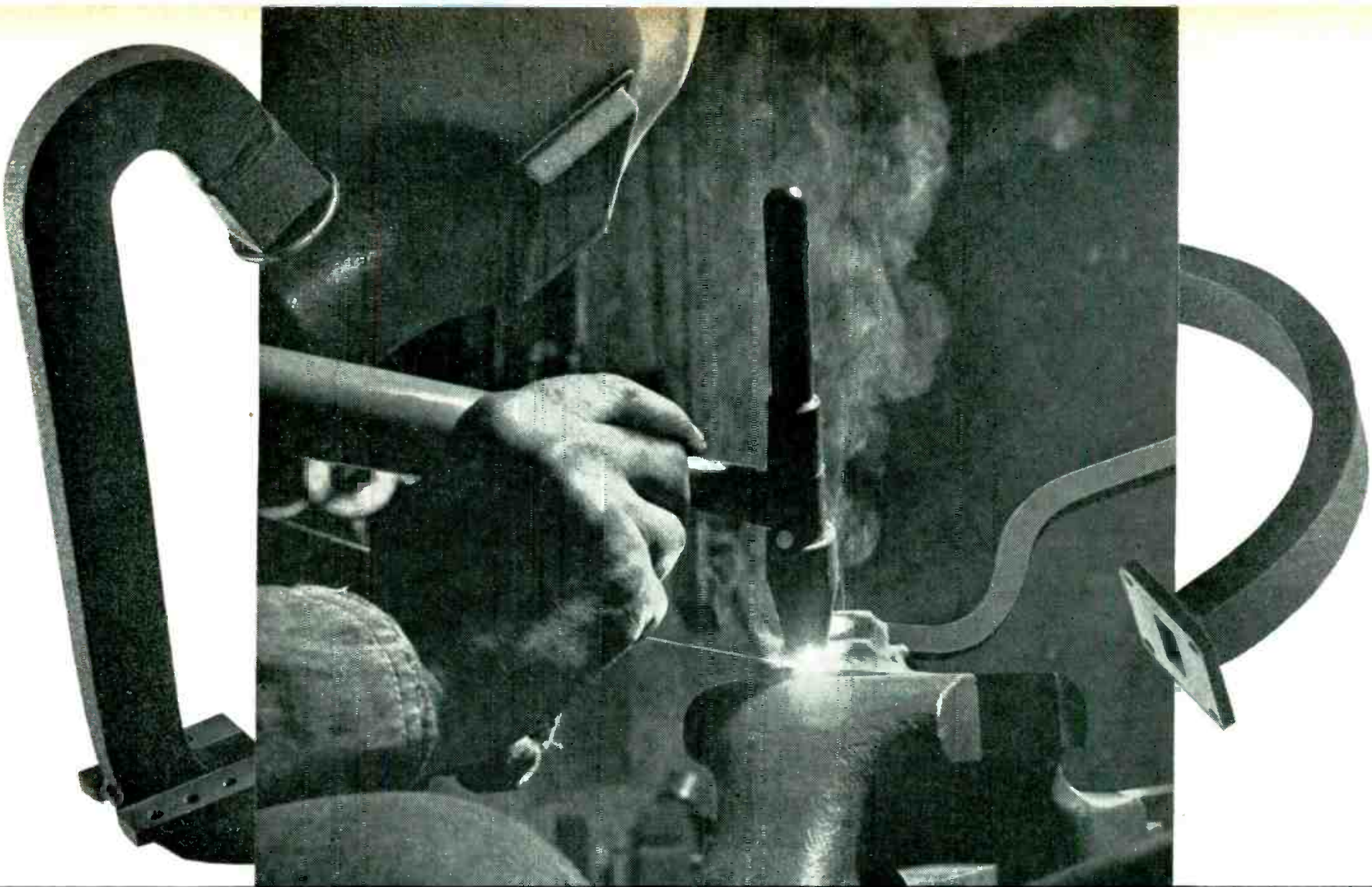


FIG. 8—Basic oscillator circuit used in bit tester

bias adjusted for zero reading with a test bit of the desired hardness in the circuit. Any deviation from the desired hardness will be apparent by a change in the magnetic loop currents in the oscillator coil cores. A differential voltage will be delivered to the amplifier voltmeter circuit (go-no-go indicator). Lower output readings will be observed for softer-than-standard bits and a higher reading for harder-than-standard bits.

Some interesting precautionary procedures are described in the patent to make certain that the circuit operates under all desired conditions. The core in the tapped coil is movable. When the bit is placed on the core, the core is depressed against a pole piece that both closes the magnetic loop to the secondary coil and shorts a bias resistor in the oscillating circuit to operate a relay whose contacts insert the appropriate bias resistances into both oscillator and amplifier circuits. A momentary switch is provided to restart oscillation should it cease.

The circuit is selectively adjustable even to the point of accounting for imperfect contact of the bit and core. To test under imperfect contact conditions thin paper or other insulating (nonmagnetic) material is inserted between the bit and core to simulate the imperfect contact and prevent re-



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One typical
DV Development

Elimination of 50 per cent of the weight of an antenna reflector has been made possible by this DV production development. Glass cloth is plastic impregnated and metal sprayed to form the front and back skins. These are then laminated with aluminum honeycomb to complete the reflector illustrated.

tell it to DV

Years of specialization as an integrated design-through-production engineering group has taught the Dalmo Victor staff a lot about complex, lightweight, electromechanical systems. Lightweight radar reflectors, shaped and welded magnesium waveguide, and fluid magnetic clutches are just a few of the individual system components to come out of Dalmo Victor engineering ideas.

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jection for this type of production occurrence.

TV Facsimile

A "Television Type Facsimile Transmission System" is the invention of John Hays Hammond Jr., of Gloucester, Mass. The invention is described in U. S. patent 2,642,492.

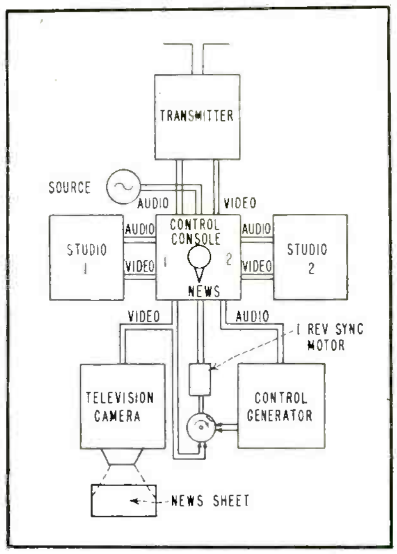


FIG. 9—TV facsimile system transmitter

In Fig. 9, the transmitter of the facsimile system is shown in interconnecting block form. The news sheet is picked up by the television camera and along with signals of a control generator the image is transmitted in the usual manner. The receiving system in a home is illustrated in Fig. 10. Control signals from the transmitter are received when a clock turns on the

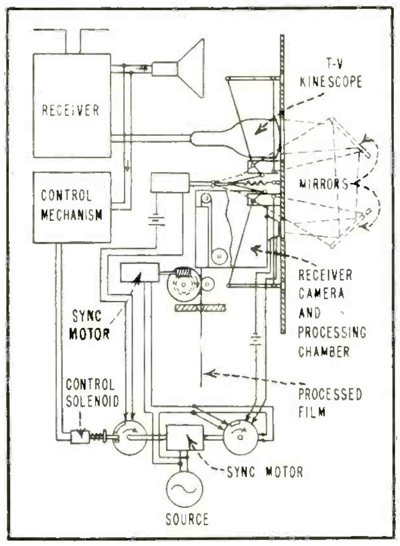
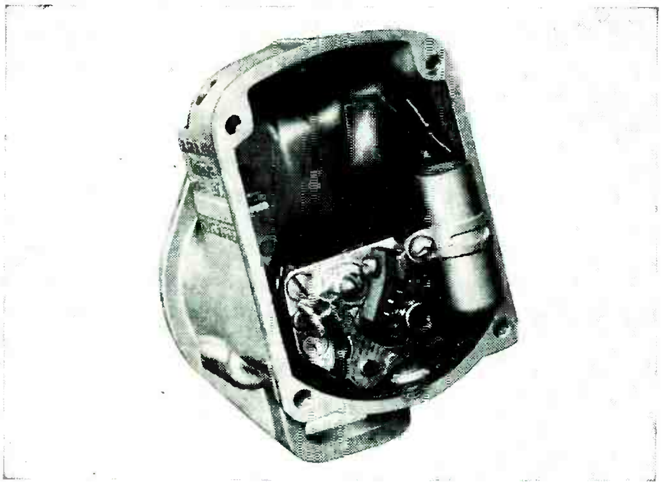


FIG. 10—TV facsimile receiver is turned on by clock (not shown)

How many of these electrical insulation problems do you have?



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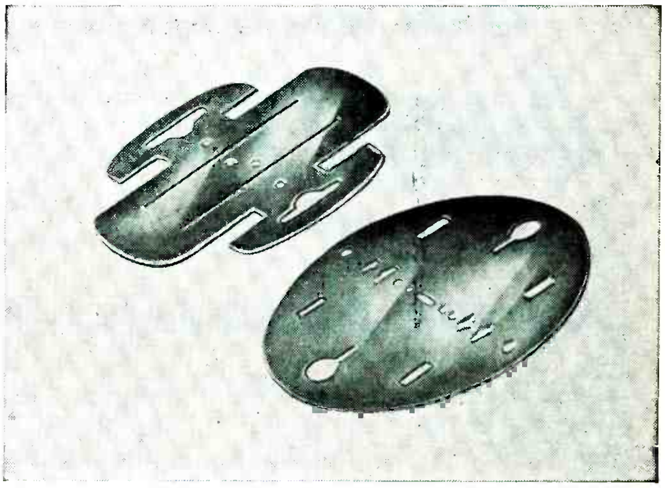

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receiver at the appropriate time.

These control signals set the mechanical system in operation. When the facsimile tv signals are received by the kinescope tube in the receiver, they are reflected into a camera box that photographs the pages at predetermined intervals and sends the exposed film or facsimile paper through a processing chamber where the images are developed and passed to the outside. The sheets may be torn off and read at leisure.

Hammond proposes that the system be placed in operation by a clock set for an early morning hour and when the owner of the tv-facsimile system awakes the facsimile newspaper will be awaiting him.

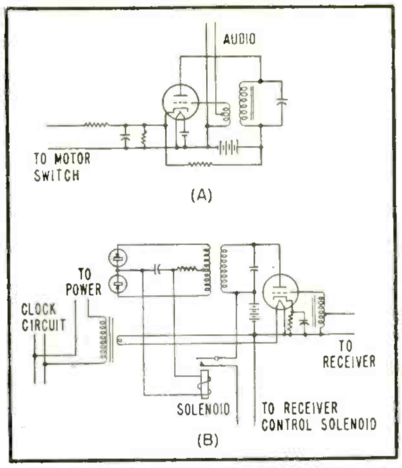
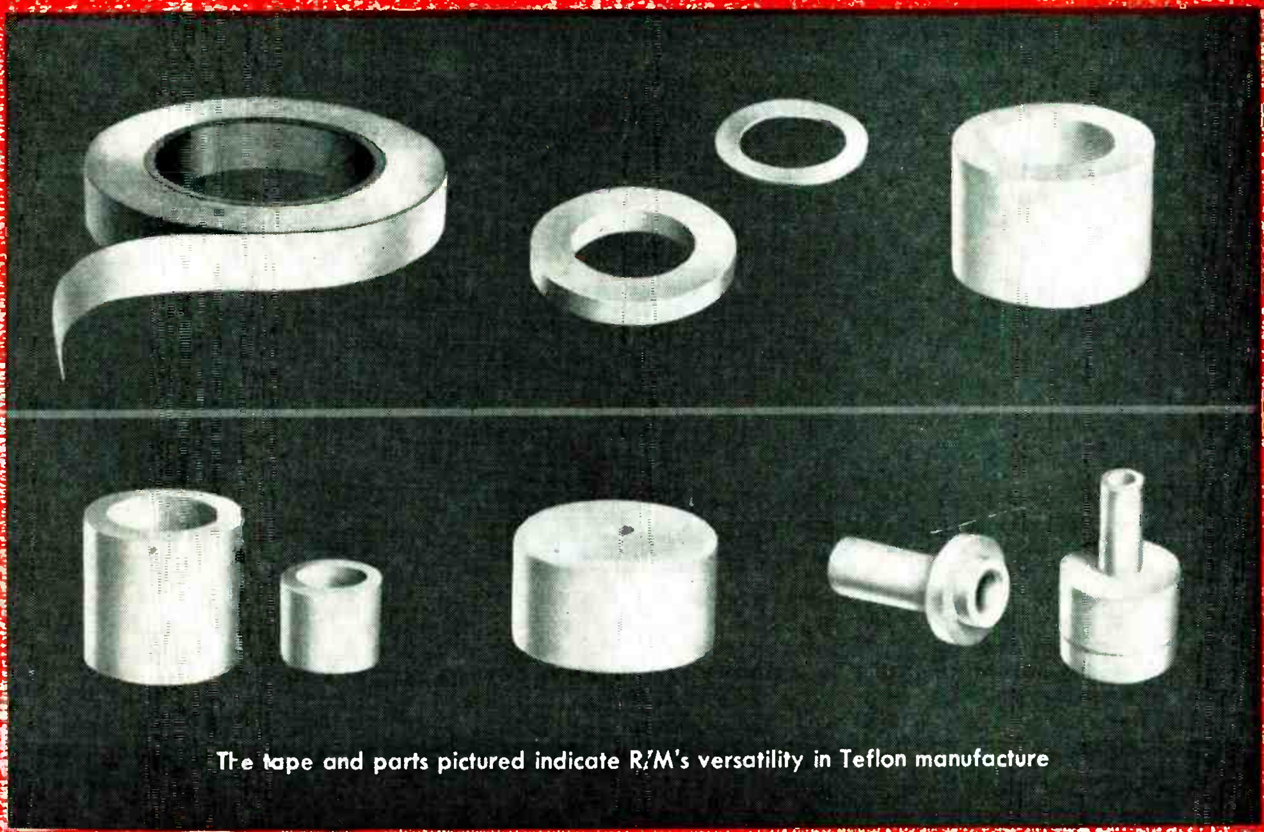


FIG. 11—Transmitter control (A) delivers starting and control tones, while discriminator detector (B) is located at receiver

Control circuits are shown in Fig. 11. The first is the transmitter control generator that delivers the starting and control tone to be transmitted. The second is the receiver control signal detector. This is a discriminator circuit to develop a direct voltage. Operation of a solenoid controls the receiver as shown in Fig. 10. Each operation of the receiver control solenoid permits one picture to be taken and initiates the operations of the mechanism of the processing chamber.

Mechanical Vibrator

A structure built to create a



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*Du Pont's trade-mark for its tetrafluoroethylene resin

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You can rely on R/M for three things: dependable source for Teflon rods, tubes, sheets or tape; fabrication of Teflon parts to your specifications; collaboration in the search for new uses to which this remarkable product can be put.

Teflon Properties: High resistance to acids and gases even at high temperatures • Moisture absorption zero • Unaffected by weather • Excellent heat stability up to 500°F. in continuous operation • As tape, leaves no carbon residue along discharge path • High impact resistance • Nonadhesive • Stretches easily Tensile strength 1500-2500 psi

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Patent 2,642,545 was granted to E. W. Smith of Melrose Highlands, Mass. for such an apparatus.

The inventor employs his apparatus for the penetration of moisture into paper sheet during the manufacturing process. He points out that a vibration of $\frac{1}{32}$nd inch in amplitude at 360 cycles involves an acceleration of 500 g. When such forces are applied to paper for an appreciable interval, the water in intimate contact with the paper under the vibration will penetrate the paper.

The mechanism is simple though massive. The vibrator is shown in Fig. 12A, the coil in Fig. 12B and

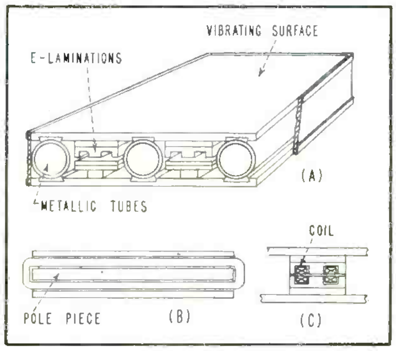

FIG. 12—Vibrating table (A) is shaken by current in coil (B) shown in cross-section at (C)

a cross-section of the coil applied to the E-lamination core is shown in Fig. 12C. When audio frequencies are applied to the coil in the range from 60 to 500 cycles vibrations are set up in the surface of the structure.

T-W C-R Tube

In patent 2,630,544 granted J. W. Tiley and assigned to Philco Corp, Philadelphia, Pa., there is described a technique for producing a high-intensity spot on cathode-ray tubes although the tube is designed for low-voltage operation.

The traveling-wave tube technique applied to this device is shown in Fig. 13. In the neck of the cathoderay tube a helical structure is inserted with a channel-like construction open to the outer surface of the neck. A coil around the neck

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energized from a d-c source produces a concentrated magnetic field that acts upon the beam traveling through the neck to keep it cen-

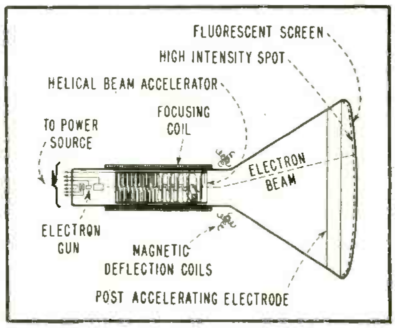


FIG. 13—Traveling-wave c-r tube gives high-intensity spot

tered, adding velocity to the beam in its traverse through the helix and magnetic fields. The velocity gradually increases as it goes toward the screen of the crt.

The helix is energized with a high-frequency field. The interaction between the high-frequency field and magnetic field produces acceleration of the beam to a much higher velocity than is experienced with high potential d-c acceleration customarily employed in crt operation. The result is a brighter spot.

Ceramic Klystron

W. W. Eitel and J. A. McCullough are the inventors of a "High-Power Klystron" tube that is distinguished from more familiar tubes by its unique structure. The invention was granted patent 2,629,066 and is assigned to Eitel-McCullough Inc., San Bruno, Calif.

The novel feature of this klystron (Fig. 14) is the construction using ceramic material. The outer walls of the cavities and drift tube, in one embodiment, are ceramic, while the drift tube and cavity

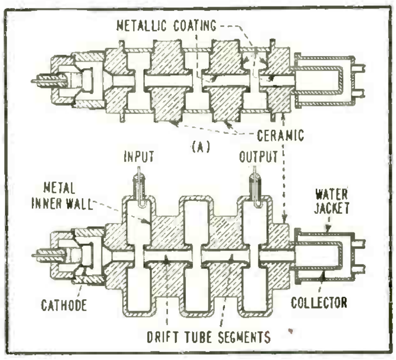
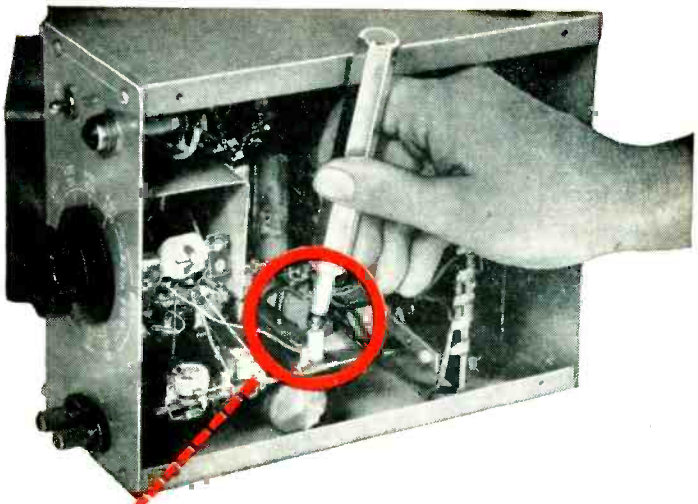


FIG. 14—Ceramic construction of klystron (A) can also take the form (B)



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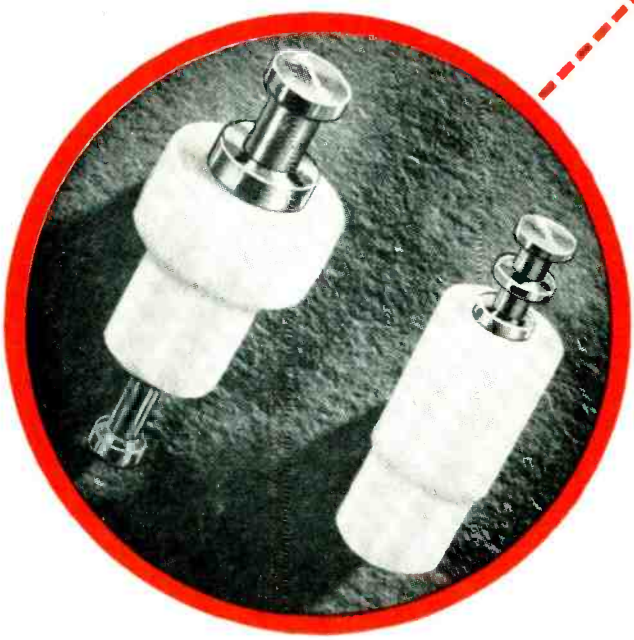

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Standoff and feed-thru insulator terminals often fail in service due to high-temperature breakdown. Cracking frequently occurs during degreasing operations. And breakage may occur during manufacture. Today's equipment and operating conditions require terminals that eliminate these failures and provide improved, lasting performance.

In designing such improved terminals, Sealectro Corporation sought an insulating material that had good dielectric properties, resistance to high operating temperatures and chemical attack, and the toughness and resiliency to eliminate breakage and cracking. And it had to provide for simple, positive installations.

They chose Du Pont "Teflon"* tetrafluoroethylene resin. "Teflon" is an excellent insulator. Its dielectric constant (2.0) and loss factor (0.0005) are unaffected in temperatures from —80°F. to 400°F. Du Pont "Teflon" is inert to all chemicals except molten alkali metals and fluorine. It is tough, durable . . . will not crack or arc. And the one-piece terminals assure simple, tight, lasting installations.

Du Pont "Teflon" serves many uses in electrical equipment—coaxial spacers, insulation for wire, cables and motor windings, and other parts where high temperatures, service, dielectric strength and durability are required. Perhaps it can help you improve or develop a product. For full information, write E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 2211T, Du Pont Bldg., Wilmington 98, Delaware.

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inner walls are coated with metal in a thin layer. In the manner shown in Fig. 14, the inventors have overcome a problem that has stood in the way of designing high-power klystrons. It is conceivable that the device can speed the development of uhf and microwave transmission at higher power levels.

Dual Radar

Those familiar with ppi radar techniques can appreciate the advantages of the "Dual Scanning Antenna Radar System" invented by W. A. Huber and N. T. Volsk. The invention was granted patent 2,627,069, which is assigned to the United States of America, Secretary of War.

During the long period of one rotary sweep in a radar system employing the ppi display, target objects may move a considerable distance. These inventors have devised a dual radar system operating to provide beams going out in two directions each 180 deg opposed to the other. Thus, while the upper part of the radar scope is displaying the reflection from targets in one direction the lower shows reflections from the other direction.

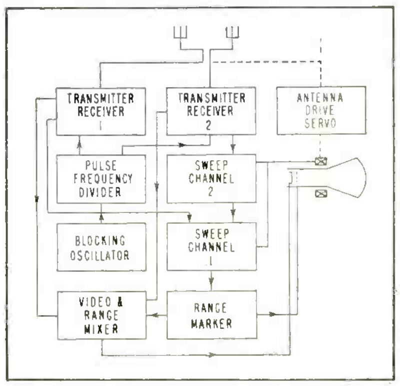

FIG. 15—Dual radar to give better resolution for high-speed targets

The operation of the dual scanning radar system is illustrated in the simplified block diagram of Fig. 15.

The system may be so adjusted that each transmitter-receiver system and its antenna covers a different elevation sector to expand the elevation range of a radar system of the ppi type.

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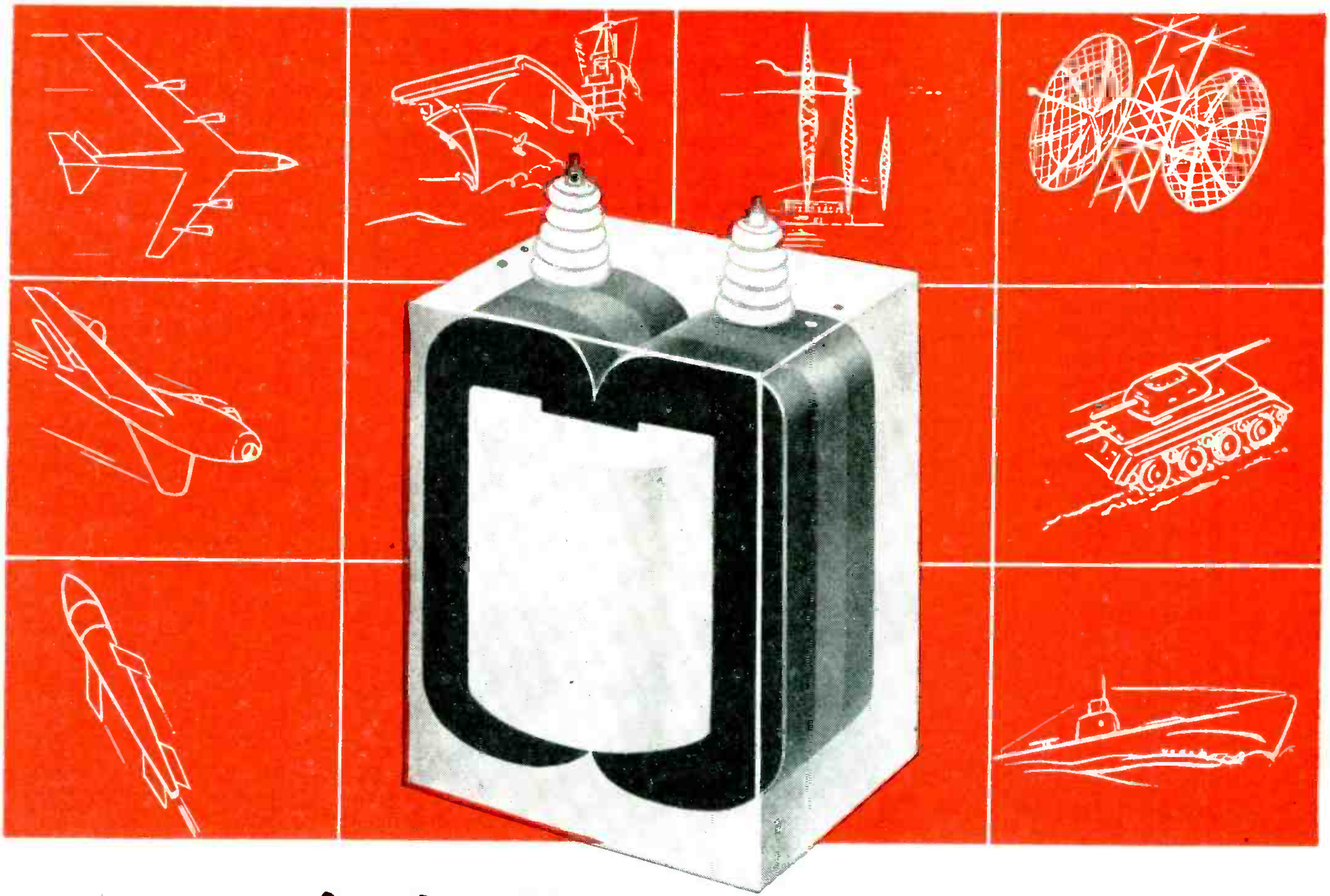

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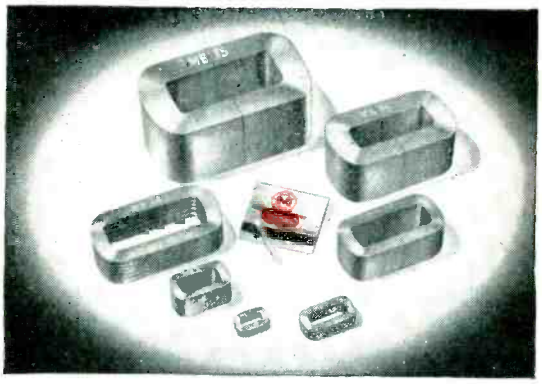

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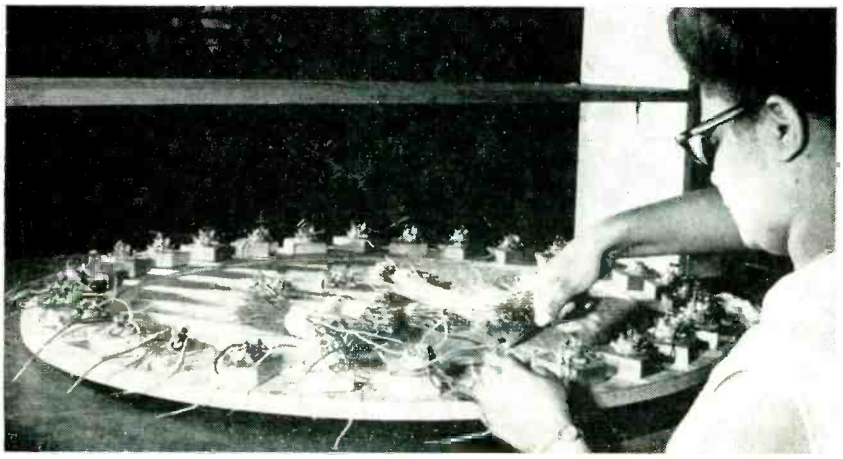
Production Techniques

Edited by JOHN MARKUS

OTHER DEPARTMENTS

featured in this issue:

Socket Subassembly Turntable



Method of using turntable to speed training of new workers in Puerto Rico electronic plant making military radio and radar equipment

IN SUBASSEMBLY work on sockets for military radio equipment, a 30-position plywood turntable makes it unnecessary for new workers to remember more than one part or lead at a time. When used in the plant of Caribe Aircraft Radio Corp. in Coamo, Puerto Rico, this training aid rapidly developed the skill of new workers. These workers were soon able to remember as many as 24 different parts and install them in sequence on a single socket without using the turntable, even though they had never before been in a factory.

When using the turntable, the operator first places an empty socket on each of the 30 wood blocks which serve as positioning jigs. She then assembles the first wire on each of the 30 sockets in turn. Next she looks at the finished sample and proceeds to put on the second wire or part in accordance with its position on the sample. This continues until all parts have been assembled, after which the operator solders all connections on each socket in turn.

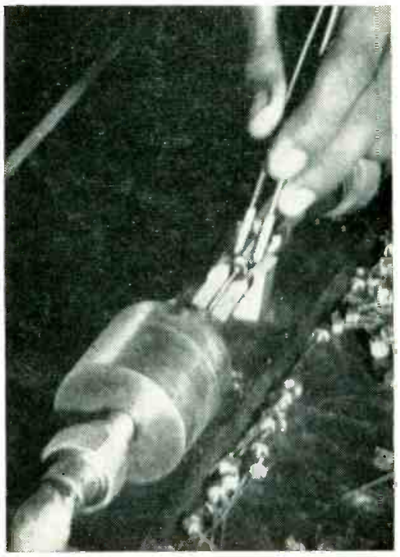
The wood turntable is cut out of ¾-inch plywood and mounted on ball rollers for easy turning on its center pivot.

Resistor-Capping Machine

TWO AIR CYLINDERS operating in synchronism serve to press metal end caps onto deposited carbon resistors. Although considerable force is employed here to obtain a friction fit that will maintain good contact throughout the life of the resistor without soldering or brazing, fixture construction is sufficiently heavy and precise so that breakage of the brittle ceramic bodies rarely occurs.

The resistors are baked at 300 F both before and after capping. Baking has been found to give a better contact and to stabilize the value of the carbon coating. Even though nowhere near the melting point of the silver plating on the caps, this temperature promotes a type of amalgamation of the silver with the carbon.

The resistor body is placed in the



Removing capped resistor from fixture at air-vise setup, using tweezers having jaws wrapped with adhesive tape to prevent scratching of deposited carbon coating on ceramic body

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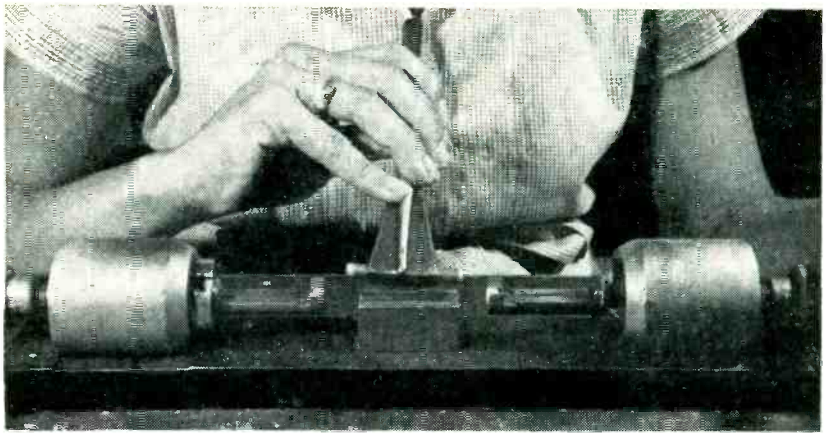
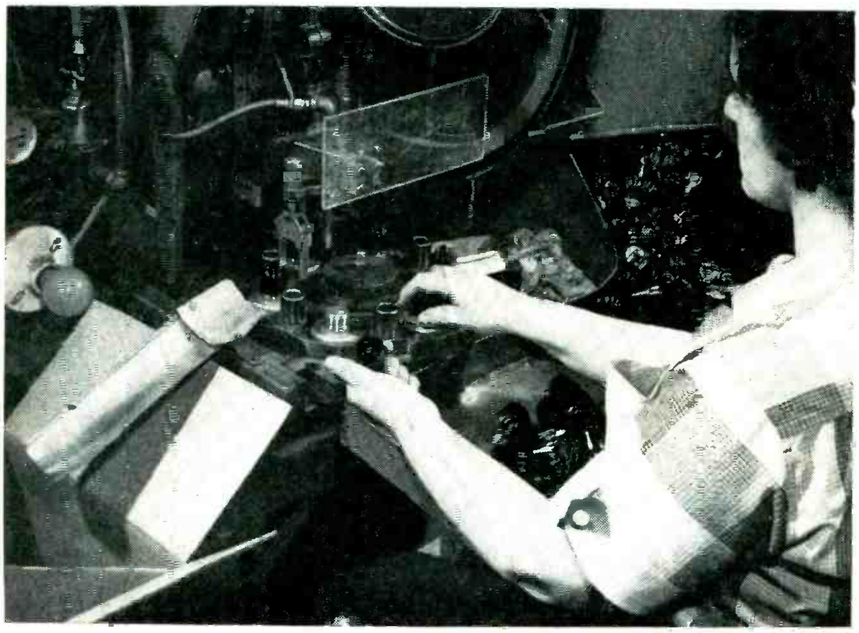


Placing resistor body on pedestal of fixture with tweezers having triangular plastic sheets riveted to insides of jaws. Curved grooves in plastic pieces conform to shape of resistor body

grooved center pedestal of the fixture with plastic-lined tweezers to prevent contamination of the coating. The operator next places end caps with attached leads in the recesses of the air cylinder plungers. Operation of the foot valve then brings the plungers together, forcing the caps onto the resistor. This technique is used in the San Juan, Puerto Rico plant of Radell Corp. for their deposited carbon resistors.

Inspecting Molded Tube Bases



Loading tube base upside down onto tapered die of automatic inspecting machine

MOLDED plastic octal bases for tubes are inspected at high speed in a bench press having a six-station dial feed, after staking of pins. The bases are loaded on tapered dies by the operator, and carried by the feed turntable to a ram where a spring-loaded hollow punch applies a 30-pound force.

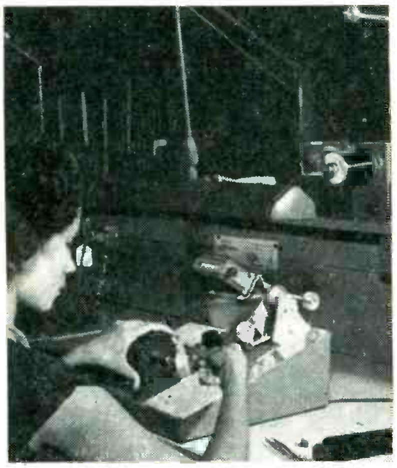
The punch has an arm that contacts a snap-action switch which is actuated when a part breaks under load, thereby turning on a signal light to warn the operator. She then stops the press and removes the defective part manually.

Parts which pass the test are lifted from the dies by a pickup arm, then blown into a chute by an air blast. About 2,000 parts an hour are inspected with this setup in Sylvania's Warren, Pa. plant.

Footage-Measuring Coil Winders

TO WIND PRECISION wire-wound resistors to very nearly the exact required resistance, from wire that may be as small as No. 52, special motor-driven winders that place a very low stress on the wires and indicate footage rather than turns have been developed by Hycor Co. for use in its Vega Baja, Puerto Rico plant.

Direct operation of a Veeder counter by the wire requires appreciable torque, with resulting stretching of the wire. If this occurs, the resulting strain in the wire would produce a resistance change. A resistor that was wound to correct value would then change in value during removal of the strain in subsequent oven heating.

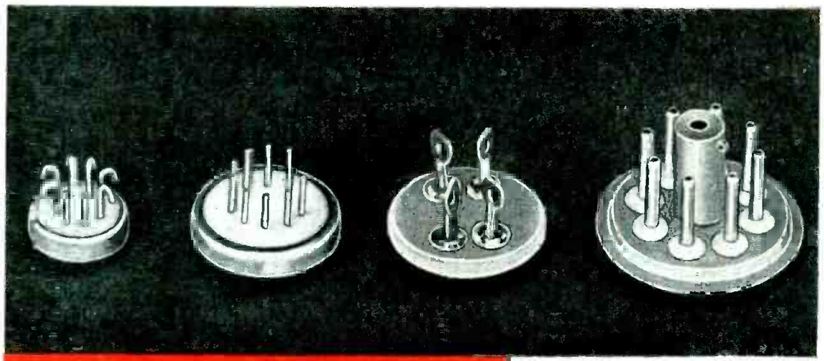


Setup for winding precision resistors for computers. Counter mounted on top of winder indicates actual footage rather than turns. Wire is being drawn from spool on shelf of bench

To measure footage, the wire runs over a ball-bearing pulley to which is attached a commutator. This commutator acts in conjunction with a wire brush to give one electrical pulse for each unit length of wire passing over the pulley.

Commutator pulses operate a sensitive d-c relay, using power obtained from a selenium-rectifier power supply. The relay in turn operates the standard 115-v a-c coil of the counter. This arrangement minimizes burning of the delicate commutator contacts.

Because of the strain-minimizing requirements, a number of different



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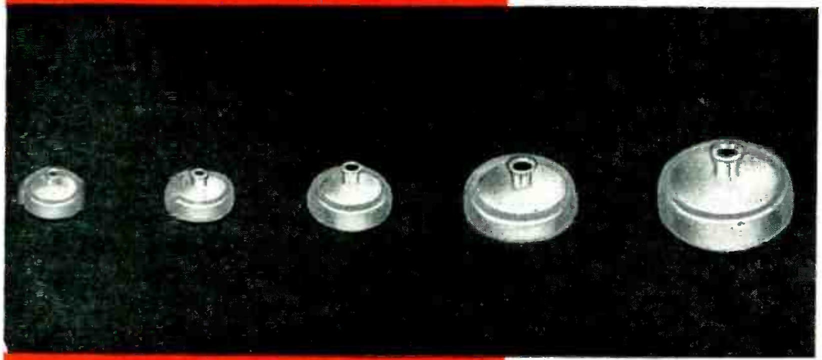

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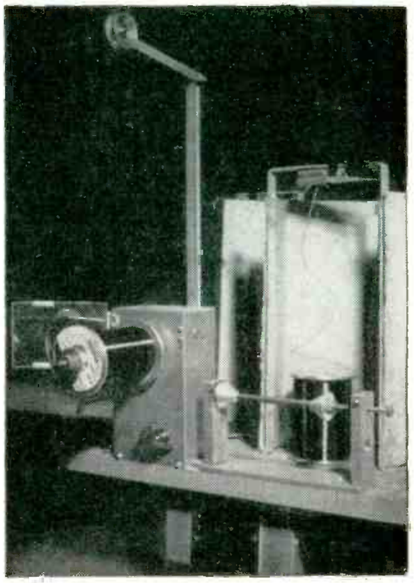

Three methods of supporting spools for coil winder. Finest wire is drawn directly up from spool standing on end. Friction box arrangement at left is used for heavier wire. Simple shaft mounting at lower right serves for still heavier wire

arrangements for unreeling the spools of resistance alloy wire are employed. The finest wire, which is No. 52 Evanohm nickel-chrome, is pulled directly off one end of the spool. Tangling is prevented by drawing the wire between two loosely clamped felt pads just above the spool. These pads are cemented to the jaws of an ordinary spring-type clothespin that is taped to the strap iron frame screwed to the shelf at the rear of the workbench.

For somewhat heavier wire, around No. 40, the spool is placed on the horizontally mounted shaft of an improvised tension control unit. A metal disc is mounted on this same shaft inside of the housing of the tension box. A knob on the outside permits varying the positions of oiled felt pads that bear against the surface of the disc, to change the amount of friction and thereby change the tension at which the wire is unreeled.

The overhead pulley just above this spool of wire is on an arm that is pivoted about an inch from its opposite end. Two coil springs in series are connected from the rear end of this arm to a fixed point on the base of the tension unit. The heavier of the two springs takes care of large overall variations in wire tension such as occur when

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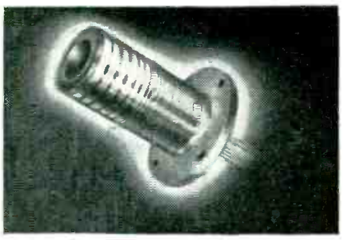
An assembly with 14 concentric, hard silver rings electro deposited into machined plastic blank. Dovetail locks rings in place. Machined blank insures accuracy. Diameter approx. 11", thickness approx. 5/16".

Cylindrical assembly with 25 rings. Three wide rings accommodate large contact area brushes for high current capacity. Length 14", O.D. approx. 5 3/8".



An assembly with 30 rings of various widths to accommodate various current requirements. Unit is approx. 4-5/16" long, designed for flange mounting.

Cylinder type assembly approx. 3 3/4" long with 24 hard silver rings. 1 5/8" O.D. with wall thickness less than 1/4".

*PATENTS PENDING

Now a Complete Service in all sizes of Slip Ring Assemblies

ELECTRO TEC is now tooled up, with new expanded facilities for production of large Slip Ring Assemblies to exact customer specification. Sizes range up to 24" in diameter, either cylindrical or disc type.

The exclusive ELECTRO TEC PROCESS*—the electro-deposition of hard silver rings into an accurately machined plastic blank—consistently yields a high degree of dimensional accuracy, excellent concentricity, and a jewel-like ring finish. This process also eliminates expensive tooling and mold charges, frequently lowers costs to 30% of other methods of manufacture. The silver rings are uniformly hard for long life—75-90 Brinell.

ELECTRO TEC one-piece construction precludes dimensional variation due to accumulated errors. The plastic base is fully cured before rings are plated into it, thus preventing separation of base material from the rings.

ELECTRO TEC LARGE SLIP RING Assemblies are widely used in Radar Equipment, Fire Control Systems, Test Tables and many other critical applications. Light weight combined with rugged durability recommends their use in airborne applications.

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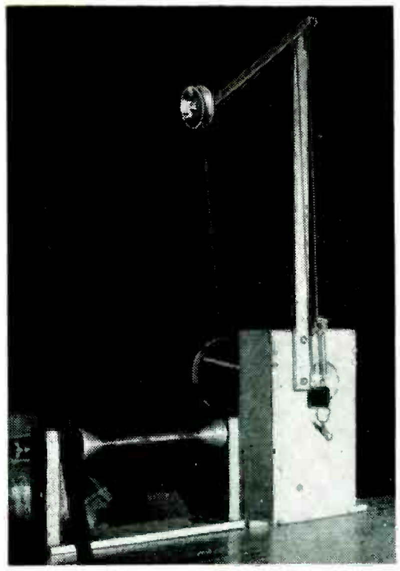

Method of using two springs in series at end of pulley arm to equalize both long-term and short-term variations in tension of wire being unreeled

the wire sticks between turns as it comes off the spool, while the lighter and more flexible spring serves to absorb rapid momentary vibrations.

For still heavier wire, around No. 26, a simpler horizontal shaft is used for the wire spool. Two metal bars, supported on a base plate, are fastened to the shelf of the bench. Between one vertical metal support and the flanged cone on the shaft is an oiled felt washer. By changing the setting of a thumbscrew pushing against the other end of the shaft, the friction between the cone and the felt can be varied to control unreeling tension.

Encasing Resistors in Kel-F Sleeves

A HEATED FORMING tool mounted on the end of a vertically clamped soldering iron is used for flaring the ends of thermoplastic sleeves required as additional insulation for deposited carbon resistors in some applications.

The tubing used for this purpose is monodichlorotrichloroethylene, marketed under the trade name of Kel-F. This material comes in long lengths of tubing, and is cut to precisely the required short lengths with an ordinary paper cutter.

Since only relatively low temperature is required for softening this

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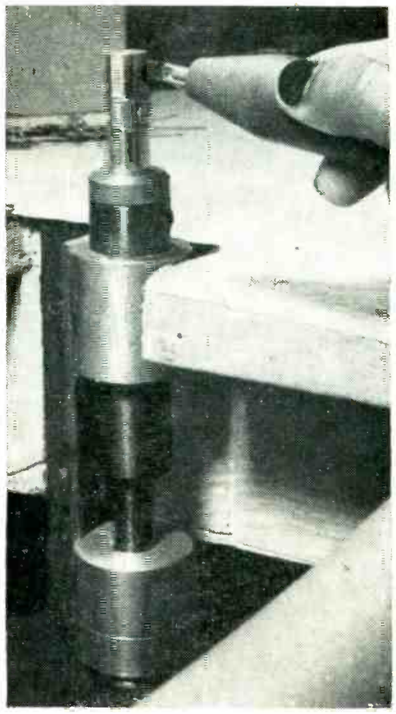
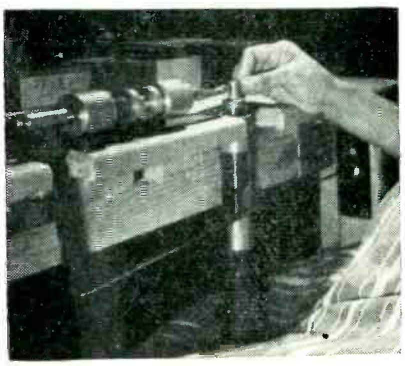


Use of wood holding tool for pressing Kel-F sleeve into hole in tip of warm soldering iron for initial flare of end. Soldering iron is standard 100-watt Vulcan unit made by the Lenk Mfg. Co., operated at about one-third of line voltage

plastic, the 100-watt soldering irons employed are operated at about 38 percent of line voltage. Heavy copper cylinders fitted onto the heating element and shank of the iron serve to radiate heat as well as anchor the soldering iron to a piece of angle iron which is in turn fastened to the bench. Holes of different sizes are drilled partly through the solid tip of the iron on opposite sides, so that one tip will handle both $\frac{1}{8}$-inch and $\frac{1}{4}$-inch diam-



Bench setup for final flaring of plastic sleeve over deposited carbon resistor. Right leg of operator actuates lever that opens spring-closed fixture for insertion and removal of resistors. Sleeving is left in contact with tool about three seconds to obtain desired flare

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Closeup view of final flaring operation

eter tubing for two different sizes of resistors.

As a first step, a length of tubing is placed over a wood peg set concentrically into a hole drilled in the end of a piece of broom handle that serves as a holding tool. With this tool, the sleeve is pushed into the heated hole of correct size for flaring the end inward. There is no need to spin the sleeve during this operation.

Next, resistors are inserted in these half-closed sleeves. Final closing of the other end is done at another work position. Here the resistor lead is inserted in a hole drilled entirely through the tip of the soldering iron, and the lead for the already sealed end is placed in the groove of a sliding horizontal fixture. The operator now releases a lever with her knee, thereby allowing a spring on the fixture to push the resistor body into the hole in the soldering iron for the final flaring operation. This technique is employed in the San Juan, Puerto Rico plant of Radell Corp.

Production-Testing UHF Radiosonde Tubes

By MATTHEW M. BELL
Tube Department
Radio Corporation of America
Harrison, N. J.

THIS article describes the equipment used for production-testing of the RCA type 5794 fixed-tuned oscillator triode designed for uhf radiosonde transmitting applications. The 5794 consists of a pencil-type triode and two integral resonators of the cavity type, one between grid and cathode and the other between grid and plate. The grid-

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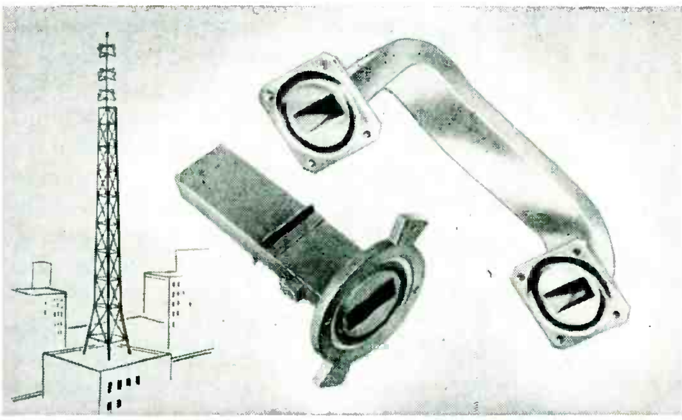

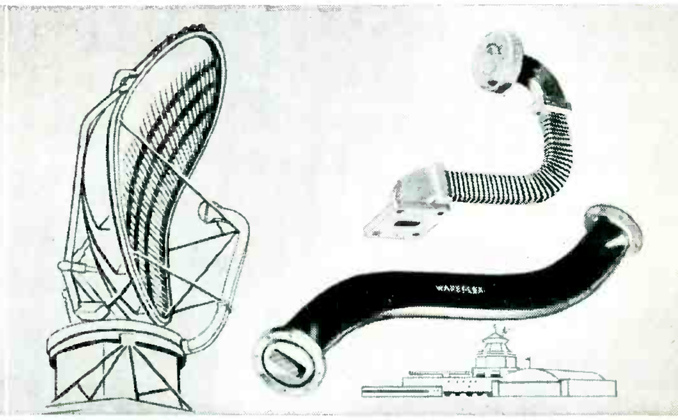

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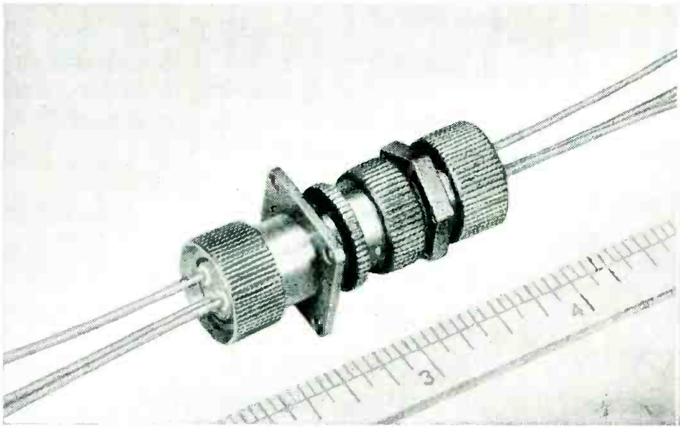

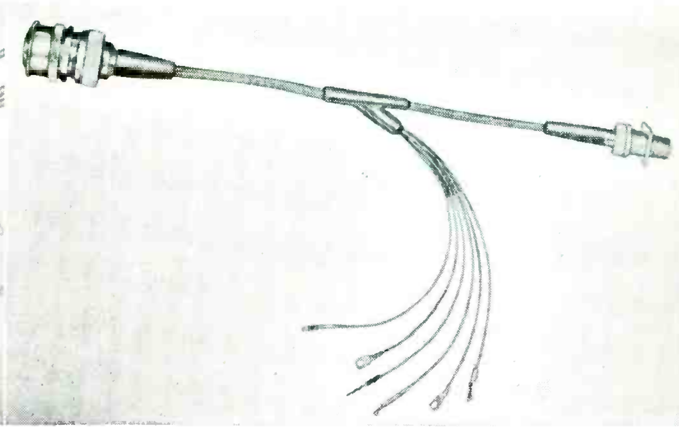

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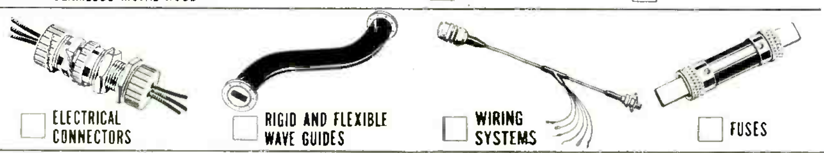

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plate cavity, tunable to 1,680 mc, has a minimum power-output rating of 300 milliwatts. A frequency adjustment screw is provided for fine tuning over a range of ± 12 mc.

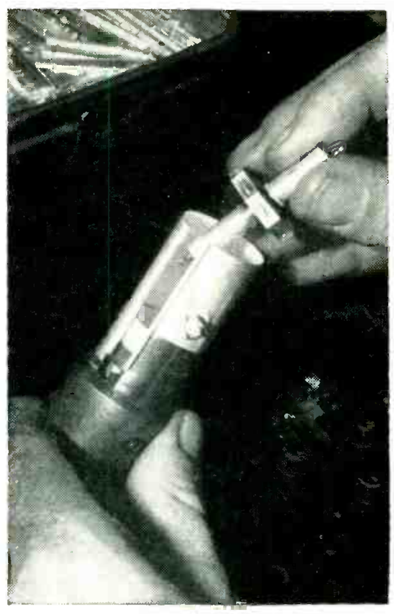
Production-testing for the 5794 involves mechanical adjustment of the grid-plate cavity so that it operates at the correct frequency and meets the specifications for minimum allowable power output. Both power and frequency are measured under fixed conditions of tube electrode voltage. A further requirement is that the cavity be terminated in an r-f output-measuring system having a characteristic impedance of 50 ohms and a vswr not exceeding 1.10.

The measuring facilities to be described are unusual in that they are combined in a single piece of equipment which is specifically designed for use in the factory and can be operated by semi-skilled factory personnel.

Assembly Technique

Assembly of the fixed-tuned RCA type 5794 oscillator triode for radiosonde service at 1,680 mc involves mounting the pencil triode in a cavity to provide two integral resonators requiring precise dimensional tolerance.

Adjustable plunger-positioning jigs connected to electronic test



Inserting pencil triode in loose outer shell of cavity after placing octagonal phosphor bronze ring around grid disk. Fixture in left hand positions one plunger inside cavity

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equipment permit setting the plungers of the cavity to exact frequency in a few minutes in the RCA tube plant in Harrison, N. J. The operator merely turns the plunger-moving knobs of the fixture while watching meters on a test panel. Air-operated tools then crimp the outer housing of the cavity to lock the plungers in position. The complete assembly is then placed in an octal-base adapter for final performance test. One of these involves tapping with a rubber hammer to check the rigidness of the assembly, as shown in one photo.

Test Setup

A block diagram of the test equipment is shown in Fig. 1. A pencil triode, a cavity shell and the other associated parts which com-

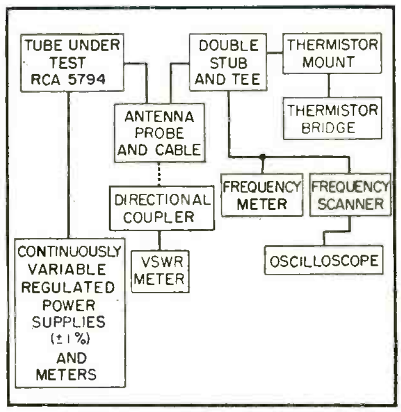

FIG. 1—Block diagram of equipment for production-testing uhf radiosonde tube

prise the complete cavity are assembled prior to being brought to the test set. The pre-assembled cavity to be tested is then mounted in a specially designed fixture which holds the cavity in the correct position. Gripping jaws engage the cavity parts in such a manner that the operator can adjust both the cathode and plate plungers to obtain the desired electrical conditions while the cavity is oscillating.

The regulation of the continuously variable regulated power supplies used is better than 1 percent. This regulation is required to prevent voltage fluctuations due to current changes which occur during adjustment of the cavity.

Output Probe and Coaxial Cable

The r-f output terminal of the cavity is coupled to the test set by

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means of a specially designed output probe and a length of standard 50-ohm low-loss coaxial cable. The probe, the design of which is very critical to the operation of the test set, is the outcome of extensive development work. Because it is subject to wear and considerable abuse as a result of continual handling each time a cavity is inserted or removed from the test set fixture, the probe must be mechanically rugged and easily repaired. Space factors dictate that it be small. The electrical requirements are also severe; in order to achieve an overall vswr of less than 1.10, the probe must have a vswr considerably less than this value.

A sectional diagram of the probe and its component materials is shown in Fig. 2. A low vswr is achieved by maintaining a balance

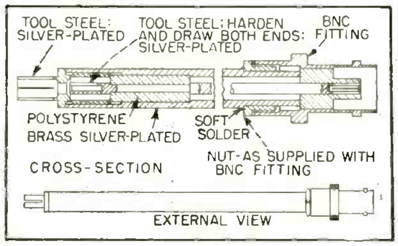

FIG. 2—Sectional diagram of output probe

between the ratio of the diameters of the inner and outer conductor and the dielectric constants of the insulating materials used.

Because the vswr of the measuring system must not exceed 1.10, the output probe and cable must be in good condition at all times. Normally, it would be necessary to check the probe periodically using a conventional laboratory-type setup to assure this low vswr. Such an elaborate check is avoided, however, by the use of a simplified checking method. Equipment for the checking method is included in the test set.

In this simple check, the output of a reference cavity is coupled to a specially constructed coaxial directional coupler. When this coupler is terminated in a 50-ohm impedance, the reflected power is a minimum. For any variation in this 50-ohm termination, an increase in reflected power occurs and is indicated on a microammeter cali-

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brated in terms of meter readings versus vswr caused by the termination mismatch. The operator periodically plugs the output probe into the directional coupler. If the resultant microammeter reading exceeds a predetermined level (corresponding to a vswr of 1.10), the probe and cable are judged unsatisfactory for use and are removed from the test set for repair.

Power Output Measurement

The power-output measuring system is composed of a special double-stub tuner, attenuator, thermistor mount and thermistor bridge.

Plunger-setting equipment. Coaxial connection at right goes to electronic test equipment that measures frequency and power output continuously during the plunger-setting operation. Insulating blocks permit applying operating voltages to tube while in fixture

Because each of the components in the r-f system contributes some small error to the overall vswr, it was found expedient to include a stub tuner as a means of compensation. The stub tuner consists of a coaxial section with two stubs spaced approximately ⅛ wavelength apart. These stubs are capacitively tuned. The use of capacitance tuning eliminates contact problems normally encountered in shorting-type stub tuners. However, because only a small capacitance change can be achieved, the device is useful only over a narrow frequency range. This frequency limitation presents no problem in the test because all of the testing is performed at the single specified frequency,

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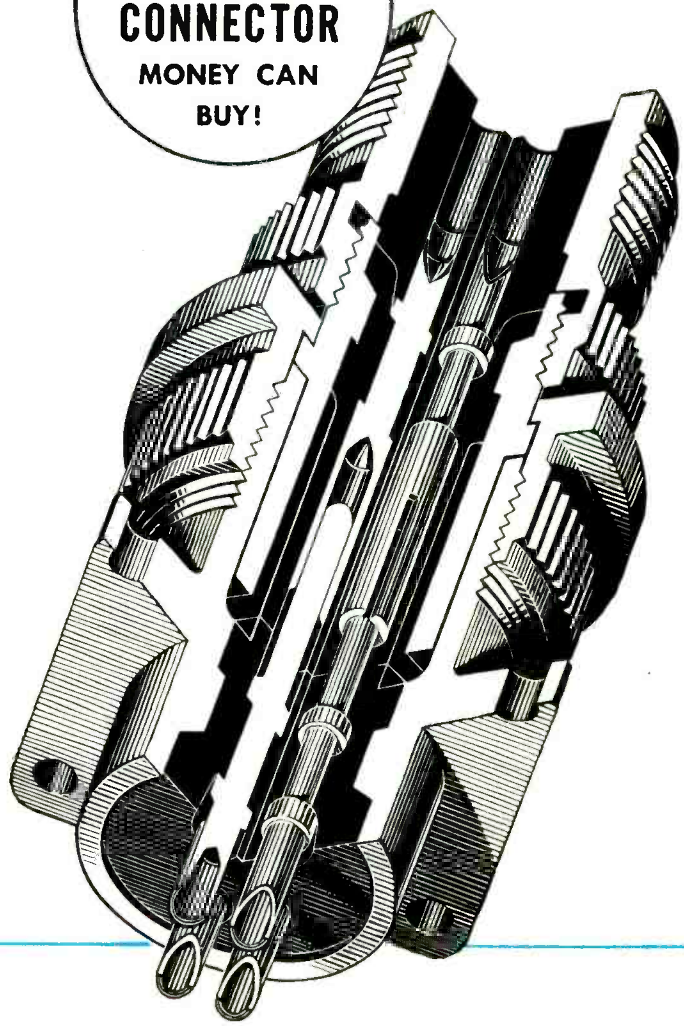

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but the tuner must be carefully designed and constructed to be effective at this frequency.

A conventional commercial coaxial attenuator is used in the test equipment to insure operation of the thermistor within its power rating and at the proper level for use with the power bridge. In this case the level is 2 milliwatts. No detailed explanation is needed for either the thermistor mount or the power bridge except to point out that the mount must be designed to match the 200-ohm thermistor impedance to the 50-ohm line impedance. The bridge used was originally designed by the MIT

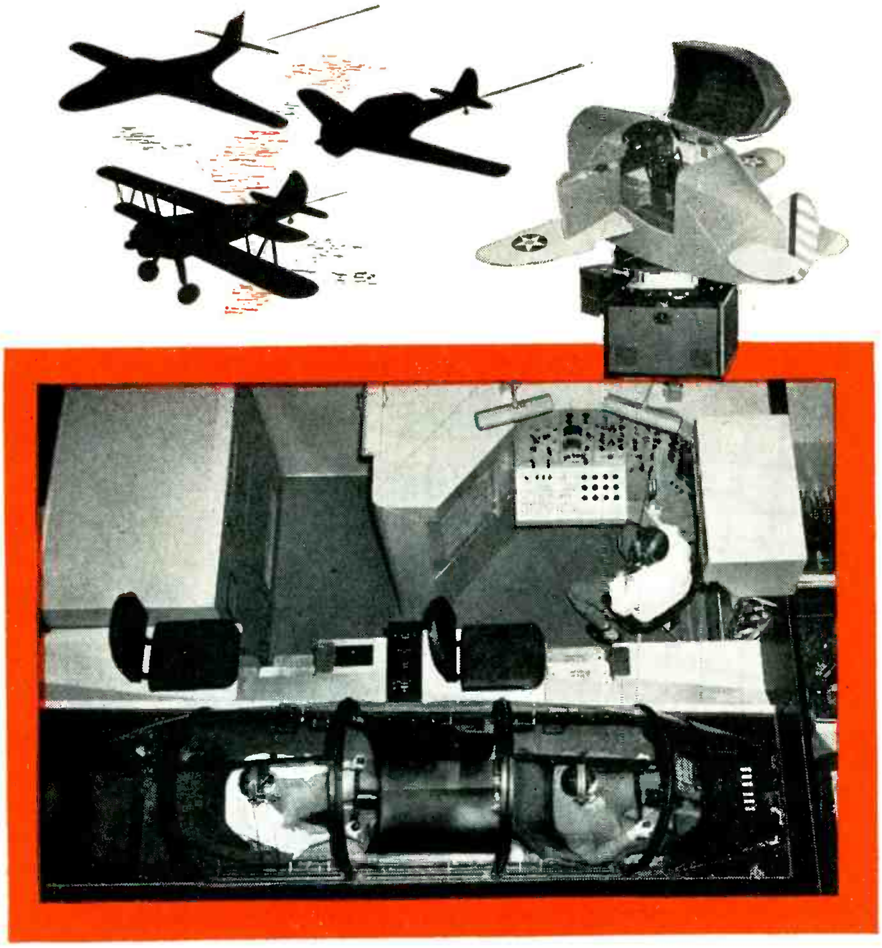
Tapping completed cavity unit with rubber hammer as part of final test

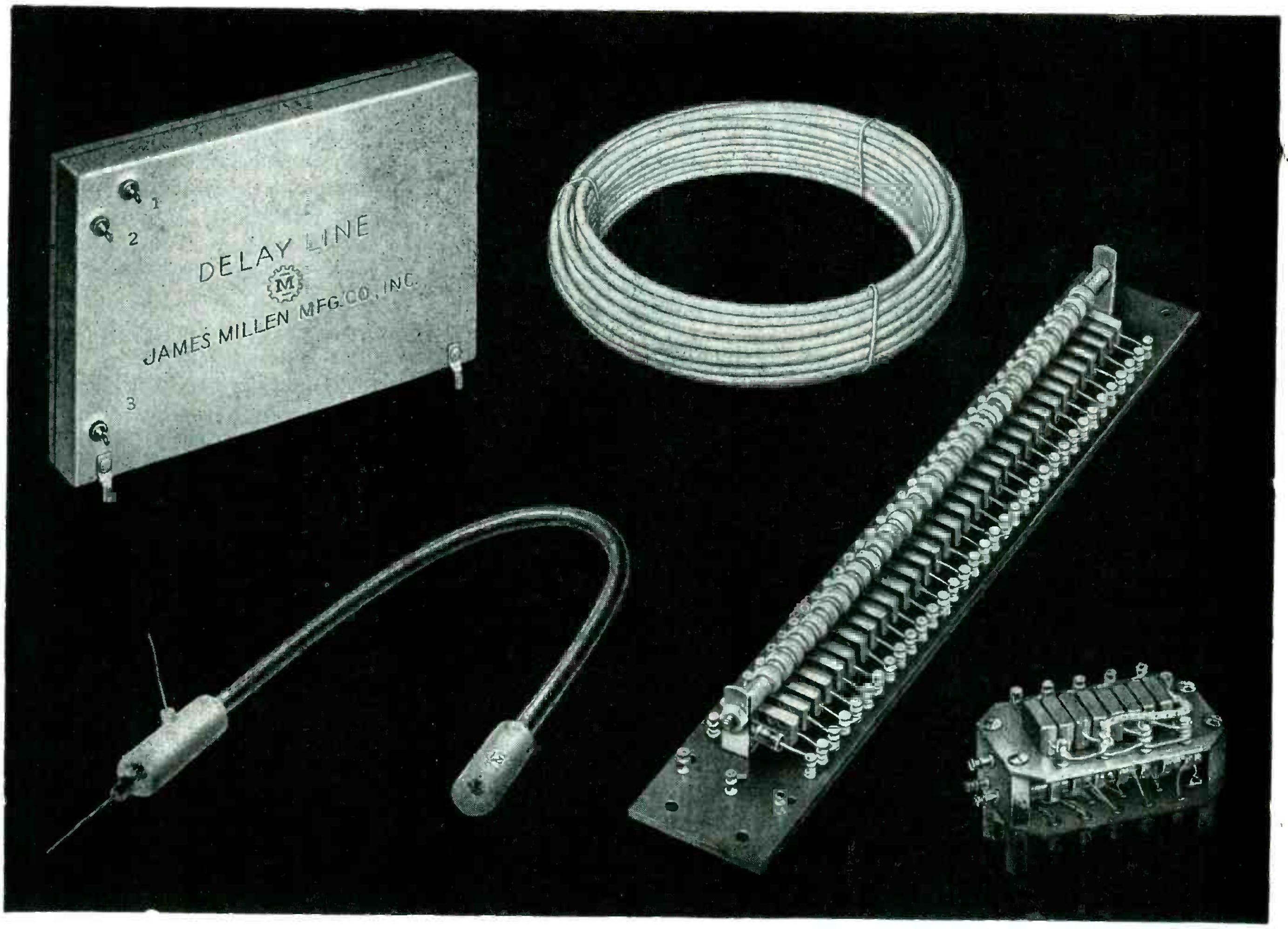
Radiation Laboratory. It is used in the type TWS-2 wattmeter and designated as a type TBN-2 thermistor bridge. This unit is described in MIT report No. 55 of March 29, 1944.

After voltages are applied to the cavity and the necessary adjustments made for frequency and plate current, the power output is read on the bridge meter. The cavity is then tuned for maximum power output.

Frequency Measurement

Included in the double-stub tuner is a small capacitance probe used to couple a small r-f signal necessary for frequency measurement. The magnitude of the energy taken is not sufficient to be measured in the system. The detuning effect of the probe is not objectionable and has a





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negligible effect on the vswr of the system.

Frequency is accurately measured with a commercial coaxial-type frequency meter accurate to within $\frac{1}{4}$ percent. Normally, it is necessary to take a reading at two points $\frac{1}{2}$ wavelength apart with this type of instrument. However, because the components all remain fixed, positioning the meter at one of these points is satisfactory and provides good accuracy.

Although this device is excellent for setting the cavity frequency to an exact value, another problem exists. At the start of the test, the initial frequency of the cavity may be considerably different from the desired value. Adjustment of the cavity to the proper frequency is facilitated by the incorporation of an elementary frequency-spectrum viewer in the test set. This device is basically a coaxial cavity whose resonant frequency is varied by means of a synchronous motor-driven cam capacitively coupled to the end of the $\frac{3}{4}$-wavelength center stub of the coaxial cavity. An oscilloscope, which is swept at the same rate as the synchronous motor, displays the frequency spectrum. By proper cam design the frequency sweep of the coaxial cavity may be selected to give a convenient bandwidth. A sharp pip appears on the oscilloscope at the tube cavity frequency; the position of the pip on the screen serves as a means of approximating the frequency. This method is sufficiently accurate to bring the frequency of the cavity within the range of the precision frequency meter.

The author gratefully acknowledges the contributions to the development of this project made by J. G. Busby, G. G. Carne, W. A. Harris, C. M. Morris, D. W. Power and G. M. Rose.

Hot-Die Wire Printer

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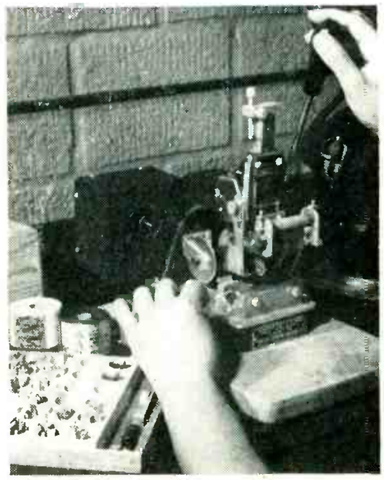


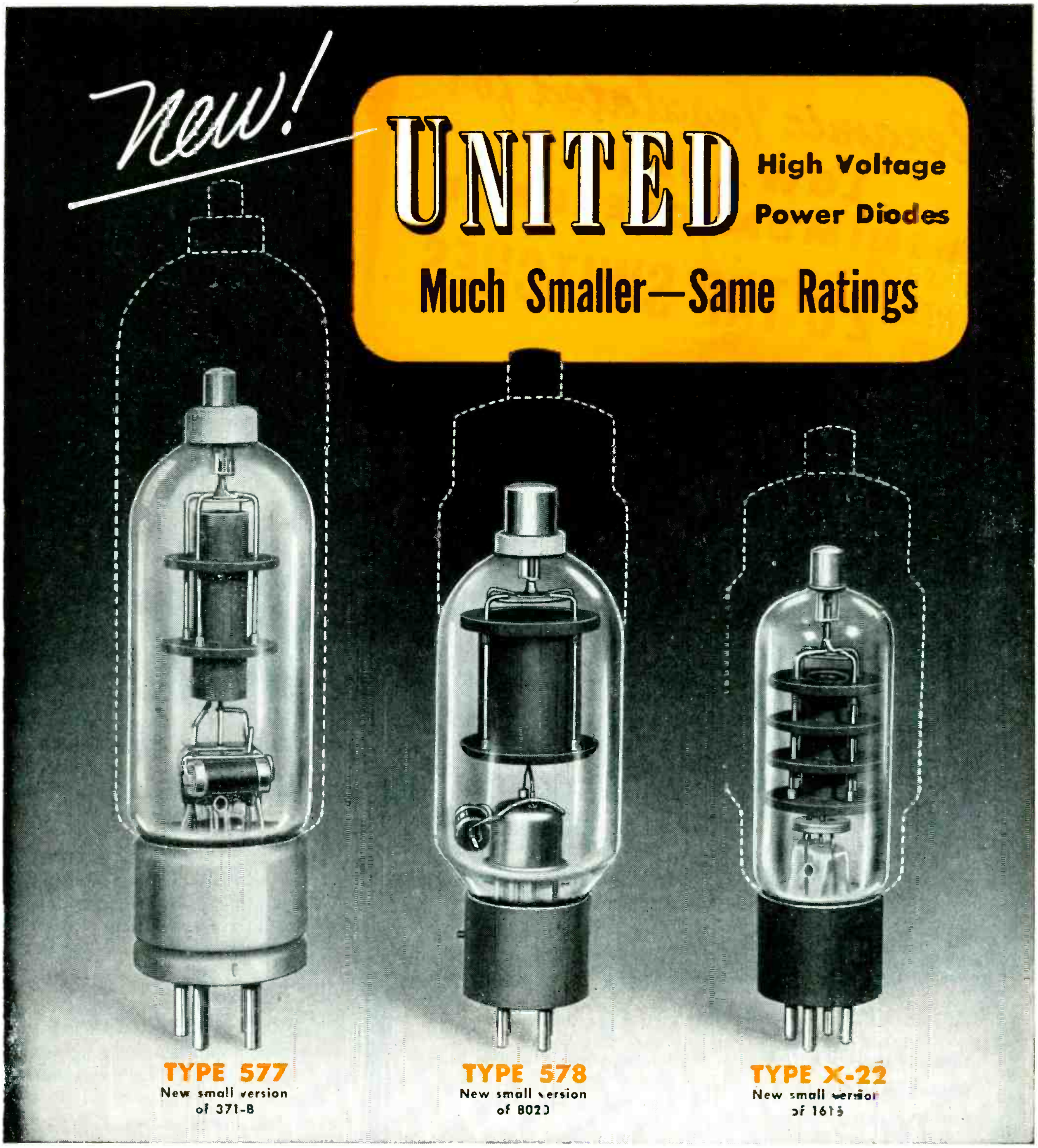
Stamping identifying numbers on insulation of leads for radar equipment. Individual dies are slipped into holder just under left hand of operator, having knurled locking screw. This holder in turn fits against the heating element of the machine

the designation are locked in position on the heating element in the movable upper part of the machine. A built-in dial thermometer indicates to the operator when the dies have reached correct operating temperature.

The wire to be printed is placed in a positioning groove on the anvil of the machine, and the operating lever is lowered to bring the dies and foil down on the wire, much as in stamping initials on leather goods. The foil is automatically advanced a small amount after each operation of the machine to expose fresh foil for the next printing.

Relay Lineup Fixtures

TO LINE UP THE moving armature of an aircraft relay accurately with respect to the two pole faces of the relay, Phillips Control Corp. in San Juan, Puerto Rico, uses a simple clamping device mounted at an angle on a block of wood. After all screws are loosened, the relay is placed in the device and the



Illustrations show relative sizes

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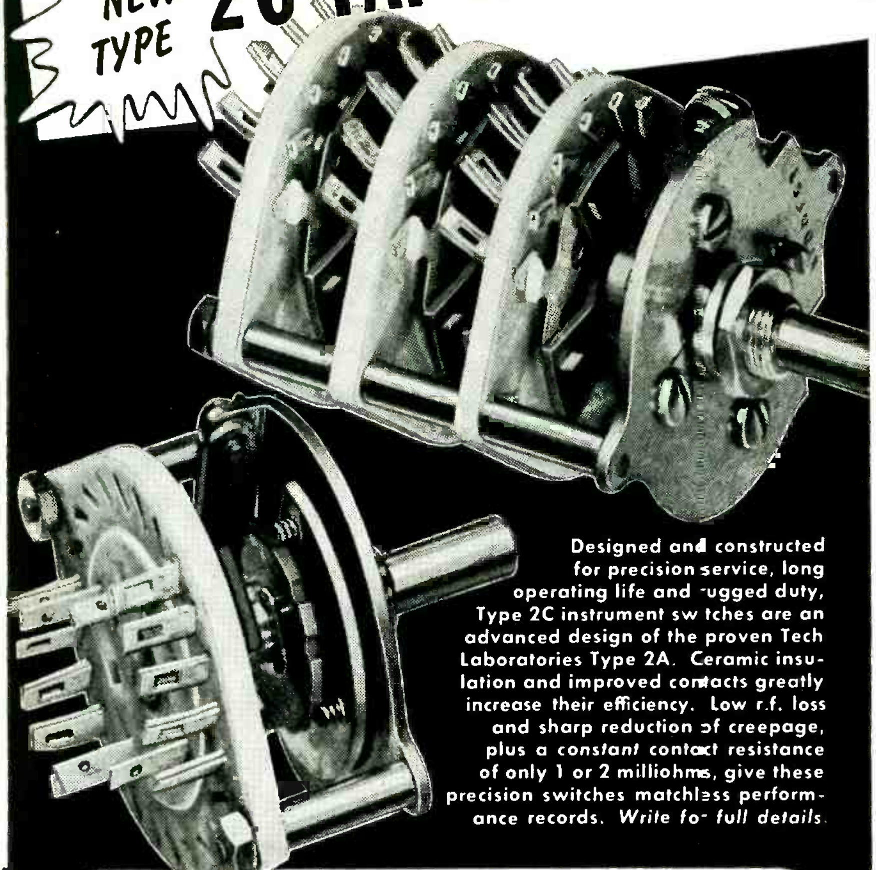

clamping lever at the top is brought down. This brings the armature into accurate alignment.

The operator now tightens the assembly screws on one side of the relay, then presses a release button and indexes the entire top of the fixture 180 degrees for tightening the screws on the other side. The indexing feature eliminates the

Relay holding fixture, designed to provide optimum working angle for tightening alignment screws

need for rotating the entire fixture and insures that the relay will stay rigidly in position during tightening of the screws. This is essential to prevent damage to the screw slots.

Plastic Small-Parts Bags

AFTER PUNCHING and inspection, mica spacers for vacuum tubes are placed in transparent plastic bags in the Rio Piedras, Puerto Rico plant of Sylvania Electric of P. R. Inc. Each filled bag is sealed with a standard heat-sealing tool, to keep out dust and moisture. The bags are made for this purpose by Howard Plastics, Council Bluffs, Iowa.

After sealing, an identifying label is stapled to each bag giving quantity, part number, type of mica and other pertinent information. The staples go through the sealing flap and hence do not break the air seal of the container. These bags serve equally as well for ship-

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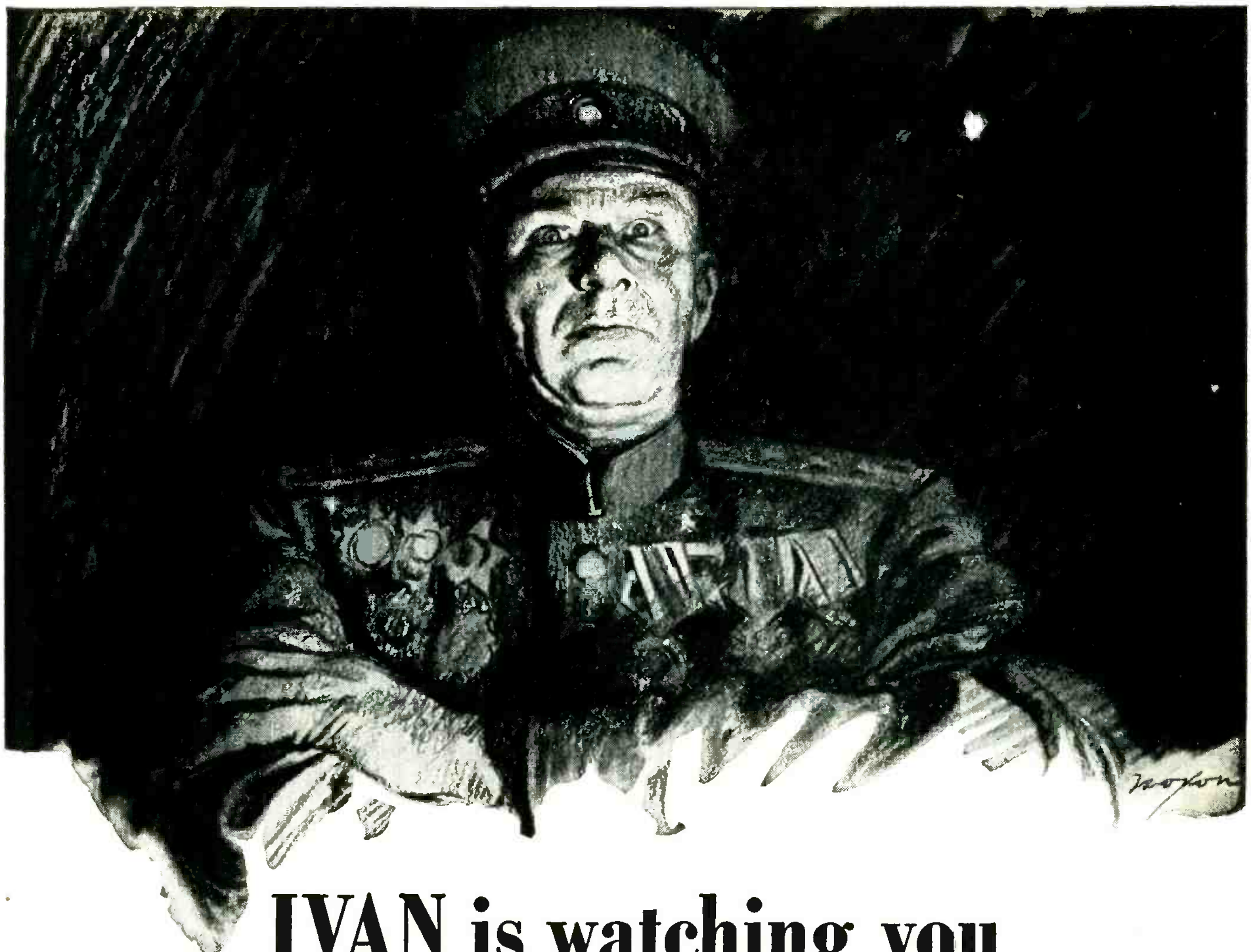

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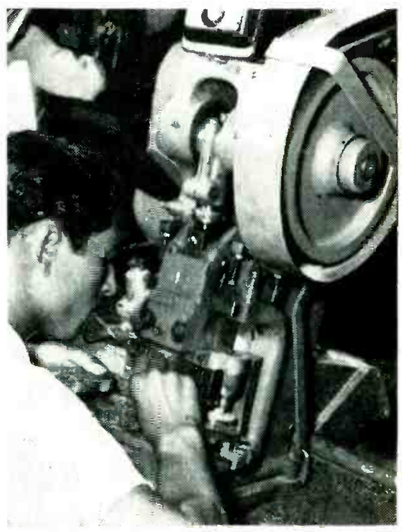
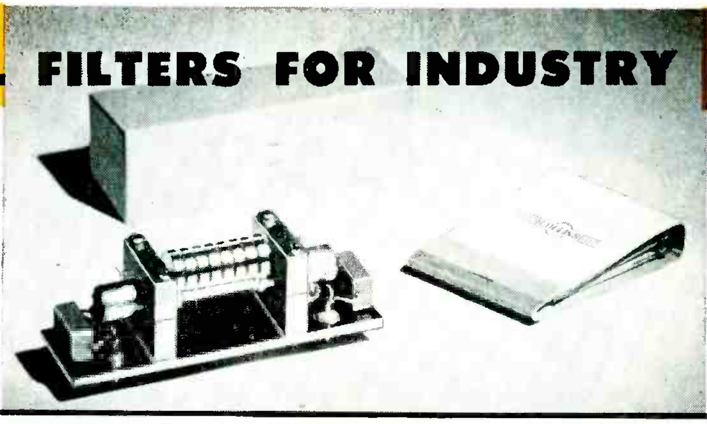
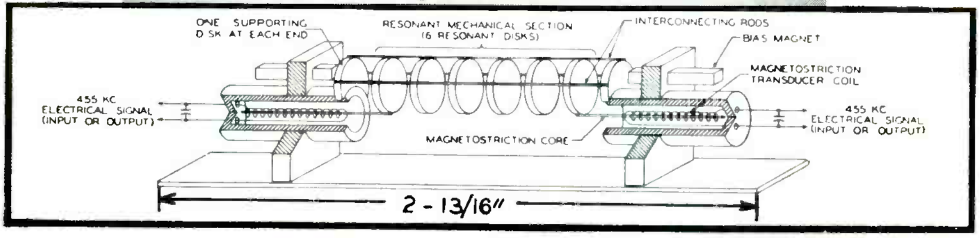


Punching mica spacers complete with holes for tube leads and supports, with fast-acting punchpress

MECHANICAL FILTERS FOR INDUSTRY



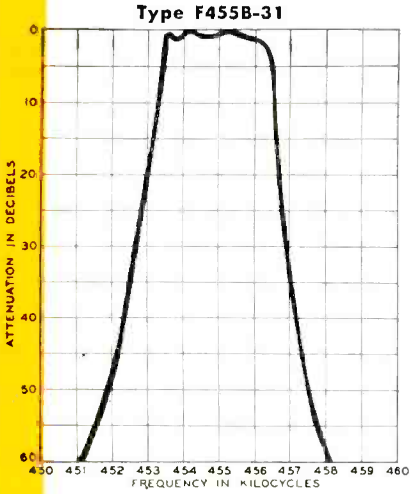
Collins Mechanical Filter with hermetically sealed shield removed. Compare size with matchbook.



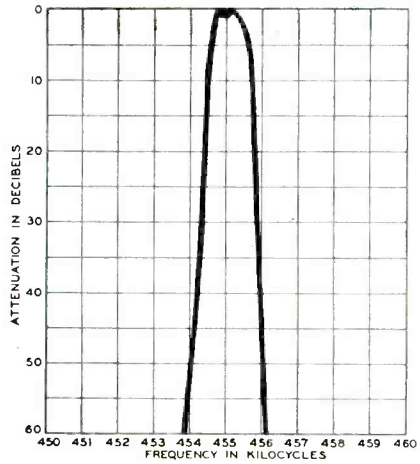
Engineers's drawing of 455 kc Mechanical Filter interior.

SELECTIVITY CURVES FOR THREE TYPICAL MECHANICAL FILTERS

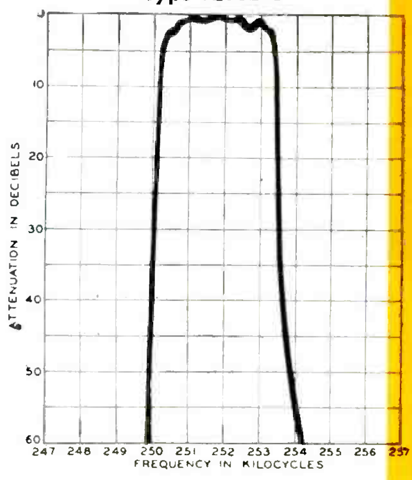
Type F455B-31



Type F455B-08



Type F250Z-2



THE COLLINS Mechanical Filter was first revealed to the Radio Industry during the 1952 IRE Convention. Since that time the original Mechanical Filter Type F455B-31 has become available in production quantities. Other Collins Mechanical Filters, designed to operate at various bandwidths in the intermediate frequencies, are also available in engineering sample quantities. All of the Mechanical Filters listed here offer a close approach to the ideal rectangular selectivity curve. Consult the chart of available Mechanical Filters (right) for the solution to your selectivity problem.

A request on your letterhead will bring full technical specifications, price and delivery information.

Type No.	Center Frequency	Bandwidth	Terminal Arrangement
F250A-60	250 kc	6.0 kc	Solder
F250Z-1	248.7 kc	3.0 kc	Solder
F250Z-2	251.3 kc	3.0 kc	Solder
F455A-08	455 kc	800 cycle	Solder
F455A-31	455 kc	3.1 kc	Solder
F455A-60	455 kc	6.0 kc	Solder
F455B-08	455 kc	800 cycle	Plug-In
F455B-31	455 kc	3.1 kc	Plug-In
F455B-60	455 kc	6.0 kc	Plug-In
F500A-14	500 kc	1.4 kc	Solder
F500A-31	500 kc	3.1 kc	Solder
F500B-31	500 kc	3.1 kc	Plug-In
F500B-14	500 kc	1.4 kc	Plug-In

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COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 W. 42nd St., NEW YORK 36 — 1930 Hi-Line Drive, DALLAS 2 — 2700 W. Olive Ave., BURBANK

the mica between punchings, without the aid of mechanical positioning guides. An expert operator can make the holes appear in a sheet almost as fast as if it were being peppered by a machine gun.

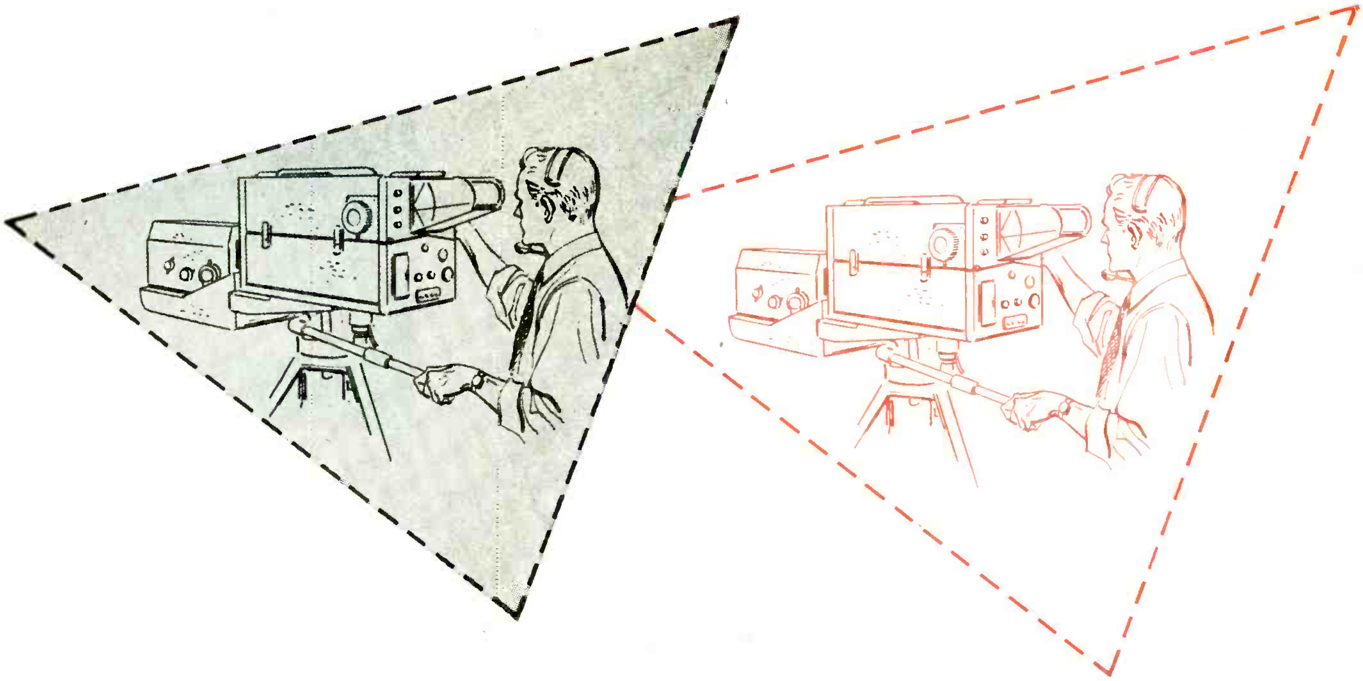
The press used for for this operation is made by Perkins Machine Co., Warren, Mass. A metal fence is bolted to the front of the press for safety, with just enough clearance underneath for easy positioning of the mica sheets. The operator looks over the top of the fence. Copper tubing entering through the fence blows a blast of air across the die to keep it clean, since particles of mica might cling to the tiny hole-punching dies that are combined with the blanking die here.

Method of feeding mica under safety fence of press

Soldering Iron Holder Automatically Cuts Voltage

VOLTAGE to a pencil-type soldering iron is automatically reduced from 6.3 v to 5 v when the iron is placed in a special holder mounted on the transformer chassis. This voltage-reducing action is obtained automatically by hinging the holder and

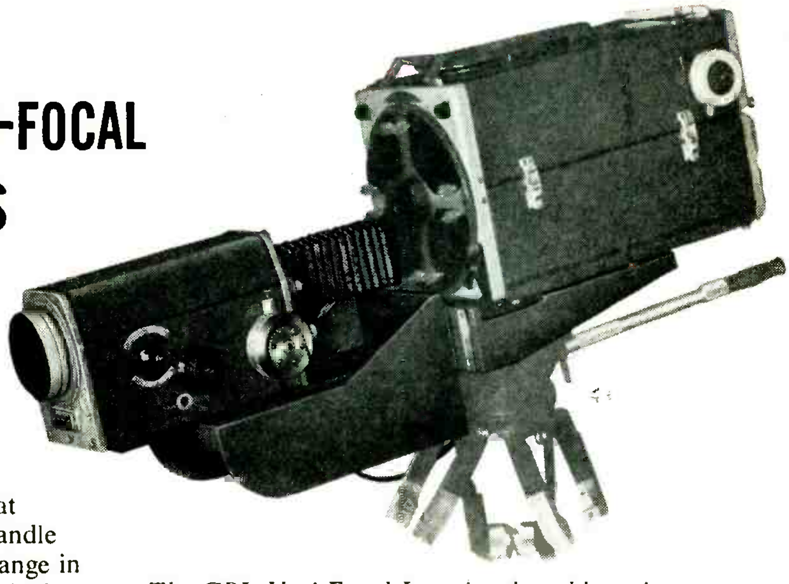
Bottom view of chassis for soldering iron holder



TURN YOUR CAMERA into TWINS...

with the GPL VARI-FOCAL LENS

(3″ to 15″ or 6″ to 30″ range)



One camera and a GPL vari-focal lens equals the work of two or more chains . . . at only the cost of a lens. One camera can handle an entire show, for the lens has a 10:1 change in focal length in two 5:1 steps—from 3 to 15 inches and 6 to 30. One camera can be used in studio or field with either range. Interchangeable back elements provide quick shift of two ranges.

Fully color-corrected, this lens has perfect overall focus at f/5.6 or higher numbers, in 3-15 range. Flat field over entire range. Motor driven lens is operated from camera or control room.

The GPL Vari-Focal Lens is adaptable to image orthicon cameras of all types.

Now in network use, this lens offers station operators new scope in camera work—new economy in making twins of any camera.

Write, wire or phone for full optical and mechanical specifications.

General Precision Laboratory GPL
INCORPORATED
PLEASANTVILLE NEW YORK

Export Department:
13 East 40th St., New York City
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Camera Chains • Film Chains • Field and Studio Equipment • Theatre TV Equipment • GPL-Continental Transmitters

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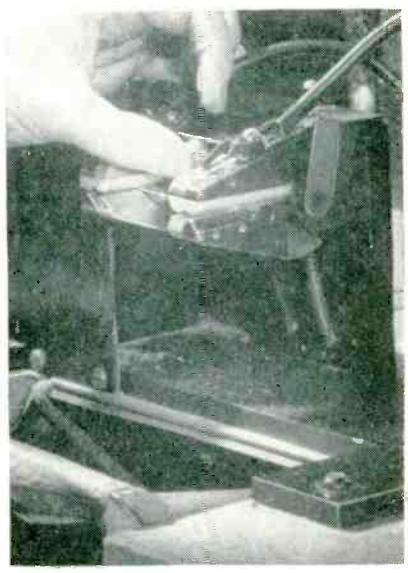
Voltage of pencil-type soldering iron is automatically reduced 1.3 v when iron is placed in holder on bench, thereby minimizing pitting of soldering iron tip when not in use. Operator uses iron here for soldering Nichrome resistance wire to terminals on ceramic bobbins for precision resistors

placing under it a snap-action switch. The weight of the pencil-type soldering iron is sufficient to actuate the switch, thereby changing from one tap to another on the primary winding of the Stancor type P-4022 power transformer used with the soldering iron. This unit is used throughout the entire plant of Caribe Aircraft Radio Corp. in Coamo, Puerto Rico.

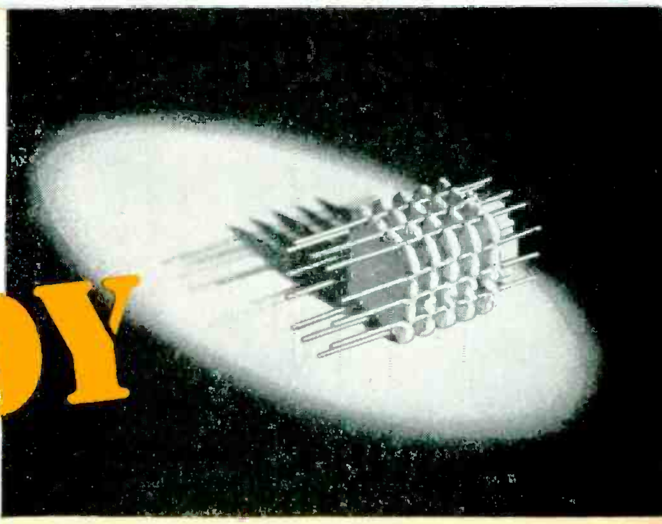
Checking Tolerances of Components

ALL resistors and capacitors used in the production of Raytheon's PRC-6 hand-carried f-m trans-



Thumb of operator is here pressing button that closes clamping jaws and initiates measurement of carbon resistor to be sorted for tolerance

PROJECT TINKERTOY



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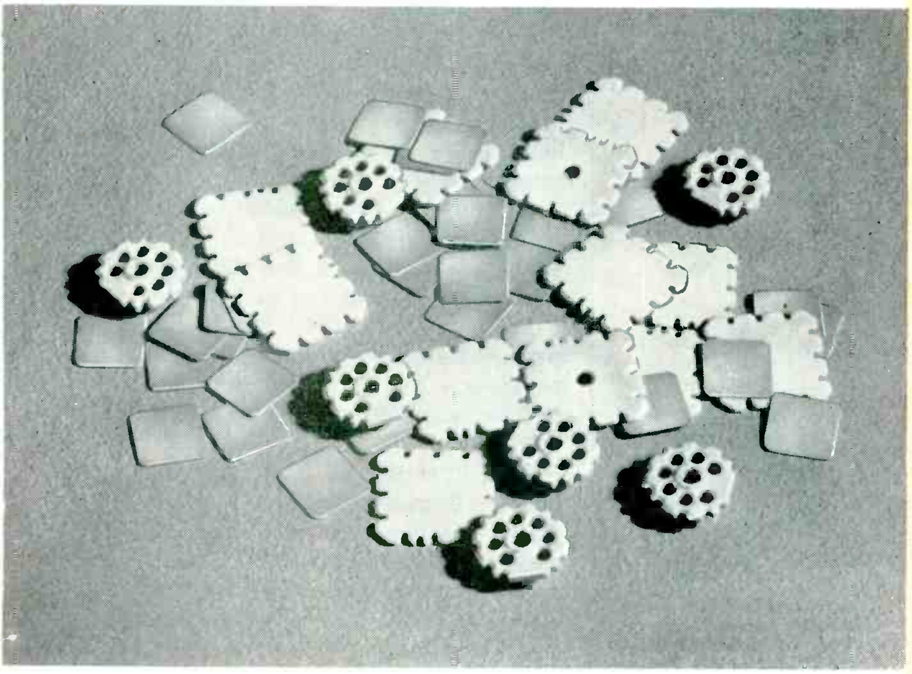
on Steatite and Titanate Ceramics



In AlSiMag you have the experience, the correct ceramics and the tooling available for ceramics for PROJECT TINKERTOY type insulators.

ALSIMAG STEATITE COMPOSITION 507 combines high strength and low dielectric losses. Produced with great uniformity and dimensional accuracy to further speed automatic assemblies. Fully proved by perfomance.

American Lava Tiolektrik® dielectrics with dielectric constants ranging from 6 to more than 6000 are available from open dies for PROJECT TINKERTOY. These superior ceramic condenser dielectrics can be had in other sizes for this or other applications.

ASSISTANCE ON NEW MODULAR PROJECTS:

In AlSiMag you have the WIDEST CHOICE OF CERAMIC MATERIALS, both in steatites and titanates, backed by the largest engineering staff in the industry. Send us your requirements for engineering study and recommendations.

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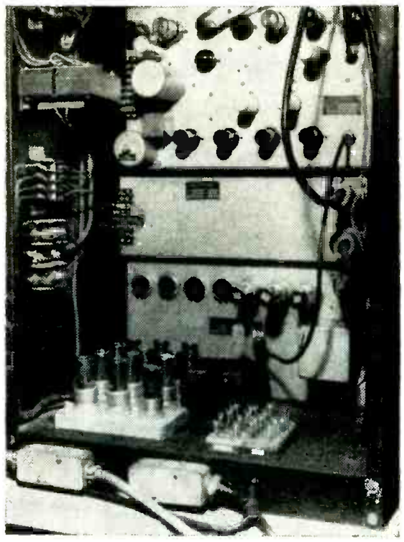

Rear view of tolerance sorting machine, with spare standards stored in bottom. Machine was made by Industrial Instruments, Inc., Jersey City, N. J.

sorting gates. The operator places each component in turn on an anvil equipped with clamps which close down on the pigtail leads to get good connections. A button located between the clamps is pushed to actuate the clamps and initiate the measuring operation.

By the time the operator has removed the part and dropped it into the chute below, the machine has set the gates or doors so that the part drops into the correct bin corresponding to a predetermined percentage of tolerance. Up to 12,000 parts a day can be checked in this manner.

Initial setup of the machine merely involves plugging in the proper standards of capacitance or resistance. The most used standards are made up as plug-in units stored at the bottom of the equipment housing.

Resistor Lead Straightener

A SIMPLE FIXTURE made from wood and metal is used for straightening the axial leads of deposited carbon resistors in the San Juan, Puerto Rico plant of Radell Corp. The operator places a resistor crosswise in the device, rolls the slide back

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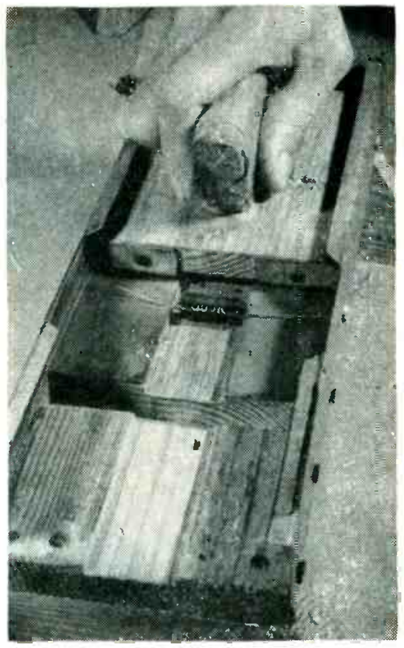

Resistor in straightening device just before operator rolls slide over its leads to straighten them

and forth over the leads about three times, then pushes the slide forward to roll the resistor into the transverse slot through which it drops into a box underneath.

Straightening is done between sheets of metal fastened to the fixture base and to the bottom of the slide. The resistor body itself rolls in precisely cut wood grooves in the bottom piece and in the slide, to insure that the leads will be centered with respect to the resistor at the same time as they are straightened.

Mica-Splitting Tool

TRIMMED BLOCKS of mica are split into sheets of uniform thickness manually at high speed with a simple bench-mounted splitting tool in the Rio Piedras, Puerto Rico plant of Sylvania Electric of P. R. Inc.

The operator passes each piece under the right-hand cutting tool as often as possible with a quick motion much like that used in cutting cole slaw. If the last piece is obviously too thin for use, it is thrown into a discard hole cut into the bench under the operator's hand. When there is a possibility that the last piece is usable, it is tested by passing under the other cutting tool, which is set to the

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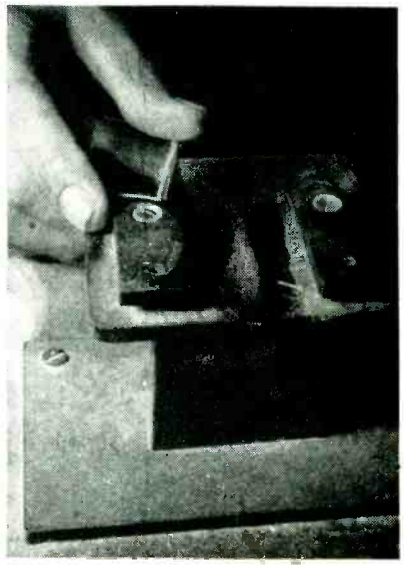


Method of holding block of mica as it is rapidly passed under the splitting tool to obtain pieces that are precisely the desired thickness

minimum tolerance limit for thickness.

The splitting blades are carefully ground and sharpened to enter the mica block cleanly for perfect splitting. The angle at which the cutting tool is ground makes it practically impossible for operators to slice their thumbs, and serves also to separate the split sheets without passing them entirely through the splitting tool. Thickness of split is easily controlled by adding or removing shims from under the blades. Both red India mica and green Canadian mica are split in this way.

Fixtures Aid Production of Spiral Coil Filters

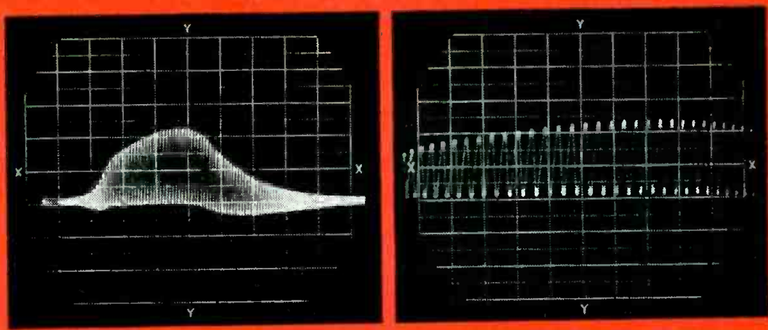
WINDING AND ASSEMBLY of spiral coils in various sizes for r-f filters is expedited through use of simple fixtures and production techniques involving only ordinary tools, in the Coamo, Puerto Rico plant of Caribe Aircraft Radio Corp.

The hand-cranked winding fixture employs easily interchanged mandrels for winding spiral coils with various numbers of turns and different spacings, to get desired inductance values. Since heavy enameled wire is employed and none of the coils have more than ten turns, manual rotation of the

ONLY THE LFE 401 OSCILLOSCOPE

Offers all these Important Features

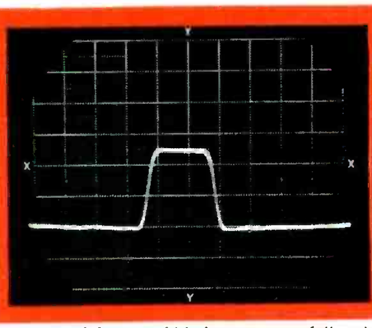
30 Mc Pulsed I.F. 2µsec long, 10 Kc Rep. rate



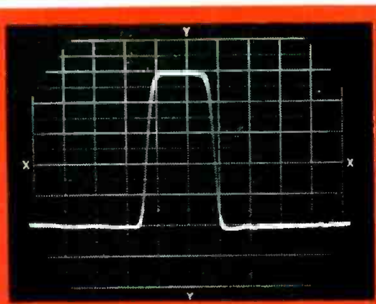
Sweep – 0.4 µ sec/cm — Sweep – 0.1 µ sec/cm Pulse Center Expanded

HIGH SENSITIVITY AND WIDE FREQUENCY RESPONSE OF Y-AXIS AMPLIFIER

The vertical amplifier of the 401 provides uniform frequency response and high sensitivity from D-C. Coupled with a sensitivity of 15 Mv./cm peak to peak at *both D-C* and A-C is a response characteristic which is 3 db. down at 10 Mc. and 12 db. at 20 Mc. Alignment of the amplifier is for best transient response, resulting in no overshoot for pulses of short duration and fast rise time. An example of the wide band response of the amplifier is shown in the accompanying photographs.



37.5 Mv., 0.2µsec width, 1µsec sweep full scale



75 Mv., 0.2µsec width, 1µsec sweep full scale

LINEARITY OF VERTICAL DEFLECTION The vertical amplifier provides up to 2.5 inches positive or negative uni-polar deflection without serious compression; at 3 inches, the compression is approximately 15%. The accompanying photographs illustrate transient response and linearity of deflection.

SWEEP DELAY The accurately calibrated delay of the 401 provides means for measuring pulse widths, time intervals between pulses, accurately calibrating sweeps and other useful applications wherein accurate time measurements are required.

The absolute value of delay is accurate to within 1% of the full scale calibration. The incremental accuracy is good to within 0.1% of full scale calibration.

SPECIFICATIONS

Y-Axis

Deflection Sens. – 15 Mv./cm, p-p
Frequency Response – DC to 10 Mc
Transient Response – Rise Time (10%-90%) 0.035 µ sec
Signal Delay – 0.25 µ sec
Input line terminations – 52, 72 or 93 ohms, or no termination
Input Imp. – Direct – 1 megohm, 30 µ µ f
Probe – 10 megohms, 10 µ µ f

X-Axis

Sweep Range – 0.01 sec/cm to 0.1 µ sec/cm
Delay Sweep Range – 5-5000 µ sec in three adjustable ranges.
Triggers – Internal or External, + and –, trigger generator, or 60 cycles, undelayed or delayed triggers may be used.
Built-in trigger generator with repetition rate from 500-5000 cps.

General

Low Capacity probe
Functionally colored control knobs
Folding stand for better viewing
Adjustable scale lighting
Facilities for mounting cameras

PRICE: $895.00

Additional Features:

TRIGGER GENERATOR with variable repetition rate from 500 to 5000 cps.

POSITIVE & NEGATIVE UNDELAYED TRIGGERS and a **POSITIVE DELAYED TRIGGER** are externally available.

An **INPUT TERMINATION SWITCH** for terminating transmission lines at the oscilloscope.

A **FOLDING STAND** for convenient viewing.

FUNCTIONALLY COLORED KNOBS for easier location of controls.

Designed and built *for* electronic engineers, the 401, with its high gain and wide band characteristics, and its versatility, satisfies the ever-increasing requirements of the rapidly growing electronics industry for the ideal medium priced oscilloscope.

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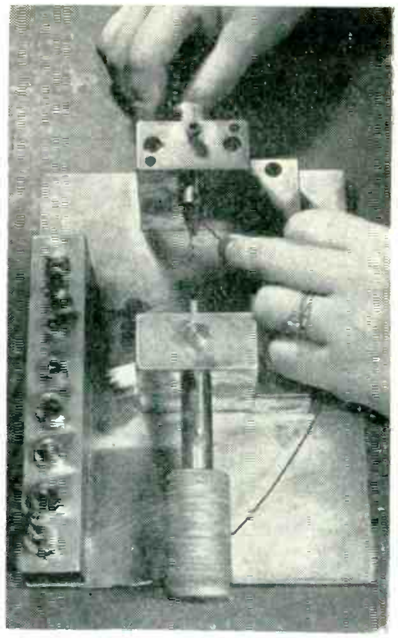
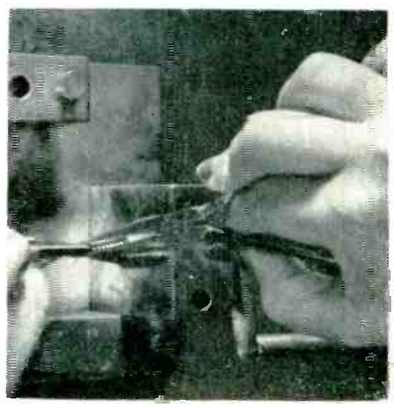


Winding a spiral coil by guiding wire onto spiraled mandrel with left hand while turning crank of mandrel with right hand. Mandrels for other coils are stored in holder at left

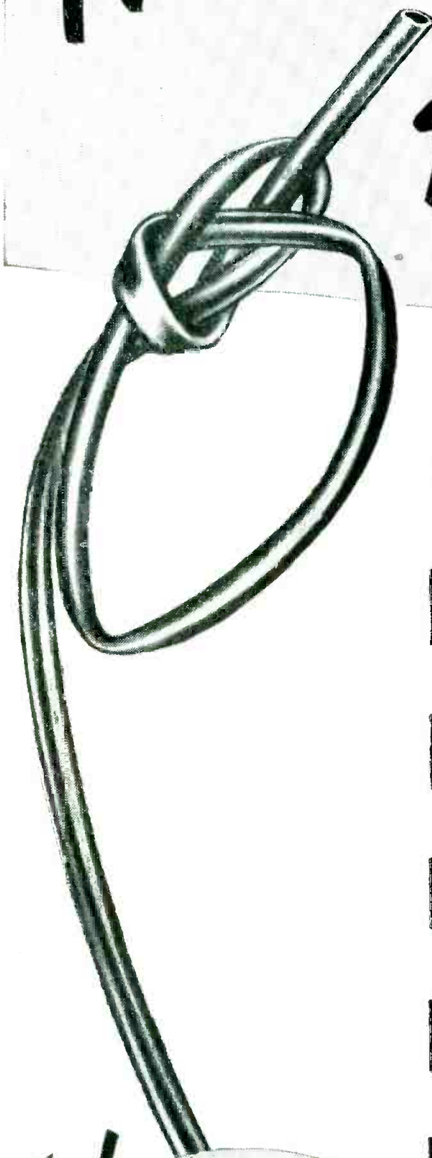
arbor is entirely satisfactory.

To wind a spiral coil, the operator first inserts the wire into the proper hole in the base of the fixture and bends it at right angles to form the starting lead for the coil. This lead is now inserted in the slot in the mandrel, and the coil is wound by guiding the wire in the spiral grooves with the left hand while turning the crank with the right hand. When winding is completed, the arbor is locked in position, slot upward, by tightening a knurled nut over its shaft. With long-nose pliers, the end of the winding is squeezed down flat against the diameter of the half-round end of the arbor. A quarter-round pin is now pushed in from the left and the wire is squeezed



Forming lead for spiral coil to correct shape with long-nose pliers

New ELECTRICAL TUBING gives *Better Performance* 5-WAYS



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VARGLAS Tubing is now impregnated with G. E. PERMAFIL

Here's how...

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. . . 7,000 volts — and *keeps* its high dielectric value under toughest service conditions.

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. . . twist it — tie it — bend it — wrap it! No crack — no peel — no dielectric loss.

3 BETTER HEAT RESISTANCE

. . . withstands more than 2,000 hours at 105° to 110° C — 1,000 hours at 125° C — extensive periods even at 150° C.

4 AVAILABLE IN COILS

. . . so that you can cut the length you need — no more, no less, no waste. Standard colors — wide range of sizes — meets or exceeds all A.S.T.M. specifications.

5 CAN BE AFTER-TREATED

. . . in baking and varnishing operations. Reacts better than most oleoresinous materials and other synthetic coated tubings.

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Please send me full information as well as a free sample of your new Varglas Tubing impregnated with General Electric Permafil. I am particularly interested in samples suitable for ....

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Fixture used for holding disc capacitors in position while soldering to spiral coils. Empty grooves at top are for another type of filter

axially against this so the terminating lead of the coil is exactly in line with the axis of the coil. The quarter-round pin is then retracted and the lead is cut to complete the winding.

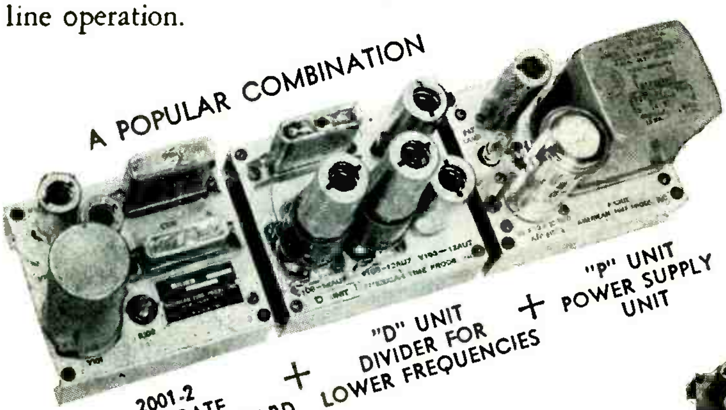
A typical filter uses three button-type ceramic capacitors and two coils. A coil lead is inserted in the center hole of the capacitor and a hook-joint is formed on the other side, to which is hooked a similar joint in the lead of the other coil. These joints are crimped with

Pulling r-f filter assembly into housing. Soldering iron holder on bench is made from pipe and pipe fittings. Holder for solder spool is U-shaped piece of scrap iron screwed to bench, with spun-on terminals projecting inward from ends to serve as shaft. Solder spool is removed by spreading end supports apart

FREQUENCY STANDARDS *Modular system*

DESIGNED AS A *Modular system*

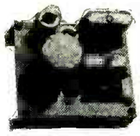
The Type 2001-2 series provides frequencies from 30 to 30,000 cycles with an accuracy of .001% (at room temperatures) in units suitable for integration with instruments of your own design — or for panel rack mounting with your own power sources — or for line operation.



WHICH WILL MEET YOUR
CUSTOM NEEDS
FROM A COMBINATION OF
STOCK UNITS

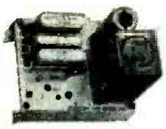
TYPICAL COMBINATIONS

2001-2	2001-2 + M
2001-2 + L	2001-2 + M + P
2001-2 + L + P	2001-2 + L + P + R
2001-2 + H	2001-2 + H + P + R
2001-2 + H + P	2001-2 + M + P + R

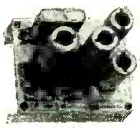


TYPE "2001-2"
FREQUENCY STANDARD
Frequencies, 200 to 3,000 cycles. Output, approximate sine wave at 5 volts.

ACCESSORY UNITS

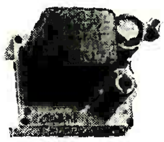


"L" UNIT.
DIVIDER, (MULTI-VIBRATOR TYPE)
Provides frequencies from 30 to 200, controlled by the 2001-2 unit.
Output, approx. 5V. Approx. sine wave.



"D" UNIT.
DIVIDER, (COUNTER TYPE)
Provides 40 to 200 cycles controlled by the 2001-2 unit. (fail safe)

"H" UNIT
MULTIPLIER
Provides frequencies from 3,000 to 30,000 cycles, controlled by the 2001-2 unit. Output, approximately 5 volts.



"M" UNIT
AMPLIFIER
Provides 2 watts at 6 and 110 volts.

"P" UNIT
POWER SUPPLY
Provides power for combinations of units illustrated, if other sources are inconvenient or not available.

"R" UNIT
PANEL MOUNTING
Accommodates up to three units. Standard size is 8¾ inches high, 19 inches long.

For details, please request our "Type 2001-2" Booklet.

American Time Products, Inc.

580 Fifth Avenue ***New York 36, N. Y.***

OPERATING UNDER PATENTS OF WESTERN ELECTRIC COMPANY

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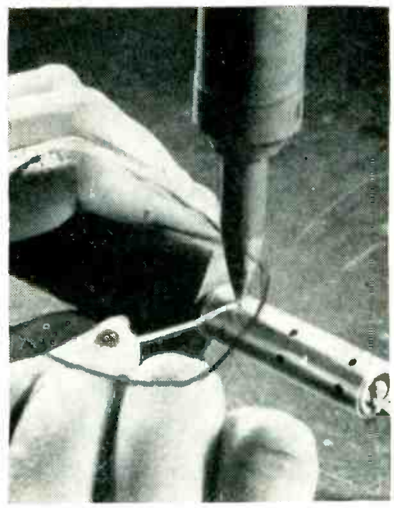


Soldering disc capacitors into position through drilled holes in housing. Wood block is used as grip so operator does not burn fingers

pliers, then the two end capacitors and an external lead are similarly attached. The assembly is now placed in a half-round positioning fixture having correctly spaced grooves for the capacitors, and all joints are soldered.

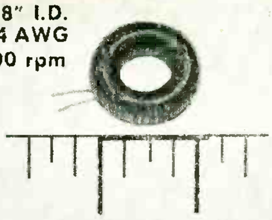
The filter assembly is next inserted in its metal housing by threading the insulated lead through the hole in the end of the housing and using this lead to pull the coils and capacitors in. The flexible lead is now pushed into a drilled hole in a wood block to provide a heat-insulating handle for the next operation, that of soldering the edges of the capacitor discs to the housing. For this operation, a soldering iron having a pointed tip is supported vertically, point down, by a holding fixture made from pipes and fittings. Each soldering hole in turn is carefully brought up to the tip of the iron and solder is applied inside the hole. Extreme care is required here to prevent the solder from getting outside the hole, as the hot solder might burn off the silver plating from the filter shield.

Storage In Mason Jars

BECAUSE DEPOSITED carbon resistors can rarely be produced to a specific resistance value and tolerance by the electric oven batch process, the carbon-depositing department must keep well ahead of the assembly line in the San Juan,

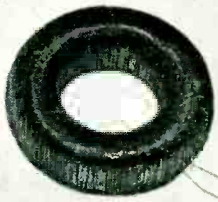
EVENLY *Wind*

SMALL TOROIDAL COILS AT HIGH SPEEDS WITH MINIMUM WIRE BREAKAGE



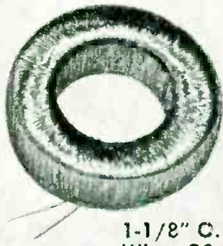
9/16" O.D. x 3/8" I.D.
Wire—44 AWG
Winding Speed—500 rpm

0   1/2 Inch

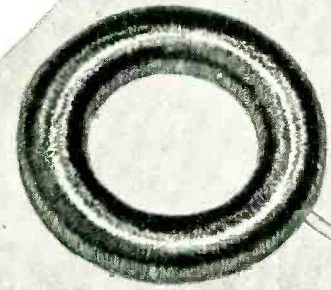


1-1/8" O.D. x 3/4" I.D.
Wire—44 AWG
Winding Speed—500 rpm

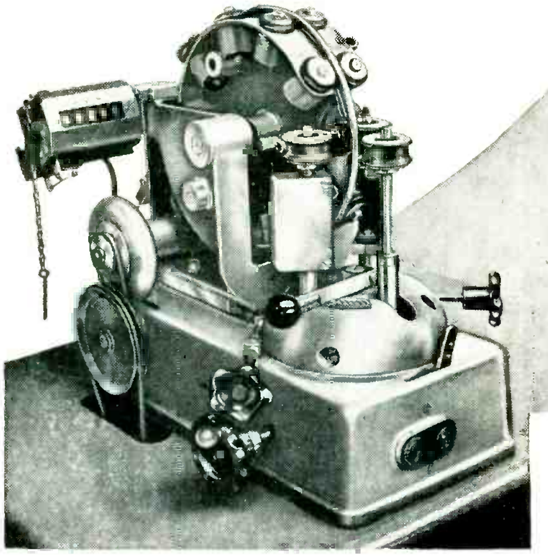
The MICAFIL Model RW-0 Toroidal Coil Winder automatically winds toroidal coils continuously around 360° and sector coils from 30° to 180°. To produce smooth, even layers of wire, the winder is adjusted easily to wind any wire size between 26 and 45 AWG and to obtain the proper pitch. Winding direction can be changed and feeds can be adjusted while machine is in operation.



1-1/8" O.D. x 3/4" I.D.
Wire—38 AWG
Winding Speed—800 rpm



O.D. 1-5/8" x 7/8" I.D.
Wire—38 AWG
Winding Speed—800 rpm



CAPACITY

Coil Sizes	
Minimum finished I.D.	¼"
Maximum finished O.D.	2"
Minimum finished O.D.	½"
Wire Sizes	26 to 45 AWG
Winding Speed—according to wire size	up to 800 rpm
Shuttle Capacity—according to wire size	48 to 500 ft.

MICAFIL Toroidal Coil Winders are made in three larger sizes for winding coils up to 8" O.D. and with 11 AWG Wire.

SPIRALING DEVICE—Device winds spirals for shuttle loads—in advance . . . Newly developed to permit continuous operation of Coil Winder . . . Winds to predetermined lengths.

SHUTTLES—Made in four different ring diameters to accommodate range of spiraled wire sizes . . . Larger wire capacities . . . *More than one coil can be wound with single loading* . . . Changed within 2 minutes . . . Loaded in less than a minute.

ACCURATE MECHANICAL TURNS COUNTER—Preset for required number of turns . . . Automatically stops winder when turn count is reached.

Let Cosa Engineers study and recommend the winder for your needs. Or, write for Literature.

COSA CORPORATION

405 Lexington Ave., New York 17

Your source for all Precision Machine Tools—from Small Bench Lathes to Large Boring Mills

IN DETROIT AREA contact COSA CORPORATION of Detroit, 16923 James Couzens Highway, Detroit 35, Mich.

Want more information? Use post card on last page.

Mason jars on racks provide dust-proof storage for deposited carbon resistor bodies. Masking-tape labels are placed high enough on jar so that low stocks can be easily noted

Puerto Rico plant of Radell Corp. Batches of resistor bodies are fired, then automatically measured and sorted into different resistance ranges well in advance of needs. From this stock, units are drawn for processing to fill current orders.

Ordinary mason jars prove ideal for storing the reserve stock of resistor bodies. Their clear glass permits quick visual inspection of the supply on hand, so that subsequent oven batches can be aimed for the low points in the stock. The resistance value and range in each jar are identified by lettering on labels cut from masking tape. White enameled screw-type covers proved most satisfactory for the jars.

Staking Hinge Bar for Aircraft Relay

A STAINLESS STEEL pin is staked onto each end of the hinge bar assembly for an aircraft relay in one punchpress operation at the San Juan, Puerto Rico plant of Phillips Control Corp.

Each pin has a knurled end which is forced into the hole in the bar in a preliminary operation. The bar is then set into the positioning fixture on the bed of the press with long tweezers; these minimize finger accidents.

As the press descends, a spring-loaded pin comes down first and

On land . . . on sea . . . in the air . . .

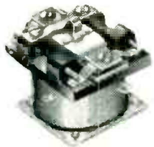
"THERE'S NO JOB TOO TOUGH FOR A HUSKY!"

For quality, efficiency and reliability - select the relay you need from Price Electric's complete line. A few of the many types available appear on this page. A more complete listing and description is available in our *Relay Reference Folder,* which will be sent free upon request.

HUSKY relays consistently meet the most exacting specifications and perform their required functions under the most adverse conditions.

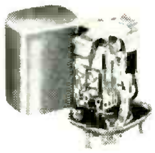
SERIES 5002-A RELAY
(AN 3320-1)
(MIL-R-6106)

CONTACTS: S.P.N.O. rated 25 Amps resistive.
COIL VOLTAGE: 26.5 Volts DC.



BALANCED ARMATURE RELAY
SERIES 1200

CONTACTS: D.P.D.T. rated 3 Amps at 115 Volts AC, non-inductive.
COIL VOLTAGE: 3 to 48 Volts DC.
MAXIMUM COIL RESISTANCE: 8500 Ohms.
AVAILABLE HERMETICALLY SEALED



SERIES 5724-IHS RELAY
(AN 3304-1)
(MIL-R-6106)

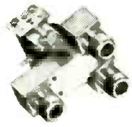
CONTACTS: 4 from C, rated 3 Amps at 115 Volts AC, non-inductive.
COIL VOLTAGE: 26.5 Volts DC.

MINIATURE HERMETICALLY SEALED RELAY
SERIES 700 HS

CONTACTS: D.P.D.T. rated 2 amps at 115 Volts AC, non-inductive.
COIL VOLTAGE: 6 to 48 Volts DC.
MAXIMUM COIL RESISTANCE: 4000 Ohms.
HERMETICALLY SEALED ONLY

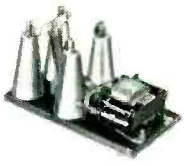
ROTARY STEPPER
SERIES 8400

Drives up to 3 wafer switches (or other load not exceeding 8½ inch-ounces total torque).
CONTACTS: Make-Break or Break-Make.
COIL VOLTAGE: 6 to 115 Volts DC.



CO-AXIAL RELAY
STYLE 6394

CONTACTS: S.P.D.T. rated at 100 Watts (RF Load).
COIL VOLTAGE: *AC*—115 or 230 Volts. *DC*—6 to 110 Volts.



HIGH VOLTAGE RELAY
STYLE 6225

CONTACTS: S.P.D.T. (Double-Break) rated 10 Amps at 115 Volts AC, Cold Break, non-inductive.
COIL VOLTAGE: 115 Volts, 60 cycles AC or 130 Volts, 60 cycles AC.

LONG FRAME TELEPHONE-TYPE RELAY
SERIES 5900

CONTACTS: 12 form *A* or 8 form *C*, rated 3 Amps at 115 Volts AC, non-inductive.
MAXIMUM COIL RESISTANCE: 20,000 Ohms.
COIL VOLTAGE: 6 to 230 volts DC or AC.
AVAILABLE HERMETICALLY SEALED

SYNCHRONOUS TIME DELAY RELAY
SERIES 4050

CONTACTS: S.P.N.O. to D.P.D.T. rated 10 Amps at 115 Volts AC, non-inductive.
COIL VOLTAGE: 115 Volts, 60 cycle AC or 230 Volts, 60 cycle AC.
TIME INTERVALS (FIXED): 15 sec. to 15 min.
AVAILABLE HERMETICALLY SEALED

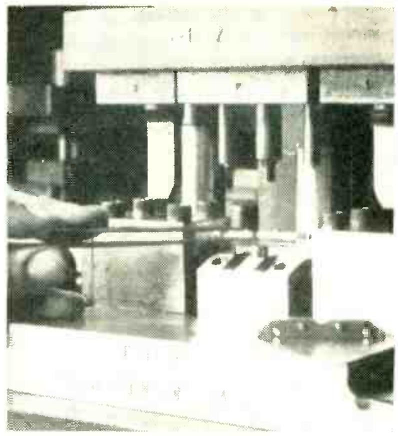
MIDGET RELAY
SERIES 1050

CONTACTS: D.P.D.T., rated 2 Amps at 115 Volts AC, non-inductive.
COIL VOLTAGE: 3 to 24 Volts DC.
MAXIMUM COIL RESISTANCE: 8500 Ohms
AVAILABLE HERMETICALLY SEALED

RELAY REFERENCE FOLDER A handy guide to Husky relays, containing photographs and specifications of 42 types. Helps you find the type relay you need in just a few seconds. Address request to Dept. NS.

Price Electric
CORPORATION
1500 CHURCH, FREDERICK, MARYLAND

PRICE ELECTRIC CORP. FREDERICK, MD.
HUSKY RELAYS AND CONTROLS

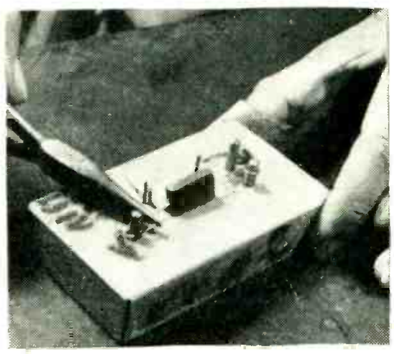


Method of using tweezers to insert aircraft relay hinge bar in press for staking bearing pins. Finished bar can be seen on bed of press

holds the hinge bar tightly in position. At the same time, two cam-driven pins force the two stainless steel hinge pins in to the correct depth and hold them there while staking rods on each side of the spring-loaded center pin come down and stake the hinge bar over the shanks of the pins.

Lead-Forming Fixture

METAL PEGS IN wood blocks serve both as centering guides and as forms for bending loops in leads for small components prior to assembly on terminal boards. When loops are formed in this manner at the correct points in the leads, the parts can be rapidly dropped over the wrap-around pins on terminal boards at subassembly positions. A quick squeeze of each loop with pliers provides the mechanical strength for mounting the parts on their terminals. This technique is used at Caribe Aircraft Radio

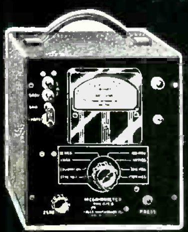


Method of preforming leads of mica capacitor with the aid of pegs on a wood block. Unused pins here serve for positioning another type of component and forming its leads. Library of blocks is maintained to take care of all parts used on the terminal boards

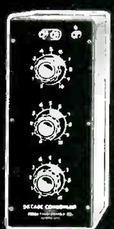
FREED *Instruments & Transformers*

Famous For **QUALITY · DEPENDABILITY · ACCURACY**

No. 1030
Low Frequency
"Q" Indicator



No. 1020B
Megohmmeter



Decade
Inductors

No. 1040
Vacuum Tube Voltmeter

FREED

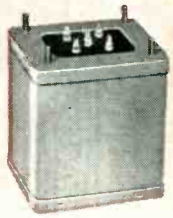
HIGH FIDELITY-HIGH LEVEL OUTPUT TRANSFORMERS

The Freed "Quality Grade" audio transformers are wide band, high fidelity components featuring astatic construction, longitudinal balance, low harmonic distortion, uniform response, high efficiency, and constant impedance match throughout the audio frequency spectrum. Maximum neutralization of stray fields is accomplished by use of humbalanced coil structures and multiple alloy shielding. High fidelity is achieved on every tap of the universal impedance winding without line reflection or transverse coupling.

All Quality Grade Components are thoroughly impregnated in a special non-hygroscopic varnish, and fully encapsulated in a moisture proof, high melting point compound.

TUBES TO LINE, TUBES TO VOICE COIL, LINE TO LINE, LINE TO VOICE COIL

CATALOG	APPLICATION	IMPEDANCE LEVEL OHMS PRIMARY	SECONDARY	MAXIMUM POWER LEVEL V.U.*	RATIO	MAX PRI DC PER SIDE Ma.	D.C. UNBAL. Ma.	FREQ. RESPONSE C. P. S.	CASE NUMBER
QGA 25	PP 2A3, 6B4, 6L6 300A, 275A to Univ. 500 ohm line	5,000 SPLIT	U-500	+42 (15 WATTS)	3.16:1	50	5	±0.5 DB 20-30000	DC-5BT
QGA 26	As above to Universal Voice Coil	5,000 SPLIT	U-16	+42	17.7:1	50	5	±0.5 DB 20-30000	DC-5BT
QGA 27	Push-pull 6V6, 6AQ5, 7C5, 6N7 to Univ. 500 ohm line	8,000 SPLIT	U-500	+42	4:1	50	5	±0.5 DB 20-30000	DC-5BT
QGA 28	As above to Univ. Voice Coil	8,000 SPLIT	U-16	+42	22.4:1	50	5	±0.5 DB 20-30000	DC-5BT
QGA 29	P.P. 6F6, 6V6, 6AQ5, 7C5, 7B5, 6AR5, 6K6, 6L6 to Universal 500 ohm line	10,000 SPLIT	U-500	+42	4.47:1	40	4	±0.5 DB 20-30000	DC-5BT
QGA 30	As above to Universal Voice Coil	10,000 SPLIT	U-16	+42	25:1	40	4	±0.5 DB 20-30000	DC-5BT
QGA 31	P.P. 807, 1614, KT-66, (Williamson Amplifier) to Univ. 500 ohm line	10,000 SPLIT	U-500	+45.5 (36 WATTS)	4.47:1	50	5	±0.5 DB 20-30000	DC-6AT
QGA 32	As above to Universal Voice Coil	10,000 SPLIT	U-16	+45.5	25:1	50	5	±0.5 DB 20-30000	DC-6AT
QGA 33	P.P. Parallel 2A3, 6A5G, 300A to Univ. 500 ohm line	2,500 SPLIT	U-500	+45.5	2.24:1	100	10	±0.5 DB 20-30000	DC-6AT
QGA 34	As above to Universal Voice Coil	2,500 SPLIT	U-16	+45.5	12.5:1	100	10	±0.5 DB 20-30000	DC-6AT
QGA 35	P.P. 6L6 or P.P. Parallel 6L6 to Univ. 500 ohm line	3,800 SPLIT	U-500	+47 (50 WATTS)	2.75:1	130	13	±0.5 DB 20-30000	DC-7BT
QGA 36	As above to Universal Voice Coil	3,800 SPLIT	U-16	+47	15.4:1	130	13	±0.5 DB 20-30000	DC-7BT
QGA 37	High level multiple line to Universal Voice Coil	U-500	U-16	+42	5.6:1	0	0	±0.5 DB 20-30000	DC-5BT
QGA 38	High level multiple line to Universal Voice Coil	U-500	U-16	+47	5.6:1	0	0	±0.5 DB 20-30000	DC-7BT



U-16 IMPEDANCES IN OHMS

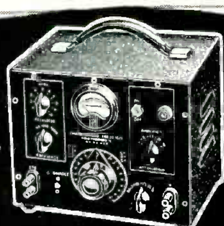
2, 4, 8, 12, 16

U-500 IMPEDANCES IN OHMS

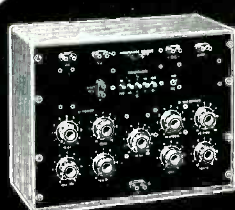
50, 125, 200CT, 250, 330, 500CT
125 and 500 ohms can be used for 150 and 600 ohms

SEND FOR COMPLETE CATALOG OF FREED INSTRUMENTS AND TRANSFORMERS

No. 121C
Null Detector &
Vacuum Tube Voltmeter



No. 1010
Comparison Bridge



No. 1110A
Incremental Inductance
Bridge

FREED TRANSFORMER CO., INC.

1722 WEIRFIELD ST. (RIDGEWOOD) BROOKLYN 27, N.Y.

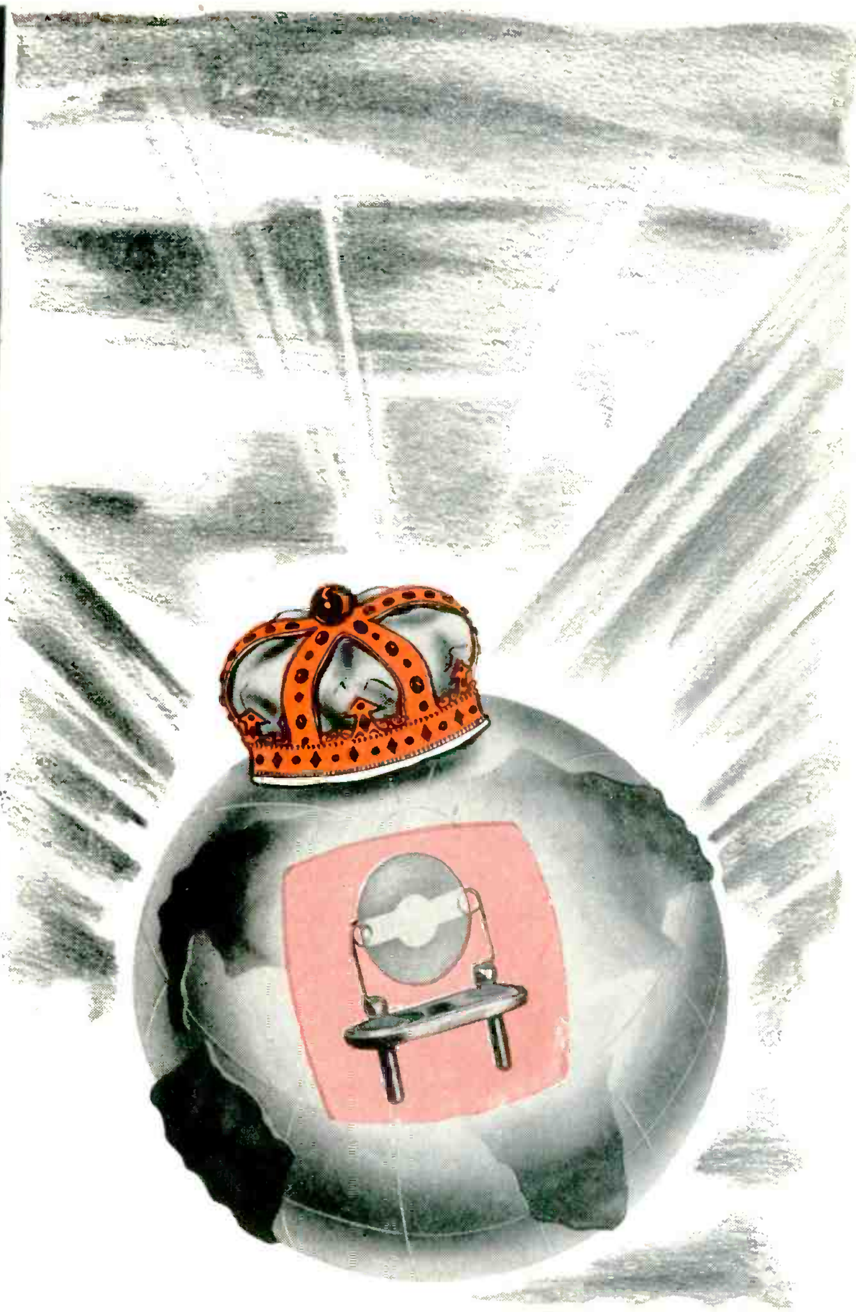
Operator can drop components quickly over terminals on board when leads have preformed loops

Corp., Coamo, Puerto Rico in connection with the manufacture of military radar equipment.

Sealing Paper Capacitors

RAPID assembly and sealing of tubular paper capacitors is achieved at Pyramid Electric Co. through use of mounting racks that hold about 60 capacitor tubes. The tubes are placed between two strips of wood in a jig that sets over a height-controlling wood strip mounted on the bench. After loading a jig, the

Placing capacitor tubes in jig. A wooden strip on the table beneath the rack keeps all the tubes at the proper height until thumbscrews are tightened



- RESEARCH
- ENGINEERING
- CRAFTSMANSHIP
- PRECISION
- PRODUCTION
- DELIVERY
- QUALITY

THE INSIDE STORY

Top quality means top performance after long service. Bliley quality control far exceeds the perfunctory steps necessary to produce and ship crystals which meet a nominal specification.

Bliley precision process techniques, rigidly followed in orientation, slicing, lapping, and plating guarantee peak crystal performance. That extra touch of engineering and craftsmanship makes the big difference in your equipment.

That's the Bliley inside story!

Bliley CRYSTALS

BLILEY ELECTRIC COMPANY

UNION STATION BUILDING • ERIE, PA.

Want more information? Use post card on last page.

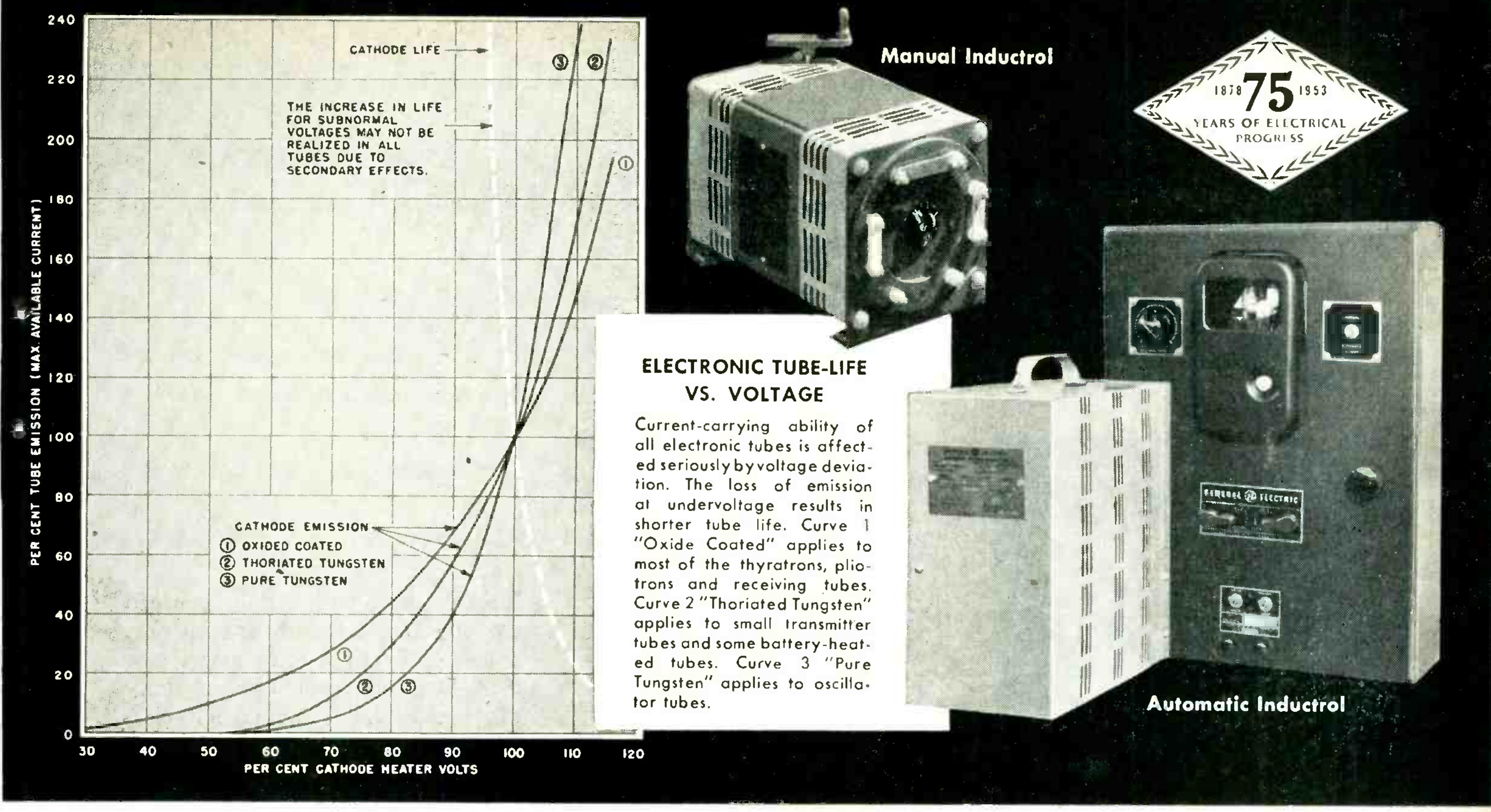
Capacitor bodies are inserted in tubes and ends of leads bent over rods to insure proper centering

tubes are locked in position by tightening thumbscrews at each end. On each jig are two metal rods, one running over each end of the paper tubes.

At another work position, a capacitor body is inserted in each tube and the ends of their pigtails are bent over the rods to hold the capacitor centered in the tube.

In the final step of the process, cement is applied to each end of the capacitor through the nozzle of a trigger-operated gun. The gun, operating at 60 to 80 lb air pressure, makes it possible for the operator to control the flow of cement precisely, filling each unit completely and smoothly without overflow.

Squirting cement into ends of tubular paper capacitors with high-pressure cement gun. Racks are inverted for filling other ends of units



For maximum tube life and performance, include G-E Inductrols as "original equipment"

Automatic voltage regulation provides an effective and economical means of avoiding losses in power capacity

The life and efficiency of the electronic equipment you manufacture depends, to a large extent, on the performance of the electronic tubes. Tube life is adversely affected by over- or under-voltage conditions *that can easily be prevented.*

G-E dry-type induction voltage regulators, called Inductrols, offer you an effective and economical means of maintaining correct operating voltage. Two types are available for indoor service on circuits 600 volts and below, single-phase 3 to 240 kva; three-phase 9 to 520 kva.

1. **Automatic** Inductrols maintain a closely regulated output voltage from a varying supply voltage with a bandwidth of ±1%. The standard range of regulation is plus and minus 10%.
2. **Hand-operated or manually controlled motor-operated** Inductrols provide a variable output voltage from a relatively constant supply voltage. They supply 100% raise and 100% lower regulation.

You can put your confidence in—

GENERAL ELECTRIC

Typical applications for G-E Inductrols that have proved highly effective include: radar equipment, induction heating equipment, medical and industrial x-ray equipment, TV and radio transmitters.

For further information, contact your nearest G-E sales office, agent or distributor...or return the attached coupon.

HERE'S HELPFUL G-E DATA ON INDUCTROLS

For full details on dry-type induction voltage regulators, return this coupon . . . today!

- Single-phase INDUCTROLS, indoor service 600 volts and below on circuits 3 to 240 kva—GEC-795A ☐
- Three-phase INDUCTROLS, indoor service 600 volts and below on circuits 9 to 520 kva—GEA-5824 ☐
- Application bulletin, Inductrols and electronic equipment—GEA-5936 ☐

General Electric Company
Section C423-201, Schenectady 5, N. Y.

Name ____________________

Company ____________________

Address ____________________

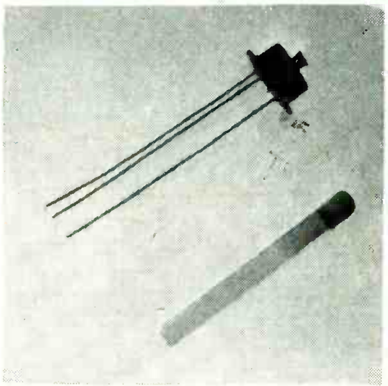
City ____________ Zone ______ State ________

NEW PRODUCTS

Edited by WILLIAM P. O'BRIEN

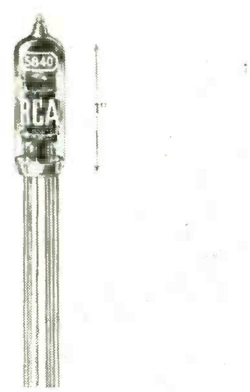
Control, Testing and Measuring Equipment Described and Illustrated . . . Recent Tubes and Components Are Covered . . . Fifty-Four Trade Bulletins Reviewed

OTHER DEPARTMENTS:
featured in this issue:



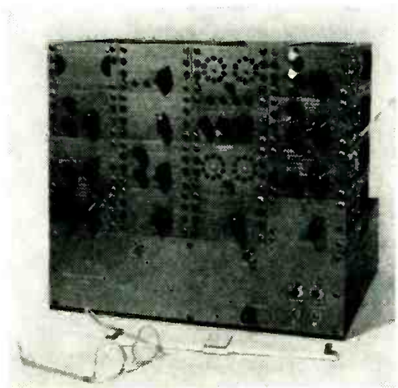
TRANSISTORS
of all-welded metal

GENERAL ELECTRIC CO., Syracuse, N. Y., is producing a new line of junction transistors that are evacuated, hermetically sealed and of all-welded metal construction. The welded metal construction allows power ratings of almost 1 watt, with two units in a class-B push-pull circuit. They have been demonstrated to operate under water at temperatures up to 100 C.



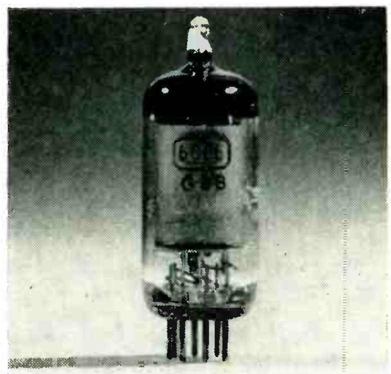
TINY PENTODE
is heater-cathode type

RADIO CORP. OF AMERICA, Harrison, N. J. The 5840 is a premium sharp-cutoff pentode of the subminiature type for use primarily as a broad-band r-f or i-f amplifier in mobile and aircraft receivers where dependable performance under shock and vibration is a prime consideration. It features a pure-tungsten heater to give long life under conditions of frequent on-off switching and three leads to the cathode to permit isolation of the input and output circuit returns and to reduce the cathode lead inductance.



MODULAR SYSTEM
of digital pulse units

AUDIO PRODUCTS CORP., 2265 Westwood Blvd., Los Angeles 64, Calif. The modular system of digital pulse units consists of 16 electrically and mechanically compatible modulars that perform all the basic functions of digital pulse operations, such as gating, pulse forming, counting and coincidence marking, as well as simpler electronic tasks like amplification, signal inversion and impedance matching. In operation the modulars are easily assembled, firmly linked together by mechanical means and quickly interconnected by patch cords. Thus design and development engineers can readily operate in the most complex systems at block diagram level without concern for circuit details. Since each unit (size—$2\frac{3}{4}$ in. high $\times$ $4\frac{1}{2}$ in. wide $\times$ 9 in. long) performs a multiplicity of independent functions selectively, a complete system consisting of 16 modular units and a regulated power supply has a capability of 72 separate functions with as many as 31 functions simultaneously available. Simple digital instruments can be quickly patched up by using the modular system.

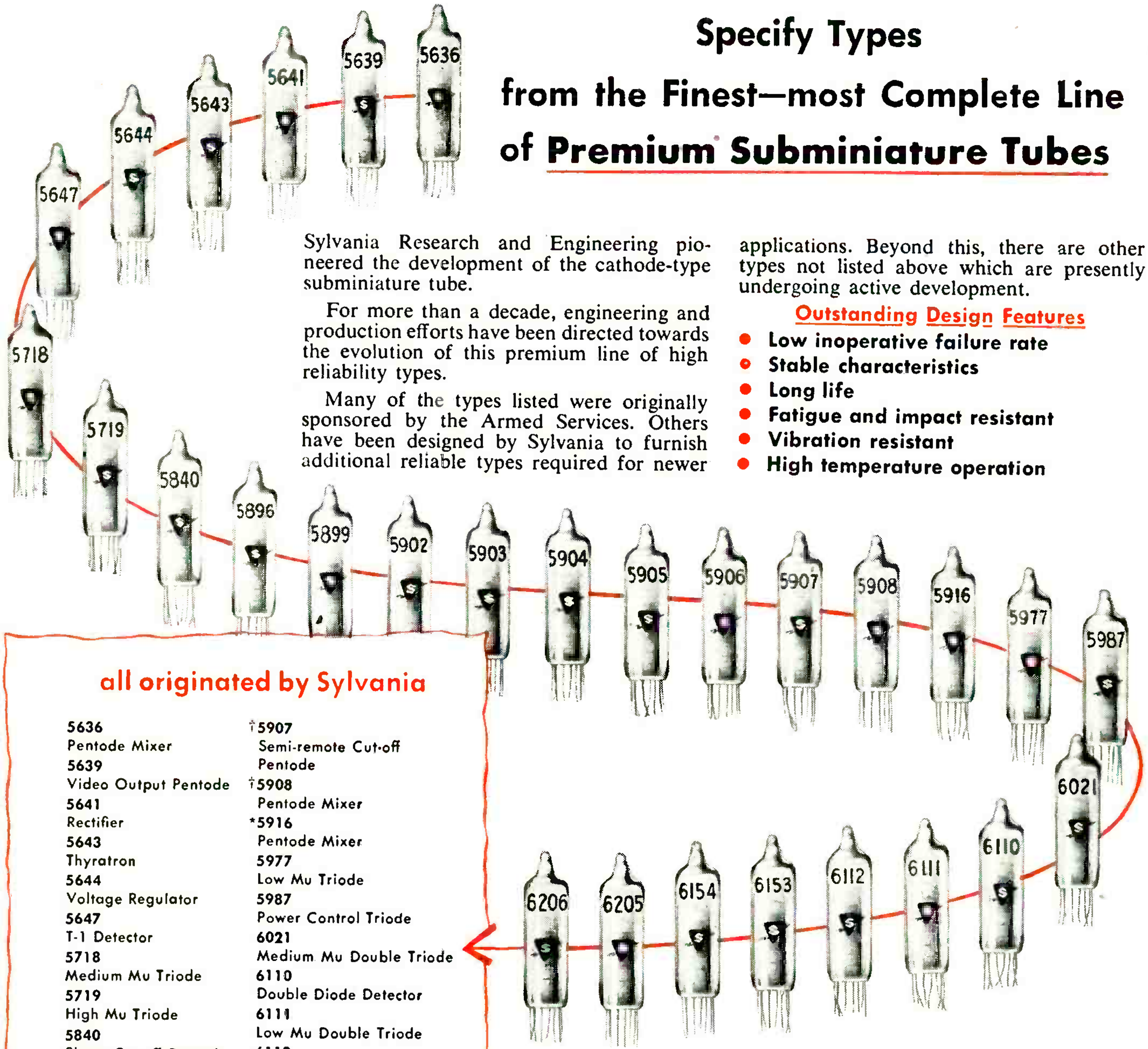


TV TUBE
aids noise suppression

SYLVANIA ELECTRIC PRODUCTS INC., 1740 Broadway, New York 19, N. Y., has announced a new tube, type 6CS6, designed for combined sync-separator, noise-suppressor use. It is designed to be used in circuits that accomplish sync separation by feeding the video signal extending in a positive direction to grid three where the negative grid-leak bias development automatically adjusts the clipping level. Noise suppression is obtained in the 6CS6

FOR YOUR EQUIPMENT-

Specify Types from the Finest—most Complete Line of Premium Subminiature Tubes



Sylvania Research and Engineering pioneered the development of the cathode-type subminiature tube.

For more than a decade, engineering and production efforts have been directed towards the evolution of this premium line of high reliability types.

Many of the types listed were originally sponsored by the Armed Services. Others have been designed by Sylvania to furnish additional reliable types required for newer applications. Beyond this, there are other types not listed above which are presently undergoing active development.

Outstanding Design Features

- Low inoperative failure rate
- Stable characteristics
- Long life
- Fatigue and impact resistant
- Vibration resistant
- High temperature operation

all originated by Sylvania

5636 Pentode Mixer
5639 Video Output Pentode
5641 Rectifier
5643 Thyratron
5644 Voltage Regulator
5647 T-1 Detector
5718 Medium Mu Triode
5719 High Mu Triode
5840 Sharp Cut-off Pentode
5896 Double Diode Detector
5899 Semi-remote Cut-off Pentode
5902 Audio Power Pentode
***5903** Double Diode Detector
†5904 Medium Mu Triode
†5905 Sharp Cut-off Pentode
†5906 Sharp Cut-off Pentode
†5907 Semi-remote Cut-off Pentode
†5908 Pentode Mixer
***5916** Pentode Mixer
5977 Low Mu Triode
5987 Power Control Triode
6021 Medium Mu Double Triode
6110 Double Diode Detector
6111 Low Mu Double Triode
6112 High Mu Double Triode
6153 Sharp Cut-off Pentode Low Cgp (Separate suppressor)
6154 Remote Cut-off Pentode Low Cgp (Separate suppressor)
6205 Sharp Cut-off Pentode (Separate suppressor)
6206 Semi-remote Cut-off Pentode (Separate suppressor)

** 26-volt heater. † 26 volts all elements.*
All other types are 6.3 volt heaters.

For complete data sheets and specifications concerning any of the above tube types and for application information, see your Sylvania Sales Engineer or write to: Sylvania Electric Products Inc., Dept. 3R-1011. 1740 Broadway, New York 19, N. Y.

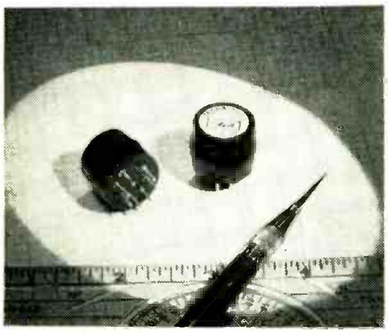
SYLVANIA

LIGHTING • RADIO
ELECTRONICS
TELEVISION

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg., St. Catherine St. Montreal, P. Q.

Want more information? Use post card on last page.

by applying a video signal extending in a negative direction to grid one. Strong noise impulses will cause tube cutoff momentarily and thus reduce the harmful effects of noise on picture-tube sweep circuits. The 6CS6 grid number three has a sharp-cutoff characteristics to facilitate the clipping action which removes picture information from the sync pulses. This tube is in the T-5½ bulb style and has a 6.3-v heater.

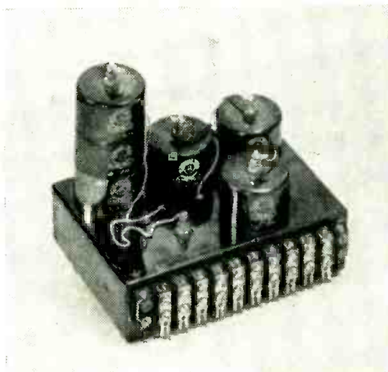


PULSE TRANSFORMERS
are tiny plug-in type

TECHNITROL ENGINEERING Co., Philadelphia 33, Pa., is now manufacturing two new miniature, plug-in pulse transformers featuring selective turns ratios. Each of the new units has a tapped secondary permitting selection of a turns ratio of 3 to 1, 4 to 1, 5 to 1, 6 to 1 or 8 to 1. TP-AVA is recommended for narrow pulses, 0.2 μsec to 0.5 μsec wide. TP-BVA is for wider pulses, 0.5 μsec to 2.5 μsec. Bulletin 166-1 gives complete information on the company's transformers.

OSCILLOGRAPH
can record 50 data traces

CONSOLIDATED ENGINEERING CORP., 300 N. Sierra Madre Villa, Pasadena 8, Calif. Fifty active data traces can be accurately recorded on 12-in. paper or film by the type 5-119 recording oscillograph. A 36-trace type with identical features is also available. Records 250 ft in length may be made at speeds from 0.10 in. to 100 in. per second. Automatic safety circuits are incorporated to give immediate warning should some failure occur to cause record loss. Circuits are provided to check condition of the main and reserve lamps, timing lamp, heater operation and paper supply. Additional test circuits check the warning systems. Frequencies from 0 to 3,000 cps may be recorded by installing precision galvanometers. Oscillograph models are available for operation from either 26-v d-c or 115-v a-c power. Further information is given in bulletin 1536.



DECADE INDUCTORS
are plug-in type

BURNELL & Co., 45 Warburton Ave., Yonkers 2, N. Y. Some of the many advantages of the new plug-in decade series of decade coils are: (1) greater flexibility in lab setups; (2) lab precision with greater economy; (3) elimination of interwiring and selector-switch capacities; (4) simplicity of service and replaceability of individual units; and (5) allowance of more than one simultaneous setup with a given set of coils. Each plug-in decade is equipped with a male plug at one end and female plug at the opposite end permitting the user to plug as many together as desired which simultaneously connects them in series. One basic set of 4 decade units will provide inductance values in decade steps of 1 to 10. At present one series of plug-in decade units is available over the entire inductance range of 1 millihenry to 180 henries.

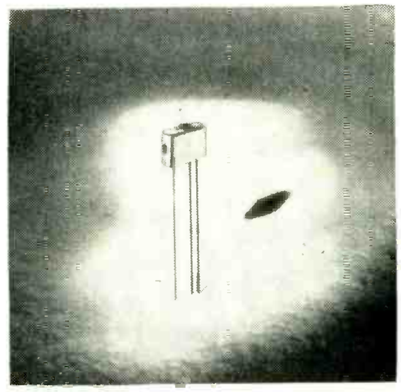
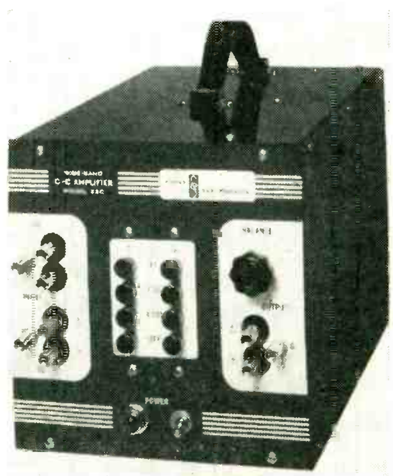


PHOTO TRANSISTOR
is *npn* junction type

TRANSISTOR PRODUCTS, INC., Snow and Union Sts., Boston 35, Mass., has developed a type X-25 germanium *npn* junction photo transistor. Its immediate applications will include use in automatic punch-card accounting machines, automatic dimmers for automobiles and automatic brilliance controls on tv receivers. It has sufficient power output to operate a relay. Maximum operating power is 60 mw and maximum nondestructive power 400 mw. It may be considered as a light-sensitive device with an incorporated amplifier.

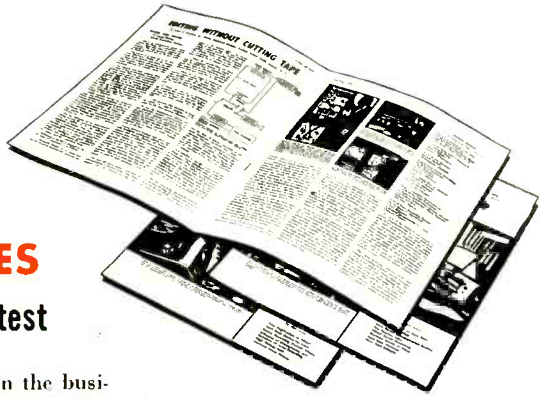


D-C AMPLIFIER
for wide-band operation

FURST ELECTRONICS, 3322 W. Lawrence Ave., Chicago 25, Ill. Model only 

offers you all this valuable new information

. . . and it doesn't cost you a cent!



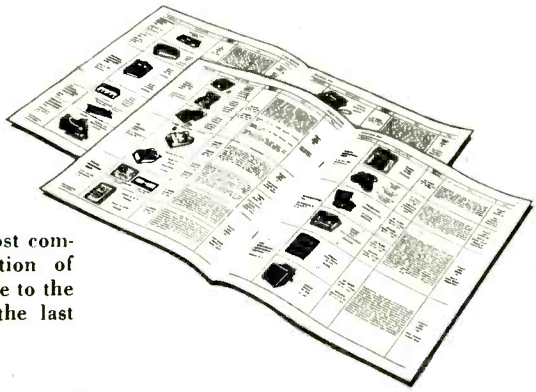
20 PRIZE-WINNING ARTICLES

from Audio's International Sound Recording Contest

Here's a wealth of new ideas on how to use tape and disc recordings to achieve greater economy and efficiency in radio, TV and sound studio operation.

With reference to these articles, one of the contest judges commented as follows: "I have never received so much information which was new and exciting in such a short time in all of my years in the business." And another judge stated that "the information and descriptions of recording operations conducted in small radio stations and recording studios throughout the country has been quite an education."

Contest winners include entries from 11 different States, as well as from Canada and Switzerland. The 20 best articles, which were awarded cash prizes totaling $1400, will be published in the pages of Audio Record. The information thus made available to the industry will be of real value to sound recordists everywhere.



QUICK FACTS ON MAGNETIC TAPE RECORDERS

Each year, Audio Record brings you a complete, up-to-date listing of all makes and models of tape recording machines—with conveniently arranged price and performance data. This directory issue, published in September, is the most complete and authoritative compilation of tape recorder information available to the industry. Over 75,000 copies of the last issue were distributed.

. . . plus many other articles of timely interest to the sound recordist

Audio Record keeps you well informed on all the latest trends and technical developments in all phases of tape and disc recording. It is not an advertising publication and its sole purpose is to render a needed and useful service to the industry.

Audio Record, published 8 times a year, is currently distributed free of charge to a request mailing list of about 35,000 sound recordists in broadcasting stations, recording studios, schools and colleges throughout the country.

IT'S YOURS FOR THE ASKING

A letter or post card will add your name to the Audio Record mailing list. And if you would like to have others in your organization read it also, send their names along, too. Just write to Audio Devices, Inc., using the Dept. No. listed below. All requests addressed to this Dept. will be started with the July-Aug., 1953 issue, so you will be sure to get *all* the prize-winning articles, as well as the 1953 Tape Recorder Directory Issue.

AUDIO DEVICES, Inc.

Dept. AR-1, 444 Madison Ave., New York, N. Y.

Export Dept.: 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

THEY SPEAK FOR THEMSELVES

audiodiscs
audiotape
audiofilm
audiopoints

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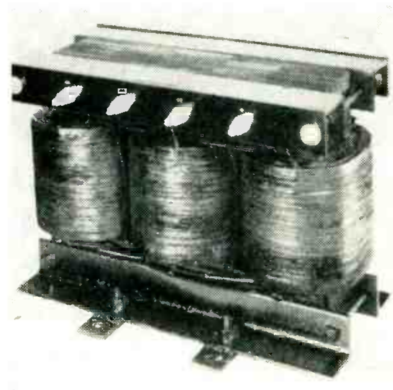
220 wide-band d-c amplifier is designed specifically to increase the sensitivity of c-r oscilloscopes with extended l-f response. It can be used to extend the range of vtvm's, frequency analyzers and other instruments when unusually low frequencies are encountered. In l-f applications its use eliminates long waiting times due to necessary coupling time-constants. Its use will also increase the sensitivity of d-c voltmeters. The new amplifier uses push-pull amplification and a special cross-coupled circuit achieves good stability and low drift. This circuit also provides excellent phase inversion for equal results with balanced or unbalanced input signals. Maximum gain is adjusted to approximately 100 and the input attenuators reduce this gain to approximately 10 and 1 (40, 20 and 0 db).



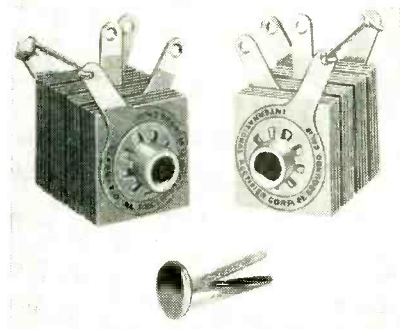
TRANSFORMER
gives power to tube plate

MAGNATRAN, INC., 246 Schuyler Ave., Kearney, N. J., has added a new air-cooled plate transformer to its line of heavy-duty electronic components. Its purpose is to furnish power to plates of rectifier tubes which in turn supply high d-c voltage to all types of electronic equipment. These transformers are conservatively designed for trouble-free life and to withstand abnormal impulse voltage encountered in rectifier service. In addition to the open-frame core and coil construction, all coils are layer wound with wire locked in place by means of special construction of the layers of insulation. This maintains con-

stant, proper coil distance throughout the life of the transformer.

MILLISEC RELAYS
are plug-in, factory-sealed

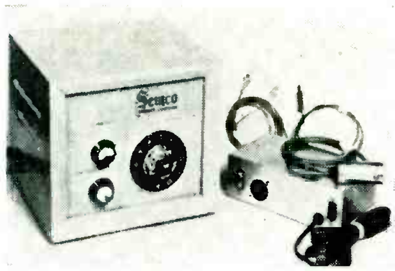
STEVENS-ARNOLD, INC., 22 Elkins St., South Boston, Mass., has available a line of plug-in, factory-sealed, ultrahigh-speed (Millisec) relays. They are being offered (1) to cover a wide range of temperatures, (2) in a larger variety of types and (3) with a choice between gold contacts and platinum-rhodium contacts. Gold covers the range of 0 to ¼ ampere at 0 to 110 v d-c. Platinum-rhodium covers the range of 0 to ½ ampere at 10 to 110 v d-c. A listing of the additional types, together with complete engineering information, is given in the new catalog 337.



RECTIFIER
for magnetic devices

INTERNATIONAL RECTIFIER CORP., 1521 E. Grand Ave., El Segundo, Calif., has developed a small, compact single-phase bridge rectifier, type D-3575, for the operation of magnetic devices such as relays, solenoids and electric counters. The unit is designed for use directly from 117-v a-c systems and is rated to deliver an output of 9 w at 90 v

d-c, continuous duty. With the addition of a 3-μf or larger filter capacitor, the rectifier will deliver 117 v d-c for operation of devices normally designed for this voltage. The magnetic device, therefore, can be used in conjunction with this rectifier to operate directly from the conventional 117-v a-c line.



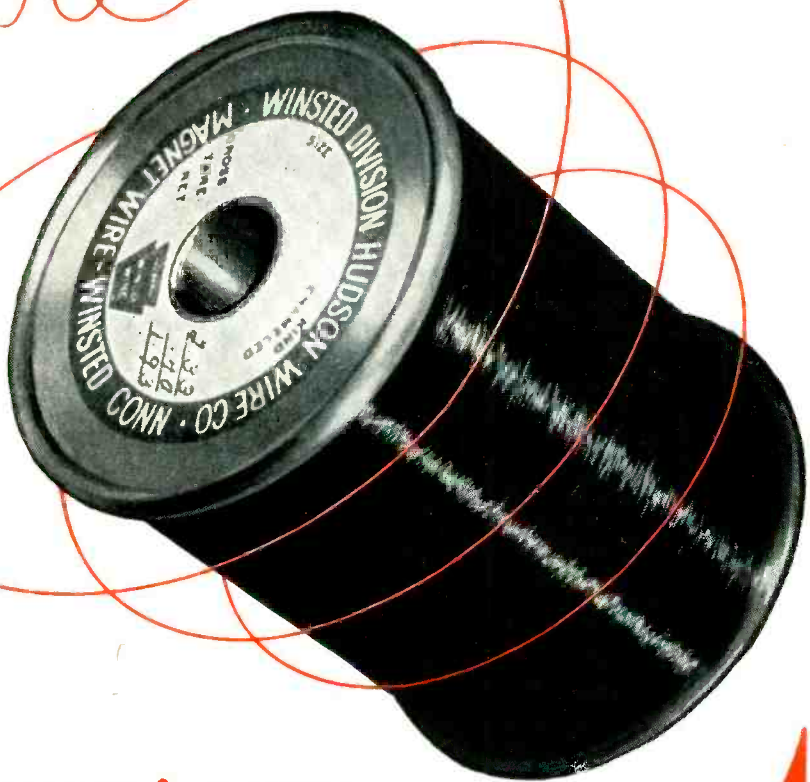
TV REMOTE CONTROL
for any current set

SEMCO ENGINEERING & MFG. CO., 8407 S. Hoover St., Los Angeles 44, Calif., has introduced a remote control that goes on any current set in a matter of a few minutes. It has provisions to receive the uhf stations by merely installing the snap-in uhf coil strips in unused channels. It saves the cost of a uhf converter. The unit has the latest cascode channel tuner, with double sensitivity; a signal booster amplifier for weak stations or fringe areas, which gives brighter and sharper pictures. Among its other features it has sound output connections for headphones at the control box. This is desirable for late night viewing in apartment houses.

PLUG-IN CIRCUITS
available in 20 versions

ELECTRONIC ENGINEERING CO. OF CALIF., 180 So. Alvarado St., Los fine wire

made finer!



custom drawn
custom insulated
custom spooled

to your most exacting requirements

Backed by fifty years (1903-1953) of fine-wire specialization! During all this time we have supplied bare and insulated wires to many of the most critical wire users.

Your specifications and requirements for *insulated wires* in the East are processed by our Winsted Division; in the West, the Cassopolis Division has been established to facilitate rapid shipments. Insulators and others requiring *bare wires* should contact the Ossining Division for prompt and efficient service.

Our research and development staff is always available to aid our customers in their requirements.

BARE WIRES
(Ossining Division)

Copper, Brass, Bronze, Phosphor-bronze, Nickel-silver, Zinc, Lead, Tin, Cadmium, Oxygen-free Copper, Silver, Fuse, Silver-plated, Specialties

TEXTILE-COVERED WIRES
(Winsted Division)

Nylon, Celanese, Silk, Cotton, Rayon, Fiberglas

Available on bare or enameled wire; single or double-coated.

INSULATED WIRES
(Winsted and Cassopolis Divisions)

MATERIALS	TYPES	COVERINGS
Copper	Instrument Tubing	Plain and Heavy Enamel
Aluminum	Litz	Formvar
Iron	Multiplied and Twisted	EZsol (Liquid Nylon)
Copper-clad Steel		Cement-coated Enamel

SPECIAL WIRES
(Ossining Division)

Silver-plated wires in coarse and fine sizes, for high-frequency conduction and high-temperature applications.

Electro-tinned, soft-annealed wire.

Other specialty wires to meet specifications.

HUDSON WIRE COMPANY

HUDCO Bare Wires — Winco Insulated Wires

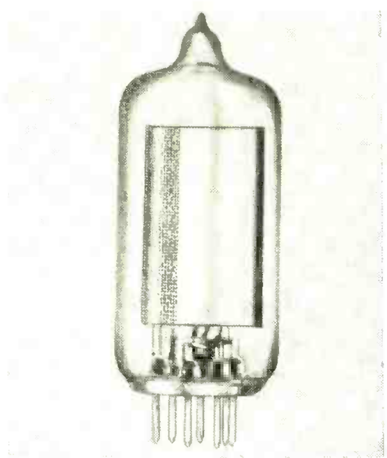
Winsted Division
Hudson Wire Company
Winsted, Conn.
Phone: Frontier 9-3341

Cassopolis Division
Hudson Wire Company
Cassopolis, Mich.
Phone: Cassopolis 56

Ossining Division
Hudson Wire Company
Ossining, N. Y.
Phone: Ossining 2-4710

Want more information? Use post card on last page.

Angeles 57, Calif., is manufacturing plug-in electronic circuits with a case which may be completely taken apart without tools. They are available in 20 catalog versions as well as special types. The cast-aluminum case can be easily disassembled by removing the tube shield, tube, and then unscrewing the base ring. This allows the entire assembly to be lifted apart for inspection. These plug-in circuits retain all of their shock and vibration advantages without dipping or potting in wax or resinous compounds. All the plug-ins are moisture and fungus-proofed by spraying with a special dielectric compound before being cased in a corrosion-resistant container. The plug-in case measures 4$\frac{5}{16}$ in. overall in height and 1$\frac{1}{2}$ in. in diameter. Seated height in a standard octal socket is 3$\frac{5}{8}$ in. and average weight for a circuit is 3$\frac{1}{2}$ oz.



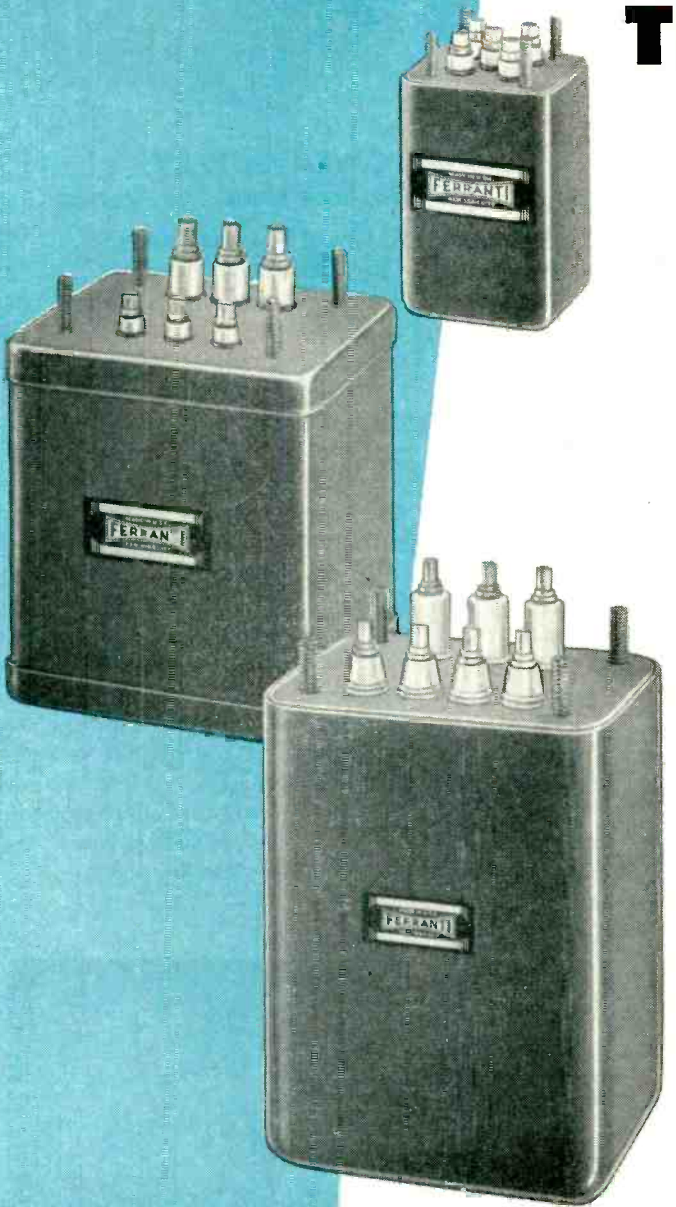
HYDROGEN THYRATRON can handle up to 10 kw

CHATHAM ELECTRONICS CORP., 630 Mt. Pleasant Ave., Livingston, N. J., is producing a new miniature hydrogen thyratron for pulse-generating applications. The tube can handle peak power up to 10 kw. Designated as the VC-1258 type it will fit a standard ceramic miniature socket. It is rated at 1,000 peak anode volts, 20 amperes peak anode current and 40 ma average anode current. Repetition rates in excess of 10,000 pps are possible at reduced ratings. The VC-1258 will withstand all shock

FERRANTI

TRANSFORMERS

HERMETICALLY SEALED



A NEW LINE OF STANDARD TYPES

- Designed to MIL-T-27 specifications
- MIL-T-27 standard steel cases
- Rugged sealed terminals
- Core and coil securely anchored to mounting studs
- High Vacuum impregnated

These types have been selected to provide standard, readily available components of the highest quality, including the specific types chosen by ASESA for universal military use.

Complete specifications on this wide range of units are contained in a new catalog. Your copy will be sent promptly on request.

In addition to the group listed in this catalog, we manufacture reactors and transformers of all varieties, including the more economical types for use where conditions do not require the superior qualities of those listed in our catalog. We can offer competitive quotations on types to suit your exact needs.

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INCORPORATED

30 Rockefeller Plaza New York 20, N. Y.

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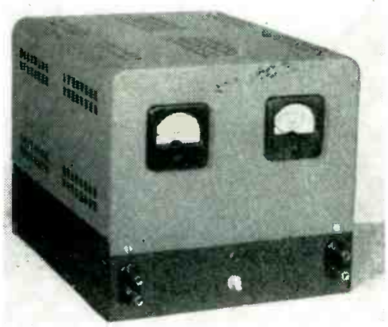
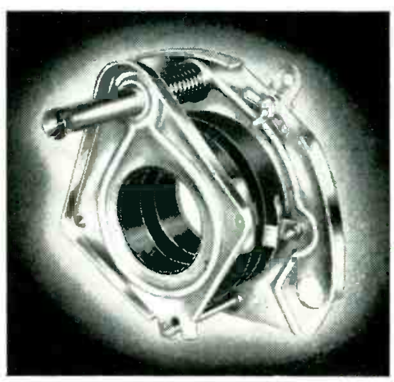
and vibration tests required of a ruggedized electronic tube.



POWER SUPPLY
has less than 2 mv ripple

HANOVER DEVELOPMENTS, 401 E. 74th St., New York 21, N. Y. Weighing 15 lb and measuring 10 in. × 12 in. × 9 in. high, the type 205 d-c power supply delivers 6 v 5 amperes, or 12 v 3 amperes, with variation less than 0.05 percent for a line-voltage change from 105 to 125 v. Ripple is less than 2 mv. Regulation is better than 0.5 percent for a load change from 0 to full load. Recovery time is instantaneous for line-voltage changes, and in the order of 0.2 sec for load changes. Applications include the supply of heaters in d-c and low-frequency amplifiers, and the replacement of storage batteries where a constant source of low voltage d-c at high current is required, such as colorimeter and spectrometer light sources.



FOCUSING DEVICES
use ceramic magnets

FERROXCUBE CORP. OF AMERICA, 35 Marshall St., North Adams, Mass. The tv focusing device illustrated uses two Magnadur ceramic mag-

"Color Television"

A special issue containing

• 15 N.T.S.C. Monographs–

The National Television Systems Committee has authorized IRE to publish its long awaited Monographs in the January 1954 special Color Television issue of "Proceedings of the I·R·E" — thus giving them industry-wide distribution for the first time in print.

• 25 additional Color TV articles–

will also appear in this issue, which brings the reader up-to-the-minute on the developments of Color Television. Copies of the first Color Television issue are still available and combined with this second Color Television issue will form a complete bibliography of major historical importance. Also included in the January issue will be a complete listing of the N.T.S.C. system specifications as submitted to the F.C.C.; and field test reports on the system's performance.

in "Proceedings of the I·R·E" January '54

Available to non-members for $3.00. Extra copies to I R E members are $1.25. All members get one copy free!

Another History Making Issue!

I R E is an organization of 33,312 member-engineers. There are no company memberships. Operating continuously since 1913, its sections meet in 78 cities. 21 specialized Professional Groups widen the scope of its member-services and 40 technical committees help the industry.

"Proceedings of the I•R•E"

Published by

THE INSTITUTE OF RADIO ENGINEERS

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Please place orders before December 10th.

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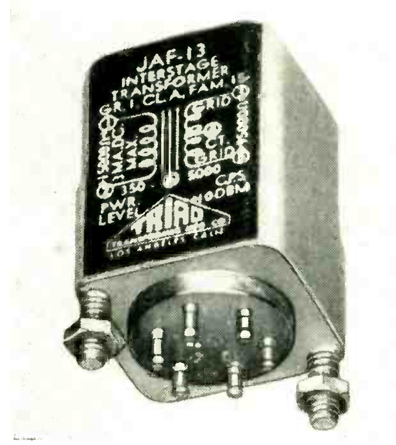
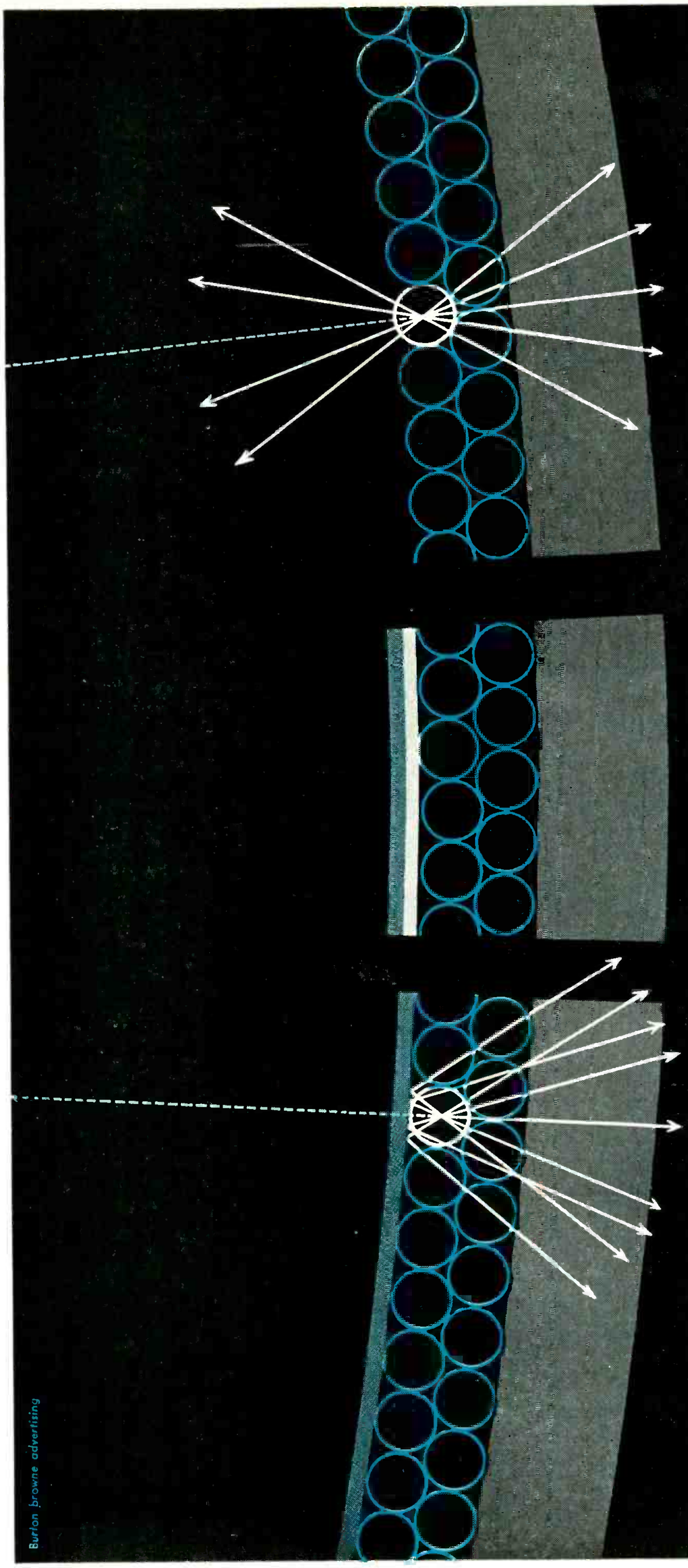
net rings in a double lens system that is focused by adjustment of the relative position of the two toroids. This reduces stray fields to a minimum and provides a highly symmetrical field of maximum sharpness and spot symmetry. Magnadur is a new and unique p-m material with very high coercive force and resistance to demagnetization as well as excellent magnetic stability. Its high resistance permits the use of Magnadur magnets in the presence of h-f fields without undesirable losses, as is the case with metallic magnets. Bulletin FC-6000 gives complete technical data as well as demagnetization and energy product curves for Magnadur permanent magnets.



TINY TRANSFORMERS cover the a-f range

TRIAD TRANSFORMER CORP., 4055 Redwood Ave., Venice, Calif., has available an expanded line of miniature magnetically shielded, hermetically sealed transformers. Used with transistor or tube amplifying equipment, these transformers cover the audio-frequency range. Advanced techniques in the handling of very fine wire permit this extreme miniaturization without compromise on insulation or moisture protection. The transformers are available in standard MIL cases with mounting studs so arranged that the units may be mounted in closest proximity to each other. All essential information for each transformer is carried on a permanently attached decal. Known as the JAF series,



what Aluminizing means

Aluminizing means the efficient use of light—light is energy—energy is the pay-off.

Aluminizing means a brighter TV picture, greater contrast, lower beam current, smaller spot size, sharper focus, reduced screen scorch—*all* from the efficient use of light.

On the inside of any TV tube face is a coating of phosphor crystals—the picture screen. As the electron beam—tracing the picture—strikes these crystals, they glow, giving off light in all directions. And there's the problem! Half the light thus generated is *inside* the tube, either lost to usefulness or lighting areas that should be dark. Both brightness and contrast suffer.

But—put a mirror behind the phosphor and "wandering" light is reflected back through the tube face. *Aluminizing creates this desired mirror!*

To aluminize a picture tube, deposit a nitrocellulose film evenly over the phosphor. Over that, deposit a film of aluminum only millionths of an inch thick—just thick enough to reflect the light and just thin enough to let the electrons pass through. Under heat, evaporate the nitrocellulose film to leave a thin smooth coating of aluminum. Result—an efficient light reflecting mirror to specifications.

Simple as it sounds, Rauland research engineers worked for three years to solve the problem and were among the first to do so.

Rauland

Perfection through Research

ZENITH Subsidiary

Burton browne advertising

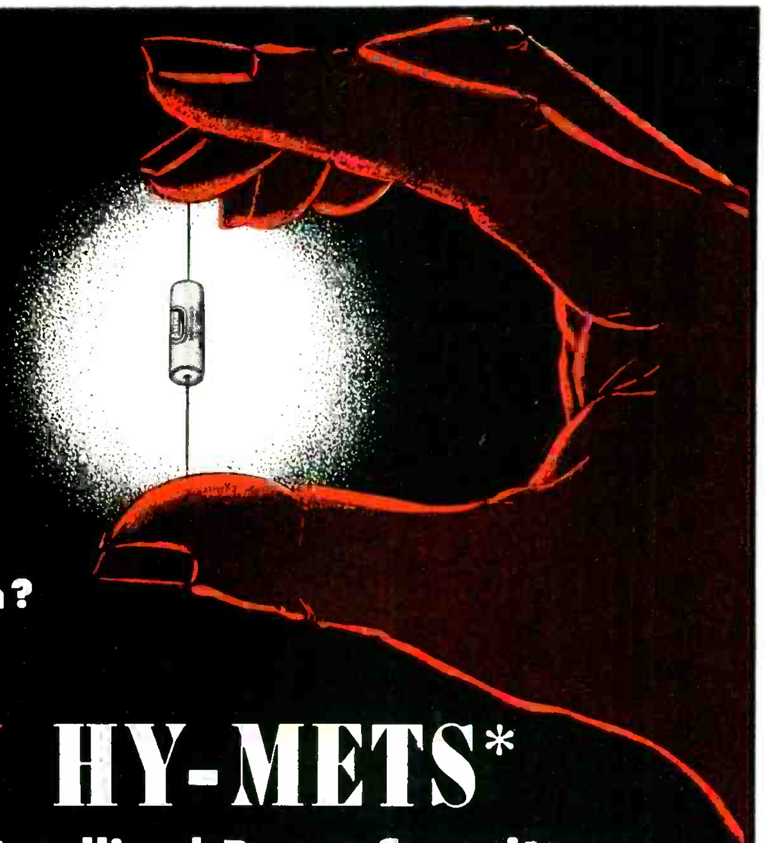
these and other transformers are described in catalog TR-53.

WIDEBAND TUNER has ± 0.5 db a-f response

PILOT RADIO CORP., Long Island City, N. Y. Model AF-723 f-m/a-m tuner has a hum level 70 db below 1.0 v. Maximum audio output is 5 v. Audio distortion is 0.2 percent at 1-v output. Audio frequency response is ±0.5 db, 20 cps to 20,000 cps. Frequency range for f-m is 88 to 108 mc; a-m—540 to 1,700 kc. Antenna input for f-m is 300 ohms to match external dipole, or built-in line-cord antenna; a-m—internal ceramic powdered iron loop stick with provision for matching to standard RETMA external antenna.

FILTER for l-f and h-f control

CINEMA ENGINEERING CO., Division of Aerovox Corp., 1510 W. Verdugo Ave., Burbank, Calif., is now producing type 6517-E variable high and low-pass filter. There are two positions for low-frequency control and the same number for high-frequency control. Standard RETMA rack mounting is used. Net weight is 15 lb. Features include wide frequency spectrum with the overlapping cutoff frequencies; zero phase distortion over transmission range; all inductance toroidally wound; hum pickup eliminated; complete flexibility afforded by two key switches, allowing insertion of either filter section or both upon cue. It was designed for sound



small size?
long life?
and
high temperature operation?

ASTRON HY-METS*

High Temperature Metallized Paper Capacitors

Type MQL

Answer several of your capacitor and assembly problems with one quick stroke. Specify ASTRON Hy-Mets—for long life in high temperature operation. Now you can have the subminiature size of metallized paper capacitors for high temperature operation without derating.

Hermetically sealed Hy-Mets utilize ASTRON's new solid impregnant—to eliminate possibility of any oil or impregnant leakage from −55C° to +125°C. Hy-Mets offer high insulation resistance, longer life, lower power factor and exceptional stability over extremes in operating conditions. ASTRON Hy-Mets are the subminiature for the biggest job.

Available in a variety of metal tubular, cardboard, and JAN case styles for voltage applications up to 600 Volts DC in a wide range of capacitance values.

Write for Bulletin AB-19 on Hy-Mets, giving complete data on sizes, ratings, mounting styles, engineering performance characteristics and test specifications.

Astron manufactures a complete line of dry electrolytic, metallized paper, plastic molded and subminiature paper capacitors, and standard and subminiature RF interference filters for every radio, television and electronic use.

Type MDL

DEPEND ON—INSIST ON

ASTRON

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ASTRON CORPORATION, 255 Grant Avenue, East Newark, New Jersey

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In Canada: Charles W. Pointon, 1926 Gerrard St. East, Toronto.

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and electronic laboratory research and control; sound recording, transmission and reproduction control.

RIBWOUND RESISTORS in high wattage ratings

MILWAUKEE RESISTOR CO., 708 W. Virginia St., Milwaukee 4, Wisc., is manufacturing ribwound resistors up to and including 2,000 w. Wound with a specially designed resistance wire on high-temperature refractory cores, these units afford greater wattage dissipation in low resistance values. All connections are silver soldered to provide absolute protection against resistance failure. Coating is high-grade enamel fired at extreme temperatures to assure freedom from moisture and complete heat dissipation. The resistors can be furnished as fixed, adjustable or with multi-taps where desired resistances are known.

CAPACIPROBE requires no pre-zeroing

ELECTRONICS PRODUCTION SERVICE Co., 871 Washington St., Canton, Mass. Model C102 Capaciprobe was designed as an aid to engineers engaged in the development of r-f pulse and switching circuitry. It enables its user to measure accurately and rapidly total capacitance at any point within a circuit with that circuit operating under its normal d-c conditions. Basically, the unit consists of a stable r-f oscillator, a current-conversion buffer, a parallel tuned circuit, and

HOW MANY *db*— AT 5,000 MEGACYCLES? AT 25,000 MEGACYCLES?

PRD

precision variable attenuators

- METALLIZED GLASS ATTENUATING ELEMENTS
- PRECISE, PERMANENT CALIBRATION
- BROADBAND CHARACTERISTICS
- NEGLIGIBLE INSERTION LOSS
- BACKLASH-FREE
- LOW REFLECTION
- WELL SHIELDED CASING

The use of metallic-film-on-glass techniques to provide attenuation at microwave frequencies is no longer new. This type of PRD attenuator is now well recognized for its constancy of attenuation with time as well as for its insensitivity to variations of humidity and temperature.

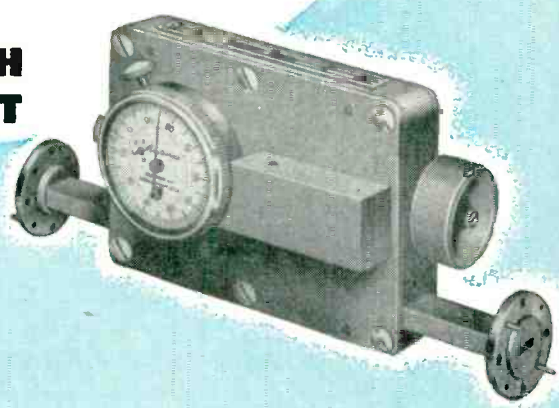
PRD has now augmented this line of attenuators with units employing metallized mica elements to provide broader-band characteristics for the millimeter region of the microwave spectrum. As a consequence, it is now possible to offer complete coverage of the range from 2,600 to 40,000 megacycles per second in designs varying from a simple level set attenuator to a precisely calibrated secondary standard. Write today for our complete catalog of microwave test equipment — address Dept. E-11.

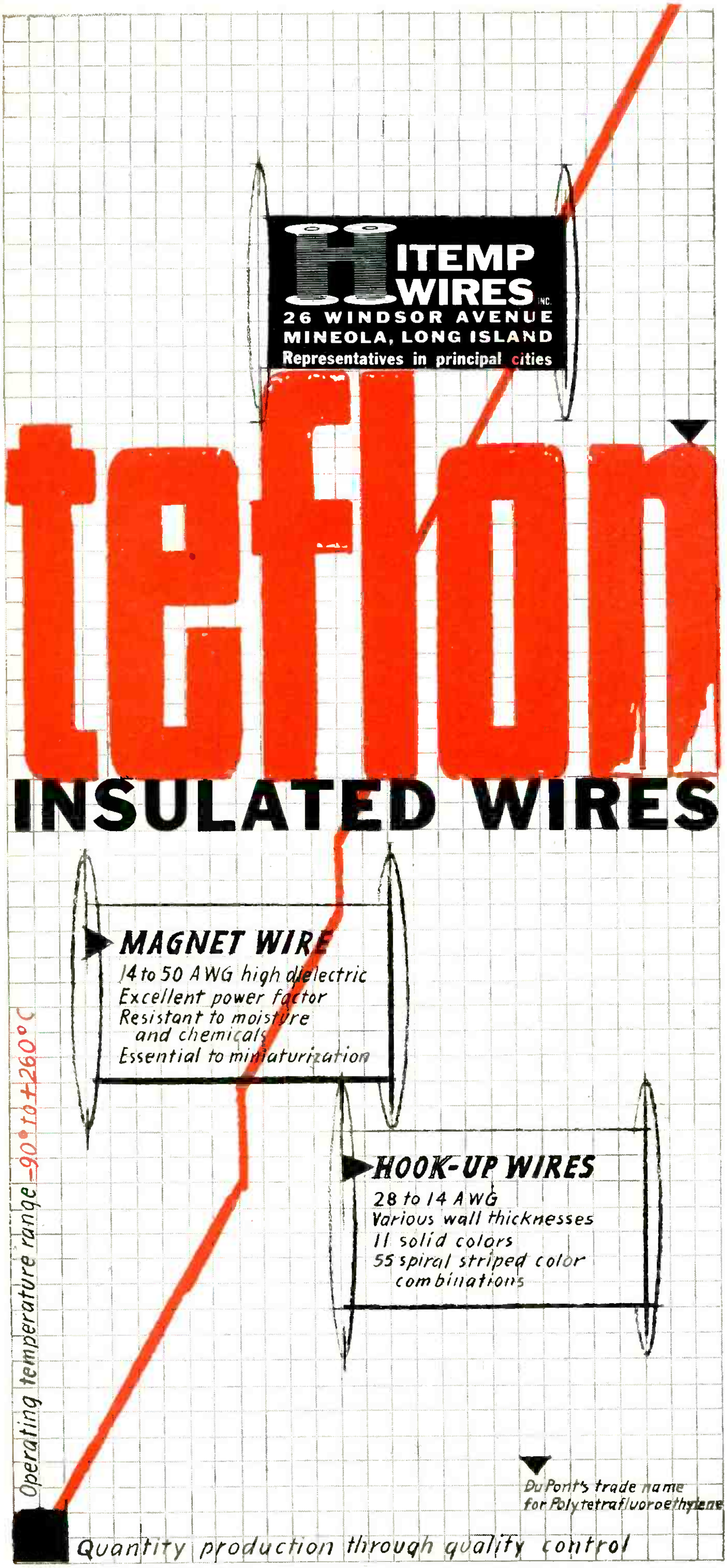
***Polytechnic* RESEARCH & DEVELOPMENT COMPANY, Inc.**

55 JOHNSON STREET, BROOKLYN 1, NEW YORK

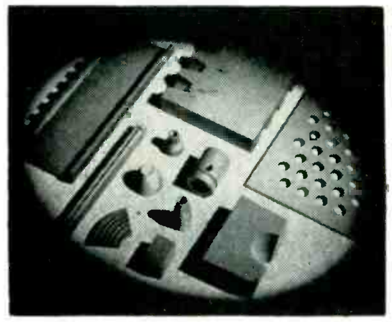
WESTERN SALES OFFICE

741 NO. SEWARD STREET, HOLLYWOOD 38, CALIF.



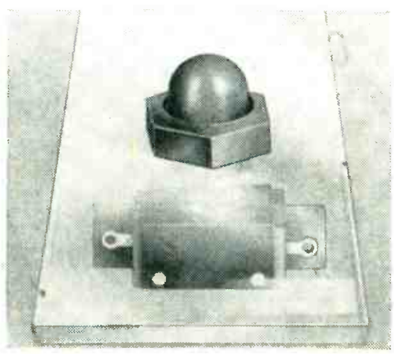


a novel variable sensitivity resonance detector. No pre-zeroing is required. The range of model C102 covers the fundamental circuit range of 0 to 110 μμf (accuracy ±1 percent). The unit operates from 95 to 125 v a-c.



CERAMIC
for high-temperature use

AMERICAN LAVA CORP., Chattanooga 5, Tenn. A new ceramic, AlSiMag 539, is finding many industrial uses. It is an excellent material for fixtures, jigs and work holding devices for fast production line handling of brazing, welding, electronic heating and flame polishing. It is also valuable as a material for making pins, pads, plates, spacers and kiln furniture for high-temperature sintering operations. Nozzles for welding tips and other extreme high-temperature devices have given outstanding performance. The ceramic is a relatively fine-grained silicon carbide material. It has been repeatedly heated white hot and quenched in dry ice without fracturing.



HERMETIC SEAL
fits push-button switches

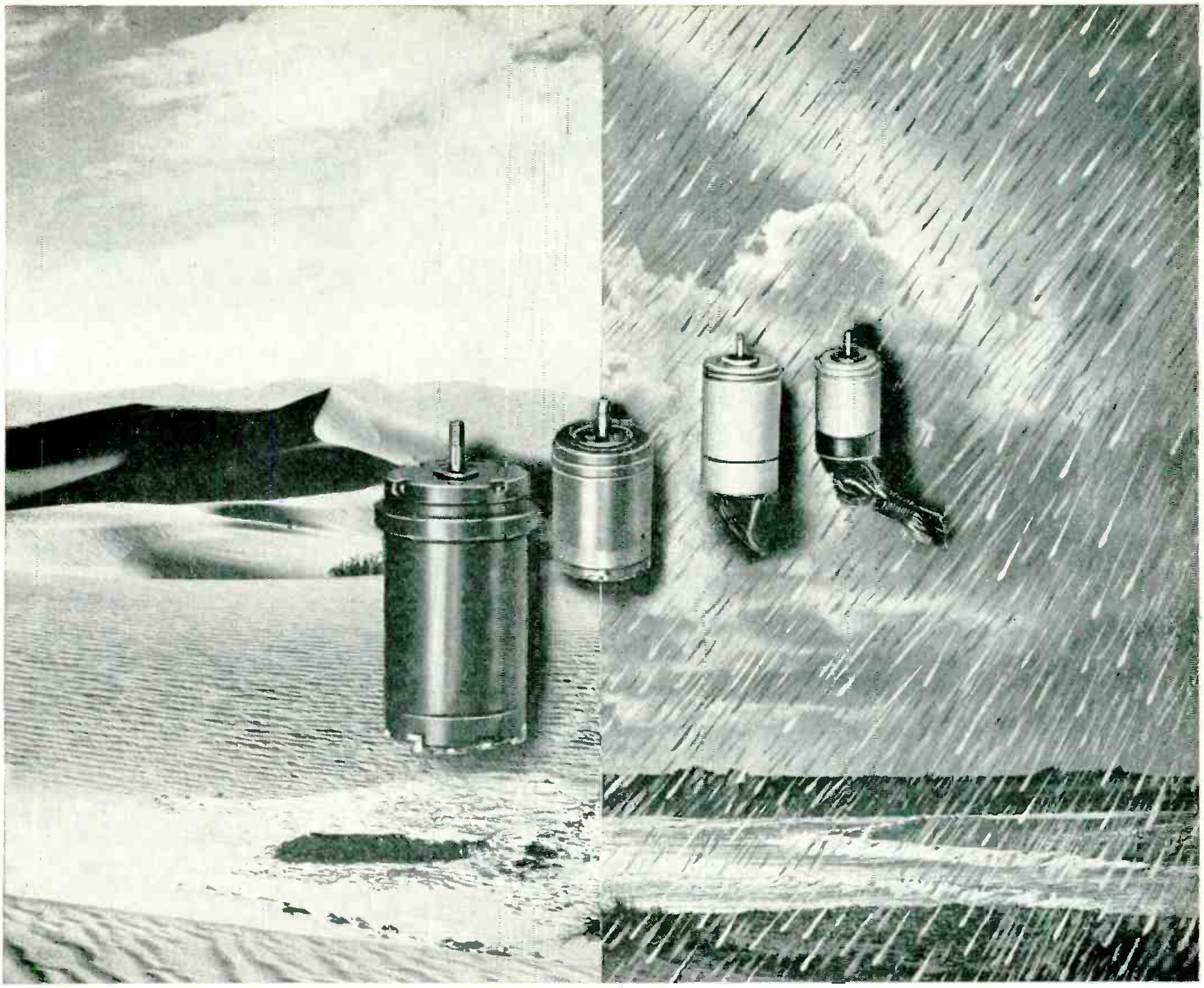
AUTOMATIC & PRECISION MFG. Co., 252 Hawthorne Ave., Yonkers 5,

Want more information? Use post card on last page.

N. Y., has added to its line of switche boots the Hexseal series 3030. The new units are high-pressure hermetic seals for all standard pushbutton switches. When installed, the boots replace the switch lock-nuts on the exterior of the panel, and serve as both seal and lock-nut. Hermetic sealing is maintained by a gasket rib—an integral part of the boot—which seats firmly against the panel to keep out moisture, dust or combustible vapors. Made of silicone rubber, which is chemically bonded to the nut, Hexseals are flexible from —80 to 500 F, and are unaffected by exposure to sun and weather. The material used surpasses the requirements of MIL specification B-5423.

SIGNAL GENERATOR
for aircraft radio use

THE HICKOK ELECTRICAL INSTRUMENT CO., 10514 Dupont Ave., Cleveland 8, Ohio. Model 292XAL airline microvolt signal generator provides continuous coverage from 125 kc to 165 mc on fundamentals. It provides complete coverage of the aircraft band including all the necessary i-f frequencies and covers all r-f frequencies with calibrated output. It can be externally modulated from 15 to 10,000 cps, and measures both input and output of units under test. The unit maintains dependable and accurate frequency calibration, is free of wave distortion, and has no spurious signals in the output system. It features temperature compensation, self-contained crystal oscillator reference level and crystal control. The attenuator is especially designed to attenuate



is CORROSION RESISTANCE
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Long experience in the development of precision instruments enables Ketay to manufacture Synchros, Servos and Resolvers to meet the cycling humidity requirements of MIL-E-5272

As a leader in the use of *corrosion resistant* materials in Synchros, Servos, Resolvers, Control Equipment and related instruments, Ketay has enormously broadened their usefulness for both the government and industry.

Ketay has built an outstanding record as originators of units to meet individual specifications. Ketay engineers will be glad to discuss your requirements.

CORROSION RESISTANT UNITS

Ketay offers a complete line of Corrosion Resistant Instruments, four of which are pictured above. From left to right they are:

- Synchro, Size 23, Frame O.D. 2.250", 26 V and 115 V 400 & 60 Cycles. (Transmitter, Receiver, Resolver, Differential, Control Transformer) Also available in same frame size: Servo Motor—115 V 60 Cycles.
- Synchro, Size 15, Frame O.D. 1.437", 26 V and 115 V 400 Cycles. (Transmitter, Receiver, Resolver, Differential, Control Transformer) Also available in same frame size: Servo Motor Mk 7—115 V 400 Cycles.
- Synchro, Size 11, Frame O.D. 1.062", 26 V and 115 V 400 Cycles. (Transmitter, Receiver, Resolver, Differential, Control Transformer) Also available in same frame size: Servo Motor Mk 14—115 V 400 Cycles.
- Synchro, Size 10, Frame O.D. .937", 26 V 400 Cycles. (Transmitter, Receiver, Resolver, Differential, Control Transformer) Also available in same frame size: Servo Motor—26 V 400 Cycles.

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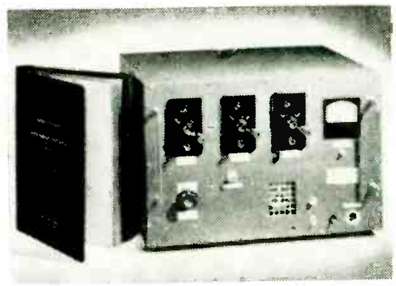
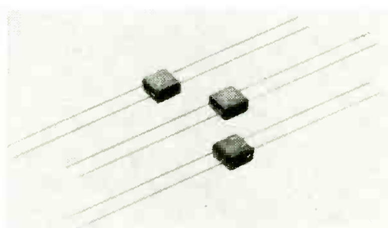
faithfully without frequency discrimination.



R-F WATTMETER
a variable impedance unit

SIERRA ELECTRONIC CORP., 1049 Brittan Ave., San Carlos 2, Calif. Model 141 variable impedance wattmeter is designed for fast, accurate power measurements between 2 and 30 mc. Designating its input impedance as $Z = R + jX$, R can be adjusted over a broad range of 5 to 500 ohms and jX can be adjusted between -250 and $+250$ ohms. Up to 250 w of power may be dissipated, and overall accuracy of the directly indicated power measurement is within 10 percent. Accuracy of impedance magnitude is within 5 percent. The equipment weighs 79 lb and measures approximately 26 in. wide × 17 in. high × 18 in. deep.



PULSE TRANSFORMERS
are tiny and encapsulated

ELECTRONICS PRODUCTION SERVICE Co., 871 Washington St., Canton, Mass. The miniature pulse transformers illustrated are capable of transferring pulses in the millimicrosecond to μsec range. They have wide application in digital computer, radar, and telemetering systems. The transformers are completely encapsulated in a color coded thermosetting resin, which enables the units to withstand severe mechanical shock and environmental conditions. Some en-

"SCOTCHCAST" EMBEDMENT RESIN

now available in new low-viscosity form

And now comes "Scotchcast" No. 3—a cold-pouring electrical embedment resin that costs less because it can be mixed with larger amounts of filler. That means better electrical properties, lower co-efficient of expansion, higher heat dissipation.

"Scotchcast" provides dependable insulation and protects against thermal and mechanical shock, oil, moisture, chemicals and weather. Well-known manufacturers find it gives longer life to most types of coils.

"Scotchcast" No. 3 has longer pot life, generates less heat during curing, resists heat after curing, has lower viscosity for ease of impregnation.

For complete data, write Minnesota Mining & Mfg. Co., Dept. ES-113, St. Paul 6, Minnesota.

1 AFTER WINDING, coils are fitted into plastic cases.

2 SEALING COILS in "Scotchcast" Resin No. 3.

"SCOTCHCAST" Electrical Embedment Resins

The term "Scotch" and the plaid design are registered trademarks for the more than 300 pressure-sensitive adhesive tapes made in U.S.A. by **Minnesota Mining & Mfg. Co., St. Paul 6, Minn.**—also makers of "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing, "3M" Abrasives, "3M" Adhesives. General Export: 122 E. 42nd St., New York 17, N. Y. In Canada: London, Ont., Can.

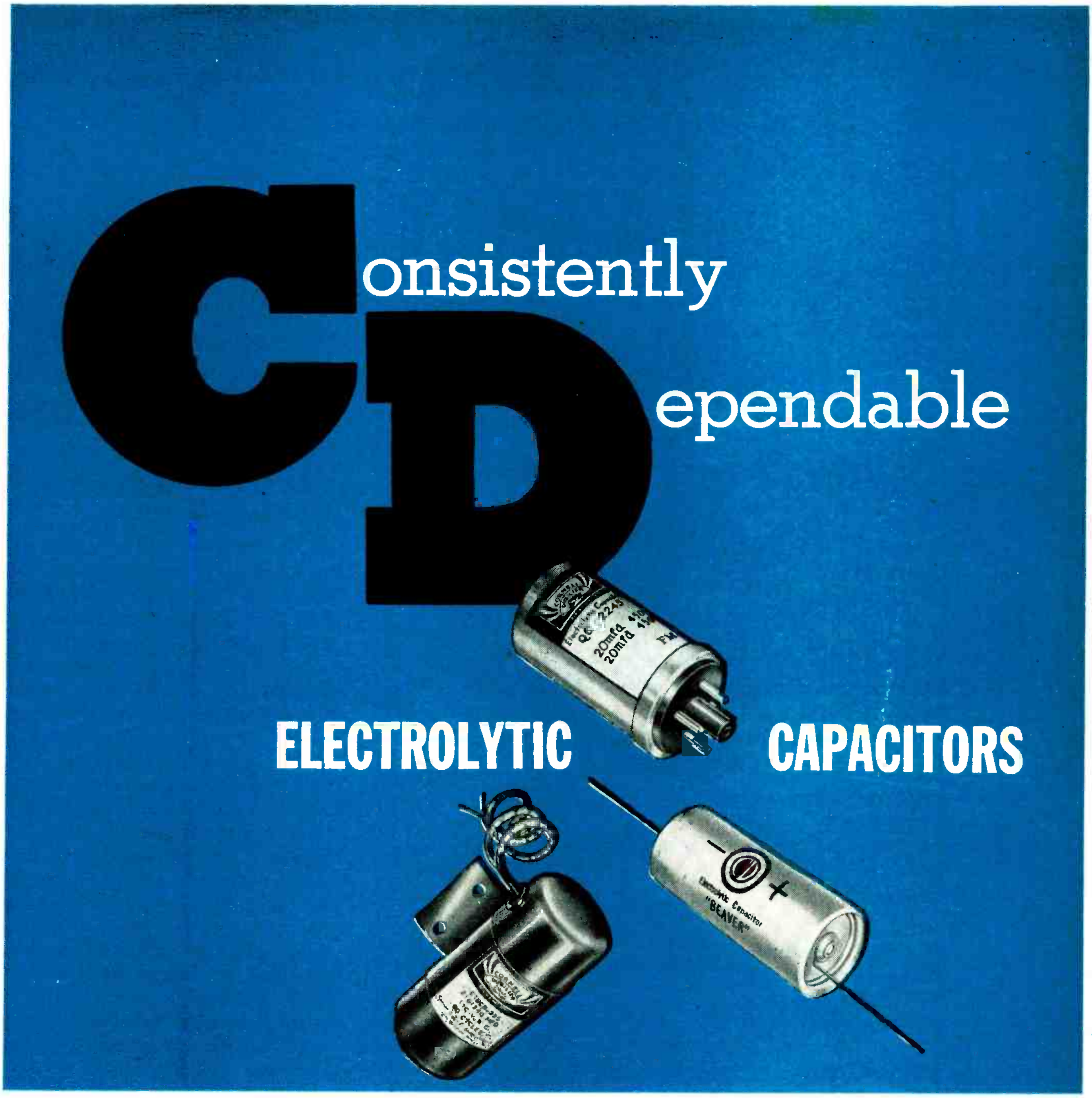
gineered characteristics include: a coefficient of coupling between any two windings, 0.97; pulse repetition rate, up to 5 mc; static capacitance between any two windings, less than 2.0 $\mu\mu$f; temperature range, —65 C to 125 C. The units measure $\frac{3}{8}$ in. × $\frac{3}{4}$ in. × $\frac{3}{4}$ in.

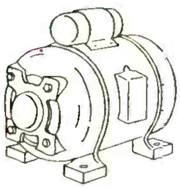
ATTENUATOR PADS
for microwave measurement

TELEWAVE LABORATORIES, INC., 100 Metropolitan Ave., Brooklyn 11, N. Y., have just put a miniaturized type of microwave attenuator pad on the market. Known as Micropads, the new products are extremely compact and rugged with no fine wires or delicate elements. Ability to withstand overloads of more than 100 percent is also a feature. Platinum-film microwave resistors are employed. Micropads are finding increasingly widespread application wherever ultrahigh precision microwave measurement is essential but space is limited.

SWEEP GENERATOR
for uhf applications

NEW LONDON INSTRUMENT CO., P.O. Box 189, New London, Conn. Featuring single range tuning and a 0 to 30-mc sweep width, the model-130 uhf sweep generator is designed for either laboratory, production test or service department use. Other features are: at least 1-v output into 75 ohms; a continuously variable attenuator; a blanked signal on the return sweep, thus providing a reference base line; no beating; no multiplication;





C-D probably has the answer to your electrolytic problem! Is it for a motor? TV circuit? Photoflash? Micro-wave communications? If anybody has the answer to your electrolytic problem, it's likely to be Cornell-Dubilier, the greatest name in capacitors. Write for the complete catalog to: Dpt. K-113, Cornell-Dubilier Electric Corp., General Offices, South Plainfield, New Jersey.

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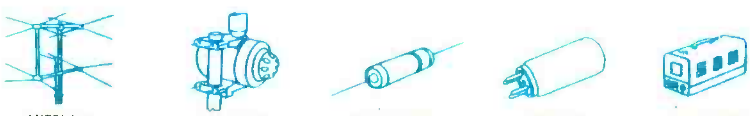

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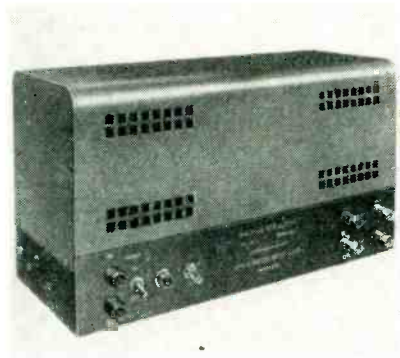
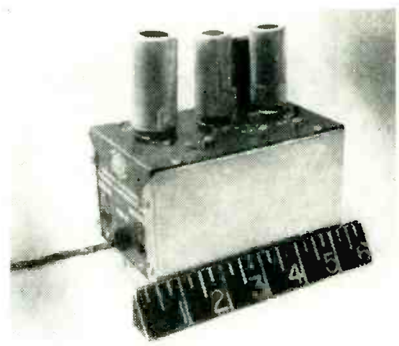
and simplicity of operation. A low-cost balun is available for conversion to 300-ohm load.



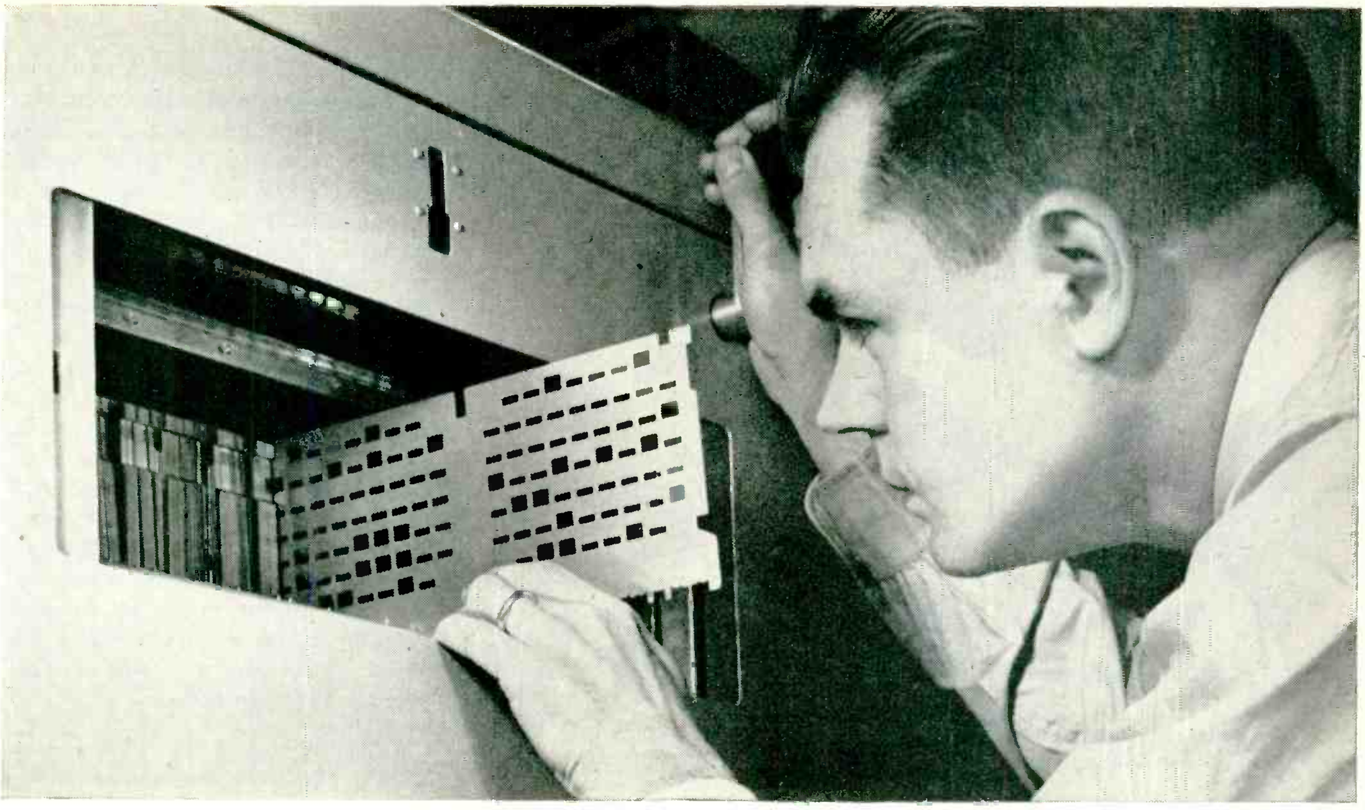
VOLTAGE REGULATOR for 400-cycle supplies

AVION INSTRUMENT CORP., Division of American Car and Foundry Co., 299 State Highway No. 17, Paramus, N. J., has developed the model 116-A precision a-c regulator for 400-cycle supplies. The rms output voltage is adjustable, with regulation to 0.01 percent up to half the rated load (50 va) and to 0.02 percent up to the full rated load (100 va). This regulation is maintained with allowable input-voltage fluctuations of ±10 percent about the adjusted output level, and frequency fluctuation of ±5 percent. Recovery time from transients is less than 0.01 sec. Developed harmonics are less than 1 percent. The unit is effective when used in the development of aircraft or other electronic equipment requiring precision regulation of voltage supplies.



CRYSTAL CONVERTER employs only three tubes

MOHAWK ELECTRONIC RESEARCH LABORATORIES, INC., R.D. 4 Amster-



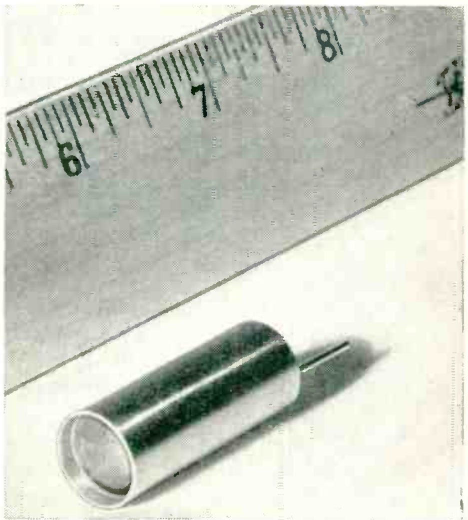
Checking perforated metal card in Bell's new "card file" which uses Phototransistors to help route Long Distance telephone calls along the best routes. If the first voice-way is in use, a "detour" is swiftly found. The equipment is known in telephony as a "card translator."

CARDS FOR CONVERSATION

To find out how to route Long Distance calls a dial system needs lots of information—fast. To provide it Bell Laboratories engineers developed a new kind of card file—one that dial systems can read.

Punched holes on metal cards tell how calls should be handled. When a call arrives the dial system "asks" the "card file" how to proceed to a particular area. Instantly the appropriate instruction card is displaced so that its pattern of holes is projected by light beams on a bank of Phototransistors. In a flash the Phototransistors signal switches to set up the best connection. Cards are quickly changed when new instructions are needed.

The "card file" will have its widest use in speeding Long Distance calls that are now dialed by a telephone operator and may one day be dialed by you personally. It is another example of how Bell Telephone Laboratories helps telephony to grow, as costs are kept down.

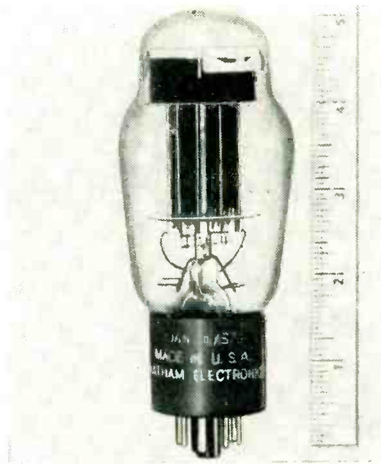


New Phototransistor unit. Light entering the cylinder is focused by the lens on a piece of germanium that responds by generating current. Like the Transistor, the Phototransistor was invented in Bell Telephone Laboratories.

BELL TELEPHONE LABORATORIES

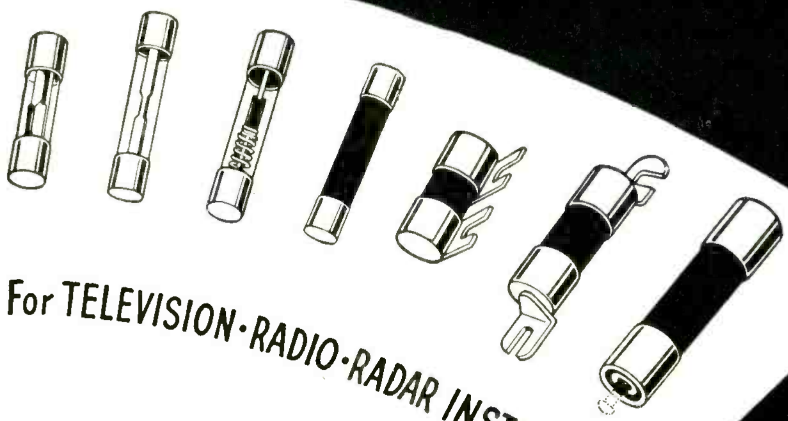
There are many opportunities for creative scientists and engineers at Bell Telephone Laboratories. For details see our advertisement on page 471

dam, N. Y., announces a new vhf cascode crystal converter. Employing only 3 tubes and measuring out 3 × 3 × 5 in., the unit is small enough to be mounted inside a communications receiver cabinet. If desired, as many as 5 units may be mounted on a standard 7 × 19-in. relay rack panel. A 6BQ7A is employed as a cascode r-f amplifier. One 6J6 combines the function of crystal oscillator and frequency multiplier while another 6J6 is used as a combined mixer and multiplier. Usable average sensitivity is better than 0.5 μv and noise figure averages 5 db. The bandwidth of these units is essentially flat over a 6-mc range but may be peaked to favor any portion desired. Standard i-f output frequency is 14 to 20 mc.



TWIN POWER TRIODE
for voltage regulation

CHATHAM ELECTRONICS CORP., Livingston, N. J., is in production on the new type 6AS7G high-perveance twin power triode for voltage regulation. Used as a series or passing tube in regulated power supplies, it incorporates certain design changes to offer the following features: absence of grid current; plate current and characteristics held within ± 10 percent; very low microphonics; and improved triode balance and reduction of plate-current drift. Upon request tubes can be supplied to meet the following additional specification beyond JAN quality level: plate voltage, 150 v; grid voltage, —55 v;



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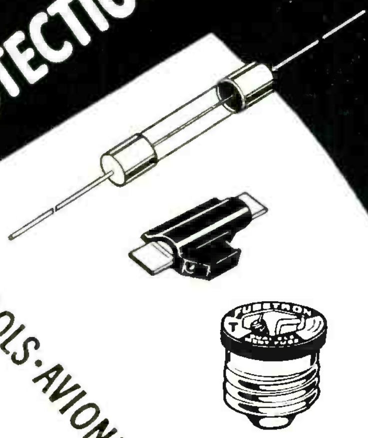
FOR EVERY CIRCUIT PROTECTION PROBLEM



CONTROLS·AVIONICS

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To maintain these high standards, each BUSS fuse is **electronically tested** for correct calibration, construction and physical dimensions.

- **On Special Electrical Protection Problems Consult BUSS Fuse Engineers . . .**

They will gladly help you select the fuse that suits your needs best . . . if possible, a fuse available from local wholesalers' stocks.

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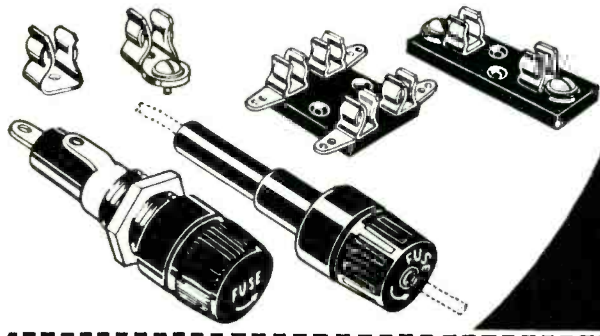

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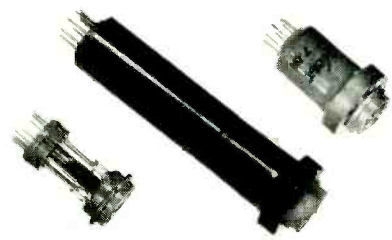
ELRC

cathode resistor, 100 ohms; grid resistor, 47,000 ohms; and plate current limits, 43 to 73 ma.

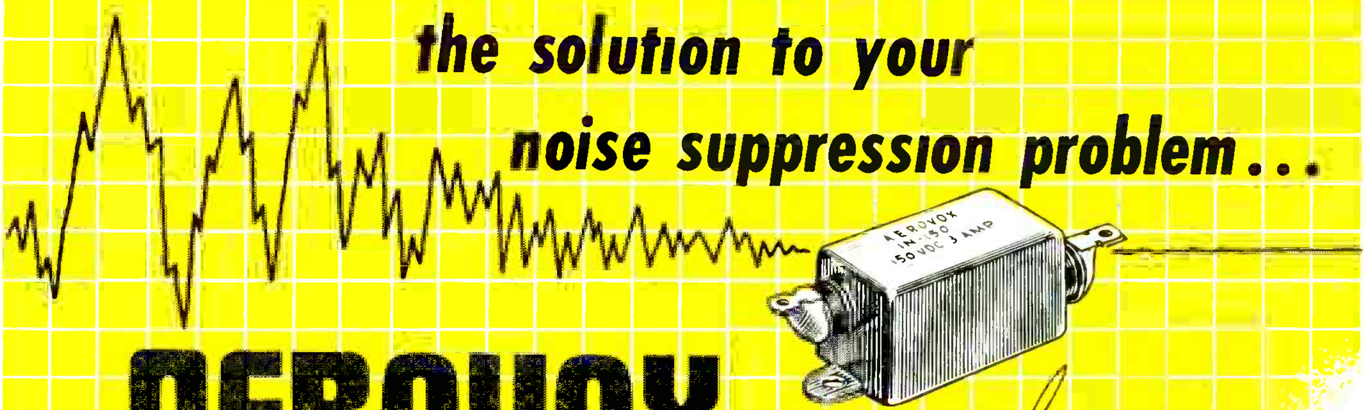
ELECTRONIC COUNTER
uses no vacuum tubes

COMPUTER RESEARCH CORP., 3348 W. El Segundo Blvd., Hawthorne, Calif., has developed a rugged, electronic predetermining counter, capable of counting up to 1,800,000 cpm without the use of vacuum tubes. The unit incorporates true ring elements in an improved ferroresonant circuit that is not sensitive to heat. It can start or stop counting on any count, control operations by the use of frequency division, or emit an output pulse at any predetermined count, for use in driving external devices. The output pulse is also adaptable for direct use with magnetic amplifiers for controlling large amounts of power without vacuum tubes or switches.



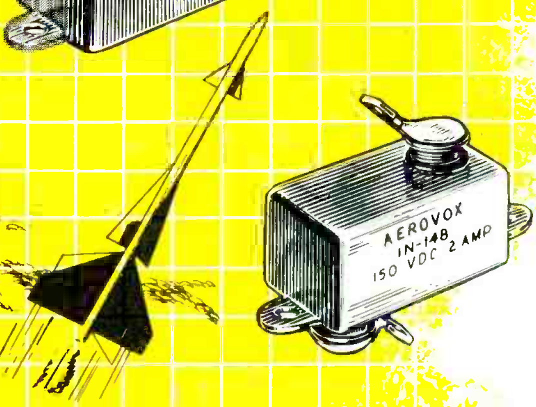
TEST ADAPTERS
for 9 tube socket types

VECTOR ELECTRONIC CO., 3352 San Fernando Road, Los Angeles 65, Calif. The adapters illustrated are used for making voltage resistance and waveform measurements from the tube side of an electronic equipment. In testing, the adapter is inserted between the electronic tube and its socket, completing the circuit and providing convenient test tabs. Adapters are made for nine socket types. For most work the short, unshielded adapters are adequate, but for hard-to-reach locations a longer adapter with shielded leads is available. Where there is a need to break tube circuits or alter the pin connections the Experimenter type is available. This third type also provides means for



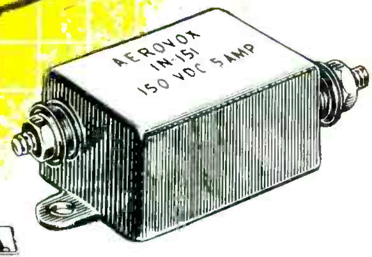
the solution to your noise suppression problem...

AEROVOX
R-F noise suppression
FILTERS*



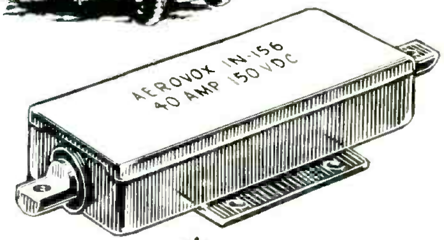
High reliability R-F noise suppression with high attenuation . . . high current ratings . . . still s aller hermetically-sealed metal-case housings . . . advanced pi-type construction for greatest efficiency . . .

Aerovox Filters are ideal for R-F noise suppression in military and commercial aircraft, vehicular low-voltage DC applications, and for special applicatio such as shield rooms and critical equipment.



FEATURES...

- Aerolite† metallized-paper sections provide maximum reliability and life factors.
- Unique "fault-isolation" characteristic offers added protection against surge voltages.
- High attenuation of R-F currents. Maximum attenuation available, from .15 mc to 400 mc.
- Low DC resistance assures minimum heating and low voltage drop.
- Operating temperature range from −55° C to +85° C. At full rating (150 v.d.c.) operating temperature range is from −55° C to +70° C. All units rated for continuous duty.
- Test voltage for all units, 200 v.d.c. at room temperature for period not exceeding 1 minute.
- Case construction of non-magnetic metal suitably protected for severest service requirements.
- Available with special terminals, special mountings and other special considerations for specific needs.



FUNCTION FITTED

* SCREEN ROOM FILTERS also available with extra-high attenuation (120db) for AC and DC applications. For literature and further information on screen room and R-F noise suppression filters, write Aerovox Corporation, New Bedford, Mass.

†trade-mark

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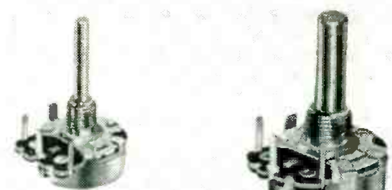
adapting tubes to nonmating sockets.

DELAY LINES
are highly miniaturized

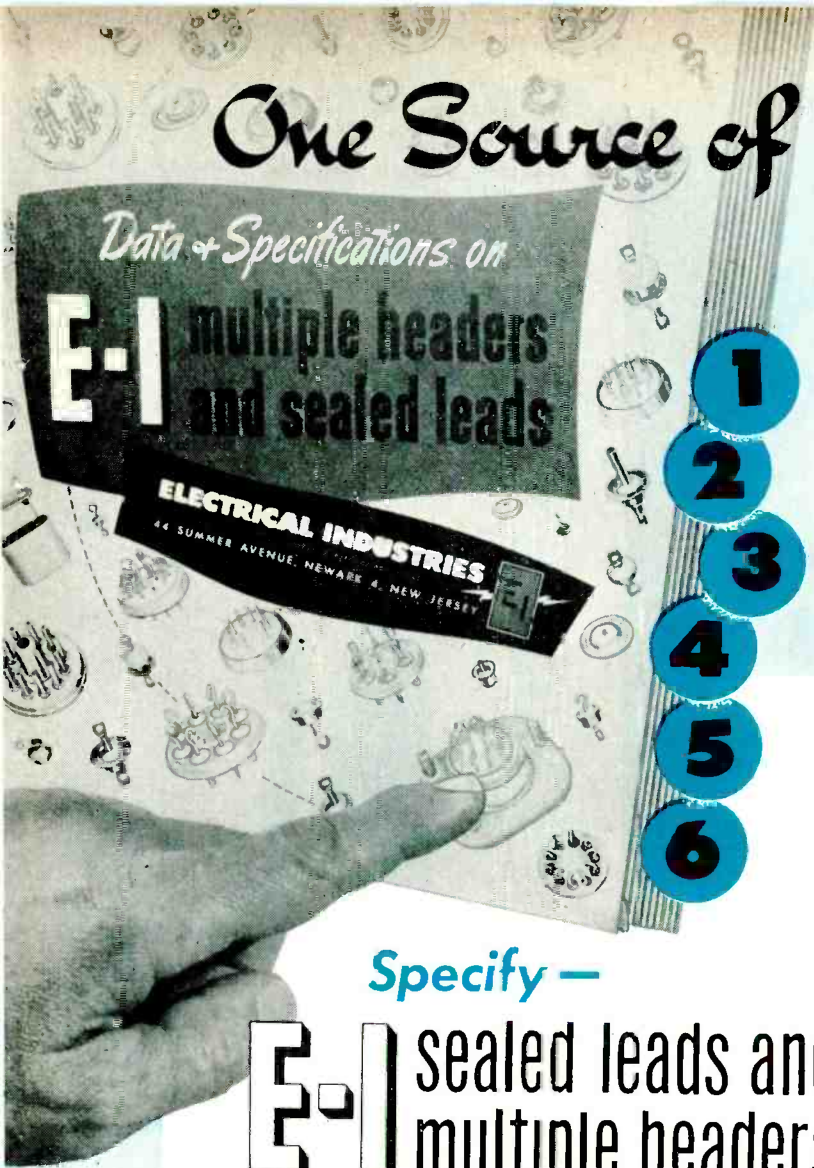
PCA ELECTRONICS INC., 6368 DeLongpre Ave., Hollywood 28, Calif., has available the first of a series of continuously variable distributed-constant delay lines. They are designed to provide a continuously variable time delay of 0 to 0.5 μsec, with a rise time as low as 0.05 μsec at full delay. Available for immediate shipment are delay lines, terminated internally, of 500 ohms nominal characteristic impedance and on special order, lines with an impedance up to 1,500 ohms. These lines are highly miniaturized, measuring $7\frac{1}{2}$ in. × $1\frac{1}{4}$ in. × $1\frac{1}{2}$ in. and are ruggedly constructed to withstand vibration and shock.



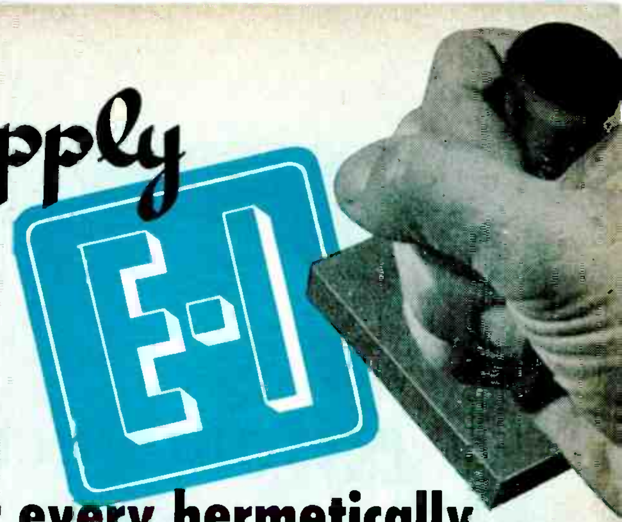
CONTROLS
for printed circuit use

CHICAGO TELEPHONE SUPPLY CORP., Elhart, Ind. Two new variable composition resistors have been announced to fill the need for controls for use in printed-in circuit applications. There are three outstanding design features: (1) Protection against bending during handling is achieved by recessing each blade-type terminal in a notch in the bakelite base of the control. (2) Valuable mounting space is conserved on the printed-circuit

One Source of Supply



by



— for every hermetically sealed termination

Specify —

E-I sealed leads and multiple headers

HUNDREDS OF STANDARD TYPES AT MASS PRODUCTION PRICES TO MEET EVERY REQUIREMENT

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Development, production and design engineers will find the complete E-I Data File a helpful addition to company files. The new brochure includes standardized terminations that economically solve all but the most unusual terminal problems. If custom types are required, E-I can supply these quickly, to exact specifications at quantity production prices.

CALL OR WRITE FOR THE NEW E-I DATA FILE NOW!

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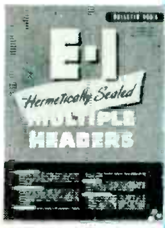
1. BULLETIN 949-A

On hermetically sealed terminals. Discusses cushioned glass construction, thermal shock resistance, preferred types and special terminals. Explains code systems and methods of installation.



2. BULLETIN 950-A

On hermetically sealed multiple headers. Explains vacuum tight feature, cushioned glass construction, strain-free qualities. Tin dipped for easy soldering and silicone treated for highest electrical resistance.

3. BULLETIN 951

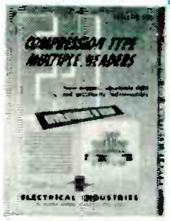
With complete information on octal type plug-in and multiple headers. Feature a new principle of hermetic sealing. Solid metal blanks insure maximum mechanical strength and rigidity.

4. BULLETIN 952

Complete information on E-I end seals for hermetic sealing condensers, resistors and other tubular electronic and electrical components. Provide a permanent hermetic seal. Completely strain-free.

5. BULLETIN 953

Individual, color-coded hermetically sealed terminals. Available with glass inserts colored in standard, easily identified RMA color codes. Coloring is in the glass—no lacquers or enamels are used.



6. BULLETIN 960*

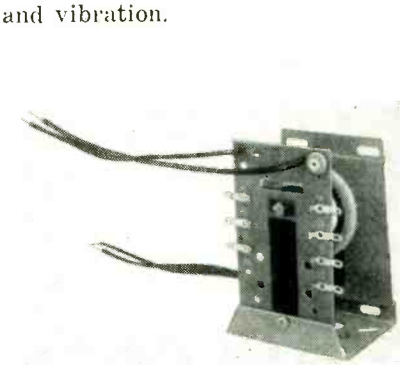
Compression type multiple headers. Super rugged, absolutely rigid and practically indestructible. An exclusive E-I achievement offers vastly greater resistance to shock and vibration. Guaranteed vacuum-tight.

*PATENT PENDING

panel by placing terminals close in to the mounted bushing. (3) Adequate clearance for circuit paths is provided by ample spacing between terminals. The controls are available in both $\frac{3}{4}$ in. diameter (type U70) and in $\frac{15}{16}$ in. diameter (type U45). The $\frac{15}{16}$ in. diameter control is also available with spst and dpst 3 ampere, 125 v switch.

SERVO CONTROLS feature high precision

KEARFOTT CO., INC., 1150 McBride Ave., Little Falls, N. J. Synchro transmitters and control transformers with maximum error limits of 7 minutes are now available. Only 1.062 in. in diameter and 1 23/32 in. long, models for either 26-v or 115-v 400-cycle excitation can be obtained. By virtue of their unique integral construction, these units assure performance under extreme conditions of humidity, temperature, altitude and vibration.

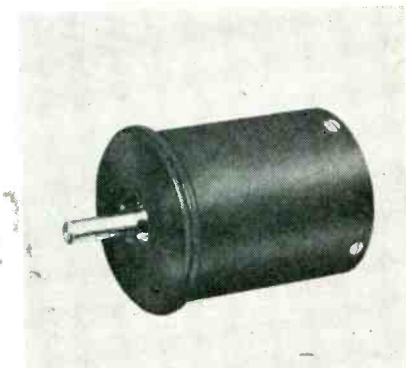


FLYBACK is multipurpose device

HALLDORSON TRANSFORMER CO., 4500 Ravenswood, Chicago 40, Ill. The FB410 multipurpose flyback

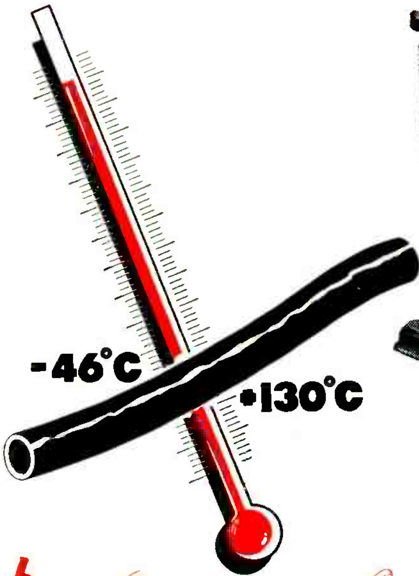
Want more information? Use post card on last page.

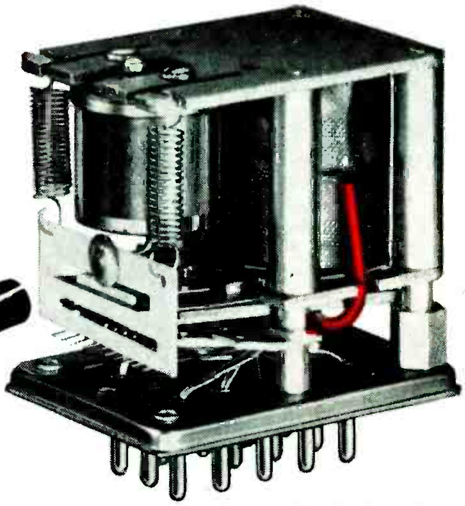
transformer answers a growing need for a single unit possessing electrical and mechanical characteristics applicable for replacement in a wide variety of tv chassis, both new and old. It is equipped with a universal mounting bracket that permits replacement of many different mounting types without drilling a single hole. The unit accommodates horizontal yoke windings of from 8 mh to 25 mh and width coils whose control ranges fall anywhere between 0.1 mh and 30 mh. Flexible construction permits conformation with popular inductively coupled and autotransformer-type horizontal output circuits. A separate winding for agc and/or horizontal phase detection is provided. No additional dual-winding width controls are needed.



POTENTIOMETER has 0.02-percent linearity

Birklan Corp., 200 E. Third St., Mt. Vernon, N. Y. Standard linearity of 0.02 percent is a feature of the series 1800 potentiometer. Resistance range is 1,000 to 150,000 ohms with a resistance tolerance of 1 percent. In the middle resistance range and above linearities better than 0.02 percent can be furnished. The unit has 10 full turns of travel at each end. The resistance element continues through the overtravel and can be tapped in that interval. Each unit is supplied with a continuous linearity curve calibrated against a standard accurate to 0.001 percent. The unit is rustproof, contains no fungus nutrient and may be operated over a wide temperature range. It is impervious to torque damage in normal





Regohm Circuit Controller, shown at actual size, with cover removed. Designed, developed and manufactured by the Electric Regulator Corp., Norwalk, Conn.

1/10¢ lengths of BH "649" ride the thermometer

Small enough to fit in the hand . . . it can control energy millions of times greater than that needed to activate it. That's the Regohm, manufactured by the Electric Regulator Corporation. It is a compact, versatile control component of the direct-acting finger type with wide acceptance as a voltage, current and speed regulator.

Electric Regulator engineers said, "We needed an insulation that would be permanently flexible through high and low temperatures. We found what we needed in BH "649" Fiberglas Tubing, and got these added advantages: BH "649" is easy to handle, it slips over wires quickly and speeds assembly time. It withstands the roughest handling without damage. It can be cut in short lengths without fraying or cracking. Its smooth, glossy surface adds to the appearance of our products."

BH "649", pioneer in the field of vinyl plastisol tubings, now offers true Class B protection at 130°C. with its improved coating formulation. Rated dielectric strength and flexibility continue after exposure to 150°C. for 300 hours, 200°C. for 20 hours, 232°C. for 3 hours—and for even longer periods if not abused after conditioning. Its resistance to chemicals and oils, as well as its high physical strength, has helped solve many tough insulation problems in a wide range of applications.

Why not investigate the advantages of BH insulations today. BH "649" is just one of a large family of Fiberglas tubings and sleevings developed specifically for the electrical industry. If you'll send facts on your requirements—voltages, temperatures, unusual conditions — we'll be happy to make recommendations and send samples for testing.

Bentley, Harris Manufacturing Co.
1311 Barclay Street
Conshohocken, Pa.

BH FIRST IN

- use of Fiberglas
- heat-treated Fiberglas
- true high temperature flexibility
- vinyl-coated Fiberglas
- silicone rubber coating
- colors in silicone rubber
- true Class B (130°C.) protection

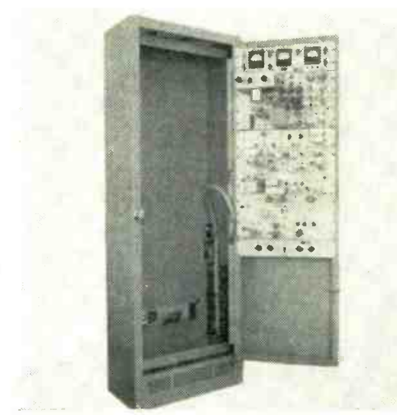
BH Fiberglas* SLEEVINGS

*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

applications by virtue of a built-in traveling-nut-type limit stop.

CONNECTORS have double-wiping contacts

U. S. Components Inc., 454 E. 148th St., New York, N. Y., has developed new features in their 980 series connectors, consisting of double-wiping contacts and guide-pin ejection springs. The double-wiping contacts offer external as well as internal wiping when connectors are mated. This assures a dependable contact under all conditions of usage eliminating possibility of circuit failure due to poor connector contact. Guide-pin ejection springs are normally compressed with balanced force when connectors are mated and serve the purpose of reducing separation force upon disconnection. They further serve as an auxiliary current path for heavy guide-pin currents. Brochures are available upon request.

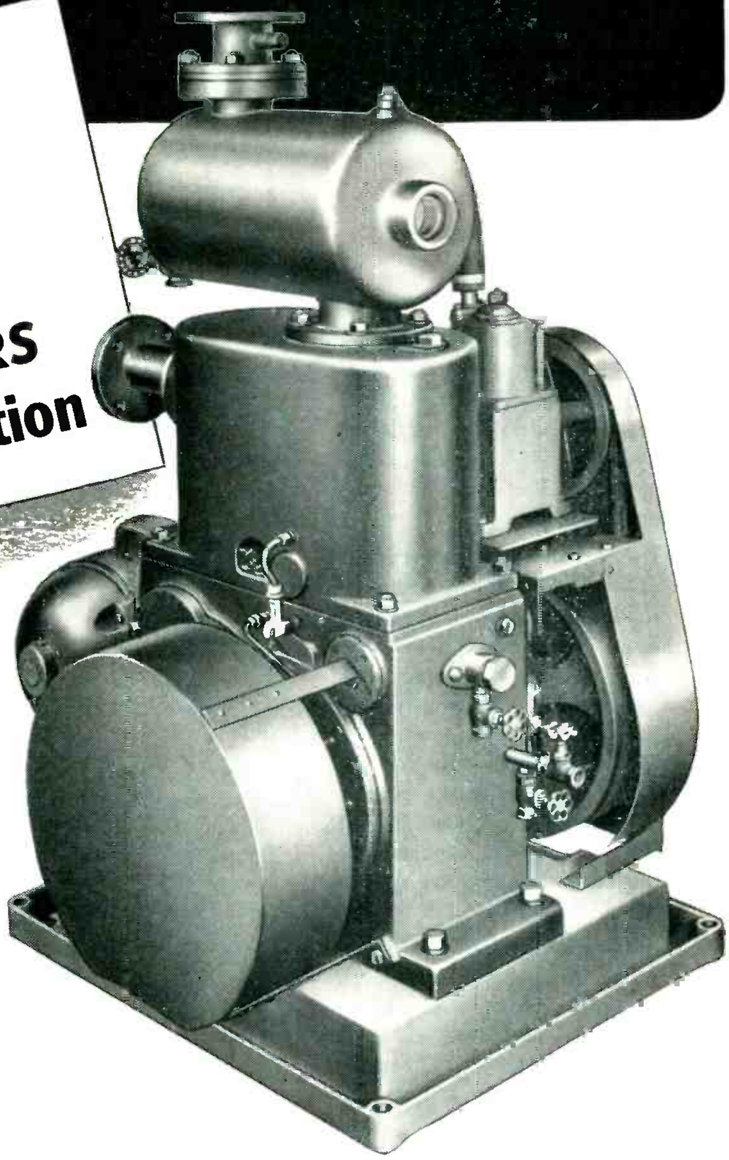


POWER-LINE CARRIER has closer channel spacing

Westinghouse Electric Corp., 2519 Wilkens Ave., Baltimore 3, Md. A complete new line of power-line carrier equipment (type FD) for power-system relaying, telemetering, supervisory control and voice communication is now available. One of the features offered in the new equipment is closer channel spacing, made possible by highly selective receiver filters and crystal control of frequency. Frequency ranges are 40 to 90 and 90 to 200 kc. Assemblies operate from

want a HIGH VACUUM rotary pump that pumps WATER VAPOR?

Here's the NEW GAS BALLAST PUMP backed by MILLIONS OF HOURS of trouble-free operation



Ends Water Vapor Trouble
Maintains Fast Pump Down Time

Eliminates Oil Reclaiming
Greater Capacity Under 1 mm Hg
Up To 80% Less Oil Charge
Capacities from 1¼ cfm to 400 cfm
Pressures Down To 10^{-5} mm Hg

Here's important news for everyone who works with high vacuum. The new NRC Rotary Gas Ballast Pump gets it for you faster — saves you time and money and is backed by millions of hours of trouble-free operation.

By keeping water vapor from condensing, this pump prevents contamination of the pump oil. The result—it never loses capacity like conventional rotary pumps when pumping condensable vapors. It continually maintains a fast pump down rate.

NRC Rotary Gas Ballast Pumps are available in a complete line of vane, piston-type and 2-stage pumps.

Send today for new bulletin explaining principle, construction and operation data on the NRC Rotary Gas Ballast Pump.

NRC

National Research Corporation
Equipment Division
Seventy Memorial Drive, Cambridge, Massachusetts

CAROL multi-conductor cable

Here's the cable that gives the best in electrostatic and interference shielding—for stationary and portable microphones, speakers, P. A. systems, automobile radios and other electronic devices.

Tinned soft copper conductors are stranded for exceptional flexibility, paper served for easy stripping, individually insulated with low capacitance rubber or polyethylene, in some sizes. Wires are cabled to perfect roundness, cotton served and shielded with tinned copper braid. Outer jacket is either rubber, neoprene or plastic, depending on service requirements.

For expert engineering assistance and prompt service on all your cable applications, write or call Carol today.

CAROL
CABLE DIVISION
of The
CRESCENT COMPANY INC.
Pawtucket, Rhode Island

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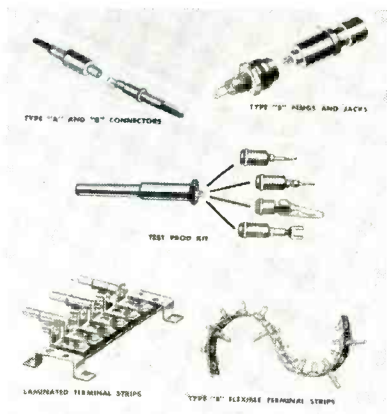
either station battery or alternating current.

INVERTERS
operate from car batteries

AMERICAN TELEVISION & RADIO CO., 300 E. Fourth St., St. Paul, Minn., has available a line of inverters that operate from 6 or 12 v car storage batteries and provide 110-v a-c 60-cycle output in various power capacities for the operation of dictating machines, tape recorders, wire recorders, radio sets, test equipment and other related small electrical or electronic apparatus. Inverter models are also available for operation from other d-c input voltages ranging from 6 v d-c to 220 v d-c in automobiles, busses, trucks, planes, trains, ships and residential d-c districts.



CONNECTORS
automatically interlock

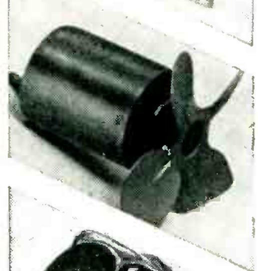
HARVEY HUBBELL, INC., State & Bostwick Ave., Bridgeport, Conn., has available a line of electrical connectors that feature an automatic locking connection that can never disconnect accidentally. The Interlock plug locks automatically

OFFERING

- **sub-miniature, rotary, electrical equipment for specialized applications...**

Mission-Western Engineers, Inc., offer a wide range of basic motor designs adaptable to highly specialized applications.

400 cps 115 VAC 1 Ø Gearmotor. 80 inch ounces at 22 RPM. Dimensions: 1.50" dia. x 2.81" long.

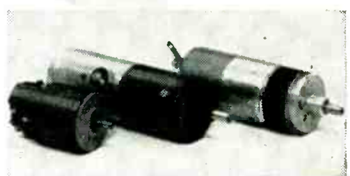


400 cps 115 VAC 1 Ø Gearmotor. 10 inch ounces at 10 RPM. Dimensions: 1.06" dia. x 2" long.

320/1000 cps 115 VAC 1 Ø motor and 3" fan assembly. 8500 RPM at 400 cps. With 2" fan, 10,000 RPM at 400 cps. Motor Dimensions: 1.45" dia. x 1.75" long.

400 cps, 115 VAC 1 Ø motor and L-R #2 Centrifugal Blower. 22 CFM free air. With 60 cps motor, 10 CFM. With 28 VDC motor. 35 CFM.

Permanent Magnet DC motor & L-R #1½ Centrifugal Blower. 20 CFM free air. Motor dimensions: 1¼" dia. x 2" long.



Permanent Magnet DC Motors & Gearmotors. Output Speeds to 1 RPM. Frame diameter 1$\frac{3}{16}$" or 1¼". Also available (1¼" dia. frame only) in Split Series DC when design forbids use of Permanent Magnet type.

If you have a problem involving design or application of AC or DC type motors, why not write us for engineering assistance and recommendations on a Mission-Western designed motor?

Many other types and frame sizes, in both AC and DC, available.

Mission-Western is associated with Western Gear Works—since 1888 a leader in the mechanical power transmission field. 5326

MISSION-WESTERN
ENGINEERS, INC.
132-134 West Colorado St., Pasadena 1, Calif.

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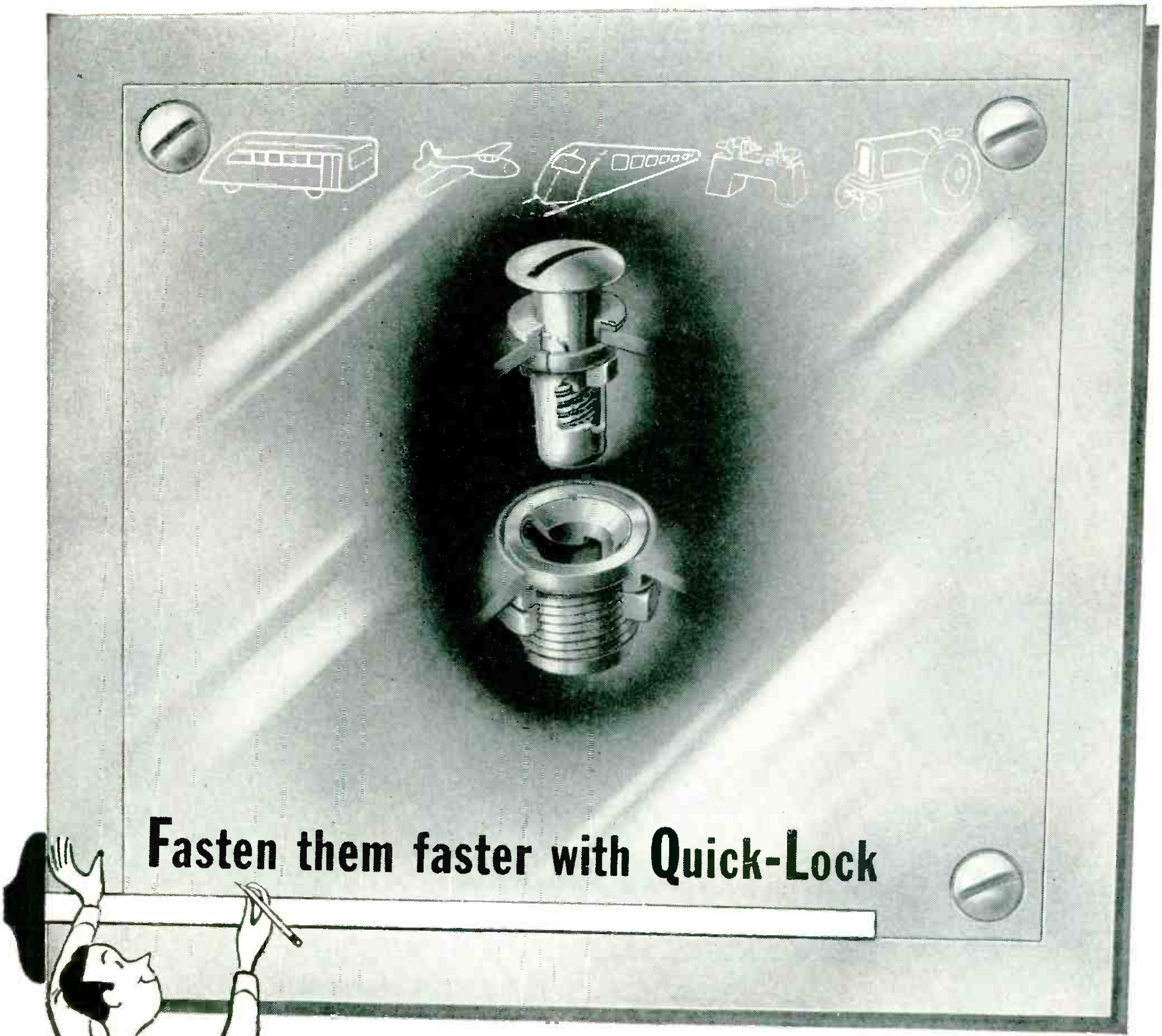
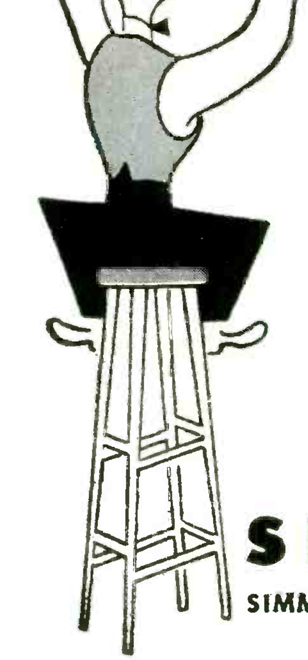
Simplify Your Access Panel and Door Assemblies...





Fastening removable access doors and panels need not be a laborious and costly production or assembly operation—not if they're fastened with QUICK-LOCK.

Designed for simple installation, QUICK-LOCK requires no special tools. It speeds up mounting and demounting detachable panels with only a 90° turn required to lock and unlock it *in a jiffy*.

The flexible mounting and tapered stud makes QUICK-LOCK ideal for assembling curved sheets and insures a tight fit when locked. Stud is self-ejecting when unlocked. Minimum deflection is assured—only initial loads are carried by the helical spring. Solid supports take up increased loads.

Industrial and agricultural equipment manufacturers would do well to analyze the cost-saving features of QUICK-LOCK's simple design. A good way would be to call in a Simmons Engineer and discuss the economy of a QUICK-LOCK installation as compared to your present fastening method. Why not send for him today?

SIMMONS FASTENERS

SIMMONS FASTENER CORPORATION • 1750 NORTH BROADWAY, ALBANY 1, N. Y.

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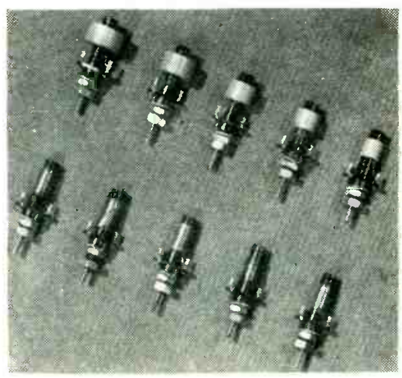
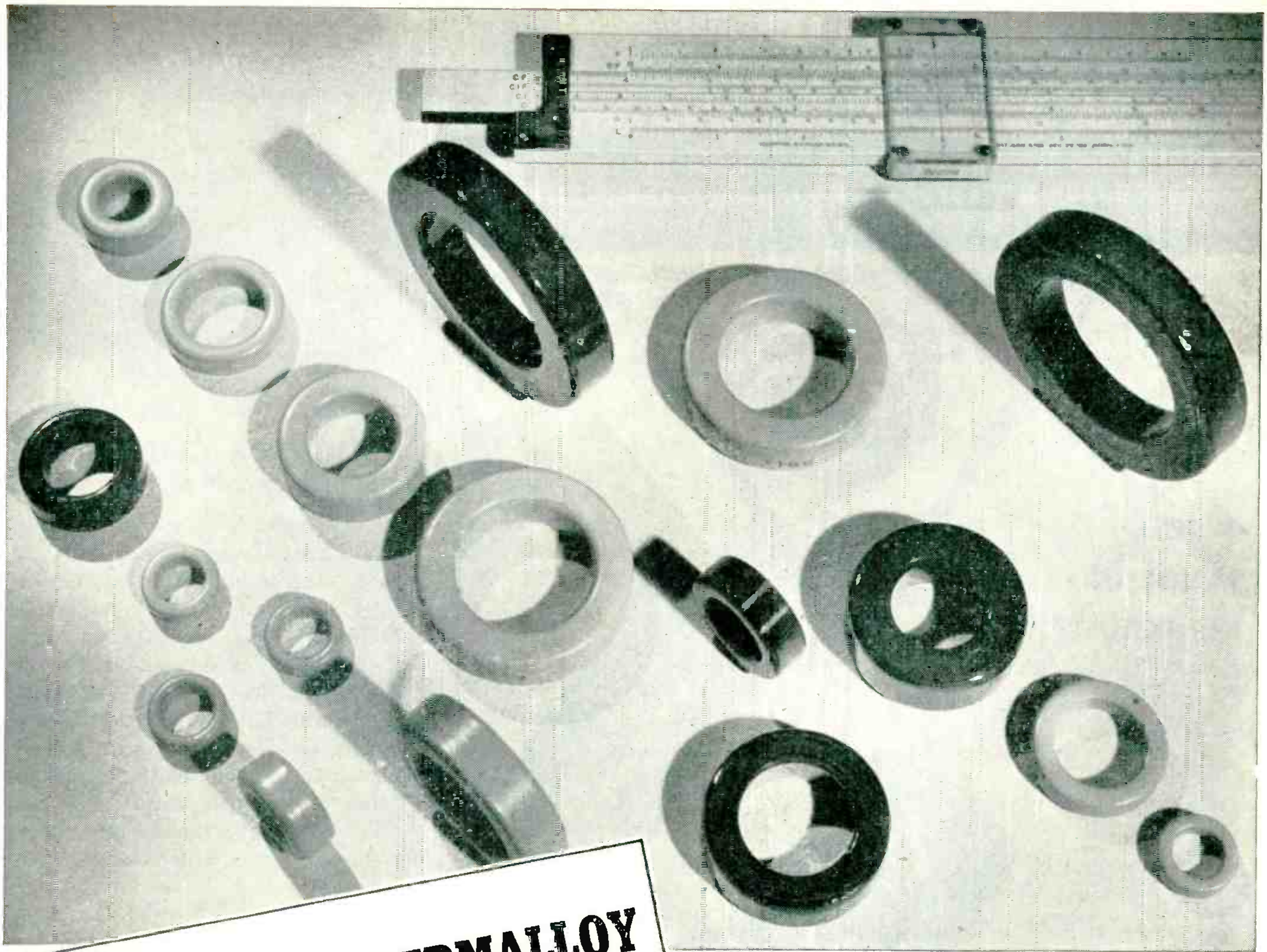
when plugged in and can be quickly and easily disconnected when desired. This locked, vibration-proof connection has constant low contact resistance and actually makes contact on two separate surfaces which are under constant coil-spring pressure. Any decrease in contact pressure on one contact surface will be automatically increased on the other surface. Various types are available: automatic locking plugs and jacks, both metal and insulated; right angle plugs, connectors and splicing links; flexible aluminum terminal strips that can be cut to any length and bent or curved to any shape for form-fitting wiring design; and a versatile 4-in-1 test prod with interchangeable attachments that lock automatically to the prod coupler.



INDUCTORS
solenoid and pi wound

INDUSTRIAL TELEVISION, INC., 359 Lexington Ave., Clifton, N. J., has announced a new line of components for manufacturers of military electronic equipment and high-quality commercial instruments. First introduced were variable slug-tuned inductors, both solenoid and pi wound, in a wide range of standard values or custom wound to specification. They are particularly suited for use as video peaking inductors in amplifiers where electrical performance, miniaturization and reliability are paramount. Designated the IT-123CS (solenoid) and the IT-123CP (pi) series these variable inductors are wound on forms of series FM-3001 black nylon (other colors available) with slugs of Pyroferric P-4399. Design-center induction range for solenoid types is 1 to 100 micro-



MOLYBDENUM PERMALLOY POWDER CORES*

(New technical data now available)

HIGH Q TOROIDS for use in Loading Coils, Filters, Broadband Carrier Systems and Networks— for frequencies up to 200 KC

COMPLETE LINE OF CORES TO MEET YOUR NEEDS

- ★ Furnished in four standard permeabilities—125, 60, 26 and 14.
- ★ Available in a wide range of sizes to obtain nominal inductances as high as 281 mh/1000 turns.
- ★ These toroidal cores are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.

For high Q in a small volume, characterized by low eddy current and hysteresis losses, ARNOLD Moly Permalloy Powder Toroidal Cores are commercially available to meet high standards of physical and electrical requirements. They provide constant permeability over a wide range of flux density. The 125 Mu cores are recommended for use up to 15 kc, 60 Mu at 10 to 50 kc, 26 Mu at 30 to 75 kc, and 14 Mu at 50 to 200 kc. Many of these cores may be furnished stabilized to provide constant permeability (±0.1%) over a specific temperature range.

*Manufactured under license arrangements with Western Electric Company

W&D 4744

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

DISTRICT SALES OFFICES . . . New York: 350 Fifth Ave.

Los Angeles: 3450 Wilshire Blvd. Boston: 200 Berkeley St.

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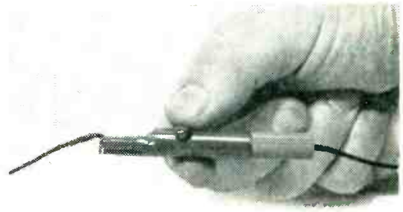
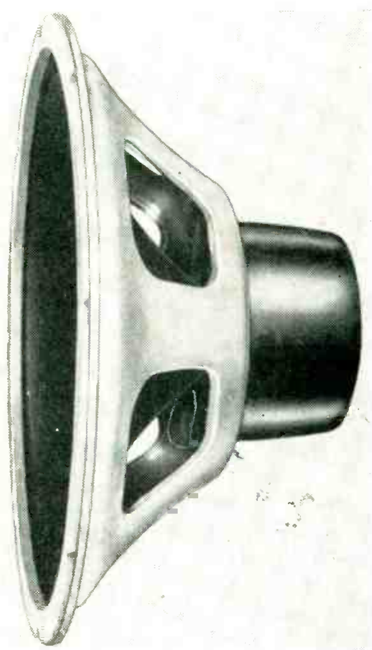
henries and for pi windings, 100 to 20,000 microhenries.



ALLIGATOR CLIP
aids live-circuit testing

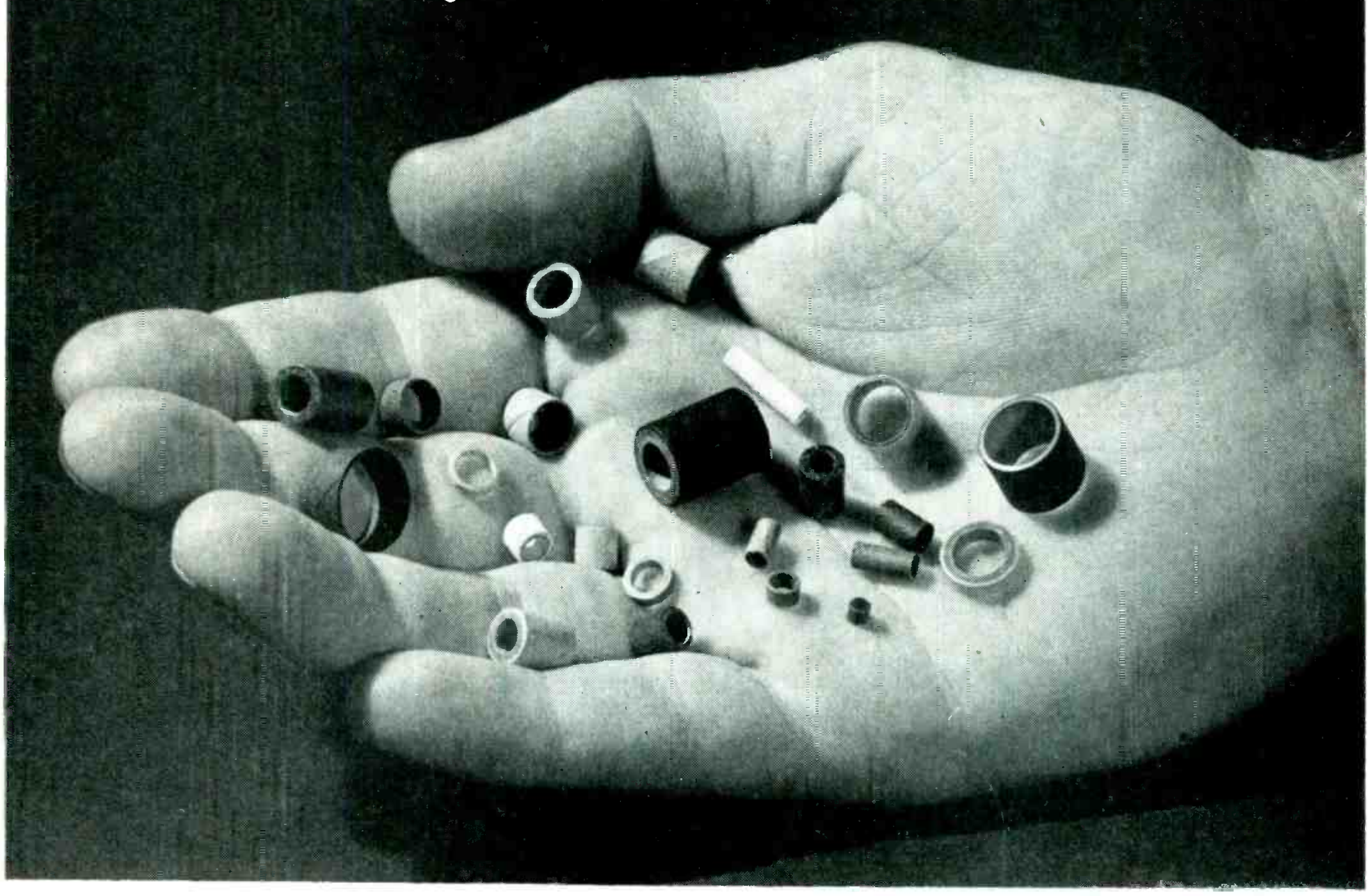
INSULINE CORP. OF AMERICA, 3602-35th Ave., Long Island City 1, N. Y., has brought out the No. 524 fully insulated alligator clip that facilitates the testing of live circuits in television and radio receivers and in electrical equipment in general. The spring-loaded jaws, which are actuated by a thumb button in the body of the clip, hold firmly on conductors up to ¼ in. in diameter. Connection to the clip is made with standard banana plugs.



SPEAKER
designed for high fidelity

OXFORD ELECTRIC CORP., 3911 S. Michigan Ave., Chicago 15, Ill., has added to its line of loudspeakers the high-fidelity 15-in. model HF-15LN. Frequency range is 50 to 10,000 cps. Alnico magnet weight is

It Costs You Less to Use STONE'S Small Diameter Bushings— Than Bushings of ANY OTHER MATERIAL



Actual size photograph unretouched

Stone's spiral wound bushings are bonded with special adhesives which retain their precision-made cylindrical forms, thus guaranteeing rapid and easy assembly over rivets, plain and threaded posts, and other small metal components.

Uniformity of size with diameters ranging downward to .046" and lengths to .040" is a Stone quality unequalled in the industry.

Most important from a cost standpoint is the flexibility of construction possible because of Stone's wide variety of immediately available materials—including hi-dielectric kraft, fish paper, and plastic films—a selection assuring lowest cost for whatever job you have in mind.

Call or write us today for prompt attention.

STONE PAPER TUBE COMPANY, INCORPORATED
STONIZED PRODUCTS COMPANY, INC.

900-922 Franklin Street, N. E., Washington 17, D. C.

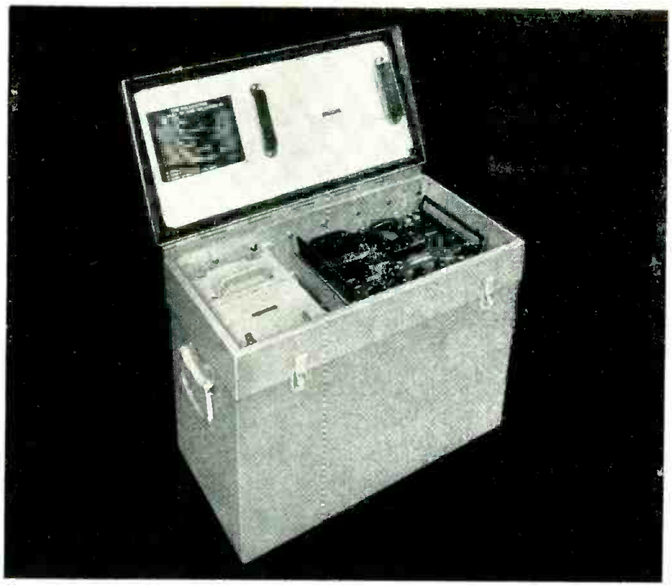
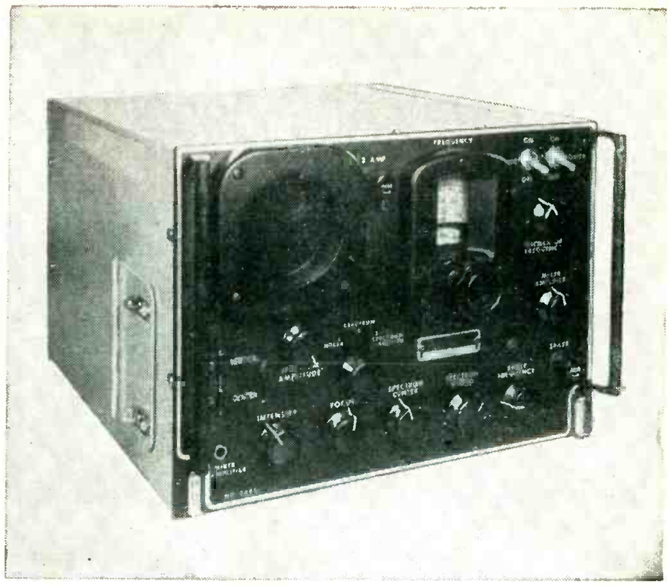
14 oz. It has a 25-w power rating and an input impedance of 8 ohms. Voice coil is 1½ in. in diameter. The speaker is finished with a silver Hammerloid enamel and has a blue pot cover.

SOLDERING FLUXES
are noncorrosive

FIM, INC., 170 Fifth Ave., New York 10, N. Y., is now marketing two new aluminum soldering fluxes. One flux (No. 18) in paste form is especially designed to solder aluminum with tin, lead, zinc, cadmium and their alloys. When heated the solder melts and spreads over the aluminum surface wherever the flux has touched. Any plain solder, torch or soldering iron can be used. Another flux (No. 24) in powder form solders all commercial metals such as steel, stainless steel, copper, brass, nickel, silver and aluminum. It is also suitable for dip soldering. Both fluxes are noncorrosive.

RASTER TIMER
provides ten sweeps

AMERICAN ELECTRONIC LABORATORIES, INC., Philadelphia, Pa. The purpose of the model-101 raster timer is to enable accurate time measurement of recurrent or transient phenomena, without losing sight of the entire cycle of events. It presents a series of 10 calibrated sweeps, one above the other on the screen, so that assuming a useful area of 4 in. × 4 in., the equivalent of a 40-in. viewing screen is created on the horizontal axis. The sweeps provided are 1, 3, 5 or 10 milliseconds each, crystal controlled to 0.01 millisecond, and each of the 10 sweeps carries time markers allowing measurements to an accu-

NE-11-20-S SPECTRUM ANALYZER

Description

The Spectrum Analyzer is test equipment designed primarily for use with aircraft radar and beacon equipment operating over a frequency range of 8470 to 9630 mc/s. Housed in a compact portable carrying case, the whole assembly weighs approximately 90 pounds.

In operation, the Spectrum Analyzer displays on an oscilloscope a pattern representative of the distribution of energy among the various frequencies in the output of a pulsed oscillator. This equipment is equal to our government models TS-148/UP.

Applications

This very sensitive micro-wave receiver will provide accurate measurement of the spectra of radio frequency oscillations in radar and beacon equipment. It will also measure, within its own range, frequencies of echo boxes, magnetrons, test sets, local oscillators and a variety of resonant cavities. It can also be used to check magnetron pulling and AFC circuits, and as a frequency-modulated oscillator to tune T/R Boxes and R/T Boxes in transmitter-converters.

The Analyzer is so sensitive that the magnetron signal can usually be picked up at some distance from the source, thus making the equipment easy to use in any convenient location.

Specifications

Power Supply	50-1200 Cps; 105-125 Volts; 125 Watts
Frequency-meter Range	Calibrated directly from 8470 mc/s to 9630 mc/s
Sweep Frequencies	Continuously Variable from 10 to 30 Cps
Attentuation (Spectrum Amplitude)	Uncalibrated. Variable from 3 to 70 db.
Operating Temperature Range	—40° C. to +55° C.
Frequency swing of analyzer r-f oscillator (sawtooth FM)	40 to 50 mc/s
Overall i-f bandwidth at half power points	50 kc/s

Sensitivity to CW — Spectrum Amplified Pos. — 80 db. below 1 watt for 1 inch of deflection on Oscilloscope Screen.
— Spectrum Position — 55 db. below 1 watt for 1 inch of deflection of Oscilloscope Screen.

Maximum dispersion of spectra	1.5 mc/s per inch
Maximum error	± 5 megacycles

We will gladly furnish all details regarding specifications, prices, and delivery.

Write, wire or telephone for information.

NORTHEASTERN ENGINEERING INC

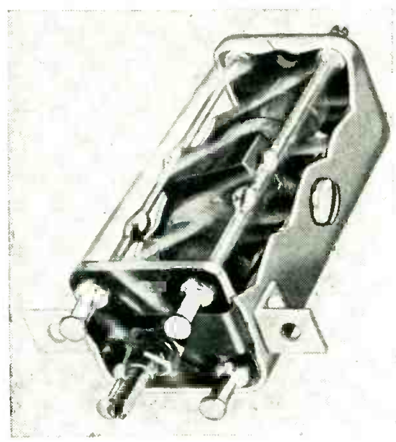
Manchester, New Hampshire

Telephone 2-6485

racy of 0.05 millisecond or better, or 0.1 to 0.05 percent of the total presented sweep time. All circuits within the unit are stabilized so that there is no jitter or wandering of the standing pattern of recurrent phenomena, which may be required for photographic recording.

TWIN TETRODE
for mobile transmitters

AMPEREX ELECTRONIC CORP., 230 Duffy Ave., Hicksville, Long Island, N. Y. Type 6252 twin tetrode is a lower power version of the 5894/AX9903. Its maximum plate dissipation rating is 20 w under ICAS conditions and it works efficiently with a power output of 112 w at 600 mc. It has been successfully operated as a frequency multiplier over the entire uhf tv band. The tube is particularly suitable for low-drain mobile transmitters and multiplier chains. It is only 3 in. in overall height and slightly less than 1¾ in. maximum diameter.



TUNED CIRCUITS
are stable and precise

VANGUARD ELECTRONICS CO., 3384 Motor Ave., Los Angeles 34, Calif., announces a series of rigidly constructed single and double-tuned circuits noteworthy for stability and precise performance. The circuits are housed in a ¾-in. × ¾-in. × 2-in. aluminum container. Features include: a rigid coil form held under force fit in metal bushings, a heavy metal bracket to secure the entire structure, grounding bushings and adjustment studs to the

PROJECT TINKERTOY

Released By The Government And Now Available To Industry

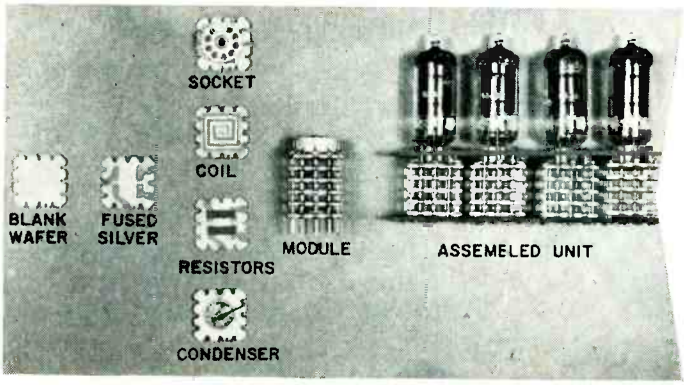
what it is

Project TINKERTOY is the code name for a development by the National Bureau of Standards. It consists of a design system and automatic machinery for the MECHANIZED PRODUCTION OF ELECTRONIC EQUIPMENT. This program was sponsored by the Navy Bureau of Aeronautics as an industrial preparedness measure in production research.

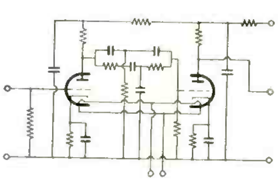
how it affects your production of electronic equipment

A high speed mechanized production process, the Project TINKERTOY method is also economical for small quantities.* Production of one *or* one million units is practical without design change. The ultimate in standardization of tooling and assembly is possible, and a minimum of skilled labor is required. Under this new design system you easily shift production over a wide range of products — rapidly and economically. This new mechanized production method guarantees uniformity of product *plus* automatic quality control, giving increased reliability. Production engineering costs are minimized because the development model actually *is* the final production design.

* Small pilot runs, using an equivalent hand module assembly method, are actually competitive with quantity production runs by present day methods.



The heart of the N.B.S. system is the "module", consisting of half a dozen ceramic wafers interconnected by a dozen "riser" wires. Each wafer can contain as many as four tape resistors, ceramic disk condensers, or a tube socket, plus silvered connections to the proper riser wire. A single module can contain an entire circuit including a tube socket and twenty components as illustrated below left. Coils and other miscellaneous components can also be included. Several modules can be sandwiched between two photo-etched circuits providing a complete package. Audio, video, IF and RF amplifiers; oscillators, sweep circuits and counters have been made by this method. Tests by Sanders Associates have shown this equipment capable of withstanding environmental conditions beyond Military requirements.



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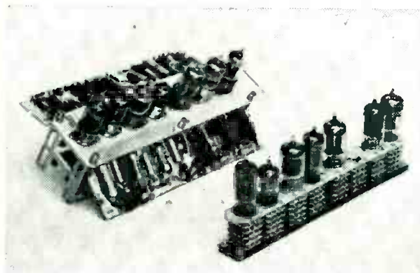
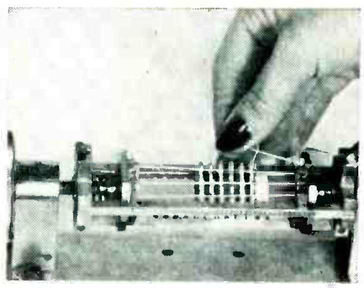
This entire circuit can be contained in one module



Section of radio altimeter before and after adaptation to Project TINKERTOY by Sanders Associates



Hand module assembly jig

Sanders Associates is proud to have been a member of the team contributing to this revolutionary development of the National Bureau of Standards and sponsored by the Navy Bureau of Aeronautics. Our responsibility was the developing and establishing of hand assembly facilities for pilot-line production. Sanders Associates successfully applied the Project TINKERTOY principles to a submarine detecting device, a radio altimeter and other military equipments.

Now Sanders Associates is able to offer to the industry its "know-how" obtained during two years of redesign engineering in association with Project TINKERTOY. We are ready to assist in engineering the conversion of conventional electronic equipment to the modular design technique, leading to automatic production. Why not send for our recent bulletin on Project TINKERTOY? Address inquiries to Department 62.

SANDERS ASSOCIATES INCORPORATED

NASHUA, NEW HAMPSHIRE

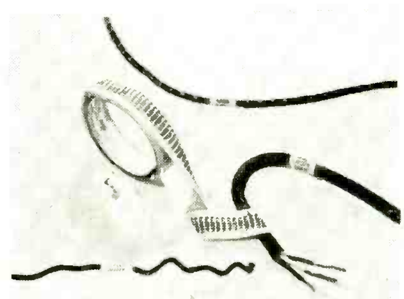
reliability in electronics

Want more information? Use post card on last page.

container. Coil frequencies range from 50 kc to 100 mc. Standard units are offered with adjustable iron cores from top and bottom. Cup cores are available for high Q in special applications.

B+ BOOSTER
has built-in time delay

WORKMAN TV, INC., Teaneck, N. J., has introduced its new model 5TV4, B+ booster. The unit replaces the 5T4G in tv receivers for more height, width and gain. A built-in time delay acts as a choke input. Other advantages are additional filtering and infrequent replacement. Literature is available.



PRINTED VINYL TAPE
for wire identification

PRINTED CELLOPHANE TAPE CO., 521 No. La Brea, Los Angeles, Calif., has announced a printed pressure-sensitive Vinyl (self-adhesive) tape for wire, cable and conduit identification. In a field where marker conformability and flexibility are a must, this tape fulfills all of the qualifications. Extremely thin with 100 percent dead stretch on itself, it is also resistant to fungi and is inert to

FOR COLOR TELEVISION AS WELL AS BLACK and WHITE

A CRYSTAL CONTROLLED TV PICTURE AND SOUND RF SIGNAL SOURCE

USED WITH THE

NEW MEGA-PIX SR.

INTERNAL or EXTERNAL SOUND MODULATION

PICTURE CARRIER CAN BE MODULATED WITH ANY STANDARD VIDEO SIGNAL

Individual output controls for sound and picture carriers.

Built-in 400 cps sound modulating frequency with carrier deviation variable to 25 kc.

Video bandwith of 5 mc.

Provision for DC insertion.

Jack for audio input from external source. Standard pre-emphasis provided.

SPECIFICATIONS

OUTPUT SIGNAL FREQUENCIES: Television RF Picture and Sound Frequencies, Channels 2 to 13.

ACCURACY OF PICTURE AND SOUND CARRIERS: $\pm$0.01%.

MAXIMUM PICTURE AND SOUND CARRIER OUTPUT: At least 30,000 microvolts into open circuit.

AMPLITUDE CONTROL RANGE: Individual output level controls for Sound and Picture Carriers plus simultaneous control range of 20 db, 20 db, 10 db, 6 db and 3 db switched, 10 db variable.

RF OUTPUT IMPEDANCE: 72 ohms.

VIDEO INPUT IMPEDANCE: 72 ohms.

VIDEO INPUT SIGNAL REQUIRED: Approx. 2 volts, peak to peak, black negative.

VIDEO BANDWIDTH: 5 mc.

SOUND CARRIER DEVIATION: Continuously variable from 0 to 25 KC.

SOUND MODULATING FREQUENCY: 400 cps., or by external audio. Standard pre-emphasis provided.

PICTURE CARRIER MODULATION PERCENTAGE: Adjustable, 0 to over 95%.

PRICE: $990.00, f.o.b. Pine Brook, N. J.

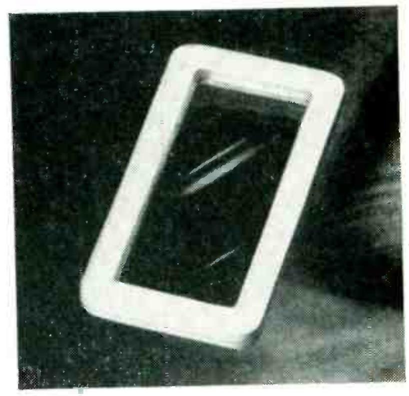
KAY

KAY ELECTRIC COMPANY

14 Maple Avenue — Phone CAldwell 6-4000 — Pine Brook, New Jersey

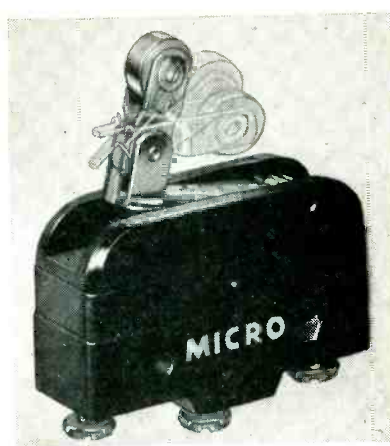
Want more information? Use post card on last page.

most solvents. Known as PEE-CEE Vinyl tape No. 471, this material is fungistatic and the ink is sealed into the vinyl backing, thus providing an abrasion-resistant marker.



WAVEGUIDE WINDOW
covers 8,200 to 12,400 mc

AIRBORNE INSTRUMENTS LABORATORY, INC., 160 Old Country Road, Mineola, N. Y., has developed a nonresonant waveguide window that covers the full bandwidth of the RG-52/U waveguide (8,200 to 12,400 mc) with a swr of less than 1.08. For special applications, windows with a maximum swr of 1.05 can be obtained. The window has a metal frame than can readily be soldered into the waveguide flange. It can be used for pressurized equipment and will withstand a pressure differential of 17 psi. It is unaffected by temperature changes from −75 C to 100 C.



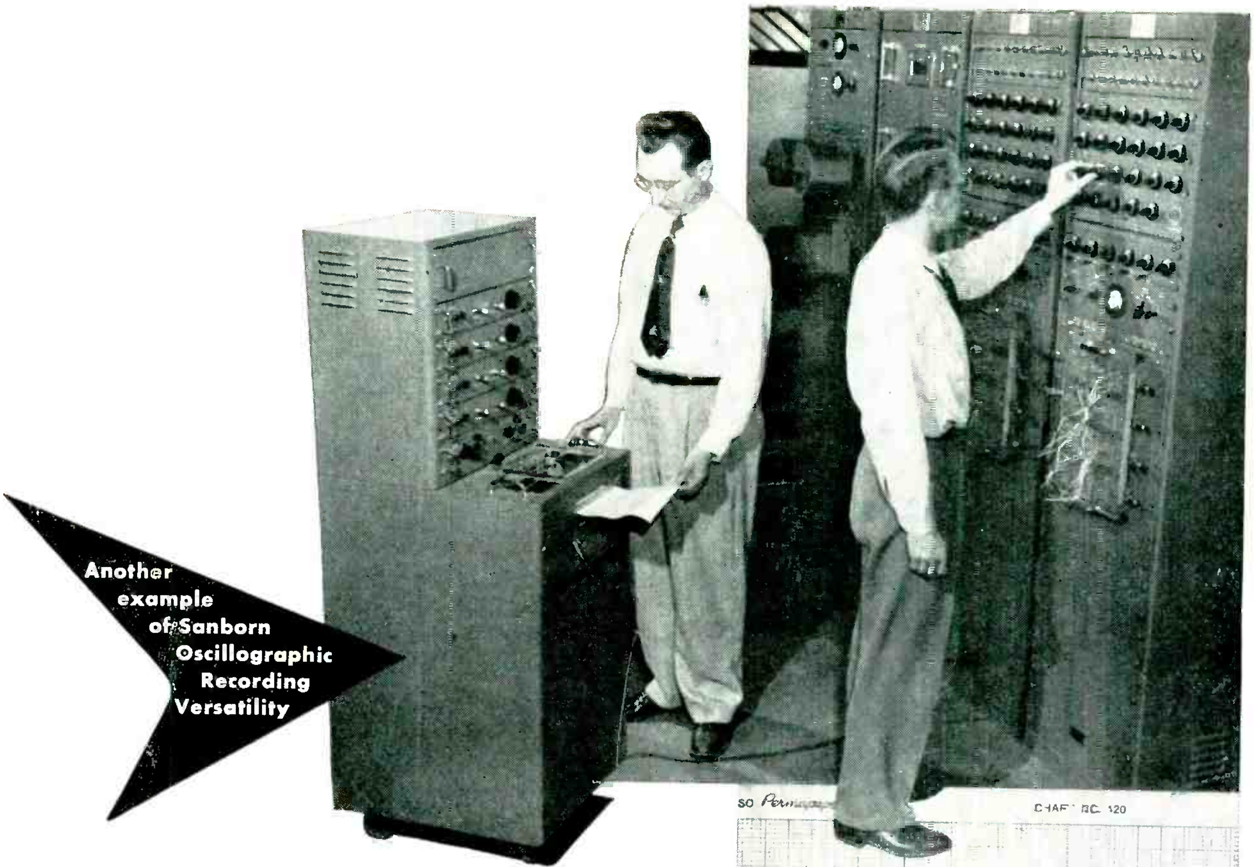
SPDT SWITCHES
for one-way actuation

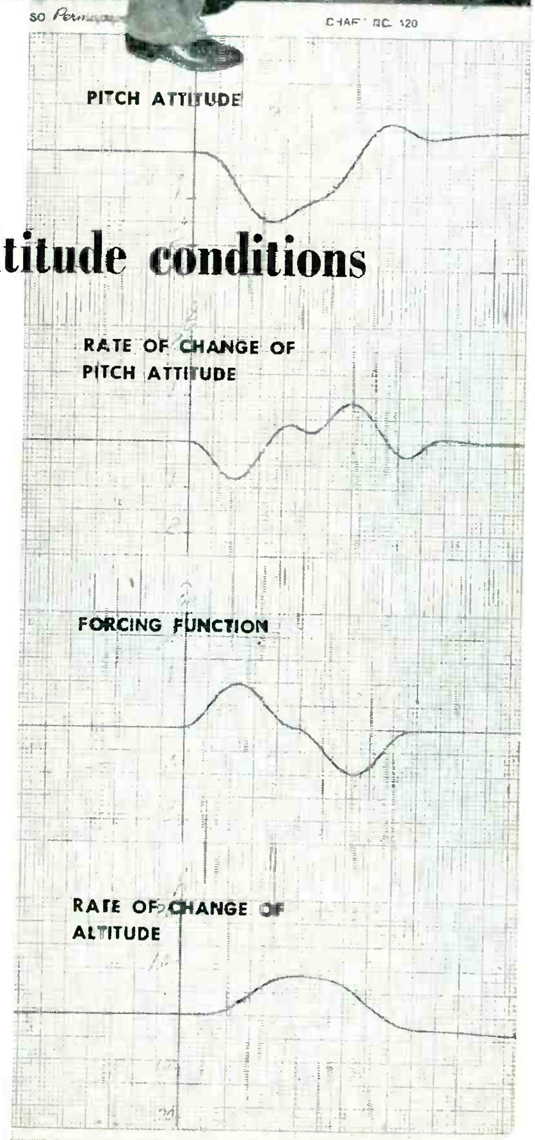
MINNEAPOLIS-HONEYWELL REGULATOR Co., Micro Division, Freeport,

Ill., has announced two new precision snap-action switches designed for one-way actuation by cams, dogs or slides. They have spring-loaded, hinged roller-arm actuators. One design has a $\frac{3}{16}$ in. diameter roller and the other, a $\frac{3}{8}$ in. diameter roller. They are particularly useful in providing an electrical impulse to relays or solenoids from only one direction of a reciprocating movement. Each of the switches is available with either solder-lug terminals or screw terminals. They are listed by Underwriters' Laboratories for 15 amperes, 125, 250 or 460 v a-c; $\frac{1}{2}$ ampere, 125 v d-c; $\frac{1}{4}$ ampere, 250 v d-c. Contact arrangement of both switches is spdt.

TINY SEALED RELAYS measure 1.6 cu in.

THE HART MFG. CO., 110 Bartholomew Ave., Hartford, Conn. New performance characteristics for the series R hermetically sealed, miniature aircraft-type 4PDT relays have been developed, providing an even wider range of variations to meet such requirements as guided missiles, jet engine controls, communications, radar, fire control, geophysical and computer apparatus. Only 1.6 cu in. in size and 3.76 oz in weight, with operational shock resistance to 50 g and higher and temperature ranges from −65 to +200 C, the relays have interelectrode capacitance less than $\mu\mu$f contacts to case, less than $2\frac{1}{2}$ $\mu\mu$f between contacts, even with plug-in type relay and socket. Vibration range is from 0 to 500 cps and upward at 15 g without any chatter.





Four-channel recording correlates simulated jet bomber airspeed and altitude conditions

At Eclipse-Pioneer, engineers make good use of Sanborn 4-channel recording systems in conjunction with high precision analogue computers to establish performance criteria for automatic flight systems and components.

At other laboratories Sanborn Systems are being used to record such phenomena as: stress, strain, pressure, displacement, thickness, velocity, acceleration, current, voltage, temperature, torque, light, flow, force, load, position, rpm, radiation and tension.

SANBORN OSCILLOGRAPH RECORDING SYSTEMS HAVE MANY APPLICATIONS. They are used in a great many different fields where accurate and permanent graphic registration of almost any electrical phenomena (whose frequency range is zero to 100 cycles per second) is required.

Sanborn Systems are widely used because of the availability and ready interchangeability of amplifiers and preamplifiers, as well as such Sanborn advantages as: inkless recording in true rectangular coordinates, high torque movement, time and code markers and wide choice of paper speeds. In addition, a basic choice of systems, 1-, 2-, and 4-channels, provides a system to fulfill almost any laboratory requirements.

WRITE FOR CATALOG

Sanborn Company

INDUSTRIAL DIVISION

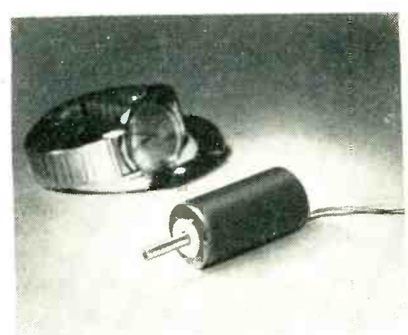
CAMBRIDGE 39, MASSACHUSETTS, U.S.A.

Want more information? Use post card on last page.

At 30 g operational shock resistance, sensitivity approaches 100 mw.

VARIABLE INDUCTOR is stable and versatile

VARI-L CO., INC., Box 1433, Stamford, Conn. By the addition of a permanent magnet to provide a stable bias flux in the core, the model PA-63 variable inductor is given new versatility and stability. It has Q's, over most of its range, of from 115 to 130, and there are no sharp peaks or valleys. Electrostatic coupling between control and signal windings is greatly reduced. Less d-c means less heating internally, and reduces creepage due to temperature rise. Manual adjustment of the magnetic bias gives better control over L-C ratio and permits operation at the point of best linearity. Illustrated is the inductor with cover removed for access to the bias magnet. Note the potted construction, size being indicated by inch scale.



VERSATILE MOTOR is 1-in. in diameter

EASTERN AIR DEVICES, 585 Dean St. Brooklyn 17, N. Y., has produced a line of extremely small pre-

mitchell-rand

features electrical insulating tapes

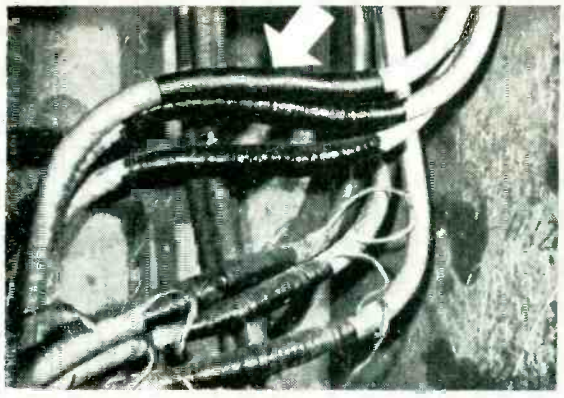
BI-SEAL

self-bonding Polyethylene, for resistance to corrosion and chemicals.

BI-PRENE

self-affixing Neoprene, for resistance to oils and chemicals.

UNAFFECTED BY LOW TEMPERATURES • SUPERIOR AGING • CORROSION-CHEMICAL OIL RESISTANT • EXCELLENT CONFORMABILITY • SELF-BONDING • MOISTURE-RESISTANT • HI-DIELECTRIC STRENGTH



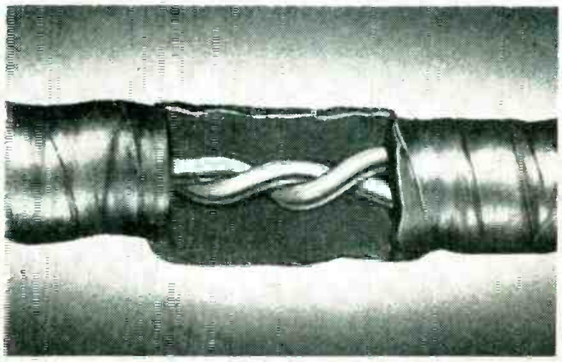
BI-SEAL INSULATION CHARACTERISTICS

Electrical Properties

Dielectric strength		1000 volts/mil avg.
Power factor	60 cycles	0.0006
	1000 cycles	0.0006
	10^6 cycles	0.0004
Dielectric constant	60 cycles	2.32
	1000 cycles	2.34
	10^6 cycles	2.13

Physical and Chemical Properties
Resistance to:

Ozone	Excellent
Oxygen	Excellent
Acids	Excellent
Alkalies	Excellent
Moisture vapor transmission	Negligible
Castor Oil	Good
Commercial Hydraulic Fluids	Excellent
Aging qualities	Excellent
Operating temperatures	197°F to −67°F
Application temperatures	150°F to −40°F



BI-PRENE INSULATION CHARACTERISTICS

Physical Tests on Press Cured Slabs 10°/310°F

Tensile	1930 p.s.i.
Elongation	400%
200% Modulus	1030 p.s.i.
Ozone	6 hours to cut

Physical Properties on Aging
80°C Oxygen Bomb for 14 days
67.4% of orignial elongation
62.6% of original Tensile

Air Bomb at 26°F for 30 Days at 80 p.s.i.
160% of original elongation
66% of original Tensile

Oil Resistance
A. S. T. M. Reference fluid number one — 11.7% maximum swell in 24 hrs. A. S. T. M. Reference fluid number two—69.7% maximum swell in 24 hrs. 18 hr. exposure in oil at 121°C — Tensile decreased 4.5%. Elongation increased 70%.

Here are two multi-purpose electrical insulating tapes for wire or cable splicing . . . the self-bonding BI-SEAL and the self-affixing (air-curing) BI-PRENE . . . to meet the strictest requirements for unusual as well as ordinary cable splice applications for the smallest wire or the largest cable . . . wherever tape can be used for splicing.

The outstanding characteristics and excellent insulation properties, plus the feature that once applied BI-SEAL and BI-PRENE tapes fuse into a solid mass, impossible to unwrap or delaminate, enables these products to offer complete and lasting protection against moisture, acids, alkalies, oils, chemicals, sunlight, corrosion, fungus, ozone, etc.

MITCHELL-RAND SINCE 1889 — Electrical Insulation Headquarters

Write for samples and detailed data

mitchell-rand INSULATION COMPANY, INC.

51 MURRAY ST. • COrtlandt 7-9264 • NEW YORK 7, N.Y.

MIRAGLAS VARNISHED TAPES, CLOTHS AND SLEEVINGS • MIRAGLAS TAPES, BRAIDED SLEEVINGS AND TYING CORDS • MIRAGLAS SILICONE TREATED CLOTHS, TAPES AND TUBINGS • MICA TAPES, CLOTHS AND MICA-FIBERGLAS COMBINATIONS • FIBRE, PHENOL FIBRE AND MIRALITE POLYESTER RESIN SHEET INSULATING PAPERS—DURO, FISH, PRESSBOARD, ETC. • VARNISHED CAMBRIC TAPES, CLOTH AND SLOT INSULATIONS • COTTON TAPES AND SLEEVINGS • TWINES AND TIE TAPES • ASBESTOS TAPES, SLEEVINGS AND CLOTH, TRANSITE AND ASBESTOS EBONY • ARMATURE WEDGES AND BANDING WIRE • VARNISHED TUBINGS, HYGRADE, MIRAGLAS, HYGRADE VF, MIRAGLAS SILICONE • THERMOFLEX AND FLEXITE EXTRUDED PLASTIC TUBING • PERMACEL MASKING TAPES AND ELECTRICAL TAPES • BI-SEAL, BI-PRENE, FRICTION TAPES AND RUBBER SPLICE • COMPOUNDS—TRANSFORMER, CABLE FILLING, POTHEAD, ETC. • INSULATING VARNISHES OF ALL TYPES.

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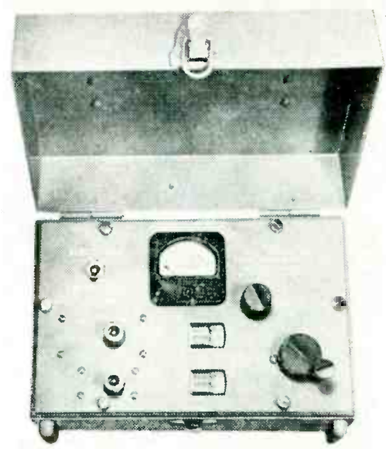
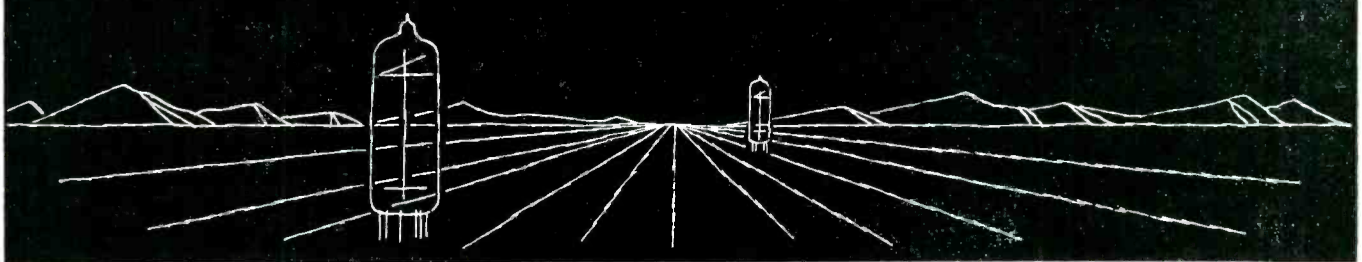
cision motors (only 1 in. in diameter), that are designed to operate fans, blowers, instruments, controls and low-power drives. With a maximum 115 v input, these motors can be used for single, two or three-phase 400-cycle operation, at running speeds of approximately 10,500 and 21,000 rpm, and for single or two-phase 400-cycle operation at a speed of approximately 7,000 rpm. They can also be used for variable frequency service. Power ratings of approximately 1/100 hp can be obtained with the 400-cycle unit. Modifications include high-ambient and high-altitude versions as well as servo, hysteresis, synchronous and gear motors.



FREQUENCY METER is accurate to 0.2 percent

NASSAU RESEARCH & DEVELOPMENT ASSOCIATES, INC., 66 Main St., Mineola, N. Y. Frequencies from 2,400 to 10,200 mc can be measured on the model-802 frequency meter to an accuracy of 0.2 percent. A transmission indication is obtained on a built-in sensitive 50-μa meter. A reactive indication is obtained by using an external tee section. The resonant elements consist of two high-Q coaxial cavities tuned by a precision micrometer head. A vernier-type crank knob allows rapid tuning and precise setting of frequency. Broadband noncontacting shorts are used to eliminate all sliding contacts. The cavities are plated with silver and rhodium, insuring a high-conductivity surface that will not tarnish or corrode. An

where is the real future in electronics?



Everyone has done a lot of military work . . . but it becomes more and more apparent every day that the electronics industry must find new markets in the industrial field. That is where the real future in electronics lies!

Westinghouse, as a leader in the production of industrial equipment, has the necessary sales, distribution and field engineers organized to enter this new market. Now is the time to get into our organization, so that when the industrial field expands, you will be in on the ground floor!

This is not a case of an organization offering just a future! Salaries are open, commensurate with experience and ability. Our patent award plan is known and respected throughout the industry. There are excellent opportunities for advanced study and degrees. The Westinghouse Electronics Division offers all of the usual employe benefits, plus!

Investigate the real future!

SYSTEMS ENGINEER

DUTIES: Systems analysis and evaluation; systems coordination; and systems test planning. Involves feedback systems, computers, video systems, indicators, switching, etc., as applied to radar and missile guidance systems.

REQUIREMENTS: 3 or more years' experience and a B.S. degree in Electrical Engineering or Physics.

TECHNICAL WRITERS

DUTIES: For writing Engineering progress reports on advanced radar and missile systems.

REQUIREMENTS: 3 years' experience and a B.S. degree in Electrical Engineering or Physics.

INDICATOR DESIGN SPECIALIST

DUTIES: Advanced development and design of new types of indicators for radar and missile guidance applications.

REQUIREMENTS: 3 years' experience and a B.S. degree in Electrical Engineering or Physics.

MAGNETIC AMPLIFIER ENGINEER

DUTIES: Design and application of magnetic amplifiers in such new fields as multi-vibrator and sweep circuits, in addition to the more common applications.

REQUIREMENTS 3 or more years' experience and a B.S. degree in Electrical Engineering or Physics.

TRANSFORMER DESIGN ENGINEER

DUTIES: The development and design of pulse transformers, filters, iron-core radio frequency transformers and advanced electronic transformers of all types.

REQUIREMENTS: 3 years' experience and a B.S. degree in Electrical Engineering or Physics.

To apply send resume of education and experience to

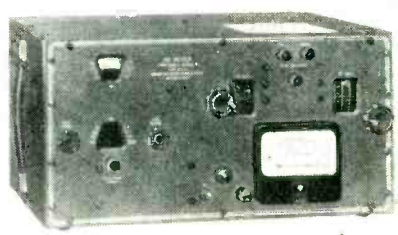
R. M. Swisher, Jr.
Employment Supervisor, Dept. N-5
Westinghouse Electric Corporation
109 West Lombard Street
Baltimore 1, Maryland

Westinghouse
ELECTRONICS DIVISION
BALTIMORE, MARYLAND

output jack provides means for connecting an external amplifier or galvanometer for increased sensitivity.

TRANSISTOR MOUNT
vacuum seals the unit

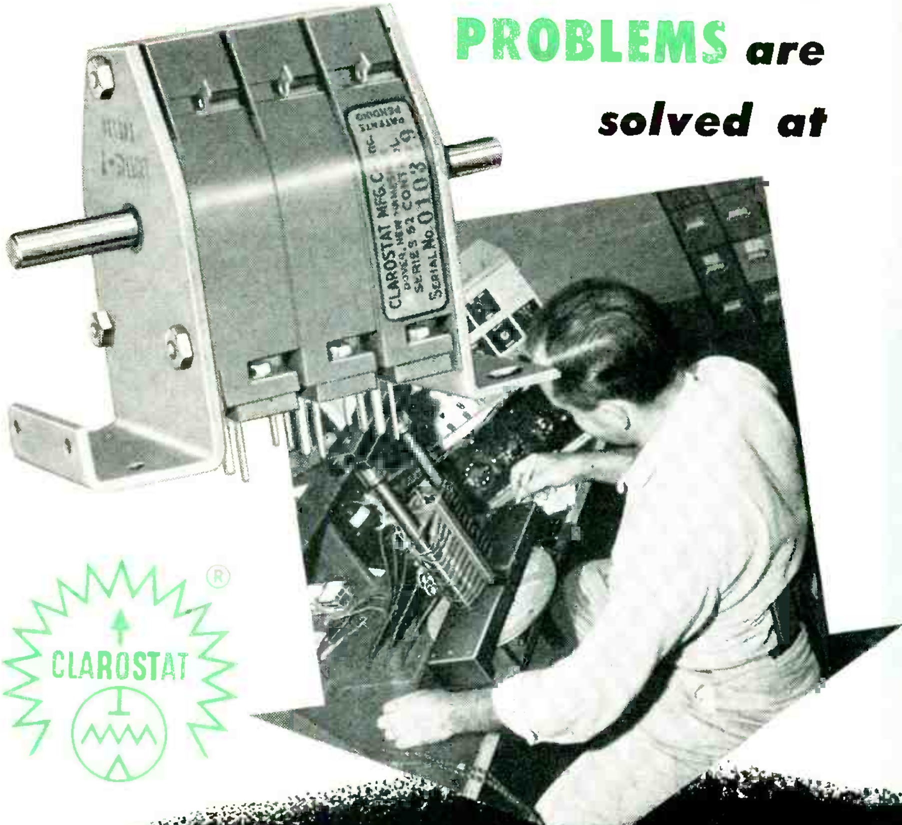
CONSTANTIN AND CO., Lodi, N. J. The new transistor mount is a glass-to-metal sealed base combined with a metal cover, which permits mounting of the germanium in a complete vacuum or inert-gas atmosphere. This makes the germanium impervious to all outside conditions and considerably increases the life of the transistor. The mounts are available as small as 0.250 in. long, 0.165 in. wide and 0.437 in. high. The base is constructed of glass to kovar metal with three 0.018-in. leads sealed through. The cover, a metal can, is constructed of 10-percent nickel-silver metal. All parts with the exception of the cover are hot-tin dipped at 530 F to facilitate easier soldering and eliminate rejection in production.



RX METER
covers 500 kc to 250 mc

BOONTON RADIO CORP., Boonton, N. J., announces a new type 250-A RX meter, a completely self-con-

THE MOST CRITICAL CONTROL PROBLEMS *are solved at*



FEATURES...

Individual sections or tandem assemblies up to 18 sections.

Resistance tolerance: Standard overall, plus/minus 5%. Plus/minus 0.5% available where resolution permits.

Linear and non-linear within plus/minus 0.5%, or a voltage ratio accuracy of 0.005 where resolution permits.

Resistance range of 10 to 100,000 ohms. Non-linear, maximum of 350 ohms per degree of rotation.

One or more taps available. Taps can be located to within one winding convolution.

Power rating: 3 watts at 40° C. Non-linear, approximately 0.01 watt per degree of rotation.

Rotation: Effective up to maximum of 358°. Mechanical, any value up to 360°.

ULTRA-PRECISION CONTROLS HEADQUARTERS

For applications requiring *ultra-precision* controls, again you can "stand pat with Clarostat."

Originated by Clarostat, such ultra-precision potentiometers are now used in intricate and critical assemblies such as servo-mechanisms, range finders, fire-control systems, computing devices, and so on.

And now the latest, further-refined, plug-in version, Series 52, is available. Arch-shaped low-loss phenolic casing. Prong terminals engaging with corresponding sockets for plug-in circuitry. Side terminal lugs on each unit facilitate checking section voltages. Heavy metal end brackets insure rigid mounting.

Built by craftsmen working under instrument-shop conditions, these Clarostat Series 52 units are *the finest controls ever offered.*

Torque: 1 oz.-in. maximum per section.

Insulation: 1000 V.A.C. at atmospheric pressure.

End brackets and other types of mountings meet any mechanical considerations.

These units exceed applicable JAN-R-19 specifications.

Section-by-section assembly of tandem controls, with critical checkups of mechanical and electrical factors at each step insure *ultra precision*.

STAND PAT WITH

Data on request. Let us collaborate on your ultra-precision control requirements.

CLAROSTAT Controls & Resistors

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario

Want more information? Use post card on last page

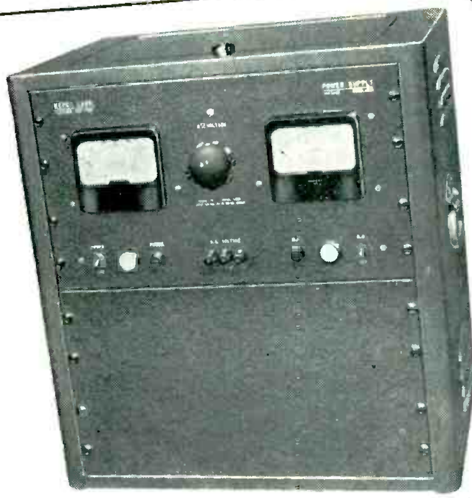
tained r-f bridge that permits the direct measurement of equivalent parallel resistance and capacitance of two terminal networks over an unusually wide frequency range. The instrument has a frequency coverage of 500 kc to 250 mc in eight ranges, a resistance range of 15 to 100,000 ohms, and a capacitance range of $+20\ \mu\mu f$ to $-100\ \mu\mu f$. Resistances from 0 to 15 ohms may be determined by indirect means; the capacitance range can be increased to 0 to 120 $\mu\mu f$ by the use of auxiliary resonating coils. The meter is particularly useful for measuring the performance of resistors and transistors at elevated frequencies and also provides a convenient tool for the determination of characteristic impedance, attenuation and velocity of propagation of transmission lines.

TAPE RECORDER is completely portable

ECTRO, INC., Delaware, Ohio. The Cub Corder is a new, completely portable tape recorder equipped for recording, playback, erase and monitoring. The recorder, which is housed in a single compact unit, weighing less than 13 lb, is designed to record for two full hours, or sufficient time to record up to 20,000 words before battery recharging is necessary. It lends itself to a wide variety of on-the-spot uses where plug-in current is not readily available. The Cub Corder motor is powered by a 4-v, nonspill storage battery which has a normal life span of 450 hours. When in need of recharging, the battery can be brought back to full strength

KEPCO
VOLTAGE REGULATED POWER SUPPLIES

VOLTS	CURRENT	REGU-LATION	RIPPLE	6.3 V.† AC. CT.	MODEL
0-1500	0-200 Ma.	0.5%	20 Mv.		1520
0-1200	0-20 Ma.	0.1%	10 Mv.	10 Amp.	1220
0-1000	0-500 Ma.	0.5%	20 Mv.		1350
200-1000	0-500 Ma.	0.5%	20 Mv.		1250
0-1000	0-50 Ma.	0.1%	10 Mv.	10 Amp.	1020
0-600	0-3 Amp.	0.5%	10 Mv.		780
0-600	0-2.25 Amp.	0.5%	10 Mv.		770
0-600	0-1.5 Amp.	0.5%	10 Mv.		760
0-600	0-750 Ma.	0.5%	10 Mv.		750
0-600 0-150 Bias	0-300 Ma. 0-5 Ma.	0.5% *	10 Mv. 5 Mv.	10 Amp.	615
0-600	0-300 Ma.	0.5%	10 Mv.	10 Amp.	500R
#1 0-600 #2 0-600	0-200 Ma. 0-200 Ma.	0.5% 0.5%	5 Mv. 5 Mv.	10 Amp. 10 Amp.	800
0-600 0-150 Bias	0-200 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	10 Amp.	815
#1 200-500 #2 200-500	0-200 Ma. 0-200 Ma.	0.5% 0.5%	5 Mv. 5 Mv.	6 Amp. 6 Amp.	510
200-500	0-200 Ma.	0.5%	5 Mv.	6 Amp.	245
0-400 0-400 0-150 Bias	0-150 Ma. 0-150 Ma. 0-5 Ma.	0.5% 0.5% *	5 Mv. 5 Mv. 5 Mv.	10 Amp. 10 Amp.	2400
0-400 0-150	0-150 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	10 Amp.	400
100-400	0-150 Ma.	0.5%	5 Mv.	10 Amp.	141
100-400	0-150 Ma.	0.01%	1 Mv.	10 Amp.	2000
0-350	0-3 Amp.	0.5%	10 Mv.		730
0-350	0-2.25 Amp.	0.5%	10 Mv.		720
0-350	0-1.5 Amp.	0.5%	10 Mv.		710
0-350	0-750 Ma.	0.5%	10 Mv.		700
100-325 0-150 Bias	0-150 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	10 Amp.	131
0-300 0-150 Bias	0-150 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	5 Amp.	315
0-150	0-50 Ma.	0.5%	5 Mv.		150
3-30	0-30 Amp.	0.5%	0.1%		3030
1-13	0-10 Amp.	0.5%	10 Mv.		3200
0.3-3	0-100 Ma.	5 Mv.	1 Mv.		3100



MODEL 700

OUTPUT DC: 0-350 volts, 750 ma.

REGULATION: ½% for both line, 105-125 volts, and load variations, 0-750 ma.

RIPPLE: 10 millivolts.

This unit is available delivering:
- 1.50 amp.—Model 710
- 2.25 amp.—Model 720
- 3.00 amp.—Model 730

KEPCO

Voltage Regulated Power Supplies are conservatively rated. The regulation specified for each unit is available under all line and load conditions within the range of the instrument.

DC POWER SUPPLY SPECIFICATIONS

REGULATION: As shown in table for both line fluctuations from 105-125 volts and load variations from minimum to maximum current.

***REGULATION FOR BIAS SUPPLIES:** 10 millivolts for line 105-125 volts. ½% for load at 150 volts.

†All AC Voltages are unregulated.

All units are metered except Models 131, 315 and 3100.

All units are designed for relay rack mounting or bench use.

WORKMANSHIP

Workmanship is of a quality with the highest existing production standards and best instrument electronic practices consistent with the intended use of the item as a continuous duty voltage regulated power supply. Oil filled paper condensers and resistor-board construction are included in the design.

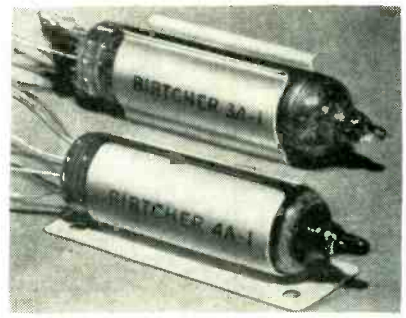
FOR NEW POWER SUPPLY CATALOG—WRITE DEPT. No. 789

MANUFACTURERS OF ELECTRONIC EQUIPMENT • RESEARCH • DEVELOPMENT

KEPCO LABORATORIES

131-38 SANFORD AVENUE • FLUSHING 55, N.Y.

either by connecting it directly from the recorder into an automobile cigarette-lighter outlet (the ideal means while in transit) or from an accessory charger which recharges the battery from regular 115–230 v current.

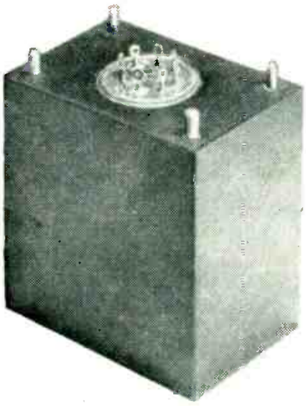


TINY TUBE CLAMPS
reduce bulb temperatures

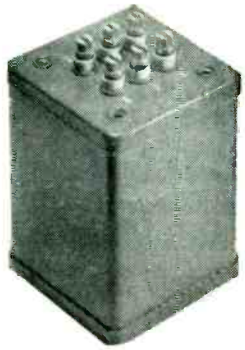
THE BIRTCHER CORP., Los Angeles, Calif., has developed a new subminiature tube clamp for use under conditions of extreme heat, vibration and shock. The clamp is made of a specially developed heat treatable alloy; having a thermal conductivity approximately 70 percent of pure copper. Kool Klamps have been designed to provide maximum heat flow and have been subjected to exhaustive tests and found to reduce bulb temperatures by as much as 40 C. They are made in two types: the clip holder was designed to permit insertion of the tube from top or end; the sleeve holder was designed for end insertion only and is preferred where overall height is critical.

TEST CHAMBER
with built-in thermometer

STATHAM DEVELOPMENT CORP., 12411 W. Olympic Blvd., Los Angeles 64, Calif. Model TC-1 temper-



AIRCRAFT TRANSFORMERS



Keystone is a ***respected*** source for special purpose and custom-made aircraft transformers and magnetic amplifiers. As suppliers to several of the nation's leading prime contractors, we're accustomed to working to unusually difficult standards of accuracy . . . so far as weight, quality and electronic accuracy are concerned.

If you require miniature transformers you'll also find KEYSTONE an unexcelled resource. Engineering service available. Get acquainted with the KEYSTONE brand of service and dependability at once.

"Moto Mag"

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This is the FIRST of *five* pre-designed magnetic amplifiers that will save precious engineering time. If you're designing an aircraft unit — design it around this KP-10-400 Magnetic Amplifier. Then watch your costs tumble down!

MOTO-MAG KP-10-400 is useful in positioning servos, computers, servo motor controls, remote control devices and other units requiring variable phase power. Send for Mechanical and Electrical specifications. Since units are already built, single pieces are available for experiments and tests at modest cost.

Prompt attention given all inquiries

KEYSTONE PRODUCTS COMPANY

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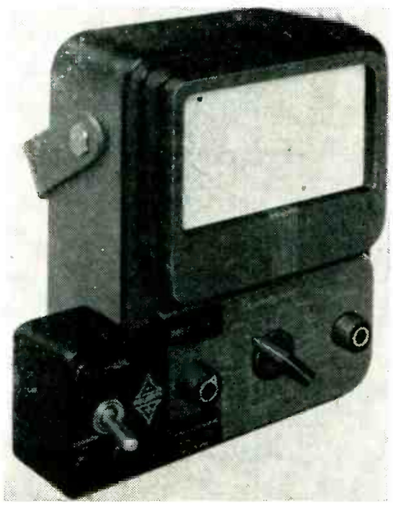
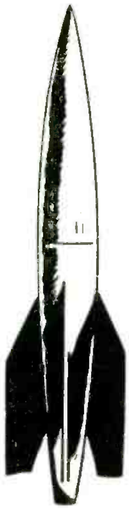
ature test chamber, a compact economical unit for testing ambient temperature variations between —65 and +275 F, can now be equipped with a thermometer as an integral component. This design eliminates the constant expense of replacing thermometers bent or broken by falling test objects. Forced circulation prevents any significant temperature variations between the thermometer and the object on the test tray. Cooling in the test chamber is accomplished with carbon-dioxide ice, and heating by a high-capacity strip heater. Thermostatic control maintains temperature by balancing heat against dry-ice evaporation. The completely portable and self-contained test chamber is ideally suited for the performance of ambient temperature tests on basic instruments, electronic subassemblies, small equipment and organic materials.



SWITCH
reverses polarity instantly

POMONA ELECTRONICS CO., 524 West 5th Ave., Pomona, Calif. Model MS-1 meter reversing polarity switch, designed to assist the radio and electronics technician, reverses polarity when making circuit tests without removing test lead to meter. It can be attached instantly by plugging into test lead holes on Simpson tester model 260 for which it is exclusively designed. The MS-1 is operated by inserting the unit on the left side of the meter in the corresponding



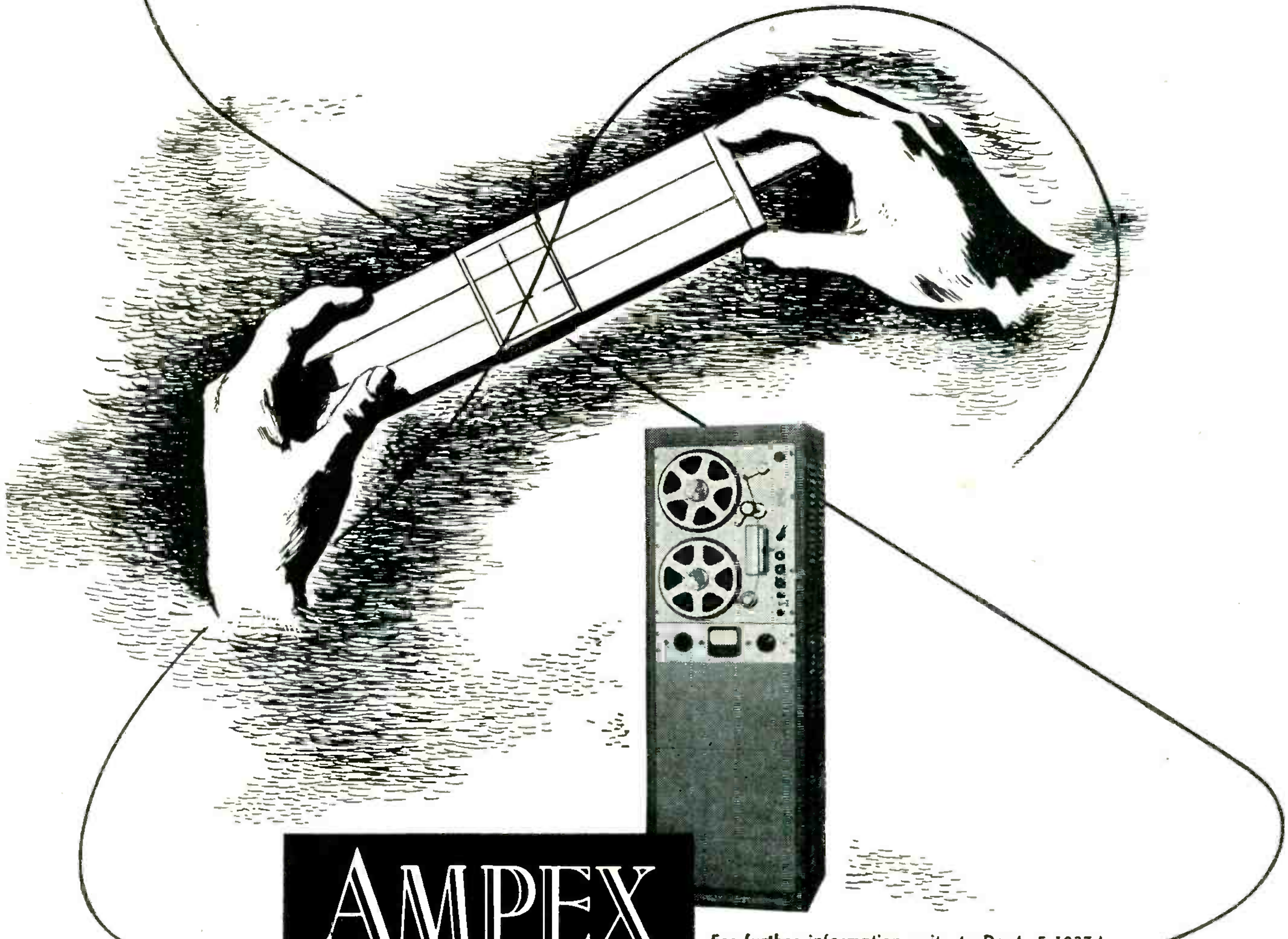
How to fly a guided missile in your laboratory

Practically any electrical, mechanical or physical phenomenon — even the full flight of a guided missile — can be precisely re-created in the laboratory from Ampex magnetic tape recordings.

Ampex retains and plays back data in the same electrical form in which it is received, making its playback in effect equivalent to a rerun of the original test. But it has these added advantages: Data can be repeated at any time or place, can either be scanned or studied in whole or part, can be speeded up or slowed down, can be fed to automatic reduction systems. Furthermore, desired portions of the data can be reduced to oscillograph traces, pen recordings or any other form that could have been made at the time of the original test.

Besides the convenience and versatility of the data itself, Ampex Magnetic Recorders and the tape they use have these desirable physical qualities:

- *Ampex Tape Recorders, being rugged, compact and portable, are usable where other equipment would not be feasible;*
- *Tape requires no processing, hence is immediately available for playback;*
- *Tape stores an enormous quantity of information at low cost and in minimum bulk.*
- *Ampex Tape Recorders cover extremely wide frequency range:*
  Model 306 — 0 to 5000 cycles/sec.
  Model 307 — 100 to 100,000 cycles/sec.
  Model 303 — Pulse width modulation
  Many other models are also available.



AMPEX

MAGNETIC RECORDERS

For further information write to Dept. E-1037A

AMPEX ELECTRIC CORPORATION
934 CHARTER STREET • REDWOOD CITY, CALIF.

Want more information? Use post card on last page.

tip jacks. The toggle switch position on the MS-1 will indicate polarity of the circuit being tested. This eliminates the necessity of reversing the meter test leads manually to obtain correct polarity. It saves time in circuit testing and reduces shock hazard. The unit is of compact durable phenolic construction.

TINY DIFFERENTIAL
is extremely accurate

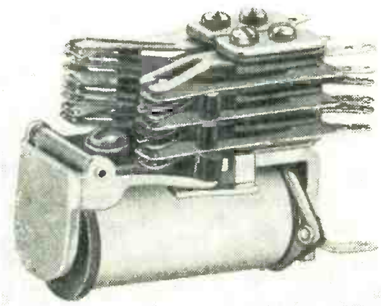
BELOCK INSTRUMENT CORP., 13-11 111th St., College Point, N. Y. The $\frac{1}{16}$-in. subminiature differential is designed for application where accuracy must be maintained in a minimum of space. The end gears are available in 64 or 96 pitch and any pitch diameter that can be cut from a $\frac{1}{2}$-in. maximum outside diameter to $\frac{1}{4}$-in. minimum root diameter. All gears are phosphor bronze to insure maximum life of the differential. Minimum backlash combined with low breakaway and running torques give the differential extremely high accuracy for a unit of this type and size. Breakaway torque is 0.15 oz in.; maximum torque, 12 oz in.; maximum rpm, 600; and backlash, 18 minutes.

CONTROL SYSTEM
for broadcast transmitters

THE HAMMARLUND MFG. CO., INC., 460 W. 34th St., New York 1, N. Y., has introduced a control system for unattended broadcast transmitters designed and built in accordance with the recently announced FCC regulation. Only a single a-f telephone circuit is required. VHF or microwave may be used but no d-c circuit is needed. The system also features full control of up to 9 separate circuits, and includes up to 4 emergency alarm indications. It consists of 3 separate sections: (1) The control panel (illustrated) for installation at the operator's console; (2) a second section of equipment installed at the control point, consisting of a number of a-f tone transmitters and receivers; and (3) a section installed at the remote broadcast transmitter, consisting of a-f tone generators and selective amplifiers, the telemetering transmitter, the control selector and an alarm keying mechanism.

LOADING COIL
for mobile antennas

K-W ENGINEERING WORKS, 3145-A N. 48th St., Milwaukee 16, Wisc. The Dyna-Q mobile antenna loading coil provides the radio amateur, small-boat owner and other users of the medium-frequency services with a dynamically efficient inductance for resonating the antenna. The Q approaches 300 at 4.0 mc. Used with a 10-meter whip above the coil the loading coils are suitable for either base or center loading. With shorting jumpers the coil will serve from 3 to 30 mc. Insulation is polystyrene, and fittings, chrome-plated brass. Turns need not be pruned from the coil, thus the frequency of the antenna can be lowered as well as raised.

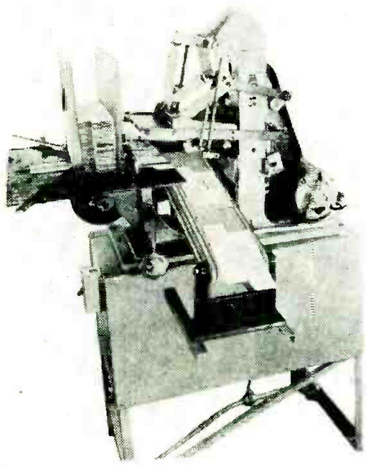


RELAYS
in four new types

JOSEPH POLLAK CORP., 81 Freeport St., Boston 22, Mass., is producing a newly developed line of relays among which are the series 100 d-c computer relay (illustrated), the series 300 d-c miniature relay, the series 400 a-c or d-c coaxial relay, and the series 500 d-c communications relay. Bearings of the series 100 have essentially zero friction and the relay has a life span of ten million cycles. The series 300 weigh under 2 oz and incorporate a special antivibration feature. The series 400 withstand 10-g vibration at 10 to 55 cps under operation tests. Since the series 500 relays can perform mechanical work in addition to operating contacts, they are ideal for those applications where automatic punching is required for control-system applications. A 12-page catalog is available.

POWER SUPPLY
is also demodulator

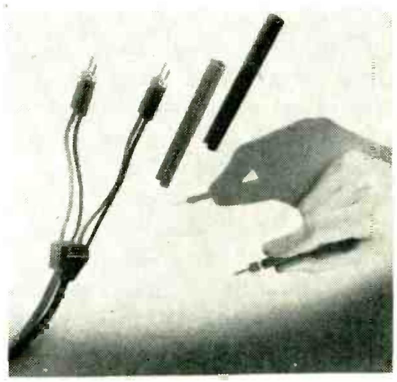
DOELCAM CORP., Soldiers Field Rd., Boston 35, Mass. The VFDD is a precision flight-test instrument consisting of power supply and 3-channel demodulator unit designed specifically to serve as the link between sensing instruments and oscillograph recording equipment. The power-supply section is ideally suited for exciting many types of transducers, such as gyros, accelerometers, position indicators or synchros. The demodulator section comprises 3 demodulator channels to transform 400-cps signals to d-c for use with recording galvanometers. The unit features regulated voltage—constant within 1 percent under all operating conditions; frequency stabilization—drift will not exceed 0.2 percent; and linear demodulation—linearity within 1 percent of full scale.



MARKING MACHINE operates automatically

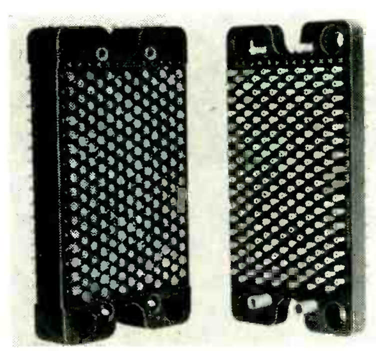
Markem Machine Co., Keene 40, N. H., has announced a new marking machine for printing on flat folding boxes, corrugated cartons, plastic panels, abrasive stones and other flat objects up to $\frac{3}{4}$ in. in thickness. Objects to be marked are automatically fed into the machine, printed and ejected at a rate of 80 imprints per minute. The automatic feed table has adjustable side gages that are easily moved to accommodate objects up to 5 in. × 14 in. Maximum imprint area is 2$\frac{5}{16}$ in. × 6$\frac{11}{16}$ in.; and the imprint may be located anywhere in an area 5 in. × 11 in. The unit, model 45AE, is mounted on a floor stand

and occupies floor space of 36 in. × 28 in.; total height, 50 in. It is powered by a $\frac{1}{8}$ hp motor.



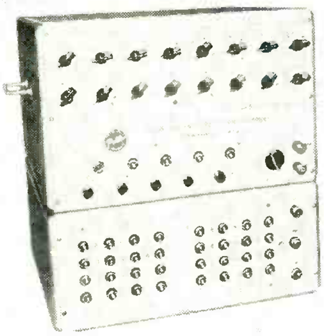
INSULATING TUBING
is especially rugged

ANCHOR PLASTICS CO., INC., 36-36 36th St., Long Island City 6, N. Y. An Ethocel tube in red and black was recently specified by the Signal Corps for a banana-type plug used on Radio City Products' model TX297/U multimeter. The test set, which is used to measure circuit values, must withstand extremes in operating conditions and all components have to be especially rugged. Ethocel tubing extruded to specifications was chosen for this purpose because of its toughness and insulating values. Coloring of the plastic is throughout the material assuring positive identification of polarity even after years of use. The Ethocel insulated banana plug is connected to a heavy neoprene-covered wire which terminates in a molded neoprene junction.



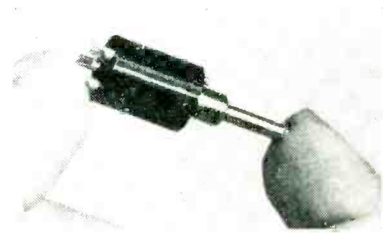
CONNECTORS
are quick-disconnecting

WINCHESTER ELECTRONICS, INC., Glenbrook, Conn. A new addition to the line of quick-disconnecting connectors is the QRE 208. Particularly suitable for rack and panel mounting, floating contacts have 0.073-in. diameter solder cups for No. 16 AWG and assure proper play for self-alignment. Four heavy guide pilots and sockets serve to polarize mating connector parts. Contacts and metal parts are precision machined and gold plated over silver for low contact resistance, prevention of corrosion and ease of soldering. Molded melamine bodies provide high dielectric, arc resistance and mechanical strength. Monobloc one-piece construction eliminates unnecessary creepage paths and dust pockets. Four $\frac{5}{16}$-in. diameter holes are provided on both the plug and receptacle for mounting purposes. Voltage breakdown between contacts at sea level is 5,700 v d-c; at 60,000 feet altitude, 1,200 v d-c. Weight of plug is 13.9 oz; receptacle 24 oz.



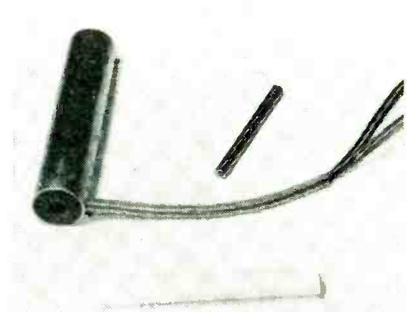
PROCESS CONTROL
is a multisequency device

POTTER INSTRUMENT CO., INC., 115 Cutter Mill Road, Great Neck, N. Y. A versatile new electronic predetermined counter has been designed for use wherever precise, multiple sequence control of manufacturing processes is desired. Increased production and reduced spoilage are achieved with the use of the new counter because it is possible to govern the operation of production machinery in terms of lineal measurement, shaft revolutions, quantity, volume or weight at operation speeds as high as 60,000 per minute. The new true-count method is not affected by speed changes or shutdowns, thus offering precise control not otherwise possible. The 4-sequence unit illustrated is one of a line now available. Each channel may be preset for any number from 0 to 9,999. Switching through the 4 channels is automatic at the end of the preset count. Separate relay outputs for each channel provide a voltage pulse for each at the end of its count.



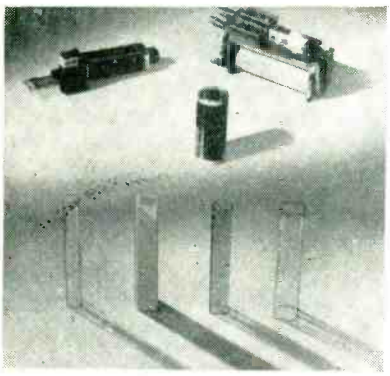
POTENTIOMETERS
are miniature wire-bound

AEROHM CORP., 282 Moody St., Waltham 54, Mass. The AP-½ linear wire-wound potentiometer has been designed to solve requirements for small space and light weight. Its all-metal case is only ½ in. in diameter × $\frac{5}{8}$ in. deep. The standard model pictured weighs less than ½ oz. This potentiometer will operate between −55 C and +85 C. At 25 C its dissipation is approximately 5 w. It also features soldered electrical connections, precious metal contacts to windings and slip rings, coin-silver tabs to protect end turns and gold-plated fork terminals to facilitate wiring. Resistances range from 10 to 10,000 ohms. Shaft locks, rotational stops, special shafts and bushings are available on order.



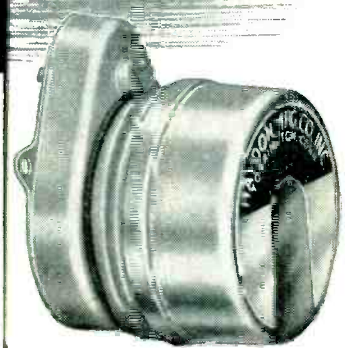
VELOCITY PICKOFF
has cylindrical p-m core

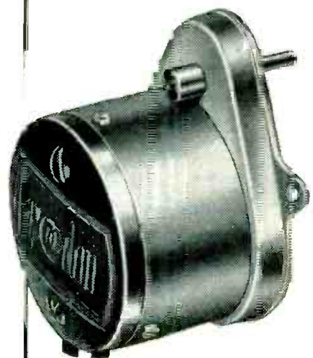
CONTROL COMPONENTS CO., 46 Walnut St., Brookline 47, Mass., has added a series of high-sensitivity linear-motion velocity pickoffs known as LVsyns to their line of linear displacement differential-transformer pickoffs. The LVsyn is a shielded cylindrical coil assembly having a coaxial hole and a cylindrical high-coercive force permanent-magnet core. The magnet core is free to move in the coaxial hole which runs the full length of the coil assembly. The relative velocity of the core with respect to the coil assembly results in the output signal. The pickoff is being used in control systems requiring velocity feedback and in machine design and ballistic instrumentation problems. Maximum displacement ranges are from a few thousandths of an inch to several inches. The sensitivity is a function of the size of the pickoff. For example, the 6V8, which has a stroke of 1 in., has a sensitivity of 450 mc per ips.



PLASTIC COIL CORES are highly durable

ANCHOR PLASTICS CO., INC., 36-36 36th St., Long Island City 6, N. Y., has announced extruded plastic coil cores for relay transformer, choke and other coils. The solid-wall plastic cores are more economical as well as more durable than the spiral-wrapped variety. Since they are of one piece construction without any seams they have greater strength and can therefore be made with thinner walls. The latter feature makes for increased magnetic flux strength due to the decreased distance between the coil and the iron core. An additional advantage of these cores is the possibility of color coding. Ex-





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truded coil cores are made to specification in square, rectangular, round or oval shapes and in any color.

FOCUS COIL
for lab and military use

SYNTRONIC INSTRUMENTS, INC., 100 Industrial Road, Addison, Ill. Designed for use as a precision standard for checking the distortions in production focus coils and as a component in units or applications requiring sharpest focus, a new electromagnetic focus coil has been announced. Type F10 fits c-r tubes having a 1½-in. maximum neck diameter. The coil will withstand up to 18 kv accelerating potential. Spot distortion is entirely eliminated by a $\frac{1}{10}$-in. wall machined case. This results in an extremely uniform focusing field. External magnetic fields are completely eliminated by the nature of the design. As a result, there is no distortion or beam bending in the magnetic gun, no beam shadowing and no interference with other components. The unit may also be used for centering the beam if desired. Complete mechanical and electrical data are available.

RESISTORS
meet military requirements

REON RESISTOR CORP., 117 Stanley Ave., Yonkers, N. Y., has available its RB series high-quality precision wire-wound resistors in tolerances up to 0.02 percent. Ratings of ¼, ⅓, ½ and 1 watt are provided in resistances ranging from 0.1 ohm to 3 megohms, stable mechanically from −55 C to 105 C. Tinned brass lug terminals designed for resiliency as well as strength are fitted on these resistors, which show less than 0.05-percent change in resistance after completion of MIL-R-93A tests.

H-V SELENIUM RECTIFIER enclosed in phenolic tubes

BRADLEY LABORATORIES, INC., New Haven, Conn. The SE7 line of h-v selenium rectifiers incorporates a new design in which the plates are produced on multiple tools. The unit is completely enclosed in a phenolic tube with an internal spring closure. Units in the line are rated up to 6,000 v peak inverse. The individual rectifiers range from 200 μa d-c to 12.5 ma d-c. The units measure from ¼ to ⅝ in. in diameter and from ⅝ to 5¼ in. long.

POSITION INDICATOR for measurement and control

DOELCAM CORP., Soldiers Field Rd., Boston 35, Mass. The Microsyn position indicator is a small electromechanical signal generator that accurately transforms angular displacement into an electrical signal for measurement of any mechanical variable. This electrical signal output, in conjunction with an appropriate feedback system, may be used to control industrial processes. It features linear output, resolution to 1/100 degree, negligible reaction torque and sensitivity up to 7 v per degree. Tested and perfected as a standard military component for use in gyro instruments and computers, it is now finding wide application in the industrial fields of

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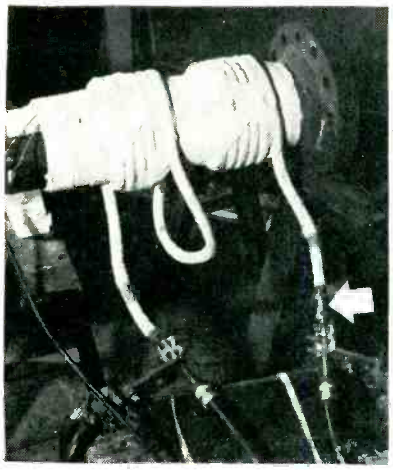
process control, data transmission, measurement of mechanical variables and analog computation. Write direct for bulletin M.

MOISTURE METERS
available in two types

MARCONI INSTRUMENT LTD., 23 Beaver St., New York 4, N. Y. The Kappa electronic moisture meters operate at radio frequency on the capacity change principle and are capable of measuring the moisture content of a substance with water content as low as 0.5 percent, and at the other end of the scale, as high as 70 percent water. The instrument is manufactured in two degrees of sensitivity—the all-purpose and the S type. The S type has an expanded scale between 0 and 15 percent moisture. The all-purpose type permits a discrimination better than 0.07 percent moisture.

DEFLECTION YOKE
fits 1½-in. neck crt's

SYNTRONIC INSTRUMENTS, INC., 100 Industrial Rd., Addison, Ill., has designed a magnetic deflection yoke for military and oscilloscope applications. Type Y15-5 is especially suited to push-pull applications requiring maximum resolution and high efficiency. It is available in normal, high or extremely high sensitivity. The yoke is of the square core, parallel-opposed magnetic-field type and fits 1½-in. neck diameter c-r tubes. Deflection angle is up to 50 deg. Type Y15-5 is available over a wide range of impedances in single-ended or push-pull combinations.



CONDUCTOR
is flexible, water-cooled

TITEFLEX, INC., 500 Frelinghuysen Ave., Newark 5, N. J., has developed a water-cooled l-f conductor that (1) has the necessary flexibility to be coiled repeatedly, even in small diameters; (2) has a large enough i.d. to carry 3 gallons of water per minute to cool the coils; and (3) will carry low-voltage, high-amperage current with minimum power loss. An induction heating setup employing these new conductors, used for relieving stresses in large diameter pipe, is illustrated. With these conductors the asbestos stocking over the coil never deteriorates from excessive heat and therefore never needs replacement on that score.

SUPER-REGULATOR
has high-gain d-c amplifier

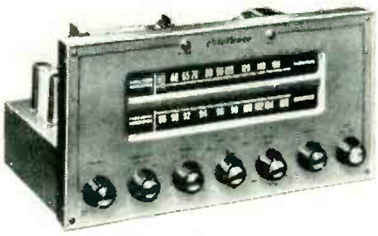
KALBFELL LABORATORIES, INC., 1090 Morena Blvd., San Diego 10, Calif. Model 121 super-regulator was designed for use with ordinary regulated or unregulated power supplies. It produces the ultimate in power-supply performance. It affords an extremely low impedance d-c voltage source with very low ripple and noise content. Output impedance is 0.005 ohm at d-c and 0.001 ohm for a-c. The unit employs a high-gain d-c amplifier (gain in excess of 105 db). It has an etched-board type of construction that keeps all units within very close tolerance, and also provides increased life and reliability. No electrolytic capacitors are employed in the operating circuitry. The unit is extremely useful whereever analysis of more than one circuit operating from the same supply is being performed.

LIQUID PLASTIC for component sealing

JAVEX, P. O. Box 646, Redlands, Calif., has announced a line of Epoxy resins that are being widely used and accepted in the electronic field for bonding, coating and encapsulation of all types of components. Javabond, the new liquid plastic, possesses excellent electrical properties and practically zero shrinkage. Excellent adhesion to metals, ceramics and other materials, make it possible to fulfill the demands of unusual applications. It sets to a hard consistency, and may be extended or colored with fillers.

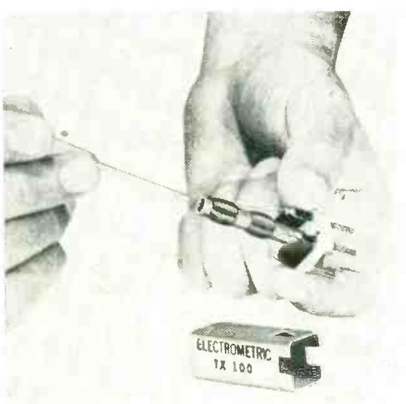
TV BAR GENERATOR covers 18 cps to 108 mc

ELECTRONIC MEASUREMENTS CORP., 280 Lafayette St., New York, N. Y., has announced a new r-f a-f crystal marker and tv bar generator. Model 700 gives complete coverage from 18 cps to 108 mc on fundamentals. It provides a bar generator for tv adjustment with a variable number of bars available for horizontal or vertical alignment and a square-wave generator to 20 kc. It features a Wien bridge a-f oscillator with sine-wave output from 18 cps to 300 kc and crystal marker and amplitude control. Other features include individually tuned coils, constant r-f output impedance, stepped r-f attenuator, electrostatically shielded transformer, thorough shielding, Colpitts r-f oscillator from 300 kc to 108 mc on fundamentals—up to 216 mc on second harmonic—and variable percentage of modulation.



F-M/A-M TUNER
incorporates 10 tubes

PILOT RADIO CORP., Long Island City, N. Y. The AF-824 tuner has a frequency range of 88 to 108 mc on f-m and 540 to 1,700 kc for a-m. Sensitivity for f-m is 10 μv for 20-db quieting; a-m—10 μv for 0.2-v output. Selectivity on f-m is 6 db down at 200 kc; a-m— 6 db down at 9 kc. Peak to peak separation is 320 kc, linear for 190 kc. Audio distortion is less than 0.2 percent at 1-v output. Maximum audio output is 3 v. Power consumption is 117 v, 60 cycles, 50 watts.



I-F TRANSFORMER
with single-end tuning

ELECTROMETRIC CO., Woodstock, Ill. Tuning both coils from the same end is one important feature of a new miniature i-f transformer type TX100, now available. Both coils can be tuned either from the top or from the bottom. This permits faster set alignment, reducing radio set production costs. Another result is a greater freedom of radio chassis design. Field trouble is minimized because all connections are soldered. Coil leads are not subject to breakage because they are soldered directly to the tops of the terminals. High Q is the result of a unique delay-line-type winding. Because the type TX100 is temperature compensated for low drift, it delivers constant high performance over a wide temperature range. It can be used for any application requiring a $\frac{3}{8}$-in. i-f transformer; and is available in a wide range of inductances and Q's for a-m, f-m, tv and military applications.

Literature

Induction Generators. Ai Research Mfg. Co., Los Angeles 45, Calif. Operating principles of a line of induction generators for aircraft and guided missiles are outlined in booklet No. EB-3-1. The booklet, illustrated with charts and photographs, contains descriptions of design features, operating function, performance characteristics and applications. In addition, equations are supplied to allow modification of performance characteristics.

C-R Oscillograph. Allen B. DuMont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J., has issued a descriptive bulletin on the type 301-A, a miniaturized wide-band quantitative c-r oscillograph. The bulletin's front cover is an actual-size illustration of the instrument's front panel, while fold-outs of the bulletin illustrate depth of instrument, providing an actual-size, 3-dimensional mock-up of the unit. Complete electrical and mechanical specifications are included.

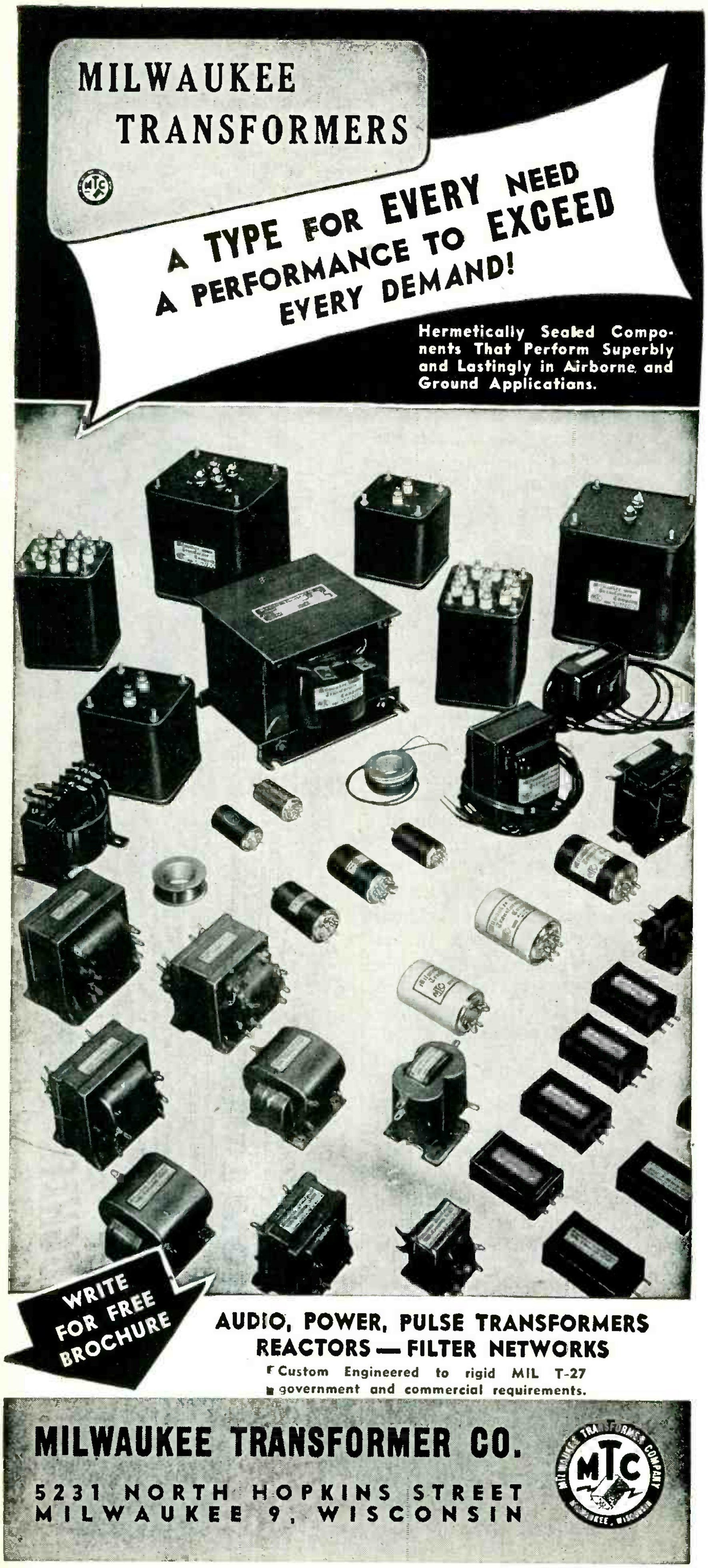
Electromagnetic Focus Coils. Syntronic Instruments, Inc., 100 Industrial Road, Addison, Ill., has available a new catalog page illustrating and describing two new electromagnetic focus coils. Type F10, for 1½-in. neck diameters, is for laboratory, military and special-purpose applications. Type F30, for 2½-in. neck diameters, is for projection, laboratory and special-purpose applications. Complete technical information includes dimensional drawings and electrical and mechanical data.

Guided-Missile Instrumentation. Electronic Engineering Co. of California, 180 So. Alvarado St., Los Angeles 4, Calif. A 24-page booklet discusses company facilities and experience and also illustrates and describes such equipment as timing and firing systems, radar components, a chain radar system, telemetering equipment, digital data-transmission equipment, missile-tracking optical equipment, plotting boards and data-reduction equipment. Also included are a listing of government contracts and plug-in unit information.

Vibrator Power Supplies. Collins Mfg. Co., 726 N. Kresson St., Baltimore 5, Md. A single-sheet bulletin illustrates and describes the Vibration miniature high-frequency vibrator power supplies. The units discussed operate at 400 cycles and higher; and are designed for input voltages from 1.5 to 32 v d-c; for outputs, 400-cycle a-c or filtered h-v d-c. Included are specifications for the representative, custom-designed model VC2-4.

Electronic Parts Catalog. Radio Shack Corp., 167 Washington St., Boston 8, Mass. The 224-page edition of the 1954 electronic parts mail-order catalog includes a 32-page rotogravure section covering high-fidelity custom music systems. Highlighting the newer products are extensive listings of transistors and germanium diodes; antennas, converters and test equipment for uhf-tv; printed circuit components; and radiation detection apparatus. The catalog lists and illustrates over 30,000 products.

Electronic Equipment Decals. Tekni-Labels Co., 232 N. Glenoaks Blvd., Burbank, Calif., has available a booklet describing its electronic equipment decals for design

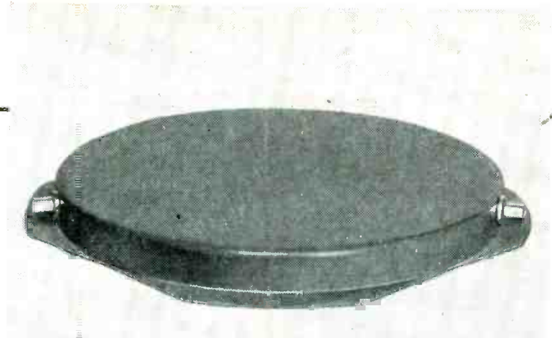


laboratories, engineers, experimenters, hobbyists, amateurs and military services. It lists alphabet and trademark decals. Designs included effect a great saving if only one item of equipment is to be marked. Use of these decals speeds work also, because the equipment can be titled right at the technician's bench. Included among the decals described are those for dials, panel titles, tv, audio, receiving tubes, transmitters, instruments and receivers.

Microwave Test Equipment. Douglas Microwave Co., Inc., 338 E. 95th St., New York 28, N. Y., has available a catalog presenting its complete line of precision microwave test equipment and component parts. The instruments described therein embody the latest design improvements and, where possible, are designed for broadband applications. Corrosion resistance is maximized by utilizing appropriate electroplating finishes. In general, all conducting surfaces are silver plated and rhodium flashed to insure permanent high conductivity. Detailed specifications concerning the catalog items are available.

Antennas and Boosters. Channel Master Corp., Ellenville, N. Y., has published an informative 16-page booklet discussing the factors that determine the performance of tv antennas and boosters. Written specifically for the benefit of tv installation and servicemen, the profusely illustrated booklet defines and analyzes gain, directivity and impedance. It also covers the four standards of booster performance—gain, noise figure, vswr and balance-to-unbalance ratio. An explanation of how these qualities are isolated and measured in the laboratory is also included.

Environmental Test Cabinets. Hudson Bay Division, Refrigeration Systems, Inc., 646 W. Washington Blvd., Chicago 6, Ill. Descriptive bulletin 108-102 covers a recently improved line of environmental test cabinets. The line includes stratosphere test chambers for altitude simulation between atmospheric pressure and 100,000 ft,



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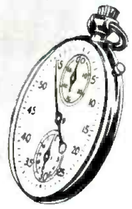

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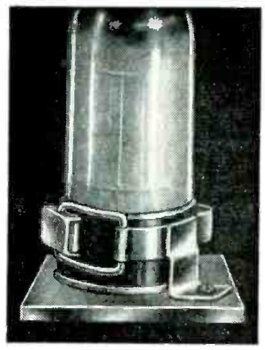

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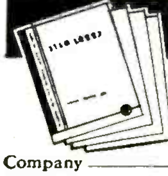

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temperature control between −100 and +200 F and humidity control between 20 and 95 percent. Each of the 3 types of available units is illustrated. Views are also included showing typical control, and air-circulating and conditioning arrangements.

Paper Tubulars. Cornell-Dubilier Electric Corp., 333 Hamilton Blvd., South Plainfield, N. J. Bulletin NB154 covers the new Budroc steatite-cased paper tubular capacitors. The capacitors described are of noninductive construction and housed in a ceramic (steatite) tube with Polykane end seals. Outstanding features, test data and average temperature characteristics charts are given.

Six-Channel Recorder. Goodyear Aircraft Corp., Akron 15, Ohio, has released a 4-page folder illustrating and describing model GN215-R5 GEDA 6-channel recorder that was specifically developed as an accessory to analog computers. The unit discussed is particularly adapted to the recording of solutions to complex dynamic problems and the testing of such devices as servomechanisms. Complete technical specifications are given.

Piston Capacitors. JFD Mfg. Co., Inc., 6101 16th Ave., Brooklyn 4, N. Y., has available a new 4-page brochure, No. 220, on piston-type variable trimmer capacitors for industrial, military, experimental and radio trade requirements. Also available is a one-page flyer (form No. 226) detailing the company's new miniature uhf piston capacitor—the Mighty Midget model VC3-G—complete with capacitance range, dielectric details, figures on moisture resistance, temperature coefficient of capacitance and universal mounting.

Transistor Manual. CBS-Hytron, A Division of the Columbia Broadcasting System, Inc., Danvers, Mass. Profusely illustrated, the new 8-page transistor manual is in three parts—theory, data and application. It contains nine different basic transistor applications. Both point-contact and junction transistor operation are explained by

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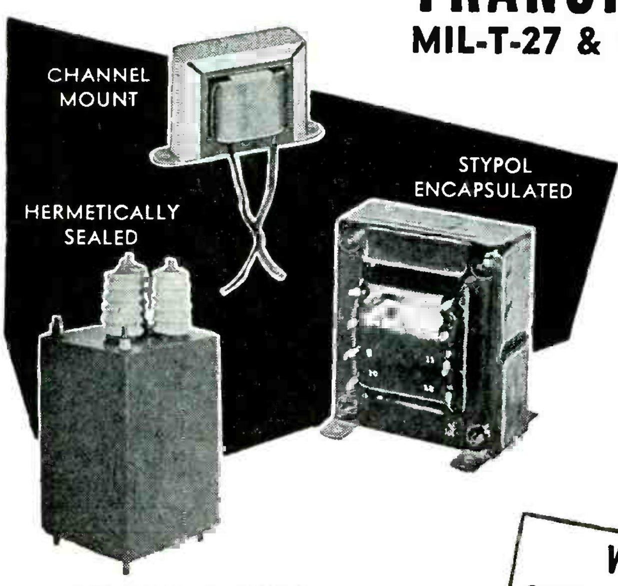

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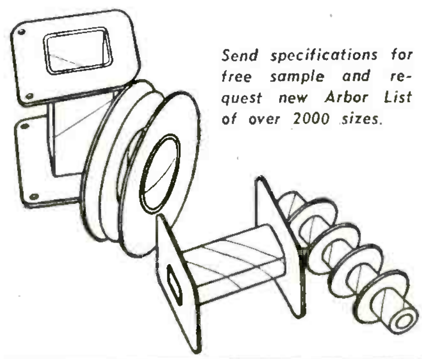

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vacuum-tube analogy. Also clearly described are conduction by holes, and *pnp* and *npn* transistors. Reduction of equipment size, elimination of filament-power requirements, instantaneous operation and exceptionally long life are among the advantages cited. Included in the manual's application section, which constitutes an introduction to transistor circuitry, are hearing-aid and radio-receiving circuits that employ transistors and a circuit for use in switching applications.

Electrical Insulation Price Catalog. Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill., has available a new 140-page catalog including information on standard put-ups, terms and aggregation policies. A table of contents and an alphabetical product index serve as guides to product prices in 12 different sections. The catalog includes prices on such material as: cords and twines, untreated woven tapes, sleevings and tubings, paper and paper products, slot wedges, reinforced or laminated plastics, vulcanized fibre, plastic or resinous films, pressure-sensitive tapes, varnishes and compounds, mica products, varnished fabrics and paper combinations and miscellaneous materials.

Packaged Plug-In Circuits. Electronic Engineering Co. of Calif., 180 South Alvarado St., Los Angeles 57, Calif. A new line of packaged plug-in circuits which may be taken apart is described in a new 12-page brochure that tells how the units were designed, advantages in their use, applications and specifications for the 20 off-the-shelf versions. The brochure also lists 26 other types of plug-in circuits that are available on special order plus information on how the new take-apart units may be used to advantage in all types of electronic equipment.

Transformers. Chicago Standard Transformer Corp., Addison and Elston, Chicago 18, Ill., has released a new catalog sheet, bulletin 467. The publication describes 6 transformers recently added to the com-

(Advertisement)

Indicating Meter Gives Automatic Direct Control

This Contact Meter Relay provides sensitive, direct control for alarm and automatic shut-off, or continuous on-and-off circuit interruption on ½ uA. or 0.1 MV.

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Model 451-C (shown) has a full scale 4" 90° arc with ranges of 0-20 microamperes or 0-5 millivolts. It is also available in compensated temperature millivoltmeters. Models 351-C and 261-C also have a full 90° arc. The meters are sensitive to changes of less than 1% of scale range. Differential between make and break is less than 1%.

Contact Meter Relays are used in electronic equipment, industrial speed-feed controls, chemical process titration and temperature controls, radiation warning and control devices, digital computors, auto-switching of standby microwave equipment.

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pany's line of stock components. Complete electrical and physical specifications are listed for three power transformers: P-6348, PC8422 and PM8422; two audio output transformers: A-3337 and A-3839; and a heavy-duty plate transformer, P-8044, for amateur use.

Photo-Recording Manual. Allen B. DuMont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J. A 36-page manual offers a complete review of the problems and associated solutions encountered in photographing c-r patterns. The publication is profusely illustrated with actual photo-recordings, scales, graphs and diagrammatic sketches. In addition to technique information, it contains complete descriptions and specifications of the company's line of photo-recording equipment. The manual is offered to qualified personnel requesting copies on business letterheads.

Instrumentation For Research. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa. The 6-page bulletin, 14-1, describes various electronic instruments that will help speed research and test problems. The bulletin briefly covers the way such instruments can help the research man, and includes descriptions of various servo-components and accessories which are also useful to the research and laboratory men.

Feed-Through Terminals. The Fusite Corp., 6000 Fernview Ave., Cincinnati 13, Ohio. A new 20-page catalog describes a complete line of hermetically sealed glass-to-steel electrical feed-through terminals. Ten different groups of terminals are described and drawn in detail. These include such variations as miniature singles, standard size singles, stand-offs, threaded bushing, multiples, miniature multiples, plug-ins and crystal can headers. Flange and panel treatments are also discussed. Besides the listing of the terminals, pertinent information is also included on specifications and electrode designs. Soldering suggestions are described

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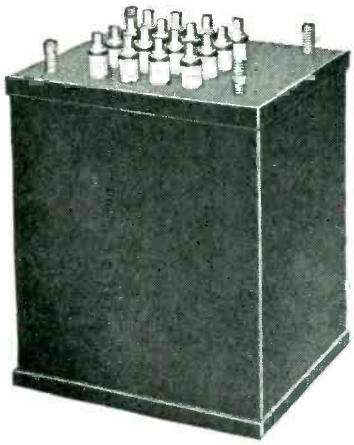

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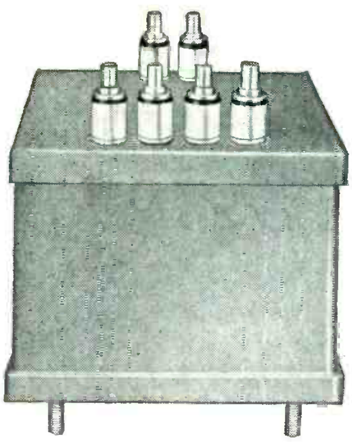

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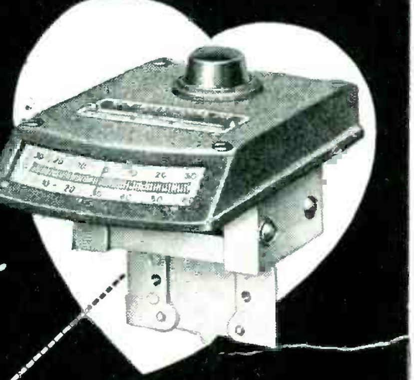

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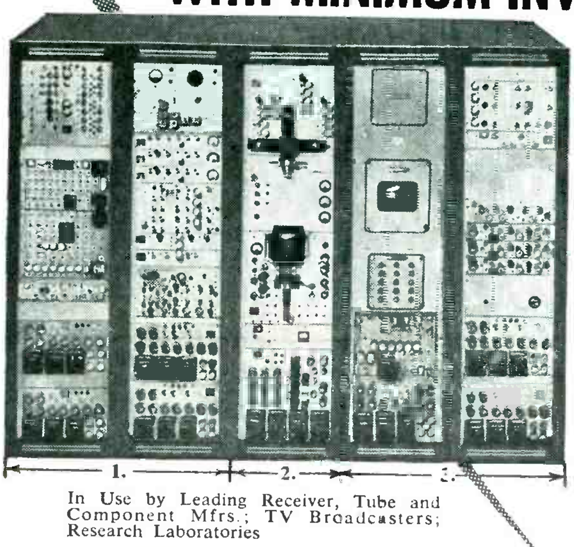

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while short case histories on the use of the terminals are included.

Rivet Catalog. Townsend Co., New Brighton, Pa., has issued a 12-page catalog describing in detail its complete line of Cherry Blind rivets—the rivet that is installed by one man from one side of the work and is comparable to conventional rivets in strength and installation speed. The new catalog includes information on applications, mechanical specifications, types, descriptions and data on the rivet guns for application, and a list of stock blind rivets available.

Transducer. Statham Laboratories, Inc., 12401 West Olympic Blvd., Los Angeles 64, Calif. A single-sheet bulletin covers the model GI transducer, a research tool designed for the measurement of forces from ± 1.5 oz to ± 80 oz and for the measurement of displacements of ± 0.0015 in. Included are an illustration and dimensional diagram, and a selection table showing force ranges, displacement ranges, nominal bridge resistances, rated input, full-scale open-circuit outputs and natural frequencies. Complete technical specifications are given.

Submicrosecond Flash Unit. Edgerton, Germeshausen & Grier, Inc., 160 Brookline Ave., Boston, Mass., has published a 4-page folder illustrating and describing the type 2307 double-flash submicrosecond flash unit for silhouette photography. The unit described was developed for the measurement of the velocities and patterns of air shock waves produced by explosives or the speeds of objects moving up to 8,000 feet per second. The entire electronic control equipment and the optical system are contained in a metal case 12 in. high $\times$ 10 in. $\times$ 20 in. long, weighing 45 lb.

Electrical Control. Micro Switch, Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill. Catalog No. 59 is a 12-page booklet dealing with Microtrip, an electric clutch control for power machines. The well illustrated booklet contains charts giving information for

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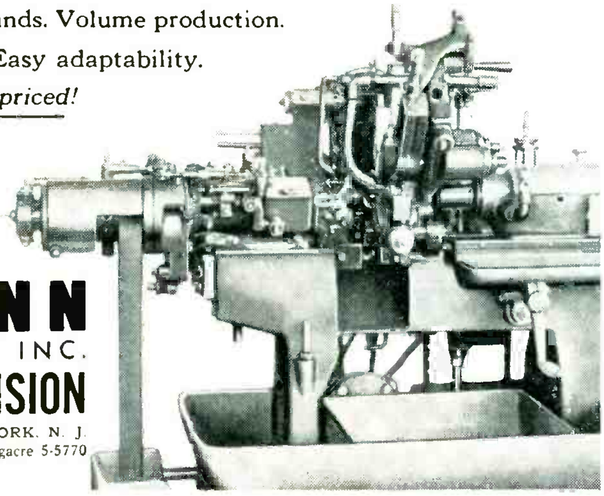

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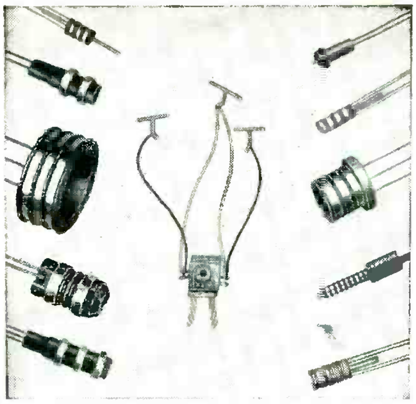
Anniversary Booklet. Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill., has published a 25th-anniversary booklet that presents easy-to-read information on company policies and operations. One section describes the nature of IMC and how it differs from other companies. This is followed by material on products, who supplies them, and their use. Graphic charts illustrate the company's organizational plan, sales growth and sales territories. Complete lists of directors, officers and employees are given. Copies are available on request.

Pyrometer Supplies. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa., illustrates and describes its pyrometer supplies in the newly revised buyers guide, 100-5. All general thermocouple assemblies and components are listed, as well as many special-purpose items. Prices and several pages on selection, care and application of thermocouples round out this 48-page catalog.

Production Engineering. Designers for Industry, Inc., 2915 Detroit Ave., Cleveland 13, Ohio. A 4-page bulletin gives a practical definition of how products are adapted to production-engineering techniques which include design analysis, production processing, process specification and work simplification. It includes a description of how these services are applied in the development and testing of prototype production models and special-purpose machinery.

Dual-Beam C-R Voltmeter. Allen B. DuMont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J., has published a bulletin on the new type 322-A c-r oscillograph. The bulletin contains complete technical specifications, description, and photo-recordings made with the new instrument. The unit described is an improved, redesigned counterpart of the type 322 dual-beam c-r oscillograph with the added feature



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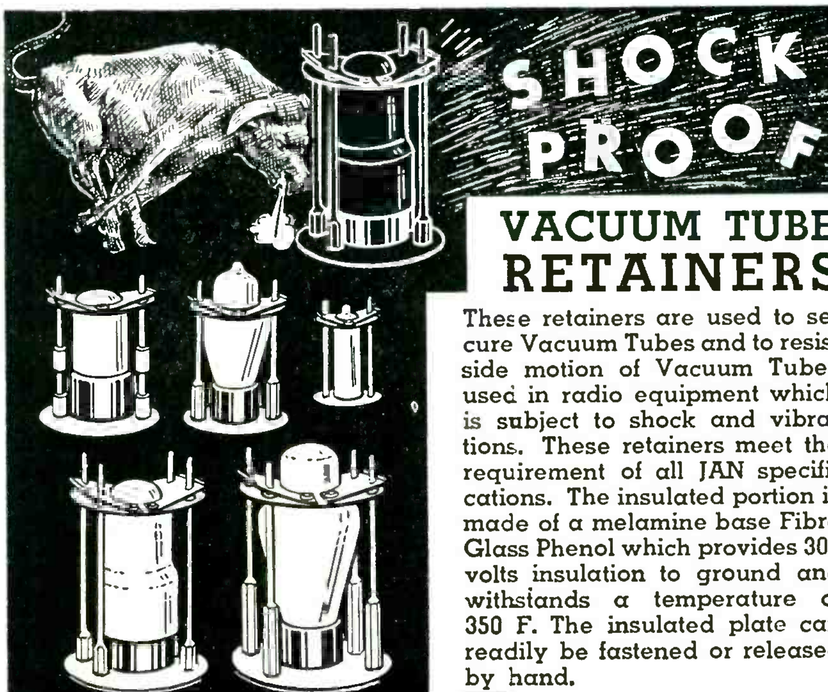

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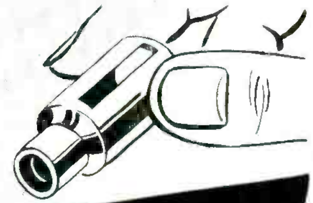

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of built-in independent voltage calibration for both beams, and which also incorporates the new tight-tolerance type 5AFP c-r tube.

Toroids & Coils. Burnell & Company, 45 Warburton Ave., Yonkers 2, N. Y., has available a 12-page catalog which gives valuable and complete information on toroids, high-quality coils and various audio filter networks. It includes complete descriptions, attenuation and Q curves that will prove valuable for equipment design engineers. Write for catalog 101-A.

Continuous Level Indicator. Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. Fourth St., Philadelphia 33, Pa. The new Telstor electronic level indicator is illustrated and described in a graphic 8-page bulletin just released. The instrument discussed features simplified circuitry, accuracy to ±2 percent and continuous indication at remote or local stations.

Attenuator Bulletin. Waveline Inc., Caldwell, N. J., has available a new 4-page brochure illustrating the company's complete line of fixed and variable attenuators, covering the frequency range from 2,600 to 26,500 mc. These attenuators are calibrated to ±0.3 db. Complete specifications and prices are included for 21 types.

Recording Potentiometer. Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J., offers a new booklet that fully illustrates and describes all features of its simplified recording potentiometer. The instrument discussed is of completely new design with all parts interchangeable, with a universal slide wire that never needs changing, and which permits chart speeds to be changed on-the-line by a simple screwdriver adjustment.

Strain Gages. Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa., has announced a new price list of SR-4 strain gages, instruments and accessories. Specifications for 105 sizes and types of gages are tabulated. Considerations in selecting

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the gages are given more fully than in the previous edition. Cements and waterproofing equipment are also included.

Vacuum-Tube Insulators. American Lava Corp., Chattanooga 5, Tenn. Bulletin No. 537 deals with internal insulators for electronic tubes. It gives the mechanical and electrical properties required in vacuum-tube insulators. Lava and synthetic ceramics are then described in relation to these requirements, as well as to necessary precision, design and quantity. The back cover is a property chart for these materials.

Portable Potentiometer. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa. Bulletin 1210 covers the Brown portable potentiometers, with direct reading temperature, millivolt and extended range scales. Wiring diagrams, instructions, specifications and special features are also included.

Strain Gage. Statham Laboratories, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif. Bulletin No. 1.5 fully illustrates and describes the model SG-1 strain gage that incorporates the advantage of repetitive use and speed of application. Technical specifications included list strain ranges, gage lengths, gage factors, nominal resistance, input current, maximum input voltage and current, accuracy and linearity, resolution, electrical connection information, overall size and weight.

Tube Shield Evaluation. International Electronic Research Corp., 175 West Magnolia Blvd., Burbank, Calif. Technical Report 53-174, initiated by the Electronic Components Laboratory, Wright-Patterson AFB, Ohio, is an evaluation of shields for cooling miniature electron tube types. The relative cooling effected by JAN type nickel plated shields for JAN-S-28A, black finish JAN shields with window cutouts, and by tubes without shields is compared with a new Sample-X type shield. It

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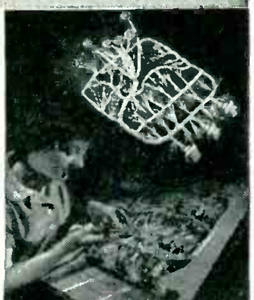

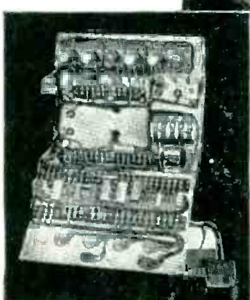

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Paste Solder and Brazing Alloys. Fusion Engineering, 4504 Superior Ave., Cleveland 3, Ohio, announces a 4-page illustrated bulletin describing its line of flux-containing electrical, electronic and mechanical bond paste solder and brazing alloys, and covering the new two-part semiautomatic soldering technique. A chart is used to illustrate the melting ranges of each solder and brazing alloy type and is color-coded to indicate whether the paste alloy is designed for electrical or mechanical connection. Line drawings of a variety of parts show the two-part soldering method which involves preapplication of paste to the part with separate heat application. This semiautomatic technique, possible only because the flux is contained in the paste solder alloy, eliminates much of the hand operation formerly required, greatly reducing labor costs. An automatic paste applicator is also shown with a description of the company's engineering service available to mechanize production soldering operations.

Printed Circuit Controls. Chicago Telephone Supply Corp., Elkhart, Ind. A new line of variable resistors designed primarily for mass production radio or tv printed circuit applications is illustrated and completely described in data sheet 166 now available. Diagrams are included showing how ample spacing between printed circuit terminal openings provides adequate clearance for circuit paths for the miniature type U70 series, type U45 series, type GC-U45 series with spst switch and type WF-U45 series with dpst switch. Complete technical data are given, including resistance range, standard tapers, JUST OUT!

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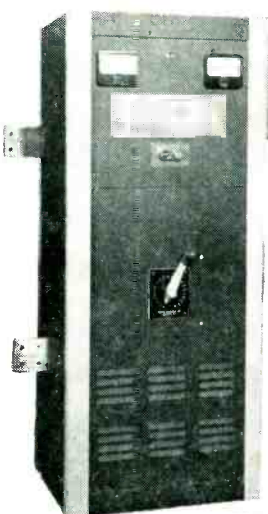

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Vibration Isolators. The Barry Corp., 807 Pleasant St., Watertown 72, Mass. Product bulletin 534 provides a complete technical description of vibration isolators of the knitted-wire type. Performance data are given without alteration from measurements made under stated JAN conditions. Organization and contents of the bulletin are explicitly designed to meet the full needs of application engineers concerned with vibration isolation of airborne equipment in military service. The information contained in the bulletin includes: transmissibility in all directions of motion; isolation curves for acceleration and displacements; the effect of load variation; the effect of extreme high and low temperatures; vibration isolation performance after severe shock; selection of isolators for unsymmetrical loads; detailed dimensions and construction data for unit isolators and complete bases; and complete load ratings.

Wire Forming and Intricate Stampings. PIX Mfg. Co., Inc., 22 Bedford St., Newark, N. J. A 16-page, 2-color illustrated catalog demonstrates the company's versatility in the production of wire formed parts and intricate stampings. It shows how PIX specializes in production for all industries, and can turn out delicate, intricate wire formings from 0.002-in. diameter to 0.156-in. diameter. The parts discussed are then used by the manufacturers for whom they are made as components for many complete products.

Drafting Machines. Charles Bruning Co. Inc., 4700 Montrose Ave., Chicago 41, Ill. Unusually realistic illustrations feature a new 2-color drafting machine booklet that presents a complete mechanical description of the various drafting machine models including gravity compensated, track type, civil engineering and detail machines. En-

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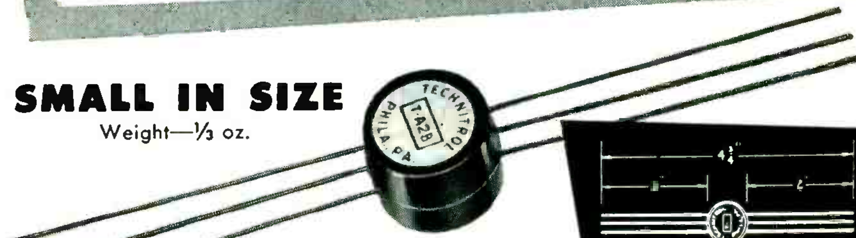

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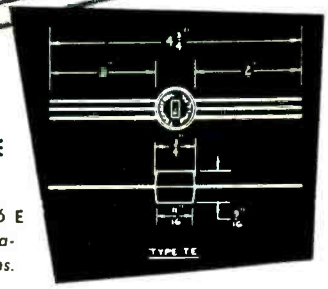

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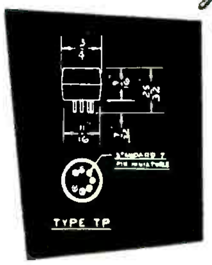

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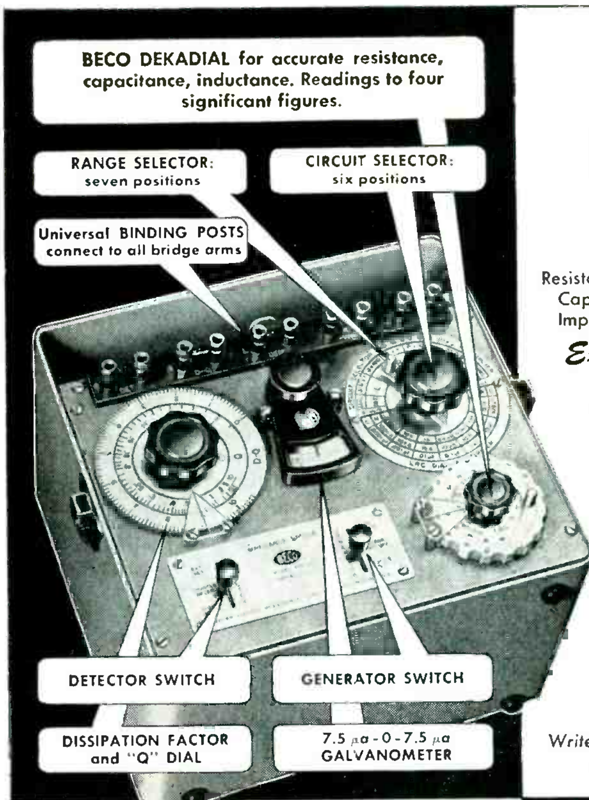

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titled "The Finest In Drafting Machines", the new booklet offer detailed illustrations which have been so carefully prepared that even the vernier degree figures, as well as similarly small but highly important designed details, are perfectly legible. The booklet also pictures and describes the latest types of scales for all uses.

High Resolution Spectrometer. Varian Associates, 532 Hansen Way, Palo Alto, Calif. A new data bulletin illustrates and describes the model V-4300 high-resolution nuclear-magnetic-resonance spectrometer. Following an introduction characterizing the instrument as a basic lab research unit for rapid nondestructive analyses of chemical bonding situations leading to identification and measurement of components in a mixture and assignment of structural formulas. the publication includes further specific data on the spectrometer and suitable magnet system. Data are included on basic operating characteristics; general arrangement of subunits encompassing the probe, the r-f transmitter and receiver, sweep device, power supply and oscillograph.

Solenoid Valve. Valcor Engineering Corp., Carnegie Ave., Kenilworth, N. J. A 12-page illustrated catalog discusses the company's solenoid valve with the floating shear seal. Included are a history of the unit along with information on its absolute minimum pressure drop, lapping action and back pressure, dependability under adverse conditions, and design and construction data. Also given is a chart showing pressure drop vs fluid flow.

Soldering Fluxes. Mico Instrument Co., 80 Trowbridge St., Cambridge, Mass., has available a 4-page folder dealing with its Solderux fluxes, a group of very effective soft-soldering agents based upon sound chemical principles not used previously in soldering practice. The fluxes described are highly active at soldering temperatures, being comparable to the

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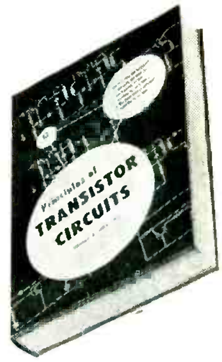

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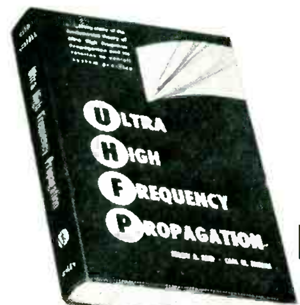

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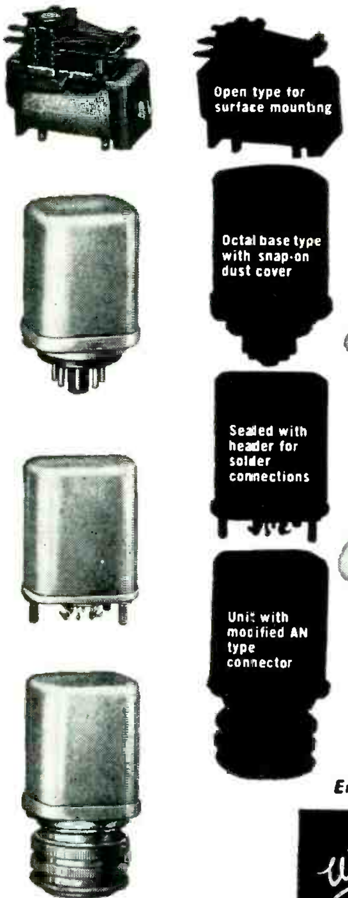
Meter-Positioner Bulletin. Texas Instruments Inc., 6000 Lemmon Ave., Dallas 9, Texas, has released a 2-page bulletin describing its instrument-size magnetic fluid clutch metering-positioning movement. The bulletin is complete with detailed performance specifications and curves and describes in detail both the movement and the component magnetic fluid clutches. The metering-positioning movement already is in operation in airborne military electronic systems. Ask for bulletin No. DL-C 311.

Pantograph Machine. Mico Instrument Co., 80 Trowbridge St., Cambridge 38, Mass., has published a 4-page folder illustrating and describing its engraver, a portable pantograph machine that can be used to produce models, molds, hobs, dies, templates and small parts requiring accuracy in three dimensions as well as the routine lettering tasks usually assigned to two-dimensional engravers. The addition of accessories make it ideally suited to the engraving of nameplates, dials, scales, panels and cabinets. One page of the folder is devoted to general information on the company's products.

High-Vacuum Applications. Central Scientific Co., 1700 Irving Park Road, Chicago 13, Ill. Completely revised and containing a great deal of additional information, charts and data, the new 60-page bulletin 10F on high-vacuum applications is now available. Included are many pages of factual data on such subjects as planning the high-vacuum system, connections and speed of evacuations, selection of high-vacuum pumping systems, low pressure technique, as well as illustrations and descriptions of various types of high-



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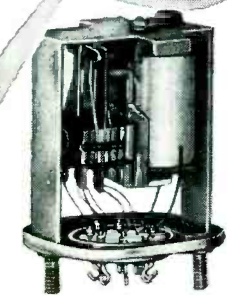

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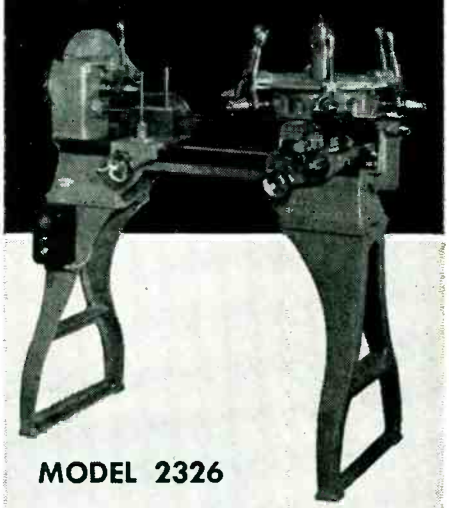

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Point-Contact Transistors. Texas Instruments Inc., 6000 Lemmon Ave., Dallas 9, Texas. A new 4-page bulletin covers two types of hermetically sealed point-contact transistors. Of special interest to electronic design engineers is the 2-page section on the theory and application of point-contact transistors—complete with formulas, equivalent circuits and characteristic curves. The other two pages describe type 102 and 103 point-contact transistors, which differ principally in cutoff time. Mechanical specifications and complete electrical data are given, as well as hints on installation and operation. Ask for bulletin DL-S 312.

Subfractional H-P Motors. Air Marine Motors Inc., 3939 Merrick Rd., Seaford, L. I., N. Y., has published a bulletin covering the end applications and selection of subfractional h-p motors. Part I gives application data—specific applications, general information and outstanding characteristics of basic types. Part II deals with motor selection data—information that should be supplied to the design engineers to enable them better to evolve the best possible results pertaining to rotary-equipment problems.

Parts and Equipment Catalog. Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. The 1954 general catalog contains 268 pages listing over 20,000 items. Special emphasis has been placed on equipment for industrial maintenance, research and production requirements. There are detailed listings of standard and special-purpose electronic tubes, test instruments, voltage stabilizers, transformers, resistors, capacitors, printed-circuit components, transistors, rheostats, relays, switches, rectifiers, fuses, tools, wire, cable, photoelectric components, counters, program clocks, batteries, sockets, generators, power supplies and a wide variety of other electronic equipment and components. A complete

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section on recording equipment includes the Ampex line of tape recorders, Magnecorders and many popular-priced units. All recording accessories are listed. Included are a kit builders' section and an expanded technical-book section that includes leading publications covering the theoretical and practical aspects of radio, electronics and electricity.

Dictating Machines. Gray Mfg. Co., 16 Arbor St., Hartford 1, Conn. A profusely illustrated booklet, "How to Communicaté with People", sells are advantages of dictating machines by using humor to describe alternative methods of transferring ideas to the typed page. It describes seven possible, but awkward methods of business communication, and points out the chief features of the Audograph electronic soundwriter that witnesses telephone conversations, covers conferences and sits in on interviews.

Electric Generating Plants. D. W. Onan and Sons Inc., Minneapolis 14, Minn., has issued a Blue Book of general information concerning the selection of engine-driven electric generating plants. The pocket-sized booklet traces the history of electric-plant development from early stages where storage batteries were necessary to today's modern single-unit, engine-generator power plants. Described in simple, easy-to-understand language are the three general groups of electric plants: a-c, d-c and battery charging. Plant operation for each type is thoroughly discussed.

Dual-Beam C-R Voltmeter. Allen B. DuMont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J., has released a bulletin on the type 322-A c-r oscillograph. It contains complete technical specifications, description and photo-recordings made with the new instrument. The type 322-A discussed is an improved, redesigned counterpart of the type 322 dual-beam c-r oscillograph with the added feature of built-in independent voltage calibration for both beams, and which also incorporates the new tight-tolerance type 5AFP crt.

PLANTS AND PEOPLE

Edited by WILLIAM G. ARNOLD

OTHER DEPARTMENTS featured in this issue:

RETMA Reorganization Moves Ahead

ELECTION OF Max F. Balcom as chairman of RETMA's Radio-Television Industry Committee and F. R. Lack as chairman of the Association's Electronics Industry Committee, along with the approval of a request for a paid general manager for electronics, highlighted RETMA meetings in New York.

During the meeting Fred D. Wilson, president of Capehart-Farnsworth, was elected a director of the set division. R. E. Cramer, Jr., vice-president of Radio Condenser, L. S. Racine, president of Chicago Standard Transformer, and W. M. Owen, president of Aerovox Corp., were elected directors of the parts division. A. L. Chapman, vice-president of Sylvania, was elected to the set division executive committee.

The tube division elected Max F. Balcom of Sylvania as chairman of its executive committee and N. B. Krim of Raytheon, R. T. Orth of RCA and I. G. Rosenberg of Du Mont as members of the committee.

At the first meeting of the Radio-Television Industry Committee, RETMA president McDaniel was authorized to register RETMA opposition to any proposed legislation designed to put subscription tv under regulation as a common carrier. Reports were made by the various divisions of the committee.

In the Electronics Industry Committee, chairman Lack was authorized to develop a plan for two or more divisions.

The set committee approved a proposal of the National Association of Better Business Bureaus that an informational booklet on color tv be published in the near future.

H. J. Schulman, chairman of the service committee, proposed production of a consumer educational film on tv set servicing. This was approved by the set committee but disapproved by the finance committee until sufficient funds were available.

In other actions, William L. Dunn of Raytheon was appointed chairman of the sales managers committee of RETMA's set division and E. L. Taylor of Stewart-Warner was reappointed vice-chairman.

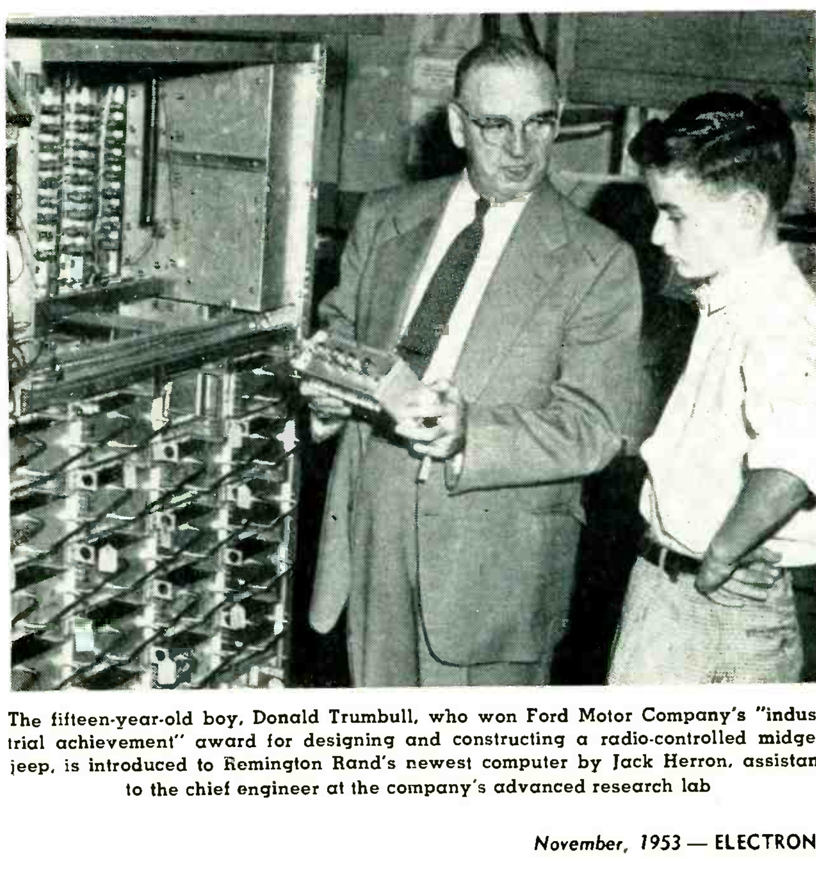
Robert C. Sprague, chairman of RETMA's board, reappointed M. F. Balcom of Sylvania as chairman of the educational tv committee for the coming year.

John F. Giligan of Philco was reappointed chairman of the RETMA public relations and advertising committee by Robert S. Alexander, chairman of the Association's set division. Also reappointed were E. L. Redden of Motorola, Inc. as vice-chairman of advertising and S. H. Manson of Stromberg-Carlson as vice-chairman of public relations.

New Coast Electronics Company Is Formed

FORMATION OF The Ramo-Wooldridge Corp. of Los Angeles, a new company to be devoted to research, development and manufacturing in the general field of advanced electronics and guided missiles, was announced by the firm's officers and

Midget Jeep Designer Meets Computer



The fifteen-year-old boy, Donald Trumbull, who won Ford Motor Company's "industrial achievement" award for designing and constructing a radio-controlled midget jeep, is introduced to Remington Rand's newest computer by Jack Herron, assistant to the chief engineer at the company's advanced research lab

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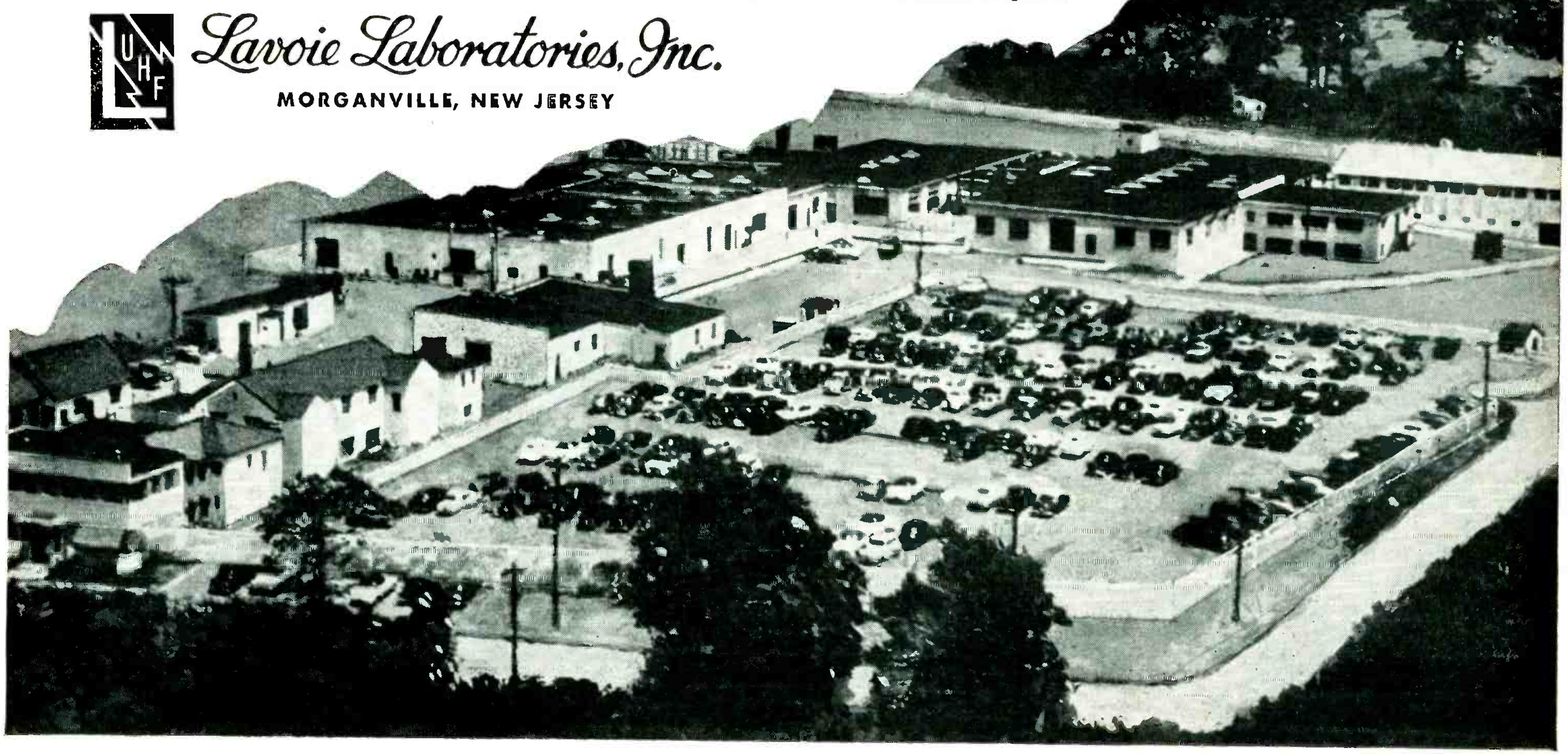

J. D. Wright, president of Thompson Products.

President of the new firm will be Dean E. Wooldridge, who for the past two years has been vice-president in charge of research and development for Hughes Aircraft.

Simon Ramo, who has served as vice-president of operations for Hughes, will be vice-president and executive director.

Thompson Products will have a stock interest in the new corporation which will provide Thompson with consulting services possibly leading to production programs for the Cleveland parts concern.

"Thompson Products and Ramo-Wooldridge have a mutuality of interests", said Mr. Wright. "They will bring us advanced engineering techniques, and Thompson will provide financing and production techniques."

Ramo-Wooldridge will specialize basically in new advanced system developments involving the general field of guided missiles, radar, computers, electronic controls and automatic intelligence devices.

Audio Engineering Society Elects Officers

JERRY B. MINTER, vice-president of Measurements Corp., was elected president of the Audio Engineering Society to succeed F. Sumner Hall, president of F. Sumner Hall, Inc., who became a governor of the Society.

Minter has been active in the audio equipment field since 1934 when he was employed by Boonton Radio in the development of band-pass intermediate-frequency transformers. In 1936 he participated in the development of aircraft radio receivers at Radio Frequency Laboratories. He subsequently became associated with the late Malcolm P. Ferris, working on development of a signal generator, a radio noise and field strength meter and other projects. Upon the death of Ferris, he joined with some associates in organizing Measurements Corp.

Other officers elected in the Society were: A. A. Pulley of RCA Victor, executive vice-president; R. C. Mayer of RCA Victor, central vice-president; Boyd McKnight of North American Aviation, western vice-president; R. A. Schlagel of WOR, treasurer; C. J. Le Bel of Audio Instrument and Audio Devices, secretary.

Elected to the board of governors were: R. H. Ranger of Rangertone; L. J. Scully of Scully Machine; W. O. Stanton of Pickering.

Managers Of GE's Electronics Laboratory Meet

FUNCTIONAL reorganization and new managerial appointments were made by Lloyd T. DeVore (right), manager of GE's electronics laboratory, as a result of a $3 million expansion, tripling the size of the lab at Syracuse, N. Y. Left to right are M. C. Evans, administration manager; B. R. Lester, advanced products development engineering manager; W. Hausz, manager of techniques and applications development engineering; R. N. Gillmor, manager of materials and processes; J. P. Jordan, manager of components development engineering. Two wings have added about 70,000 sq ft to the lab.

Jensen Names EP&PM Committees

APPOINTMENT of seven committees of the Association of Electronic Parts & Equipment Manufacturers was announced by Karl W. Jensen of Jensen Industries, chairman of the association. Committee chairmen named were:

P. N. Cook of Chicago Standard Transformer, chairman of the social committee; E. Van Deveer of Jensen, chairman of the credit committee; O. D. Jester of Standard Coil, chairman of the publicity committee; Roy S. Laird of Ohmite, chairman of the educational committee; Theodore Rossman of Pentron, chairman of the industry relations committee; Wilfred Larson of Switchcraft, chairman of the membership and attendance committee; Ben Boldt of Amphenol, chairman of the merchandising analysis committee.

Federal Labs Promotes Busignies And Hawk

APPOINTMENT OF Henri G. Busignies as vice-president and member of the management advisory board and Walter H. Hawk as manager of television operations was announced by Federal Telecommunications Laboratories.

Busignies has been associated with IT&T for nearly a quarter of a century. He joined the labs in 1941 and advanced from senior engineer to the post of technical director during the ensuing eight years. He is known chiefly as the inventor of the first automatic direction finder for aircraft. His contributions to the World War II

Henri G. Busignies

effort include the development of a shore-based direction finding system known as Huff Duff. In recognition of these activities he was awarded the U. S. Navy Certificate of Commendation for outstanding service to the U. S. Navy and the Presidential Certificate of Merit.

Hawk has been with FTL since 1948, serving successively as a division head, director of electronic production engineering and technical services manager. He will be in charge of the production and development of FTL's complete line of vhf and uhf tv broadcasting and studio equipment. He has been in the electronics industry since 1934, and was formerly with Federal Telephone and Radio Co., also a division of IT&T, serving successively as production line manager of the crystal division, and chief engineer of the rectifier and intelin division.

Luck To Receive Ballantine Medal

THE STUART BALLANTINE MEDAL of The Franklin Institute of Pennsylvania will be awarded to David G. C. Luck of RCA Laboratories "for his invention of the Omnidirectional Radio Range, an essential element in present-day air traffic control".

In 1932 he joined the staff of RCA-Victor as research engineer. Since 1942 he has been a member of the technical staff of the RCA Labs. He has been granted over

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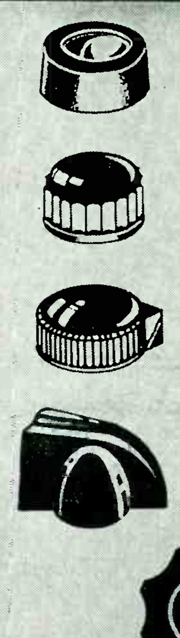

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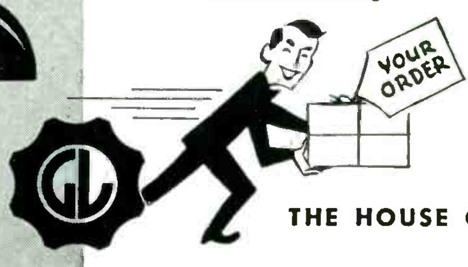

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sixty patents for devices in the radio field, most of which pertain directly or indirectly to direction finders or navigational aids. He has taken part in the work of RTCA committees studying various problems of air navigation and traffic control and has been active, as well, in the study of color tv systems.

Pilot Course For TV Technicians Opens

THE FIRST CLASS of RETMA's pilot training course for tv technicians at the New York Trade School has been held. Harold J. Schulman, chairman of the Association's service committee and service manager of Du Mont, explained that the program is based on a need by the nation's technical schools for an industry-approved syllabus for tv technician training.

The pilot course is being supported with both money and equipment donated by RETMA companies. A preliminary course of instruction, drawn up by the service committee, is open to revision on the basis of experience gained during the course. Following this, an industry-recommended course of training will be drawn for use in vocational schools throughout the country.

Erie Resistor Names Heibel And Shenk

Jerome D. Heibel

JEROME D. HEIBEL and Allen K. Shenk have been appointed vice-presidents of the Erie Resistor Corp., according to G. Richard Fryling, president.

Heibel has been named vice-

Want more information? Use post card on last page.

Allen K. Shenk

president in charge of research and engineering. He joined Erie in 1936, coming from Talon, Inc. of Meadville, Pa., and was manager of the capacitor division. In 1945 he became manager of sales engineering and since 1949 has served as director of research and engineering. He is chairman of the RETMA committee on ceramic dielectric capacitors.

Shenk was appointed vice-president in charge of sales. He joined Erie in 1942 as assistant sales manager of the electronics division. He was previously associated with the W. S. Hill Co. of Pittsburgh for 12 years.

These appointments, according to president Fryling, have been made coincidental with the company's expanded production facilities in Erie and the construction of a new plant in Holly Springs, Miss., and to strengthen the firm's entire sales program. He also stated that in line with these expansions, greater emphasis is also being placed on research in all phases of the company's activities.

Other promotions within the ranks of the company were also announced. J. C. Van Arsdell has been appointed assistant general manager of the electronics division. William Klevans advanced to manager of sales engineering, the post previously held by Van Arsdell. William J. Wervey moved up to field sales engineer, Klevan's former position.

Malcolm Young, formerly manager of quality control, has been named assistant general manager of the plastics division. Ralph L. Hathaway has been promoted from superintendent to works manager

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of the electronics division. Philip B. Ehrman has been promoted from assistant superintendent to superintendent of the electronics division. Horace S. Herrick has been promoted from division manager of quality control to manager of quality control of the electronics division.

Audio & Video Elects New Board Members

THE FOLLOWING new members were elected to the board of directors of Audio and Video Products Corp., according to Charles E. Rynd, president and chairman of the board:

Kenneth B. Boothe, vice-president and director of instrumentation and sales for the company; Martin V. Kiebert, Jr., formerly project director of Bendix and technical consultant in guided missiles; Bernard B. Smith, attorney, who is regarded as an expert on legal and economic aspects of radio and tv; Irving B. Buckley, executive vice-president of Trans-Caribbean Airways.

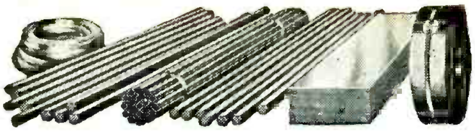
The following men were re-elected on the Board of Directors: Max Graff, Edward V. Otis, Charles E. Rynd, Sidney K. Wolf and Erwin S. Wolfson.

GE Established Control Department

G. E. BURENS, general manager of GE's switchgear and control division, announced the establishment of a specialty control department and the appointment of Louis T. Rader as its general manager.

The new department will be responsible largely for industrial electronic regulator and aircraft control equipment. Dr. Rader announced the following appointments to his staff: K. N. Bush, manager of manufacturing; H. L. Palmer, manager of engineering; J. P. Rutherford, manager of marketing; and C. S. Van Wormer, manager of finance.

Rader joined GE on the test course at Schenectady and completed the advanced engineering program a year later. Assigned to the control division, he worked as a design engineer until 1945 when he



BRIDGEPORT BRASS COMPANY

COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Parts of ⅝" diameter miniature volume controls used in hearing aids and in many other applications. Courtesy of Centralab, a Division of Globe-Union Inc., Milwaukee, Wisconsin.

Copper Alloys Play Important Role In Miniaturization Trend

Throughout the electronics industry, the trend is to smaller, lighter, more compact assemblies. Hearing aids, for example, must incorporate all the elements of a radio amplifier in a package not much larger than the average cigarette case. Portable communications equipment like radio sets for aircraft and automobiles, miniature personal radios, walkie-talkie units, airborne radar receivers all must be designed so that every possible extra inch of space and ounce of weight can be trimmed off the finished product.

Miniature Volume Control

Illustrated above with its copper-base alloy components is a volume control no bigger in diameter than a dime. This type of control has a rating of 1/10 watt and is obtainable with resistance ranges of from 0 to 500 ohms and on up through 10 megohms. It is probably one of the smallest volume controls commercially available. It is currently being used as a component in many hearing aids, test instruments, miniature radios, microwave sets and other miniaturized apparatus.

Copper-Base Alloys Excellent for Precision Parts

Copper-base alloys are preferred for many electrical and electronic applications because of their fine properties. Conductivity, good corrosion resistance, ability to withstand severe forming operations, high wear resistance, excellent plating and finishing properties explain their wide use in the many thousands of products with which we are familiar.

Many of the parts in this control are made of brass. Some are plated with either nickel or cadmium for increased wear resistance or silver for improved contact characteristics.

Among the parts made from brass rod are the contact blade pivot pin, the mounting studs, the shaft, rivet, hex screw and nuts. The terminals were made from yellow brass strip which is easily stamped and formed. The spacers and washers were also made from brass.

Phosphor Bronze Vital in Electronics Equipment

In complex assemblies like these volume controls and switches, satisfactory performance depends on each tiny part, especially those spring parts used in making mechanical and electrical contacts. For this reason, the selection of the correct alloy, temper, and gauge is most important.

The contact spring washer and spring pivot pin washer in the tiny volume control illustrated were made of Phosphor Bronze Grade C, approximately 92% copper, 8% tin, and 0.1% phosphorus. Supplied for these applications 8 B&S numbers hard, the material has a tensile strength of about 112,000 psi. It is widely used throughout the electronics industry because it combines superior spring properties as well as conductivity and high corrosion resistance.

Parts like contact springs must have high fatigue resistance to withstand millions of flexing cycles. Spring washers must withstand constant compression without taking a set if they are to be satisfactory. They must also be corrosion resistant under all climatic conditions. Phosphor Bronze meets all these qualifications and yet can be stamped and formed into precision parts. That is why Phosphor Bronze is in such wide use in the fields of radar, radio, television, sound reproduction and amplification, and in all types of electronic and electrical equipment and controls.

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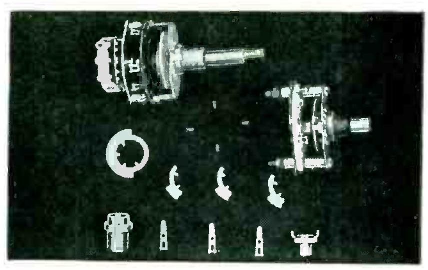
Bridgeport Brass supplies copper-base alloys — in strip, rod, tubing, and wire — used in the electronics field. Our Laboratory will be glad to assist you in the selection of proper alloys for your applications. Write for Bridgeport Brass Technical Handbook for properties and applications of copper-base alloys. Call or write the Bridgeport District Office nearest you. (714)



Parts of electronic switch and assembled switches. Courtesy of Centralab, Milwaukee, Wisconsin.

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left the company to become head of the electrical department at the Illinois Institute of Technology.

Two years later he returned to GE to manage the engineering laboratory of the control division. In 1949 he became assistant manager of engineering and was appointed manager of engineering in 1951.

Motorola Plans Plant Moves

TWIN ONE-STORY plants which cover an area of 150,000 sq ft on 300,000 sq ft of property, now under construction in Chicago, will soon be occupied by Motorola manufacturing and parts and service departments, according to Robert W. Galvin, executive vice-president of the company.

Most of the departments in the company's Washington Boulevard plant and Halstead Street plant in Chicago will move to the new buildings. Some departments, however, will be consolidated in the Franklin Park, Ill. tv assembly plant, also under construction.

Gagg Joins Bendix Executive Staff

Rudolph F. Gagg

RUDOLPH F. GAGG, recently president of Air Associates, has joined the administrative staff of Raymond P. Lansing, vice-president and group executive of Bendix Aviation Corp.

Gagg, who was assistant to the general manager of Wright Aero-

nautical Corp. before becoming president of Air Associates, will assist Lansing in the administration of seven Bendix divisions, which manufacture aircraft instruments, control and navigational equipment, starters, generators, special-purpose electron tubes, ignition systems, meteorological instruments, precision electrical units and many other products. These divisions employ some 22,000 employees, or about 45 percent of the corporation's total.

Gagg joined Wright Aeronautical as an experimental engineer in 1930. He became assistant chief engineer in 1934 and assistant general manager in 1940. He was named president of Air Associates in 1948.

Wilcox-Gay Establishes Scholarship At IIT

WILCOX-GAY CORP. established a scholarship at Illinois Institute of Technology that is designed to produce experts in the field of magnetic recording. It provides $650 tuition a year for students enrolled in studies preparing them for magnetic recording development.

In making the grant, Wilcox-Gay president L. H. Ashbach said, "We are establishing this scholarship because we want to help deserving students obtain expert knowledge in the magnetic recording field. By doing so, I believe we are advancing the interests of the entire industry."

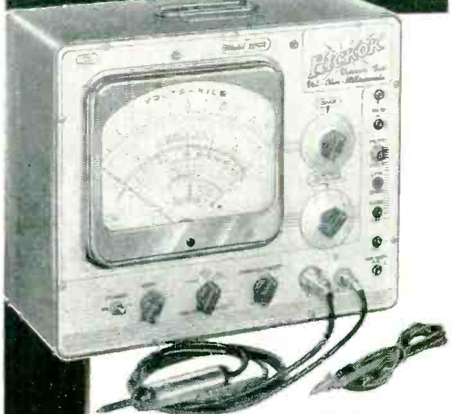
In another move, the company announced the construction of two additional one-story buildings, adjacent to its plants in Charlotte, Mich. They will be devoted to increasing production of magnetic tape recorders and recorder accessories. The plants will add 25,000 sq ft of space to present facilities.

Clary Multiplier Appoints Gen. Davis

BRIG. GEN. MARLE H. DAVIS, who retired in August as chief of the Army Ordnance Industrial Ammunition Branch, has accepted a position as manufacturing and engineering consultant for Clary Multi-

HICKOK

Model 209A



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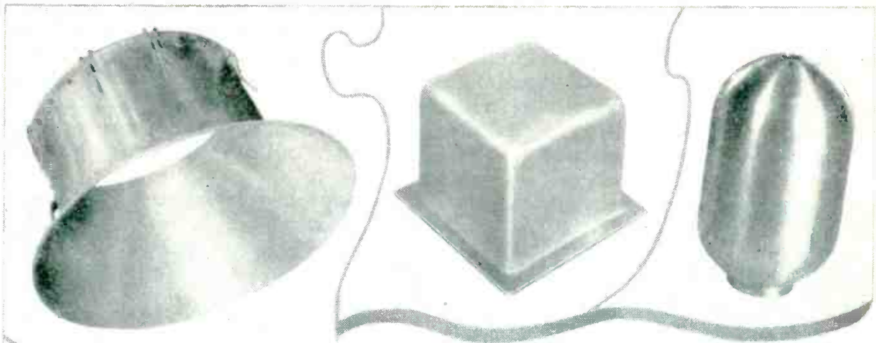

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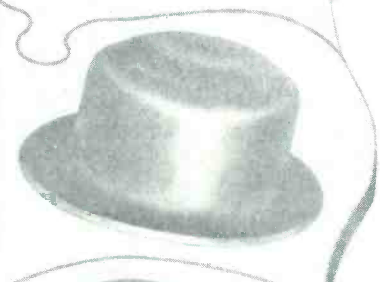

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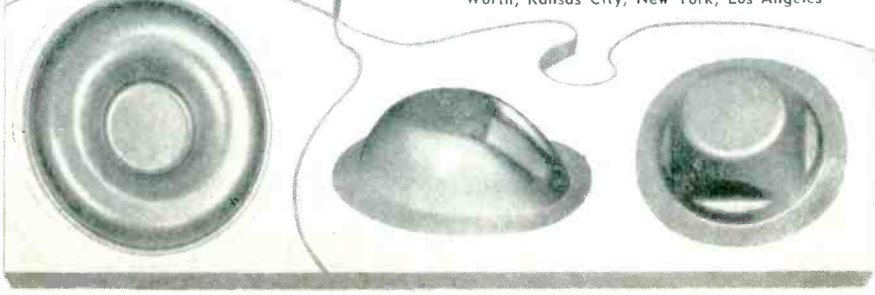

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plier Corp. He will work with all phases of production operations, including business machines and electronic equipment as well as guided missile instruments and ammunition components, at the company's San Gabriel, Calif. plant. The firm has announced a new $6 million program for guided missile instruments and is expanding production of its electronic data handling equipment, office machines and other lines.

Marandino Appointed Sylvania Plant Head

Ned J. Marandino

NED J. MARANDINO has been appointed manager of the new Sylvania tv set plant in Batavia, N. Y., which is expected to be completed in February, 1954. The plant is the company's largest one-building facility and will employ approximately 2,700 persons.

Marandino joined Sylvania in 1950 as superintendent of test and inspection. In the same year, he was appointed superintendent of tv set production, a post he held until his present appointment.

Stromberg Enters Electronics Control

STROMBERG-CARLSON participated in the establishment of a new industrial process control firm in Los Angeles known as Electronic Control Systems.

The new firm, headed by Leonard Mautner as president and A. F. Brewer as executive vice-president and secretary, will concentrate on problems in the fields of automatic process control and data handling. R. C. Tait, president of Stromberg, serves as a director of the company and helped to set it up.

Mautner, who was associated with the radiation laboratory of MIT during World War II, was formerly manager of Du Mont's tv transmitter division. He was president of Television Equipment Corp. and headed electronic research and development of guided missile laboratories for Hughes Aircraft.

Brewer has also specialized in radar and guided missiles for more than 13 years. He has carried on development work for the armed services at Sperry, Hughes and similar organizations.

National Electronics Expands Plant

NATIONAL ELECTRONICS, industrial tube manufacturers, have completed an addition to the Geneva, Ill. plant increasing floor space by more than 40 percent. The additional space will be used to expand production of thyratrons, rectifiers and ignitron tubes. Output this year is running 35 percent ahead of the 1952 rate, according to J. H. Hutchings, vice-president.

Aerovox Makes New Moves

W. MYRON OWEN, president of Aerovox Corp., announced the appointment of G. Milton Ehlers as chief research engineer. He has held positions as director of research with the Globar Corp. and chief ceramic engineer with Globe Union. From 1946 until his recent appointment, he was president of the Herlec Corp. of Milwaukee, a subsidiary of the Sprague Electric Co.

In another move, two of the largest divisions of Aerovox, the Wildor manufacturing operation and the ceramic capacitor operation of the Hi-Q division, were merged. Wildor has moved from Cleveland to three Hi-Q plants in New York and South Carolina. The combined

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operations will be known as the Hi-Q division of Aerovox but the Wildor name will continue to be carried on all resistor products of the Hi-Q division.

Elwood Schafer Joins CBS-Hytron

Elwood W. Schafer

ELWOOD W. SCHAFER, former vice-president of National Union Radio, has been named assistant to Charles F. Stromeyer, vice-president in charge of manufacturing and engineering at CBS-Hytron.

Schafer was for seven years an engineer with GE and has served as chief factory engineer on receiving tubes for RCA.

His duties at CBS-Hytron will be to assist in planning expansion of the firm's tv tube manufacturing facilities, including operation of a color tube pilot plant.

Tinnerman Products Makes Changes

A. H. TINNERMAN, president of Tinnerman Products, announced five organizational changes in the engineering and sales departments of the company.

Lawrence H. Flora, director of engineering since early this year, has been appointed to the newly-created post of director of sales. He joined the Tinnerman engineering staff in 1942 and served as head of the product development department until 1949 when he became chief engineer.

In his new capacity, Flora will coordinate and integrate field activ-

ities of the sales force and continue to direct policy of the engineering department.

Edward E. Griger, who joined the company in 1943 and was assistant sales manager, has been named sales manager. He absorbs many of the duties of William H. Taylor, Tinnerman's former general sales manager who resigned to become director of purchases for Packard Motor Car Co.

William L. Seitz, formerly in charge of development engineering, has been appointed chief engineer. He has been with the company for 12 years. Clarence Van Neil takes Seitz's former position.

John Balint, formerly in charge of product engineering, has been advanced to the post of new product manager. He joined the company in 1947, coming from Ford Motor Co.

Cook Names Anderson And Washburn

Alton D. Anderson

ALTON D. ANDERSON has been appointed chief engineer of the Cook Research Laboratories, succeeding D. C. McDonald who resigned. Earl L. Washburn has been named technical head of the systems development section.

Anderson spent over 10 years as research engineer with the Naval Ordnance Laboratory and as chief of the pressure mechanisms development section. Since coming to Cook in 1950, he has been director of the systems development section and most recently assistant chief engineer. He will continue to have responsibility for the company's work in oceanographic instrument development, digital computer research and design, rocket instrumentation, and coordination of overall technical programs in addition to his new duties as chief engineer.

Washburn, who has worked for the past two years as a project engineer at Cook on atmospheric systems studies to determine the optimum organization, technique and equipment for use in such systems, was a senior project engineer for over seven years with Wallace Tiernan Products Co. In his new position, he will be in charge of all engineering phases of geophysical and physics research as well as digital computing equipment and special test instrumentation development.

Sprinkle Joins Ampex Corp.

MELVIN C. SPRINKLE, formerly chief engineer for Shrader Manufacturing, has been appointed audio sales manager of the Washington, D. C. office of Ampex Corp. For many years he was in the sales engineering department of Altec Lansing Corp.

Sarkes Tarzian Changes Personnel

G. EANNARINO, director of Sarkes Tarzian rectifier division, announced that Stanley Niciejewski has been named sales manager. Alfred D'Urso was promoted from sales engineering to assistant sales manager of distributor sales. Fred Lucas joined the division as assistant sales manager of industrial sales. He was previously employed by Federal Telephone and Radio in rectifier engineering and sales.

Du Mont Realigns TV Transmitter Division

ADDITION OF new sales engineers and revision of duties of the present staff have been made by the television transmitter division of Du Mont.

C. E. Spicer has been promoted

Want more information? Use post card on last page.

to sales operations manager and manager of the sales engineering department.

Joining the division's staff are R. B. Bollen, formerly engineering supervisor for WDTV; F. D. Bonvouloir, formerly chief engineer of WAAB; L. O. Keys, formerly a Philco microwave engineer; F. Klimowski, former maintenance supervisor for the Stavid Engineering Co.; L. Litchfield, formerly a Du Mont research engineer; W. K. Terrell, an engineering supervisor for WABD and N. C. Ritter, formerly a Keith Electric Construction Co. engineer.

Morris A. Mayers, educational tv consultant, has been appointed general manager of Du Mont network closed circuit operations.

Stephen Pozgay, sales representative, has resigned to become manager of station WNAM-TV in Appleton, Wisc.

Audio Devices Acquires Advance

AUDIO DEVICES of New York has acquired the assets and goodwill of Advance Recording Products of Long Island City, N. Y., according to an announcement by William C. Speed, president of Audio.

Founded in 1941, Advance Recording was one of the oldest companies in the U. S. in manufacture of recording-disc blanks for radio stations, recording studios and phonograph record producers.

American Mica Moves

THE AMERICAN MICA Insulation Co. of Newark, N. J. has completed its move to Manasquan, N. J. where it will occupy expanded facilities for the manufacture of fabricated mica parts for the electronics industry.

Ford Names Assistant Chief Engineer

THEODORE JARVIS has been promoted to assistant chief engineer at the Ford Instrument Co., according to William Newell, vice-president for engineering. Jarvis, who is now responsible for engineering work connected with atomic energy

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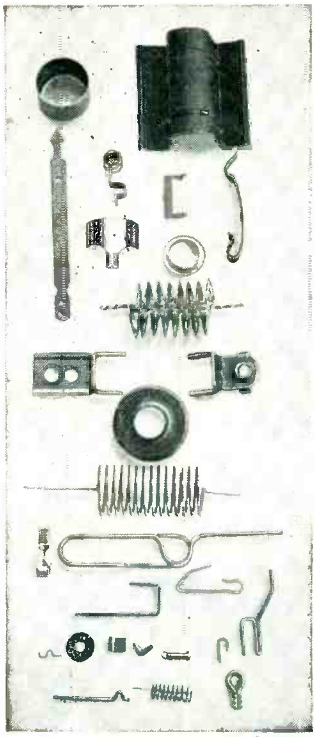

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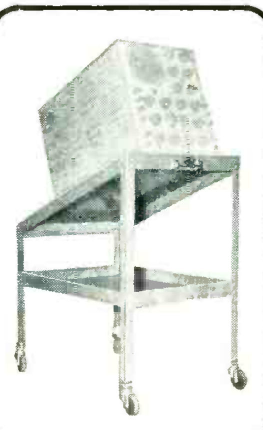

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projects, recently completed a year's study at the Oak Ridge School of Reactor Technology. Ford instrument specializes in the manufacture of computers for the armed services.

Cal-Tronics Moves

CAL-TRONICS CORP., manufacturer of test equipment, has moved to a new plant in Los Angeles. The building, containing 20,000 sq ft of floor space, provides executive offices and 3,500 sq ft for engineering, with the balance devoted to manufacturing and assembly. Employing 65 people at present, it is expected that employment will double with the new plant.

Williams Named Jensen Chief Engineer

Philip B. Williams

THOMAS A. WHITE, president of Jensen Manufacturing, announced the appointment of Philip B. Williams as chief engineer. He joined the company 11 years ago as a member of the engineering staff.

In his new position, he will be in charge of all product design, development and research for the company.

Bristol Expands

BRISTOL CO., manufacturers of automatic instruments, has completed an expansion of its socket screw division. New facilities include a new building equipped with the latest types of precision equipment for screw manufacture.

The company also promoted three executives, according to announcements by Harry E. Beane, vice-president of sales.

D. C. Sanford, applications engineer, who joined the company in 1937, has been appointed manager of the applications engineering department.

F. W. Borchers, who joined Bristol in 1922 and was appointed assistant sales manager in 1948, has been named general sales manager.

Ernest Nuber has been appointed sales manager of the instrument division of th company. He joined Bristol in 1929 and, previous to his new post, held the position of manager of the applications engineering department.

Broadcast Engineers Attend RCA Course

A TOTAL OF 77 broadcast engineers from tv stations throughout the U. S. and Canada attended RCA's 17th Technical Training Program. The clinic, conducted by the Engineering Products Department, is designed to meet demands for instruction in operation and maintenance of new uhf and vhf tv broadcast equipment.

Stewart Appointed By Maico

W. E. Stewart

W. E. STEWART has been appointed director of engineering for the Maico Co., acording to an announcement by L. A. Watson, president.

Stewart spent the past 11 years

Want more information? Use post card on last page.

with RCA Victor and was in charge of broadcast audio and tv film engineering.

He was chief engineer for WOI in Ames, Iowa from 1934 to 1939 and spent two years in civil service before joining RCA Victor. He has been active in standardization of audio and magnetic recording equipment, serving on standarization committees of several industry associations.

Little To Establish Midwest Office

ARTHUR D. LITTLE, Inc. of Cambridge, Mass. will open a new midwest liaison office in Chicago, according to Earl P. Stevenson, president. The new office will maintain a staff to carry out technical-economic, technical-audit and market research surveys in that area.

J. R. Kirkpatrick will be manager of the office. He previously participated in the industrial development activities of the company on behalf of the Puerto Rican government.

National Research Appoints Moore

RICHARD S. MORSE, president of National Research Corp., announced the appointment of James H. Moore as general manager of Vacuum Metals Corp., a subsidiary.

Moore, formerly director of metallurgical research for National, has for several years been in charge of equipment and process development concerned with the vacuum melting, casting and fabrication of high-purity metals and alloys that are now being produced by Vacuum Metals.

An increased backlog of orders indicated the need for the appointment of a general manager to coordinate production and sales efforts of Vacuum Metals Corp., president Morse stated.

Nine Join Hughes Technical Staff

J. N. CONSTANT, R. L. Crone, G. M. Greene, E. E. Herman, C. S. McCormick, D. R. McKim, J. H. Parsons, M. Phister, Jr. and W. Rose have joined the technical staff

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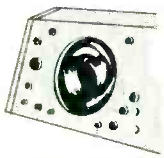

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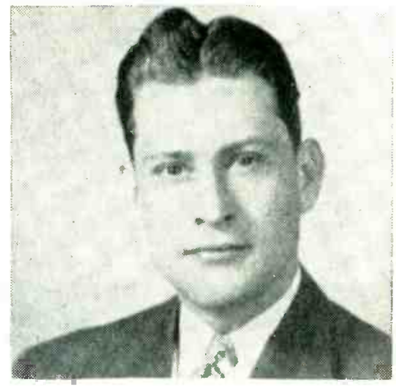
of Hughes Research and Development Laboratories in Culver City, Calif.

Littlefuse Promotes Jack D. Hughes



Jack D. Hughes

JACK D. HUGHES has been promoted to the position of vice-president and operations general manager for Littlefuse of Des Plaines, Ill. He formerly served as vice-president in charge of sales. In his new post, he will continue to supervise sales and will assume responsibility for the purchasing, production, production control and time study departments of the company.

Rotron Appoints Berkeley Williams

BERKELEY WILLIAMS has been appointed assistant chief engineer of Rotron Manufacturing Co., according to an announcement by J. Constant van Rijn, president.

Williams, who has had 11 years of technical experience in development engineering at Sperry, will help promote the company's program of design and development in the field of cooling devices for electronic equipment.

Barth Manufacturing Undergoes Reorganization

BARTH MANUFACTURING Co. of Milldale, Conn. has been sold and reorganized and is now incorporated as Barth Engineering and Manufacturing Co. The new company will emphasize engineering development and production of electronic, electro-mechanical and electro-hydraulic control equipment and will continue to manufacture sheet metal working machinery.

Head of the new concern is Charles Russell, who was previously associated with the Eclipse Pioneer Division of Bendix as an engineering head.

John K. Mitchell, who is vice-president and general sales manager, was formerly connected with Sperry Gyroscope, serving for several years as that company's representative to the U. S. Navy.

Chief engineer of the new firm is Harvey M. Nilson, who was previously senior engineer with the Allen D. Cardwell Co.

Charles E. Gregory has been named plant superintendent.

Vitro Elects White Executive V-P

GEORGE WHITE, JR., has been elected executive vice-president of Vitro Corp. of America, according to an announcement by J. Carlton Ward, Jr., president.

Mr. White, with Vitro since 1946, has been a director and vice-president of its parent, the Vitro Manufacturing Co., and has served as chairman of the board and president of another subsidiary, Vitro Chemical Co. He is now executive vice-president, a director and member of the executive committee of the three companies.

CBS-Columbia Names Eight Engineers

ALBERT BECKMAN, Theodore H. Cook, Jr., Israel Melman, Frank J. Powers, Eugene W. Rose, Robert E. Savold, Fred T. Schick and Edward S. White have been named to engineering positions with CBS-Columbia.

Beckman, who has been named a mechanical project engineer on government assignments, was associated with Tele King as a mechanical project engineer and head of the drafting department.

Cook, who previously worked on the development of color tv receivers and studio equipment at RCA Laboratories, has been appointed

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senior electronic engineer.

Melman, formerly engineer in charge of the advanced development laboratory, has been advanced to chief engineer of the special products division where he will be concerned with the development of CBS-Columbia color tv receivers.

Powers, who has been named head of the industrial engineering department, held a similar post at the Burndy Engineering Co. and also has had managerial posts with Federal and Sperry.

Rose, previously employed in a supervisory capacity by Western Electric, has been appointed electronic engineer for military equipment.

Savold, who has been appointed manager of field engineering, has been employed by the company for the past eight years, four of them as foreman of the test department and the last four as field engineer. In his new post he will coordinate all field engineering activity with the engineering and quality control departments.

Schick, formerly head of product design for Du Mont and assistant chief engineer of Emerson, has been named chief mechanical engineer for the company.

White, who has been named engineer in charge of the advanced development laboratory, will continue advanced circuit development work, as well as act as consultant on special engineering projects.

Rath Joins Jack & Heintz

WILBERT A. RATH has joined the purchasing department of Jack & Heintz of Cleveland and will serve as company buyer of special electrical items and fasteners. He replaces Jack Mills, who has established offices as manufacturers' representative. Rath has held buying and stock control positions with Clark Controller and Weldon Tool. His purchasing experience covers a period of 11 years.

Smith Named At Burroughs

JAMES W. SMITH has been named assistant to the director of the advanced development division at the

Want more information? Use post card on last page.

Research Center of Burroughs Corp. He was formerly administrative assistant to the vice-president in charge of research.

William Sage Acquires Sealtron

William C. Sage

WILLIAM C. SAGE acquired the name and a substantial portion of the assets of the Sealtron Co. of Cincinnati, manufacturers of hermetic seals and subassemblies, for over $250,000.

Officers of the new corporation are: W. C. Sage, president; H. G. McKnight, vice-president; L. M. Paul, secretary and treasurer. Directors are L. M. Paul, chairman; F. Bader, O. W. Hirschfield, W. H. Nieman and William C. Sage.

Warwick Names Chief Designer

WILLIAM A. WAGNER, formerly chief divisional designer for Montgomery Ward, has been named chief product designer for Warwick Manufacturing, according to John S. Holmes, president. He will be in charge of product design for the company's Chicago and Zion, Ill. plants and for its Chicago research and development lab.

Nuclear-Chicago Elects Chairman

E. B. TILTON, formerly president and treasurer of Vilter Manufacturing, has been elected chairman of the board and chief executive officer of the Nuclear Instrument and Chemical Corp. of Chicago.

Before joining Vilter, he was a vice-president of the Bank of America and of the Central Trust Company of Illinois.

Sterling Names Howard Meuche

HOWARD O. MEUCHE has been named production superintendent of Sterling Engineering Co. of Laconia, N. H., according to an announcement by Morehead Patterson, chairman and president of American Machine and Foundry, the parent company. In his new position, Meuche is responsible for general coordination and all production activities.

Prior to joining Sterling, he was assistant plant manager of National Union Radio Corp. for three years. From 1947 to 1950 he was associated with Tevel Laboratories as production manager. He previously was with RCA as quality control engineer.

Scott Elects New Officers

JOHN S. MECK, president of Scott Radio Laboratories, announced that Russell Eggo, previously secretary-treasurer, has been elected executive vice-president and secretary of the company. Samuel W. Block has been elected to the newly created position of assistant secretary.

Scott officers re-elected for the fiscal year are Meck, president and treasurer; C. E. Palmer, vice-president in charge of production; and Louis Woycke, vice-president in charge of engineering.

Re-elected by stockholders to the board of directors were: John S. Meck, Hugh Conover, S. W. Black and Russell Eggo. Newly elected to the board is Daniel Gibson, Indiana insurance executive.

New Firm Formed In Philadelphia

RESE ENGINEERING CORP., a new company that will specialize in the design and production of test equipment and components for the computer field, has been established in

Philadelphia, Pa. Other activities of the company will include the development of specialized apparatus for industrial and scientific applications.

Jerome Rovins, formerly associated with Philco, has been appointed president. Julian Saltz is vice-president of the firm.

Pyroferric Buys Manufacturing Plant

Pyroferric plant

PYROFERRIC Co. of New York City has purchased the building that houses its manufacturing plant.

Expansion of both production and laboratory facilities is now in process. The additional space now available will enable the company to meet increasing demands for iron cores and other powdered metal components.

Timberlake And Wallack Join RCA Field Sales

FLOYD A. TIMBERLAKE and Chester A. Wallack have joined the Engineering Products Department of RCA Victor.

Timberlake, who previously served as tv operations supervisor of ABC in Chicago, was, at one time, chief engineer of the city of Gary, Indiana. In his RCA post he will be the broadcast field sales representative in the company's central region with headquarters in Chicago.

Wallack, who becomes field sales representative of the broadcast marketing division for the Denver

region, was formerly chief engineer of station KVGB in Great Bend, Kansas, where he served since 1948.

Heising Retires From Bell Labs

Raymond A. Heising

RAYMOND A. HEISING, president of the IRE in 1939, has retired from the Bell Telephone Laboratory after 39 years of service. Entering Western Electric in 1914, he conducted their first carrier experiments and constructed their first radio transmitters. He invented and developed transmitter circuits for the SCR 68 and CW 936 which were made for the military in World War I. He participated in engineering the pioneer transoceanic commercial radiotelephone circuits. For the last nine years he has been engaged in patent engineering and other patent work.

Dr. Heising plans to continue his professional activities as a consulting electronic engineer and patent agent.

Smith And Jagmin Advance At Varo

JACK G. SMITH assumed the duties of chief engineer and Walter J. Jagmin, general counsel, took over duties vacated by Smith as plant manager, according to an announcement by Robert L. Jordan, vice-president of Varo Manufacturing Co.

Smith began with Varo as project engineer in the electrical design section in 1947. Jagmin joined Varo in 1949 as patent attorney and general counsel.

Jordan explained that the moves were made to fill the vacant chief engineer position and to further Varo's commercial production. In the past, the firm's production has been largely military and was concentrated on the development of precision electronic power supplies for use with airborne equipment.

Harrison To Receive Cresson Medal

GEORGE RUSSELL HARRISON, dean of science of MIT, will receive the Elliott Cresson Medal at the annual medal day ceremonies of the Franklin Institute of Pennsylvania.

In making the announcement, Henry B. Allen, executive vice-president and secretary of the Institute, stated that the award was being made for his valuable work in spectroscopy.

Largely responsible for the ten International Spectroscopy Conferences held at MIT, Dr. Harrison developed ingenious machines which automatically determine spectroscopic data. His work has culminated in the development of the MIT wave length tables.

Air Force Needs More Engineers

THE ROME AIR Development Center has jobs at salaries from $5,040 to $9,600 a year in all phases of electronic research and development, and in the installation and maintenance of radio, radar and wire-communications equipment.

Write the Professional and Scientific Recruiter, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y., or phone Rome-3200.

GPL Shifts TV Sales Organization

BLAIR FOULDS, vice-president, announced four changes in the sales organization of General Precision Laboratory.

E. Arthur Hungerford, Jr., returning from a leave of absence for special work with the Joint Com-

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mittee on Educational Television, has been named manager of the tv department.

Nathaniel M. Marshall has been designated as eastern district manager. He has been a field representative for GPL since 1950.

Edward Manzo, who has been assigned as southeastern district manager, has a background of tv studio design for the Navy.

Robert F. Johnston, formerly chief engineer of radio station WILL, has joined the company as manager of the midwest district.

Avien-Knickerbocker Appoints Frary

RUSSELL H. FRARY has been named director of service engineering for Avien-Knickerbocker, according to Leo A. Weiss, president.

Frary was formerly with Northwest Bell Telephone and was, for many years, associated with sales and service engineering for Minneapolis Honeywell and Associated Air Services.

"Mr. Frary will be in charge of Avien's rapidly growing sales and field service engineering force", Mr. Weiss stated, "which now comprises 10 percent of our total work force."

Van Horn Elected Telecom President

John Van Horn

JOHN VAN HORN has been elected president of Telecom, a new company in Kansas City, Mo. that will

Want more information? Use post card on last page.

manufacture telephone switchboards and other electrical and electronic specialties in the communication field. Marketing will be handled through established distributor channels.

Van Horn has been associated for the past five years with Midwest Research Institute, specializing in instrumentation and remote control applications. He has also been active as a consultant in industrial control design and specialized telephone engineering projects. He has devoted the past 14 years to the design and manufacture of telephone, electronic and electrical equipment.

Smith Moves To New Brooklyn Plant

New Smith plant

THE HERMAN H. SMITH Co. has moved to a new plant in Brooklyn, N. Y., according to an announcement by Herman Smith, president. The building, newly designed and constructed, is equipped with modern machinery for maximum efficiency in the production of plugs, jacks, switches, test leads and other electronic hardware for both commercial and military users.

Smith Named By Gray Research

NEWLAND F. SMITH has been appointed general manager of Gray Research and Development Co. of Manchester, Conn., according to an announcement by Walter E. Ditmars, president.

Smith was named assistant general manager earlier this year. He was previously director of general engineering for the Mutual Broadcasting System and WOR. He has also been associated with the television engineering group at RCA and has been with Philco Corp.

NEW BOOKS

Dielectric Aerials

BY D. G. KIELY, *foreword by Professor H. M. Barlow. Methuen's Monographs on Physical Subjects. Methuen & Co., Ltd., London; John Wiley & Sons, Inc., New York,* 132 *pages,* 1953, $2.00.

THIS IS A most interesting monograph on a subject about which too little is known. The author, according to Professor Barlow, has made considerable contributions to this subject. The references to his own work indicate that he, along with those others mentioned in the bibliography of some 29 citations, are working in a vitually virgin field.

For the most part the monograph deals with the mathematical attempts to analyze the action of nonmetallic rod, cylinder and horn antennas. Many pages are intensely mathematical, but for the reader not interested in these attempts to come to a full understanding of the radiation phenomena from dielectric antennas, there is much of interest and value. The experimental results of the investigators are described. The electrical, mechanical advantages and disadvantages of dielectric aerials make for thoughtful reading and cogitation.

There are five chapters and the bibliography; the chapters deal with the general introductory and historical remarks, wave propagation along a dielectric rod, dielectric rod aerials, dielectric tube aerials and other dielectric aerials. The nonmathematical portions are easily readable; in fact, the only portion of these passages which this reviewer could not fathom was this statement: "Short dielectric rods have been used in the apertures of hog-horns feeding cheese aerials."—K.H.

Sound Reproduction

BY G. A. BRIGGS. *The Wharfedale Wireless Works, London,* 368 *pages,* 1953, *Third Edition,* 17*s* 6*p.*

MR. BRIGGS has established himself as one of the most popular writers on the reproduction of sound. His material is at a level accessible to the advanced amateur, usually with a sufficient base of engineering so that it is useful to the professional in the field. This third edition of his "Sound Reproduction" is greatly enlarged with new material, and has all his virtues of a concise style interspersed with a reasonable amount of chattiness. The book therefore assays out a very high percentage of useful information.

Among the valuable features of the book are oscillograms showing the frequency response of loudspeakers under many different conditions of loading, construction and magnetic field strength. These bring out clearly a lot of information that the seeker for loudspeaker perfection will find helpful. For instance, the prime importance of solidity in a loudspeaker mounting, to eliminate panel vibrations, is demonstrated. The ultimate solution, the brick or concrete enclosure, shows its superiority in the tests, but some less drastic recourses are offered, especially the double-front enclosure with sand between the panels. The fact that Mr. Briggs has a note on how to get a bag of sand thoroughly dry is an amusing reminder of the fantastic range of techniques a man gets mixed up with, when he loses his head about the reproduction of sound.

Mr. Briggs sums up his oscillographic investigation of reflex boxes with a set of rules for the experimeter, among which are: use a speaker with the lowest possible resonance; use the biggest possible enclosure, up to 9 cubic feet; use the lowest convenient cross-over in dual systems; avoid a tall shape, to reduce resonance effects.

Besides loudspeaker enclosures, Mr. Briggs covers the physics of the ear, room acoustics, crossover networks and intermodulation. In a second part, he reviews briefly present-day recording systems. There are some excellent microphotographs of record grooves under various conditions of wear. As he admits in his introduction, the book is "patchy", but this is a virtue: given the ground Mr. Briggs has set himself to cover,

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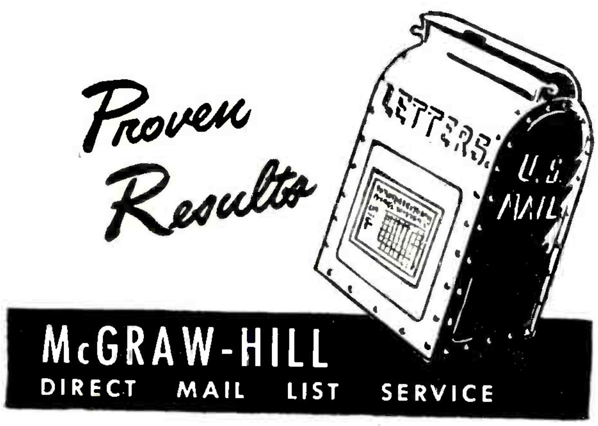

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and the high degree of usefulness to the experimenter that he imposes on his material, a wide range of topics is the natural result.—R. S. LANIER, *20th Century Fund.*

Industrial Electronic Engineering

BY W. L. DAVIS AND H. R. WEED. *Prentice-Hall, Inc., New York*, 1953, 514 *pages;* $11.35.

THIS BOOK is typical of a number of works with similar ambitious titles which contain selected discussions of a few topics in this broad field. The contents of the eleven chapters are briefly summarized below, but broadly speaking, the book may be considered to treat primarily the "power" or "large-current" aspects of industrial electronics.

A stated purpose of the book is "to present basic methods of analyzing and solving problems," and the authors have included many useful techniques. Nevertheless, this reviewer has the impression that too many topics have been covered somewhat too briefly to make the book outstanding. Many discussions are sufficiently detailed to demand the reader's careful attention, but topics are only rarely covered in a manner completely satisfying to an advanced student. The outstanding lack of references will be a disappointment to the general reader.

Line drawings and graphs are used freely, and most of them are clear and adequately labeled. Technical, grammatical, and typographical errors are relatively few. The index is notably adequate.

The early chapters described the general characteristics of gas tubes emphasizing power thyratrons and ignitrons, and the more common methods of control. There is a good and reasonably extensive treatment of single phase and polyphase rectifiers including controlled types.

The nature, characteristics and uses of semiconductor rectifiers are covered briefly with emphasis on copper oxide and selenium cells. The theoretical explanation of metal-to-crystal rectification is con-fused by the supposition that the potential difference between two materials is the potential between their surfaces (here called the zero-energy levels) rather than between their Fermi levels as is actually the case. While the resulting energy-level diagrams permit a plausible explanation of rectification, it is unfortunate that they are misleading.

The treatment of phototubes appears to be an "extra" in this book, but does concisely assist a general reader to understand the principles of light measurement. Light is defined as "the visual sensation produced by that portion of radiant energy that is known as luminous flux." However, light is actually not visual sensation, but radiant energy evaluated in terms of its ability to produce this sensation; and luminous flux is analogous not to energy but to power. The derivation of an incremental equivalent circuit for a phototube is highly commendable. No mention is made of the effects of grid current in phototube amplifier circuits, even though these effects often constitute a design difficulty.

The chapter on Industrial Timing Circuits deals almost exclusively with the principles and operation of resistance welders and the *R-C* timing circuits used to control them. The sections on Servomechanisms and Regulation give a conventional mathematical treatment of first- and second-order systems, system stability, and the use of simple derivative and integral control, and offer a few examples in the area of voltage control of d-c generators. All-electronic voltage regulators are only briefly mentioned. A short chapter is devoted to the study of thyratron-controlled d-c motors.

Much of the basic mathematical theory of radio-frequency heating is presented. The material is adapted primarily from the book by Brown, Hoyler, and Bierwirth, and is perhaps excessively mathematical; the empirical nature of practical design problems is not stressed, and actual design equations are difficult to locate. The discussion of X-rays in the last chapter is a good brief summary of the physics of production of X-rays and of some of their physical characteristics.

This book could serve as a text for those primarily large-current portions of the field of industrial electronics which it covers. In 500 pages, the coverage is frequently too brief for the inexperienced engineer, and the unfortunate lack of references limits the value of the work.—ELERY F. BUCKLEY, *Assistant Professor of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.*

Fundamentals of Electronic Motion

BY WILLIS W. HARMAN. *McGraw-Hill Book Co., New York*, 315 *pages*, 1953, $6.50.

THIS BOOK deals with the mathematical processes and physical reasoning which are fundamental to an understanding of the principles of operation of the wide variety of electron tubes in existence today. There are several chapters devoted exclusively to the analyses of a few types of microwave tubes. This text will be very useful to any engineer who is entering the tube engineering field, as it will supply him with the fundamentals of the analytical approach to a great many problems in this area.

The author's primary objective, as quoted from the preface, is "to nurture the ability to deal wih new problems and new situations." Toward this end he has covered a large number of diverse problems. There is essentially no new material in this book. There are other texts on electron tubes, some specialized to certain tubes and some general, which treat the same material in greater detail on a slightly higher level. Professor Harman, however, gives a very clear presentation of the material which he covers. He explains not only the steps of the mathematical analyses but also conveys the physical meaning of the equations. After the completion of a section the reader is left with a feeling of a fairly complete understanding of the subject matter.

One of the most important assets

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of this book, as the author points out in the preface, are the numerous problems included in each chapter. At the end of each major section are offered problems based on the principles presented. For full comprehension of a subject, problems which stimulate thought and reasoning are essential, and the problems which Professor Harman uses in this text are well integrated with the reading material. The insight and understanding gained from faithful performance of the problems is invaluable.

The book begins with a discussion of units and basic electric field equations, such as Laplace's and Poisson's equations. Methods of solution of these equations are discussed. The equations of motion of electrons in a uniform electric field are then developed. The paraxial ray equation for an electric field is derived and some general properties of electrostatic electron lenses are considered.

The third chapter discusses the wave-particle quality of electrons, and interference phenomena resulting from electron diffraction are explained. The chapter concludes with a discussion of thermionic, photoelectric and secondary emission and applications to electron tubes.

Electron motion in magnetic fields is considered next. The general equations of motion in an axial magnetic field are derived. The paraxial ray equation is obtained and general properties of magnetic lenses are presented. Space charge effects and motion in time-varying fields are treated in Chapters 5 and 6. The analyses contained in these first six chapters are utilized and extended in three of the remaining four chapters, which give operating principles of the klystron, the electron wave tube, the traveling wave tube, the traveling wave magnetron and the magnetron oscillator.

The final chapter deals with the relativistic effects in electron dynamics. These effects are applied briefly to some of the electron tubes treated above and to particle accelerators.

Professor Harman's book provides the mathematical tools and the physical analyses necessary for an understanding of the fundamentals of electron tube operation. While the material herein has been more fully treated in numerous other texts which precede it, perhaps no single book covers the breadth of the electron tube field as does this one. It is a valuable contribution to this field.—DARYL W. SHIPLEY, *Physics Laboratories, Sylvania Electric Products Inc., Bayside, New York.*

THUMBNAIL REVIEWS

Principles of Television Servicing. By C. V. Rabinoff and M. E. Wolbrecht. McGraw-Hill Book Co., New York, N. Y., 1953. 560 pages, $7.50. Combined textbook and practical field reference text assuming only a basic knowledge of electronic circuits and superheterodyne radio principles. The absence of mathematics and unnecessary complex theory greatly enhances the value of the book to those for whom it is intended. In addition, much is of real value to the engineer who seeks to fix his own television receiver.

Materials Handling. By John R. Immer. McGraw-Hill Book Co., New York, N. Y., 1953, 591 pages, $8.00. General principles as applied to all industry. Although only a few specific examples are taken from the electronic industry, there is much basic information in almost every chapter that can readily be adapted to expedite production in electronic plants. Major sections include coverage of motion and time study, materials handling equipment, packaging, handling procedures and organization of personnel.

The Saturday Review Home Book of Recorded Music And Sound Reproduction. By E. T. Canby, C. G. Burke and I. Kolodin. Prentice-Hall, Inc., New York, N. Y., 1952, 308 pages, $4.50. Three major sections, each by one of the authors. Canby provides interesting background information and basic knowledge by tracing recording and playback equipment and techniques from Edison's 1877 tinfoil gadget through to modern magnetic tape. Burke deals with home reproduction and its improvement, telling how to choose, install and operate the units of a modern high-fidelity audio system; examples of systems in five price categories are given and analyzed, ranging from about $225 to $2,000 for the basic elements. Kolodin covers the musician's interests with his "Learning to Listen and Listening to Lean".

Simplified Drafting Practice. W. L. Healy and A. H. Rau. John Wiley & Sons, Inc., New York, N. Y., 1953, 156 pages, $5.00. Tested techniques for eliminating unnecessary work in preparing working drawings, including greater use of freehand drawing, symbols, mechanical aids, abbreviations, arrowless dimensioning, typewriters for lettering, and modern reproduction processes. The greater part of the material definitely applies to electronic drafting. The book is the result of a comprehensive study of drafting practices throughout General Electric Co.

Planseeberichte für Pulvermetallurgie. A new German magazine in the field of powder metallurgy, corresponding in aims and style to the American Powder Metallurgy Bulletin. Available in U. S. through the latter publication, 320 Yonkers Ave., Yonkers, N. Y. About 3 issues per year are planned; $3 for six issues; checks should be made payable to Planseeberichte für Pulvermetallurgie.

UHF Television. By Edward M. Noll. Paul H. Wendel Pub. Co., P.O. Box 1321, Indianapolis, Ind., 1953, 72 p, $1.00. Practical technical information on uhf and vhf tuners and antennas, propagation characteristics and converters.

Glossary of Terms Used in Methods, Time Study and Wage Incentives. Booklet No. 104, Society for Advancement of Management, 411 Fifth Ave., New York, N. Y., 32 pages, $1.00. Definitions of 332 terms, prepared by 93 management leaders as a serious attempt to cut down aimless discussion and hair-splitting interpretations of contract language.

High-Fidelity Design, Construction, Measurements. Gernsback Publications, Inc., New York, N. Y., 1953, 128 pages, $1.50. Compilation of articles from *Radio-Electronics* by 21 different audio experts, edited by Martin Clifford for maximum reading and reference value to high-fidelity audio enthusiasts who prefer to design and build their own equipment.

Atmospheric Noise at High Frequencies. H.M.S.O., London, 1953, 45¢. A survey of existing data based on measurements from 2.5 to 20 mc during the period 1945-1951.

Master Index to Supreme Publications. 3727 West 13 St., Chicago 23, Ill. 1953, 32 pages, 25¢. Index to servicing data for radios and television sets arranged by manufacturers.

NARDA TV Blue Book. National Appliance Trade-in Guide Co., 2142 Fordem Ave., Madison 1, Wisc., $5.00, 1953. Trade-in values on over 4,000 tv sets, the products of over 50 manufacturers, including the majority of sets produced between 1946 and 1953.

Metal Powder Association, Proceedings 9th Annual Meeting. Metal Powder Association, 420 Lexington Ave., New York 17, N. Y., 111 pages, 1953, $2.50. All papers, illustrations and discussion, giving an up-to-the-minute commentary on the latest developments in this field.

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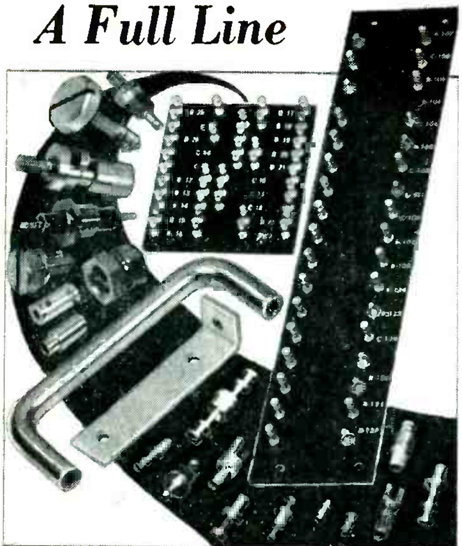

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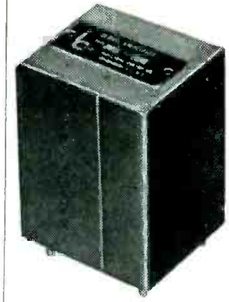

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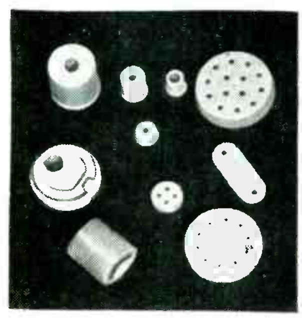

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BACKTALK

"Complaint"

DEAR SIRS:

I HAVE READ your *"Crosstalk"* editorials for some time and have found them to be both interesting and informative. In the August issue of ELECTRONICS, I took particular interest in your editorial titled "Complaint". I agree wholeheartedly.

My organization, Electronics Engineering Corporation, is devoted entirely to the industrial field of electronics. Four of us in the organization left the engineering field some years ago to enter the service field. Each one of us managed separate successful television service organizations in the city of Baltimore. Upon investigation over the past three years, we discovered that there was no organization in this large industrial area devoted to the service of industrial electronic equipment. The larger industrialists can afford to have their own service and engineering departments. The smaller industries must do one of two things—either do without time-and-labor-saving equipment or depend on factory service. This latter service is slow and costly, due to travel involved. Hence, the inception of Electronics Engineering Corporation.

Manufacturers of industrial equipment realize the importance of these time-saving devices and, if given the opportunity, can design a circuit to do almost anything. However, their consideration of saving time and production costs stops there on the original design. They fail to take into consideration the thing which will make their product and future product sales a success—service. Very few manufacturers take this item into consideration. A breakdown of an electronic device is very costly to a manufacturer. Very often, as we have found, an entire assembly line must quit production until the machine is repaired. With inadequate schematics, wiring and parts without coding, the service engineer is hampered in his work.

Your "Complaint" to manufac-

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turers of electronic equipment is well put. By supplying clear, informative schematics and service manuals and by color-coding wiring and component parts, the service engineer's job would be greatly simplified. Manufacturers using electronic equipment would benefit due to less lost time of breakdown and less cost for service. Manufacturers of electronic equipment would benefit due to increased acceptance of easily maintained equipment. This could very easily work into a good sales item for the salesmen contacting a customer—ease and simplicity of maintenance.

I realize that color-coding of wiring would probably increase the production cost of original equipment; but it would pay off.

Design engineers must realize that equipment they design is only as good as the maintenance so far as the user is concerned. By simplifying circuit tracing, the design engineer aids his concern. As mentioned earlier in this letter, there is a tremendous shortage of skilled maintenance personnel in the industrial electronics field. Unless training programs are set up as in television and proper service information is supplied, industrial electronics will lag far behind the rest of the electronics industry.

I would appreciate comments from some of the major manufacturers. Incidently, a representative in this area of one of the major manufacturers of electronic control panels has stated that, in many instances, his department has spent more time in maintenance than an item costs. This is due not to faulty design or engineering, but in large part to the fact that their own service personnel are unable to read the schematics. Is this sound business?

J. EDWIN PARRISH
Vice-President
Electronics Engineering Corp.,
Baltimore, Maryland

Frequency Stability

DEAR SIRS:

WITH REFERENCE to the article entitled "Wide-Band Data Transmitter" appearing on page 168 of the September, 1953 issue of ELECTRONICS, the writer would like to add the following comments to the frequency stability discussion by the authors of the double phantastron.

It is pointed out in this article that the frequency of operations of the double phantastron is directly proportional to the voltage E_{cc}'. This voltage is the difference between the input voltage E_{cc} and the average grid bias during plate rundown, E_g. Now the voltage E_g is not only a function of the phantastron gain, but is also dependent upon the initial emission velocity potential of the cathode. This potential will vary with tube aging and with line voltage if the heater supply is unregulated. Heater voltage variations of $\pm$ 10 percent can be expected to produce a variation in this potential of about $\pm$ 0.1 volt, or since $f \sim E_{cc}'$ and $\Delta f/f$ expressed as a percentage is equal to 100 times $\Delta E_{cc}'/E_{cc}'$, approximately $\pm 10/E_{cc}$ percent variation in frequency.

At a center-frequency voltage of 150 this can only amount to about ± 0.06 percent. However, at a value of E_{cc} which will give an operating frequency of 1 kc for which a modulation linearity of 0.1 percent is reported, the frequency drift caused by line-voltage fluctuations can be as much as $\pm$ 2 percent.

It is felt that these are relatively insignificant for the application reported; however, the inference that heater supplies need not be regulated may be misleading to those unfamiliar with this problem, and who might wish to employ the double phantastron in critical applications with low center values of E_{cc}.

ROBERT G. ROUSH
The Johns Hopkins University
Baltimore, Maryland

Credit

DEAR SIRS:

THE UNDERSIGNED would appreciate it if you would put the following erratum in the next issue of Electronics.

In the article by MacQuistan entitled, "Determining Properties of Bulk Semiconductors (p 150, June, 1953), the acknowledgement should read, "The method used here for

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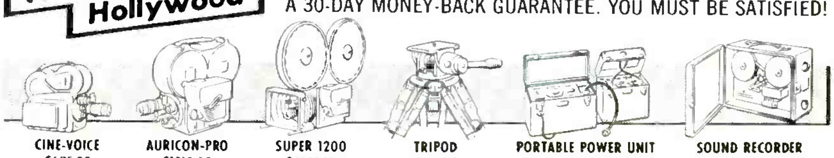

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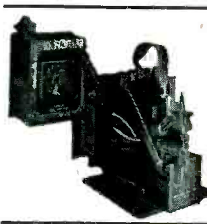

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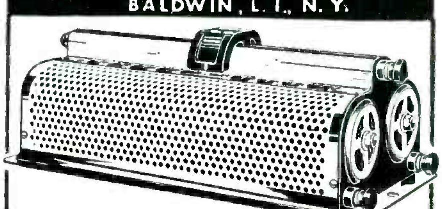

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the measurement of bulk resistivities of semiconductors with pulse heating, and the method of temperature measurement has been designed by J. Hirsch during his stay at Purdue University. We are also indebted to H. M. Bath, who prepared the manuscript for print."

DR. K. LARK-HOROVITZ
Head, Dept. of Physics

R. B. MACQUISTAN
Mechanical Engineering Department
Purdue University
West Lafayette, Indiana

Predestination

DEAR SIRS:

I, TOO, WAS disturbed by Norbert Wiener's essay on Ashby's Design For A Brain (p 368, June, 1953), but only to the extent that I have ordered the book!

From a philosophical point of view I find that Fred Hoyle, etc. of the cosmologists, and Erwin Schrödinger, of the physicists, would seem to agree, basically, with Dr. Wiener rather than Dr. van Slooten (*Backtalk*, p 444, Sept, 1953). His premise that even so prosaic a thing as the Model T *might* not have been the result of randomness does not weigh against the recorded facts of even that machine: it was trial and error!

I had thought that predestination, which seems the advocacy of Dr. van Slooten's letter, was also a baseless delusion: a proposition not pure nonsense, however, any more than man's current preoccupation with his own transmutability into galactic hydrogen!

D. VON RUYSDAEL DRENNER
Engineer, KGGF
Coffeyville, Kansas

Sub or Super?

DEAR SIRS:

IN THE Parallel-Resistor Chart article by Mitchell Aron in the July 1953 issue of ELECTRONICS (p 192), there is an error in Eq. 6. As it now stands, it reads

$$\frac{E_2}{R}x = \frac{E^2}{R^2}A$$

whereas it should be

$$\frac{E^2}{R}x = \frac{E^2}{R_2}A$$

RICHARD W. PLAHN
Mechanical Engineer
Aircraft Radio Corp.
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See Page 479

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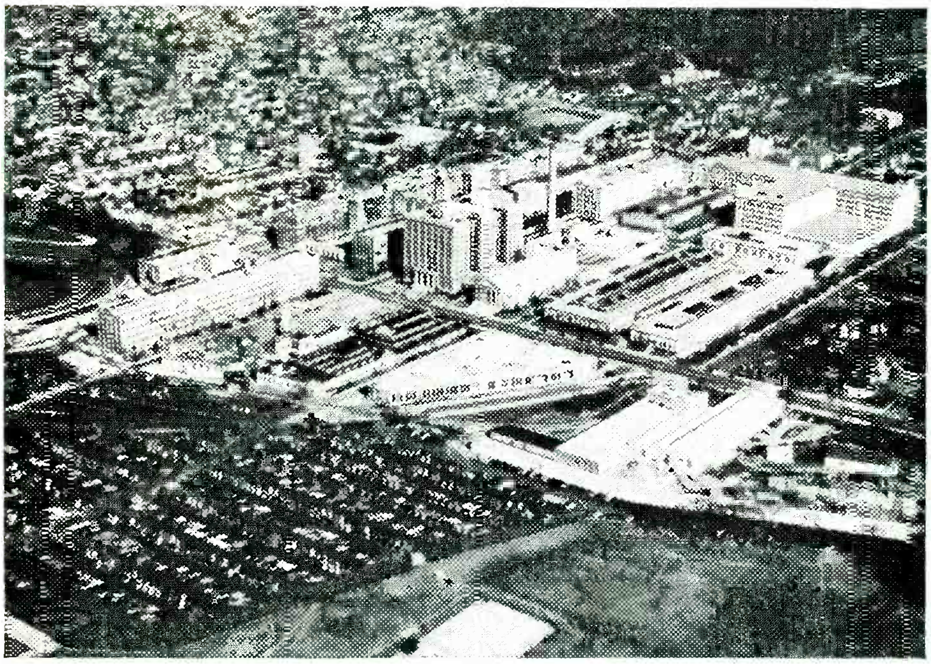

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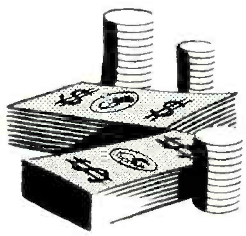

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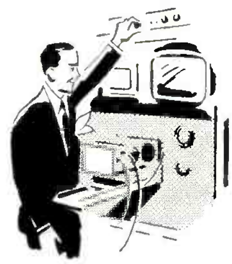

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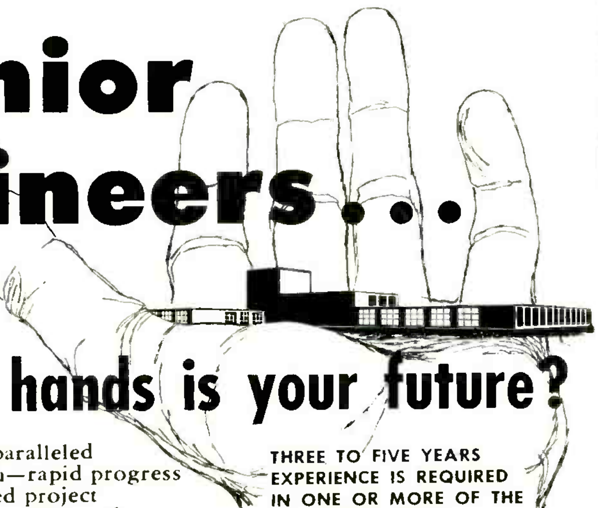

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BC-602 BC-603 BC-604 BC-522
BC-474A TVK-5 TVJ-8
BC433G & BC433F Rradio Compass
Receiver Units (partial listing only)

SHORT WAVE & INTERPHONE

150 BC347C Amplifiers, T24 Microphones
T30 Throat Mike, HS30 Head Sets
BC365 12V Interphone Amplifiers
BC367 Interphone Amplifiers
10 National Ship-to-Shore Receivers
Short Wave Receivers
Walkie-Talkies & Handie Talkies
SD5 Pulse Timers
Hand Mikes & Head Sets

Model BA Radio MG Sets
Directional Loops
Field Phones—Phone Equipment
Large quantity of Coaxial & Power Cable
250 APS Antenna Drive Motors
(Thousands of component parts)

RADAR EQUIPMENT

5 SG-1 Radar Complete
SA Radar Console
SC Radar Transmitters
SF & SL Radar Unit
RC-100 Radar Unit Complete
1500 3-CM Radar Wave Guide Sections
150 SCR 518 Radar Altimeters complete
SF Radar Domes. Radar Indicators
Radar Screens. SC Radar Transmitters
APQ13 Component Kits

ELECTRONIC COMPONENTS

4000 Transformers
MC385 Head Set Adjusters
PE237 Vibrators 5000 Tubes
BC434F Control Boxes
5000 CD343 Cord Sets
1200 Dynamotors 12 to 28V
Amphenol and Cannon Plugs
1000's Switches—Relays—Condensers

Power Supplies
Chokes
Circuit Breakers
Selsyn & Autosyn Motors
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Volt. Regulators BC 937-B
Inverter Motors
Motor Generator Sets
Gunnery Trainers
Instruments, Meters, Ind.
Thousands of Misc. items

TEST EQUIPMENT

RCA, Jackson, Supreme,
Hallicrafter & Western
Pulse Generators
Volt Meters, Volt Ohmeter
Oscillographs
Tube Analyzers, etc.
Audio Chanalyst
Frequency Meters
15 Kohler Power Plants
1M21A (New)
Maintenance Tools

Cut Out This Memo Now:

POWER ELECTRONICS CO.
AUCTION

Thursday, November 5, 1953, starting at 10:30 A.M. P.S.T.

on premises
534 Market St., San Diego, Calif.

NOTE: Above is only a partial listing of merchandise to be auctioned.
Write, wire or phone to address below for descriptive literature or hotel accommodations.

DAVID WEISZ CO. *Auctioneers*
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Applications ENGINEER

An engineer is needed to study circuitry problems involving the use of small electron tubes and semi-conductor devices; in the applications laboratory of major radio tube manufacturer. A degree in electrical engineering, electronic engineering or physics is required. Salary commensurate with experience and ability. Applicants without experience will be considered. We offer good pay and many employee benefits. Send resume to or apply at

TUNG-SOL ELECTRIC INC.
200 Bloomfield Avenue, Bloomfield, N. J.

WANTED

WILL BUY

All ART-13/type T-47A \$200.00; ART-13/type T-47, \$150.00; BC-348 unmodified \$65.00, BC-848 modified \$50.00; APN-9 \$200.00; ARC-3 complete \$600.00; R77 Receivers \$300.00; ARC-1 \$300.00; BC-312 \$60.00; BC-342 \$60.00.
Ship via Express C.O.D., subject to inspection to:

H. FINNEGAN
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WANTED
BC-1016
TAPE RECORDERS

COMMUNICATION DEVICES CO.
2331 Twelfth Ave. NYC 27, N. Y.
Cable: Communidev Tel: Ad 4-6174

ELECTRONIC TUBES
URGENTLY NEEDED

CASH PAID FOR:

Radio, TV, Special Purpose, all types, small and large quantities. State types, quantities, prices.

WRITE NOW to

W-9166, Electronics
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SALES ENGINEER

Must have successful record of sales to electrical and electronics industry in Midwestern states and be desirous of working in that area.

Excellent opportunity for qualified man to become affiliated with long range program to expand sales of coil winding machinery.

Send complete resume to Personnel Director

UNIVERSAL WINDING CO.
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PROVIDENCE 1, RHODE ISLAND

WANTED TO BUY:

One—General Radio Type 667-A Inductance Bridge.
One—Boontar Type 160A "Q" Meter.
They must be in A-1 Condition.

DELUXE COILS, INC.
First & Webster Sts. Wabash, Indiana

If there is anything you want

or something you don't want that readers can supply—or use—*advertise it in the*

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WILL PAY FOR
BC 348R—\$110.
BC 348L, K & H—\$90.
ID-17/APN3
T-11/APN3
T-12/CPN2
CM-3/APN3

Other equipment wanted
What have you?

RADALAB
1964 Webster Ave. Bronx 57, N. Y.
Tel: WE 3-3232-3

Weston offers modern facilities for the PRODUCTION, MODIFICATION & DEVELOPMENT *of* PRECISION EQUIPMENT

ENGINEERING

Staffed by experienced engineers and skilled technicians, Weston Laboratories is constantly at work with customers, in problems relating to microwave and allied products. No problem is too large or too small for our consideration.

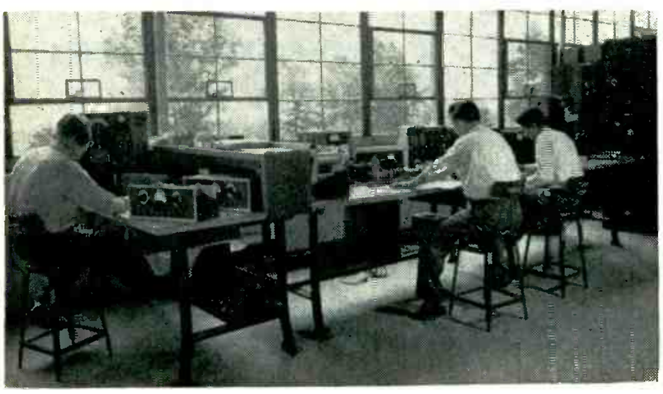
STOCK

Having one of the largest stockrooms in New England, Weston is prepared to "draw from stock" for quick assembly of its production and "custom made" units. It serves as the important link between customer requests and the finished product.

ASSEMBLY

Our production assembly departments are equally prepared for short or long-run contracts. The section shown here illustrates a production run of some of our "stock" units.

Here, in the Research and Development Laboratories, the know-how of our engineers and laboratory technicians is put to the test. With a practically complete complement of standardizing and testing equipment for measurements from D-C to 45,000 MC, we are prepared to tackle a great variety of problems advanced by the customer. Research and development is also being carried on in an effort to improve our own line of test equipment, and keep abreast of the latest developments.

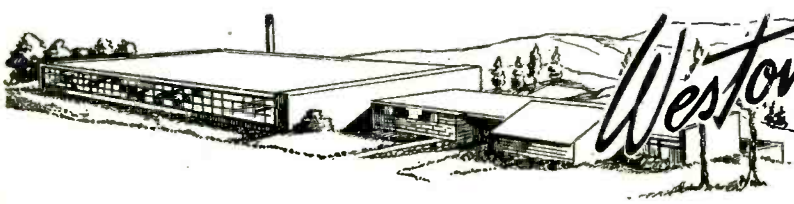


LABORATORIES

Our Machine shops reflect the quality, precision and workmanship that characterizes the New England machine tool industry. These people, skilled in their trades, have been schooled in the art of microwave fabrication, and are equipped with the tools and the "know how" to do the job speedily and correctly.

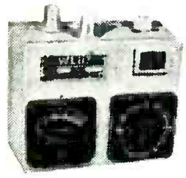
MACHINE SHOP

• QUOTATIONS PROMPTLY SUBMITTED •



Weston LABORATORIES, INC.
HARVARD, MASS.
Tel: HARVARD 250—AYER 300—TWX HARV 193
Cable: WESLAB

Weston HIGH QUALITY TEST EQUIPMENT

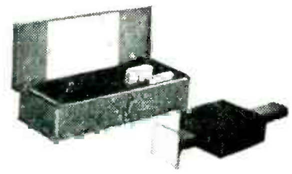


WL-117 WAVEMETER

A precision wavemeter having a range from 2400 mc to 3400 mc with an accuracy of better than 0.1% over the entire range. The resonant cavity has a Q of not less than 1000 and normally from 1000 to 2000. The unit, supplied with a pickup dipole interconnecting cable and adapters, may also be used for relative field strength measurements.
PRICE: $390.00

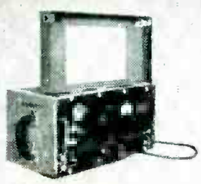
WL-62 ECHO BOX

A portable ringing cavity for microwave research; the unit has a frequency range from 9320 to 9420 mc, with a Q of 50,000 to 80,000. The echo box is used for relative power measurements, spectrum analysis, frequency checks, tests for unstable operation and a host of other applications in the laboratory.
PRICE: $550.00



WL-108 TERMINATION

This 1" x ½" waveguide hi-power load is capable of dissipating a peak power of 200 kilowatts and an average power of 150 watts. The VSWR is less than 1.10 over the entire frequency range of 9300 to 9450 mc. All accessories including carrying case and coupling adapters are supplied with the unit.
PRICE: $90.00



WL-13 SIGNAL GENERATOR

A versatile x-band signal generator providing a source of pulsed or CW power and having provisions for square-wave and sawtooth modulation. Accurate monitoring of the RF output is accomplished with a thermistor bridge and a calibrated attenuator. The power supply is electronically regulated to insure stable operation of the 723A/B Klystron oscillator.
PRICE: $1275.00

WL-89 VOLTAGE DIVIDER

An indispensable aid in high power radar and transmitter measurements this unit has provisions for 100:1 and 10:1 voltage division. It can be used with an oscilloscope to measure video pulses between 200 and 20,000 volts in high-impedance circuits. The ratio accuracy is within +15% and transmission is within 2 db from 150 cycles to 5 megacycles.
PRICE: $45.00

WL-102 PULSE GENERATOR

Equivalent to the TS-102/AP Range Calibrator, this crystal controlled pulse generator produces a square-topped, 50 volt synchronizing pulse of .8 microseconds at a prf of 400, 800, 1600 or 2000 cps, and a triangular marker pulse of 0.4 microseconds duration at a prf corresponding to a pulse-echo distance of 1500 ft. The phase between the marker and sync. pulses is continuously variable from —180 to +180 degrees.
PRICE: $550.00

WL-125 POWER METER

This instrument is a compact, battery operated thermistor bridge designed to measure power in the range of 2400 to 3335 mc., and having a full-scale sensitivity of 2 milliwatts. Among other applications, it can be used to measure antenna patterns, check standing wave ratio and determine average or peak powers. A complete set of accessories, including a 10 db and 16 db attenuator pad for measuring higher power levels, are supplied with the unit.
PRICE: $390.00

SG-8/U NOISE GENERATOR

This popular model, employing a 5722 temperature limited diode as the R.F. noise source, can be used as an absolute means of receiver noise measurements as well as for fundamental studies. The normal input impedance is 270 ohms but a 50 ohm adaptor is supplied with the unit as a standard accessory.
PRICE: $290.00

WL-90 DUMMY LOAD

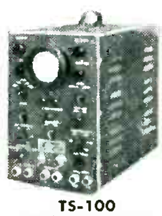
Provides a 50 ohm termination in the form of a 50 to 1 ratio voltage divider for making over-all performance tests on radar units such as the AN/APQ-7, 13, 13A, 23 and a host of other equipments in this frequency and power range. The 49 and 1 ohm resistor elements are carbon coated ceramic rods in helium filled glass tubes and are capable of dissipating up to 500 watts at a peak voltage of 5000 volts.

BC-221 FREQUENCY METER

This universally used and time-tested instrument is a precision meter designed to measure or radiate R.F. impulses between 125 and 20,000 KC. The overall accuracy of the unit is 0.034% over the entire operating range. It is portable and completely self contained or, if desired, it can be obtained with a power supply for 115 volt operation.

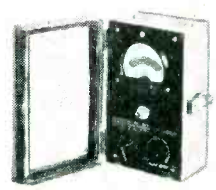
PRICE:

Without Modulation	**$125.00**
With Modulation	**165.00**
115v Power Supply	**35.00**



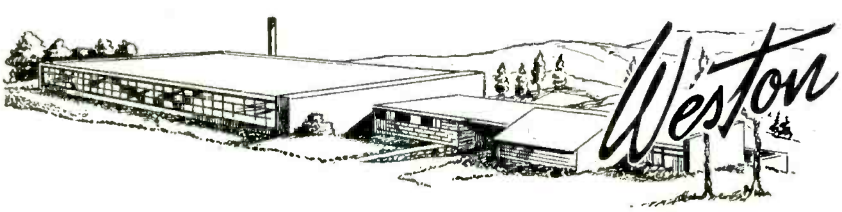
TS-100 OSCILLOSCOPE

This instrument can be used with a linear sweep as a general purpose test oscilloscope or it can be used with a circular sweep as a precision range calibrator. It has a PRF rate of 300 to 1500 per second. Trigger input — 15 volts at 100 volts per microsecond rise. Trigger output — 120 volts (+ 20 volts). It can be used for detecting "jitter" in trigger divider circuits and modulator trigger pulse, and also for determining and adjusting division rate.
PRICE: $550.00



WL-268B/U CRYSTAL RECTIFIER TEST SET

A combination ohmmeter-ammeter designed to measure the electrical characteristics of microwave crystal rectifiers such as the 1N21 and 1N23 series. The instrument is completely self contained and requires only a single 1½ or 2-volts cell for operating power.
PRICE: $53.75



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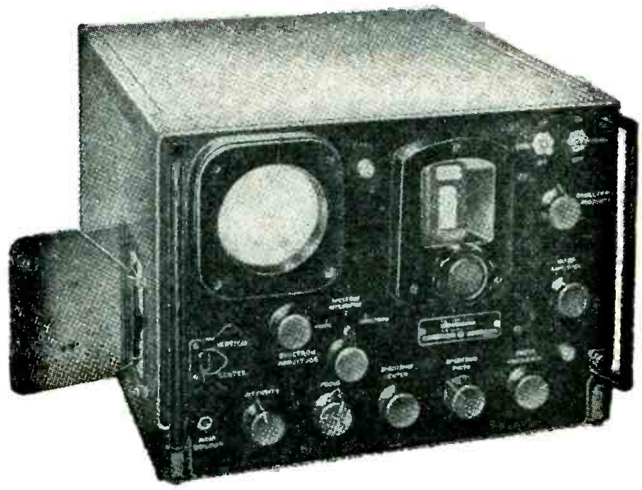
SPECTRUM ANALYZER

T S 148/UP

Most versatile instrument in the Microwave field for frequencies from 8470 mc/s to 9630 mc/s all directly calibrated.

It will measure within the above frequencies spectra of radar transmitters, receivers, echo boxes, local oscillators, resonant cavities, T R boxes, magnetrons, klystrons and test sets.

This instrument is manufactured to the highest standards of the industry and is used by the largest radar and aircraft manufacturers as well as the services of the United States.



Specifications

Power Supply.........................50-1200 Cps; 105-125 Volts; 125 Watts
Frequency-meter Range....Calibrated directly from 8470 mc/s to 9630 mc/s
Sweep Frequencies.................Continuously Variable from 10 to 30 Cps
Attenuation (Spectrum Amplitude).....Uncalibrated, Variable from 3 to 70 db.
Operating Temperature Range..........................—40°C. to +55°C.
Frequency swing of analyzer r-f oscillator (sawtooth FM)......40 to 40 mc/s
Overall i-f bandwidth at half power points..........................50 kc/s
Sensitivity to CW — Spectrum Amplified Pos. — 80 db. below 1 watt for 1 inch of deflection on Oscilloscope Screen.
—Spectrum Position — 55 db. below 1 watt for 1 inch of deflection of Oscilloscope Screen.
Maximum dispersion of spectra..........................1.5 mc/s per inch
Maximum error ....+ 5 megacycles

We will gladly furnish all details regarding specifications prices and delivery.

Other test equipment, used checked out, surplus.

TSK1/SE K Band Spectrum Analyzer
TS3A/AP Frequency and power meter S Band
RF4A/AP Phantom Target S Band
TS12/AP VSWR Test Set for X Band
TS13/AP X Band Signal Generator
TS14/AP Signal Generator
TS33/AP X Band Power and Frequency Meter
TS34/AP Western El Synchroscope
T35/AP X Band Signal Generator
TS36/AP X Band Power Meter
1-96A Signal Generator
TS45 X Band Signal Generator
TS47/APR 40-400 MC Signal Generator
TS69/AP Frequency Meter 400-1000 MC
TS100 Scope
TS102A/AP Range Calibrator
TS108 Power Load
TS110/AP S Band Echo Box
TS125/AP S Band Power Meter
TS126/AP Synchroscope
TS147 X Band Signal Generator
TS270 S Band Echo Box
TS174/AP Signal Generator
TS175/AP Signal Generator
TS226 Power Meter
TS239A Synchroscope
TS239C Synchroscope

SURPLUS EQUIPMENT

APA10 Oscilloscope and panoramic receiver
APA38 Panoramic Receiver
APS 3 and APS 4 Radar
APR4 Receiver
APR5A Microwave Receiver
APT2 Radar Jamming Transmitter
APT5 Radar Jamming Transmitter

MINIMUM ORDER
25 Dollars

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Cables:
TELSERSUP

SPECIAL

Wide Band S Band Signal Generator 2700/3400MC using 2K41 or PD 8365 Klystron, Internal Cavity Attenuator, Precision individually calibrated Frequency measuring Cavity. CW or Pulse modulated, externally or internally.

Large quantities of quartz crystals mounted and unmounted.

Crystal Holders: FT243, FT171B others.

Quartz Crystal Comparators.

North American Philips Fluoroscopes Type 80.

Large quantity of Polystyrene beaded coaxial Cable.

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PHONE WORTH 4-8262

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SOUND POWERED HANDSET

Brand New

TS-10 Type—includes 5 ft. cord. USES NO BATTERIES OR EXTERNAL POWER SOURCE
PAIR—$18.95

SOUND POWERED HEAD & CHEST SET

Navy Type M Head and Chest Set. Brand New For Work Requiring Free Use of Hands. Heavy Duty—Consists of Headset with 2 Phones and Chest Mike. Includes 20 Ft. Rubber Cord .... EACH $14.88

TELEPHONE FIELD WIRE

W-110-B

½ MILE COIL.... $7.95
1 MILE REEL.... $14.95

HAYDON TIMING MOTOR

1 R.P.M. 115 V., 60 Cycle..$1.95

TIMING MOTOR

8 RPM 115 V. 60 cyc
E. Ingraham Co.

$1.79

Timer—Industrial Timer Corp. 15 min. on 15 min. off continuous 115 V. A.C. Fully cased Plugs into octal socket $5.50

TIME DELAY RELAY

Raytheon CPX 24166
1 Min. Delay. 115 V., 60 Cycle
2½ second recycling time spring return • Microswitch contact, 10A • Holds ON as long as power is supplied • Fully Cased •
ONLY $6.50

JONES BARRIER STRIPS

2-140Y	$0.17	2-141	$0.17	7-141¾W	$0.56
3-140	.18	3-141	.20	8-141	.44
3-140¾W	.21	3-141¾W	.27	8-141¾W	.64
4-140	.20	3-141W	.27	9-141Y	.71
6-140	.28	4-141	.24	3-142	.24
10-140W	.59	5-141	.29	2-150	.43
10-140¾W	.59	5-141¾W	.41	3-150	.60

Brand New Meters—Guaranteed

0-10 ma. D.C. 3½" $3.95
0-1 Ma D.C. 3½" Dejur (Scale Reads 0.4 KV) $5.75

SELENIUM RECTIFIERS

Full Wave 200 MA 115V $1.70
Half Wave 100 Ma 115V .... .91

3 AG FUSES

Amp.	Per 100	Amp.	Per 100	Amp.	Per 100
⅛	$4.00	¾	$4.00	8	$3.00
⅜	4.00	1	3.00	10	3.00
½	4.00	4	3.00	15	3.00
		5	3.00		

3 AG FUSE HOLDERS (Finger) 25¢

RESISTORS

Type EB ½W 10%	6¢ ea.	$4.00 per C
EB ½W 5%	12¢ ea.	8.00 per C
Type GB 1W 10%	9¢ ea.	7.00 per C
GB 1W 5%	18¢ ea.	14.00 per C
Type HB 2W 10%	12¢ ea.	9.00 per C
HB 2W 5%	24¢ ea.	18.00 per C

AVAILABLE IN ALL STANDARD RMA VALUES

POSTAGE STAMP MICAS
AVAILABLE IN ALL STANDARD RMA VALUES
PRICE SCHEDULE

5 mmf to 910 mmf .... 5¢
.001 to .0013 mfd .... 8¢
.0015 to .0056 mfd .... 15¢
.0062 to .0091 mfd .... 20¢
.01 mfd .... 28¢

SILVER MICA—POSTAGE STAMP
AVAILABLE IN ALL STANDARD RMA VALUES
PRICE SCHEDULE

10 mmf to 910 mmf .... 10¢
.001 mfd to .002 mfd .... 20¢
.0022 mfd to .0091 mfd .... 50¢
.01 mfd .... 95¢

ASSORTMENTS

GEARS—100 SMALL GEARS, BUSHINGS & SHAFTS. $6.50
RESISTORS—200 ½ WATT ALL INSULATED AMERICAN MADE $2.50
HARDWARE—5 lbs. BOLTS—NUTS—LUGS—WASHERS ETC $2.00

PULSE TRANSFORMERS

UTAH—9262 9278 9289 9318 9340 9350
WESTERN ELECTRIC—D166173 D161310
KS8696, KS9800, KS9862, KS13161
GENERAL ELECTRIC—80-G-5
JEFFERSON ELECTRIC—C-12A-1318
DINION COIL—TR1048 TR1049
also 352-7250-2A: 352-7251-2A: T-1229621-60

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See Our Ad February, 1953 Electronics
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TERMS — Cash with Order or 25% Deposit — Balance C.O.D. Net 10 Days to Rated Accounts. All Prices are Net F.O.B. Our Warehouse.

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¼" hole, ½" O.D. 1-⅛" long with two 6/32 tapped set-screw holes EACH 85c
3/16" hole, ⅜" O.D. 1-¼" long with two 6/32 tapped set-screw holes EACH 80c

OIL FILLED CONDENSERS

MFD	V.D.C.	Price	MFD	V.D.C.	Price
5 2	50	$0.89	0.5	3,000	$2.40
6	400	.85	2	3,000	4.50
3 x 3	400	1.00	2	4,000	7.95
4	500	.85	0.01	5,000	.95
1	600	.55	1	5,000	4.88
0.5-0.5	600	.40	0.03-0.03	6,000	1.50
2	600	.75	1	6,000	9.95
4	600	1.75	0.02-0.02	7,000	1.55
8	600	1.85	0.1	7,000	1.79
10	600	3.25	0.1-0.1	7,000	5.95
4 x 3	600	2.50	0.1	7,500	2.25
8-8	600	1.95	0.075-0.075	8,000	6.50
1	800	.60	0.15-0.15	8,000	6.95
1	1,000	.69	0.25	20,000	19.95
2	1,000	.95			
3	1,000	1.70			
1	1,500	1.45			
0.02	2,000	.65			
0.1-0.1	2,000	1.30			
0.1-0.5	2,000	.95			
0.5	2,000	1.65			
3	2,000	3.75			
8	2,000	7.95			
0.25	3,000	2.25			

1 mfd
6,000
V.D.C.
G.E.
$9.95

OIL FILLED AC CONDENSERS

MFD	V.A.C.	Price	MFD	V.A.C.	Price
7.5	220	$2.00	15	440	$6.25
20	220	4.95	1	660	2.95
1	236	.49	2 9	660	4.35
4	236	1.60	3	660	4.45
8	236	1.95	4	660	4.95
3	330	1.45	5	660	5.45
4	330	2.25	6	660	5.95
20	330	6.75	8	660	7.50
25	330	7.50	0.2	750	.69
4.4	375	2.15			

COAXIAL CABLE CONNECTORS

A full line of jan approved connectors in stock

83-1AC	$0.42	PL-274	$1.10	UG-88/U	$.90
83-1AP	.30	PL-275	2.10	UG-89/U	1.10
83-1BC	.35	SO-239	.40	UG-102/U	.80
83-1F	1.10	UG-13/U	1.70	UG-103/U	.68
83-1H	.12	UG-18B/U	1.05	UG-104/U	1.40
83-1HP	.22	UG-20B/U	1.60	UG-105/U	1.50
83-1J	.73	UG-21/U	.85	UG-106/U	.15
83-1R	.40	UG-21B/U	1.00	UG-107B/U	2.75
83-1RTY	.65	UG-21C/U	1.05	UG-146/U	2.00
83-1SP	.45	UG-21D/U	1.45	UG-167/U	3.75
83-1SPN	.50	UG-22/U	1.30	UG-175/U	.12
83-1T	1.30	UG-22A/U	1.60	UG-176/U	.12
83-2AP	1.95	UG-22B/U	1.20	UG-185/U	.95
83-2J	2.10	UG-23/U	1.20	UG-196/U	1.65
83-2R	1.65	UG-23B/U	1.50	UG-203/U	.65
83-22AP	1.40	UG-23C/U	1.10	UG-224/U	1.15
83-22F	2.10	UG-24/U	1.30	UG-255/U	1.95
83-22J	1.40	UG-27/U	1.25	UG-260/U	.85
83-22R	.68	UG-27A/U	2.25	UG-261/U	1.10
83-22SP	.80	UG-27B/U	2.95	UG-262/U	1.10
83-22T	1.95	UG-28A/U	2.95	UG-273/U	1.45
83-168	.12	UG-29B/U	1.75	UG-274/U	2.30
83-185	.12	UG-30/U	2.30	UG-290/U	.90
CW-123A/U	.45	UG-57B/U	1.85	UG-291/U	.95
M-358	1.30	UG-58/U	.70	UG-306/U	2.65
M-359	.30	UG-58A/U	.90	UG-414/U	1.95
M-359A	.65	UG-59A/U	1.90	UG-499/U	1.25
PL-258	.75	UG-88/U	1.75	UG-625/U	1.35
PL-259	.45	UG-85/U	1.65		
PL-259A	.50	UG-87/U	1.40		

NEW COAXIAL CABLES Jan approved

	Price per 1000 ft.		Price per 1000 ft.
RG5/U*	$140.00	RG22/U*	$150.00
RG6/U	180.00	RG22A/U	285.00
RG7/U*	85.00	RG24/U	675.00
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RG9/U*	250.00	RG29/U*	50.00
RG9A/U	275.00	RG34/U*	300.00
RG10/U	240.00	RG35/U	900.00
RG11/U*	100.00	RG41/U*	295.00
RG11A/U*	150.00	RG54A/U	97.00
RG12/U	240.00	RG55/U*	110.00
RG13/U*	216.00	RG57/U*	325.00
RG17/U	650.00	RG58/U*	60.00
RG18/U	900.00	RG58A/U*	70.00
RG19/U	1250.00	RG59/U*	60.00
RG20/U	1450.00	RG62/U*	75.00
RG21/U*	220.00	RG77/U*	100.00

Add 25% for orders less than 500 feet.
* No minimum order—other 250 minimum.

NEW RG-8/U Unmarked 100 Ft. Coil..Special $5.95

SELSYN MOTORS

Army Ordnance Type C-78248 115V, 60 Cy. Transmitter. Approx. 3-⅜" dia. x 5-⅜" L. Like new..EACH $27.50

SELSYN MOTORS

50 V. 50 Cy. High Torque. Connect in Series For Use On 110 V. 60 Cy. Approx. 3-⅜" dia. x 5-⅜" L. Like New .... ONLY $12.95 PAIR

DIFFERENTIAL Used $4.95
115 V., 60 Cycle #C78249 New $9.95

3⅜" dia. x 5⅜" long
Used between two C78248's as a dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted) $5.50
Mounting Brackets—Bakelite for selsyns, and differentials shown above .... 35c pair

PRECISION RESISTORS
(WIRE WOUND SPOOL TYPE)

½ watt one percent tolerance WW3 or Equal 35¢ ea.

.250	7.4	19.37	105.8	400	5000	20K
.334	9.1	20	123.8	414.3	5900	25K
.502	10.48	25	125	705	6500	30K
.557	10.84	30	130	723	7000	32.89K
.627	11.1	46	147.5	750	7500	33.3K
.760	11.25	50	180	855	8000	35.89K
1	11.74	52	210	2193	8500	36K
1.01	12.32	55.1	220.4	2200	8800	37K
1.53	13	62.51	235	2250	10K	40K
2	13.02	75	260	2500	12K-2%	47K
2.04	13.15	79.81	270	2850	14.82K	50K
2.5	13.52	87	298.3	3427	15K	59K
3.5	13.89	97.8	301.8	4000	15.75K	59.15K
5.26	14.98	100	366.6	4300	16.7K	79.01K
				4451	17K	125K

1 watt one percent tolerance WW4 or Equal 45¢ ea.

.861	3.39	20	270	2000	7000	50K
1.01	5.1	28	425	2200	8000	55K
2.55	5.21	38	1250	3300	9000	80K
2.58	12	50	1750	6000	20K	

1 watt one percent tolerance WW4 or Equal 60¢ ea.

100K	128K	150K	240K	320K	500K	600K
120K	130K		250K			

1 watt WW5 or Equal 65¢ ea.
84K-2% 522K-1% 645K-1% 700K-1% 1 meg-5%

1 MEGOHM 1 WATT 1% $1.50

TYPE "J" POTENTIOMETERS

Ohms	Shaft	Ohms	Shaft	Ohms	Shaft
100	SS*	2.5K	SS	100K	7/16
150	SS	3.0K	3/8	200K	SS
150	SS*	4.0K	3/8	250K	5/8
500	1/4	15K	3/8	250K	SS
1.0K	9/16	25K	SS	1.0 Meg	1/4
1.5K	5/16	75K	SS		
2.0K	1/4	100K	3/8		

SS: Screw-driver slot.
*: Split locking bushing.
$1.25 EACH

TYPE "JJ" POTENTIOMETERS

Ohms	Shaft	Ohms	Shaft	Ohms	Shaft
10K-10K	5/16	30K-10K	⅜†	90K-3K	¼
15K-15K	SS	†With switch.			

PRICE—$2.50 EACH

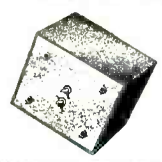
High Current Filament Transformer

Amertran type W Pri. 105-125 V. 60 cy. 1 Phase—Sec. 5V. 190 amps.—.97 KVA 35 KV. RMS Insul. Test 7x10x12; Wt. 80 lbs. Ideal For Use As Arc Welder.
SPECIAL $29.50 ea.
Kenyon S-14940 S.C. #2Z9943-1073 Pri. 105-125 V. 60 Cy. Sec. 5V. 115 Amps .... $19.50 ea.
Kenyon S-13377, S.C. #2Z9943-7 Pri. 115 V. 60 Cy. Sec. 5V. 60 Amps. .... $15.25 ea.

RAYTHEON PLATE TRANSFORMER
TYPE U8355A

PRI. 110V/220V/440V/60 cy.
SEC #1 300V @ 4 AMPS. SEC. #2 300V @ 4 AMPS.
1780 RMS TEST, 9¾"x9½"x8½" HIGH. $19.95

Choke
10 hy
400 MA
90 OHMS
HERMETICALLY
SEALED



$4.88

2J1G1 SELSYNS $8.50
400 CYCLE BRAND NEW

400 CYCLE INVERTERS
Leland Electric Co.

#10800 in; 20-28 V.D.C., 92 A. 8000 R.P.M. Out: 115V. 400 Cyc. 1 phase, 1500 V.A. 90 PF $29.50

Minimum Orders $3 ... ... Get on our Mailing List

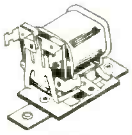
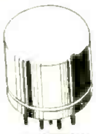
RELIANCE MERCHANDIZING CO.

Arch St., Cor. Croskey Phila. 3, Pa. Telephone Rittenhouse 6-4927

Want more information? Use post card on last page.

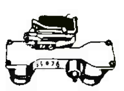
RELAYS RELAYS RELAYS

SIGMA RELAYS

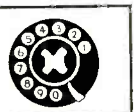

4F8000S: 1 ma; SPDT; 8000 ohm; #R287...**5.95**
41FS7: 2 ma; SPDT; 10,000 ohm; #R914....**2.95**
41F8000S: 2.5 ma; SPDT 8,000 ohm; #R1002..**2.95**
41FZS7: 115VAC; SPDT; Will Operate Continuously on 220VAC; #R909..**2.95**
41FR: 6VDC; SPDT; 62 ohm; Will Operate on 1½ VDC; #R924........**1.75**
41FR: 12VDC; SPDT; 340 ohm; Will Operate on 6 VDC; #R925..........**1.95**
4AH: 4 ma pull-in, 2.5 ma hold; SPDT; 2000 ohm; Air Tight Seal, RTMA 5-prong Plug Base; #R444 ....**4.25**
4RJ-47G: 3VDC; SPDT; 47 ohm; Hermetically Sealed; Solder Head Terminals; #R448 ....**5.95**
5F150G: 20 ma; SPDT; 150 ohm; #R1003 ....**2.95**
5RLP150G: Same as #R1003 (Sigma 5F150G) except with dust cover; #R1004 **4.50**
5RJ100S: 1.5VDC; SPDT; 100 ohm; Hermetically Sealed; Solder Head Terminals; #R1001 ....**6.95**
5RJ2000G: 2.3 ma; SPDT; 2000 ohm. Hermetically Sealed; #R1005......**7.50**
5RJ5000G: 1.4 ma pull in, 0.4 ma hold; SPDT; 5000 ohm; #R281.........**6.95**

COAXIAL RELAY



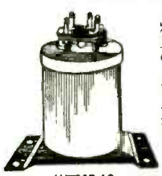
ARC 3 55476 (K101); 12-24V. DC; SPDT; 275 ohm; #R751 ....8.95

IMPULSE DIAL



To open a normally closed circuit. Ten holes — capacity: 1-10 impulses. Has 3 shunt springs, arranged to make when dial is moved off normal. #D101 ....4.95

TRANSFORMERS

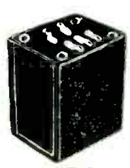


#TX240

2:1 AUTOTRANSFORMER 220-110V, 50-60 cyc., Open Frame
40W #T106 ......**$2.49**
250W #T107 ......**$4.75**

LINE TO VOICE COIL, RAYTHEON 30418, Ratio 600 ohms to 6 ohms (100:1) POWER LEVEL +17db, Hi Fidelity #TX-240 ....**$2.95**

PREAMP OUTPUT (TRIODE PLATE) TO LINE OR PHONES G.E. 400 to 4000 cyc. #TX214 **$1.49**

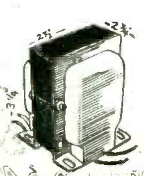


#T39

P.P. INTERSTAGE P. P. PLATES to P. P. Grids, Stancor #87A15 or Kenyon T54, Ratio 1.2 to 1, Hi Fidelity, T112 **$2.50**

4:1 INTERSTAGE FERRANTI Single Plate to Grid, Hi Fidelity T39 **$1.89**

CLASS B DRIVER, Driver Plate to P. P. Class B Grids, Ratio Pri. to ½ sec, 1 to 0.9 #238 **$1.95**



#T38

3000V, 10Ma. 115V. 50-60 cyc., W. E. #D161913 #T109 ....**$4.95**

3000V 50Ma Constant Current Xfmr, 115V 50-60 cyc., Westinghouse ST90, for "Sterilamp" or Neon #T110 ......**$7.95**

JOBBERS—EXPERIMENTERS LABORATORIES

WRITE OR PHONE YOUR RELAY REQUIREMENTS

We have a large variety of standard types of relays and solenoids for a multiplicity of uses which for various reasons are not listed in our advertising. When inquiring concerning your needs give as much information as possible. Catalog numbers are not sufficient. Give coil voltage; specify AC or DC; give current or resistance; contact current and arrangement.

CHOKES

#T111

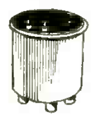
SWINGING CHOKE Thoardson T74C29, 5 to 30 hys, 125 ma, 200 ohms, S.C. #4G1668c/R1 2000V Test, #T111 ....**$3.49**

#T78

DELUX FILTER Amertran #L218, 60 ma 45 hy, 600 ohms, Heavy Cast Case, S.C. #2C2770/R2 #T33A **$2.95**

25 Hy, 20 Ma, 975 ohms, G.E. K54J112 Hermetically Sealed, 2500V insul #T78 ....**$.95**

4 Hy, 60 Ma, 200 ohms, Rola KS8729 Hermetically Sealed, Hi Q, Very Compact #T92 ....**$1.19**

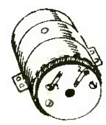


#T74

3 Hy, 10 Ma, 325 ohms, ARL 5634 Compact Shielded #T74 ....**$.69**

1 Hy, 25Ma, 100 ohms, Westinghouse 382626, Shielded #T71 ....**$.49**

600 Hy, 1 Ma, 6000 ohms, Raytheon CRP 30380 Hermetically Sealed. Hi Q. #T76 ....**$1.95**

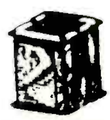


#T76

200 Hy, 10 Ma, 5260 ohms, Westinghouse CAY301161 Shielded #T73 ......**$2.49**

325 Hy 3 Ma, 5500 ohms, G. E. 400V Insul. #T35A **$1.25**

SERVO OUTPUT



PP6L6 to Servo mechanism with 10% feed-back winding. Mu metal core ....**$3.50 ea.**

DUAL unit PP6V6 to Servo mechanism with 10% feedback winding and 6SN7 to Servo mechanism. Both in 1 can. Mu Metal Core..........**$3.95 ea.**

120 CYCLE FILTER

Input Impedance: 1000 ohm, Output Impedance: 1000 ohm, Kenyon 213104-1. Shielded. #T289.................**$3.95**

FILAMENT TRANSFORMERS

110V 50-60 cyc. Primary

Stock #	Volts	Amps	Insul.	Price
T154	6.3 CT	1	2500	$1.35
T155	5	2	2500	1.65
T156	6.3 CT	2	2500	1.80
T157	6.3 CT	6	2500	3.00
T158	2X6.3 CT	3+3	2500	3.29
T159	6.3V	16	1500	3.49
KENYON Shielded; 6.3V; 2.5A; 2500V Insul; #T153				2.25
T250	7.5V	7	1500	3.49
T251	6.3V	4	1500	2.49

AUDIO XFMRS

Multiple Line & Voice Coil to Multiple Line & Voice Coil. Good Fidelity. Kenyon S20130. Shielded. #T287..........**$2.25**

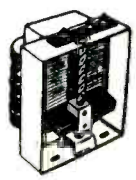
Input Line to Single or P.P. Grids. 500-ohm C.T. Primary. Overall Ratio 1:13.7, Kenyon 213089-1. Shielded. #T288....**$2.25**

Multiple Line or Mike to Single Grid. 300-ohm C.T. Primary. Overall Ratio 600:1. Kenyon 213307-2. Shielded. #T289.**$2.25**

P.P. INTERSTAGE. Single or P.P. Plates to P.P. Grids. Ratio 1:1.2 Hi-Fidelity. Stancor 87A15. Shielded. #112...........**$2.50**

VOLTAGE REGULATOR

Amertran Transtat



103 to 126 V, 50-60 cyc, 2.17 Amps, #T283.**$9.95**
W. E. D122855, 92 to 115 V. 400 cyc. 5.5 Amps, #T281 ....**$6.75**
10 for $60.00

2.5 AMP H.D. FILTER REACTOR

Amertran Type PBN 0.5 Hy, at 2.5 A, 2.3 Ohm, 2.5 KV insul, 5½ x 7 x 8" overall, Heavy Shield, #T284............**$12.95**

TRANSFORMERS

110/220 V 50-60 cycles

STEP-UP-DOWN

40W, #T106, 2.49; 150W, #T113, 5.95; 250W, #T114, 7.49; 350W, #T115, 8.95; 500W, #T116, 11.95; 750W, #T117, 17.95; 1000W, #T118, 25.00; 1500W, #T119, 37.50.

CARBON MONOXIDE DETECTOR SIGNAL ASSEMBLY

MINE SAFETY APPLIANCES CO. Type K-1 and K1-N—Manufacturer's Part No. SK 1557 and SK 1557-1—Spec. No. 27493

NEW! REG. PRICE $300

89⁰⁰ each

3 for $250.00
10 for $825.00

TERMS:—All prices F.O.B. Our Plant. Rated Firms Net 10 Days: All Others Remittance with Order.

Delivery From Stock While They Last!

Orders Under $10 Remittance With Order. Plus Approximate shipping charges (overage will be returned)

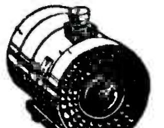
324 CANAL ST., N.Y.C., 13, N.Y. WAlker 5-9642

Universal general corp.

Want more information? Use post card on last page.

SWEEP GENERATOR CAPACITOR
Magnavox Part #XC-260048-G1

Rotating split stator capacitor. Cylindrical silver plated rotor concentric to silver plated stator on inside of Bakelite housing. Housing diameter 1⅝". Square end bells 1⅝" sq. Shaft extension ½" x 0.1875 dia. High speed ball bearings. Capacity 5 to 10 mmf. Ideal for motor driven high frequency sweep generator. BRAND NEW $2.50



G. E. GENERATORS

General Electric Type 5-ASB-31JJ3; 400 cycles out at 115 volts; 7.2 amps; 8,000 rpm.; size 6" long x 6" dia. $99.50 ea.

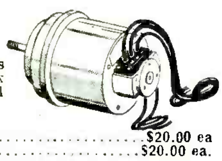
SINE-COSINE GENERATORS
(Resolvers)

Diehl Type FJE43-9 (Single Phase Rotor). Two stator windings 90° apart, provides two outputs equal to the sine and cosine of the angular rotor displacement. Input voltage 115 volts, 400 cycle..$30.00 ea.
Diehl Type FPE-43-1 same as FJE-43-9 except it supplies maximum stator voltage of 220 volts with 115 volts applied to rotor....$25.00 ea.
Arma Resolver Type 213014; equal in size to size 5 synchro; 55-60 cycle; single phase primary, 2 phase secondary $79.50

VOLTAGE GENERATORS (RATE)

ALNICO MIDGET D.C. VOLTAGE GENERATOR Type B-35-D $17.50
ALNICO MIDGET D.C. VOLTAGE GENERATOR Type B-44-D $17.50
A.C. GENERATOR: 67 V., 20 Cyc., 2-Phase. .015 Amps. Type PM-1, 1200 R.P.M. $15.00

SYNCHRONOUS SELSYNS



110 volt, 60 cycle, brass cased, approx. 4" dia. x 6" long. Mfg. by Diehl and Bendix.
Quantities Available.
REPEATERS ....$20.00 ea
TRANSMITTERS ....$20.00 ea.

AUTOSYN MOTOR TYPE 1

115 VAC; 60 cycle; 1-phase; DR. = CB 4279 Foot Mounted; Mfg. Bendix Aviation Corp. ....$22.50 ea.

SELSYN GENERATOR

General Electric MOD. 2J5M1; 115-57.5 Volts 400 Cycle ....$22.50 ea.

SYNCHROS

AUTOSYN MTR. KOLLSMAN Type #403; 32 VAC; 60 cycle; single phase....$22.50
AUTOSYN MTR. BENDIX Type #851; 32 VAC; 60 cycle; single phase....$22.50
SYNCHRO TRANSMITTER, KEARFOTT Type R-212-1A-A Rotor: 26 Volts; single phase; Stator: 11.8 Volts; 3-phase; 400 cycle....$25.00
MICROSYN UNIT. Type 1C-006-A....$35.00
1F Special Repeater (115V-400 Cy.)....$15.00 ea.
2J1F 3 Generator (115-400 cyc.)....$10.00 ea.
5CT Control Transformer: 90-50 Volt; 60 Cy..$45.00
5F Motor (115/90 Volt—60 cyc.)....$45.00
5/DG Differential Generator (90-94 volts—400 cyc.) $30.00 ea.
TRANSMITTER. BENDIX C-78248; 115 Volt, 60 Cycle....$25.00 ea.
Differential C-78249; 115 V., 60 Cy....$5.00
5N MOTOR (115 Volts/60 Cycle)....$22.50
REPEATER, BENDIX C-78410; 115 Volt, 60 Cycle $37.50 ea.
REPEATER. AC synchronous 115 V., 60 cycle. C-78863....$15.00 ea.
REPEATER. DIEHL MFG. No. FJE 22-2; 115 Volt; 400 Cy.; Secondary 90 V....$27.50
5G GENERATOR (115/90) 60 cycles....$45.00
7G Synchro Generator (115/90 volt; 60 cycle)..$75.00
6G Synchro Generator (115/90 volt; 60 cycle)..$60.00
6DG Synchro Differential Generator (90/90 volt; 60 cycle)....$50.00
2-JF5-J Selsyn Control Transformer: 105-55 Volts; 60 Cycle....$50.00
5JD5HA1 Selsyn Generator: 115-105 Volts; 60 cycle $50.00
2J1F1 GENERATOR: 115—57.5 Volt; 400 cycle. $12.50 ea.
2J1H1 DIFFERENTIAL GENERATOR: 57.5—57.5 Volt; 400 cycle....$12.50 ea.
2J1G1 CONTROL TRANSFORMER: 57.5—57.5 Volt; 400 cycle....$7.50 ea.

PIONEER TORQUE UNITS

TYPE 12606-1-A: Contain CK5 Motor coupled to output shaft through 125.1 gear reduction train. Output shaft coupled to autosyn follow-up (AY43). Ratio of output shaft to follow-up Autosyn is 15.1. $70.00 ea.
TYPE 12604-3-A: Same as 12606-1-A except it has a 30:1 ratio between output shaft and follow-up Autosyn....$70.00 ea.
TYPE 12602-1-A: Same as 12606-1-A except it has base mounting type cover for motor and gear train $70.00 ea.

INVERTERS

10563 LELAND ELECTRIC

Output: 115 VAC; 400 cycle; 3-phase; 115 VA; 75 PF. **Input:** 28.5 VDC; 12 amp....$59.50

PIONEER 12126-2-B

OUTPUT: 26 Volts; 3 Phase; 400 cycle; 10 Volt Amperes; .6P.F. **INPUT:** 27.5 Volt DC; 1.25 Amp. $39.95

PIONEER 12117

OUTPUT: 26 volts; 400 cycles; 6 volt amperes, 1-Phase. **INPUT:** 24 VDC; 1 amp....$25.00 ea.

ALTERNATOR, CARTER

Mfg. Carter Motor Co.; OUTPUT: 7 VAC; 9.7 amp.; 650 cycles, and 295 VDC. 200 amps. INPUT: 26.5 VDC; 10.5 amps; 6500 rpm....$49.50 ea.

PE 218 LELAND ELECTRIC

Output: 115 VAC; Single Phase; PF 90; 380/500 cycle 1500 VA. **INPUT:** 25-28 VDC; 92 amps; 8000 RPM; Exc. Volts 27.5.
BRAND NEW ....$39.95 ea.

PE 109 LELAND ELECTRIC

Output: 115 VAC, 400 cyc; single phase; 1.53 amp.; 8000 RPM; **Input:** 13.5 VDC; 29 amp....$65.00

MG-0-75 ONAN

Navy Type PU/11 . . . **Output:** 115 VAC; 480 cyc.; single phase; 5.3 amp and 26 VDC @ 3.8 amp. **Input:** 115/230 VAC; 60 cyc.; single phase...$225.00

MG 153 HOLTZER-CABOT

Input: 24 V. DC. 52 amps; **Output:** 115 volts—400 cycles, 3-phase, 750 VA. and 26 Volt—400 cycle, 250 VA. Voltage and frequency regulated $95.00 ea.

PIONEER 12130-3-B

Output: 125.5 VAC; 1.15 amps. 400 cycle single phase. 141 VA. **Input:** 20-30 VDC, 18-12 amps. Voltage and frequency regulated....$75.00

12116-2-A PIONEER

Output: 115 VAC; 400 cyc.; single phase; 45 amp. **Input:** 24 VDC 5 amp....$65.00

10285 LELAND ELECTRIC

Output: 115 Volts AC, 750 V.A., 3 phase, 400 cycle, .90 PF. and 26 volts, 50 amps, single phase, 400 cycle, .40 PF. **Input:** 27.5 VDC, 60 amps. cont. duty, 6000 RPM. Voltage and Frequency regulated. $95.00

10486 LELAND ELECTRIC

Output: 115 VAC; 400 Cycle; 3-phase; 175 VA; .80 PF. **Input:** 27.5 DC; 12.5 amp; Cont. Duty. $90.00 ea.

PIONEER 10042-1-A

DC INPUT 14 Volts; **OUTPUT:** 110 Volts; 400 Cycle 1-Phase; 50 Watt....$75.00

94-32270-A LELAND ELECTRIC

Output: 115 Volts; 190 VA; Single Phase; 400 Cycle; .90 PF. and 26 Volts; 60 VA; 400 Cycle; .40 PF. **Input:** 27.5 Volts DC; 18 amps; cont. duty, voltage and freq. regulated....$95.00

PIONEER 12147-1-B

OUTPUT: 115 VAC; 400 cycle; Single phase. **INPUT:** 24-30 VDC; 8 amps....$79.50

MG 149F HOLTZER-CABOT

OUTPUT: 26 VAC @ 250 VA; 115V @ 500VA; Single Phase; 400 cycle. **INPUT:** 24 VDC @ 36 amps. $75.00

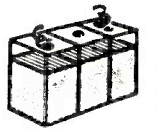
EICOR CLASS "A" NO. 1-3012/08-7

OUTPUT: 125 VAC; 400 cycle; single phase; 100 VA. **INPUT:** 24-30 VDC; 11 amps; Duty int. Voltage and Frequency Regulator $99.50

PIONEER AUTOSYNS

AY-1	26 Volt—400 Cycle	$6.95
AY-5	26 Volt—400 Cycle	$7.95
AY27D		$12.50
AY6—26 Volt—400 cyc.		$4.95 ea.
AY30D—26 Volt—400 cyc.		$25.00 ea.
AY14D		$10.00
AY34		$20.00
AY20—26 Volt—400 cyc.		$12.50 ea.

MIDGET TYPE NT-6 WILLARD 6V. STORAGE BATTERIES
Dry Charged



3 Amp-Hour rating. Transparent plastic case. SIZE: 3⅝" x 1-13/16" x 2¾". Weight approx. 1¼ lbs. Uses standard electrolyte. Regularly lists at $12.00 each. **NOW....New, unused....$2.49 ea.: Four for $8.50: Quantities: 36 or more $1.85 each.**

ALNICO FIELD MOTORS

(Approx. size overall . . . 3¾" x 1¼" diameter)
DELCO TYPE #5069600; 27.5 volts DC; 250 RPM $19.95
PM Motors Delco Type #5069371; 27.5 volts; DC Alnico Field; 10,000 r.p.m.; dimensions 1" x 1" x 2" long; shaft extension ½" diameter 0.125"....$15.00

PIONEER GYRO FLUX GATE AMPLIFIER

Type 12076-1-A, complete with tubes....$27.50 ea.

AC CONTROL MOTOR

A. C. SYNCHRONOUS MOTOR Type RBC 2505; Volts 115; Cycles 60; RPM 2; Mfg. HOLTZER CABOT ELECT. Approx. size: 2⅝" x 2⅝" x 2⅝"..$15.00 ea.

400 CYCLE MOTORS

PIONEER: TYPE CK5 2 Phase; 400 cycles $25.00 ea.
EASTERN AIR DEVICES TYPE J49A: 115 V; 0.1A; 7000 r.p.m. Single phase 400 cycle....$17.50 ea.
AIRESEARCH: 115V; 400 CPS; Single phase 6500 RPM; 1.4 amp; Torque 4.6 in. oz.; HP .03. $10.00 ea.
EASTERN AIR DEVICES TYPE JM6B: 200 VAC; 1 amp; 3 phase; 400 cycles, 6000 RPM....$12.50 ea.
EASTERN AIR DEVICES. TYPE J31B: 115 V. 400-1200 Cycle. Single Phase....$12.50 ea.
AIRESEARCH: AC induction, 200 V; 3 Phase, 400 Cycle, 2 H.P.; 11,000 RPM; 8 amps....$79.50 ea.
AIRESEARCH: AC Induction. 200 V; 3 Phase, 400 Cycle, 12 H.P. 6500 RPM; 1.5 amps....$25.00
Electric Motor: PNT—1400—A1—1A Serial No. 207, 208 V., 400 Cycles, 3 Phase Kearfott Co., Inc. $17.50 ea.

SERVO MOTOR 10047-2-A; 2 Phase; 400 Cycle, with 40-1 Reduction Gear

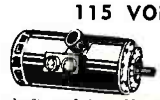
SYNCHRONOUS CAPACITY INDUCTION MOTOR

Mfg. Eastern Air Devices; 1/40th HP; Single Phase; Current .7 amperes; 115 VAC; 60 Cycle 3600 RPM; Shaft length 2½"; impeller cooled; includes starting condenser. **BRAND NEW**....$9.95

SMALL DC MOTORS

DELCO #5072000; 27.5 VDC; 11.75 rpm....$15.00
DELCO #5068750; constant speed; 27 VDC; 160 RPM; built-in reduction gears and governor. $17.50 ea.
J. OSTER: series reversible motor; 1/50th H.P.; 10,000 RPM; 27½ VDC; 2 amps; **SPERRY** #806069; approx. size 1⅝" x 3½"....$7.50 ea. (Approx. size . . . 4" long x 1½" dial.)
General Electric Type 5AB10AJ37: 27 volts, DC; 5 amps. 8 oz. inches torque; 250 RPM. shunt wound; 4 leads; reversible ....$15.00 ea.
General Electric. Mod. 5BA10FJ33; 12 oz. inches torque, 12 DC, 50 RPM, 1.02 amp....$15.00 ea.
General Electric Type 5BA10AJ52C: 27 volts DC; 5 amps. 8 oz. inches torqque; 145 RPM; shunt wound; 4 leads; reversible....$15.00 ea.
GENERAL ELECTRIC DC MOTOR Mod. 5BA10AJ64. 160 r.p.m.; 65 amp; 12 oz.-in. torque; 27V DC. $19.95 ea.
2¼ H.P. MOTOR—Mfg. LEECE-NEVILLE Co; Type 1454-MO; 24VDC; 4000 RPM; 100 amp....$35.00

115 VOLT GENERATORS



Brand new Eclipse generators; 115 VAC; 9.4 amp; 1000 watts; single phase; 800 cycles, 2400-4200 rpm. DC output is 30 volts at 25 amp. Unit has spline drive shaft and is self-excited....$29.95

MICROPOSITIONER

Barber Colman AYLZ 2133-1 Polarized D.C. Relay: Double Coil Differential sensitive, Alnico P. M. Polarized field, 24V contacts; .5 amps; 28 V. Used for remote positioning, synchronizing, control, etc. **$12.50 ea.**

BLOWER

Eastern Air Devices, Type J31B; 115 volt; 400-1200 Cycle; single phase; variable frequency; continuous duty; L. & R. =2 blower; approx. 22 cu. ft./min. $15.00

BLOWER ASSEMBLY

115 Volt, 400 Cycle, Westinghouse Type FL. 17CFM, complete with capacitor. New....$12.50 ea.

SENSITIVE ALTIMETERS

Pioneer Sensitive altimeters, 0-35,000 ft. range . . . calibrated in 100's of feet. Barametric setting adjustment. No hook-up required. **$12.95 ea.**

BENDIX AIRCRAFT TYPE GENERATOR

Bendix-Eclipse Aviation; Type 1235 . . . Counter-clockwise rotation. Speed 2500-4500 RPM; 28.5 VDC @ 15 A. A. Two-Brush ball bearing generator suitable for any application where 28 volt output is required. Field and armature taps for adjustment of voltage from 12 to 28 volts....**NEW $15.00**

Immediate Delivery
ALL EQUIPMENT FULLY GUARANTEED
All prices net FOB Pasadena, Calif.

C and H Sales Company
BOX 356-X EAST PASADENA STATION • PASADENA 8, CALIFORNIA

Want more information? Use post card on last page.

COMMUNICATIONS EQUIPMENT CO.

MICROWAVE COMPONENTS

MICROWAVE MIXER

CV-12/APR-6: Waveguide/mixer unit, 4000-6000 mc. Designed for use with microwave receiver. Has pick up loop for coupling to lighthouse cavity local oscillator. RF input is to 1" x 2" waveguide (contact flange). Output (thru 1n21 xtl.) is from standard 50-ohm coax connector. Brand new, complete with crystal. As shown $35.00

APS-2 SPARE PLUMBING

Z-601C: Elevation Joint $9.50
Z-601B: Transmission Line from El. Jt. to antenna feed $4.50
Z-601A: Antenna and Dipole feed assy $12.50
Z-601E: Azimuth Rotating Joint $15.00
Z-911: Long Rt. Angle Bend, 90 Deg $4.50
Z-910: Short Rt. Angle Bend with pressure fitting $3.50

"S Band," RG48/U Waveguide

POWER SPLITTER for use with type 726 or any 10 CM Shepherd Klystron. Energy is fed from Klystron antenna through dual pick-up system to 2 type "N" connectors ..... $22.50 EACH
DIRECTIONAL COUPLER. Broadband type "N" Coupling, 20 db. with std. flanges. Navy #CABV 47AAN-2 ..... $37.50
LHTR. LIGHTHOUSE ASSEMBLY. Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc Tr. Cavity and Type N CPLG. To Recvr. Uses 2C40, 2C43, 1B27, Tunable APX 2400-2700 MCS. Silver Plated $49.50
BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice, each $47.50
MAGNETRON TO WAVEGUIDE Coupler with 721-A Duplexer Cavity, gold plated $45.00
RT-39 APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr-TR, cavity compl. recvr. & 30 MC IF strip using 6AK5 (2C40, 2C43, 1B27 lineup) w/Tubes.
721A TR BOX complete with tube and tuning plungers $12.50
McNALLY KLYSTRON CAVITIES for 707B or 2K28 ..... $4.00
WAVEGUIDE TO ⅞" RIGID COAX "DOORKNOB" ADAPTER CHOKE FLANGE, SILVER PLATED BROAD BAND $32.50
AS14A AP-10 CM Pick up Dipole with "N" Cables $4.50
OAJ ECHO BOX, 10 CM TUNABLE $22.50
HOLMDELL-TO-TYPE "N" Male Adapters, W.E. #D167284 ..... $2.75
I.F. AMP. STRIP: 30 MC, 30 d.b. gain, 4 MC Bandwidth, uses 6AC7's—with video detector A.F.C. less tubes $24.50
POLYROD ANTENNA, AS31/APN-7 in Lucite Ball. Type "N" feed $22.50
ANTENNA, AT49A/APR: Broadband Conical, 300-3300 MC Type "N" Feed $12.50
"E" or "H" PLANE BENDS, 90 deg. less flanges $7.50

X Band— RG 52/U WAVEGUIDE

VSWR Measuring Section. Consisting of 6" straight section, with 2 pick-up. Type "N" Output Jacks. Mounted ½ Wave apart $8.50
UG 40A/U Broadband Choke Flanges $1.65
1" x ½" waveguide in 5' lengths, UG 39 flanges to UG40 cover ..... per length $7.50
Rotating-joints supplied either with or without deck mounting. With UG40 flanges ..... each, $17.50
Bulkhead Feed-thru Assembly $15.00
Pressure Gauge Section 15 lb. gauge and press nipple $10.00
Pressure Gauge. 15 lbs. $2.50
Directional Coupler. UG-40/U Take off 20db. . $17.50
TR-ATR Duplexer section for above $8.50
Waveguide Section 12" long choke to cover 45 deg. twist & 2½" radius, 90 deg. bend $4.50
Waveguide Section 2½ ft. long silver plated with choke flange $5.75
Rotary joint choke to choke with deck mounting $17.50
90 degree elbows. "E" or "H" plane 2½" radius $12.50
45 degree twist $8.00
Microwave Receiver, 3 CM. Sensitivity: 10-13µ Watts. Complete with L.O. and AFC Mixer and Waveguide Input Circuits. 6 I.F. Stages give approximately 120 DV gain at a bandwidth of 1.7 MC. Video Bandwidth: 2 MC. Uses latest type AFC circuit. Complete with all tubes, including 723A/B Local Oscillator $175.00
ADAPTER, waveguide to type "N", UG 81/U. p/o TS 12, TS-13, Etc. $27.50
ADAPTER, UG-163/U round cover to special Intl. Flange for TS-45, etc. ..... $2.50 ea.

1¼" x ⅝" WAVEGUIDE

CG 98B/APQ 13 12" Flex. Sect. 1¼" x ⅝" OD $10.00
X Band Wave GD. 1¼" x ⅝" O.D. 1/16" wall aluminum ..... per ft. 75c
Slug Tuner Attenuator W.E. guide, old plated $6.50
BI-Directional Coupler. Type "N" Takeoff 25 db. coupling $27.95
BI-Directional Coupler. UG-52. Takeoff 25 db. coupling $24.95
Waveguide-to-Type "N" Adapter. Broadband $22.50

RADAR SETS

SO-1

10 cm. with a range of 4, 20, and 80 miles. PPI presentation on a 5 inch screen. 360 deg rotation of antenna with a pattern 8 deg in horiz. and 18 deg in vert. plane. Operates from 115 vdc. Set consists of following: antenna, m/g—modulator, xmtr—rcvr, PPI unit, accessory control, and rectifier power unit ..... POR*

MK10

GUN RADAR. Extremely accurate, rugged and compact. Designed for ship board use to direct naval gun turrets. Antenna utilizes conical scanning for accurate pointing. Max. range is 20,000 yards with an error of pm 15 yds pm .1% of range. Pointing accuracy is pm .25 deg. Pulse dur. 0.5 usec. at prr of 3600 cps. Pk. power output is 25 Kw. Primary power consumption is 1300 watts. Operates from 115V, 60 CPS Source.
BRAND NEW, COMPLETE WITH SPARES AND INSTRUCTION MANUAL ..... POR*

SQ

Portable radar with type PPI, "A", or "B" Scope. Frequency is Approx. 3000 Mcs. 3 ranges: 3, 15, and 45 miles. Operates from 115v, 60 cycles $850

SE

10 cm radar for use on small surface craft for Sea-Search use. Max. range 80,000 yards, with an accuracy of 100 yards ± 1% of range. Bearing accuracy 2 degrees. Operates from 115 VDC. Complete Equipment. Brand new, in original matched sets @ $850.00

SN

Portable, lightweight, 10 cm set with ranges of 4 and 20 Mi. Presentation is on 5" "A" Scope. Operates from 115V, 50-60 Cy. Ideal for labs, Classrooms, and small boats $850.00

IFF SETS RC 148 RC 184 Navy BM
RC 145 RC 188

*PRICE ON REQUEST

COMPONENTS

AIA*	APN-1*	MK IV
ABA-1	APN-2*	MK 10
APA-9	APN-3*	SCR 545
APG-5*	APN-4*	SCR 515
APG-15*	APN-7*	SCR 585
APQ-13*	APN-9*	SG-1
APS-2*	APN-19*	SJ-1
APS-3*	ASB-7	SO-8
APS-4	ASD*	IFF

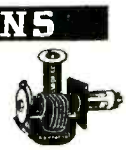
*Major Components and/or Spare Parts

SCR 584 PARTS

- BC 1088
- BC 1096
- BC 1094
- BC 1058

MAGNETRONS

Type	Price	Type	Price
2J21	$8.75	2J39	$24.50
2J22	7.50	2J49	59.50
2J27	19.95	2J61	34.50
2J31	24.50	2J62	34.50
2J32	28.50	2J31	85.00
2J37	12.50	725-A	Write
2J38	16.50	730-A	24.50



QK 60, 61, 62—$85 ea.

KLYSTRONS

723A	$12.50	2K25/723A/B	$27.50
723A/B	19.50	417-A (Sperry)	17.50

10 CM R.F. HEAD

Complete R.F. Head and Modulator delivers 50 KW Peak R.F. at 3000 MC. Pulser delivers 12KV pulse at 12 Amp. to magnetron of .5, 1, or 2 microsec. duration at duty cycle of .001. Unit requires 115V, 400-2400 Cycles, 1 phase @ 3.5A. Also 24-28 VDC @ 2A. External sync. Pulse of 120V Req'd. Brand New. Complete with schematic and all tubes $375.00

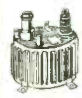
THERMISTORS

D-164699	Bead Type DCR: 1525-2550 Ohms @ 75 Deg. F, Coefficient: 2% Per Deg. Fahr. Max. Current 25 MA AC/DC	$2.50
D-167332	Bead Type, DCR is 1525-2550 Ohms. Rated 25 MA at .825-1.175 VDC	1.50
D-167613	Disk Type DCR: 355 Ohms @ 75 Deg. F. P. M. 2.5%, 1 Watt	1.50
D-166228	Disk Type 7120 Ohms @ 60°F. 4220 Ohms @ 80°F 2590 Ohms @ 100°F, 1640 Ohms @ 120°F	1.50

PULSE EQUIPMENT

MIT. MOD. 3 HARD TUBE PULSER: Output Pulse Power 144 KW (12 KV at 12 Amp). Duty Ratio: .001 max. Pulse duration: 5, 1.0, 2.0 microsec. Input voltage: 115 v. 400 to 2400 cps. Uses: 1-71B, 4-89-B, 3-72's, 1-73. New ..... Less Cover—$135
APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk pwr. out 35 KW Energy 0.018 Joules $49.00
TPS-3 PULSE MODULATOR. Pk. power 50 amp. 24 KW (1200 KW pk); pulse rate 200 PPS, 1.5 microsec. pulse line impedance 50 ohms. Circuit series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New with all tubes $49.50

PULSE TRANSFORMERS



GE #K-2449A
Primary: 9.33 KV, 50 ohms Imp.
Secondary: 28 KV, 450 ohms
Pulse length: 1.0/5 usec @ 635/120 PPS. Pk. Power Out: 1,740 KW
Bifilar: 1.5 amps (as shown) ... $62.50

GE #K-2748-A. 0.5 usec @ 2000 Pps. Pk. Pwr. out is 32 KW impedance 40:100 ohm output. Pri. volts 2.3 KV Pk. Sec. volts 11.5 KV Pk. Bifilar rated at 1.3 Amp. Fitted with magnetron well $39.50
K-2745. Primary: 3.1/2.8 KV, 50 ohms Z. Secondary: 14/12.6 KV 1025 ohms Z. Pulse Length: 0.25/1.0 usec @ 600/600 PPS. Pk. Power 200/150 KW. Biflar: 1.3 Amp. Has "built-in" magnetron well $42.50
K-2461A. Primary: 3.1/2.6 KV—50 ohms (line). Secondary 14/11.5 KV—1000 ohms Z. Pulse Length: 1 usec @ 600 PPS. Pk. Power Out: 200/130 KW. Bifilar: 1.3 Amp. Fitted with magnetron well $39.75
UTAH X-151T-1: Dual Transformer, 2 Wdgs. per section 1:1 Ratio per sec 13 MH inductance 30 ohms DCR $7.50
UTAH X-150T-1: Two sections, 3 Wdgs. per section. 1:1:1 Ratio, 3 MH, 6 ohms DCR per Wdg. ... $7.50
68G711: Ratio: 4:1 Pri: 200V, Sec. 53V. 1.0 usec Pulse @ 2000 PPS, 0.016 KVA $4.50
TR1049: Ratio: 2:1 Pri. 220 MH, 50 Ohms, sec. 0.75 H DCR 100 Ohms $6.75
K-901695-501: Ratio 1:1, Pri. Imp. 40 Ohm. Sec. Imp. 40 Ohms. Passes pulse 0.6 usec with 0.05 usec rise $8.95
Ray UX 7896—Pulse Output Pri. 5v. sec. 41v ... $7.50
Ray UX 8442—Pulse inversion—40v + 40v $7.50
PHILCO 352-7250, 352-7251, 352-7287
RAYTHEON: UX8693, UX5986 ..... $5 ea.
W.E.: D-166310, D-166638, KS 9800, KS9948.
UTAH #9262, with Cracked Beads, but will operate at full rated capacity $5.00
UX 8693 (SCS #2Z9627-54); 3 Wdgs. 32 turns #18 wire. DCR is: .362/.372/.4 ohms. Total voltage 2500 vdc. $5.00
D-166173: Input: 50 ohms Z. Output: 900 ohms 3 Wdgs. Freq. range 10 kc-2mc. P/O AN/APQ*-13 ..... $12.50

PULSE NETWORKS

15A—1.400-50: 15 KV, "A" CKT, 1 microsec. 400 PPS, 50 ohms imp. $37.50
G.E. #3E (3-84-810) (8-2.24-405) 50P4T: 3KV "E" CKT Dual Unit; Unit 1, 3 sections, 0.84 Microsec. 810 PPS .50 ohms imp.; Unit 2, 8 Sections, 2.24 microsec. 405 PPS 50 ohms imp. $6.50
7-5E3-1-200-67P. 7.5 KV "E" Circuit, 1 microsec. 200 PPS. 67 ohms impedance 3 sections $7.50
7-5E4-16-60. 67P. 7.5 KV "E" Circuit, 4 sections 16 microsec. 60 PPS, 67 ohms impedance $15.00
7-5E3-3-200-67P. 7.5 KV, "E" Circuit, 3 microsec. 200 PPS, ohms imp. 3 sections $12.50
KS8865 CHARGING CHOKE: 115-150 H @ .02A, 32-40H @ .08A, 30,700V Corona Test, 21KV Test $37.50
G.E. 25E5-1-350-50 P2T "E" SKT, 1 Microsec. Pulse @ 350 PPS, 50 OHMS Impedance $69.50
KS9623 CHARGING CHOKE: 16H @ 75 MA, 380 Ohms DCR, 9000 Vac test $14.95
G.E. 6E3-5-2000 50 P2T: 6 KV., "E" Circuit 0.5 usec/2000 PPS/50 ohms/2 sections $7.50

MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEY YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P. O. ALL MDSE SUBJECT TO PRIOR SALE AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE. PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK OR RAILEX

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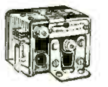
COMMUNICATIONS EQUIPMENT CO.

D.C. RELAYS



CR2792B116A3

SPST—50 Amp Contracts. Operates from 22-30 VDC. Coil Res. 200 Ohms. Completely enclosed in transparent plastic case, which may be removed for adjustments. $1.59

GE #CR2791B116W3

Same as above, except additional terminal brought out from contact arm. $1.74

GE #CR2791-F100D3

Differential: DPST. Norm. open. Dual coil, 1500 ohms per coil—25 Ma. Operating Current. Contacts: 20 Amp. $2.25

GE #CR2791F100G3

Same as above, except has extra 1A contact. Rated 5 Amp. $2.35

GE #CR2791D101F3

All Ceramic Insulation, DPDT. Coil—12VDC. 100 Ohms DCR. Contacts designed for fast operation. Rated at 5 Amps. $1.25

GE #CR2791B106J3

3PDT, 5 Amp. contacts. Coil rated 22-30VDC. 150 Ohms DCR. Contacts are designed for fast operation, and enclosed by clear plastic cover. $1.35

GE #CR2791B106C3

SPDT, Dual Contacts will handle 20 Amps. Coil: 18-28VDC 125 Ohms DCR. $1.25

DYNAMOTORS

TYPE	INPUT VOLTS	INPUT AMPS	OUTPUT VOLTS	OUTPUT AMPS	PRICE
DM 416	14	6.2	330	.170	$6.75
DM 33A	28	7	540	.250	3.95
BD AR 93	28	3.25	375	.150	7.50
23350	27	1.75	2?5	.075	3.95
B-19 Pack	12	9.4	275	.110	8.95
DA-3A*	28	10	500 300 150 14.5	.050 .260 .010 5.	6.95
5053	28	14	250	.060	3.95
PE 73 CM	28	19	1000	.350	22.50
BD 69†	14	2.8	220	.08	12.95
D-402†	13.5	12.2	300 8.8VAC	.200	
SP 175	18	3.2	450	.06	12.50
DM 25†	12	2.3	250	.05	4.49 6.95

‡ Less Filter
† Used, Excellent
* Replacement for PE 94.

INVERTERS

PE-218-H: Input: 25/28 vdc. 92 amp. Output: 115v. 350/500 cy 1500 volt-amperes. NEW $37.50

PE-206: Input: 28 vdc. 36 amps. Output: 80 v 800 cy. 500 volt-amps. Dim: 13"x5½"x10½". New $22.50

NAVY COR-21109: Input 22-30 VDC/75-60A. OUTPUT: 115V/400 CY. 1 KVA/8.7A. RPM: 4800. With coupling provision for motor. Brand New. Original packing $150.00

SELENIUM RECTIFIERS

Current (Continuous)	18/14 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1 Amp.	$1.35	$2.15	$3.70	$8.50
2 Amps.	2.20	3.60	5.40	10.50
2½ Amps.	.....	.....	6.00	13.00
4 Amps.	4.25	7.95	12.95	25.25
6 Amps.	4.75	9.00	13.50	33.00
10 Amps.	6.75	12.75	20.00	44.95
12 Amps.	8.50	15.25	20.59	49.00
20 Amps.	13.25	25.50	38.00	79.50
24 Amps.	16.25	32.50	45.00	90.00
30 Amps.	20.00	38.50	.....	.....
36 Amps.	25.00	48.50		

* F. W. Bridge

EE-89 REPEATER

Extends range of EE-8 field phone up to 20 miles of dry or wet wire operation. Extremely rugged, portable and lightweight. Uses hybrid coils and V.T. Amplifier, with extreme long-life characteristics. Brand new, complete with tube and tech. Manual only........

$12.75 EACH

HELMHOLTZ PHASE-SHIFTER

Stator consists of 4 loops oriented at 90 degrees to each other. Total stator inductance is 40MH. Rotor: 10MH. Total phase shift 0-360 deg. Designed for range unit of SCR-268 .... **3.95 EACH**

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps Input

CT-766	300-0-300V/120MA, 2 x 5V/3A, 2.5V/5A	$3.95
CT-129	550-0-550V @ 150 MA, 6.3V/4A, 2.5VCT/5A	5.79
CT-013	450-0-450V @ 200 MA, 10V/1.5A, 2.5V/3.5A 5V/3A	6.95
CT-15A	550VCT .085A 6.3V/.6A, 6.3V/1.8A	2.85
CT-341	1050 10MA, 625V @ 5 MA, 26V @ 4.5A 2x2.5V/3A, 6.3V @ 3A	9.95
CR 825	360VCT .340A 6.3VCT/3.6, 6.3VCT/3A	3.95
CT-626	1500V .160A 2.5/12, 30/.100	9.95
CT-071	110V .200A 33/.200, 5V/10, 2.5/10	4.95
CT-367	580VCT .050 A 5VCT/3A	2.25
CT-403	350VCT .026 A 5V/3A	2.75
CT-931	585VCT .086 A 5V/3A, 6.3V/6A	4.25
CT-456	390VCT 80 MA 6.3V/1.3A, 5V/3A	3.45
CT-931	585VCT 86 MA 5V/3A, 6. V/6A	4.95
CT-442	525VCT 75 MA 5V/2A, 1 CT/2A, 50V/200 MA	3.85
CT-43A	600-0-600V/.08A, 2.5VCT/6A, 6.3VCT/1A	6.49
CT7-501	650VCT/200MA, 6.3V/8A, 6.3V/5A	6.49
CT-444	230-0-230V/.085A. 5V/3A, 6V/2.5A	3.49

Filament Transformers 115V50-60 cps Input

Item	Rating	Each
FT-140	5VCT @ 10A 25KV Test	$22.50
FT-157	4V/16A, 2.5V/2.75A	2.95
FT-101	6V/.25A	.79
FT-924	5.25A/21A, 2x7.75V/6.5A	14.95
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	8.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V/3A	8.95
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A, TAP 2.5V/2.5A, 16 KV TEST	18.95
FT-608	6.3V/3A/750V Test	1.79
FT-873	4.5AV/.5A, 7V/7A	2.19
FT-899	2x5V A5A, 29KV Test	24.50

Special Fil. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STF-370	220/440	3x2.5V/5A, 3KV Test 2.5V/15A	6.95
STF-11A	220V	2x40V/.05A, 2x5V/6A 12.6V/1A	4.49
STF-608	220V	24V/0.6A, 5V/3A, 6.3V/1A, 6.3V/1A	3.45

Transformer Special

#766: Primary: 115 V, 60 cy. 1ϕ. Secondary: 300-0-300 V @ 120 MA. D.C., 2.5V WDGS @ 3 A ea. Also 2.5 VCT @ 5 A. Ruggedized. Herm. Sealed. Size: 4¾" H x 3⅜" x 4½". 11 Solder Tmls. M.F.D. W.E. **$3.95**

400 CYCLE TRANSFORMERS

(All Primaries 115V. 400 Cycles)

Stock	Ratings	Price
352-7102	6.3V/2.5A	1.45
M-7472426	1450V/1.0MA, 2.5V/.75A, 6.4V/3.9A, 5V/2A, 6.5V/.3A, P/O ID-39/APG-13	4.95
352-7039	640VCT @ 380MA, 6.3V/.9A, 6.3V6A 5V/6A	5.49
702724	9800/8600 @ 32MA	8.95
K59584	5000V/290MA, 5V/10A	22.50
KS9607	734VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V0.9A, 6.3V 25.A 6.3V/.08A, 5V/CA	6.95
352-7070	2x2.5V/2.5A(2KV TEST) 6.3V/2.25A, 1200/100/750V. @ .005A	7.45
352-7196	1140/1.25MA,2.5V/1.75A,2.5V/1.75A—5KV Test	3.95
352-7176	320VCT/50MA,4.5V/3A,6.3VCT/20A, 2x6.3VCT/6A	4.75
RA6400-1	2.5V/1.75A, 6.3V/2A—5KV Test	2.39
901692	13V 9A	2.49
901699-501	2.77V @ 4.25A	3.45
901698-501	900V75MA, 100V/.04A	4.29
Ux8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/806MA5V/3A, 6V/1.75A	4.25
352-7098	2500V/MA, 300, VCT, 135MA	5.95
KS 9336	1100V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 63.V/.66A, 6.3VCT/21A	4.25
KS8984	27V/4.3A, 6.3/2.9A, 1.25V/.02A	2.95
52C080	650VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
68G631	1150-0-1150V	2.75
80G193	6VCT/.00006 KVA	1.75
302433A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5V/3.5A	4.85
KS 9445	592VCT/118MA, 6.3V/8.1A. 5V/2A	5.39
KS 9685	6.4/7.5A, 6.4V/3.8A, 6.4/2.5A ALL CT	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95
352-7069	2-2.5V Wdgs. at 2.5A, Each Lo-Cap., 22Kv Test	5.95
352-7096	2.5V/1.75A, 5V/3A, 6.5V/6A, 6.5V/1.2A, P/O BC800	
352-7099	360VCT/20MA, 1500V/1MA, 2.5V/1.75A, 6.3V/2.5A, 6.3V/.6A, P/O BC-929	6.45
D163253	5200V/.002A, 2.5V/5A	5.35
M-7471957	2.5V/20A, 12KV Test	4.85
352-7179	250V/100MA, 6.5V/12ACT 5V/2A	3.45

SPECIALS

DC RELAYS
- ALLIED TYPE "AS", SPST, N.O. COIL 3 VDC, 77 OHMS MIDGET .... .85c
- LEACH 1257, DPDT, 10 AMP CONTACTS COIL: 60 VDC, 2400 OHMS, 25 MA $2.85
- COL. RAD #55251, FOR ARC-3 .... $1.35
- COL. RAD #55528, FOR ARC-3 .... $1.35
- PHILCO 452-1127, SPST, N.O. COIL, 28 VDC, 300 OHMS .... .85c

SWITCHETTES
- CR1070C122A3 .... .32c
- CR1070C130D3 .... .32c

TEST SET I-104 For testing 274-N, ARC-4, ETC $47.50

TEST SET, IE-36, FOR TESTING SCR-522, Less Meter $47.50

SPARE ARMATURES FOR GENERATORS: GN-35, GN-45, GN-37, BD 86 .... $4.95

EE-89A Telephone repeater, New $12.50

PHOTOTUBE 932: Infra-red, but may be used with incandescent light. Complete with data .... .75c

ID-24/ARN-9 Cross Point. Indicator, Contains 2—0-200 U AMP MOVEMENTS $6.95

MP-22 Mast Bases, original packing $4.95

COILS. C-387-D, For BC 610 transmitter $3.95

COILS, C-390-A For BC 610 transmitter $2.79

DYNAMIC MIKE and HEADSET COMBO, as used in B-19 TANK TRANSMITTERS $3.75

OSCILLOGRAPH Photo Recording paper, HIGHLY SENSITIVE, 35 mm x 250 Ft. Rolls $1.00

BRUSH CAPS For BD77 Dynamotor SCS #3111777/8 ea. .12c

POWER SUPPLY For Super-Pro Receiver, #RA-74, NEW $69.50

- Driver Transformer, for ART-13, T-202 .... $1.29
- Side-Tone Transformer, for ART-13, T-203 .... $1.19
- Modulation Transformer, ES-691025 for BC 456 $1.19
- AN-104A Antennas for SCR-522 .... .95c
- BC 929 Indicators, p/o APN-2 .... $32.50
- BC 451 Trans. Control Box, p/o SCR 274N $1.85
- C-30/ARC-5 Control Box $1.65
- FT-225-A Mounting Racks $1.65
- FT 227-A Shock Mount Racks $1.65

MD7/ARC-5 Modulators, all Tubes $5.95

MC 211 Right Angle Drives .... .21c

BC 433G Compass Rcvrs., Used, Excellent $32.50

ART-13 Barometric Limit Switches $8.75

BC 306 Antenna Loading Unit for BC 375 .... $3.00

RL-7 Interphone Amplifiers, Used, Excellent, Less Tubes $3.75

SA-4A/APA-1 Motor Driven (28 VDC) Yagi-Antenna Switch $24.50

MT-36-C Ant. Loading Unit for TA-2J XMTR $35.00

A-62 Phantom Antennas. for use with Mobile XMTRS. 20-38.9 MC 40 Watts $3.95

RT-19/ARC-4 Trans-receivers, 24 VDC, covers Amateur 2—Meter Band. Complete with Tubes and Crystals $39.50

Radar Trainer. Type 15-C. Consists of 4 separate XMTRS. Operating 380-500 MC., 1—Pulse Gen. 1—Power Supply, all Cables, 2 Inst. Books $215.00

Rubber Inserts, M-300 for HS-30 Headsets $3.25/M

BC 496A Dual Control Boxes (Receiver) for SCR 274N $1.35

T-30 Throat Microphones .... .69c

National XS-3 Double-Bown Insulators, fits 2¾" Hole. All Hardware included .... .65c

IN-84 Double Cone Insulations .... 12 for $1.00

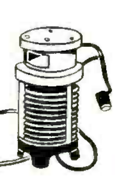
ARC-5 PLUGS

#5842	35c	#7027	45c
#5577	35c	#7025	45c
#PL 154	70c	#PL 152	65c
#PL 154A	70c	#6418	35c

C-114 Loading Coils .... .85c

VOLTAGE REGULATORS

CARBON—PILE TYPES



LELAND TYPE "A": Coil: 245 ohms. Current 108-110 MA. Reg. Resistance: 1.5-2.5 ohms with 1.2-3.3 Amps. For 80 V.

LELAND TYPE "B": Volts In: 21-30 V. Volt Out: 18-25 V DC. at 5 A.

LELAND TYPE "C": Spec. VR 9000—2 C. Input: 22-30 VDC. Coil: 300 MA. Output: 19 V @ 5.7 A.

WEBSTER: 35x025: Philco 451-1035 Input: 21-30 V. D.C. Output: 18 VDC/4.75 A.

Price, Any Model ...... $2.25 ea.

GN 35 HAND GENERATORS

BRAND NEW, IN ORIGINAL CARTONS. WILL DELIVER 8 V @ 2.5A AND 325-365 V @ 100 MA OR 10 V 1.25A AND 380-420 V @ 70 MA. LESS HAND CRANKS. A GREAT VALUE $17.50

CIRCUIT BREAKERS

HEINEMANN: .01A, 2340 V — Insulated for 5000 V. Separate Tmls. for coil and contact $1.95

#1510 M-7: 7 A, 24 VDC SCS #311900-7-3 .... $1.65

#AM 1614-100: 100 Amps, 24 VDC $1.65

#AM 1614-80: 80 Amps. 24 VDC $1.45

#AM 1610-.5: 500 MA, 1000 VDC. Curve 3, SCS #3H900A-50 .... $2.25

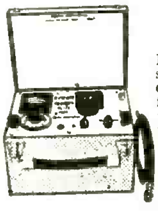
SCS #3H900-10-3: 40 VDC, 10 Amps $1.65

MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P. O. ALL MDSE SUBJECT TO PRIOR SALE AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE. PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK OR RAILEX.

131 Liberty St., New York 7, N. Y. Dept E-11 Chas. Rosen Phone: Digby 9-4124

Want more information? Use post card on last page.

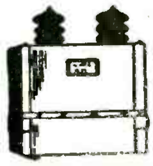
Micro-Wave Lavoie Freq. Meter 375 to 725 MCS



Model TS-127/U is a compact, self-contained, battery powered, precision (± 1 Mc) frequency meter which provides quick, accurate readings. Requires a standard 1.5V "A" and 45V "B" battery. Has 0.5 MIN. time switch. Contains sturdily constructed HI-"Q" resonator with average "Q" of 3000 working directly into detector tube. Uses 957, LS6 and 3S4 Tubes. Complete, new with inst. book, probe and spare kit of tubes. Less batteries.

Full data on request
$79.50

HIGH VOLTAGE OIL CAPACITORS

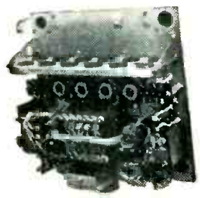


.001 MFD	50,000V DC	$37.50
.01 MFD	5,000V DC	$2.95
.02 MFD	8,000V DC	$9.50
.025 MFD	50,000V DC	$45.00
.025/.025 MFD	50,000V DC	$59.50
.1 MFD	500V DC	$ .95
.1 MFD	3,000V DC	$2.95
.135 MFD	7,500V DC	$6.95
.15 MFD	12,000V DC	$7.50
.2 MFD	50,000V DC	$67.50
.25 MFD	15,000V DC	$19.50
.25 MFD	20,000V DC	$26.50
.25 MFD	50,000V DC	$72.50
1. MFD	7,500V DC	$12.50
1. MFD	15,000V DC	$49.95
2. MFD	6,000V DC	$14.50

FLUXMETER

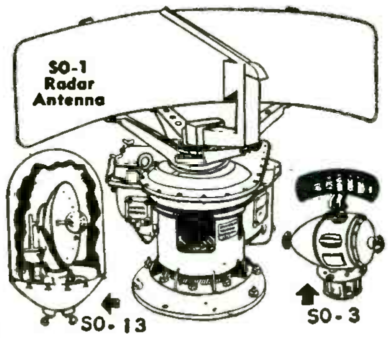
Used to calibrate field strength of magnets from 500 to 4000 gauss and indicate polarity. Probe has gap of 1¼". Beautifully built in hardwood case with hinged cover. Instructions for operation on under side of cover. Size 12¾ x 9 x 6 in. Ideal for lab and school use. New. An exceptional value at....$29.50

G.E. Servo Amplifier



Used in B29 planes for Central Station Fire Control Systems B2, B3 and B4. Used to drive Amplidyne 5AM31NJ9A and Control Motor 5BA50LJ2A. New less tubes. $29.50

RADAR EQUIPMENT



RADAR ANTENNAS

Type SO-1 (10CM) assembly with reflector, wave-guide nozzle, drive motor. New..........$279.50
Type SO-3 (3 CM.) Surface Search type with reflector, drive motor, etc., but less plumbing. New in original cases $189.50
Type SO-13. (10CM.) Assembly with 24" dish, dipole, drive motor, gearing. New........$149.50
Also in stock — spare reflectors, nozzles, probes, right angle bends for SO-1 antennas.

CRYSTAL DIODE

Sylvania 1N21B. Individually boxed and packed in leaded foil $3.00

HIGH POT TRANSFORMER

High Voltage Trans. Westinghouse Pri: 115, 60 cy., Sec: 15,000 C.T., 60 MA. Good for HI-Pot test set up. C. T. ungrounded..................$29.50

Telrad Frequency Standard

Complete self contained, dual 100/1000 kc crystal, multivibrator and harmonic amplifier. Calibrates with WWV and provides 1000, 100, and 10 kc check points from 100 to 45,000 kc. 115V. 60 cycle. New with instructions. $29.50

INVERTERS

Onan M-G.-215H. Navy type PU/13. Input 115/230, 60 cy., 1 Ph. Output: 115, 480 cy., 1 Ph., 1.2Kw and 26V DC at 4 amps. New..............$295.00
Onan M-G.-075. Navy type PU/11 Input: 115/230, 60 cy., 1 Ph. Output: 115, 480 cy., 1 Ph., 5.3 amps. and 26 VDC @ 3.8 Amps. New.........$225.00
Leland Elec. Co. PE206A. Input: 28DC at 38 Amps. Output: 80V. 800 cy. 1 Ph., 485VA. New....$22.50
G.E. J8169172. Input: 28DC. Output: 115, 400 cy., 1 Ph. 1.5KVA. New.......................$32.50
G.E. 5AS1315511A. Model 218J. Input: 28 DC. Output: 115, 400 cy., 1 Ph., 1.5 KVA. Regulated. New $89.50
Elcor. 74DC to 110AC, 60 cy., 1 Ph. at 2.4 Amps. New $39.50

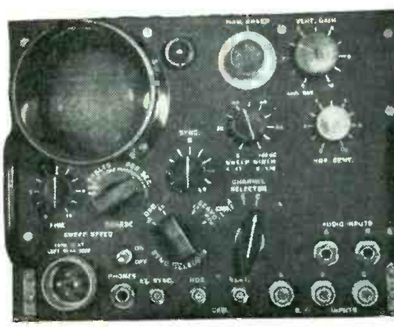
TS-47/APR Test Oscillator

Provides calibrated CW, mod. or pulse signal source from 40 to 500 mc. Operates on 80, 115 or 230 V. from 50 to 2600 cy. or battery supply. New with tech. manual. $265.00

DYNAMOTORS

Navy type **CAJO-211444.** Input: 105 to 130DC. Output: either 26DC at 20 amps. or 13DC at 40 amps. Radio filtered and complete with line switch. New $89.50
Type PE94CM. For SCR-522. Brand new in overseas cases. Has wide band input and output filters. $19.50

MODEL AN/APA-10 PANORAMIC ADAPTER



Provides 4 Types of Presentation:
(1) Panoramic (2) Aural
(3) Oscillographic (4) Oscilloscopic

Designed for use with receiving equipment AN/ARR-7, AN/ARR-5, AN/APR-4, SCR-587 or any receiver with I.F. of 455 kc. 5.2mc or 30mc. With 21 tubes including 3" scope tube. Converted for operation on 115 V. 60 cycle source.
Price........................$245.00
Gov't Cost $1800.00.
AN/APA-10 80 Page Tech Manual..........$2.75

REPAIR PARTS FOR BC-348 RECEIVERS (H, K, L, R, Only)

Also BC 224 Models F. K., Coils for ant., r.f., det., osc., I.F., c.w. osc., xtal filters, 4 gang cond., vol. conts., etc. Write for complete list and free diagram.

AMPLIDYNES

G.E. 5AM21JJ7. Input: 27VDC. Output: 60VDC. 150 Watts. 4600 RPM. Type MG-27-B. New..$34.50
Edison 5AM31NJ18A. Input: 27VDC, 44 Amps. 8300RPM. Output: 60VDC at 8.8 Amps. 530 Watts. New $12.50
G.E. 5AM31NJ9A. 530 Watts. 7500 RPM. Input: 27VDC. Output: 60VDC. Weight 34½ lbs....$29.50

SCR-522 EQUIPMENT

Complete BC-624C receivers and BC-625AM Transmitters including mounting racks, plugs, connectors, P.E. 94C dynamotor. Brand new equipment with instruction manuals.

SMALL D.C. MOTORS

G.E. 5BA50LJ2A. Armature 27VDC at 8.3 Amps. Field 60VDC at 2.3A RPM 4000. H.P. 0.5. New $27.50
Oster E-7-5. 27.5DC. 1/20HP, 3600RPM. Shunt Wound. New $9.50
Dumore Co. type ELBG. 24VDC. 40-1 gear ratio. For type B-4 Intervalometer. New............$6.75
G.E. 5BBY47AB12. ¼ H.P. Perm. Mag.—1 amp. 250V. 1725 RPM. New $22.50

400 CY. BLOWERS

Westinghouse. Type FL. 115V. 400 cy., 6,700 RPM. Airflow 17C.F.M. New $6.75

MULTI-CONDUCTOR CABLE

CO-215. Stock 3E2215. Bulk 9 conductor No. 20 A.W.G. Stranded tinned copper plastic insulated, color coded, tinned copper braided shield. Flamenol jacketed. Made by G.E. Available 1000, 1500, 2000 ft. reels. Price..........................$.15 Ft.

SYNCHROS

Ford Inst. Co. Synchro Differential Generator. Mod. 3 Type 5SDG. 90/90V. 400 cy., Ord. Dr. 173020. New $22.50
Armor. Synchro Differential Generator. Type 6DG. New $60.00
Hobart Mfg. Co. Synchro Differential Synchro Type XIX 115V. 60 cy. New....................$9.50

STEP BY STEP MOTOR

Bendix—Type CAL 14810 (MK1 Mod 0). 70 Volts DC input $16.50

TRANSMITTING MICA CAPACITORS

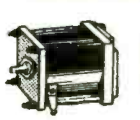
LARGE QUANTITIES IN STOCK
WRITE FOR LIST

TERMS: Rated Concerns Net 30, FOB Bronxville, New York. All Merchandise Guaranteed
Prices Subject to Change

HIGH QUALITY CRYSTAL UNITS

Western Electric — type CR-1A/AR in holders. ½" pin spacing. 5910-6350-6370-6470-6610-6670-6690-7270-7350-7380-7390-7480-7580-9720. All fundamentals in KC........................$1.25 each

SWEEP GENERATOR CAPACITOR



High speed ball bearings. Split stator silver plated coaxial type 5/10 mmfd. Brand new.
Price $2.25

ELECTRONICRAFT INC.

27 MILBURN ST. BRONXVILLE 8, N. Y.
PHONE: BRONXVILLE 2-0044

1 K.W. MODULATION TRANSFORMER

R.C.A. Broadcast Type. Primary 15,000 ohms. Secondary 5,030 ohms 0.8 KVA audio. Designed for 833 class B modulation to two 833's in final amplifier. Size 11¼ x 9¼ x 13. Weight 143 lbs. Type 900777-502. Price, new.....$97.50

A LEADING SUPPLIER OF ELECTRONIC & AIRCRAFT EQUIPMENT

IMMEDIATE DELIVERY -- FULLY GUARANTEED

A. C. SYNCHRONOUS MOTORS

110 Vt. 60 Cycle

HAYDON TYPE 1600, 1/240 RPM
HAYDON TYPE 1600, 1/60 RPM
HAYDON TYPE 1600, 4/5 RPM
HAYDON TYPE 1600, 1 RPM
HAYDON TYPE 1600, 1 1/5 RPM
TELECHRON TYPE B3, 2 RPM
TELECHRON TYPE BC, 60 RPM

SERVO MOTORS

PIONEER TYPE CK1, 2ϕ 400 CYCLE
PIONEER TYPE 10047-2-A, 2 ϕ, 400 CYCLE, with 40:1 reduction gear.

D. C. MOTORS

BODINE NFHG-12, 27 VTS., governor controlled, constant speed 3600 RPM, 1/30 HP.

DELCO TYPE 5068750, 27 VTS., 160 RPM, built in brake.

DUMORE, TYPE EIY2PB, 24 VTS., 5 AMP., .05 HP, 200 RPM.

GENERAL ELECTRIC, TYPE 5BA10AJ18D, 27 VTS., 110 RPM, 1 oz. 1 ft. torque.

GENERAL ELECTRIC, TYPE 5BA10AJ18D, 27 VTS., 250 RPM, 8 oz. 1 in. torque.

BARBER COLMAN ACTUATOR TYPE AYLC 5091, 27 VTS., .7 amp., 1 RPM, 500 in. lbs. torque.

WHITE ROGER ACTUATOR TYPE 6905, 12 VT., 1.3 amp., 1½ RPM, 75 in. lbs. torque.

DELCO TYPE 5069230 27 volts 145 RPM.
DELCO TYPE 5071895 27 volts 250 RPM.
DELCO TYPE 5069600 27 volts 250 RPM.
DELCO TYPE 5067127 27 volts 250 RPM.

AMPLIDYNE AND MOTOR

AMPLIDYNE, GEN. ELEC. 5AM31NJ18A input 27 vts., at 44 amp. output 60 vts. at 8.8 amp., 530 watts.

MOTOR, GEN. ELEC. 5BA50LJ22, armature 60 vts. at 8.3 amp., field 27 vts. at 2.9 amp. ½ HP, 4000 RPM.

PIONEER AUTOSYNS 400 CYCLE

TYPE AY1, AY5, AY14G, AY14D, AY20, AY27D, AY38D, AY54D.

PIONEER AUTOSYN POSITION.
INDICATORS & TRANSMITTERS.

TYPE 5907-17, single, Ind. dial graduated 0 to 360°, 26 vts., 400 cycle.

TYPE 6007-39, dual Ind., dial graduated 0 to 360°, 26 vts., 400 cycle.

TYPE 4550-2-A, Transmitter, 2:1 gear ratio 26 vts., 400 cycle.

INVERTERS

WINCHARGER CORP. PU 16/AP, MG750, input 24 vts. 60 amps. outputs 115 vts., 400 cycle, 6.5 amp., 1 phase.

HOLTZER CABOT, TYPE 149F, input 24 vts. at 36 amps., output 26 vts. at 250 V.A. and 115 vts. at 500 V.A., both 400 cycle, 1 phase.

PIONEER TYPE 12117, input 12 vts., output 26 vts. at 6 V.A., 400 cycle.

PIONEER TYPE 12117, input 24 vts., output 26 vts. at 6 V.A., 400 cycle.

WINCHARGER CORP., PU/7, MG2500 input 24 vts. at 160 amp., output 115 vts. at 21.6 amp., 400 cycle, 1 phase.

GENERAL ELECTRIC, TYPE 5D21NJ3A, input 24 vts. at 35 amps., output 115 vts. at 485 V.A., 400 cycle, 1 phase.

LELAND, PE 218, input 24 vts. at 90 amps. output 115 vts. at 1.5 K.V.A., 400 cycle, 1 phase.

LELAND, TYPE D.A. input 28 vts., at 12 amp. output 115 vts. at 115 V.A., 400 cycle, 3 phase.

ENGINE HOUR METER

JOHN W. HOBBS, MODEL MI-277 records time up to 1000 hours, and repeats, operates from 20 to 30 volts.

VOLTAGE REGULATOR

LELAND ELEC. CO. TYPE B, CARBON PILE. Input 21 to 30 volts D.C. regulated output 18.25 vts. at 5 amp.

WESTERN ELEC. TYPE BC937B, input 110 to 120 volts, 400 cycle. Output variation 0 to 7.2 ohms at 5 to 2.75 amps.

WESTERN ELEC. TRANSTAT, input 115 vts., 400 cycle output adjustable from 92 to 115 vts., rating .5 K.V.A.

AMERICAN TRANS. CO., Transtat input 115 vts., 400 cycle output 75 to 120 vts. or 0 to 45 volts, rating .72 K.V.A.

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2J1F1 GENERATOR, 115 vts. 400 cycle.
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2J1G1 CONTROL TRANSFORMER 57.5 vts. 400 cycle.
2J1H1 DIFFERENTIAL GEN. 57.5/57.5 vts. 400 cycle.
5G GENERATOR, 115 vts. 60 cycle.
5DG DIFFERENTIAL GEN. 90/90 vts. 60 cycle.
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5CT CONTROL TRAN. 90/55 vts. 60 cycle.
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8DJ11- INDICATOR, dial 0 to 360°, 24 vts.

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SPERRY A5 PILOT DIRECTION INDICATOR, part No. 645262 contains AY 20.

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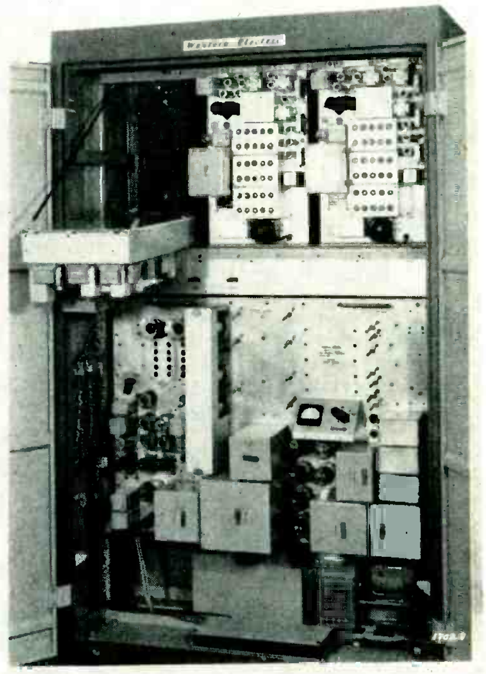

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The 48A Radiotelephone Transmitter provides 30 channels of transmission, all crystal controlled, and is rated at 250 watts output. However, a Western Electric Modification Kit is supplied with each, which will increase the power to 300/350 watts. Features of this transmitter include automatic variable-gain audio amplifier; sidetone (hearing of one's own voice in the telephone receiver); interlock safety relays; provision for Selective Ringer installation within cabinet (up to 3 units, 1 for each receiver) for automatic selective calling; motor driven switches for channel selection, controlled by the 43A Remote Control Unit which incorporates a telephone handset, monitoring loudspeaker; ventilating fan for cooling and providing filtered air within cabinet; hinged transmitter and individual receivers for easy access to parts, etc.

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808	4.20
WL-810	16.25
811	2.95
811-A	2.55
812	2.95
812-A	3.60
WL-813	18.00
814	3.75
816	1.20
822	19.50
826	1.00
827-R	53.00
828	10.50
829	7.95
829-A	7.40
829-B	9.00
WL-829-B	16.25
830-B	2.75
832	7.75
832A	9.95
WL-833A	49.50
834	9.50
SD-834	4.00
836	5.00
837	1.25
838	3.35
843	.50
WL845	13.75
849	75.00
860	3.50
865	2.50
866-A(JAN)	1.75
866-A (Hytron)	1.75

869-B	65.00
872-A	3.50
884	1.55
885	1.65
WL-889-RA	295.00
WL-891	223.00
892-R	150.00
902	5.00
902P1	9.00
SD917A	3.00
918	2.20
921	2.00
922	1.60
924	2.50
927	1.75
931A	4.75
SN949	3.50
954	.35
955	.42
956	.45
957	.43
958	.68
958A	.68
959	1.95
968	1.50
SN980D	3.00
991/NE16	.50
FM1000	.25
CK-1005	.65
CK-1027	2.75
1201-1201A	.65
1203A	.45
1299A	.57
1612	2.00
1613	.85
1616	.88
1619	.35
1622 (6L6M)	1.95
1625	.26
1629	.29
1632	.30
1636	2.70
1638	.49
1655	1.79
1665	1.85
38022	write
38222 (3B23)	4.90
CK-38233	.75
5514	4.75
5516	7.75
WL-5550/681	50.00
WL-5552/651	121.00
WL-5553/655	265.00
WL-5554/679	190.00
WL-5557/17	8.50
WL-5558/	

32	15.50
WL-5559/	
57	22.00
5636	5.75
5645	7.75
5646	7.75
5654	2.35
WL-5683	9.43
WL-5685	31.90
5693	6.25
5726	1.85
5732	3.95
WL-5736	160.00
5744	2.00
5749	1.75
5751	2.90
5800	6.50
5814	2.20
5829	1.75
5837/SD1104	110.00
5838	3.00
5840	8.00
5844	3.00
WL-5846	130.00
5886	3.00
5991	3.95
5910	.75
WL-5934	15.00
WL-5966	25.00
5995	write
6013	write
6095	write
6096	write
6097	write
6099	write
6101	write
6161	110.00
6216 (Hytron)	3.20
7193	.35
WL-8000	14.50
8003	11.00
8005	4.95
8008	6.20
8011	.75
8012	2.50
8013A	3.95
8020	1.98
8025	5.25
9001	1.15
9002	.85
9003	1.15
9004	.25
9005	1.90
9006	.25
9025	write

AND MANY OTHERS write

—TELEPHONE—
REctor 2-2562

Terms! F O B-N Y C—25% Deposit with order —or send full remittance to save C O D charges —Rated Firms (D. & B.) Net 10 days—All merchandise guaranteed. CABLE: BARRYLECT, N. Y.

BARRY ELECTRONICS CORP.

136-C LIBERTY ST. N. Y. 6, N. Y.

PLUGS WITH PIN CONTACTS


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PLUG


Type AN 3106
STRAIGHT
PLUG

TALLEN Co., Inc.

ARC-PLUGS

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PLP Plugs
PLQ Plugs

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PLQ 63
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SO 92
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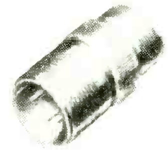
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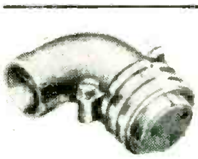
Type AN 3108
ANGLE
PLUG


Type AN 3106
STRAIGHT
PLUG

RECEPTACLES WITH PIN CONTACTS


Type AN 3102
BOX MOUNTING
RECEPTACLE


Type AN 3101
CABLE
RECEPTACLE


Type AN 3100
SHIELDED
RECEPTACLE

TALLEN CO. Inc.

159 Carlton Ave.
Brooklyn 5, N. Y.

Want more information? Use post card on last page.

TEST EQUIPMENT

Spectrum Analyzer, Model TSX-4SE-8500-9600 MC., calibrated linear below cut-off attenuator, calibrated frequency meter, tuned mixer, 4 I.F. stages, 3 video stages, overall gain 125 db., regulated power supply.

Spectrum Analyzer, same as above but modified for 100 to 1000 MC frequency range.

X Band VSWR Test Set, TS-12, complete with linear amplifier, direct reading VSWR meter, slotted waveguide with gear driven traveling probe, matched termination and various adapters, with carrying case.

R. F. Power Meter—1 to 600 MC 0-15 and 0-60 Watt scales. May be used as dummy load for 0 to 1000 MC.—100 W maximum, VSWR less than 1.1 from 0 600 MC., less than 1.3 from 600 to 1000 MC.

X Band Pick up Horn, AT48/UP with coax fitting.

TS-45/APM-3 Signal Generator 8700-9500 MC, 110V 60-800 cps.

TS-35A/AP X Band Signal Generator, pulsed, calibrated power meter, frequency meter, calibrated attenuator, 110V 60-800 cps.

30 MC I.F. Strip, Video and Audio Amplifier and 115 volt 60-2600 cps Power Supply, Bandwidth 10 MC. new, part of SPR-2 receiver.

High Pass Filter, F-29/SPR-2, Cuts off at 1000 MC. and below; used for receivers above 1000 MC.

TS-125 Calibrated S Band Power Meter with attenuator.

TS-110 S Band Echo Box 2400 to 2700 MC., Portable.

S Band Signal Generator Cavity with cut-off attenuator. 2300 to 2950 MC., 2C40 Tube, with modulator chassis.

VD-20K Voltage Divider for measuring high video pulses, ratio's 1:10 and 1:100, transmission flat within 2db 150 cps to 5 MC.

Waveguide Below Cut-off Attenuator L101-A, UHF connectors at each end, calibration 30-100 db.

TAA-16 Tuned Linear Audio Amplifier, 300 to 8000 cps. output meter reads direct in VSWR or Power DB. Regulated power supply, 110V 60 cps.

FPM 3 X Band Power and Frequency Meter, frequency meter 8500 to 9600 MC., accuracy ± 4 MC absolute, ± 0.5 MC on frequency difference up to 60 MC. Calibrated attenuator 0-30 db, power measuring range .1 to 1000 MW, pulsed or CW without external attenuator, video detector, self-contained battery powered, portable, with coaxial and waveguide adaptors.

T85/APT 5, 300 to 1600 MC, 40 watt noise modulated transmitter.

110-330 MC Oscillator Butterfly.

80-300 MC. Mixer Butterfly with socket for 955 (used as diode).

400-800 MC. Oscillator Butterfly with 703 tube mounted on it.

Field Intensity Meter, RCA 308A, 120 to 18000 KC.

S Band Signal Generator—2K28 Klystron, self-pulsed or ext. triggered.

Mark 5, "S" Band Signal Generator—2.4 to 3.4 KMC 2C40 Oscillator, Motor tuned.

X Band Receiver, tunable, waveguide input 9200-9600 MC.

QX Checker, Boonton, Type 110.-A.

Synchroscope—Sylvania Model 5.

Synchroscope—Model P4.

D.C. Amplifier—TS 580/U-GR Model 715 AM.

Hetrodyne Frequency Meter—GR616C, 100 to 5200 KC.

Noise Distortion Analyzer—H.P. Model 325B.

Sweep Speed Calibrator, 200 KC, 1 MC, 5 MC.

Tuning Units P/O APR-4 TN16 30-80 MC, TN17 80-300 MC., TN18 300-1000 MC. TN19 1000-2200 MC., TN54 2200-4000 MC.

AN/APR 1 Receiver, used with above tuning units. 110V 60 cycle.

Measurements 75 Standard Signal Generator, Calibrated output, 124 to 510 MC.

Rotary Joints, Coaxial, S Band.

Antenna, Coaxial, pressurized S Band. Can be used with parabolic reflector.

"S" Band Waveguide Components, Tuners, T's, Directional Couplers, Terminations, etc.

Microvolter—Ferris Model 10B + 10C.

Frequency Standard—James Knight Co. 1, 5 and 10 MC check points.

F.M. Test Set—X Band, with wavemeter and wattmeter, 110V 60 cycle AC.

Recording Ammeter—Esterline Angus 0-5MA.

Recording Ammeter—Esterline Angus 0-1MA.

TS-36—8.5 to 9.6 KMC Power Meter .1-1000 MW.

TS-338.7 to 9.5 KMC Frequency Meter and Video Detector.

K Band—slotted line, gear driven traveling probe.

K Band—Attenuator 27 to 34 KMC.

K Band—Misc. Waveguide + Waveguide components.

Dummy Loads.

TS-13/AP Consists of Signal Generator "Xa" Band, Wavemeter + wattmeter.

TS-14—Test Set for "SA" Band radar—uses 2C40 oscillator, self-contained, power monitor, self-pulsed 115V 60-800 cycles.

Impedance Bridge—Type TBX-1BR 8.5 to 9.6 KMC—CRT Indicator.

Audio Signal Generator—Hewlett Packard 205A 10-20,000 cycles.

HIGH POWERED DUMMY LOADS

X Band, 1¼" x ⅝" guide, choke or plain flange, dissipates 350 watts average power continuously in still air. VSWR less than 1.15 between 7 and 10 KMC, weight 5¼ pounds.

X Band, ½" x 1" guide, choke flange, dissipates 250 watts average power continuously in still air, VSWR less than 1.15 between 8.2x12.4 KMC, weight 3¼ pounds.

X Band 1¼" x ⅝" guide, plain flange, dissipates 200 watts average power continuously in still air, VSWR less than 1.15 between 7-10 KMC, weight 3¼ pounds.

X Band, 1¼" x ⅝" guide, plain flange, dissipates 250 watts average power continuously in still air, weight 2 pounds 4 ounces.

S Band, 1½" x 3" guide dissipates 1,500 average power in still air, VSWR less than 1.15 between 2.5 to 3.7 KMC, choke flange, weight 13 pounds.

NIBUR SALES CORPORATION

P. O. Box 811 Red Bank, New Jersey

Telephone: Red Bank 6-5810

OVER 250,000 TYPE J POTENTIOMETERS

55¢ EACH

(To Quantity Buyers)

75¢ in Smaller Quantities

10¢ Extra for Locking Bushing

Ohms	Shaft	Bushing	Ohms	Shaft	Bushing
50	1/8 S	1/2 L	20K	5/16 F	1/4
60	3/8 F	1/4	20K	1/2 R	1/4
60	1/4 R	3/8	20K	1/8 S	1/2 L
70	1/2 R	3/8	25K	2 3/4 F	1/4
100	1/8 S	1/2 L	25K	1/8 S	3/8
100	2 1/8 F	3/8	25K	1/2 R	1/4
200	1/8 S	1/2 L	25K	2 1/8 F	3/8
300	1/8 S	1/2 L	30K	5/16 F	1/4
500	1/8 S	3/8	50K	1/8 S	3/8
500	5/16 R	3/8	50K	1/4 S	1/4
500	3/8 S	3/8	50K	1/2 F	1/4
1000	1/8 S	3/8	50K	1/2 R	1/2 L
1000	1/8 S	1/2 L	50K	1/8 S	1/2 L
1300	1/4 S	1/4	50K	3/8 R	3/8
1500	1/8 S	3/8	50K	3/8 F	3/8
1500	1/8 S	1/2 L	50K	1/2 S	3/8 SW
1500	1/2 F	1/2	60K	1/4 S	1/4
2000	1/4 F	1/4	60K	1/8 S	1/2 L
2000	1/8 S	3/8	70K	1/8 S	3/8
2000	1/8 S	1/2 L	100K	1/4 R	1/4
2500	1/8 S	3/8	100K	1/2 F	1/4
2500	1/8 F	1/4	100K	1/2 R	1/2
2500	1S	3/8	100K	1/8 S	1/2 L
5000	1/4 F	1/4	100K	2 1/8 R	3/8
5000	1/4 S	3/8	150K	1/8 S	1/2 L
5000	1/8 S	1/2 L	150K	1S	3/8
5000	3/8 R	3/8	150K	3/8 R	3/8
6500	1/8 S	1/4	200K	1/4 F	1/2 L
7500	1S	3/8	200K	1/4 R	3/8
10K	5/16 R	1/4	200K	3/8 R	3/8
10K	1/4 S	3/8	200K	1/8 S	3/8
10K	7/8 R	1/2	200K	1/8 S	1/2 L
10K	5/16 R	3/8	250K	1/8 S	1/4
10K	1/8 S	1/2 L	250K	3/8 S	3/8
10K	5/8 R	3/8	250K	1/8 S	1/2 L
10K	1/4 S	1/4	250K	2 1/8 F	3/8
10K	3/8 F	3/8	300K	1/8 S	1/4
10K	1/4 F	1/4	500K	1/2 S	3/8
10K	1/2 R	3/8	500K	2 1/8 F	3/8
10K	2 1/8 R	3/8	500K	2 1/8 R	3/8
10K	2 1/8 F	3/8	1 Meg	1/8 S	1/4
15K	1/8 S	1/4	1 Meg	1/8 S	3/8
15K	1/2 S	3/8	1 Meg	1/8 S	1/2 L
20K	1 1/8 R	3/8	1 Meg	2 1/8 R	3/8
20K	1/4 S	1/4	1 Meg	1/2 S	3/8
20K	3/8 R	3/8	4 Meg	3/8 R	3/8
20K	1/2 R	3/8	5 Meg	2 1/8 F	3/8

TYPE "JJ"—$1.25 EA.

($1.50 in Small Quantities)

Ohms	Shaft	Bush	Ohms	Shaft	Bush
250-250	2 1/8 R	3/8	25K-25K	2 3/4 F	1/4
500-500	1/8 S	1/2 L	25K-10K	2 1/4 F	1/4
600-600	1/4 R	1/4	35K-35K	1/4 S	1/2 L
1K-1K	2 1/8 R	3/8	50K-50K	1/8 S	3/8
2K-30K	3/8 F	3/8	100K-100K	2 1/8 R	3/8
3K-3K	1/2 S	1/4	150K-150K	1/8 S	1/2 L
5K-500	3/8 F	1/4	175K-225K	1/4 R	3/8
5K-500	1/8 S	1/2 L	250K-250K	3/8 S	1/4
10K-10K	2 1/8 R	3/8	250K-250K	1/4 R	3/8
15K-15K	1/8 S	1/2 L	250K-250K	2 1/8 R	3/8
20K-350K	5/16 F	1/4	300K-300K	1/8 S	1/2 L
20K-800K	1/2 R	1/4	500K-500K	2 1/8 R	3/8

OVER 100,000 ELECTROLYTICS BATHTUB TYPE

10¢ EACH

(To Quantity Buyers)

MFD	Volt.	Style Terminals	MFD	Volt.	Style Terminals
10/10/30			50	25	Side*
/30	25	Side	50	25	Side
12/12	50	Side	50	25	Top*
16/16/16	250	Side	50	40	Side
20	50	Side	50	50	Side
20	350	Side	100	25	Side
25	50	Side*	100	50	Top
25	50	Top*	200/200	6	Side
25	250	Bottom	* can common		

SPECIAL

10 MFD—220 VAC

85¢ EACH

Largest Stock of Oil Filled Condensers in the East in Bathtub, Rectangular and Round Types. Send Us Your Requirements.

Industrial Assembly Corp.

46 Howard St., New York 13, N.Y.

Phone CAnal 6-3474

CONDENSERS

. . . CONDENSER SPECIALS . . .

6 mfd—600 V $1.49
Top Quality—Qua. disc.

6 mfd—150 V . . . . $.35
Three term. dual 3mfd. oil cond. complete with brackets, measuring 4¼"x 1¾"x1". Ideal for audio crossover networks.

3 x .1 mfd—600 V . . . . $.22
Avox #618 Channel. 3 Terms. bot. mtg.

1 mfd—600 V . . . . $.59
Top Term. Bathtub. Lots of 100 10% disc.

OVER 16,000 SOLD
10 mfd—600 V . . . . $.98
Three term. bot. mtg. channel type. Dims. 3¾"x2½"x2". Two 5 mfd. sections rated 400 V at 72 deg "C". 1800-V test. Meets commercial specs. for 600 V operation up to 40 degs "C". Ideal for filter or power factor application. Repeat sales prove this rugged high-quality condenser to be of outstanding value. Carton of 24, weight 42 lbs. Large qua. available **$.89**

16 mfd—600 V $1.89
Dual 8 mfds. hermetically sealed and packed. Tobe type PT-SC-11 measuring 3¾"x2⅝"x2⅝". Stud mtg centers 2" Plugs into standard four prong socket.

12 mfd—450 V . . . . . . $.69
Rectangular case—Electrolytic

4 mfd—600 V $1.10
Dual 2mfd section; 4 glasseal term. Standard dimensions.

5 mfd—1000 V $1.99

.5 mfd—400 V . . . . $.20
Avox #416MCT, 100 10%. 500 25%

Mfd	Volts	Price	Mfd	Volts	Price
.0016	15KV	$5.75	2	2500V	3.95
.005-.005			2	3000V	5.80
.01	10KV	4.75	2	4000V	7.95
.012	25KV	22.50	2	5000V	12.50
.02	10KV	5.25	2	6000V	19.95
.02	20KV	17.90	2	12.5KV	P.U.R.
.025-.025			2	32KV	P.U.R.
	50KV	55.00	2-2	600V	1.25
.03	16KV	15.95	3	600V	.59
.035	10KV	12.95	3	4000V	P.U.R.
.05	5KV	2.49	3-3	150V	.35
.05	7500V	2.95	3-3-3	400V	1.05
.08	12.5KV	15.95	4	600V	1.25
.1	1500V	.59	4	600VTLA	1.40
.1	2500V	.49	4	1000V	1.95
.1	2500V	1.39	4	1500V	2.65
.1	3000V	1.89	4	2000V	4.35
.1	5000V	1.95	4	2500V	5.95
.1	7500V	1.75	4	3000V	7.55
.1	7500V	3.50	4	4000V	P.U.R.
.1	10KV	9.50	4	5000V	P.U.R.
.1	10KV	12.95	4-4-4	600V	2.40
.1	12KV	14.95	5	330VAC	1.75
.1	12KV	14.95	5	600V	1.75
.1	15KV	16.95	5	1000V	1.99
.125	27.5KV	P.U.R.	5	1500V	2.98
.1-.1	7500V	3.50	6	330VAC	1.75
.15-.15	8000V	1.95	6	600V	1.85
.2	10KV	10.95	6	1000V	2.49
.2	15KV	17.95	6	1500V	3.65
.25	2000V	1.35	6	2000V	3.95
.25	3000V	2.05	7	600V	1.45
.25	6000V	1.75	7	800V	1.99
.25	15KV	15.95	7	1000V	2.49
.25	20KV	19.95	8	500V	1.35
.25	50KV	85.00	8	600V	2.25
.3	2000V	1.45	8	600V Rd	1.79
.4	10KV	19.95	8	660VAC	3.50
.5	1500V	1.20	8	1000V	3.25
.5	2000V	1.85	8	1500V	4.65
.5	2500V	2.20	8	2000V	7.25
.5	3000V	2.39	8-8	600V	1.75
.5	4000V	3.15	8-8-8	500V	2.25
.5	5000V	4.15	10	600V	2.75
.5-.1	2000V	.90	10	660VAC	5.90
.5-.5	600V	.69	10	1000V	4.55
.5-.5	1000V	.69	10	1500V	6.25
.5	25KV	55.50	10	2500V	14.95
1	400V	.45	10	6000V	P.U.R.
1	500V	.59	12	1000V	4.95
1	1000V	.69	12	1500V	6.75
1	1500V	1.35	12	2000V	6.95
1	2000V	1.95	15	330VAC	3.95
1	2500V	2.50	15	440VAC	4.95
1	3000V	3.50	15	1000V	5.35
1	5000V	6.85	15	1500V	6.35
1	6000V	8.98	17	25V	.69
1	7000V	12.60	20	600V	5.85
1	10KV	P.U.R.	20	330VAC	4.69
1	15KV	P.U.R.	30	330VAC	5.25
1	16KV	P.U.R.			
1	20KV	P.U.R.			
1	25KV	P.U.R.			
2	600V	.59-.79			
2	1000V	.85			
2	1000V	TLA 1.29			
2	1500V	1.69			
2	2000V	2.80			

TYPE "G" MICA CAPACITORS

Mfd.	Volts	Price	Mfd	Volts	Price
.00005	10KV	$24.95	.00082	30KV	56.95
.00005*	40KV	59.50	.001	6KV	5.85
.0001	10KV	16.95	.001	20KV	32.50
.0001	20KV	33.50	.001	25KV	49.80
.0001	35KV	55.60	.0013	15KV	32.50
.00015	10KV	18.95	.002	3KV	5.25
.0002	6KV	10.00	.002	20KV	49.80
.0002	10KV	21.95	.0024	6KV	9.50
.0002	15KV	24.95	.0025	12KV	29.00
.0002*	25KV	45.25	.0025	15KV	29.00
.0002	30KV	47.25	.0025	25KV	59.75
.00024	6KV	8.00	.003*	6KV	6.95
.00025	10KV	22.95	.003	15KV	33.25
.0003*	20KV	25.95	.004	8KV	15.96
.00032	25KV	45.50	.00575	10KV	33.50
.00035	20KV	32.50	.01*	15KV	56.50
.00035	35KV	59.95	.01	15KV	59.50
.0004	30KV	48.50	.011	4KV	9.25
.0005	6KV	8.00	.0225	3KV	33.75
.0005	20KV	28.95	.045	2KV	14.50
.0006	35KV	62.75	.08	1500V	8.95
.0008	20KV	30.75	.09	1500V	8.95
* Faradon			.09	15KV	89.50

TRANS. MICA CONDS.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.000024	2500	$.23	.002	5000	2.98
.000033	2000	.65	.002	6000	3.50
.000047	2500	.29	.0024	5000	2.35
.00005	1200	.32	.0025	1200	.42
.00005	2500	.32	.0025	6000	3.50
.00008	1200	.29	.0035	2500	.69
.00009	3000	.69	.004	2500	.82
.0001	600	.22	.0045	600	.30
.0001	1200	.30	.005	600	.35
.0001	2500	.33	.005	1200	.45
.0001	3000	.89	.005	2500	.85
.0001	5000	1.75	.006	600	.30
.00015	5000	1.95	.006	1200	.52
.00025	600	.29	.0068	1200	.65
.00025	1200	.33	.008	600	.32
.00025	5000	2.05	.01	600	.38
.00027	2500	.41	.01	1200	.69
.0004	2500	.47	.01	2500	.85
.001	600	.28	.015	2500	.99
.001	1200	.32	.0125	6000	6.25
.001	2500	.49	.02	600	.21
.001	4500	1.25	.02	600	.50
.0015	5000	2.25	.02	1200	.85
.0015	6000	3.65	.02	2000	1.25
.002	600	.27	.03	1200	.77
.002	1200	.40	.033	600	.69
.002	2500	.65			

CHANNEL COND.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.025	600	$.19	.4	600	.30
.05	1000*	.22	.5	400*	.21
2x.05	600	.30	.5	500*	.33
.1	500	.28	.5	600	.49
.1	600	.32	2x.5	600	.59
.1	2500	1.25	2x.5	400	.39
2x.1	400	.34	.5	1000*	.49
2x.1	600	.40	.5-.1	600	.39
3x.1	400	.40	1	400	.50
3x.1	600	.41	1	500	.58
3x.1	1000	.52	1	500*	.58
.25	400V	.34	1	600	.63
.25	600V	.39			
.25	600	.48			
.25	1000*	.45			

* Top Terms.

METAL TUBULAR OIL CONDS.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.0025	400	$.10	.05	600V	.16
.005	600	.14	.05	1000V	.19
.01	300	.09	.1	400V	.17
.01	600	.15	.1	600V	.20
.01	2000	.19	.25	600V	.18
.02	400	.14	.5	600V	.19
.03	400V	.15			
.05	200V	.07			

Quans. of 100. 10% disc.

MICA CONDENSERS

5, 6, 8, 10, 15, 25, 30, 34, 39, 50, 70, 75, 100, 140, 150, 185, 200, 230, 240, 250, 300, 350, 390, 400, 470, 500, 510, 600, 650, 700, 750, 1000, 1200, 1250, 1400, 1500, 2000, 2200, 2400, 3000, 3300, 3700, 3900, 4000, 4700, 5000, 5100, 6000, 6200, 6500, 7900, 7950, 7960, 8000, 9100 & 10,000 mmfd.

PRICE SCHEDULE

5 to 750 mmfd . . . . 5¢
1000 to 1500 mmfd . . . . 6¢
2000 to 5100 mmfd . . . . 10¢
9100 to 10000 mmfd . . . . 26¢

Special Mica Kit—100 @ $3.50

SILVER MICA CONDENSERS

7, 24, 25, 33, 50, 60, 75, 95, 100, 120, 150, 170, 200, 270, 300, 330, 390, 400, 450, 500, 750, 800, 1000, 1400, 1450, 1700, & 2500 mmfd.

7 to 95 mmfd . . . . 8¢
1000 to 1700 mmfd . . . . 14¢
100 to 800 mmfd . . . . 9¢
2500 mmfd . . . . 16¢

Special S. Mica Kit—100 @ $6.50

BATHTUB CONDS.

Mfd	Volts	Price	Mfd	Volts	Price
.01-.01	600	$.25	.25-.25	600	.49
.02-.02	600	.25	3x.25	600	.65
.04-.04	600	.25	.25	1000	.48
.05	600	.20	.3	400	.15
.05-.05	600	.25	.5	400	.37
.05-.05	1000	.44	.5	600	.47
.08-.08	600	.25	.5	1000	.52
.1	600	.39	2x.5	600	.59
.1	1000	.42	3x.5	600	.69
.1	1200	.45	1	200	.25
.1-.1	400	.29	1	300	.30
.1-.1	600	.39	1	400	.45
.1-.1	1000	.51	1	600	.59
3x.1	600	.40	1-1	600	.95
.2	1000	.21	2	400	.69
.25	800	.19	4	100	.49
.25	400	.30	Sp. Bathtub Kit 15 @		1.00
.25	600	.41			

Available in Other Sizes

—TRANSTAT—

115 V, 1 phase, 100 amps., Kva. 115, Range 0-115 V Amertran #29145. Specially priced.

DIESEL GEN.

25 KW 3 phase 60 cy. Hill diesel, G.E. gen. Complete with control panel & starting batteries. Ready for immediate operation. Guaranteed, P.U.R.

TYPE "J" POTS $.89

OHMS	SHAFT	OHMS	SHAFT
50	1/8 S	25000	3/8 & 1/8 S
60	1/8 LS	3000	1/8 S
150	1/4 S	40000	1/8 LS
300	3/8 S	50000	1/4 & 1/8 S
500	3/8 & 1/8 S	50000	1/8 LS
1000	1/8 S	100000	1/2"
1500	1/4 S	150000	2 1/8
2000	1/8 LS & 3/8 S	200000	1/8 LS
2500	1/8 S	250000	1/8 LS, 9/16 & 1/8 S
3000	1/8 LS		
6000	1/4	300000	1/8 S (2 terms)
5000	1/8 LS & 3/8		
10000	3/8 & 1 1/7	.5 Meg.	1/8 LS & 1/2
10000	5/16	1 Meg.	1/8 S & 1/8 LS
15000	1/8 S	Other Types Available	
20000	1 1/4 & 1/8 LS		

—WANTED—

Condensers of all Types in any quantity. Also other standard components.

Write ART HANKINS, *Owner*

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BOX 159 Long Branch 6-5192 OAKHURST, N. J.

MAGNETRONS KLYSTRONS
New JAN Boxed

2J27	Ray	$17.95
2J32	"	27.00
2J31	"	23.95
2J34	"	24.95
2J61	"	34.00
2J48	"	24.00
3J31	"	79.00
QK59	"	55.00
QK62	"	55.00
417A	—	7.75
715B		9.95
725A		7.49
724B		3.00

2C51 (396A) w.e. $4.75

Handset TS11 like new $5.75
Telechron motor 3 RPM 110V 60 cy 1.95
Haydon Motors ½ to 5 RPM many types 110V, 220V etc. from 1.00
ARB Receiver compl. 39.95
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APR4 Butterfly Cond. Approx. 485 Mc. 12.95
Parts available: ARC3, ARC5, ARC1, BC348 BC312, BC191, SCR 284, APN4, 522, 433, ARN7, ART13, etc.

1N21 xtal diode checked Gtd. 69¢

Cycle Inverter — Soundscriber — 1152/any freq./ Brand new in orig. pkg. $12.00
Selenium Rectifiers 2-½ λ bridges back to back—in 12 vac out 6v DC-150 MA 20
Sockets all types 4-5-6-7-8 Png. Ceramic, Bake, Mica.

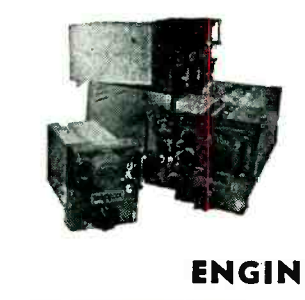
CONDENSERS

.5 400v ST. BT. 32¢
.1 300v TT. BT. 19¢
.08 1500v TT. BT. 20¢
.1 1000 Pigtail oil . . . . . . 35¢
.001 600 Pigtail oil Imp . . . 8¢

Resistors Standard Brands 20% off current prices
Mica Cond. Rec. and xmtr. types low prices

R28/ARC5 Rec. 2 MR 100-156 MC 2/tubes w/dyn. 24.95
MD-7/ARC 5 Mod. w/2-1625, 1-12V5, 1-VR150 w/dyn. . 6.95
ASB7 Rec. less tubes 3.95
ASB6 Ind. w/5" cr. tube only 4.95
ASB6 switch less tubes 5.95
ASB7 Rect power supply less tubes 4.95
ASB6 xmttr w/ tubes 6.95

TELEPHONE RECTOR 2-1591
TELECTRAD 148 CHAMBERS ST. NEW YORK, 7, N. Y.



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Complete with all five Tuning Units, covering the range 38 to 4,000 Mc.; wideband discone and other antennas, wavetraps, mobile accessories, 100 page technical manual, etc. Versatile, accurate, compact—the aristocrat of lab receivers in this range. Write for data sheet and quotations.

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$2.95 EACH OR 2 FOR $5.00!

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Dept. 22. Simpson, Pa.

HIGH FREQUENCY EQUIPMENT
BRAND NEW!

Ballantine MG set. 1KVA. 1-ph., 400-cy. alternator, 115V, self-excited; belt-driven by 2HP motor, 220V, 3-ph., 60-cy. With voltage regulator & variable speed sheave $300.00
MG sets of many sizes and frequencies in stock for immediate delivery. Your inquiries are invited.

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CARRIER EQUIPMENT

Western Electric CF-1A 4-channel carrier telephone terminals.
EE-101-A 2-channel 1000/20 cycle carrier ringers.
CFD-B 4-channel carrier pilot regulated telephone terminals complete with four channels 1000/20 cycle ringing.
CFD-B 4-channel pilot regulated telephone repeaters.
C-42-A V. F. telegraph in from 2- to 12-channel terminals.
FMC 1 or 2 channels carrier telephone terminals, automatic regulation, duplex signaling each channel. Carrier frequencies above 35 KC. Ideal for adding channels above type "C".
Complete engineering and installation services offered.

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Raytown, Missouri
Telephone: FLeming 2121

TYPE G MICA CONDENSERS

MFD	Voltage	Type	Price
.04	1 KV	G-1	$12.50
.09	1.5 KV	G-1	16.30
.08	1.5 KV	G-1	16.30
.0008	3 KV	UC-2509K	13.75
.02	3 KV	G-1	19.50
.00095	5 KV	C-D48274	14.50
.0015	5 KV	CRV-48416	15.50
.006	5 KV	CRV-48415	19.50
.00025	6 KV	PL-586-59	15.90
.00024	6 KV	G-1	15.90
.0006	6 KV	G-1	16.40
.0004	6 KV	G-1	16.25
.0002	6 KV	1950-207	15.90
.004	6 KV	G-1	19.50
.001	6 KV	G-1	17.50
.0012	7 KV	CRV-48157	15.00
.003	7 KV	UC-3048	17.50
.002	8 KV	UC-2371	27.50
.000375	10 KV	CRV-48418	28.50
.00068	10 KV	MX-61	28.50
.00057	10 KV	CD-38897-2	28.50
.00025	10 KV	CRV-48155	28.50
.00015	10 KV	UC-3123	28.50
.00002	10 KV	UC-3292	25.50
.0008	10 KV	CRV-48417	28.50
.0005	10 KV	UC-2617	28.50
.0002	10 KV	48270-B5	28.50
.001	10 KV	UC-3296	28.50
.02	10 KV	PL-133-52	87.50
.0025	12 KV	XPXW	57.50
.008	12 KV	G-4	62.40
.00532	15 KV	1980-318	60.40
.00002	15 KV	MX-60	49.50
.002	15 KV	G-3	52.90
.0025	15 KV	1970-218	54.10
.01	15 KV	1940-225	92.50
.00035	20 KV	PL-289-51	52.40
.00025	20 KV	G-3	52.40
.00015	20 KV	1970-404	53.50
.0066	20 KV	PL-1391-97B	59.50
.0005	20 KV	G-3	54.70
.0003	20 KV	UC-3112K	54.70
.0002	20 KV	G-3	52.50
.0001	20 KV	G-3	49.90
.004	20 KV	G-3	99.50
.0025	25 KV	G-4	190.00
.002	30 KV	1940-217	210.00
.0005	35 KV	G-4	210.00
.001	35 KV	1940-214	225.00
.001	75 KV	PL-49-728	360.00

MICA CONDENSERS

TYPE 4

MFD	VDC	Price
.00005	1200	$ .69
.0022	1200	.69
.025	600	1.49
.022	600	1.25
.004	1200	.79
.001	600	.49
.01	500	.89
.01	600	.69
.01	1100	1.25
.01	1200	1.35
.01	2500	2.25

TYPE 9

MFD	VDC	Price
.0005	1200	$ .69
.024	1500	2.50
.005	2500	1.50
.003	2500	1.90
.01	2500	2.05

TYPE F MICA

MFD	VDC	Price
.00055	5000	$6.90
.00051	5000	6.90
.0009	3000	5.10
.0001	3000	5.25
.056	1000	3.90
.025	2500	5.10
.02	2000	4.90

TYPE E

MFD	VDC	Price
.00005	3000	57.25
.001	8000	10.25

FILAMENT TRANSFORMER — AMERICAN TRANSFORMER CO. — TYPE EFS:
Primary: 210/240 volts, 60 cycles. Secondary: 5 volts & 10 amps. Johnson socket, 123-211—50 watt. Height 12" $14.95

SPECIAL
PRECISION RESISTOR
Wire Wound
IRC TYPE WW5
1 Meg. 1W 1%
Quantities Available
4.00 ea.

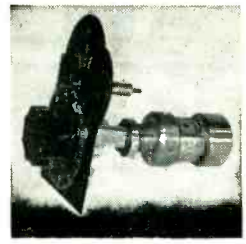
POWER UNIT PE 143 G

28.5 VOLTS DC
175 AMPS 5 KW
MFG BY ONAN
TRAILER MOUNTED, COMPLETE WITH BATTERY AND LEADS
LIKE NEW
1200.00

PULSE NETWORKS

SPRAGUE:

6-A5-½-2000-50M
6-E3 .25-2000-50P
9-E3-.25-2000-50P
9-E3-.5-2000-50P
9-E5-2-1000-50P
10-E3-.5-2000-50P
10-ES-1-400-50P
15-E3-½-400-50P (Vitamin "Q")
15-E3-.4-800-50P
15-E4-1-400-50P
15-E3-.5-2000-50P
15-A-1-800-50P
25-E5-4-120-50P



K BAND CAVITY — TKF-7SW:
Gear Tuning, calibrated range 23400 — 24500 MCS. Panel mounting $47.50

PULSE TRANSFORMERS

UTAH:

9280	9296	9340
9281	9287	9350
9282	9237-D	X 121 T2
9283	9288	X 124 T3
9284	9239	X 143 T3
9285	9318	X 146 T1

RAYTHEON:

UX 7307	UX 7361 A	UX 10066
UX 7350	UX 8092	U 12970

WESTINGHOUSE:

1P1	132 AW	145 EW2
1P2	132 BW	145 EWP
1P4	132 BW2	166 AW
1P8	132 DW	176 AW
1P13	133 AW	407 CW2
1P26	134 EW	
1P29	145 EW	

GENERAL ELECTRIC:

68G627	68G894	80G59
68G666	68G979	80G625
68G709	80G13	
68G813	80G58	

FREED:

#22647	K 2478	K 35J564-D2
	K 2721A	BX 17-17
K 2449	K 2728	7472407
K 2460	K 2746 A	

HIGH VOLTAGE CAPACITORS

MFD	VDC	Type*	Price
.00365	15 K	14F162	$22.50
.0091	15 K	14F222	27.50
.005	25 K	25020	29.50
.025	10 K	Y-3605	9.90
.035	400 K	P6756	1.25
.045	16 K	D-4495	10.25
.075	16 K	572	19.75
.1	7.5 K	25F175	7.50
.1	12K	26F628	10.25
.1	15K	14F63	9.75
.11.1	7.5 K	7520	7.25
.15	8 K	8020	7.50
.15	65 K	14F72	92.50
.151.15	5K/8K	Vitamin "Q"	37.50
.25	15 K	26F359	27.50
.25	20 K	TK 200002 - 2	42.50
.25	25 K	D 91281	$57.50
.25	50 K	14F97	72.50
.33	8.5 K	26F267	22.50
.35	30K		62.50
.49	10 K	LD	42.50
.5	25K	14F103	62.50
.5/.5	9 K	PC 2151	35.50
.51	10 K	LD	42.50
1	7.5 K	26F213	22.50
1	10 K	14F267	42 50
1	13 K	25F313	45.00
1	15 K	14F63	47.50
1	25 K	TJ	82.50
1.25/1.25	7.5 K	26F360	31.00
2	7.5 K	56	27.50
2	32 K	43J861-Z30	210.00

Electronics, INC. 92 Broad Street, Babson Park 57, Mass. — Wellesley 5-5210-1

PORTABLE SONAR QBG

Portable U. S. Navy equipment for sonic, supersonic listening and echo ranging under water for locating submerged targets. Includes:

1 Ea. Driver-Receiver CFF-43043 with all tubes; including carrying case.
1 Ea. Power Supply case CVW-19041 less A & B batteries (standard type)
1 Ea. Projector, CFF-78187 and cables.
1 Ea. Set accessories.
1 Ea. Set spare parts and tubes in chest.
1 Ea. Instruction Manual.

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Made by R.C.A. for U.S. Navy small craft. Frequency range 240 to 2000 Kcs. in three bands. Designed for 115 volts AC input. (Converters available for any voltage input, DC or AC.) Includes:

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1 Ea. Loop assembly CRM-69074.
1 Ea. Set spare parts and tubes in chest.
1 Ea. Set accessories and cables.
1 Ea. Instruction Manual.

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Complete Stocks of Radiotelephones, Transmitters, Receivers, Communication Accessories and spare parts.

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Shipments FOB warehouse. 20% Deposit on orders. Minimum order $5.00. Illinois residents, add regular sales tax to remittance. Prices subject to change without notice.

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Chicago 16, Ill.
PHONE: HArrison 7-9374

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Brand new Cenco Megavac Vacuum Pumps, Model 92010A, complete with connecting cord, hose assembly and attachment plug. Specially priced at $137.50 each, f.o.b. New York.

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New York 10, N. Y. MUrray Hill 4-4267

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TUBES: Industrial Receiving Transmitting

Specialists in JAN Tube Types

Standard Brands Only — Fully Guaranteed

Type	Price
OA2	$.90
OA3	1.20
OA4G	1.00
OB2	1.00
OB2	1.00
OC3	1.00
OD3	.95
1B22	1.85
1B23	6.50
1B24	9.00
1B26	2.25
1B27	12.00
1B32	2.50
1B42	9.50
1P21	49.50
1P23	3.75
1P28	11.50
1P40	1.75
1P41	2.80
1P42	5.00
2B22	2.95
2C40	7.95
2C43	17.50
2C44	1.85
2C51	3.75
2D21	1.20
2D21W	2.35
2J26	20.00
2J31	25.00
2J37	12.00
2J40	22.50
2J50	36.75
2J54	62.95
2J54B	125.00
2J61	39.95
2K22	23.00
2K23	11.50
2K25	30.00
2K28	27.75
2K29	25.00
2K30	325.00
2K33	250.00
2K33A	250.00
2K34	175.00
3B24	5.00
3B24W	9.00

Type	Price
3B25	3.95
3B26	3.50
3B28	5.95
3B29	8.50
3BP1	4.95
3C21	5.00
3C24	1.15
3C45	10.00
3DP1	3.95
3E29	9.95
3FP7	1.95
3GP1	3.00
4B22	7.75
4B25	8.00
4J32	225.00
4J36	140.00
5BP1	5.00
5BP4	5.00
5D21	15.00
5FP7	1.75
5J29	15.00
5LP5	17.00
5R4GY	1.20
5R4WGY	4.00
6AC7W	3.25
6AK5(WE)	1.25
6AR6	2.75
6AS6	1.90
6AS7G	3.50
C6J	14.50
6C24	40.00
6F4	3.50
6J4	5.75
6J6W	1.50
6K4	2.25
6K4A	3.50
6L6WGA	8.45
7AK7	7.00
7C30	85.00
9C24	300.00
15R	1.90
FG32	14.00
FG33	23.00
28D7	1.40
35T	3.00
FG105	18.50
FG172	29.95
250TH	16.50
250TL	16.50
274B	2.75

Type	Price
304TH	7.75
304TL	7.75
316A	.80
359A	7.00
388A	2.75
394A	4.00
GL414	120.00
GL434A	17.95
GL446A	1.95
703A	4.95
704A	.85
705A	1.90
707A	7.75

Receiving Tubes

Type	Price
6AQ5	$.48
6SN7GT	.69
6V6GT	.50
12AT7	.73
12AU7	.60
12SL7	.60
12SN7	.69
12SQ7	.50
25L6GT	.60

All Other Types in Stock. Write for Quotes

Type	Price
707B	14.80
708A	4.50
709A	3.50
713A	1.20
714AY	53.00
715B	7.95
721A	3.75
829B	12.50
832	7.75
830B	2.75
832A	9.95
837	1.25
838	1.25

Type	Price
872A	3.75
921	2.00
922	1.85
954	.30
955	.35
956	.35
959	2.00
966	1.50
1612	2.70
1614	1.95
1616	.90
1619	.35
1620	6.20
1625	.30
1636	2.70
1641	2.00
5544	20.00
5545	35.00
5550	39.50
5551	60.00
5557	8.50
5558	14.00
5559	22.00
5560	28.00
5632	12.15
5634	4.50
5637	3.00
5638	3.00
5639	12.00
5640	12.50
5641	8.00
5642	.75
5643	8.00
5644	12.00
5645	7.75
5646	7.75
5647	5.50
5651	2.30
5654	1.65
5656	10.00
5653	.80
5670	3.25
5676	1.15
5686	3.00
5687	2.75
5691	9.50
5692	9.75
5693	7.75
5802	2.95
5702WA	4.50
5703	1.20
5703WA	3.50
5704	2.80
5718	6.00
5719	5.50
5720	23.00

Type	Price
5725	4.25
5726	1.50
5744	2.25
5749	2.15
5750	2.50
5751	2.95
5763	1.30
5783	6.00
5787	4.25
5814	2.25
5825	12.75
5829	2.75
5837	110.00
5840	7.75
5844	2.00
5881	2.50
5901	6.50
5902	11.00
5910	.75
5915	1.20
5932	8.50
5937	24.00
5963	1.30
5964	1.45
5995	6.00
6005	3.75
6072	5.50
6080	5.95
6082	5.25
6095	write
6096	write
6097	write
6099	write
6101	write
6111	11.50
6112	11.50
6135	2.75
6146	4.85
6163	3.25
6187	2.50
8001	5.50
8013A	3.95
8020	2.00
8025	5.25
1N21	1.20
1N23A	2.00
1N21B	2.00
1N23B	2.25
1N34A	.70
1N44	1.20
1N45	1.30
1N48	.50
1N54	.75
1N54A	1.00
1N63	4.50
1N69	.90
1N70	1.35

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120 Liberty St.
New York 6, N. Y.
REctor 2-1297-8

DYNAMOTORS

Type	Input		Output		Excellent Used	Brand New
DM-32A	28V	1.1A.	250V	.05A.	$4.90	$7.50
DM-33A	28V	5A.	575V	.16A.	2.25	3.95
	28V	7A.	540V	.25A.		
DM-34D	12V	2.8A.	220V	.080A.	14.50	....
DM-37	25.5V	9.2A.	625V	.225A.	14.75	....
DM-40	14V	3.4A.	172V	.138A.	7.40	9.50
DM-28	28V		224V	.07A.	3.95	6.95
DM-21	14V		235V	.09A.	6.85	16.50
PE-73	28V	20A.	1000V	.350A.	9.50	12.50
PE-86	28V	1.25A.	250V	.060A.	2.95	5.50
PE-94A	28V	10A.	300V	.200A.	7.50	11.50
			150V	.101A.		
PE-94B	28V	10A.	300V	.200A.	8.50	11.75
			150V	.101A.		
PE-94C	28V	10A.	300V	.200A.	10.00	12.75
			150V	.101A.		
PE-98	14V	21A.	300V	.200A.	22.50	37.50
			150V	.101A.		
PE-101-C	13V	12.6A.	400V	.135A.	3.75	4.85
	26V	6.3A.	9V AC	1.12A.		
PE103	6V		500V	.160A.	27.50	44.50
	12V		500V	.160A.		
PE-104	6V	1A.	84V	.09A.	12.50	14.50
(Vibrator)	12V	5A.	51V	.03A.		
			1.4V	.400A		
DM-414 (with filter)	14V	2.8A.	220V	.080A.	....	12.50
PS-225 (with filter)	28V	3.2A.	375V	.150A.	....	10.50
EICOR Dynamotor D-401	27V	6.05A.	300V	.200A.	....	9.95
			18V AC	2.2A.		
PE-135AX (with filter)	24V	12A.	500V	.200A.	....	34.50

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Type	Input		Output		Excellent Used	Brand New
GN-39-F (16"L, 8" dia. 50 lbs.)	14.6V	25A.	1000V	.350A.	....	39.50

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PE-206 Inverter—Leland In: 28V DC—38A.
Out: 500V 800 cyc. 80VA. 1 Ph. 9.75 12.50

PE-218 Inverter—Leland-Wincharger-GE.
In: 28V DC—92A.
Out: 115V 380/500 Cyc. 1500VA. 1 Ph. . 16.50 24.50

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0-400 Microamps	5.95
0-500 Microamps	5.95
0-150 Milliamp	4.50
0-200 Milliamp	4.50
0-100 Milliamp	4.50
0-1.5 Volts AC	4.95
0-3 Volts AC	4.95

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10 MFD 600 VDC	1.77
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1 MFD 5000 VDC	2.97
2 MFD 5000 VDC	5.97
2 MFD 12,500 VDC	29.97
.25 MFD 25,000 VDC	17.97
.5 MFD 25,000 VDC	26.97
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Min. Order $3.00—25% with Order

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New in original cartons. Complete. Consists of all accessories, plus AS-27A, R89B/ARN-5 and BC-733D. Modified to flag alarm.

TBS 4 & 5, NEW, COMPLETE
IE-17 TEST SET
AN/ARN-7 COMPLETE
SCR-269 COMPLETE
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Quantity available.

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ATC XMTR	T-47A/ART-13 XMTR
T-47/ART-13 XMTR	CU-24 ANT. LOAD
CU-25 ANT. LOAD	DY-11 & 12 Dynam't'r
MT-283 MOUNT	0-16 LFO
MT-284 MOUNT	ATC DYNAM'T'R
SA-22 ANT. LOAD	C-87 CONTROL BOX

AN/APG-13A RADAR
Absolutely complete, brand new

AN/APN-2	MG-153
SCR-729 New	APS-2, 3, & 15 Components
TA2J-24	AN/ARC-5 VHF
RTA-1B	SCR-274 & ARC-5, Command Equipm't
BC-1016	R-4/ARR-2 Receivers
APA-6 INDICATOR	BC-640 VHF XMTR
APA-11 INDICATOR	SCR-510
APA-17 RADAR	SCR-522
HS-33 HEAD SETS, NEW	MG-153
MG-149F & H	

SPARE PARTS

SCR-720	SCR-522
SO-7	AN/ART-13
AN/ARN-7	AN/ARC-1
SCR-269	BC-611

SCR-718 A, AM, B & C
Altimeter equipment—complete

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1N21B	2.00
1N21C	20.00
1N22	1.70
1N23	1.95
1N23A	2.25
1N23B	2.85
1N25	5.25
1N26	8.00
1N27	8.00
1N28	4.25
1N31	6.00
1N34	.71
1N34A	.71
1N35	2.20
1N38	1.10
1N40	11.50
1N41	12.00
1N43	1.75
1N44	1.50
1N48	.62
1N51	.50
1N52	1.37
1N54	.90
1N58	1.25
1N60	.61
2AP1	10.00
3AP1	10.00
3AP1A	12.00
3BP1	6.00
3CP1-S1	2.00
3DP1-S2	7.50
3GP1	5.50
5BP1	5.00
5CP1	6.00
5FP7	2.90
5GP1	5.20
5LP1	20.00
7BP7	8.00
OA2	1.00
OA3-VR75	1.10
OB2	.90
OB3-VR90	.95
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1B21A	2.50
1B22	2.50
1B23	7.00
1B24	12.00
1B26	3.50
1B27	13.00
1B29	2.75
1B32	3.25
1B35	9.00
1B42	9.00
1B63A	60.00
C1B	8.00
1P21	28.00
1P28	10.00
2B22	1.90
2C26A	.60
2C34	.60
2C39	20.00
2C39A	21.00
2C40	10.00
2C43	17.50
2C44	1.50
2C46	30.00
2C50	9.00
2C51	5.00
2C53	13.00
2D21	1.50
2E22	2.50
2E24	3.00
2E26	3.40
2E27	3.50
2E36	3.50
2J21A	10.50
2J22	10.50
2J26	20.00
2J27	20.00
2J31	30.00
2J32	26.00
2J33	25.00
2J34	25.20
2J36	110.00
2J37	15.00
2J38	24.00
2J39	15.00
2J40	38.00
2J42	150.00
2J48	45.00

2J49	63.00
2J51	250.00
2J55	80.00
2K22	30.00
2K23	20.00
2K25	28.00
2K26	100.00
2K28	33.00
2K29	30.00
2K39	100.00
2K41	150.00
2K45	125.00
2X2	60.00
3A5	1.10
3B22	3.50
3B24	5.50
3B24W	8.50
3B25	6.50
3B26	6.00
3B27	4.50
3B28	4.50
3C21	5.00
3C24	1.50
3C31	6.00
3C33	21.00
3C45	18.00
3E29	12.00
4X100A	40.00
4-125A	25.50
4-150A	30.00
4-250A	38.00
4-500A	100.00
4-1000A	140.00
4B24	5.75
4B25	8.50
4B26	10.00
4B28	6.00
4C27	38.00
4C35	26.00
4E27	18.00
4D32	21.50
4J52	300.00
5C22	47.50
5D21	16.50
5J26	125.00
5J32	80.00
5R4GY	1.50

6AK5W	2.00
6AK5	1.00
6AN5	3.00
6AN6	3.25
6AR6	2.75
6AS6	2.25
6AS7G	4.00
C6J	9.00
6C21	22.00
6C24	55.00
10Y	.80
12A6	.65
15E	2.00
15R	1.25
FG-17	8.00
RX21	8.00
35T	6.00
RK60	2.50
RK65	32.00
75TH	13.00
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FG-172	25.00
211 Sp	1.25
GL-218	30.00
249B	7.00
249C	7.00
249R	6.50
250R	20.00
250TH	22.00
250TL	20.00
252A	28.00
253A	20.00
255B	130.00
258B	10.00
304TH	9.00
304TL	9.50
307A	4.00
316A	2.50
319A	21.00
323B	11.00
327A	4.00
328A	8.00
329A	8.50
332A	45.00
350A	8.00
350B	8.00
355A	21.00

357A	19.00
371A	.85
371B	.85
388A	3.00
393A	12.00
394A	4.00
407A	5.50
408A	3.00
417A	12.00
434A	20.00
446A	2.50
450TH	50.00
450TL	50.00
451	10.00
468	26.00
471A	3.00
502	73.00
527	15.00
530	16.00
532A	3.50
375A	21.00
600	7.00
602	9.00
604	7.75
614	7.50
700A	24.00
700B	24.00
700C	26.00
701A	5.80
703A	5.50
705A	1.90
707B	16.00
708A	5.50
714AY	16.00
715A	6.00
715B	9.00
715C	29.00
717A	1.20
719A	28.00
721A	4.00
721B	6.00
723A/B	20.00
724A	3.00
724B	2.00
725A	10.00
726A	14.00
726B	49.00

726C	69.00
730A	35.00
731A	4.50
801	2.10
802	4.00
803	4.00
804	16.00
805	3.00
807	1.65
807W	11.50
808	2.25
809	3.50
810	11.50
811	2.95
811A	3.75
812	3.50
813	11.50
814	3.75
815	4.50
816	1.50
826	1.50
828	12.00
829B	12.75
830B	4.50
832	7.00
832A	9.50
833A	41.00
834	13.00
836	3.75
837	1.45
838	3.95
843	1.25
845	10.00
851	55.00
852	19.00
860	3.25
861	26.00
864	.40
866A	1.65
869B	90.00
872A	3.50
876	1.35
878	1.75
884	1.58
885	1.75
931A	6.00
954	.45

955	.67
956	.55
957	.40
958	.95
958A	1.00
1612	2.00
1613	.80
1616	1.50
1619	.40
1620	6.00
1622	2.25
1624	1.50
1625	.30
1626	.25
1630	.85
1631	1.40
1632	.75
1633	1.00
1641	2.25
1665	1.30
2050	1.50
2051	.80
5516	7.20
5527	46.00
5545	35.00
5559	18.50
5560	27.00
5563	44.00
5581	2.25
5582	2.65
5585	150.00
5633	11.00
5634	11.50
5635	12.75
5636	8.00
5638	10.50
5645	12.85
5651	2.50
5654	2.80
5657	200.00
5672	1.40
5675	17.00
5676	1.30
5678	1.20
5679	1.25
5683	9.50
5686	4.50

5687	4.00
5702	4.45
5703	1.90
5704	2.75
5718	8.50
5719	11.00
5720	18.75
5722	6.25
5725	3.90
5726	2.00
5734	16.00
5751	3.25
5763	1.50
5814	2.50
5829	3.80
5840	9.00
5863	14.00
5879	1.65
5881	3.00
6005	3.25
7193	.65
8005	6.75
8008	7.10
8012	2.00
8013A	5.00
8014A	70.00
8019	4.00
8020	2.25
8025	3.90
9001	1.20
9002	.90
9003	1.30
9004	.50
9005	2.10
9006	.40

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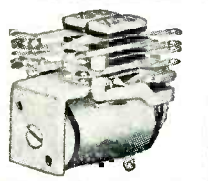

26.5 VDC midget 425 ohm $2.95

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TRANSISTOR or 5 pin submini socket..... .15
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Wheatstone Bridge Leeds & Northrup No. 5300	Exc.	100.00
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* PUR—Price upon request.

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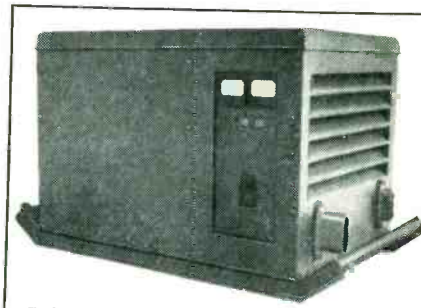

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50 KW 250 volts DC —	$2,187.00
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NEVER SUCH LOW PRICES BEFORE

Superior Powerstats — NEW	
Type 1256-3Y	$228.00
Type 1156-L-3Y	228.00
MZ-1126-3Y motor dr.	165.00
Type 1126-3Y	100.00
1226-3Y	100.00
Type 216-U-2D	32.00
Type 20	14.00
GR Variacs—V-10-G-3	90.00
West. DB-25 Cr Breakers 400 amps 3 ph	300.00
Boston Ratiomotors 220/3/60 ¼ hp 172.5 rpm	80.00
Sola Voltage Regulators No 30804.	10.00
Weston Swbd voltmeters Model 801 0/500 v DC	10.00
Model 271 0/500 v	25.00
Model 271 0/500 amps	25.00

Many Others, all new, fob Calif.

HEADQUARTERS FOR INDUSTRIAL ELECTRONIC EQUIPMENT

CLARK ELECTRONIC CORPORATION

PALM SPRINGS, CALIF.
Phone 8-3011

INDEX

SEARCHLIGHT

NOVEMBER, 1953

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TO THE ADVERTISERS

NOVEMBER, 1953

SEARCHLIGHT SECTION
(Classified Advertising)
H. E. Hilty, Mgr.

THE *Electro* INDEX

HIGH VOLTAGE CAPACITORS

Cat. No.	Mfd.	Wvdc	Price
2LXP30	120	3KV	$99.50
22F985	2	4KV	14.50
22F221	4	4KV	22.50
PFD40244	7	4KV	34.50
22F225	1	5KV	14.50
14F1	4	5KV	32.50
14F2	7	5KV	49.50
19F210	0.1	6KV	32.50
A7548	2x.25	6KV	17.50
TK00020	2	6KV	27.50
26F513	2x.68	7.5KV	27.50
7520	2x1.0	7.5KV	27.50
14F338	4.5	7.5KV	79.50
CC21B	2x0.5	9KV	32.50
3DA20-136	.02	10KV	7.50
10020	0.1	10KV	9.95
Inerteen	1.0	10KV	25.00
14F13	5	10KV	124.50
26F68	0.1	12KV	9.95
TK120065	.65	12.5KV	19.95
15020	.25	15KV	19.50
14F17	1	15KV	49.95
14F63	1	15KV	49.95
14F18	1.5	15KV	62.50
20020	.25	20KV	27.50
14F64	.25	20KV	27.50
37485	.25	20KV	27.50
XSW200	.25	20KV	27.50
PC1925	2x.25	20KV	37.50
20005	0.5	20KV	45.00
14F22	1.0	20KV	62.50
14F139	.01	22KV	15.50
26F585	.06	25KV	17.50
Inerteen	.5	25KV	57.50
25020	.5	25KV	57.50
14F24	.5	25KV	57.50
14F83	.75	25KV	72.50
Inerteen	1.0	25KV	85.00
A6734	1.0	25KV	85.00
S1258441	1.5	25KV	124.50
14F112	.001	50KV	24.50
14F98	2x.025	50KV	37.50
14F127	.025	50KV	37.50
14F126	.2	50KV	70.00
14F97	.25	50KV	70.00

DIEHL AC CONTROL MOTORS

FP25-2, 22V 2ph 60~ .85A 1600RPM	$22.50
FP25-3, 20V 2ph 60~ .5A 3200RPM	22.50
FPE25-8, 75/75V 60~ .11/.11A 2ph 2 watts, 2 pole	24.50
FPE25-9, 100/100V 400~ .44/.44A 2ph 4 watts, 2 pole	27.50
FPE25-11, 75/75V 60~ .11/.11A 2ph 4 watts, 2 pole	29.50
FPE25-12, 115/115V 60~ .16/.16A 2ph 5 watts, 2 pole, 3200rpm	34.50
FPE25-14, 20/20V 60~ .5/.5A 2ph, 2 pole	22.50
FPE25-16, 20/20V 60~ .85/.85A 2ph, 2 pole, 1600RPM	24.50

SINE-COSINE GENERATORS

(Resolvers)

Diehl Type FPE43-1, (Single Phase Rotor), Two stator windings 90° apart, provides two outputs equal to the sine and cosine of the angular rotor displacement. Pri: 115V, 400~; Sec: Sinusoidal, 220V 400~ 2ph, 2 pole 1300Ω	30.00
Diehl Type FJE43-9, same as above except output is 55V 400~ 2ph 2 pole 80Ω	30.00
Diehl Type FJE43-10, same as above except output is 13.5 volts 400~	30.00

TACHOMETER OR RATE GENERATORS

Elnico Type PM-1, DC Generator	$29.50
Elnico Type PM-2, DC Generator	29.50
Elnico Type F-15, AC Generator	29.50
Elnico Type B-16, AC Generator	29.50
Elnico Type F-17, AC Generator	34.50
Elnico Type B-35, DC Generator	29.50
Elnico Type B-35D, DC Generator	29.50
Elnico Type B-44, DC Generator	29.50
Elnico Type FBZ-55, DC Generator	39.50
Elnico Type FB-84, DC Generator	34.50
Elnico Type FB-298, DC Generator	39.50

SELSYNS—SYNCHROS

Immediate Delivery—From Stock

1CT Control Transformer, 90/55V 60~	$64.50
1HCT Control Transformer, 90/55V 60~	80.00
1G Generator, 115/90V 60~	64.50
1HG Generator, 115/90V 60~	80.00
1DG Differential Generator, 90/90V 60~	64.50
1HDG Differential Generator, 90/90V 60~	80.00
1F Synchro Motor, 115/90V 60~	64.50
2J1M1 Control Transformer, 105/63V 60~	59.50
1N Synchro Motor, 115/90V 60~	49.50
1SF Synchro Motor, 115/90V 400~	17.50
1F Special Motor, 115/90V 400~	17.50
2J1D1 Generator, 115/90V 400~	12.50
2J1F1 Generator, 115/57.5V 400~	9.50
2J1F3 Generator, 57.5/57.5V 400~	9.50
2J1G1 Control Transformer 57.5/57.5V 400~	9.50
2J1H1 Differential Generator 57.5/57.5V 400~	12.50
2J1H2 Generator, 115V 400~	17.50
2JD1J1 Motor, 115/90V 400~	15.00
3F Motor, 115/90V 60~	84.50
3HCT ControlTransformer, 90/55V 60~	84.50
2JD5R1 Motor, 115/90V 400~	27.50
5SF Motor, 115/90V 400~	32.50
5SG Generator, 115/90V 400~	32.50
5SDG Differential Generator 90/90V 400~	32.50
KS5950 Generator, 115/90V 400~	19.50
KS5950L2 Generator, 115/90V 400~	22.50
2JA39BB2 Motor, G.E., 110/55V 60~	55.00
2J5FB1 Control Transformer 105/55V 60~	60.00
2JD5C2 Motor, 115/105V 60~	60.00
2J5H1 Generator, 115/105V 60~	50.00
2J5HA1 Generator, 115/105V 60~	60.00
2J5A4 Generator, 115/105V 60~	60.00
2J5S1 Differential Generator 90/90V 60~	60.00
2JD5J2 Motor 115/90V 60~	60.00
2J5LA1 Generator 115/105V 60~	60.00
2J65F1 Generator 110/55V 60~ (used)	35.00
2JD123A16 Motor, 110/40V, 60~	55.00
5A Generator, 115 Volts 60 Cycles	22.50
5B Generator, 115 Volts 60 Cycles	22.50
5CT Control Transformer 90/55V 60~	50.00
5HCT Control Transformer 90/55V 60~	69.95
5D Differential Motor, 115/90V 60~	50.00
5DG Differential Generator, 90/90V 60~	50.00
5F Motor, 115/90V 60~	50.00
5G Generator, 115/90V 60~	50.00
5M Motor, 115 Volts 60 Cycles	22.50
5N Motor, 115 Volts 60 Cycles	22.50
2J6F1 Generator, 115/90V 60~	64.50
2J6F2 Generator, 115/90 Volts 60~	64.50
6SG Generator, 105/90 Volts 60~	60.00
6CT Control Transformer, 90/55V 60~	60.00
6DG Differential Generator 90/90V 60~	60.00
6G Generator, 115/90V 60~	57.00
7G Generator, 115/90V 60~	69.95
C44968-6 Type II-1, Repeater, 115V 60~	22.50
C56701 Type II-4 Repeater, 115V 60~	22.50
C56776-1 Repeater AC Syn. 115V 60~	22.50
C69406 Diehl FJ84-8 Transmitter 115V 60~	22.50
C69406-1 Type II-2 Repeater, 115V 60~	22.50
C77610 Type III Repeater, 115V 60~	22.50
C78248 Transmitter AC Syn. 115V 60~	24.50
C78249 Differential AC Syn. 115V 60~	9.50
C78254 Type XII Differential, 115V 60~	22.50
C78411 Transmitter AC Syn. 50V 50~	14.50
C7841414 Transmitter ACSyn. 115V 60~	49.50
C78359 Diehl 84-4, Receiver 115V 60~	22.50
C78360 Diehl 84-5, Transmitter 115V 60~	22.50
C78386 Type XV Transformer 115V 60~	22.50
C78791 Transmitter AC Syn. 115V 60~	22.50
C79331 Type I-4 Transmitter 115V 60~	22.50
C81369 Type II-8 Repeater, 115V 60~	22.50
PATT-6547 Admiralty Transmitter 115V 60~	17.50
PATT-6548 Admiralty Transmitter 115V 60~	17.50
Type I-82A Radio Compass Indicator	7.95
Type I-82F Radio Compass Indicator	9.00

SPECIAL OF THE MONTH

High Kva Mica Capacitors

Leading Mfg'er, Type 57
Cat. # 676-57 .002 Mfd 40 KV **$85.00**

Electro INDEX *to Electronic Component* VALUES

These listings represent only a small portion of our tremendous Electronic inventories. If your requirements are not listed, write and allow us to quote you accordingly. Prices subject to change without notice. Terms: Rated firms net 10 days, Non-rated 25% with order balance COD. FOB Boston. Minimum order $10. Merchandise Fully Guaranteed.

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Want more information? Use post card on last page.

TACHOMETER GENERATOR

GENERAL ELECTRIC
PART #2CM5-AAK-20
MARK V STUD MTG
NEW......$4.98: 2 for $8.00

STORAGE BATTERIES

36 Volt WILLARD Mini-BRAND NEW 5 oz Designed Portable Equip. Models...98c; 4 for $3
Four 36V BATTERIES w/acid*.......... 3.35
2V 20AH Willard PLUS 2V. Vibrator...... 2.98
2V 20AH Batt. W/Vib. & Acid*.......... 3.59
4V/16AH Gould........................ 2.89
6V/6AH Willard NT6/BB214U............ 2.98
6V/6AH Batt. W/Acid*................. 3.25
6V/40AH Willard...................... 6.98
6V/40AH Batt. W/Acid*................ 9.25
* Acid is shipped in Bottles.R'Exp only.

LAB OR HI-FI POWER SUPPLY

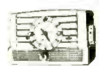
Sola constant voltage power transformer mounted on chassis with 2 octal rectifier sockets.
New Mfgrd By Dumont
Furnishes 400VDC/250MA to filter system 12.6VCT/6 AMP or 2x6.3V/6AMP (common tap) and 5V/6AMP regulated special.............$13.98
With filter condensers, choke and rectifier tubes. SPECIAL......................$18.98

PRECISION RESISTORS

2 MILLION IN STOCK
GUARANTEED 1% TOLERANCE
ORDER ANY VALUE YOU NEED
42 to 970K OHM..........35c: 10 for $3.29
1MEG & UP...............70c: 10 for $6.49

CLOCK RADIO

WAKE UP TO MUSIC
Just set the dial, & radio automatically turns on. Beautiful plastic cabinet. MAROON OR IVORY
Powerful 5 tube design.
"TAB" SPECIAL....$21.00
Same Less Clock.....$17.00



YOU PICK THEM **39¢** WHILE THEY LAST
Lots of 10
ELECTROLYTIC CONDENSERS
40MF/25VDC 2X15MF/350VDC
40MF/450VDC 2X20MF/25V.30MF/450V
15MF/300VDC 40MF/250V. 20MF/25V
20MF/350VDC 3X100MF/35VDC
100MF/25VDC 30/15/10MF/250VDC
ALL SIZES & TYPES NEW STOCK

EICO TEST EQUIPMENT

Stock #	Type	Kit Price	Built Price
145K	Sig Tracer	$19.95	$28.95
215K	Volt Meter	34.95	
221K	Volt Meter	25.95	49.95
315K	Sig Gen	39.95	59.95
322K	Sig Gen	23.95	34.95
360K	Sweep Gen	34.95	49.95
377K	Audio Gen	31.95	49.95
470K	Oscilloscope	79.95	129.50
625K	Tube Tester	34.95	49.95

Industrials & Schools Write Qty Price

TEST CORDS

15 Foot Extension Cord, Hvy Duty, SJ Rubber Covered Insulation, as Shown....98c
4 Foot Instrument Test Leads, High Quality Red & Black. Per Pair..........59c: 2 for 98c
TV Cheater Cord Approx 32"....25c; 5 for $1.00

SELSYNS

2J1H1 GE Selsyns...................Each $8.98
2J1F3 GE Brand New 115V/400 cy. ea...... 9.75
C78248 Sync. Trans. 115/60 cy 30.00; 2 for 55.00
C78249 Sync. Diff. 115V 60 cy 12.95; 2 for 25.00
Sync. Repeater 115/60 cy Type 11-4..2 for 99.00
Bendix Autosyns AY1 & AY5...........2 for 6.95
Bendix AY20 New Orig Crtns............12.98
OTHER TYPES IN STOCK

DYNAMOTORS

INPT 6VDC, Output 200V/100ma. or 12/24V Output 500V/50ma "P" Magnt. As Illustrated.. 6.95
INPT 28VDC/1.4A Output 250V/60ma.......... 3.69
DA3A 28V/10.5A out 300VDC/260ma 150VDC/10ma. 14.5vdc/5amp........ 6.75
PE94 Plate Supp., Uses DA3A (SCR522)... 8.93
PE97 Plate Supp.. Less Tubes.............. 9.98

FL-5 FILTER

Range of voice. Filters 1020 cycle audio, excellent for CW Work...59c: 2 for $1.00

BANDPASS FILTER

Sharp Cutoff HIQ, Cased & Shielded 60, 90, 150 cycles...............Each $1.75; 2 for $3.00
UTC 854. 1024 1250 Cyc. Ea. $1.50; 2 for $2.50

OIL CONDENSER SPECIAL

10 MFD 600 VDC **$1.75 ea**
LOTS OF 3
Case Dimensions, Not Including Insulators 4⅛H—3¾W—1¼"D
Quantities Less Than 3, Ea..............$1.98

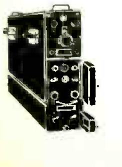
OIL CONDENSERS

WAREHOUSE CLEARANCE SALE
RECTANGULAR CASE
.5MFD 1500VDC..........95c: 2 for $1.50
3MFD 600VDC..........1.50: 3 for 4.00
3MFD 330VAC 1000VDC...49c: 3 for 1.20
2x2MFD 600VDC.........89c: 2 for 1.59
BATHTUB SIDE TERMINALS
1MFD 600VDC..........39c: 3 for 1.00
4MFD 50VDC...........50c: 5 for 2.00
3MFD 2000VDC.........1.05: 5 for 4.50
2x.1MFD 400VDC.........49c: 5 for 2.00

CONDENSER SPECIALS

2 MFD 1000 VDC 330 VAC "CD" MFGR **25¢** LOTS OF 10
Smaller Quantities Each..........49c: 3 for $1.25
2MFD 600VDC Porcelain Insulators With Adjustable Mounting Clamp..........3 for $1.50

FREQUENCY METER AND WAVE METER



BC1162 Control Unit. Part of RC150 & SCR270 Radar Equipment 19 Tube Line Up, Operates 150-210 Megacycles, 115V 60cy. Includes Heavy Duty Power Supply. Excellent Condition Less tubes.................$19.95
Two for.......................$36

"TAB" THAT'S A BUY

"AN" CONNECTORS REDUCED UP TO 90% OFF LIST

EXTRA 10%		QUANTITIES OF 100	
AN3102-10S-2P	23c	AN3108-22-4S	$1.32
AN3101-12S-3S	52c	AN3102-22-4S	89c
AN3102-12-5P	29c	AN3102-36-9S	2.95
AN3102-14S-5P	45c	AN3057-4	25c
AN3108-14S-7S	69c	AN3057-12	30c
AN3108-16S-4P	67c	GK-C8-21 1/2B	1.15
AN3062-20	55c	GK-9-32S	66c
AN3102-20-26P	72c	Others In Stock.	

866A KIT AND XFORMER

2 Tubes, Sckts, xfmr 115v 60cyc Inp. outpt. 2.5vct. 10A/Hv insul. SPECIAL..........$4.98

DIODE PROBE TUBE

Unexcelled for No-Loss VHF testing. Ultra sensitive subminiature-envelope. New. w/data VR92..........................25c; 5 for $1

DC POWER-SUPPLY

0 to 12VDC/2 AMP Variable DC supply—inpt 115v/60 cy. Usable LAB supply, filament D.C. plating, battery charging, model railroad includes voltage or speed control and center off reversing sw. Ideal for two "HO" loco's..............$10.95: 2 for $20.00

RHEOSTAT SPECIALS

15 ohm 25W w/knob..........$1.49; 2 for $2.49
20 ohm 50W Model J.......... 1.98; 2 for 3.50
60 ohm 50W w/knob........... 2.25; 2 for 3.98
100 ohm 50W Model K......... 1.98; 2 for 3.50
200 ohm 25 Model D.......... 1.49; 2 for 2.49
250 ohm 25W................. 1.19; 3 for 2.98
300 ohm 225W Model P........ 2.98; 2 for 5.00
350, 500, 5000 ohm Slotted shaft, 25 watt..............79c; 3 for 2.00
Many Other Types In Stock

"TABS" NEW TRANSFORMER STOCK.

2.5VCT/10A 12.5KVINS Kenyon $6.98; 3 for $19
778VCT/200MA, 5V/3A, 6.3VCT/5A Thordarson....................$5.98; 3 for $15.
800VCT/150MA Stancor.............$5.98; 3 for $15.
850VCT/148MA 5V/3A. 6.3V/5A. 6.3V/3A...$6.49
2500VDC/200MA KIT, Transformers Power & Bridge Filaments & 4/866's Special........$23.00
600VCT/50MA, 6V/3A, 6V/1.5A, 5V/1A.....$2.49

TRANSFORMERS

All 115 V 60 Cycle Input TV & CR Pwr Xmfr up to 20" tubes. Hi VOLTS to 20 KV (w/quadrupler ckt.) ALL Tubes. PL & Fil wndgs 300 VDC/275Ma Full-Wave.; 6.4V/10.3A, 5.4V/8A, 2.5V/3A Hypersil Core, Oil Impreg. $6.49; Two for..............$12.49
1000VCT/45MA, 795VCT/80MA, 360VCT/55MA 3X5V/3A, 6.3VCT/1A, 6.3VCT/3A CSD HVINS CAN BE USED 2X RATING RAYTHEON, HYPERSIL CORE.......................$4.98
950VCT/100MA, 5V/2.5A, 5V/5A, 45V/1A, 10V/1.5A WESTERN ELECT............$5.49
900V/35MA, 2X2.5V/2A, XCLENT 1800V DBLER TWO 2X2 FIL WNDGS...........$2.25
780VCT/250MA, 5V/6A, 12.6V/5.5A........$7.95
770VCT/200MA, 5V/6A, 12.6V/5.6A.......$6.95
720V/85MA, 5V/3.5A, 6.3V/3.5A..........$2.98
700VCT/120MA, 2X6.3V/3A, 6.3V/1A Price.............$3.98; Two for...........$7.25
680VCT/200MA, 5V/3.5A, 6.3V/4A, 78V/1A $4.39; 3 for $12.
420VCT/90MA, 6.3V/1.9A, W/INPUTS 6, 12, 24, 115VDC & 115 & 230 VAC @..........$1.49

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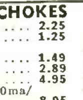


12Hy/80ma/3KVins.......... 2.25
10Hy/75ma................. 1.25
10Hy/125ma/UTC/Csd/H'sld/1 KVins.......... 1.49
50Hy/125ma/Csd/H'Sld...... 2.89
12Hy/300ma/5KVins......... 4.95
20Hy/300ma to 15Hy/400ma/12KVins Kenyon.......... 8.95
13.5Hy/1Amp/17KVins/Raytheon..........39.95
Dual 2 Hy/300ma USN..........95c; 2 for 1.49
6 Hy 175ma 250 Ohm..........$1.49; 2 for 2.49
10 Hy 100ma Freed..................... 1.39

FILAMENT TRANS.

6.3V/2AMP $1.08; Two for.................$1.98
2.5V/2A @ 79c, 2 for $1.49, 10 for......... 6.49
2.5VCT/10A 5KVINS......................... 3.59
7.5VCT/12A CSD KENYON 15 KVINS....10.95
24V/1.25A CSD @ $1.98 Two for............ 3.49
2X12V/2A or 24V/2A @ $3.89 Two for...... 6.98

ELECTROLYTIC CONDENSER KIT

POPULAR VALUES **25¢** EA LOTS OF 15

15 ASSORTED CNDSRS. ONLY $3.75

METER BUYS

0-30 VDC "AN"$1.98; 2 for $3.25
0-60 AOC "AN" Type Mtg Less Shunt..........2.95; 2 for 5.00
0-15 VAC GE 2½ Rnd 800cy 1.29
0-150 VAC/Wstghs/2½ Rnd 3.49
0-150 VAC/25-125cy/3½" Square RA35/Wstgh.......... 5.98
0-1MADC Wstghs 3½" Sq RA35 LN........ 6.49
0-500 MADC/2½"; Rnd Triplett 221T...... 4.98
VU-20 + 3 Weston 301 3" Sq. L.P. $41...14.98
0-120 MA RF 3½" Rnd Weston 301..........12.98

RELAY SPECIAL

SPST Mini Size 115VAC 3A CTS.......98c; 3 for $2.75
SPDT Mini Size 115VAC 3A CTS....$1.39; 3 for $3.75
DPDT 6VDC/5A CTS
ALLIED....$1.49; 2 for $2.49
SPNO 115VAC/15A CTS S'Dunn.......$1.98; 2 for $3.50
DPDT & SPNO 12 VDC/10A CTS.......$2.25; 2 for $3.75
DPDT Clare SK5010, Octal Base, 18-28V 2A Contacts. Nitrogen Sld. New Stock.......$2.98

INFRARED SNOOPERSCOPE

SEE IN DARK TUBE

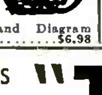


Image-Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—Resolution up to 350 lin/in. Complete data & tube..........ea. $4.98; 2 for $9.49
Snooperscope Pwr Supply 1800VDC/35MA, Using Doubler Crkt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram 115V/60cy Oper..........................$6.98

FEDERAL "ITT" SELENIUM BATTERY CHARGER RECTIFIER

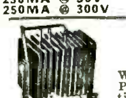
10-0-10 Volts (CT) 100 Amp (Fan-Cooled). Replace Your Old inefficient Sulphide Rect. with the New Selenium Types. SPECIAL..$11.98

SELNIUM RECTIFIERS

1/2 WAVE FOR RADIO & TV

CURRENT (Cont.)	LIST PRICE	"TAB" PRICE	QTY 12 FOR
65MA @ 130V	$1.50	$0.59	$6.48
75MA @ 130V	1.85	.69	7.58
100MA @ 130V	2.05	.79	8.68
150MA @ 130V	2.25	.99	10.78
200MA @ 130V	3.15	1.39	14.98
300MA @ 130V	3.30	1.49	15.98
400MA @ 130V	4.25	1.89	20.38
500MA @ 130V	4.40	1.98	21.28
230MA @ 18V	1.40	.59	5.98
230MA @ 36V	2.25	.89	8.38
250MA @ 300V	6.95	1.39	14.98

SELENIUM RECTIFIERS



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1 Amp	$1.35	$2.15	$3.70	$7.50
2 Amp	2.20	3.60	5.40	10.50
4 Amp	4.25	7.95	12.95	25.25
6 Amp	4.75	9.00	13.50	33.00
10 Amp	6.75	12.75	20.00	40.00
12 Amp	8.50	16.25	25.50	45.00
20 Amp	13.25	25.50	39.00	79.50
24 Amp	16.25	32.50	45.00	90.00

Full Wave Rect & Trans. 115V/60cy inputs
up to 14VDC at 12 amps...................$23.98
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PRIMARY 115V 60 cyc
SECONDARY 0-9-12-18-24-36V
CONT. CURRENT { 4 amp.......$8.75 / 12 amp.......16.75 / 24 amp.......35.75
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RECTIFIER CHOKES

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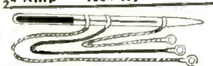

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Ea. 98c; 12 for $10.00

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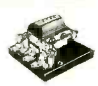
650 Ohm
5 Amp CTS
$3.95 LOTS OF 3



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No other soldering gun offers all these features at any price. 115VAC 180 Watt, light weight 28 ozs, melts solder 3½ secds. swivel 180 Deg tip, Special alloy Korodless tip, heavy duty transformer, Positive trigger—easy action, Balanced luger pistol feel. "TAB" special..........................$7.45

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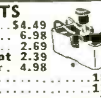

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GE RPX050 Triple Play Cart.. 6.98
Electrovoice Triple Play..... 2.69
Pickup Arm & Xtal Hi-Outpt 2.39
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Crystal Mike Cartridge (Lapel Type)...... 1.98
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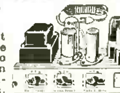

Model 305MP 5 Watt Ampl. as Pictured Above Features Mike & Phono Inpts. W/Sep. Gain Ctrls. Latest Conpensated Tone Cntrl Design. Complete with Tubes $14.98
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Model 200MO Mike OSC. Broadcasts Through Your Radio with No Direct Connection. W/Tubes. "TAB" SPECIAL..............$6.98
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TAB 308 Pre & Pwr Amp 8 Watt 20 to 20 KC.................................$35.77
GARRARD-RC 80 & GE RPX-050............45.00
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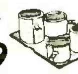
ART 13A HI-VOLTAGE CERAMIC CONDENSERS

185MMF-200MMF
280MMF-400MMF
Sig#2C6900-47A/11
All Four Condensers..... **$2.49**



CU-24/ART 13 LOADING CONDENSERS

Three 25MMF 10,000V condensers P/o ART13 XMTTR. NEW..................$2.49

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Helipot 50K ohm 10 Turn 0.5% 50KAJZ..$8.95
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Daven Attenuator T323G dual 600 ohm, 20 step 1½ DB per/step...............10.98
Eveready 6V Hotshot 1461 Battery......... .98
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Lacing cord #12 Waxed, linen............. 1.89
K. Miller stripper #100 & cutter......... .89
Carbide drills for TV/Ant ¼, ⅜, ½"..3 for 3.89
Hytron adapter SH27, 28, 29 Asst....3 for 5.00
Line filter F/5 AR for AN/ARC5 installation, used, as-is................ 1.98

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Type 20/0-135V3Amp/ (N) $10.98
Type 116U/0-135V/7.5 Amp/(N)................ 16.98
Type 116 As above, except cased (N)..... 20.49
Type 1126/0-135V/15 Amp/(LN)........... 41.98
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HF-1 Oscilloscope (N) Special......... 79.95
(N) NEW & (LN) LIKE NEW

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Silver & Mica Cndsrs.........15 for 1.25
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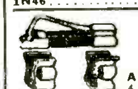
"TAB" YOU PICK 'EM **$1.00**
Special Lots of 5

CRYSTAL DIODES

1N23B Sylvania **$1.89**
New, Boxed & Jacketed Lots of 10
Smaller Quantity, Unit Price $2.25

1N21..............85c; 6 for $ 4.00
1N21A............$1.55; 5 for $ 7.00
1N21B............$2.89; 4 for $10.00
1N27.............$1.55; 5 for $ 7.00
1N46..............69c; 5 for $ 3.25

CIRCUIT BREAKER FUSES



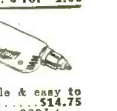
PUSH TO RESET
Amps 3-5-7-10-15-20 Ea. 27c
4 for $1.; 25 for $5.; 100 for $18.
Circuit Breaker Fuse W/2 Mounting Clips 39c; 3 for....$1.00; 20 for....$5.98; 100 for.....$25.
Fuse is 3AG Size. Operates up to 24 Volts. Please State Amps (current) desired.

MICA CONDENSERS

A B C

Fig.	MFD	WVDC	PRICE
A	.03	600	69c; 5 for 2.39
A	.02	600	69c; 5 for 2.25
A	.015	2500	1.75; 2 for 3.00
B	.01	600	56c; 3 for 1.20
B	.01	1000	49c; 3 for 1.25
B	.01	1200	69c; 3 for 1.49
A	.005	2500	1.19; 3 for 2.95
B	.004	600	49c; 3 for 1.10
B	.002	1200	58c; 3 for 1.25
A	.002	2500	98c; 3 for 2.25
A	.001	1200	55c; 3 for 1.20
C	.0007	3000	89c; 3 for 2.39
A	.0004	2500	39c; 6 for 1.95
A	.0001	600	25c; 5 for 1.00
C	.0001	3000	89c; 3 for 2.00
C	.0001	5000	1.49; 4 for 5.00
C	.00005	3000	39c; 4 for 1.00

¼" Electric Drill Model 200J



High torque (powerful) UL appvd. 2400 RPM 115V AC/DC motor, Jacobs geared chuck & key, self aligning oilless ball thrust bearing, comfortable & easy to handle. "TAB" Special.....................$14.75
Model 210 Drill stand, converts above 200J to a Drill press, special.......................$9.69
29 Drills Chrome Vanadium Speed Steel. Top Quality for Machinists or All Purpose Use. 1/16 to ½ by 64th's. w/"Huot" Drill Index....$9.69
Drills, 60 Pcs 1 to 60 C.V. W/Index...... 7.98
Drills, 13 Pcs 1/16" to ¼" C.V. w/Index 2.69
Drills, 12 Pcs 1/16" to ½" C.V........... 3.49
½" Speed Electric Drill with Jacobs worm-gear chuck & 29 Pcs Drills & index..........$39.00

AUDIO COMPONENTS

Western Electric Push-Pull Pentode Output Transformer 197A. Rated 10 Watts for 6V6's or 6AQ5's. Excellent Freq. Response Flat 30 to 15000 Cycles. Secondary 600 Ohm.
"TAB" Special...$3.49; 2 for $5.98
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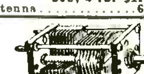
XFMR HMT-SLD UTC Super Electric 3 Wdg. 600 Ohm Ct & 400 Tapped 250 & 150 Ohm. Can be Used Mike to Grid, Line to Line & Line to Grid.
Special 49c........10 for $4.49; 100 for $25.00

UHF ANTENNAS

Microwave Antenna AS125/APR 1000 to 3400 MC W/UG58U Terminal. Inbuilt Hi Pass filter Flange mtg Special...............$5.98
Mobile Whip Ant 6 ft.. Spring Steel, Broad response, with antenna, matching Base..........$2.89
UHF Antenna 12" 30CM AT5/ARRI, usable Citizen & Ham band, insul coax Terminal, Mobil mounting—
39c; 4 for $1.00
PL-259 plug for above antenna...............65c

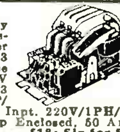
VARIABLE CONDENSER

Dual 75MMF Ea Section 1000V Gap **98¢** EACH
Reg. $3.98



Vernier Drive 10 to 369MMF Each 59c; 2 for 98c
Midget 3 to 15MMF, Midline Each..........29c
Cardwell TK300-US 53 to 312MMF, Can Be Made Split Stator. New................$9.98
2½ Meter Butterfly Condenser 30MMF W/RF Tank & Choke..................59c; 2 for 98c

CONTACTOR



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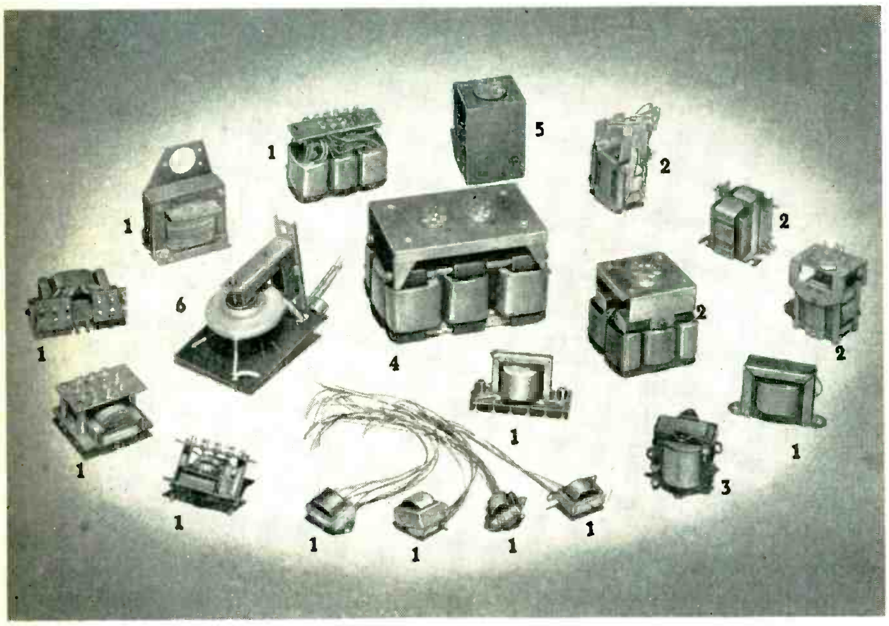

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Audio Oscillator
Equalization Filters

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This unit provides the necessary information on transmission characteristics for the installation of terminal equipment, for the maintenance of terminal equipment, and for the field service of transmission lines and terminal equipment for microwave relay systems.

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