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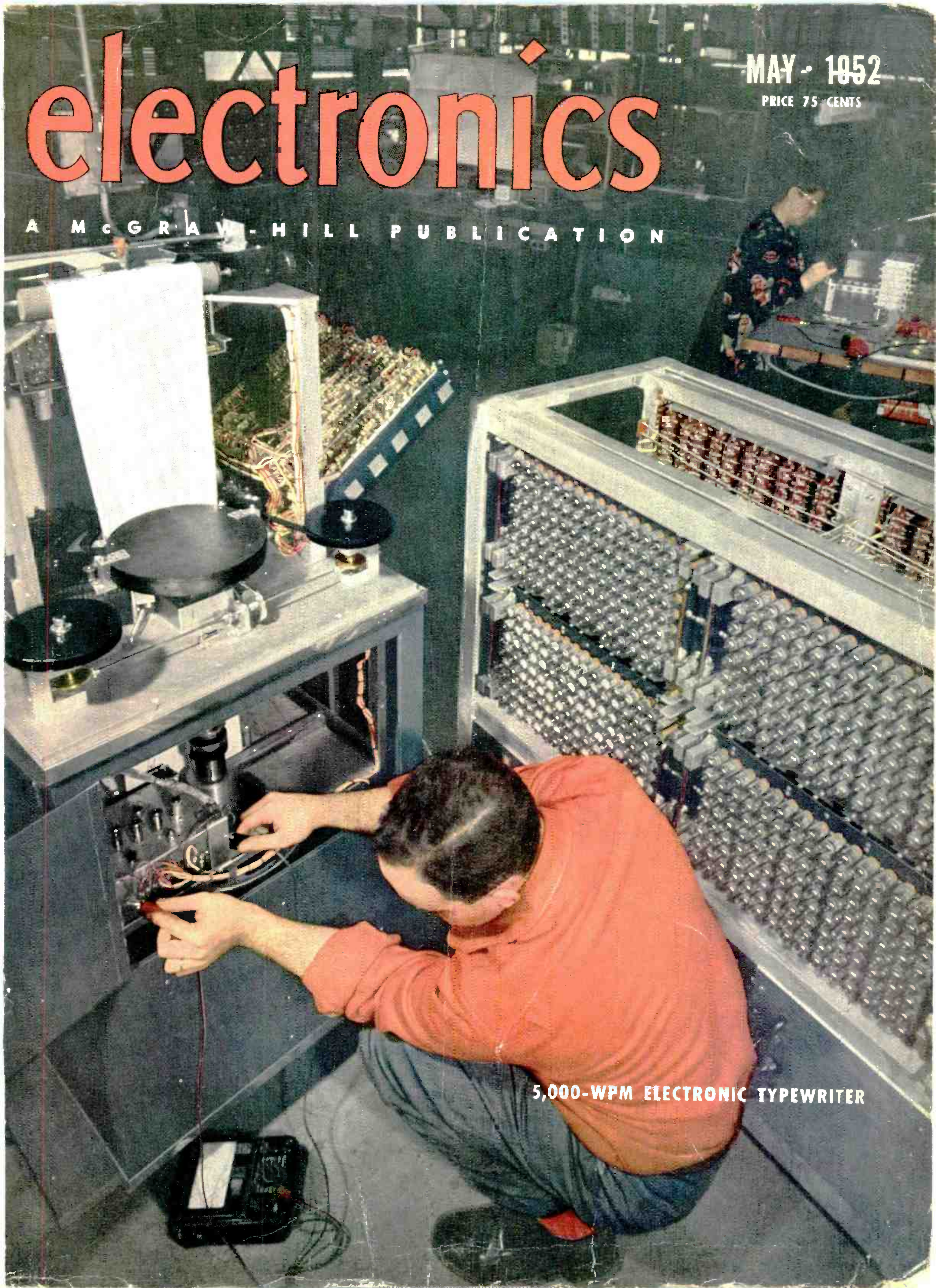

5,000-WPM ELECTRONIC TYPEWRITER

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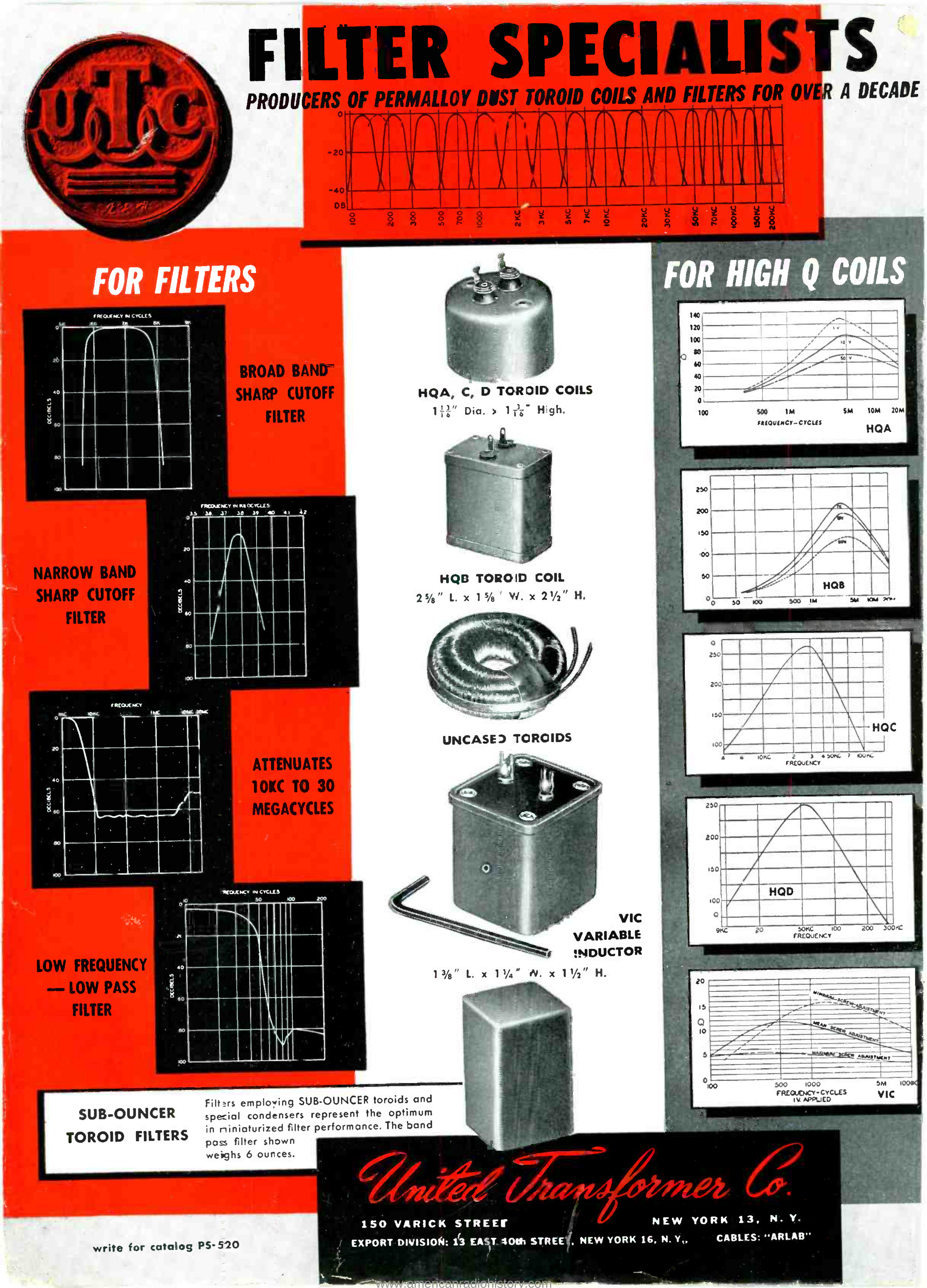
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5,000-WPM ELECTRONIC TYPEWRITER—Development by Potter Instrument Co., Great Neck, New York, provides high-speed link between machine and man by typing out information from electronic storage devices and/or communications circuits (see p 116) ..... COVER

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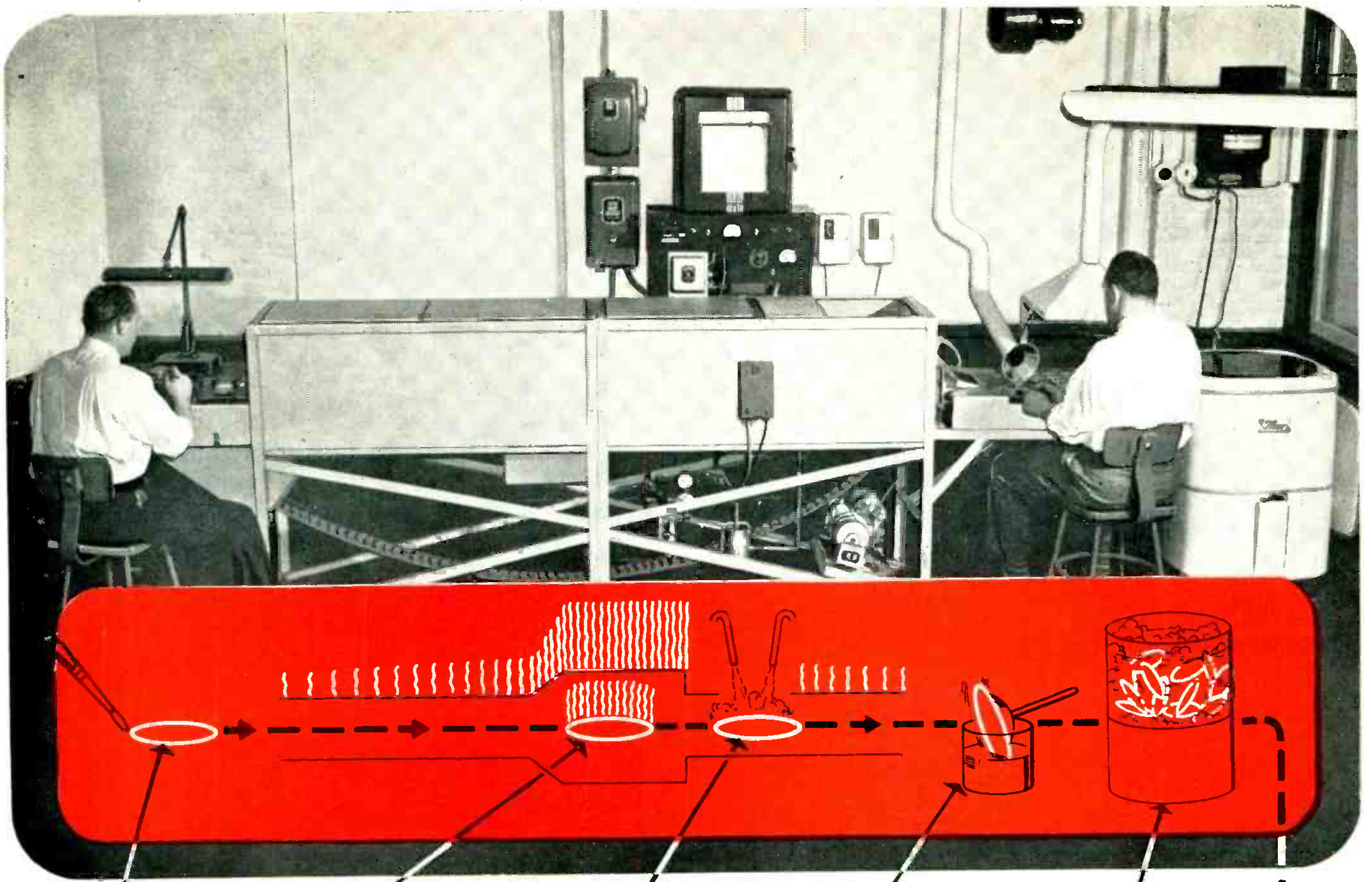

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As the glass windows for Marion Ruggedized Meters slowly revolve on a turntable, their edges are coated with Hanovia Chemical #130A platinum alloy.

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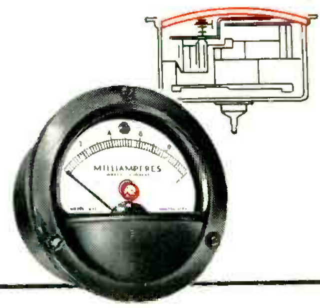

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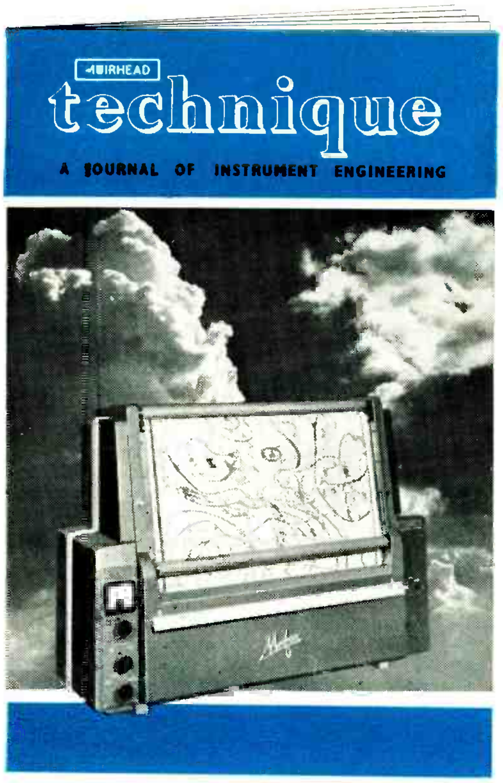

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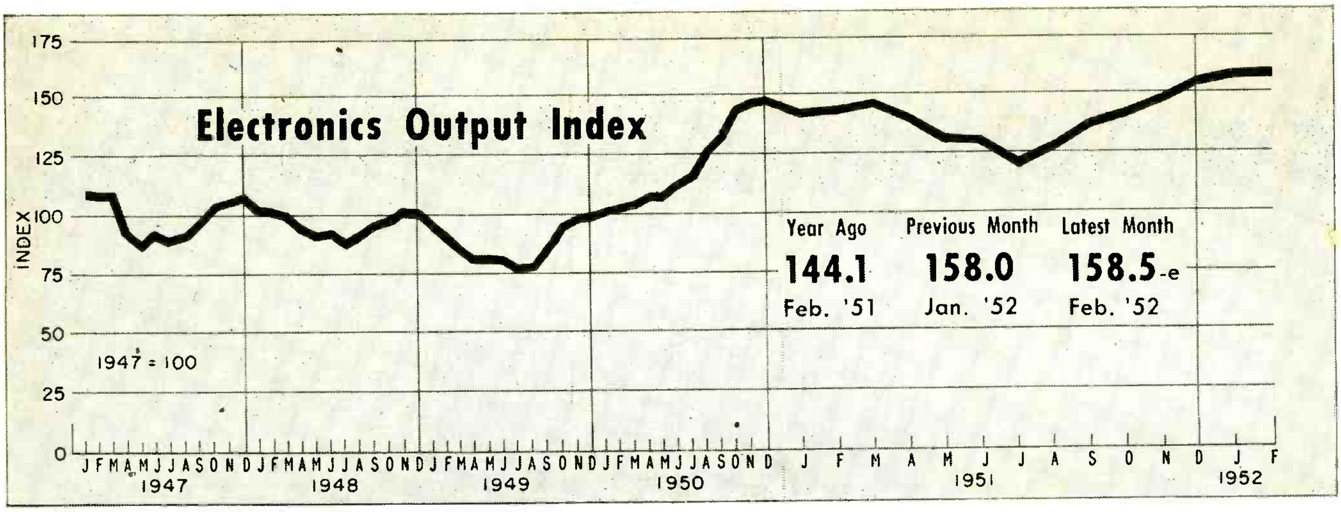

FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RTMA)	Year Ago Feb '51	Previous Month Jan '52	Latest Month Feb '52
Television sets	679,319	404,933	409,337-p
Home Radio sets	764,679	368,875	418,808-p
Portable sets	79,859	68,433	72,866-p
Auto sets	437,779	195,147	267,779-p

RECEIVER SALES

(Source: Licensee figures)	Jan '51	Dec '51	Jan '52
Television sets, units	633,708	384,112	462,252
Electric radio sets, units	602,726	498,140	390,005
Battery sets, units	95,588	92,533	45,578
Auto sets, units	203,538	212,417	165,549
Television sets, value	$126,908,218	$62,450,714	$82,105,399
Electric radio sets, value	$16,879,994	$9,830,047	$8,046,422
Battery sets, value	$1,782,364	$1,711,553	$893,100
Auto sets, value	$5,881,445	$6,191,627	$4,693,660

RECEIVING TUBE SALES

(Source: RTMA)	Feb '51	Jan '52	Feb '52
Receiv. tubes, total units	36,821,794	26,736,695	28,262,407
Receiving tubes, new sets	26,934,347	15,763,221	17,608,162
Rec. tubes, replacement	8,237,372	6,338,157	6,623,798
Receiving tubes gov't	220,292	3,209,025	2,877,177
Receiving tubes, export	1,429,783	1,426,292	1,153,270
Picture tubes, to mfrs.	634,080	340,192	330,431

BROADCAST STATIONS

(Source: FCC)	Mar '51	Feb '52	Mar '52
TV Stations on Air	107	108	108
TV Stns CPs—not on air	2	0	0
TV Stns—Applications	396	506	521
AM Stations on Air	2,239	2,336	2,339
AM Stns CPs—not on air	124	74	74
AM Stns—Applications	265	313	320
FM Stations on Air	656	636	636
FM Stns CPs—not on air	18	14	14
FM Stns—Applications	11	8	6

NETWORK BILLINGS

(Source: Pub. Info. Bureau)	Feb '51	Jan '52	Feb '52
AM/FM—ABC	$2,702,721	$3,307,464	$3,177,970
AM/FM—CBS	$6,097,737	$5,160,182	$4,788,561
AM/FM—MBS	$1,426,705	$1,678,409	$1,600,399
AM/FM—NBC	$4,731,626	$4,331,884	$3,994,018
TV—ABC	$1,254,851	$2,007,314	$2,120,911
TV—CBS	$2,600,339	$5,109,023	$5,103,043
TV—Dumont	$406,079	$717,148	$748,544
TV—NBC	$3,949,360	$7,380,307	$6,813,549

TV AUDIENCE

(Source: NBC Research Dept.)	Year Ago Mar '51	Previous Month Feb '52	Latest Month Mar '52
Sets in Use—total	11,748,400	16,129,300	16,535,100
Sets in Use—netw'k conn.	9,950,200	15,262,600	15,642,200
Sets in Use—New York	2,240,000	2,840,000	2,890,000
Sets in Use—Los Angeles	877,000	1,100,000	1,125,000
Sets in Use—Chicago	890,000	1,093,000	1,110,000

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	Feb '51	Jan '52	Feb '52
Aeronautical	30,722	31,076	31,707
Marine	28,854	34,310	34,660
Police, fire, etc.	8,625	10,292	10,442
Industrial	8,229	11,859	12,237
Land Transportation	3,934	4,700	4,767
Amateur	91,290	103,570	105,016
Citizens Radio	444	792	833
Disaster	0	26	26
Experimental	475	425	359
Common carrier	837	877	895

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	Jan '51	Dec '51	Jan '52
Prod. workers, electronic	267,800	272,100-r	270,700-p
Prod. wkrs., radio, etc.	180,500	170,900-r	169,700-p
Av. wkly. earnings, elect.	$60.11	$65.08-r	$65.99-p
Av. wkly. earnings, radio	$57.55	$60.61-r	$60.90-p
Av. weekly hours, elect.	41.3	42.4	42.6-p
Av. weekly hours, radio	40.8	41.6-r	41.6-p

STOCK PRICE AVERAGES

(Source: Standard and Poor's)	Mar '51	Feb '52	Mar '52
Radio—TV & Electronics	232.0	276.2	295.7
Radio Broadcasters	212.1	268.8	286.9

INDUSTRIAL EQUIPMENT ORDERS

	Quarterly Figures		
(Source: NEMA)	Year Ago 4th '50	Previous Quarter 3rd '51	Latest Quarter 4th '51
Dielectric Heating	$370,000	$210,000	$560,000
Induction Heating	$1,120,000	$3,960,000-r	$3,400,000

INDUSTRIAL TUBE SALES

(Source: NEMA)	4th '50	3rd '51	4th '51
Vacuum (non-receiving)	$4,380,000	$8,420,000	$14,300,000
Gas or vapor	$2,100,000	$2,620,000	$3,170,000
Phototubes	$280,000	$280,000-r	$400,000
Magnetrons and velocity modulation tubes	$2,690,000	$3,740,000-r	$6,670,000

p—provisional; r—revised; e—estimated

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INDUSTRY REPORT

Lifting of Freeze Opens Up New Television Markets

Effect of April 14 FCC order largely psychological this year, but it will start a new boom in 1953

PSYCHOLOGICAL LIFT given the television business by the Federal Communications Commission's April 14 thaw-out of the 3½-year freeze on new station licenses is substantial, despite advance discounting.

First construction permits will not be issued until July 1. Competition for specific channels will delay licenses indefinitely in some cases. Neither transmitters nor receivers will be immediately available in quantity for new ultra-high-frequency channels which constitute a large part of the long-awaited tv 'lebensraum.' So actual business increases may not be startling in 1952 (p. 5, ELECTRONICS, March).

But by mid-1953 a new boom should be rolling. Lifting of the freeze makes television potentially one of the biggest businesses in the United States, and there are few people now who don't know it.

▶ **Station Totals** — Today there are 108 commercial television stations, all operating on very high-frequency channels 2 to 13 (54-216 mc). Up to 509 more will be licensed. Eighty of these can be 'educational' in character, selling no advertising.

Ultra-high-frequency channels 14 to 83 (470-890 mc), until now strictly experimental and largely unused, will also be issued for as many as 1,436 new stations. Of these, 162 can be educational.

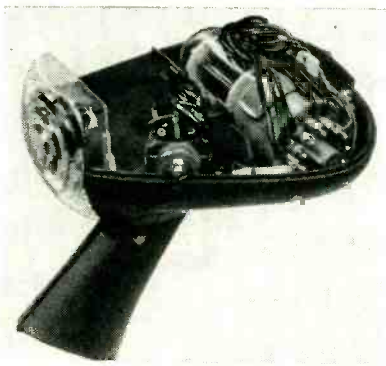
Licenses thus become available to a total of 2,053 stations in 1,291 communities in the U. S., its possessions and territories.

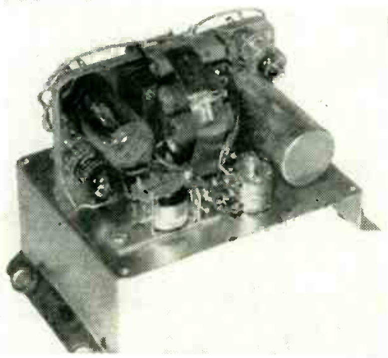
▶ **Licensing Approach**—Between now and July 1 operators of 30 vhf stations ordered to move to other vhf channels to minimize interference must indicate when and how they propose to do so. Some 523 applications for new station licenses which have accumulated in Washington since September 1948 must be resubmitted on new forms. And still more virgin applicants who want licenses must file by the same date.

The Commission expects to receive a total of about 1,250 requests for frequencies by midsummer.

The vhf-station frequency shifts will, it is said, be handled quickly. Priority will then be given applications from big cities having no stations and located 40 miles or more from existing services. Consideration will simultaneously be given cities requesting uhf licenses and less than 40 miles from existing stations, those in which all vhf channels are occupied but uhf channels are available, those with no local station but within 40 miles of one, those with one local station but 40 miles or more away from others and cities having two or more services within 40 miles . . . in this order.

Applicants must specify desired channels, in accordance with a long list prepared by FCC showing those available in American cities. The Commission plans to consider applications channel by channel rather than community by community. Where competition for the same channels in specific areas is keen there will be hearings, which will





Autronic Eye Deflects Car Headlights

Factory-installed extra for 1952 Oldsmobiles and Cadillacs, a multiplier phototube mounted inside the windshield automatically deflects headlights from high to low beam at the approach of another car, puts them back up after it passes. Good streetlighting will also hold lights down. A footswitch permits the device to be overruled. Amplifier and relay are placed under the engine hood. Power is supplied by the car battery. Price is $53.95

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almost certainly result in considerable delay. Petitions for modification of construction permits, once these are issued, will be handled as a separate matter and probably not with the dispatch of new and uncontested applications. Requests for permission to modify existing stations, except as encouraged in the new rules and regulations, will be subject to an even greater delay.

Channel assignments will, we are told, hold for at least a year, with few exceptions.

► **Technical Details**—Minimum effective radiated power for television stations is now fixed at 50 kilowatts for those serving cities having a population of a million or more, 10 kw for those with over 250,000 people, 2 kw over 50,000 and 1 kw under 50,000.

Maximum erp on vhf channels 2 to 6 is 100 kw. On 7 to 13 it is 316 kw. And on uhf channels 14 to 83 it is 1,000 kw.

Minimum geographical spacing for vhf stations operating on the same channel ranges from 170 to 220 miles. Minimum for uhf is 155 to 205 miles. Three zones have been set up on the basis of population density and anticipated transmission phenomena, and this accounts for the latitude.

Engineers who have been critical of 'outmoded' standards of good engineering practice can throw away their books. Just about the only thing that remains unrevised in new FCC printed matter released concurrently with lifting of the freeze pertains to the desirability of enclosed, rack-mounted tv equipment.

TV Space Decides Convention Scene

Four networks pool half million dollars in equipment for Chicago coverage

PARTY leaders selected Chicago's International Amphitheatre, instead of the Chicago Stadium, for both major political conventions, because the 57,000-square-foot amphitheatre provided working space for tv and the Stadium did not. So says CBS-TV's Sig Mickelson, general chairman of the Television Networks Committee.

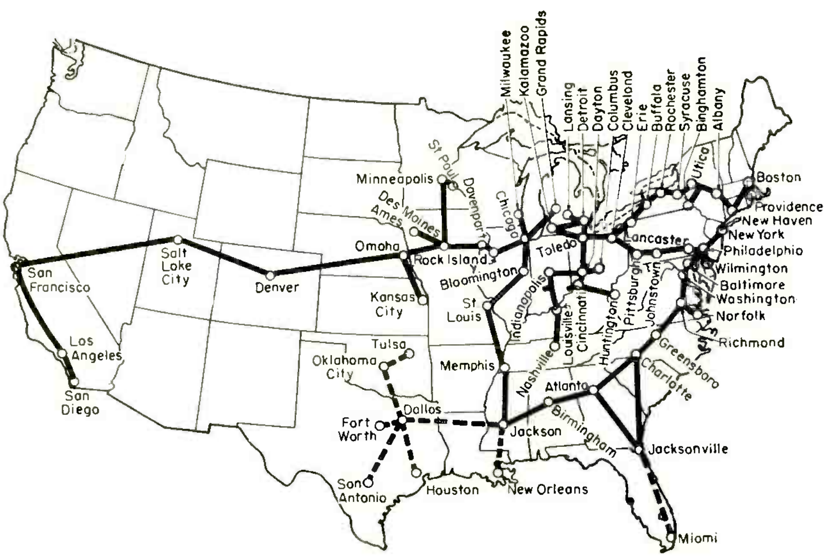
A 'pool' has been worked by CBS, NBC, ABC and DuMont. Each will contribute one quarter of the equipment and personnel needed to televise proceedings from the floor of the convention. Over $150 thousand will be spent on new equipment and construction, and $350 thousand worth of on-hand equipment will also be provided by the networks participating in the pool.

►**Pooled Equipment**—During floor coverage, the tv pool will use eight cameras, six of which will be working constantly. The other two are for emergency use.

The cameras alone will require almost two miles of coaxial cable within the amphitheatre, one-half mile of camera cable and another mile of shielded wire. Operation will require the services of 32 technicians.

Sound will be picked up by 55 microphones. Every delegation, the speakers' platform, a commentator, the orchestra and crowd noise, will have one apiece. At a cost of $250 for both conventions, independent stations can buy four audio lines carrying activities from the speakers' rostrum, the delegations, music or audience reaction.

►**Getting Ready**—Construction of special radio-tv studios and preparation for placing equipment on the convention floor is expected to be completed by June 14th. The networks hope to have approximately three weeks for ironing out kinks before the first convention starts.



Sixty percent of U. S. population will be within range of television stations on transcontinental television network. Solid lines show present hookup and dashed lines include eight cities to be added by the time Republicans convene July 7

After The Freeze—Steel, Please

NPA tells broadcasters how to self-allocate material

J. BERNARD JOSEPH, Chief of the Broadcast and Communications Equipment Section, Electronic Division of the National Production Authority, told engineers meeting at the NARTB convention in Chicago how to keep their stations going as well as plan for new construction.

Maintenance, repair and operat-

(Continued on page 8)

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THE LAST WORD IN CRYSTAL CIRCUITS

40 new, helpful applications for Sylvania Crystal Diodes . . . never before published

Don't miss this book! It contains the very latest tested circuits using crystal diodes.

Here are short cuts and tested circuits of value to radio amateurs, engineers, as well as radio and TV service men.

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Partial List of Contents includes How to Make:

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A Voice (Modulation) Controlled Relay.

A High-Resistance Crystal Voltmeter.

A TV Antenna Orientation Meter.

A Tuned Crystal-Type Signal Tracer.

A Square-law D.C. Voltmeter

An FM Dynamic Limiter.

An Amplitude Modulator.

An Audio-Frequency Microvolter.

A Spike Generator.

A Voltage-Selective Circuit.

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ing supplies (MRO), as well as minor capital additions and installation materials can be sought without a priority, but once a priority rating is applied under Controlled Materials Plan Regulation 5 (CMP 5) a station must continue under its provisions. The MRO materials are limited to a quota of $1,000 for each category in any one calendar quarter.

▶**Big Stuff**—Prospective broadcasters have some hope of self-allocating enough steel, copper and aluminum under CMP 6 to take care of modest needs. They can obtain per calendar quarter 25 tons of steel, 2,000 pounds of copper and 1,000 pounds of aluminum. If they can't make do with these amounts, the alternative is application to NPA for specific permission, which may take a long, long time.

Joseph admitted that such application might have to be made for sufficient copper. He pointed out, furthermore, that a tower using 100 tons of steel would have to be built so as to use the allotment of 25 tons during each of four quarters. If stored more than 45 days it comes under a stockpiling regulation.

Applicant must have a valid FCC construction permit before he can start using any allotment. Foreign steel is not subject to NPA regulations, but may be scarce and costly.

Transistor Output Gains Momentum

New companies entering field will eventually ease shortage

ONE COMPANY is now selling and delivering transistors in small quantities for general experimental and developmental work. These are the point-contact type, priced near $10. Large-scale operations are hoped for by the end of 1952.

Junction transistors are not yet commercially available from any manufacturer.

▶**General Outlook**—A less optimistic delivery situation exists in the field in general. Even though many companies heretofore not engaged in transistor production are obtaining licenses from Western Electric to begin operations, their effect on the overall picture will not be felt for some time.

One important reason for the delay is that it takes time even to initiate production of such a totally new device. Because of the physical nature of the transistor, many additional difficulties arise when substantial volume is sought.

▶**Government's Role**—Another factor affecting availability is that the government has a big say about where transistor output goes. At present the military is taking a sizeable percentage of transistor output, probably well over half.

Experimental radio transmitter built at General Electric. It uses germanium transistor (right) and has broadcasting range of several hundred feet

Answers to the military's requirements for transistors may be forthcoming at the Symposium on Progress in Quality Electronic Components to be held in Washington May 5th through 7th. Lt. Colonel William F. Starr of the Department of Defense will speak on the subject, "Availability of Transistors".

DeForest Files Transistor Patent

LEE DEFOREST, a tube man if there ever was one, has just applied for a patent covering one aspect of transistor design.

Dr. DeForest disclosed his active interest in solid-state electronics at a testimonial dinner commemorating his 50th year in radio and invention of the three-element electron tube.

House Passes Big '53 Military Electronics Bill

$900-million identifiably in our field, rest spread through Defense Department budget

THE 1953 military appropriations bill passed by the House but not yet acted upon by the Senate contains nearly $900 million in specific electronic procurement, while unspecified amounts of electronic money are lumped in Navy aircraft and ship construction and Army research.

Electronic procurement specified in budgets for the three Services is as follows:

▶**Air Force**: $400 million, divided into eight projects—

UHF Communications System: $39.8 million.

Identification Systems: $19.3 million.

Command Communications Systems: $14.5 million.

Navigational Aid Systems: $83 million.

Tactical Electronics Systems: $164.4 million.

Communications Security System: $6.6 million.

Communication Replacement Program: $24 million.

Communications Facility Program: $48.4 million.

Already in Air Force research funds is $68.6 million for electronics development.

▶**Army** plans to procure radios, radar and similar equipment used

(Continued on page 10)

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• WITHSTANDS 250°C

• HAS HIGH SPACE FACTOR

• EXCELLENT ELECTRICAL PROPERTIES

CEROC® ST

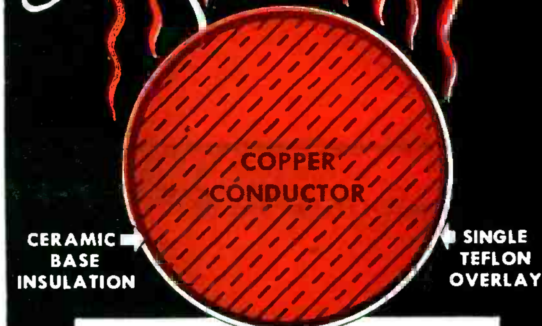
A NEW MAGNET WIRE

If smaller, lighter electrical components are needed in the military electronic gear or aircraft controls you are concerned with, investigate the use of CEROC ST, the newest Sprague magnet wire.

Application of a single Teflon overlay to the base ceramic insulation results in a magnet wire which has many of the best properties of both Sprague's CEROC 200 silicone-coated ceramic-insulated wire and CEROC T double-Teflon ceramic-insulated wire.

Complete details of this important new development are given in Engineering Bulletin 404, available on letterhead request.

For latest information on CEROC 200 and CEROC T, write for Bulletins 401-B, 402-H, and 403-C.



QUICK DELIVERY

Immediate deliveries from stock on small sample quantities of all CEROC wires as well as short delivery cycles on production runs are now in effect.

There is plenty of room for your orders on the production schedules of our North Adams, Mass. and Bennington, Vt. plants with their newly-expanded facilities.

SPRAGUE

SPRAGUE ELECTRIC COMPANY

35 Marshall Street, North Adams, Massachusetts

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to control vehicles and troops in forward areas, control gunfire and provide communications in the field to the tune of $225.9 million.

Army also wants $450 million for research and development, which includes guided missiles.

►Navy budget divides like this—

Buships: $143 million.

Marine Corps: $32.8 million.

Also, electronic money involved but unspecified in Navy aircraft and ship construction funds is $5.4 million.

Rigidizing Cuts Chassis Weight

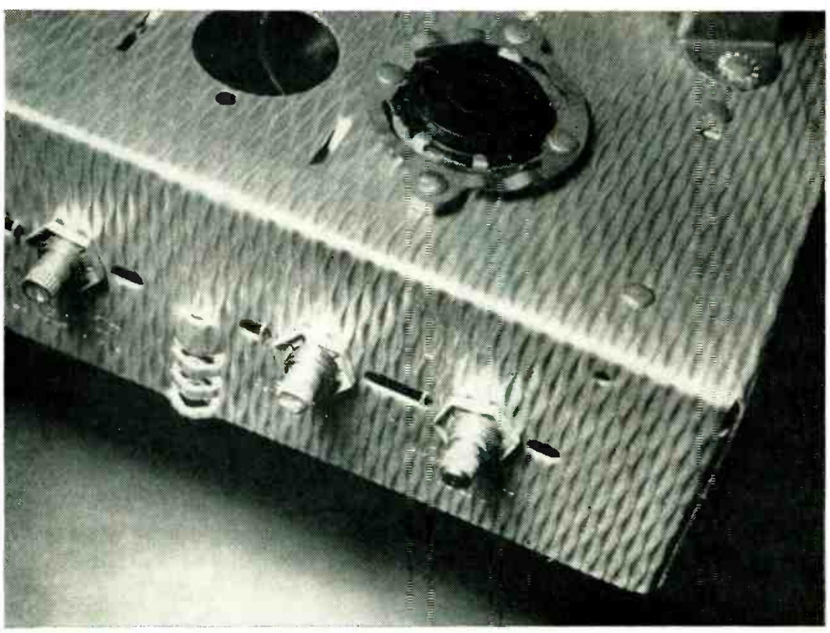
Technique is ideal for airborne electronic equipment. Stretches allocations of scarce sheet metal

WHEN sheet steel is put through a rolling process called rigidizing, thickness can be two gages less for the same strength, reducing weight 25 percent. Because of this weight saving, rigidized metal is already being used extensively in airborne electronic equipment.

Rigidizing involves dimpling or embossing metal in any of over a dozen different patterns to increase the cross-section thickness. By choosing the optimum pattern for each size of chassis or housing, even greater savings in weight can be achieved. One pattern permitted reducing the thickness of an autopilot control amplifier housing 50 percent.

►**Costs Slightly More** — Cost of rigidized steel is slightly higher than equivalent-strength plain steel, hence the chief electronic application is where minimum weight is essential. For commercial products such as radio and television receivers, however, the technique offers a simple means of stretching steel allocations. With sheet aluminum, brass and stainless steel, there is an appreciable saving in cost as well as weight.

Rigidized metal can be bent, drilled, punched, welded and riveted conventionally when allowances are made for the increased cross-section thickness. The textured pattern gives added eye-appeal to products, and the increased surface area improves heat-radiating ability. The process is a development of Rigidized Metals Corp., Buffalo, N. Y.



Example of television-receiver chassis made from rigidized steel, showing feasibility of conventional punching, forming, stamping and riveting operations

No Real Relief Of Controls In Sight

PRODUCTION controls most directly affecting the electronics industry do not appear to be lifting on such problem materials as copper, nickel, cobalt, tungsten and selenium due to present tight supply and little or no prospect of improvement in the near future.

This, say Washington control officials, is one of the big problems in the control situation. The other is that industry is competing with itself for these materials, with heavy military buying crowding out production of civilian items.

►**Only Partial**—The electronics industry, at the start of 1952, had over $5 billion in military orders (with perhaps another $2 billion being held back by the Services) on the books but has made delivery on less than 20 percent to date. So partial removal of tight materials controls, now set for January 1953, won't mean too much beyond an always-welcome diminution of paperwork.

Copper will stay under tight allotment for probably a year or more. Nickel-bearing stainless steel, vital to electronics production, will be in the same boat. There is no big increase in supply of these two materials in sight.

The future of the tungsten supply remains uncertain. As yet, no one has come up with a substitute in tube filaments.

Continuous-Motion Film Dazzles TV Men

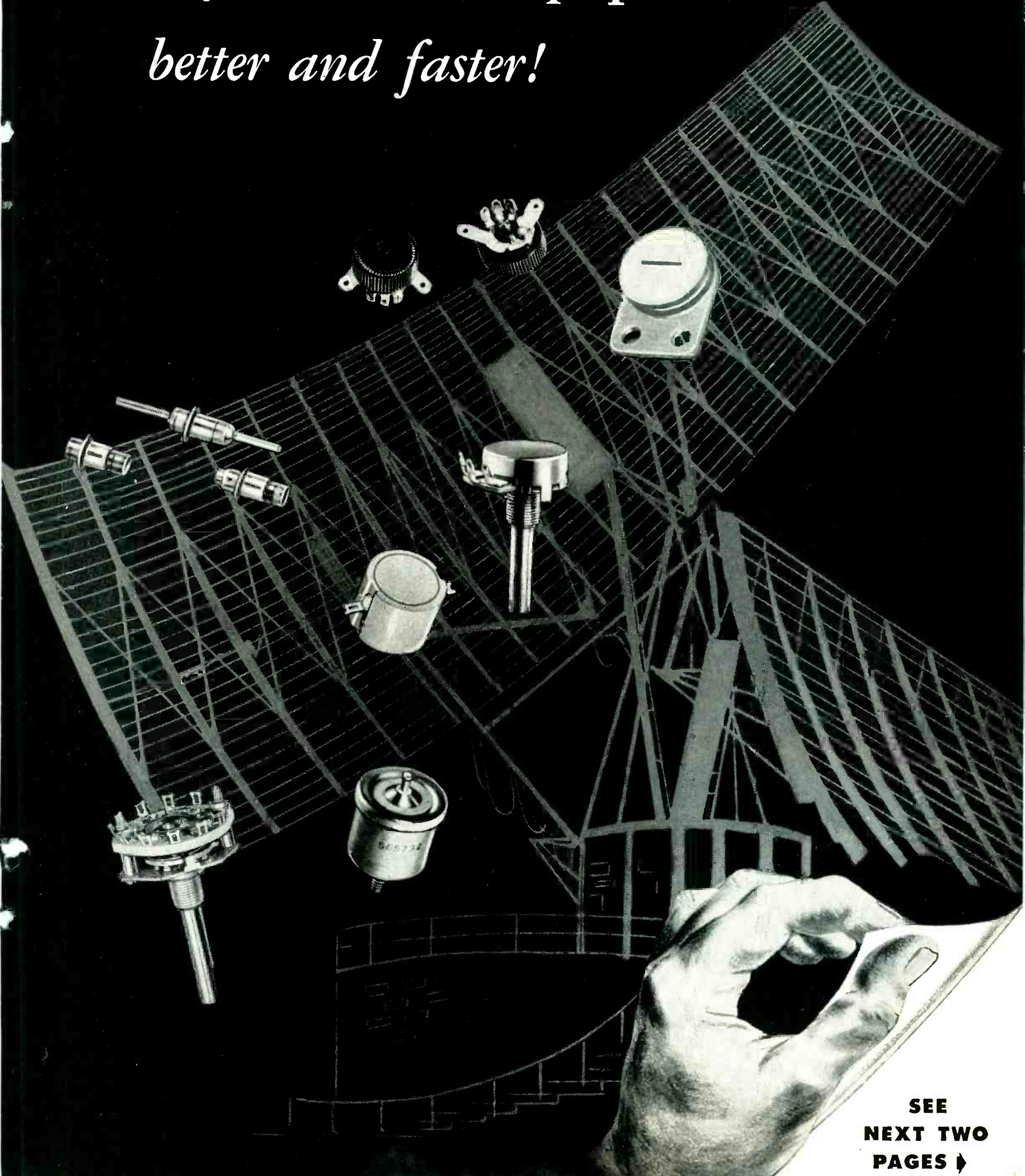
WITH film shows becoming even more important to the television broadcaster than recorded tapes and platters to his a-m counterpart, there has long been a lively interest in projectors.

Extremely tantalizing, therefore, was the recent demonstration of a new DuMont continuous-film flying-spot system at the NARTB

(Continued on page 14)

how to handle orders for military electronic equipment...

better and faster!



SEE NEXT TWO PAGES ▸

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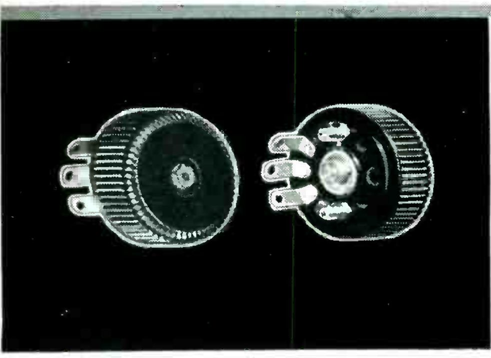
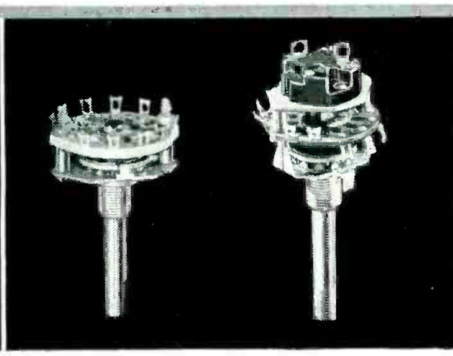
Choose CENTRALAB...

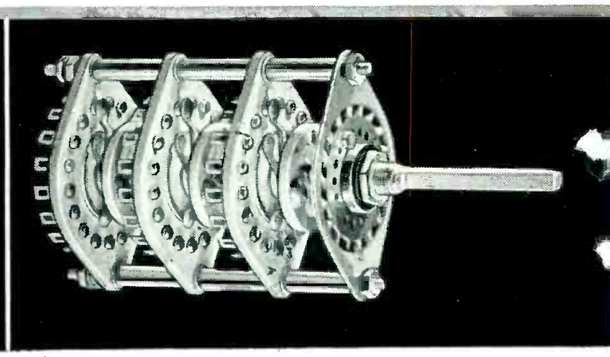
America's widest line of components that meet military specifications

CENTRALAB MODEL 2 VARIABLE RESISTORS

There's no prior contract approval or waivers required if you specify Centralab's Model 2 variable resistors on your next military order. They meet JAN R94, characteristic U requirements. Two types available — RV2A and RV2B — plain or with attached switches. Ratings from 2000 ohms to one megohm. For complete engineering data, check Bulletin No. 42-85 in coupon below.







Model 1, miniature variable resistors ... no bigger than a dime ... available in Standard or Hi-torque types. Either with or without on-off switch. Also available with slot — front or rear — for screw-driver adjustment. Hi-torque units hold settings under conditions of vibration or shock. For complete data check No. 42-158 in coupon below.

For miniature switches — specify Centralab's Series 20 with Steatite or Phenolic sections. Steatite is Grade L5. Meets JAN I-8 specs. Phenolic sections conform to JAN P-13 ... Grade LTSE4. Available in 2 to 11 positions with stops, or 12 positions, continuous rotation—single or multiple sections—with or without attached on-off switch. Check No. 42-156.

Centralab's Medium-Duty Power Switches. Use for R. F. or 110-115 V. application ... 7½ amps. Voltage breakdown to ground — 3000 volts — RMS 60 cycles. Available with Grade L5 (JAN I-8) Steatite sections — shorting or non-shorting contacts. Models in 1, 2 or 3 poles, 18 contacts per section with adjustable stops, can be furnished up to 20 sections per shaft. Contacts and collector rings are coin silver. For complete data, check No. 42-136 in coupon.

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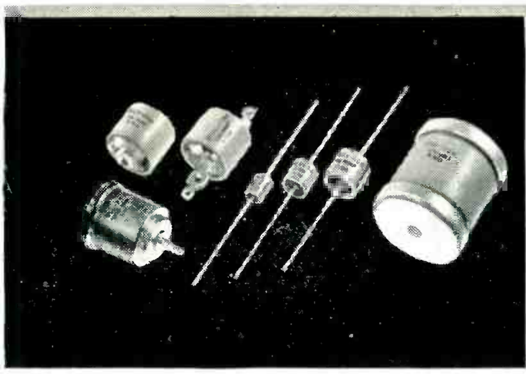
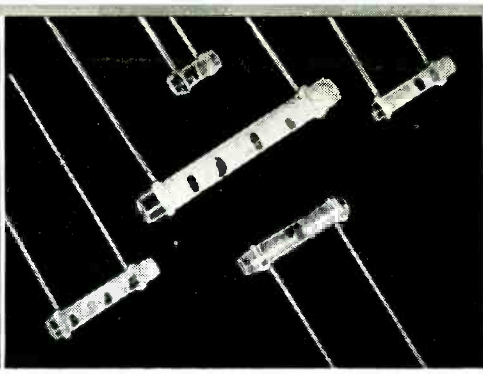
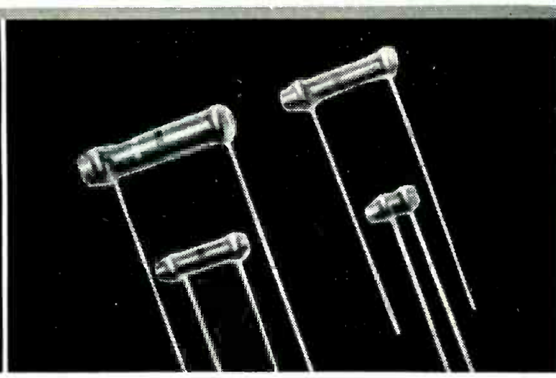


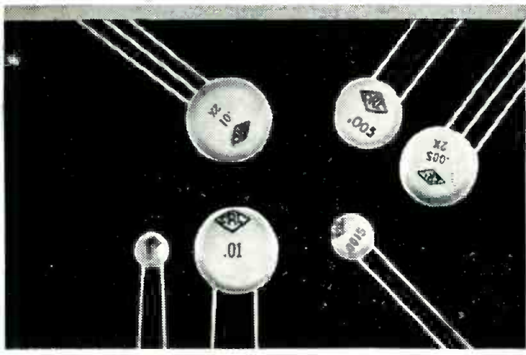
Centralab's Type 850 high voltage ceramic capacitors are especially designed for high voltage, high frequency circuits. Centralab's Type 950 high accuracy ceramic capacitors are especially developed for exacting electronic applications. Check bulletin No.'s 42-102 and 42-123.



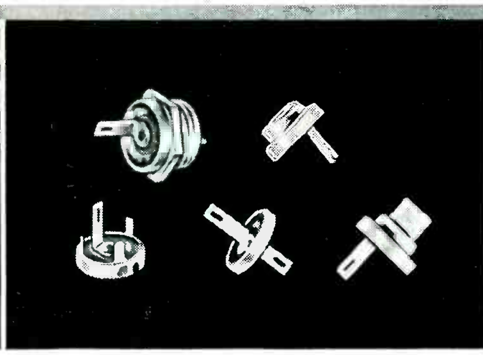
TC (Temperature Compensating) Tubulars — No prior contract approval or waiver necessary. Meet JAN-C-20A requirements. Type TCZ shows no capacitance change over wide range of temperature. Type TCN has special ceramic body to vary capacitance according to temperature. Bulletin No. 42-18.



BC (Bypass Coupling) Tubulars — Recommended for bypass coupling. Well suited to general circuit use. Centralab's own Ceramic X body provides imperviousness to moisture and low power factor. Easily withstands temperatures normally encountered in most electronic equipment. Bulletin No. 42-3.

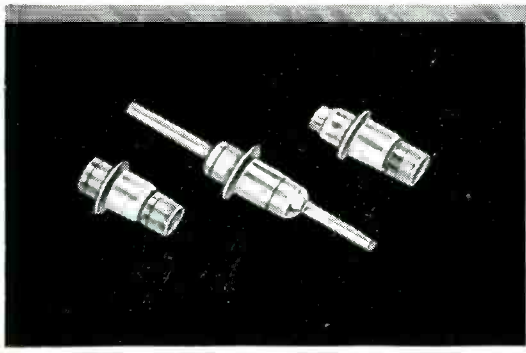


Ceramic Disc Hi-Kap Capacitors hold thickness to a minimum . . . have very high capacity in extremely small size. Use in h.f. circuits for bypass and coupling. Ceramic body assures low inductance. Other characteristics— humidity resistance, power factor, etc — similar to BC Tubulars, Bulletin No. 42-4R.

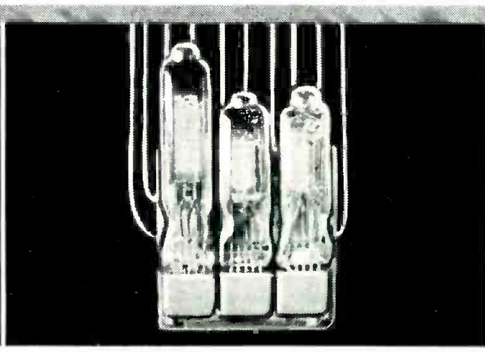


Something new in miniature ceramic capacitors! These "button types" are available in 5 different styles. Used for bypassing in low-power, high-frequency applications where small size, low inductance and light weight are essential. Check Bulletin No. 42-122 in coupon for more information.

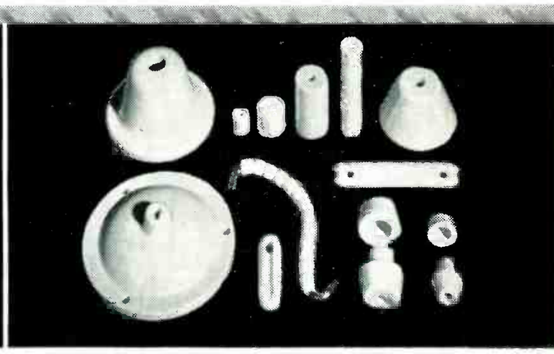
Centralab Ceramic Trimmers meet applicable portions of JAN-C-81. Very small size. Screw driver adjustment over full capacity range (180° rotation). Maintain stability in any position and under vibration. Spring pressure contact for rotor and stator. Bulletin No. 42-101.



Centralab's New Eyelet-Mounted Feed-Through Ceramic Capacitors are smallest available. They meet applicable portions of JAN-C-20A specifications. Capacities range from 10 to 3000 mmf...the widest range on the market. Voltage rating. 500 V.D.C.W. Check No. EP-15 in coupon.



New Sub-miniature Model III Ampec — a full three-stage speech amplifier of remarkably small dimensions — approximately 1$\frac{1}{32}$" x $\frac{15}{16}$" x $\frac{11}{32}$" (barely larger than a postage stamp!). Excellent for microphone preamplifiers and similar applications. Check No. 42-130 on coupon for complete information.



Centralab standard and custom-molded Steatite ceramics plain or metallized . . . fully comply with JAN I-8. Steatite is Grade L5 for military use. Characteristics — high dielectric strength, low loss at high frequencies, high mechanical strength. For data on standard parts or custom molding, check No. 720.

Centralab

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☐ 42-3 ☐ 42-4R ☐ 42-122 ☐ 42-101 ☐ EP-15 ☐ 42-130 ☐ 720

Name..........

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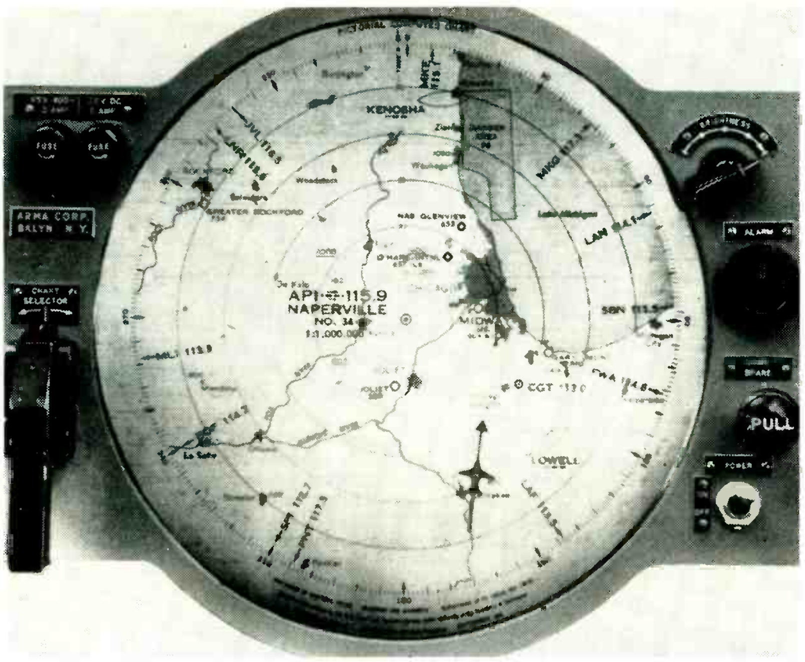
Convention sessions in Chicago.

►**What It Will Do**—There is no intermittent movement to jerk, wear or tear film. The mechanism can be run at variable speed within the limits imposed by the associated sound track. It can be stopped for single-frame operation and requires no phasing to the sync generator or to the power line.

The flying-spot scanner requires no critical ancillary circuits for shading and no back or rim lights are needed. The operator just sets it going and leaves it. Provision is made for color. As a further dividend, the device can be used in reverse to record pictures on raw film stock.



Pictorial computer gives continuous indication of plane's position and heading on charts projected on ten-inch screen on instrument panel

New Instrument Shows Airplane's Position on Map

SIMPLIFYING air navigation has long been the goal of a large segment of the electronics industry. Significant progress is indicated by the announcement of a pictorial computer that shows, on a rear-screen projected map on the pilot's instrument panel, the exact location and heading of his plane.

Charts are projected from a microfilm reel containing up to 700 charts. Each chart is coded to tune the instrument's omni-bearing and distance-measuring equipment to the radio station associated with that particular chart. The pilot simply maneuvers his plane so that the airplane-shaped shadow on his map moves in the desired direction. When the shadow covers the desired spot the plane is over its destination.

►**Commercial Item** — Announcement of the somewhat radical instrument indicates that at least one company hitherto involved primarily in military work is now eyeing the commercial field for opportunities. The Arma Corporation, which has done over $1 billion worth of business with Uncle Sam as its sole customer, has, with the pictorial computer, taken the plunge. It is also interesting to note that this came about at a time when the company has a $70-million backlog in military contracts.

NARTB Shows Cheerful Face In Chicago

Meeting dishes up constructive ideas for both management and engineering

MORE than 1,600 broadcasters, 25 percent of them engineers, listened to speeches and participated in discussions staged by the National Association of Radio and Television Broadcasters from March 30 through April 2 at Chicago's Conrad Hilton.

Management hassled over 'Give David Back His Slingshot' (f-m), 'Merchandising—The Way to More Business' and 'Should Radio and Television Broadcasting of Congressional Hearings and Judicial Proceedings Be Permitted?'

►**High Spots of Exhibits**—The Exposition Hall had enough a-m and tv equipment and talent to put several shows on the air, including recording services, emergency power plants, antennas, microwave relays and lighting equipment. Smaller gear was displayed in suites on the 5th floor.

Selling, business politics and plain good fellowship pervaded several hundred other rooms and adjoining hotels. There was a background rustle of ultrapolite claims and counterclaims, delivery dates and dexterous hedging. Cockiest were probably the DuMont boys who, with their $25,000 Eimac klystron, think they have the answer to real power at uhf. They were also happy about the excitement their prototype flying-spot tv film scanner stirred up.

►**High Spots for Management**—The joint NARTB-RTMA promotion plan is pushing a broadcaster-manufacturer - distributor - dealer - advertiser liaison for f-m.

Chairman Paul Walker of FCC assured a Grand Ballroom packed with attentive listeners that the tv freeze would be lifted in two weeks. (See p 5). He praised broadcasters for their efforts (through political-

(Continued on page 16)

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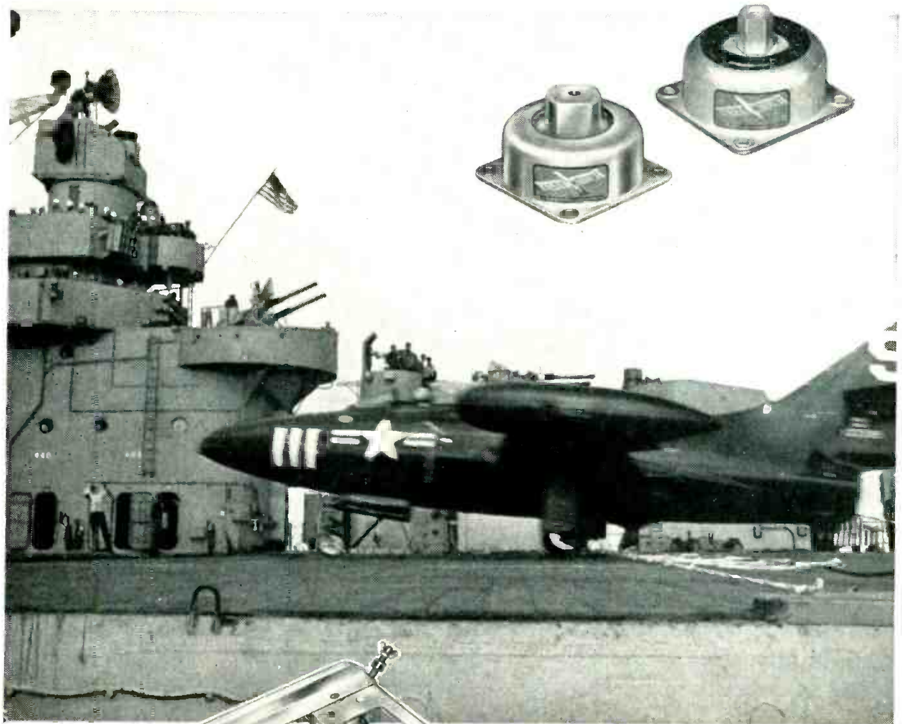
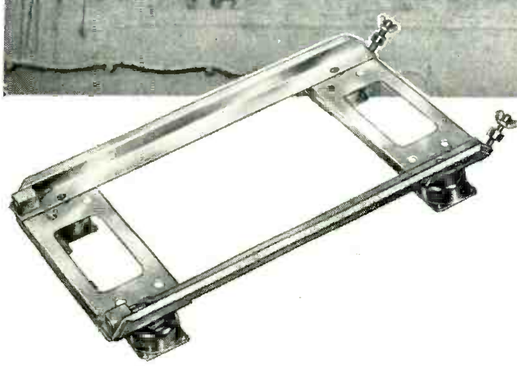
can YOUR EQUIPMENT stand the SHOCK of carrier landings?

—BARRYMOUNTS CAN!



Official United States Navy Photograph



New military specifications for all services require ruggedization of your equipments with their mountings.

Ruggedized Air-damped and All-Metl Barrymounts and mounting bases are now available to meet the shock test requirements of specifications MIL-T-5422 (Aer), MIL-E-5272 (USAF), and AN-E-19. These mountings hold your equipment securely and maintain uniform performance characteristics even after the repeated shock of many aircraft carrier landings.

For full information about Barrymounts and bases, write today for your free copy of each of these Barry catalogs:

Catalog #524—Ruggedized Barrymounts and ruggedized mounting bases.

Catalog #523—Air-damped Barrymounts and mounting bases.

Catalog #509—All-Metl Barrymounts and mounting bases.

THE BARRY CORP.

707 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS

SALES REPRESENTATIVES IN

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convention tv coverage) to get out the vote and for their voluntary cooperation in supporting CONELRAD (by the million dollars spent towards minimizing navigational aid from transmitters during possible air attacks). He affirmed the importance of 'bird-in-the-hand radio' and urged 'more aggressive, daring and realistic employment of f-m'.

▶**High Spots for Engineers**—The 400-odd registrants for the engineering conference exchanged scuttlebutt and took a particularly lively interest in three papers.

Bill Doherty of Bell Labs gave a tantalizing glimpse of new circular-waveguide and laminated-coaxial-cable techniques that permit wide-band transmission at higher frequencies than are now possible. He showed how a form of pulse-code modulation might permit better detail at reasonable bandwidth in picture transmission by leaving out all elements of the picture that showed no change from one frame to the next.

Ralph Harmon of Westinghouse, and former member of the government-industry Ad Hoc committee on propagation, tossed a small bombshell by stating that the Commission's proposed 155-mile spacing of uhf station channels was just an invitation to cochannel interference. He recommended 200-mile spacing.

Doc Brown of RCA summed up the problems of high-gain antennas that may have to be tilted (he did it mechanically) to cover the cash customers near the transmitter. Best quote of the conference came from a chance perusal of his hotel-room Gideon Bible: *Luke* 14:28, 'For which of you intending to build a tower sitteth not down first and counteth the cost whether he have sufficient to finish it?'

Engineer Shifts Worry Washington and Industry

Wage-stabilizers consider ways and means of inducing electronics technicians to stay put

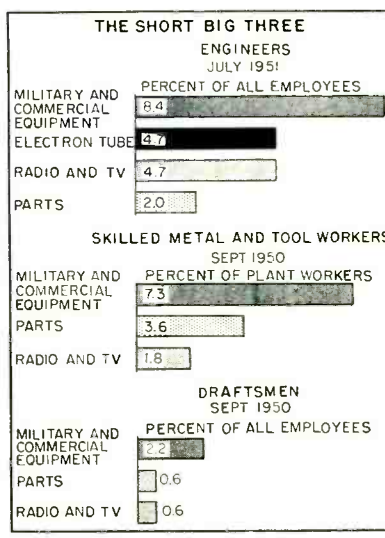
GETTING NO BETTER FAST, the technically-trained-manpower situation in the field of electronics is causing Washington wage-stabilizers to seriously consider ways and means of discouraging men from moving for money alone.

Were it not for the extreme difficulty of classifying electronics engineers . . . perhaps the impossibility of doing so . . . more rigid regulations might already be in effect to induce them to stay put.

▶**Why the Shortage?**—Production of military electronic equipment requires abnormal research, development and design activity. Not only is such equipment more complex than home radio and tv receivers, but it is manufactured in short production runs and there are frequent changes in specifications. Many components must be specially designed. Exacting specifications require extensive quality control. All this creates a pressing need for engineers, electronics technicians, tool-makers and draftsmen.

In September 1950, there was one engineer for every 11 plant workers employed in the manufacture of military and industrial electronic equipment, while the ratio was one to 56 in the home-receiver field and one to 67 in parts manufacturing.

Earnings in the electronics industry, traditionally below those in many other industries, have brought about a turnover rate generally higher than that for industry as a whole.

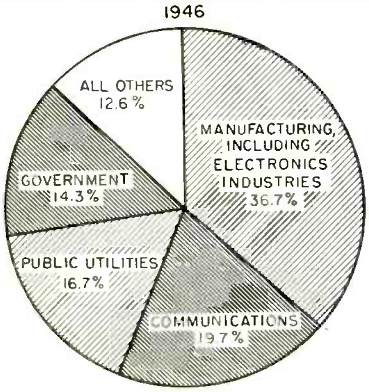


In December 1951, average hourly earnings in the electronics industry were $1.46 against a general industry average of $1.63. In the same month, labor turnover figures showed 2.9 accessions per 100 workers to 4.0 separations in the electronics industry; for all other industry, average figures were 2.9 and 3.3. Thus the industry is faced with a severe recruiting and training burden.

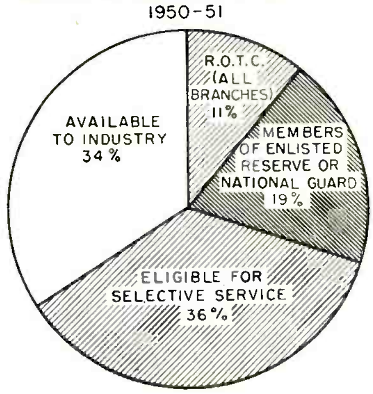
Pirating of engineers, often for hoarding, imposes a further burden and also disrupts important engi-

(Continued on page 18)

DISTRIBUTION OF ELECTRICAL ENGINEERS, 1946



STATUS OF ENGINEERING GRADUATES, 1950-51



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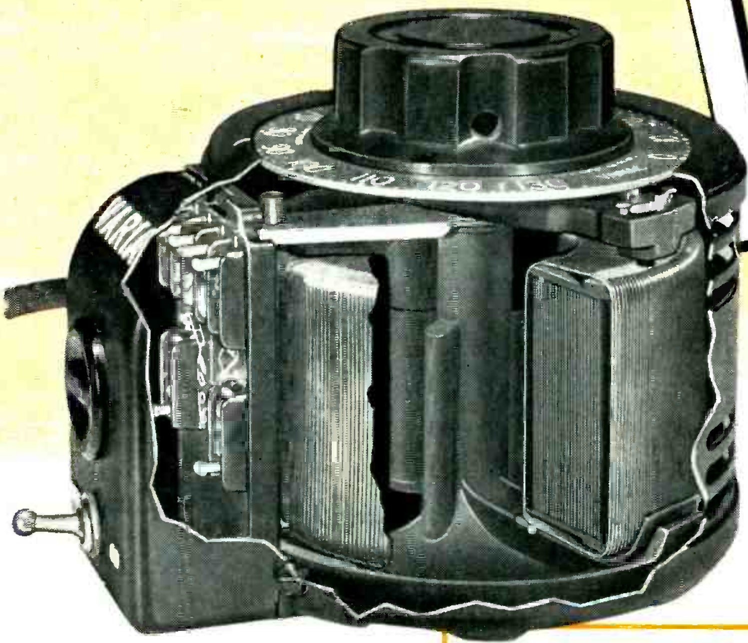
for Smooth Voltage Control Variac®



— the original continuously-adjustable auto-transformer — is the ideal device for controlling any a-c operated equipment.

VARIACS not only supply perfectly smooth control of voltage from zero, but also furnish output voltages 17% above line voltage. VARIACS are correctly designed for many years of trouble-free operation.

Illustrated below are the more popular units in the complete VARIAC line. Other models are available. VARIACS can be used singly, or in gangs for higher power and for polyphase operation.

Variac The trade name Variac is registered at the U. S. Patent Office. Variacs are patented under U.S. Patent No. 2,009,013 and are manufactured and sold only by General Radio Company or its authorized agents.

Input Voltage	OUTPUT — SINGLE PHASE DATA KVA	Output Voltage	Rated Amperes	Maximum Amperes	Type of* Mounting	Type	Price
115	0.17	0–115 0–135	1	1.5 1.0	I	200-B	$12.50
115	0.86	0–115 0–135	5	7.5 5.0	I II III	V-5 V-5M V-5MT	18.50 20.50 25.00
230	0.60	0–230 0–270	2	2.6 2.0	I II III	V-5H V-5HM V-5HMT	21.00 23.00 27.50
115	1.5	0–115 0–135	10	13.0 10.0	I II III	V-10 V-10M V-10MT	33.00 35.50 40.00
230	1.2	0–230 0–270	4	5.2 4.0	I II III	V-10H V-10HM V-10HMT	34.00 36.50 41.00
115	3.	0–115 0–135	20	26.0 20.0	IV	V-20M	55.00
230	2.4	0–230 0–270	8	10.4 8.0	IV	V-20HM	55.00
115	5. 10.	0–115 0–115	40 80	45.0 90.0	IV V	50-A 50-AG2	140.00 310.00
230	7. 14.	0–230 0–230	20 40	31.0 62.0	IV V	50-B 50-BG2	140.00 310.00

Type 200-B

Type V-5

Type V-10

Type V-20

Type 50

* I Unmounted model.
II Protective Case around windings.
III Protective Case, terminal cover, line switch, convenience outlet and line cord.
IV Protective Case, terminal cover and BX outlet.
V Two gang assembly — requires type 50-P1 choke — $12.00.

GENERAL RADIO Company
275 Massachusetts Avenue, Cambridge 39, Mass.
920 S. Michigan Ave. CHICAGO 5 · 1000 N. Seward St. LOS ANGELES 38
90 West Street NEW YORK 6

For Complete Information Fill-In Coupon

GENERAL RADIO COMPANY, 275 Mass. Ave., Cambridge 39, Mass.

Please send me the VARIAC BULLETIN 514-A

Name ....

Address ....
(Street) *(City & Zone)* *(State)*

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neering projects in progress.

▶**Sources of Engineers**—In view of military production requirements superimposed upon the steadily increasing commercial demand for engineering talent, the supply of new engineers is not encouraging.

Colleges will graduate an estimated 7,000 electrical engineers during 1951-52. This represents a decline from 9,500 in 1950-51 and from 13,260 in 1949-50. The electronics industry will have to bid against several related industries for these men.

Pentagon sources say that the mechanized army of World War II has now become an electronic army. The Navy and Air Force are known to rely even more on electronics equipment.

Figures for 1951 give some clue to the bite the military will put on available electronic engineering manpower in 1952. Projecting the figures, it is estimated that 15 percent of this year's graduates may enter service via ROTC, while the number of graduates faced with obligated reserve duty may not exceed 10 percent.

On the other hand, reserve electronics officers due to be released from active duty in fiscal 1953 may provide a valuable source of trained engineers.

Physics majors may offer a source of electronic engineering talent. Colleges are expected to grant 2,500 bachelors' degrees in physics this year. However, here too the supply of graduates is diminishing: 2,788 in 1950-51; 3,414 in 1949-50.

▶**Relieving the Shortage**—According to the Bureau of Labor Statistics, a hard-pressed manufacturer can:

• Accelerate plant training programs for student and junior engineers.

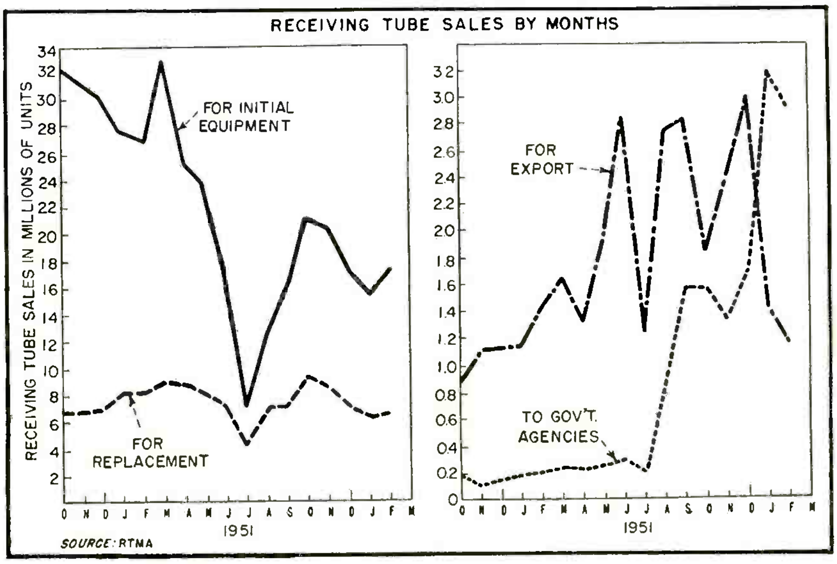
• Upgrade qualified semi-professional workers. Many competent engineers in the electronics industry have had no formal training.

• Hire top graduates of approved technical institutions other than accredited engineering colleges.

Electronic Ignition Systems Coming?

INTRIGUED by tangible evidence of automotive interest in things electronic (p 5), Tung-Sol is reported to be working on an 'electric eye' of its own to dim car headlights.

More interesting still, the company is also reported to be actively experimenting with an 'electronic ignition system.' Such systems were suggested years ago, to provide a more intensive spark and to eliminate moving distributor parts, but nothing has yet been done with them commercially.



What's Behind the Figures—RTMA Receiving Tube Sales

Third of a series outlining background of *Figures of the Month* statistics

THIRD item in our *Figures of the Month* listing (p 4) is "Receiving Tube Sales".

In this item we report the number of receiving tubes and picture tubes shipped and billed during the indicated month, according to the Radio-Television Manufacturers Association statistical department. Included are "entertainment" types used in radio and tv sets, and allied types, manufactured by General Electric, Hytron, Lansdale, National Union, Radio Corporation of America, Raytheon, Sheldon, Sylvania and Tung-Sol.

Five receiving tube figures are reported: total units, units to equipment manufacturers for new sets, units to dealers and distributors for replacement purposes, units to government agencies, and units shipped for export.

▶**Receiving-Type Trends**—Two accompanying charts, labelled "Receiving Tube Sales," show the units shipped and billed by months from October 1950 to the latest month (February, 1952). The curve representing sales to initial equipment manufacturers follows the trend in manufacture of radio and tv sets. The pronounced dip at July 1951 resulted from a corresponding dip in set production (see chart, p 20, ELECTRONICS, March, 1952).

Tubes sold for replacement, as shown in the lower curve, display a much steadier trend, averaging

(Continued on page 20)

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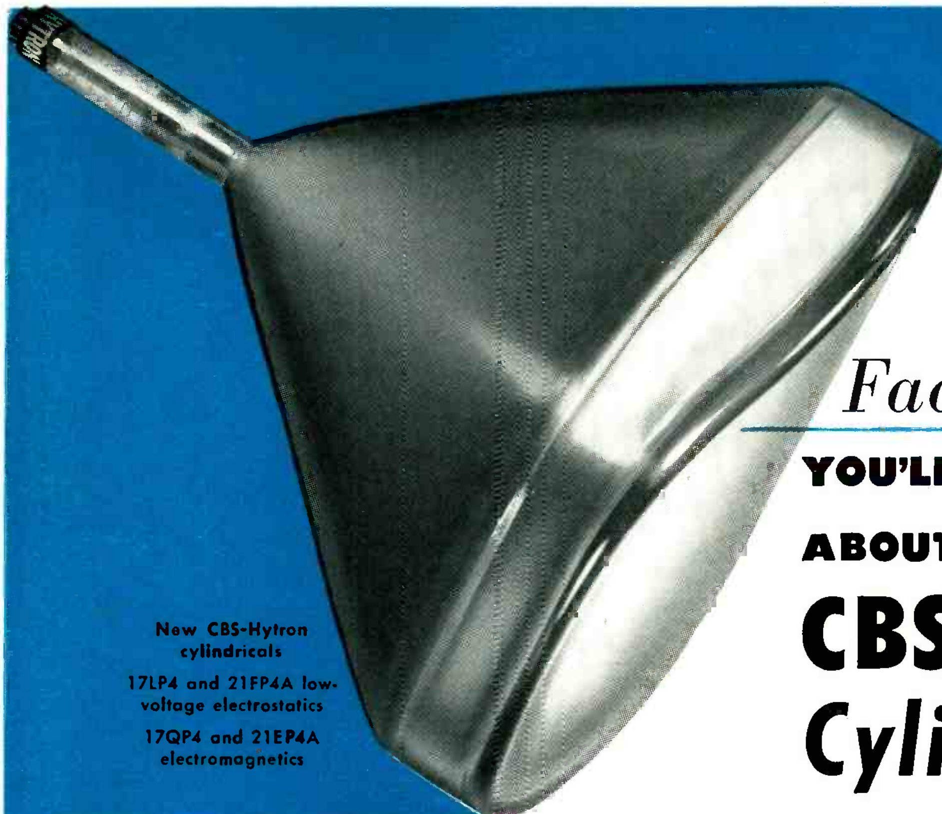
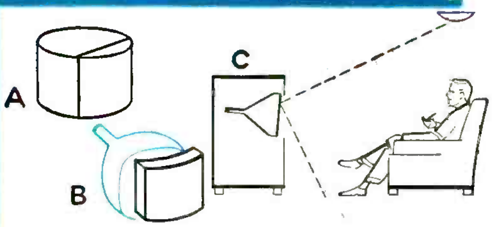
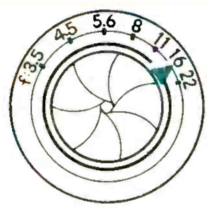


Facts YOU'LL WANT TO KNOW ABOUT NEW CBS-HYTRON Cylindricals



WHY CBS-HYTRON CYLINDRICAL?

To eliminate reflected glare? How? Simple as ABC: A. Imagine a cylinder; slice it vertically. B. You now have the shape of the face plate of a cylindrical tube: curved horizontally; straight, vertically. C. Light falling on this surface at an angle from above is reflected at the same angle... downward. Tilting the tube directs glare downward even more, away from the viewer's eyes.



WHY CBS-HYTRON SHIELDED LENS?

With this shielded lens in the electron gun, greater depth of field and better definition are achieved. Just as when you stop down the diaphragm of a large, fast camera lens (f/3.5) to a small aperture (f/16). Distortion caused by interaction of external electrostatic fields used to focus and accelerate the electron beam is avoided. Focusing is easier, less critical. Slight changes in voltages and currents do not cause drift.

WHY CBS-HYTRON BLUE-WHITE SCREEN?

Ever notice how a shirt laundered with bluing appears whiter? With the CBS-Hytron blue-white screen, whites appear whiter; blacks, blacker. Picture definition is crisper. In fringe areas, the expanded gray scale of the blue-white screen gives noticeably clearer pictures. No wonder CBS-Hytron's original blue-white screen is fast becoming the standard preferred by consumers for best definition.

CBS HYTRON RADIO TUBES

MANUFACTURERS OF RECEIVING TUBES SINCE 1921
HYTRON RADIO AND ELECTRONICS CO.
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

MAIN OFFICE: SALEM, MASSACHUSETTS

These are just a few reasons why it's smart to demand CBS-Hytron... original studio-matched rectangulars. Try the new CBS-Hytron cylindricals yourself. Discover for yourself why 9 out of 10 leading set manufacturers pick CBS-Hytron.

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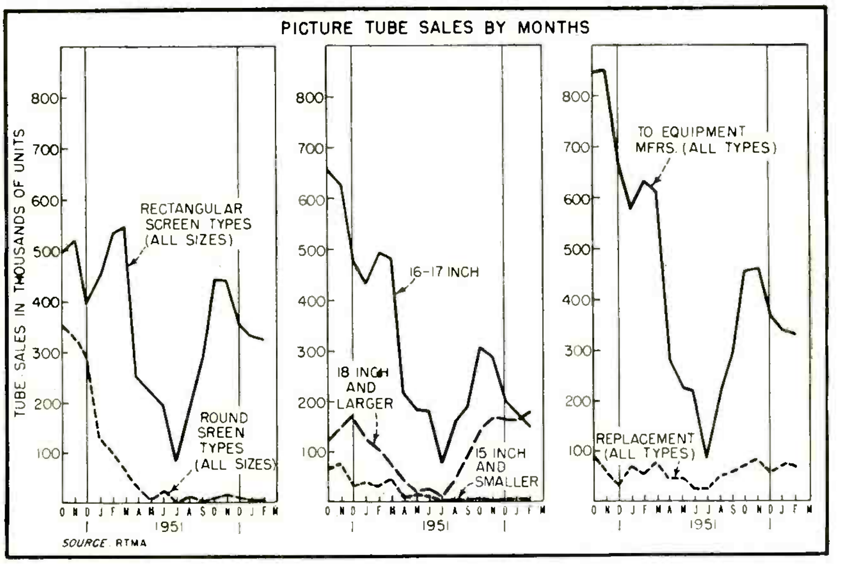
about 7 million a month. Tubes sold for export and government agencies are shown in the second diagram (note ten-to-one change in scale). Export business is spotty and variable, although generally upward during the past year. Tube sales to government agencies have been steeply increasing since last July and now considerably outnumber export sales.

▶Picture-Tube Pattern — Picture tubes are listed in terms of total units sold to equipment manufacturers for new tv sets, and hence tend to follow the corresponding production figures for tv sets. Minor differences in the figures are accounted for by stocks of tubes in manufacturers' inventories.

The current RTMA figures on picture tubes reflect sales by DuMont, Eimac, Federal, General Electric, Hytron, Lansdale, N. A. Philips, Radio Corporation of America, Rauland, Raytheon, Sylvania and Tung-Sol. A more detailed breakdown is prepared by the RTMA statistical department, giving sales according to the shape and size of the viewing screen, initial equipment and renewal sales. Accompanying charts based on the latter classifications cover the period October 1950 to the latest month.

Sales of picture tubes to equipment manufacturers, as in the case of receiving tubes, follow tv production figures, whereas replacement business is much more steady. However, replacement picture tube sales are a small fraction of initial equipment sales, currently about 20 percent, whereas the replacement in receiving types accounts for nearly 50 percent.

▶Big Screens Gain—One of the charts shows the trend in shape of viewing screen, as reflected in sales to equipment manufacturers. The round screen tube was a factor late in 1950, although even then less popular than the rectangular tube. Today, sales of round-screen tubes for initial equipment have all but disappeared.



Another chart shows the trend in tube sizes over the same period. Tubes measuring 15 inches or smaller in diameter or diagonal have virtually disappeared in new equipment. The 16 and 17-inch sizes, which commanded the largest share of the market until late last year, have lost ground rapidly in recent months, whereas tubes 18 inches and larger have gained. In February 1952, the 19, 20, 21, 24 and 30-inch sizes took first place for the first time.

Lightplane Users Buying More Radio, Omni, ADF

Electronic aids multiply usefulness of ships for business and pleasure

PRIVATE AVIATION failed to live up to lofty expectations at the end of World War II. Many factors are blamed, among them being the cost and complexity of electronic equipment necessary for maintaining most-weather usefulness of light aircraft.

Now a period of emergency has again prompted enthusiastic speculation. Many lightplane companies have shifted completely to military work, but keep their eyes on the peace-time fallback, private (business and pleasure) flying. Also eyeing the post-emergency private-aviation market are producers and potential producers of compact communications and air-navigation equipment.

▶Flying Tube Racks—A recent survey by Piper Aircraft, one of the leaders in the lightplane field, has revealed some interesting information regarding the private pilots' willingness and ability to buy electronic equipment. The facts are revealed in the following table.

	Pacer	Tripacer
Cost of Plane	\$5,175	\$5,355
Radio-equipped	100%	92.5%
VHF and LF	51%	69 %
VHF only	2%	4 %
LF only	20%	4 %
Omni	25%	17 %
ADF	2%	8.5%

It will be noticed that practically all planes are equipped with some kind of radio gear, and a good share (25 and 17 percent) are equipped with omni facilities. Some have automatic direction-finding equipment, and few have automatic pilots.

Average expenditure for electronic aids is about \$600. For the full treatment, less automatic pilot, it takes \$1,700 to outfit one of these craft. This includes vhf radio for

(Continued on page 22)

prompt delivery

OF PRECISION DEPOSITED CARBON RESISTORS

temperature cycling

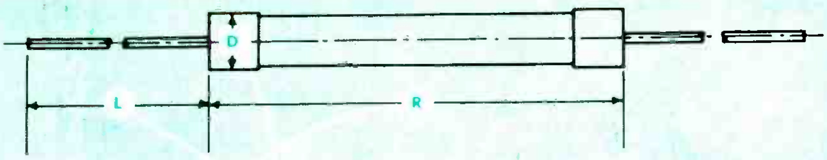
No mechanical damage or changes greater than 1.0% will be apparent on Radell Deposited Carbon Resistors when subjected to temperature cycling ranging from plus 25°C to plus 100°C for 30 minutes, return to plus 25°C for 15 minutes, then to —55°C for 30 minutes and return to 25°C.

high relative humidity

At a temperature of 40°C and a relative humidity of 95 ± 5%, a change in the basic resistance will not exceed 1%.

the load life characteristic

Load life tests conducted at 75°C for 500 hours consists of intermittent application of calculated rated continuous working voltage. The voltage is on for 1.5 hours and off for 30 minutes during the entire 500 hours. The initial resistance of Radell Deposited Carbon Resistors subjected to the test, will change on the average less than 1.0%.



type	nominal dimensions R	nominal dimensions D	nominal dimensions L	nominal watts	ranges ±1% *tolerance 25°C.*	maximum voltage
CD½M	17/32"	11/64"	1½"	½	25 ohms to 2 meg.	500
CD½S	13/16"	11/64"	1½"	½	25 ohms to 19 meg.	1000
CD1S	15/16"	9/32"	1½"	1	25 ohms to 9 meg.	1000
CD2S	2.⅛"	9/32"	1½"	2	25 ohms to 50 meg.	2000

type	continuous rating	maximum body temp. rise(°C)	derating characteristic 80°C	100°C	125°C	150°C
CD½M	½	45°C	90%	60%	30%	10%
CD½S	½	50°C	90%	60%	30%	10%
CD1S	1	65°C	90%	60%	30%	10%
CD2S	2	75°C	90%	60%	30%	10%

For complete specifications write Radell Corporation, United States Sales Office, 7900 Pendleton Pike, Indianapolis 26, or phone Cherry 2466.

RADELL

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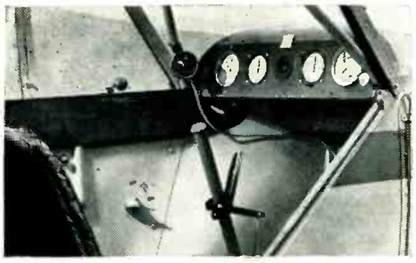
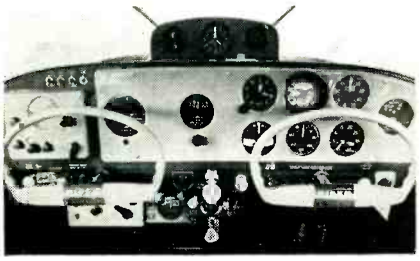


Not too long ago, most lightplane instrument panels looked like this, but . . . .



Today lightplane pilots want and buy electronic equipment. Setup shown cost over $5,000

communications, l-f receiver for radio range and broadcast, loop antenna for homing, omni, and adf. For radio only the cost is approximately $300.

▶ **Peanuts to Millions**—Any upsurge in lightplane business will be felt advantageously by the electronics industry. Experts agree that the day of the family plane is coming. They maintain their reputations as experts by not saying when. The optimists point out that 20 years ago automobile-radio business was in the peanuts class. Last year it accounted for over $125 million worth of the electronics industry.

DPA Releases Tax Amortization Totals

$130 MILLION in tax amortization benefits on new plants and equipment has been given the electronics and communications-equipment industries by DPA to date. As of February 25, applications for five-year amortization were pending on proposed additional plants to the tune of $52.6 million.

First figures showing the breakdown for our industry were released just before presstime.

MEETINGS

MAY 2–3: Association for Computing Machinery, Pittsburgh, Pa.

MAY 4–8: Electrochemical Society, Benjamin Franklin Hotel, Philadelphia, Pa.

MAY 5–7: Second Government-Industry Conference, sponsored by RTMA, NEMA, AIEE, at National Bureau of Standards, Washington, D. C.

MAY 5-16: British Industries Fair, Earls Court and Olympia, London, England, and Castle Bromwich, Birmingham, England.

MAY 6–9: Scientific Apparatus Makers Association, Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

MAY 10: North Atlantic Region, IRE, Copley Plaza Hotel, Boston, Mass.

MAY 12–14: National Conference on Airborne Electronics, Biltmore Hotel, Dayton, Ohio.

MAY 13: RADIO CLUB of America, Room 502, Engineering Societies Building, New York.

MAY 16–17: Fourth Southwest IRE Conference and Radio Engineering Show, Rice Hotel, Houston, Tex.

MAY 19–20: Third Conference on Electron Tubes, AIEE, William Penn Hotel, Pittsburgh, Pa.

MAY 19–22: 1952 Electronics Parts Shows, Exhibition Hall, Conrad Hilton Hotel, Chicago.

MAY 22–24: Electronics Section, Quality Control Convention, Syracuse, N. Y.

MAY 23–24: 1952 Audio Fair, Conrad Hilton Hotel, Chicago.

JUNE 8–12: National Association Electrical Distributors, Ambassador Hotel, Atlantic City, N. J.

JUNE 23–27: AIEE Summer General Meeting, Hotel Nicole, Minneapolis, Minn.

AUG. 11–21: Congress of U.R.S.I. Sydney, Australia.

AUG. 12–15: 1952 APCO Conference, Hotel Whitcomb, San Francisco, Calif.

AUG. 15–16: Emporium Section, IRE, Annual Summer Seminar, Emporium, Pa.

AUG. 27–29: Western Electronic Show and Conference, Municipal Auditorium, Long Beach, Calif.

SEPT. 8–12: National Instrument Conference and Exhibit, Cleveland, Ohio.

OCT. 20–22: Radio Fall Meeting, RTMA Engineering Department, Hotel Syracuse, Syracuse, N. Y.

NOV. 10–30: International Radio and Electronics Exhibition, Bombay, India.

Business Briefs

▶**Employment** in the Chicago area's electronics plants is off 27 percent as against last year, according to Leslie F. Muter, president of the Radio-Radar Industries of Chicago, Inc.

▶**$2,300,000 Order** for copper-oxide rectifiers has been placed with GE by the Atomic Energy Commission. An estimated total output of 9,000 kw will be supplied by the rectifiers.

▶**Spanish** passenger ships of over 1,000 tons will have to carry radar equipment in the future. Deadline for license applications is May 1.

▶**Radar Industry**, not television, will soon be started in Australia. Electronics Industries Ltd., will make equipment for the Navy. Experimental tv service is deferred indefinitely because it would involve importing large quantities of specialized equipment.

New regulations "down under" cut imports of electronics equipment as much as 80 percent.

▶**West Coast** electronics manufacturers find space scarce for the WCEMA show at the Long Beach, California, auditorium August 27-29. With 200 booths spoken for, 44 applicants have been placed on waiting list.

▶**Serad** means *S*pecial *E*lectronics *R*epair *a*nd *D*istribution and is a program set up by the Navy's Bureau of Ships to rescue gear from the scrap heap and return it to use.

▶**Madam** is the name of a new instrument designed to handle masses of data turned out by telemetering systems.

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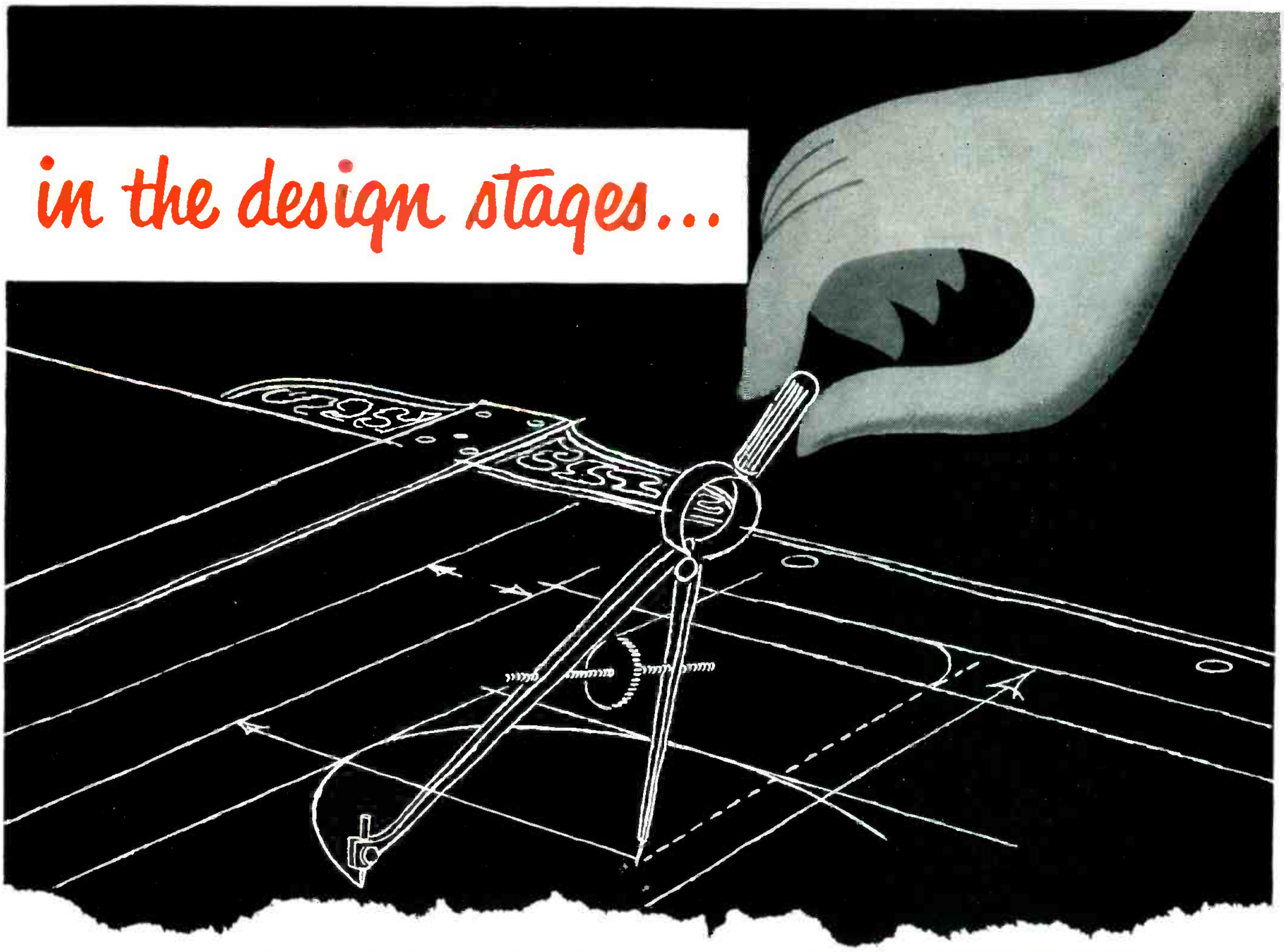

...the ideal time to ENGINEER SPEED NUT® Savings into your product

Take full advantage of SPEED NUT economy and performance, design SPEED NUTS into your product. Here's why...

1. SPEED NUTS simplify design problems through low-profile, one-piece construction and multiple-function characteristics.
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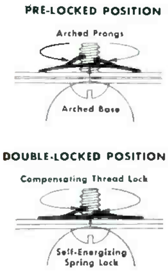
3. The double-locking SPEED NUT principle of Spring Tension Fastening can best be adapted to your design requirements.

Your Tinnerman "Fastener Expert" stands ready to help you profit these 3 ways—call him in soon. And write for "SPEED NUT Savings Stories," Vol. II. Tinnerman Products, Inc., Dept. 12, Box 6688, Cleveland, Ohio.

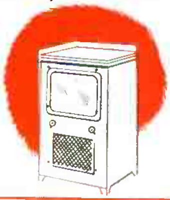
In Canada: Dominion Fasteners, Ltd., Hamilton. *In Great Britain:* Simmonds Aerocessories, Ltd., Treforest, Wales. *In France:* Aerocessoires Simmonds, S. A.—7 rue Henri Barbusse, Levallois (Seine) France.

Let the SPEED NUT Principle save you TIME, WORK, DOLLARS



LOOK AT ALL THE LOCATIONS WHERE SPEED NUTS SAVE ON COMMUNICATIONS EQUIPMENT

controls • coil forms • antennae • wiring • cabinets
yoke deflectors • connectors — plus many more



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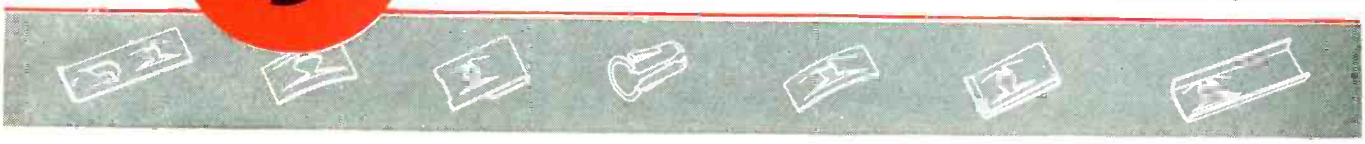

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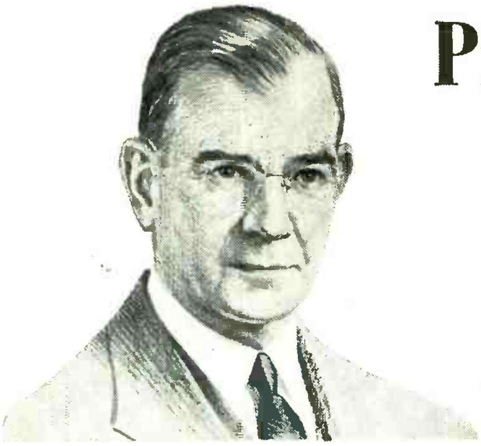
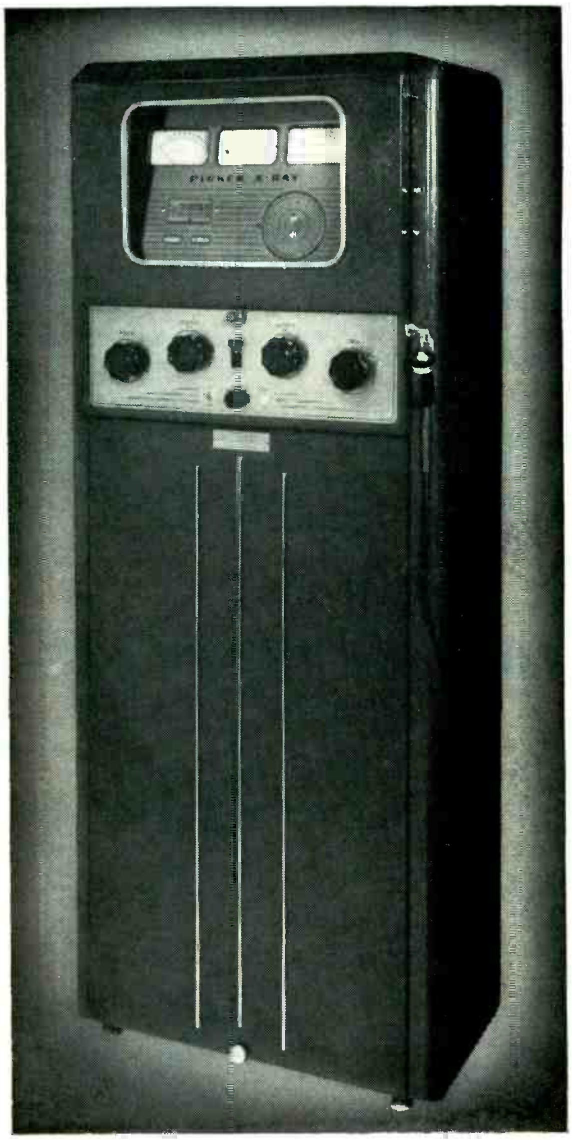
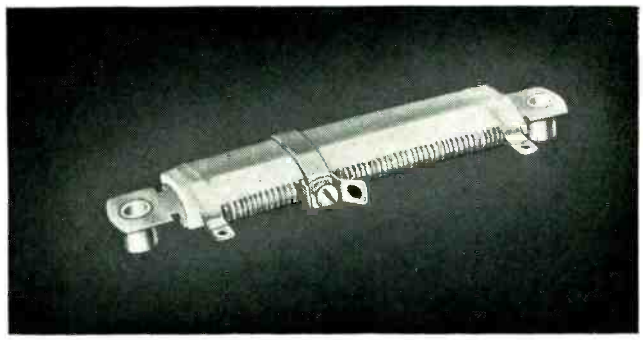


Picker X-Ray Corporation

"For accurate duplication of X-ray densities their resistors must be stable"

says O. N. Jones, The Ambos-Jones Company, Cleveland, Ohio, representative for Ward Leonard Electric Company





Duplicating densities of precise radiographs over prolonged periods demands exacting control of milliamperage through the X-ray tube. This means filament temperature must be accurately set.

That is why the absolute balance of thermal characteristics of Ward Leonard resistors is of utmost importance to the Picker X-Ray Corporation.

The only way to be sure that all resistor components will react the same to changes in temperatures is to balance their thermal characteristics. In this way, there is no loosening, no failure, due to unbalance. Heat affects all parts the same way, which, in turn, means longer life, *stable performance.*

This stability in the presence of thermal shock is one of the major reasons the Picker X-Ray Corporation uses Ward Leonard STRIPOHM resistors in their V-12, 200 milliampere, 100 PKV X-ray controls.

The performance of VITROHM wire-wound resistors, rheostats, and other electric controls under the severest operating conditions is proof of their complete dependability.

For correct, accurate current control, specify Ward Leonard VITROHM Resistors.

WARD LEONARD

WARD LEONARD ELECTRIC COMPANY

MOUNT VERNON, NEW YORK

Result-Engineered Controls Since 1892

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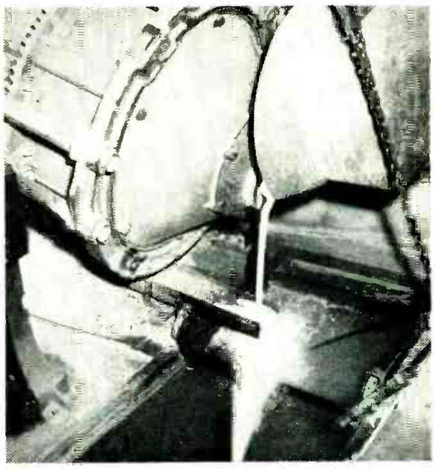
LIMIT BRIDGE FOR TESTING resistance accuracy of Stripohm resistors is operated by Theresa Collura (foreground).

TERMINALS ARE SPOT WELDED to Stripohm cores by Frances Baxter who has been with the company 10 years.

KATHERINE GRUNENTHAL (foreground), 27 years at Ward Leonard, is winding special alloy resistance wire on Stripohm cores.



VITREOUS ENAMEL being fritted is poured white hot into a cold bath to break up the mass into small particles.

From Raw Material to Finished Product Ward Leonard VITROHM Resistor Quality Is Carefully Controlled

The dependable performance of VITROHM resistors in actual operation is the result of Ward Leonard's unified manufacture.

Design and construction are based on specialized experience. Quality is carefully guarded by Ward Leonard engineers, chemists, and technicians.

All components of VITROHM resistors are made by Ward Leonard. Vitreous enamel coating and ceramic cores are formulated in the plant, wire is drawn to Ward Leonard's specifications.

You can be sure of uniform quality by buying your resistors from the *one* manufacturer who manufactures, not just assembles, all the components that go into resistors.

Before you buy or specify resistors, be sure to call in Ward Leonard.

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Atlanta 5, Georgia	C. B. Rogers and Associates
Baltimore 18, Md.	Durling Electric Co.
Charlotte 1, N. C.	James L. Highsmith & Co.
Chicago 4, Illinois	Ward Leonard Electric Co.
Cincinnati 2, Ohio	Sheldon Storer and Assoc.
Cleveland 14, Ohio	The Ambos-Jones Co.
Corpus Christi, Texas	Brance-Krachy Co., Inc.
Denver 2, Colorado	Mark G. Mueller
Detroit 21, Michigan	Jesse W. Eakins Co.
Hartford 6, Conn.	Ward Leonard Electric Co.
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St. Louis 10, Mo.	Ward Leonard Electric Co.
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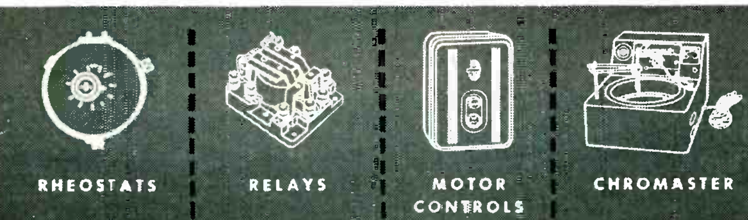
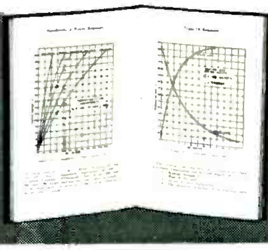
Vancouver, B. C.	D. M. Fraser, Ltd.
Winnipeg, Man.	D. M. Fraser, Ltd.

EXPORT

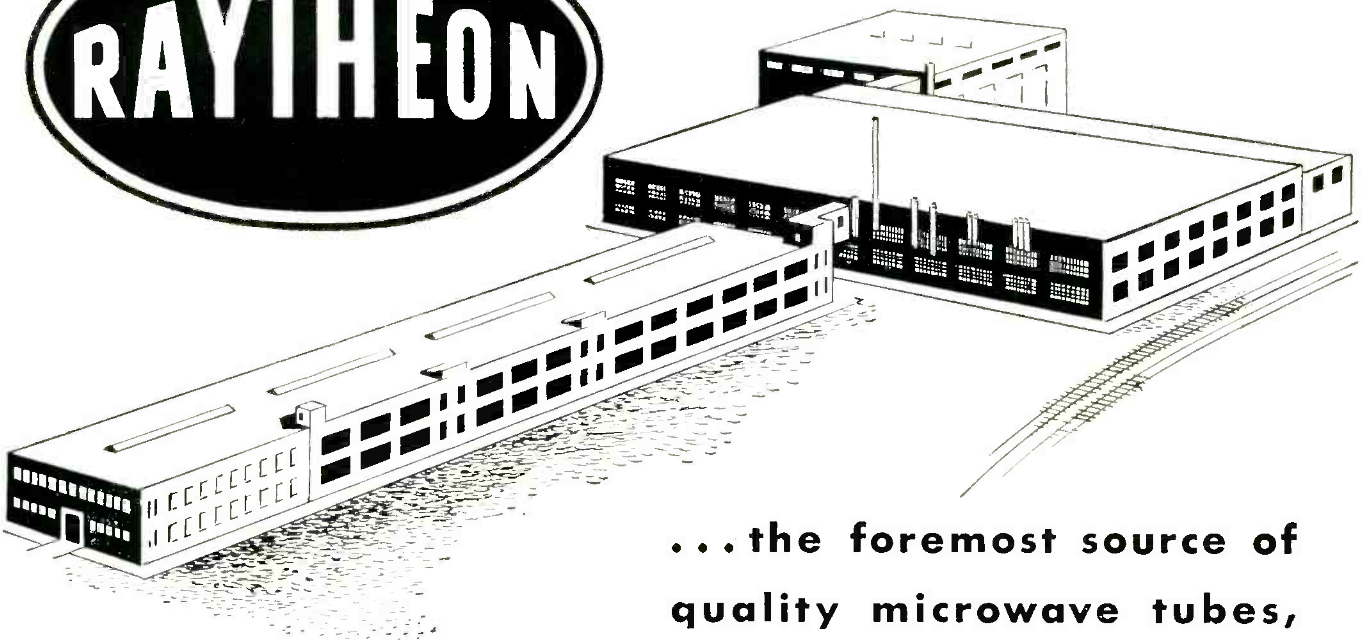
New York 4, N. Y.	Ad. Auriema, Inc.





Ward Leonard's complete engineering textbook, "Handbook of Power Resistors," $3. per copy.

RAYTHEON



...the foremost source of quality microwave tubes,

backed by eleven years of pioneering leadership in the field, and by the largest microwave tube engineering and development laboratories in the world.

RAYTHEON

World's Largest Producer of

PULSE TYPE MAGNETRONS

Tunable or fixed frequency — 1,000 to 25,000 megacycles — power range from a few watts to several megawatts.

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Fixed frequency, tunable and frequency modulated tunable — 1,000 to 10,000 megacycles — power range from a few watts to several kilowatts.

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World's Largest Producer of

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Integral and external cavity, low power — frequency range, 500 to 50,000 megacycles.

For detailed information, get in touch with

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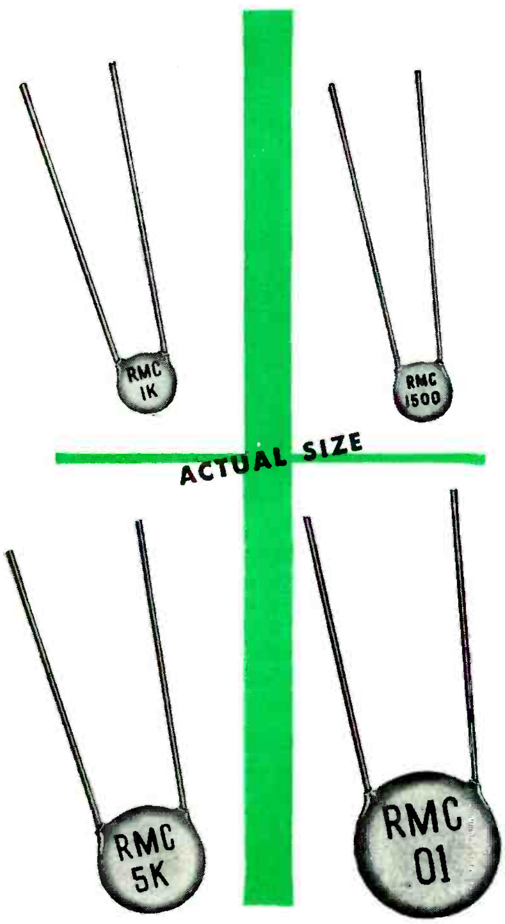
NOW...

RMC By-Pass DISCAPS

are Rated at 1000 Working Volts!



Modern Engineering Requires This

"HEAVY DUTY" CERAMIC CAPACITOR

The heavier ceramic dielectric element made by an *entirely new process* provides the necessary safety factor required for line to ground applications or any application where a steady high voltage condition may occur. Designed to withstand constant 1000 V.A.C. service.

It is wise to specify RMC "HEAVY DUTY" by-pass DISCAPS throughout the entire chassis because they *cost no more* than ordinary lighter constructed units.

Specify them too, for your own peace of mind, with the knowledge that they can "take it." And if you want proof—request samples.

"RMC DISCAPS" *The Right Way to Say Ceramic Condensers*

A New Development from the RMC Technical Ceramic Laboratories

DISCAP CERAMIC CONDENSERS

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FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Condensers

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Now!
Transient-free test voltages down to 0.01 cps!

Versatile, general purpose generator for subsonic and audio work! Continuously variable, 0.01 to 1,000 cps, 5 bands. High stability, distortion less than 1%. Radical new circuitry offers sine, square and triangular waves.

-hp- 202A Low Frequency Function Generator

SPECIFICATIONS
-hp- 202A Low Frequency Function Generator

FREQUENCY RANGE: 0.01 to 1,000 cps in five decade ranges.

DIAL ACCURACY: Within 2%.

FREQUENCY STABILITY: Within 1% including warm-up drift.

OUTPUT WAVEFORMS: Sinusoidal, square, and triangular.

MAXIMUM OUTPUT VOLTAGE: At least 30 volts peak-to-peak across rated load for all three waveforms.

DISTORTION: Less than 1% RMS distortion in sine wave output.

OUTPUT SYSTEM: Can be operated either balanced or single-ended. Output system is direct-coupled; dc level of output voltage remains stable over long periods of time. Adjustment available from front panel balances out of any dc.

FREQUENCY RESPONSE: Constant within 1 db.

HUM LEVEL: Less than 0.1% of maximum output.

SYNC PULSE: 5 volts peak, less than 10 µsec duration. Sync pulse occurs at crest of sine and triangular wave output.

POWER: 115-volt, 50/60 cycles, 175 watts.

DIMENSIONS: 10½" high, 19" wide, 13" deep.

PRICE: $450.00 f.o.b. Palo Alto, California. End frames, for table use, $5.00 per pair f.o.b. factory. (Specify No. 17.)

Data subject to change without notice.

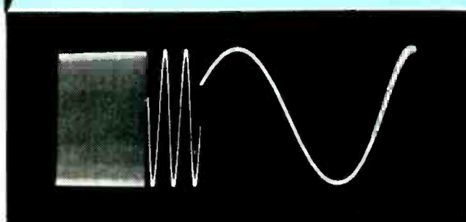

Figure 1. Oscillogram shows freedom from transients as output frequency is changed.

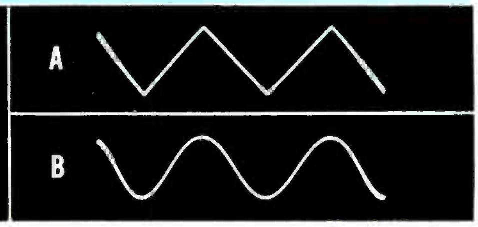

Figure 2. Oscillogram of (a) triangular wave applied to shaping circuit and (b) resulting sine wave.

–hp– 202A Low Frequency Function Generator offers you a compact, convenient and versatile source of transient-free test voltages between 1,000 and 0.01 cps. It provides virtually distortion-free signals for vibration studies, servo applications, medical and geophysical work, and other subsonic and audio problems. For such applications, the equipment generates 3 wave forms: sine, square and triangular. (Desired wave form is selected on front panel switch.) Output is 30 volts peak-to-peak for all 3 wave forms.

NEW CIRCUIT CONCEPT

–hp– 202A differs from conventional low-frequency oscillators in that the sine wave is electronically synthesized. A controlled bi-stable circuit generates a rectangular wave. This wave is passed through a special integrator providing a true triangular wave (Figure 2a). The triangular wave then enters a shaping circuit developed by *–hp–*. Here 6 duo-diodes modify or "shape" the peaks and provide a true sine wave with distortion of less than 1% (Figure 2b). This synthesizing circuit provides virtually transient-free output even when range switch is operated or frequency is rapidly varied. This circuit also maintains the amplitude constant under all conditions. It is not necessary to wait long periods for the circuit to stabilize at a new level as with conventional oscillators.

OTHER FEATURES

The output system of *–hp–* 202A is fully floating with respect to ground. May be used to supply a balanced voltage or either terminal may be grounded. It will deliver 10 v RMS to a load of 5,000 ohms or greater; internal impedance, however, is only 100 ohms. There are no coupling capacitors in the output system, and a high degree of dc balance is achieved by means of a special circuit.

-hp- field engineers, in most major cities, have complete details. Or, write direct.

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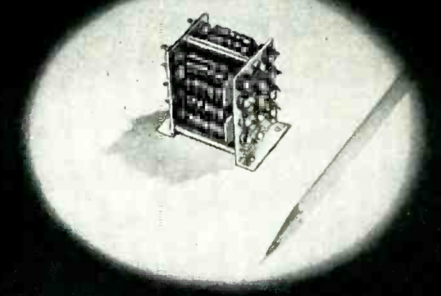
MUST YOUR EQUIPMENT BE RADIO INTERFERENCE FREE?



8 circuit miniaturized filter for wide band RF Interference Suppression.

IF YOURS IS A TOUGH RF INTERFERENCE PROBLEM—LET FILTRON SOLVE IT....

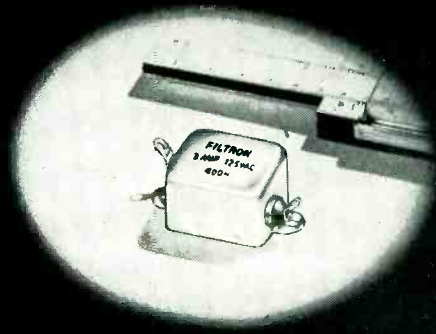
FILTRON'S engineering department, cooperating with engineers of leading companies, has solved RF Interference Suppression problems throughout the country.

If your equipment must meet the RF Interference limits set by the military specifications, consult with FILTRON'S engineers in the earliest stages of design. FILTRON can furnish RF Interference Suppression Filters whose size, weight and overall configuration will fit into your equipment.

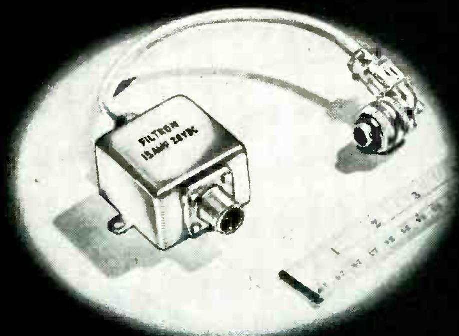
FILTRON has *custom designed* over 1000 different types of RF Interference Suppression Filters for equipment that meets military RF Interference Suppression limits and specifications.

FILTRON'S completely equipped screen rooms are always available for the RF Interference testing of your units and equipment.

An inquiry on your company letterhead will receive prompt attention.



Miniature 3 amp.—125 VAC-400~ filter—hermetically sealed—size 1⅛" x 1" x 11/16"



15 amp.—28 VDC filter, size 2" x 2" x 1¼", with pressurized AN connectors—high attenuation from 150 KC to 400 MC.

FILTRON can best solve your RF Interference problems because:

- FILTRON'S engineering, research and design divisions are staffed by experienced RF Interference Suppression filter engineers.
- FILTRON'S modern shielded laboratories are equipped to measure RF Interference from 14 KC to 1000 MC in accordance with military specifications.
- FILTRON'S production facilities, comprising a capacitor manufacturing division, coil winding division, metal fabrication shop, metal stamping and tool and die shops, are exclusively producing the highest quality components for FILTRON'S RF Interference Suppression Filters.
- FILTRON'S extensive production facilities permit us to meet your delivery requirements. NOW!

RF INTERFERENCE SUPPRESSION FILTERS FOR:

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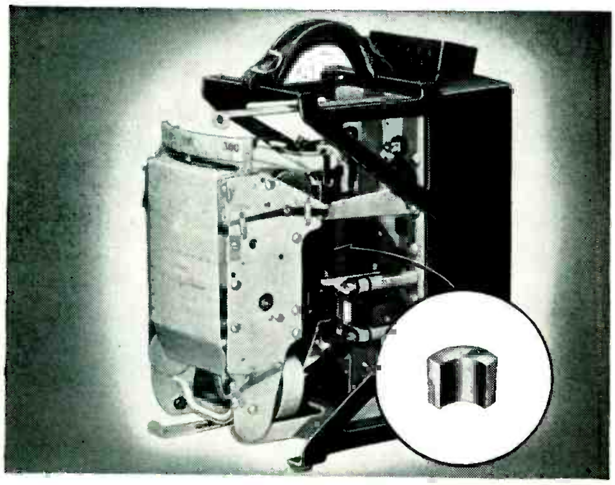
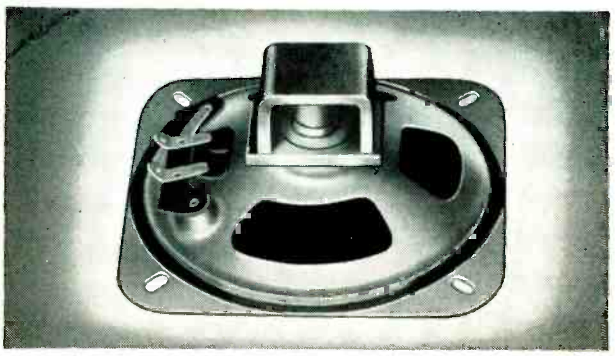
Can Carboloy permanent magnets

These 4 cases show how lasting energy without wires breaks down design barriers, opens the door to finer product performance, big new profit opportunities



METERS—Here, a Carboloy concentric magnet element is the measuring mechanism of this new-type portable current recorder. The permanent magnet cut down fabrication costs by eliminating other power-supplying parts. It also reduced the recorder's weight by 10 pounds and greatly contributed to the sensitivity and accuracy of the instrument. A typical case of modernization through magnets.



SPEAKERS—Many radio and TV speakers now use Carboloy permanent magnets to replace other electrical fixtures in the voice coil. Current passing through this uniform magnetic field causes the voice coil and attached cone to vibrate in proportion to the applied voltage . . . producing truer tone. These Carboloy magnets will never fail, never need maintenance. Permanent magnets are also used in television focusing assemblies.

Is magnetic energy essential or useful in your product?

Then the chances are excellent that Carboloy permanent magnets can improve its function, lower its cost . . . put you out front of your competitors with a finer-performing, more dependable product.

Here's why: Carboloy permanent magnets are simple, self-containing sources of magnetic energy that *never fail.* They need no outside power. They help simplify design and reduce fabrication costs by eliminating wires, coils and other operating parts.

Because they are very powerful, even in small sizes, they let you build a lighter, more compact product, too (particularly important in magnetos, motors, instruments, control devices, communications equipment and other items for the aircraft industry).

Thousands of applications

The Carboloy magnet applications on these pages are but 4 of thousands. Perhaps they'll spark an idea for a similar application in your radio or TV set, thermostat, voltmeter or whatever electrical product you build.

Check them. Then check Carboloy magnet engineers . . . the most skillful in the business. They'll give you a hand in magnet design and application at no cost to you. *And Carboloy production lines can supply you with the finest, most uniform magnets that money can buy.* Any size, any shape. Cast or sintered.

For more information, send coupon for free copies of the Carboloy Magnet Design Manual and Standard Stock Catalog.

CARBOLOY

DEPARTMENT OF GENERAL ELECTRIC COMPANY

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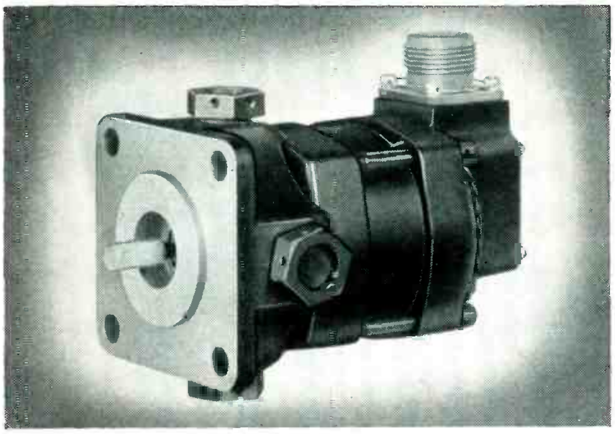
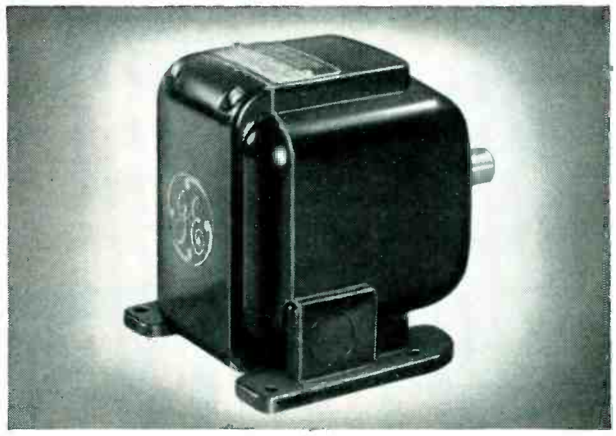
improve your electrical products?



GENERATORS—When plane engineers left only a 6″ x 6″ space for a jet's tachometer generator, the design problem was whipped with a Carboloy permanent magnet. One tiny magnet supplied the strong magnetic field required. It eliminated coils and wires previously used, thereby saving space and permitting a compact generator design that fit the limited area.



CONTROLS—A new plugging control for brakeless stopping of polyphase induction motors features a Carboloy permanent magnet. An eddy current disk, rotating in the magnetic assembly, creates a torque. As the motor's speed nears zero with the power reversed, the torque decrease interrupts the circuit and quickly stops the motor.

Which of these outstanding advantages of Carboloy permanent magnets can help you improve your product?

1 SIMPLE—Compact, self-containing sources of energy with no operating parts.

2 UNIFORMLY POWERFUL—Guaranteed to meet or surpass the standard external energy minimum.

3 LAST FOREVER—Will supply a constant, uniform magnetic field indefinitely.

4 NO WIRING—Eliminate need for coils, windings, or other electrical fixtures.

5 COOL-RUNNING—Won't generate heat; need no provisions for heat dissipation.

6 NO OPERATING COSTS—Operate without maintenance costs or any power supply.

7 NO POWER FAILURES—There is no outside source of power to fail!

8 COMBINE ELECTRICAL AND MECHANICAL FEATURES—Transform electrical energy into mechanical motion; mechanical motion into electrical energy.

9 SIMPLIFY MECHANICAL ASSEMBLIES—Exert strong tractive force for holding, lifting and separating devices, which eliminates component parts, makes product design and fabrication extremely simple.

10 UNINTERRUPTED OPERATION—Magnetic energy flows *continually* and *forever!*

11 MOISTURE-RESISTANT—No coils to collect moisture.

12 CREATE SAVINGS—Reduce weight, save space, lower cost of fabricating and eliminate other, often more costly, power-supplying parts.

"Carboloy" is the trademark for the products of Carboloy Department of General Electric Company

ALNICO PERMANENT MAGNETS

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Gentlemen:
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William Thomson
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As electrical engineer for the first two Atlantic cables, this famous British physicist and inventor made numerous contributions to the advancement of cable communication. His earlier invention of the mirror galvanometer, used to detect extremely weak electrical signals, first made underwater cable telegraphy possible over long distances. Kelvin is also noted for his important work in thermodynamics, molecular physics, wireless, and the wave theory of light.

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More manufacturers have standardized on Ohmite high-current tap switches than on any other make on the market. This industry-wide preference is a result of the unmatched *dependability* built into every unit. Their distinctive, time-proven features—completely described on the next page—are combined with unusual compactness and high current capacity. Investigate these fine units for *your* product.

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Advancement in Emergency Communication

Eimac tubes fill key sockets In continuous service transmitters

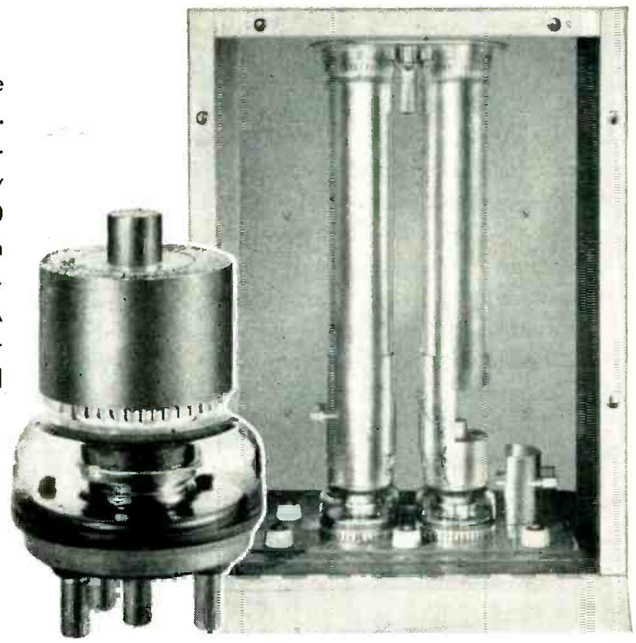
REL type 757C transmitter

New and unique in civil emergency communication systems is the New York City Fire Department's five borough radio network planned to meet the threat of any emergency, including atomic attack. Transmitters designed by Radio Engineering Laboratories to give continuous operation are significant contributions to this electronic accomplishment.

Eimac's 2C39A triode is utilized in REL's type 757C point-to-point radio relay transmitter operating in continuous around the clock service at 900 mc. The 2C39A is used in two stages—as a tripler from 150 mc. to 450 mc. and as a doubler from 450 mc. to 900 mc. The 2C39A is a natural to serve in REL's 757C where it can perform as a frequency multiplier at ultra high frequencies with excellent operating efficiency. This compact, rugged, high-mu tube is designed for a variety of uses as a power amplifier, oscillator or frequency multiplier wherever dependability and durability are demanded.

Two Eimac 4X500A's give dependable performance in the REL type 715 emergency service transmitter. These external-anode tetrodes are in the power output stage of the final amplifier in each of the New York City Fire Department's eight main station 350 watt transmitters. Operating in the 150 mc. region the 4X500A's meet the challenge of 24-hour performance. Designed for application the 500 watt 4X500A has small size and low inductance leads which permit efficient operation at relatively large outputs well into VHF.

Write our application engineering department for the latest information and technical data about these and other Eimac tubes.



Power amplifier of REL's type 715

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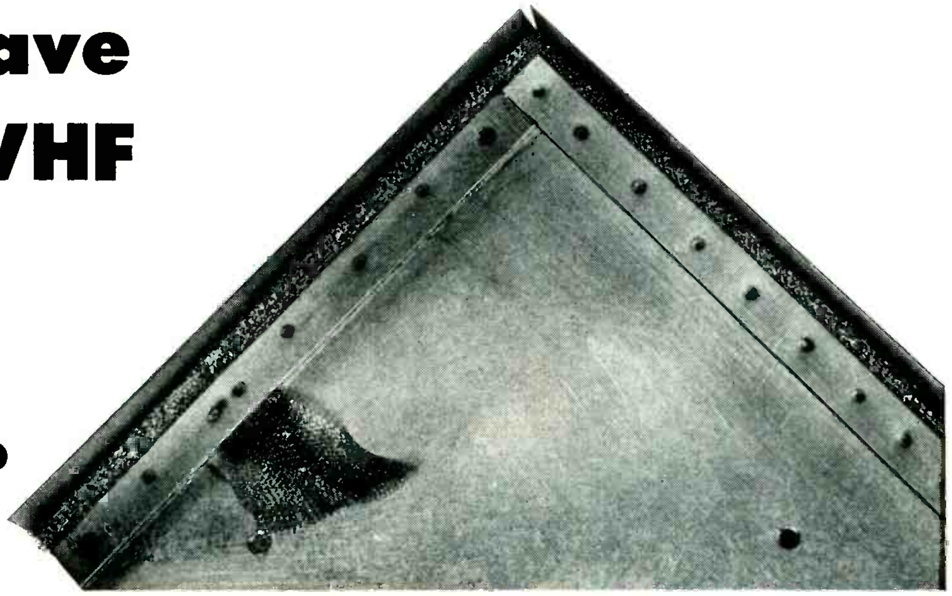
Do you have an HF or VHF harmonic shielding problem?



Sealing in stray harmonic waves, knit Monel mesh strip or gaskets, mounted around lids and other openings help reduce electrical harmonic interference.

Could your plant or operation be shut down because some piece of your equipment is unsuspectedly generating HF or VHF harmonic interference?

It *can* happen . . . *and has.* So it's a real problem for you to consider.

High power generators, welding machines, amateur radio transmitters, diathermy, and even lawn mower machines . . . all are potential trouble makers . . . unless they're properly shielded . . . adequately screened!

That's where Monel® comes in.

Metal Textile Corporation, Roselle, N. J., developed a line of effective shielding gaskets and strip—metal mesh, knitted in tubular form like a stocking, and compacted. As a result of comparative tests on shielding effectiveness and service life, the material used is resilient, corrosion-resisting, flat Monel wire. Known as "Metex Electronic Weather Stripping," its uses include flange gaskets in square wave guides and shielding strip around metal lids and openings of portable and amateur transmitting equipment. A combination Monel gasket and sealing member is also used experimentally to shield "dunkproof" motor housings.

Why Monel? Because it offers several far-reaching advantages.

• • •

Monel possesses adequate conductivity. It provides positive shielding and sealing for a wide variety of sizes and types of electronic equipment.

And, on the job, it withstands corrosion and heat oxidation, doesn't build up contact resistance. Its compressibility, resilience and fatigue-resisting qualities make for excellent contact with relatively slight pressure, despite warped or irregular surfaces.

Resilient Monel mesh shielding rings assure continuous contact and adequate conductivity despite corrosive attack.

Available in a wide variety of cross-sectional shapes and dimensions, the mesh can be fabricated, compacted, folded, and installed with a minimum of difficulty.

Perhaps you have a special shielding or sealing problem that Monel can help solve. You may find the answer in the bulletin "Metex Electronic Weather Strips." Write for a free copy today. Address: Metal Textile Corporation, 641 East First Ave., Roselle, N. J.

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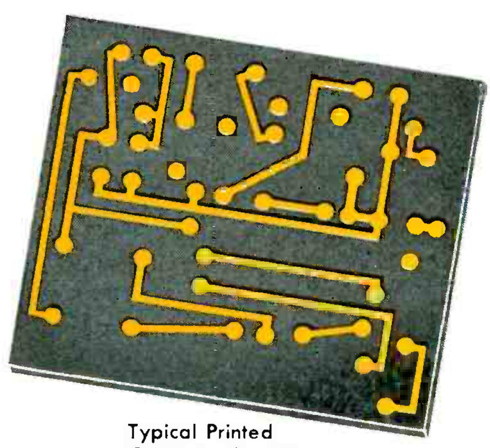
metal-clad INSUROK® T-725 and T-812 plastic laminates

Laminated INSUROK Grades T-725 and T-812 have made history ever since they were first introduced to the electronics industry. These laminates, possessing a unique combination of properties, have shown sensational performance in critical high-frequency applications.

Now these superior electrical laminates are available in *Metal-Clad* form (with copper or aluminum sheet bonded to one or both surfaces) for the production of "printed circuits."

Metal-Clad INSUROK exhibits outstanding electrical properties which remain remarkably stable under repeated temperature and humidity cycling. In addition, it possesses high physical strength and low cold flow, and punches readily into intricate shapes. The metal foil is bonded by a special process assuring consistently higher bond strengths than ever offered before.

Samples of Copper or Aluminum-Clad INSUROK are available for testing purposes. Send for complete information, today.



Typical Printed Circuit made with Metal-Clad INSUROK

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THE TRUTH ABOUT

GENERAL ELECTRIC has recently been deluged with letters, telegrams, phone calls and personal visits from electronic engineers, designers and equipment manufacturers seeking information about the availability and applicability of TRANSISTORS.

We believe these inquiries are directed to General Electric for several reasons:

- G.E. is the largest supplier of germanium products in the country.*
- More than 4½ million point contact germanium diodes were used by industry in 1951. General Electric made, sold, and delivered the largest portion of these.
- Point contact or whisker-type germanium transistors have been commercially available from G.E. for over three years (Types G11 and G11A).

**Of all manufacturers reporting through RTMA in 1951, G. E. delivered more germanium diodes than all others combined.*

- G-E Research and Electronics Laboratories have been developing junction germanium devices for several years.
- G.E. announced the first commercial junction (P-N) rectifier (G10 types) in October 1951 and these are now in production.

General Electric has developed several types of junction transistors (P-N-P) and these are now in product engineering. They have not been announced commercially because we want to establish the most desirable characteristics for your use. We want to improve their design without interrupting your program, and test them for stability and life. This is standard General Electric practice on new products and for this reason we cannot give you a specific calendar date for availability. It is fair to state that G.E. intends to lead in the production of transistors

You can put your confidence in—

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TRANSISTORS

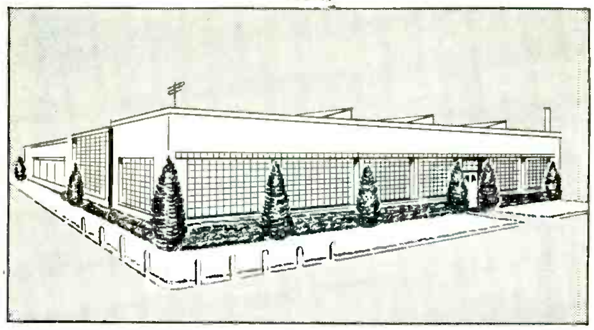
for commercial and government use as it has with diodes.

Many new and revolutionary devices are also under development in our laboratories: high power transistors: high power rectifiers: phototransistors: semiconductor pentodes: high frequency transistors. And many more—all to help you design better equipment.

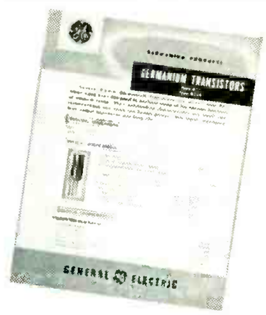
TRANSISTORS TODAY

Transistors have several advantages over other components. These include small size, no cathode power or warm-up time required, very high efficiencies, long life, ruggedness, stability.

Uses are limited today, however, by factors like frequency response (usually below 1 megacycle) and temperature effects (usable at temperatures only slightly above normal ambients at present). Both of these problems are being actively studied.



PLANT CAPACITY! A complete factory, employing upwards of 500 people, is devoted to the manufacture of G-E germanium products. Located at Clyde, New York, this modern installation is turning out diodes, rectifiers, and point contact transistors for your use now, and eventually will be producing junction transistors.



NEW TRANSISTOR BULLETIN! Just printed, this new illustrated bulletin gives you complete specifications on G-E point contact transistors (Types G11 and G11A). Write us and we'll mail your copy immediately. No charge. *General Electric Company, Section 452, Electronics Park, Syracuse, New York.*

GENERAL ELECTRIC

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It Subtracts... so Pilots can "add up the score"

Everyone Can Count on

VEEDER-ROOT

Yes, jet pilots count on this interesting instrument to tell them how much fuel is left . . . when they'd better "hit for home." And in the same way, it counts rounds of ammunition remaining in the plane's machine guns, the number of film-exposures remaining in aerial cameras, etc., etc. So you can see how one type of Veeder-Root Counter can come up with many answers to many problems. And within the literally *infinite* scope of the counting process, there may well be some badly needed answers we can work out for *you* . . . if your work is badly needed for defense. Write.

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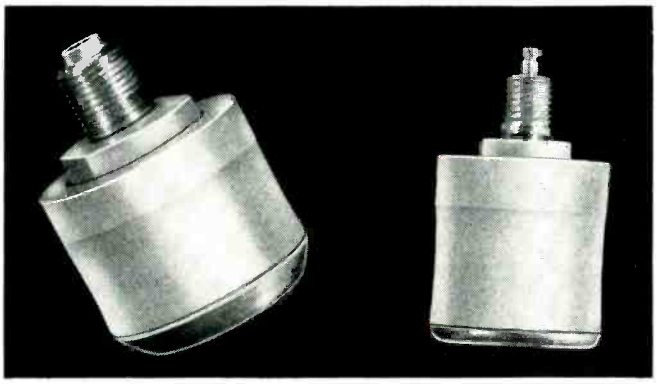
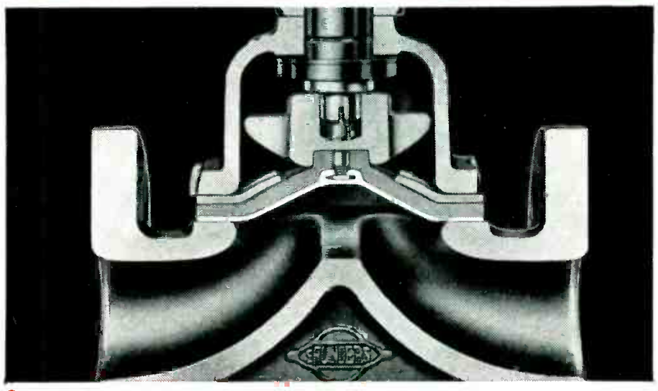
Application Report #1

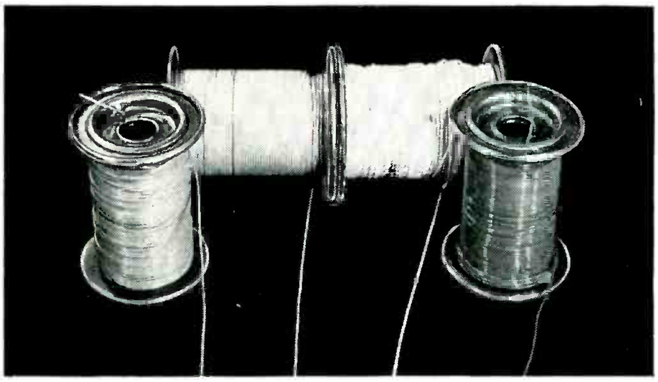
.. how **POLYTRIFLUOROCHLOROETHYLENE** has been used to solve tough design problems.



1. For these antenna bases, Kel-F's properties of zero moisture absorption and high electrical resistance immediately suggested it as a desirable material. However, its final selection was deemed mandatory because Kel-F could be injection molded around a metal insert, thus providing a completely hermetical seal.



2. Diaphragm valves for acid handling dramatize several of Kel-F's basic values. Its use in this commercial valve points up Kel-F's properties of low cold flow (good memory); chemical inertness; flexibility; and wide temperature range. Again however, the fact the Kel-F could readily be compression molded around an insert was a determining factor in its use.



3. This electronic hookup wire is Kel-F insulated, capitalizing on the plastic's high temperature and high electrical resistance. In the production of this wire, Kel-F is extruded onto copper wire in conventional equipment. Commercially available from several sources, the wire comes in an assortment of keying colors.

4. Fittings for chemical equipment are excellent examples of the design values found in five of the principal properties of Kel-F: high chemical resistance; a wide temperature range; non-wetability; plus ease of molding and machining. These commercial fittings are made from extruded rod which is conventionally machined to final, close tolerance.

A Capsule Report on the Properties of KEL-F

- ★ Chemical Inertness
- ★ Wide temperature range —minus 320 F to 390 F
- ★ High electrical resistance
- ★ Low Cold Flow
- ★ Zero Moisture Absorption
- ★ Variable transparency and flexibility properties
- ★ Readily molded, extruded and machined

Basic Kel-F Products Available

MOLDING POWDERS

Unplasticized

- #300 .. for high temperature service
- #270 .. for less severe temperatures

Plasticized *(in either #300 or #270)*

- P 20 .. with 20% plasticizer
- P 25 .. " 25% "
- P 30 .. " 30% "

DISPERSIONS

- NW-25 .. flows readily at fusion temperatures
- N-1 .. High molecular weight

OILS, WAXES and GREASES

- #1 .. Light Oil
- #3 .. Medium Oil
- #10 .. Heavy Oil
- #40 .. Waxy Oil (pour point 80-90 F)
- #150 .. Hard Wax at 70 F

(Greases compounded to order)

Standard Fabricated Kel-F Materials and Parts Available from Commercial Sources

Molded Sheets ★Extruded and Molded Rod ★Extruded Tubing
Thin Film (extruded as lay-flat tubing)
Gaskets ★Washers ★Valve Discs ★"U" Packing
"O" Rings ★Kel-F coated Resilient-core "O" Rings
Valve Diaphragms
Transformer Terminals ★Rotary Electric Switches ★Hook-up Wire
Electronic Terminals, Tube Bases and Coil Forms

For full information on various molders, extruders and fabricators of Kel-F products; also technical data on detailed properties, molding and application techniques — write

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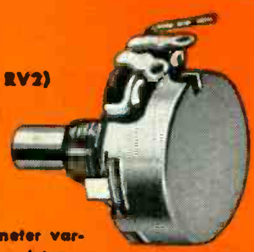
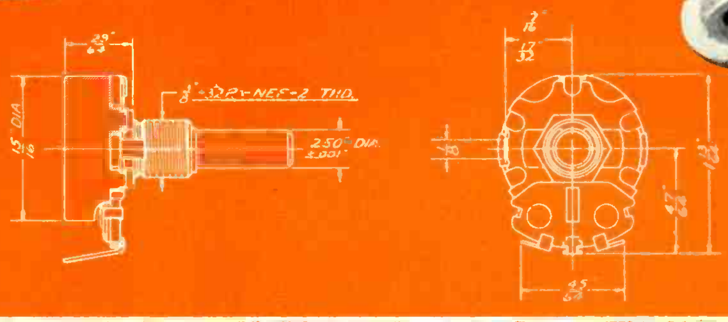
A Complete Line that

TYPE 45
(JAN-R-94, Type RV2)

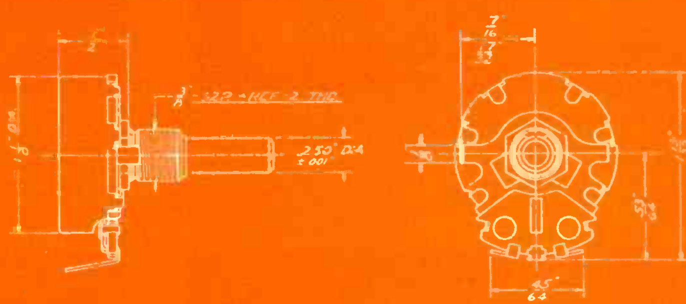


¼ watt, 15/16" diameter variable composition resistor.
Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.



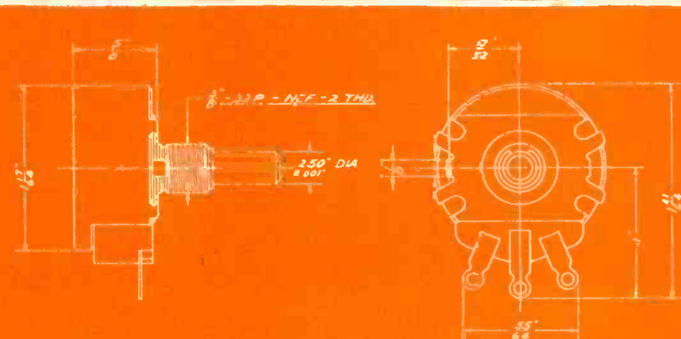
TYPE 35
(JAN-R-94, Type RV3)

½ watt, 1⅛" diameter variable composition resistor.
Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.



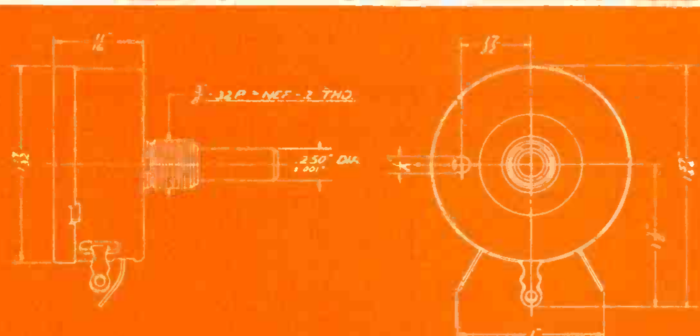
TYPE 252
(JAN-R-19, Type RA20)

2 watt, 1 19/64" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19. Attached Switch can be supplied.



TYPE 25
(JAN-R-19, Type RA30)

4 watt, 1 17/32" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19. Attached Switch can be supplied.



For additional information on these 7 controls, write for Data Sheet No. 160

EXCEPTIONALLY GOOD DELIVERY CYCLE on military orders due to enormous mass production facilities . . . *Immediate delivery from stock on more than 170 different types and resistance values . . .* Please give complete details on your requirements when writing or phoning for further information.

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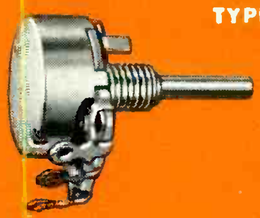
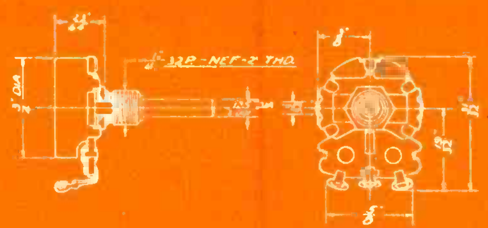
of Variable Resistors

MEETS MILITARY SPECIFICATIONS

−55°C to + 150°C . . . complete aridity to saturation . . . are the unprecedented temperature and humidity range of Types 65, 90 and 95. These controls are used in military equipment subjected to extreme temperature and humidity.

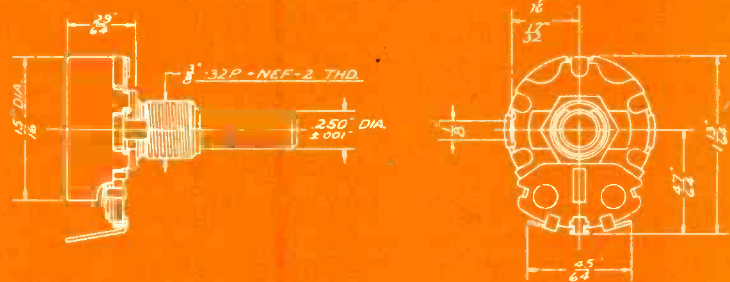
TYPE 65





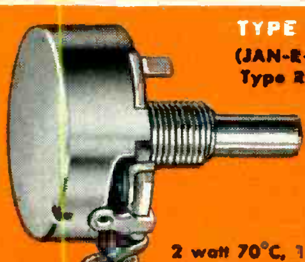
½ watt 70°C, ¾" diameter miniaturized variable composition resistor.

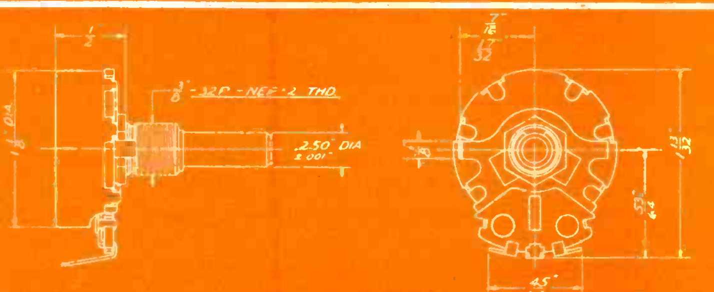
TYPE 90



1 watt 70°C, 15/16" diameter variable composition resistor. Attached Switch can be supplied.

TYPE 95
(JAN-R-94, Type RV4)





2 watt 70°C, 1⅛" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.

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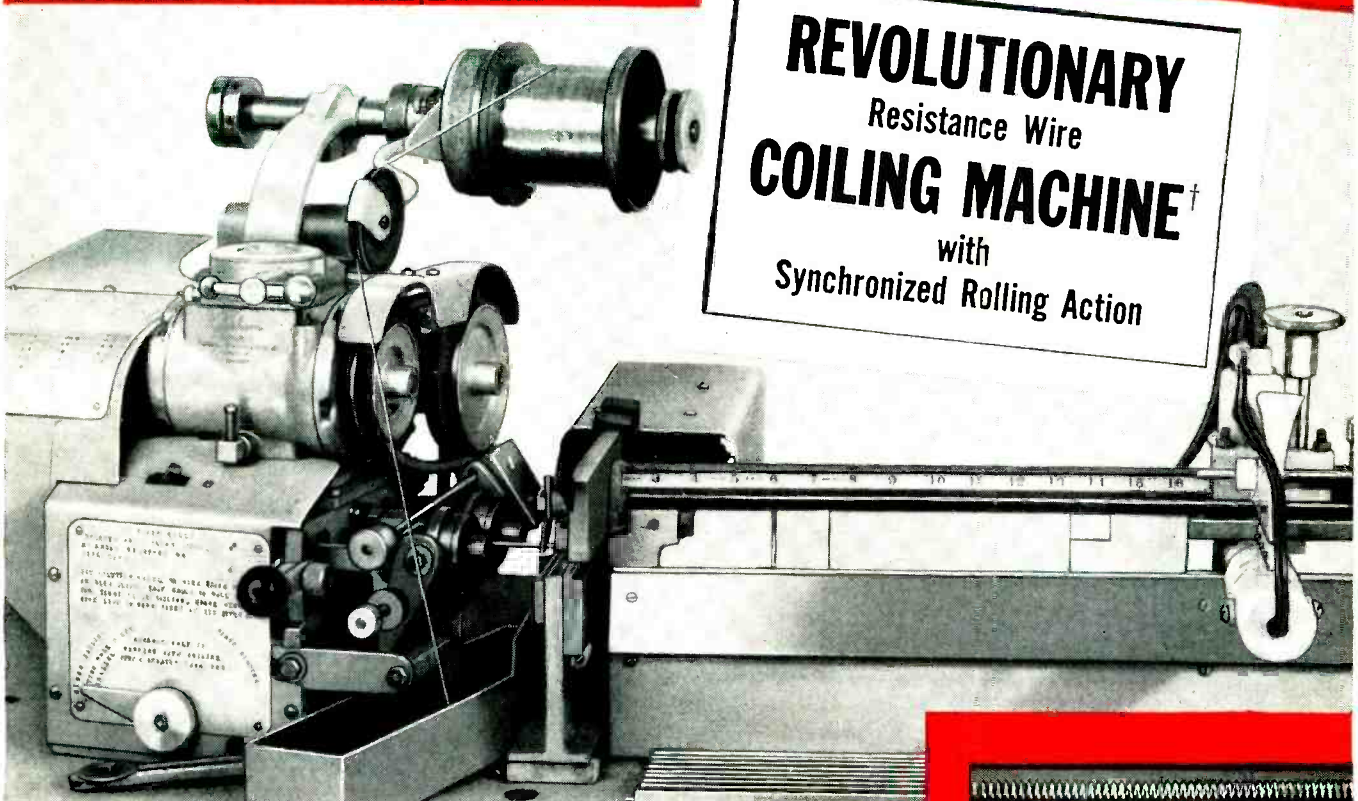
DRIVER-HARRIS ANNOUNCES . . .

REVOLUTIONARY Resistance Wire COILING MACHINE† with Synchronized Rolling Action



As producers of the world famous "Nichrome"* and other outstanding electric heating and resistance alloys, Driver-Harris engineers are interested in obtaining application results commensurate with the exceptional advantages their alloys afford. Therefore they have developed a new coiling machine which eliminates wire coiling faults—especially coil irregularity due to work-hardened areas produced during coil formation.

This new machine is the result of knowledge accumulated during forty years of close association with wire coiling problems. Its revolutionary principle of operation—*the synchronized rolling action of all coiling parts*—results in vastly improved performance over that of any other type machine.

Product of long study and a thorough knowledge of the requirements of the industry, this Driver-Harris unit—

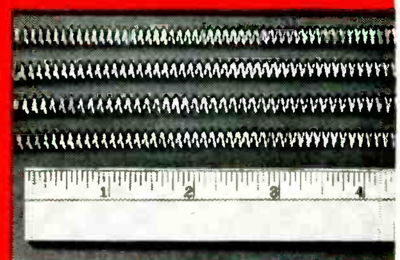
(1) handles the full range of resistance wire coiling normally required, close or open winding (and can be adapted for twin wire coiling);

(2) cuts coil ends clean on all sizes, close or open wound;

(3) maintains resistance accuracy of cut coils at all times by photo-electric control (variation not exceeding ± 1%);

(4) affords the lowest operational and maintenance costs of any comparable coiling machine.

Standard Model coils #20 to #36 B&S gauge wire. Units for other gauges built to order. Send for illustrated Bulletin C-52, giving full information.



Note even spacing between turns of stretched coils.

Coil ends lie *flat*. No burring or twisting of wire.

*T.M. Reg. U.S. Pat. Off.
†Patent Pending

SPECIAL PURPOSE ALLOYS SINCE 1899 · D H · TRADE MARK REG. U. S. PAT. OFF.

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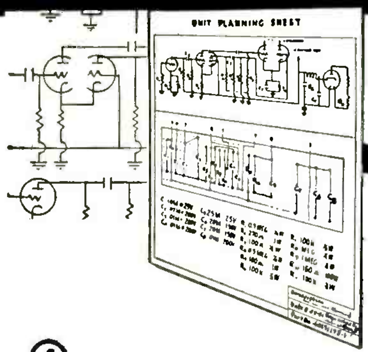
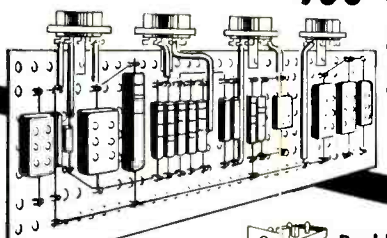
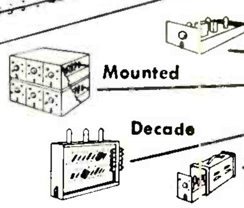
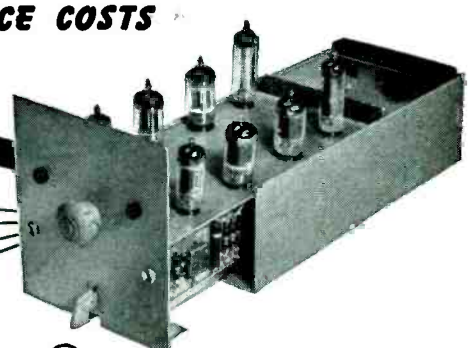




FROM STANDARD STOCK COMPONENTS YOU CAN SIMPLIFY DESIGN — SPEED PRODUCTION — AND CUT SERVICE COSTS





①

ORGANIZE CIRCUITS QUICKLY

Schematics of most electronic equipment can be broken down into circuit blocks of logically associated functions. These functional circuit blocks con be mounted readily either in the Alden "20" plug-in packages or Basic Chassis unit. Tube sockets and associated components quickly lay out on full scale Unit Planning Sheets for mounting on terminal cards. These special pre-punched, multi-hole terminal cards have wide flexibility to take an infinite variety of circuit variations. Both sides of card can be used to obtain maximum component density area. Using the Unit Planning Sheets, functional circuit units are all planned in one step.

②

GET EASY SUB-DIVISION OF LABOR

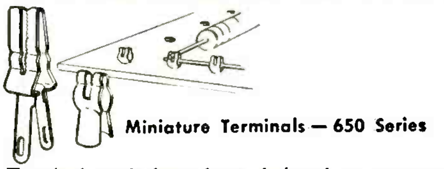
Solder terminals and sockets quickly rivet to Alden terminal card according to layout on Unit Planning Sheet. Components snap into the special Alden Miniature Terminals which hold them for soldering — (No twisting or wrapping of leads necessary) — With all tube sockets and their associated components mounted on one card — the wiring and soldering of circuits is an open, easy-to-work sub-assembly operation.

③

CUT SERVICE AND MAINTENANCE COSTS IN FINAL EQUIPMENT

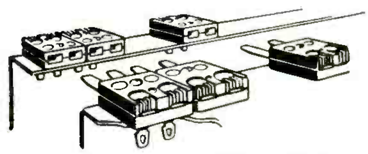
In field, shop, or office your equipment maintenance is reduced to 30 second changeovers. Basic replacement elements are small enough in weight and size to be shipped by parcel post for repair.

IT'S AS SIMPLE AS THIS!



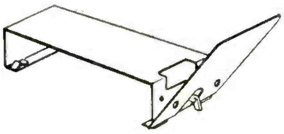
Miniature Terminals — 650 Series

Terminal cards have been designed to accommodate tremendous number of circuit variations — to make neat tube and component sub-assemblies with a minimum of wiring and simplified assembly techniques. Special Alden Miniature Terminals are new and radical punch press configuration — ratchet slot holds various size component leads for soldering — no twisting of leads with pliers. Figure "eight" shape accommodates cross wiring and buss leads. Terminals are punch press parts — so take a minimum of solder, reduce solder time, eliminate danger of cold solder joints.



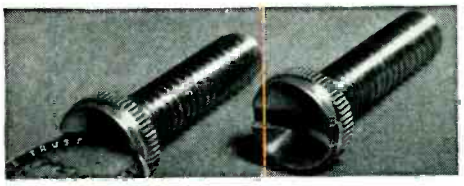
Back Connectors — 462MIN Series

Alden Terminal Card System means minimum of inter-cabling — but even this cabling can be laid out easily and proceed as simple sub-assembly. Open sided chassis construction makes cable easy to wire to front panel, terminal cards and back connectors. The Alden Back Connectors are units that can be discretely positioned on the back of the chassis — isolating lines with incompatible voltages, currents, or frequencies. This design insures accessible solder terminals for soldering — avoids rat nests of congested conventional back connector wiring. Color coded, the Alden back connectors provide beautiful operational or service check points for all leads to and from chassis.



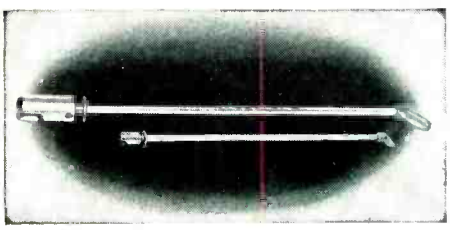
Hinged Front Panel Design

Hinged front panel design of chassis allows rheostats, indicator lights, jacks, etc. to be mounted on panel as another easy-to-work sub-assembly. This panel attaches easily to chassis — is wired — swung up and fastened with Alden Target Screws.



Target Screws

These screws have concave head with arced notch so power screw driver locates head quickly, no danger of it slipping out and marring panel surface — yet same screw can be unfastened with coin in order to hinge forward the front panel for servicing and check in the field.



"Serve-A-Unit Lock"

Assembled — the Basic Chassis simplifies operation of equipment — Slashes service and maintenance time. Smooth, positive insertion and removal of the chassis is provided by the Alden "Serve-A-Unit Lock." A simple twist of the handle and the chassis backs off with finger tip ease. It also pilots the chassis back into place — securely locking it for operation with the same facility.

TO GET STARTED QUICKLY!

Send for these tremendously useful Laboratory Work Kits and have them in your lab for use on present equipment or immediately ready for next new project:

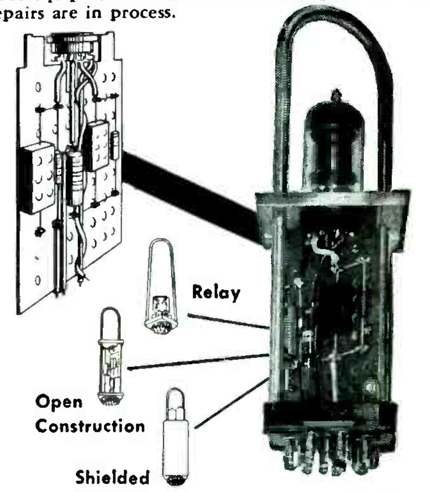
Kit #4	Alden "20" Plug-in Packages	$10.00*
Kit #24	Alden Basic Chassis	$26.50*
Kit #25	Terminal Card Mtg. System	$11.50*
Kit #26	Basic Terminal Staking Tools	$15.00*
Kit #8	Target & Cap Captive Screws	$ 3.00*
Kit #29	Color Coded Back Connectors	$ 4.50*

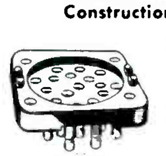
—or send for free booklet, "Basic Chassis and Components for Plug-in Unit Construc-

*Prices shown are for sample kits only— For production runs send us your schedule.

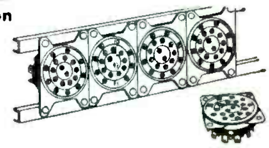
FOR SMALLER UNITS ALDEN "20" PLUG-IN PACKAGES

Here is a plug-in package unit using the above method of converting schematic into finished assembly quickly. Simply mount the completed terminal card sub-assembly on the Alden "20" Non-Interchangeable base, dip solder the leads — add cover or housing and handle and it's completed — In operation, visual or instrument checks are easily made — if trouble occurs doubtful units are quickly isolated — these units easily unplug and a comprehensive inspection made. Spare units can be plugged in so equipment doesn't have to be inoperable while repairs are in process.





"20" Non-Interchangeable Base



"20" Rack and Chassis Mounting Sockets

ALDEN PRODUCTS COMPANY 127 North Main Street, Brockton, Massachusetts

Here's the full line of SORENSEN

STANDARD UNITS AND SPECIFICATIONS

Nobatron Model E-6-15

AC Regulator Model 500S

Nobatron Model 5WR-5

B-Nobatron Model 500BB

Ranger Model SR-10.0

Variable Auto Transformer

AC REGULATORS Models available (numbers denote VA capacities) 150S 250S 500S (-2S) also 1000S (-2S) also 2000S 3000S (-2S) also 5000S (-2S) also 10000S (-2S) also 15000-2S	Input	95-130 VAC, 1Φ, 50-60~, 190-260 VAC in "-2S" models
	Output	115 VAC ±5%; 230 VAC with "-2S" models
	Reg. accuracy	±0.1% against line or load
	Distortion	2% — 3% max.
	P. F. range	Down to 0.7
	Load range	0 to full load
	Miscellaneous	Fully protected against overload or over-voltage. Models 150S, 250S, 500S, 1000S, 5000S, 10000S, and 15000-2S are self-contained. Cabinets available for others.
NOBATRONS** (DC Supplys—low voltage) Models available (numbers indicate voltage & current) E-6-5A E-6-15A E-6-40A E-6-100A E-12-5 E-12-15 E-12-50 E-28-5 E-28-10 E-28-30 E-28-70 E-28-150 E-28-350 E-125-10 E-200-5 Also Model SWR-5 with output either 6VDC @ 10 amp or 12VDC @ 5 amp	Input	95 — 130 VAC, 1Φ, 50-60~. In heavy current 28-volt series — 115/208, 3Φ, 4-wire, wye.
	Reg. accuracy	±0.2% against line or load changes
	Ripple	1% RMS max.
	Load range	1/10 to full load
	Output range	Adjustable ±10%; down to −25% at lesser accuracy
	Recovery time	0.2 seconds — this value includes charging time of filter circuit for most severe change in load or input conditions.
	Miscellaneous	Fully protected against overload and over-voltage. Normally for rack mounting — cabinets available. Normal finish — gray wrinkle. Meters standard in some models; available in all.
	Note	"A" models output either 6 or 7 volts.
400~ EQUIPMENT: **LINE REGULATORS**	Similar to 60~ regulators except: Accuracy ±0.5%; distortion 5% max.; VA capacities 250, 500, 1200, 2500.	
NOBATRONS**	Same general specifications as 60~ Nobatrons. Models 6VDC @ 40 amp., 12VDC @ 10 amp., 28VDC @ 10 amp.	
B-NOBATRONS** (DC Supplys — high voltage)	Input	105-125 VAC, 1Φ, 50 — 60~.
	Load range	0 — full load
	Ripple	10 mv (20 mv in 1000BB)

	Model	325BB*	360BB**	500BB*	520BB**	560BB*	1000BB*
output	VDC	0-325	175-360	0-500	200-500	0-500	200-1000
	Ma	0-125	0-120	0-300	0-200	0-200	0-500

* meters furnished as standard equipment.
regulation accuracy ±0.5%
bias supply 0-150 VDC @ 0.5Ma (except model 1000BB)

** no meters, no bias supply
regulation accuracy ±1.0%

All have 6.3 VAC, 6-10 amperes, unregulated, C.T. except Model 1000BB.

* "Isotronic" is a registered trademark denoting the electronic regulation and control of voltage, current, power, and frequency.

** Reg. U. S. Pat. Off. by Sorensen & Co., Inc.

Standard design AC regulators can be converted to meet appropriate AN-E-19, MIL, and JAN specifications.

www.americanradiohistory.com

Isotronic* PRODUCTS

STANDARD UNITS AND SPECIFICATIONS

RANGERS (Full-range-variable DC Supplys)	Input range	95 — 130 VAC, 1Φ, 50 — 60∼.			
	Reg. accuracy	±0.25% at any voltage setting.			
	Ripple	1% RMS max.			
	Output	Model	SR-100	SR-30	SR-2
		VDC	3-135	3-30	100-300
		Amps	1-10	3-30	1-10

ISOTRONIC EXCLUSIVES

Super-accurate AC Line Regulator Model 1001	Load range	0 — 1000 VA
	Input volt. range	95 — 130 VAC, 1Φ, 55 — 65∼.
	Load P. F. range	0.7 lagging to 0.95 leading
	Output voltage	115 VAC, 1Φ (adjustable from 110-120 volts)
	Distortion	3% max.
	Time constant	0.1 seconds
	Reg. accuracy	±0.01%
DC Power Source for Spectrophotometers Model E-6/2-5 Nobatron	Input volt. range	95-130 VAC, 1Φ, 50-60 cycles
	Output	
	#1 for lamp	6VDC adjustable ±10% at 5 amperes
	#2 for filament	6VDC at 100 Ma.
	#3 for bias	2VDC adjustable ±10% at 100 Ma.
	Filtering	
	#1	1% max.
	#2 & 3	0.05% max.
	Reg. accuracy	±0.01% against line changes
	Time constant	0.1 seconds under most severe line changes
Frequency Changer Model 3FCD250	Input voltage	95-130 VAC, phase to neutral, 3Φ, 4 wire
	Input frequency	45-65 cycles
	Output voltage	115 VAC, 1Φ, adjustable between 110-120 VAC
	Output frequency	400 cycles ±10%
	Output voltage regulation	±1.0%
	Output frequency regulation	±1% in standard model ±0.01% with auxiliary frequency standard
	Capacity	250 VA
	Load range	0.1 to full load
	Distortion in output	5% maximum
	P. F. range	Down to 0.7 P. F. lagging
	Time constant	0.25 seconds
	Envelope modulation	2% maximum

A single phase input model is also available.

Frequency Changer Model 3FCD250

DC Power Source for Spectrophotometers Model E-6/2-5 Nobatron

AC Line Regulator Model 1001

COAST TO COAST

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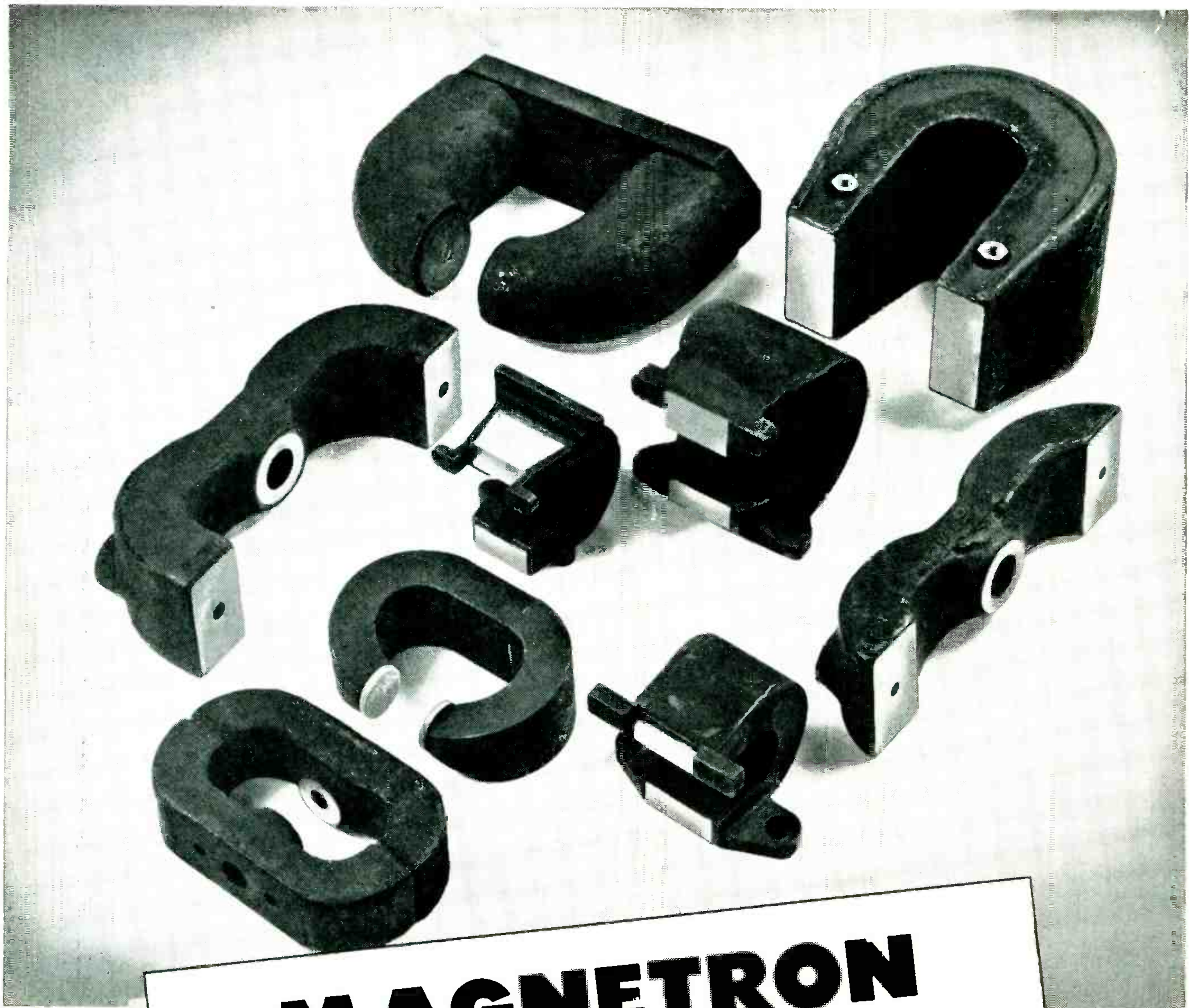

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with

- ☆ **Die Cast Aluminum Jackets**
- ☆ **Sand Cast Aluminum Jackets**
- ☆ **Celastic Covers**

Complete assemblies with Permendur, steel or aluminum bases, inserts and keepers as specified. Magnetized and stabilized as required.

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General Office & Plant: Marengo, Illinois

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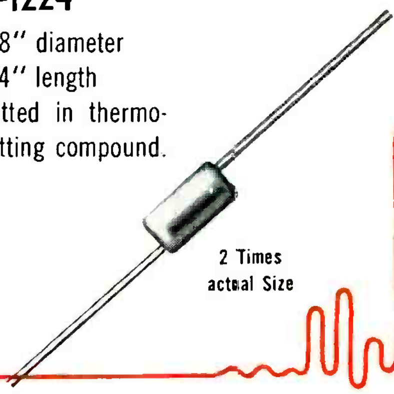
International RECTIFIER CORPORATION

EL SEGUNDO CALIFORNIA

Selenium Diodes

D-1224

1/8" diameter
1/4" length
Potted in thermo-setting compound.



2 Times actual Size

D-1290

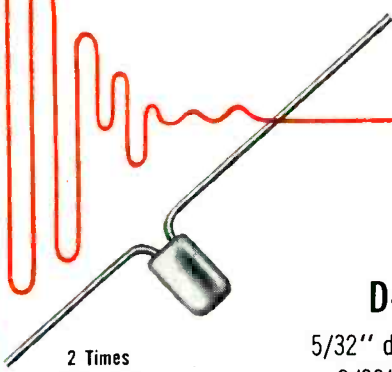
RMS applied voltage, max.	26 volts per cell
Peak inverse voltage	60 volts per cell
RMS input current, max.	3.75 milliamperes
DC output voltage	20 volts per cell
Voltage drop at full load	1 volt per cell
DC output current, avg.	1.5 milliamperes
DC output current, peak	20 milliamperes
Max. surge current	80 milliamperes
Reverse leakage at 10V RMS	2.4 microamperes
Reverse leakage at 26V RMS	12 microamperes
Frequency max. CPS	100 KC

Also available in 2, 3 and 4-cell Diodes.

D-1224

RMS applied voltage, max.	26 volts per cell
Peak inverse voltage	60 volts per cell
RMS input current, max.	500 microamperes
DC output voltage	20 volts per cell
Voltage drop at full load	1 volt per cell
DC output current, avg.	200 microamperes
DC output current, peak	2.6 milliamperes
Max. surge current	10 milliamperes
Reverse Leakage at 10V RMS	0.6 microampere
Reverse Leakage at 26V RMS	3 microamperes
Frequency max. CPS	200 KC

Also available in 2-cell Diodes.



2 Times actual Size

D-1290

5/32" diameter
9/32" length
Potted in thermo-setting compound.

International
RECTIFIER CORPORATION

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Phone El Segundo 1890

CHICAGO BRANCH OFFICE:
205 W. Wacker Dr.
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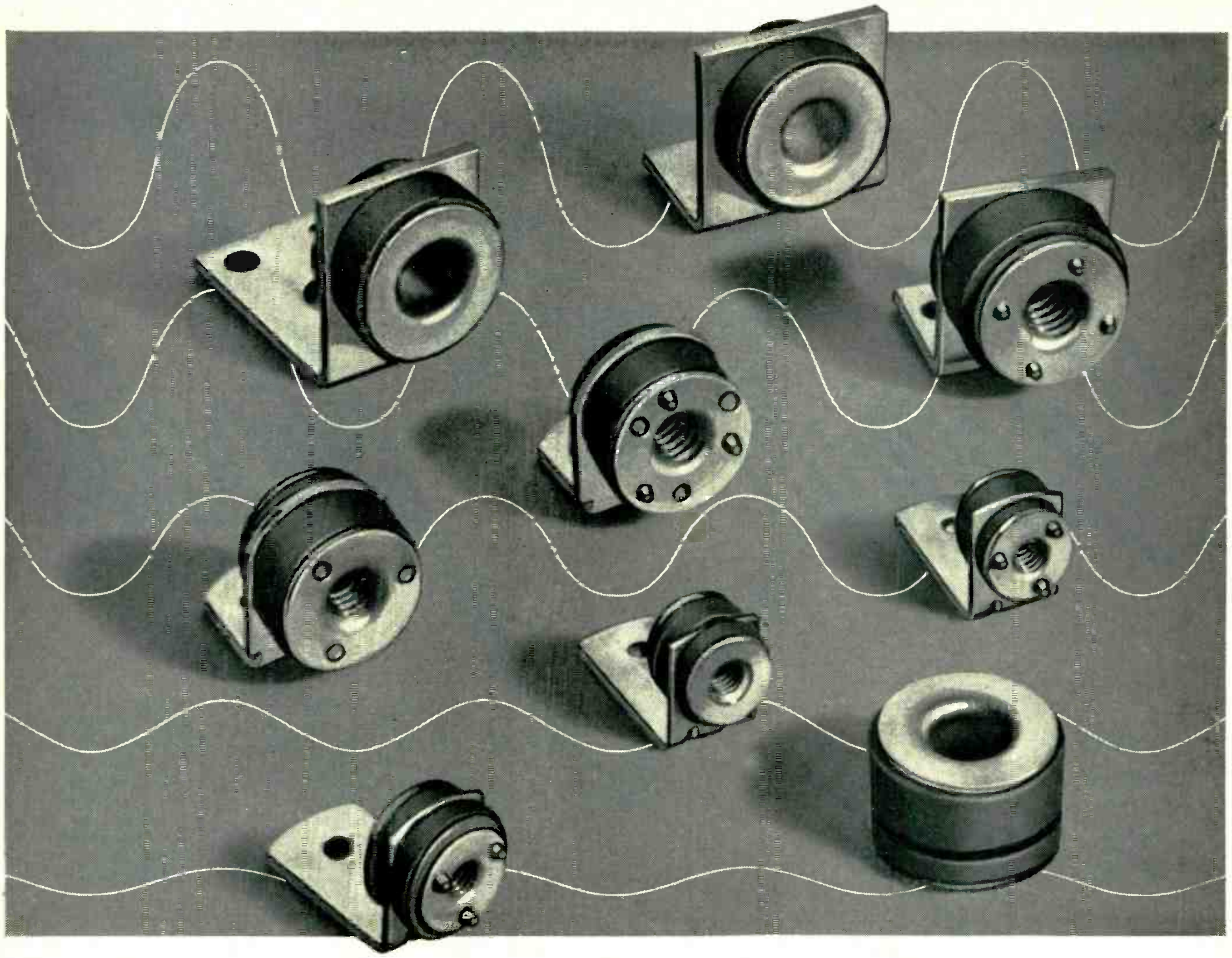

Ucinite Shockmounts

DAMP OUT VIBRATION

Designed to protect fragile equipment from impact, these cushioned assemblies also serve to isolate high frequency vibrations.

The rubber cushions can be varied to give many degrees of flexibility. Mounting brackets can be designed for equipment of various sizes and weights. Center components are available as plain eyelets or as threaded United-Carr Teenuts . . . with or without locking teeth.

Variations of the basic shockmount can be designed to meet special conditions. One version, for example, is insulated for mounting "hot" chassis. In addition to the rubber cushion, it has a fibre tube and washers which insulate the bracket from contact to ground.

* * * *

For shockmounts designed to your specifications . . . and manufactured in volume quantities . . . contact your nearest Ucinite or United-Carr field representative.

ELECTRICAL ASSEMBLIES
Ucinite
RADIO AND AUTOMOTIVE

The UCINITE CO.
Newtonville 60, Mass.
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WASTING TECHNICAL TALENT

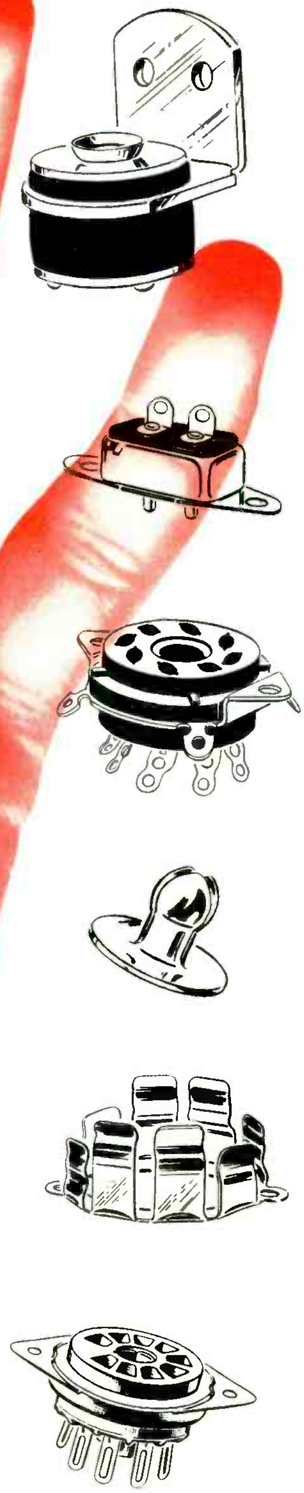
Turn over your special fastening problems to *specialists* . . . trained fastener engineers who have been through the trial-and-error stage in this highly specialized field and can free your own engineering staff for finished-product engineering.

It pays. We've proved it . . . for leading manufacturers in the electronics industry . . . and in the automotive, aviation, appliance and furniture industries, too.

United-Carr and its subsidiaries have had years of experience in the design and production of *tailor-made* fasteners and allied devices. Each division of the company provides a reservoir of special knowledge for the others. The result: an integrated organization that makes use of every improvement in materials and methods to produce fasteners that *speed assembly, cut costs* and, in many cases, actually *improve product performance.*

With complete facilities in our own plants for the volume production of special metal stampings and for the assembly of metal to plastic and ceramic components, we are in a position to supply practically any fastening need.

Before bidding on government contracts requiring fasteners or special fastening devices, consult your nearest United-Carr field representative.



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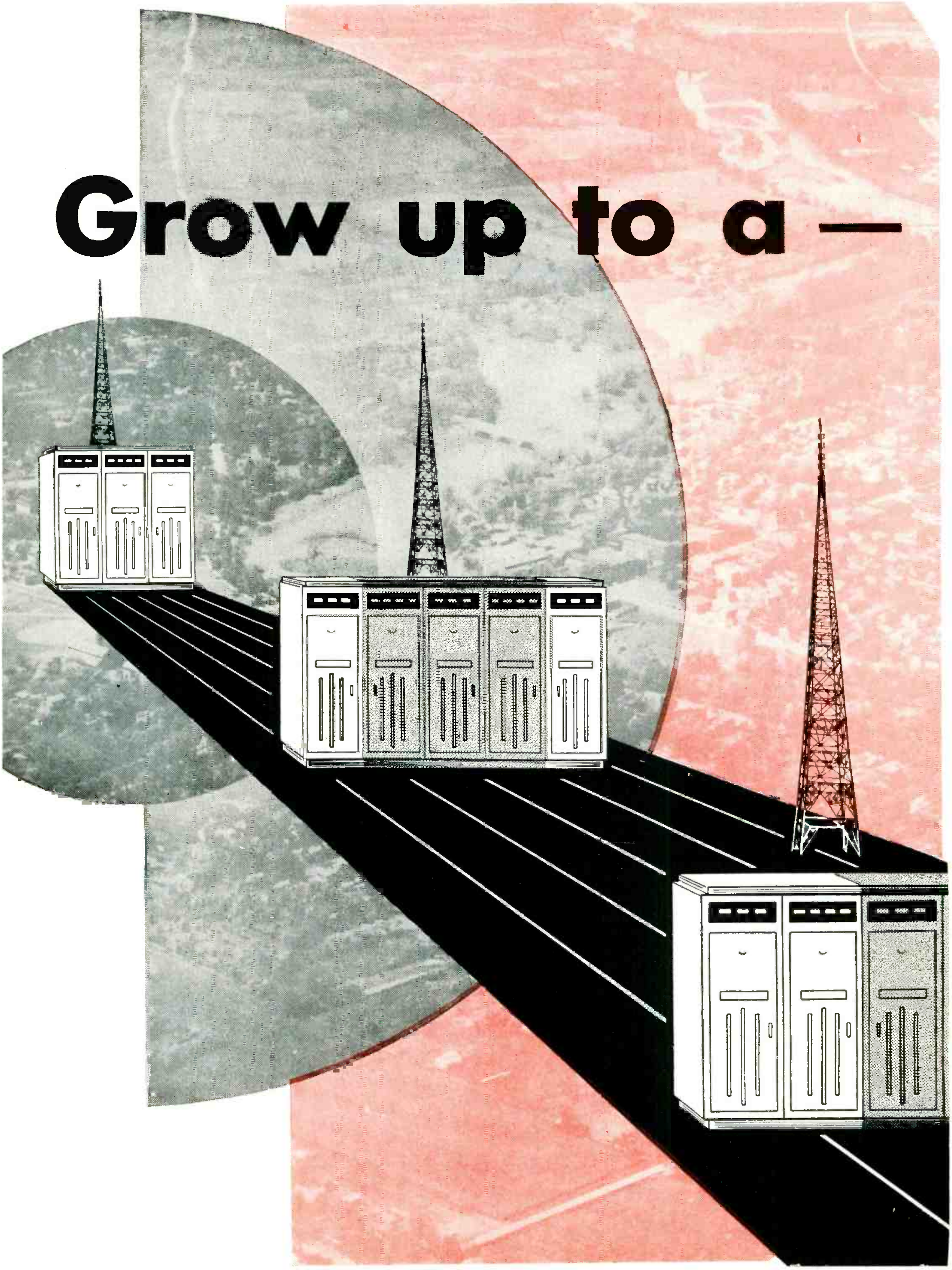

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high powered future

IN TELEVISION

When the time comes for you to consider high power, whether you are on the air now and wish to increase your power, or whether you are making application, it will pay you well to consider Du Mont. An investment in Du Mont — a Du Mont high-power transmitter is *your* investment in the same long-term operational advantages . . . the same low costs . . . the same reliability that has been proved by the Du Mont Acorn 500W and the Du Mont Oak 5KW transmitters.

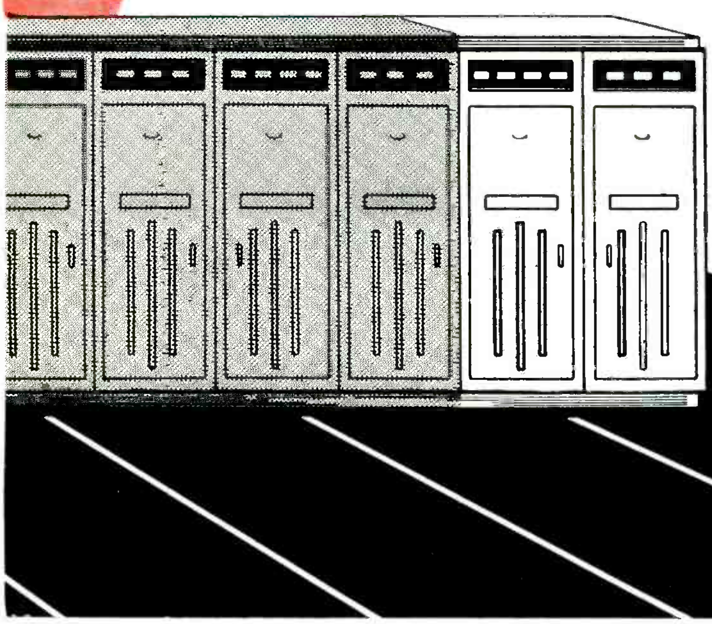
Du Mont offers two outstanding high-power transmitters — the Series 9000, 20KW low-band — the Series 12000, 40KW high-band.

Either of these transmitters driving a high-gain antenna will easily meet the maximum FCC allowed ERP of 100KW for the low-band and 200KW for the high-band.

The Series 9000 low-band transmitter employs intermediate-level modulation for most economical utilization of available tubes and features the time-proved Oak Transmitter driving a single power output tube in each of the Aural and Visual Transmitters.

The Series 12000 high-band transmitter contains the Oak Transmitter driver but utilizes a single r.f. power output tube in the Aural Transmitter and a pair in the Visual Transmitter.

No matter what power you require, consider Du Mont first for a long range, economically-sound investment. Du Mont protects your investment through minimum obsolescence.



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TELEVISION TRANSMITTER DIVISION

Allen B. Du Mont Laboratories, Inc., Clifton, N. J.

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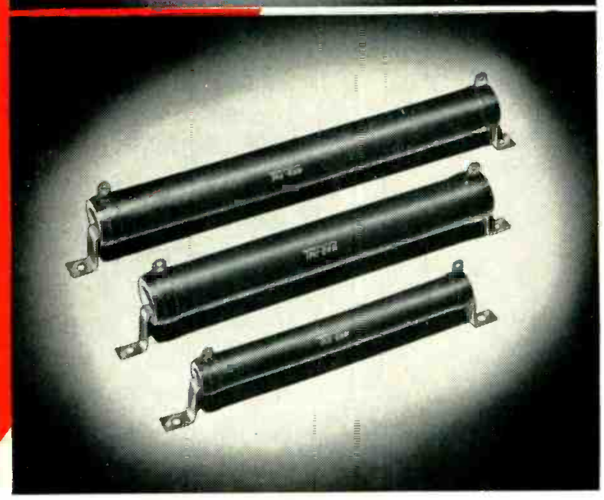
VITREOUS ENAMELED RESISTORS

The resistor line which is specified by engineers employed by the nation's foremost manufacturers of original equipment.



DELIVERY . . . two separate self-contained resistance plants guarantee prompt delivery.

QUALITY . . . as the world's leading manufacturers of wire wound resistors, we assure you that only the finest engineering techniques and material are utilized.

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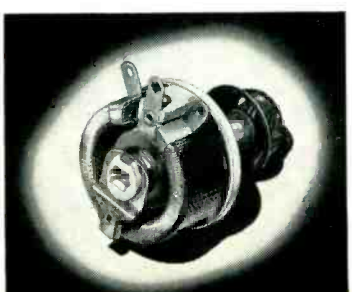
We invite your inquiries.



The New TRU-OHM Power RHEOSTAT

. . . the practical rheostat in its most exacting form, with a compensating constant pressure contact brush . . . *designed to meet JAN Specifications.* Write for complete technical literature.

Our new multi-colored catalog, complete with engineering data and illustrations, is yours without obligation. WRITE TODAY!

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MANUFACTURERS: Power Rheostat, Fixed Resistors, Adjustable Resistors, "Econohm" Resistors

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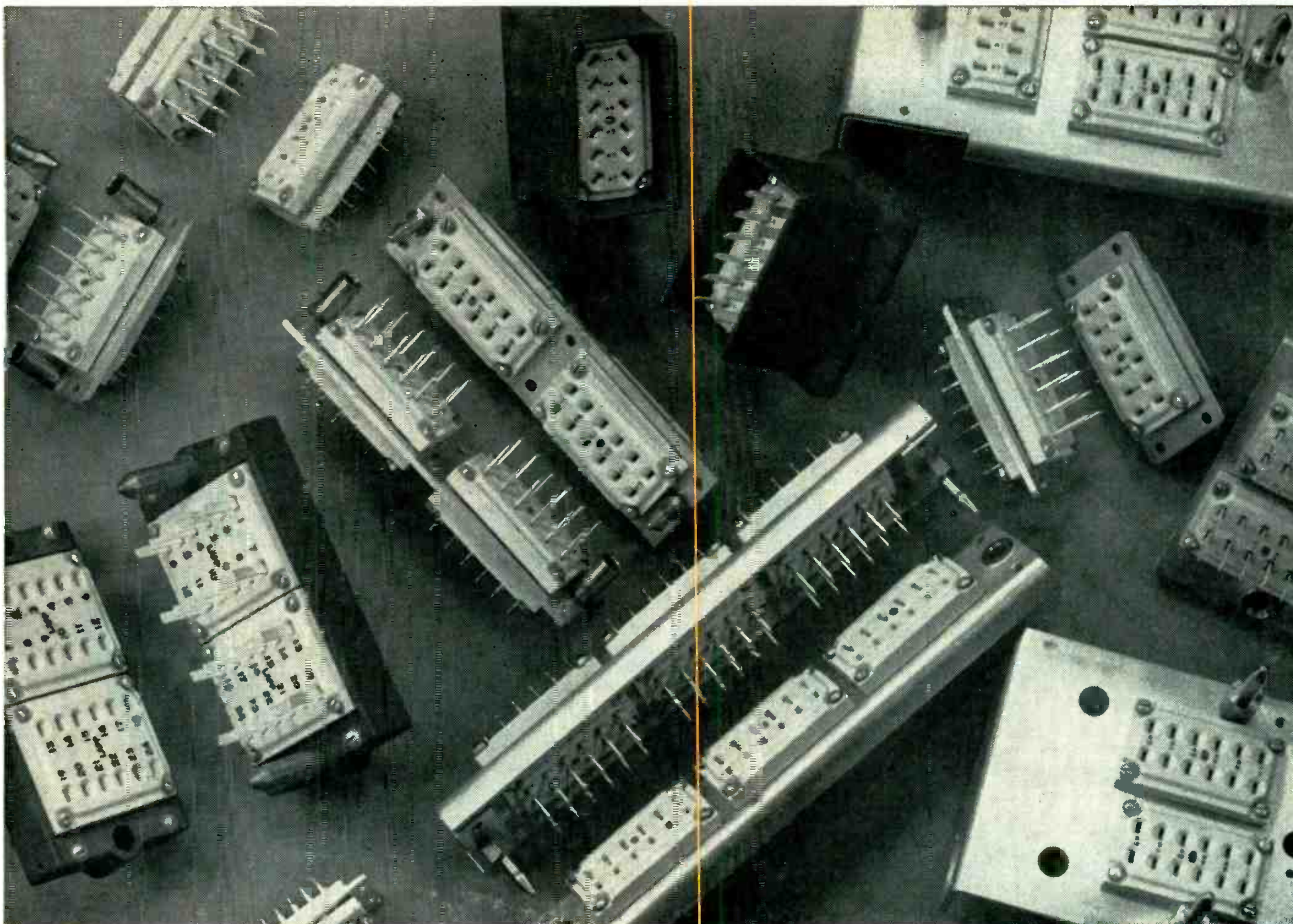

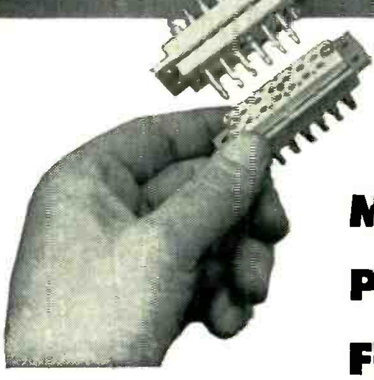

MULTIPLE-CONTACT PLUG-RECEPTACLE UNITS FOR SECTIONALIZING CIRCUITS

FOR panel-rack or other sectionalized circuits, Lapp offers a variety of plug-and-receptacle units, some of which are shown above. Any number of contacts can be provided (in multiples of twelve). Male and female contacts are full-floating for easy alignment and positive contact. Contacts are silver-plated, terminals tinned for soldering. Polarizing guide pins are provided where desired. Insulation is Steatite, the low-loss ceramic which is non-carbonizing even under leakage flashover resulting from contamination, moisture or humidity. Write for complete electrical and mechanical specifications of available units or engineering recommendations for an efficient component for your product. Radio Specialties Division, Lapp Insulator Co., Inc., LeRoy, N.Y.

Lapp

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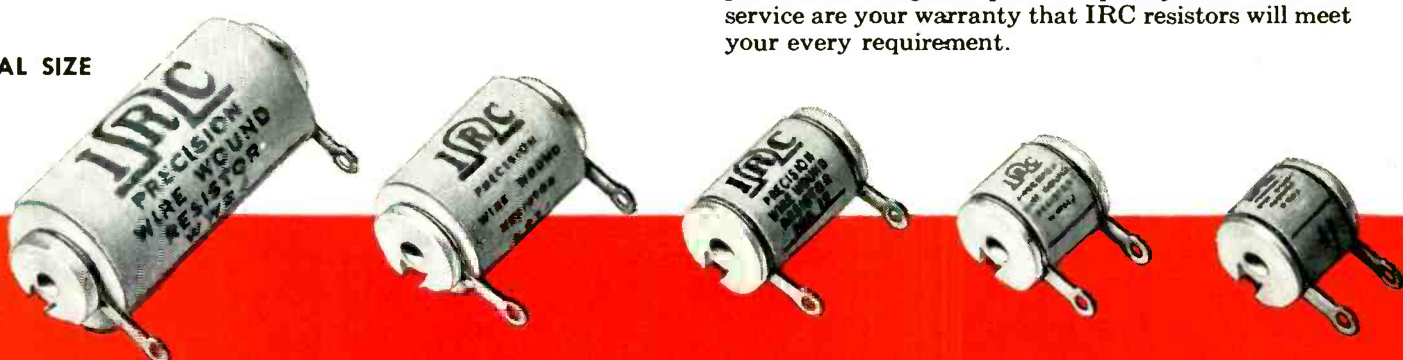
Test data are *in resistors too!*

Rigorous Tests Prove New Precision Wire Wounds Best of All for JAN-R-93 Specifications

No other resistor so far exceeds JAN-R-93 Specifications as IRC's newly developed Precision Wire Wounds! This is the impartial verdict of the most modern electrical and mechanical testing equipment applied to our own and competing resistors.

Largest producers of resistors in the world, IRC makes rigorous, thorough testing a *continuous* job, rather than an intermittent one. Pre-testing proves the design soundness of every IRC product. Tests-in-production safeguard product quality. And tests-in-service are your warranty that IRC resistors will meet your every requirement.

ACTUAL SIZE



ALL NEW Type WW Wire Wound Resistors for JAN Equipment — Industrial Applications — Miniaturization

Specifically designed for close tolerance requirements, new IRC Type WW Wire Wounds offer the finest balance of accuracy and dependability, excel in every significant characteristic under extreme heat and humidity conditions. Choice of leading producers of military equipment, these newly developed Precision Wire Wounds far surpass JAN-R-93 characteristic B Specifications! High stability suits them to a multitude of industrial uses, and compactness and small size make them ideal for miniaturization.

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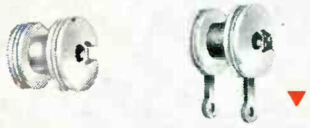
important

NEW WINDING FORMS AND TECHNIQUES—NEW TYPE INSULATION—NEW TERMINATIONS—GIVE NEW CLOSE TOLERANCE EFFICIENCY

New Winding Forms hold more wire—provide higher resistance values. Non-hygroscopic ceramic forms assure high insulation qualities, high mechanical strength, and low coefficient of thermal expansion.



New Winding Technique, developed by IRC engineers, eliminates possibility of shorted turns or winding strains. All wire used receives rigid insulation tests of special enamel coating. Additional production tests assure high quality in the finished resistor.

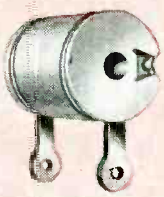
New Type Insulation insures long life under *all* environmental conditions. Winding is multiple vacuum impregnated with a new compound developed by IRC chemists. This has the unique characteristic of retaining the same consistency throughout the entire range of temperatures to which the resistors may be subjected. It is neither glassy hard nor tacky soft under any conditions. Result:—A higher degree of stability and freedom from noise, and much greater resistance to humidity.

Test the IRC Industrial Service Plan and you'll always use it to get maintenance, pilot-run or experimental quantities of standard resistors in a hurry. Your nearby IRC Distributor has these units on his shelf, can make 'round-the-corner delivery without delay. He's a good man to talk with about JAN Specifications, too. Ask for his name and address.

Typical Cycling and Load Tests Show Minimum Change in Resistance of New IRC Precision Wire Wounds

A glance at the adjacent chart will show the negligible resistance change undergone by IRC Precision Wire Wounds subjected to the most stringent and protracted cycling and load tests. Here is your assurance that new IRC Precision Wire Wounds withstand the toughest kind of service without loss of efficiency. This is only one of the many rigid tests applied to IRC Precision Wire Wounds.

	Original Resist.	1st Cycle % Chge	2nd Cycle % Chge	3rd Cycle % Chge	4th Cycle % Chge	Resist. at End of 100 hrs. load	Total % Chge	% Chge from Last Temp. Cycle to End of 100 hrs. load %	Resistance Chge at End of 100 Hrs. Load only % (no cycling)	
1	100,010	+.04	+.04	+.05	+.05	100,050	+.04	—.01	100,040	—.02
2	100,000	+.03	+.04	+.03	+.05	100,060	+.06	+.01	100,000	0
3	100,000	+.01	+.02	+.02	+.05	100,000	0	+.05	100,050	—.02
4	100,000	+.02	0	+.02	+.02	100,000	0	—.02	100,040	—.01
5	100,010	+.03	+.04	+.04	+.05	100,000	0	—.05	100,030	—.03
6	100,000	0	+.03	+.04	+.04	100,100	+.1	+.06	99,980	0
7	100,000	+.04	+.05	+.04	+.04	100,070	+.07	+.03	100,000	0
8	100,000	+.03	+.05	+.05	+.05	100,050	+.05	0	100,000	0
9	100,000	+.04	+.03	+.05	+.04	100,010	+.01	—.03	100,050	0
10	100,000	+.02	+.02	+.02	+.04	100,010	+.01	—.03	100,000	0
11	100,000	0	+.01	+.01	+.03	100,000	0	—.03		



New Terminations. All precision resistors, with the exception of WW-10, are provided with rugged lug terminals for solder connections. These provide dependable and strain-free winding terminations. WW-10, because of its small size, has wire lead termination 2" long.

SIZES AND RANGES

JAN-R-93.	1 5/32" Max.	29/32" Max.	27/32" Max.	13/16" Max.		3/4" Max.	Dia.
	2 1/8" ± 1/16"	1 1/8" ± 3/16"	1" Max. 7/8" Min.	5/8" ± 1/16"		15/32" Max.	Length
	4.00 Meg.	750,000	300,000	300,000		185,000	Max. Range
Style	RB14	RB13	RB12	RB11	RB11	RB10	None
New IRC Style #	WW2J	WW5J	WW4J	WW11J	WW3J	WW8J	WW10J
Dia.	7/8" D	3/4" D	9/16" D	9/16" D	9/16" D	9/16" D	9/32" D
Length	2 1/8" L	1 1/4" L	1" L	21/32" L	9/16" L	29/64" L	13/32" L
No. of Pies	8	4	4	2	2	1	1
J. A. N. .0015" Dia.	4.200 Meg.	1.5 Meg.	0.5 Meg.	0.300 Meg.	0.185 Meg.	0.185 Meg.	40,000 Ohms.
Commercial .0013" Dia.	6.00 Meg.	2.7 Meg.	0.9 Meg.	0.450 Meg.	0.225 Meg.	0.225 Meg.	80,000 Ohms.
.0013" Dia. 1000 Alloy							100,000 Ohms.

Power Resistors • Voltmeter Multipliers • Insulated Composition Resistors • Low Wattage Wire Wounds • Volume Controls • Voltage Dividers • Precision Wire Wounds • Deposited Carbon Precistors • Ultra-HF and High Voltage Resistors • Insulated Chokes.

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Wherever the Circuit Says —WV—

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Mail Coupon today for Full Details of New IRC Precision Wire Wounds in Technical Data Bulletin 00

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Please send me Technical Data Bulletin (Number) ☐, and/or name and address of nearest IRC Distributor ☐

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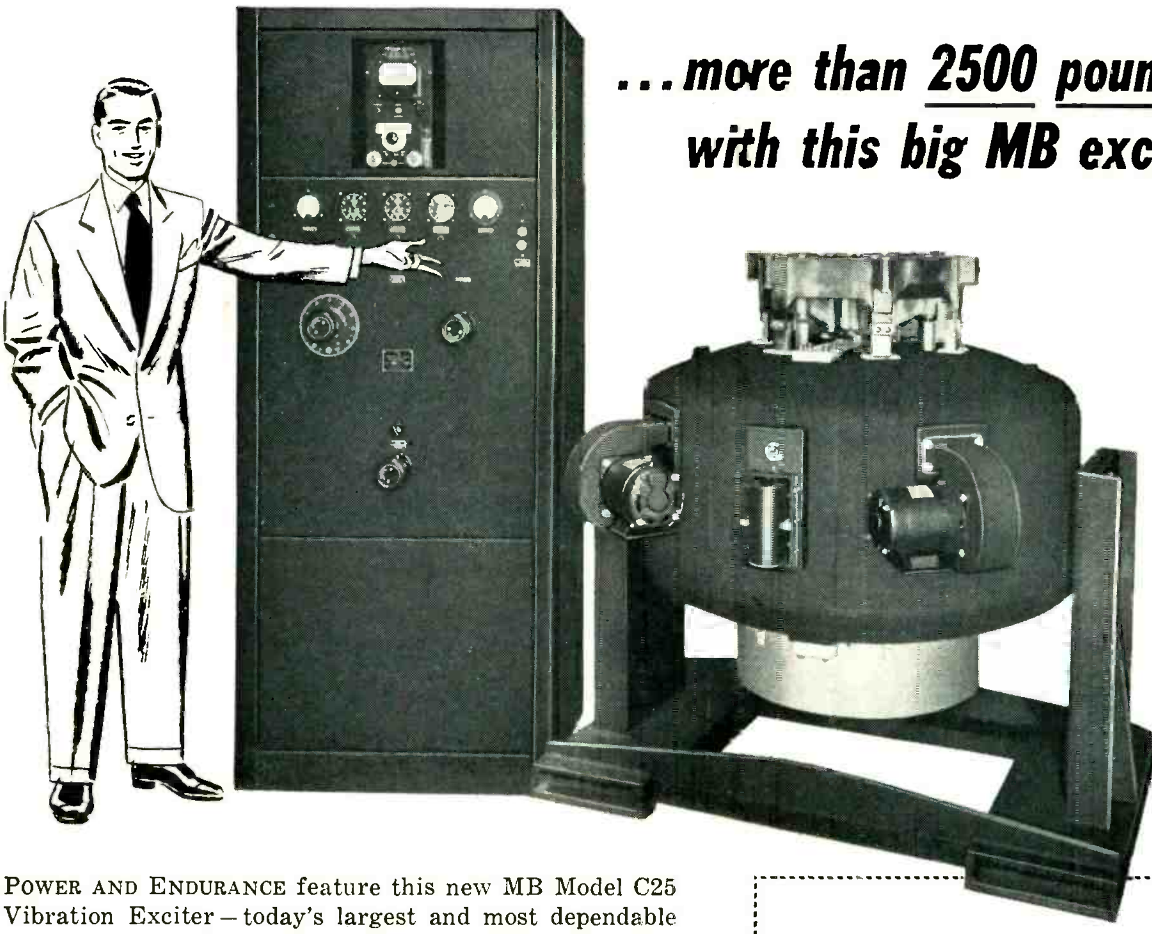
Put FORCE behind your vibration testing

...more than 2500 pounds of it with this big MB exciter



POWER AND ENDURANCE feature this new MB Model C25 Vibration Exciter—today's largest and most dependable electromagnetic shaker.

It has already proved its heavy-duty capacity in a number of important military vibration testing applications. In frequencies from 3 to 500 cps, it easily develops required forces to produce accelerations of 15g with 100 lb table load or 20g with 60 lb table load, for example.

Like all MB Exciters, Model C25 Shaker provides easy, accurate, continuous control of force and frequency. It allows "scanning" for response to vibration of parts under test. Electrically interlocking controls assure trouble-free operation. Automatic cycling control available to meet specifications of MIL-E-5272.

Vibration testing shakes out troubles before they start. It's not only a "must" for much military equipment, but also a good idea for *any* product. If you'd like to know more about it, why not contact "headquarters" for vibration engineering—MB! You'll find the help and advice you're seeking.

APPROVED MOUNT FOR ISOLATING VIBRATION

This Type 17 MB Vibration Isolator incorporates a principle first achieved by MB in mountings. It has equal spring rates in all directions in order to isolate all modes of motion with equal efficiency. Available for loads from 0.5 to 100 lbs to meet MIL-I-5432 (AN-I-16a) specification on vibration isolation. Write Dept. 5 for details.

MORE DETAILS

New bulletin containing specifications, operational information and helpful hints on usage, is now available on the complete line of MB Vibration Exciters which includes models from 10 lbs to 2500 lbs force output. Ask for **Bulletin No. 1-VE-5.**

THE MB MANUFACTURING COMPANY, INC.
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PRODUCTS AND EQUIPMENT TO CONTROL VIBRATION . . . TO MEASURE IT . . . TO REPRODUCE !

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IDEAS
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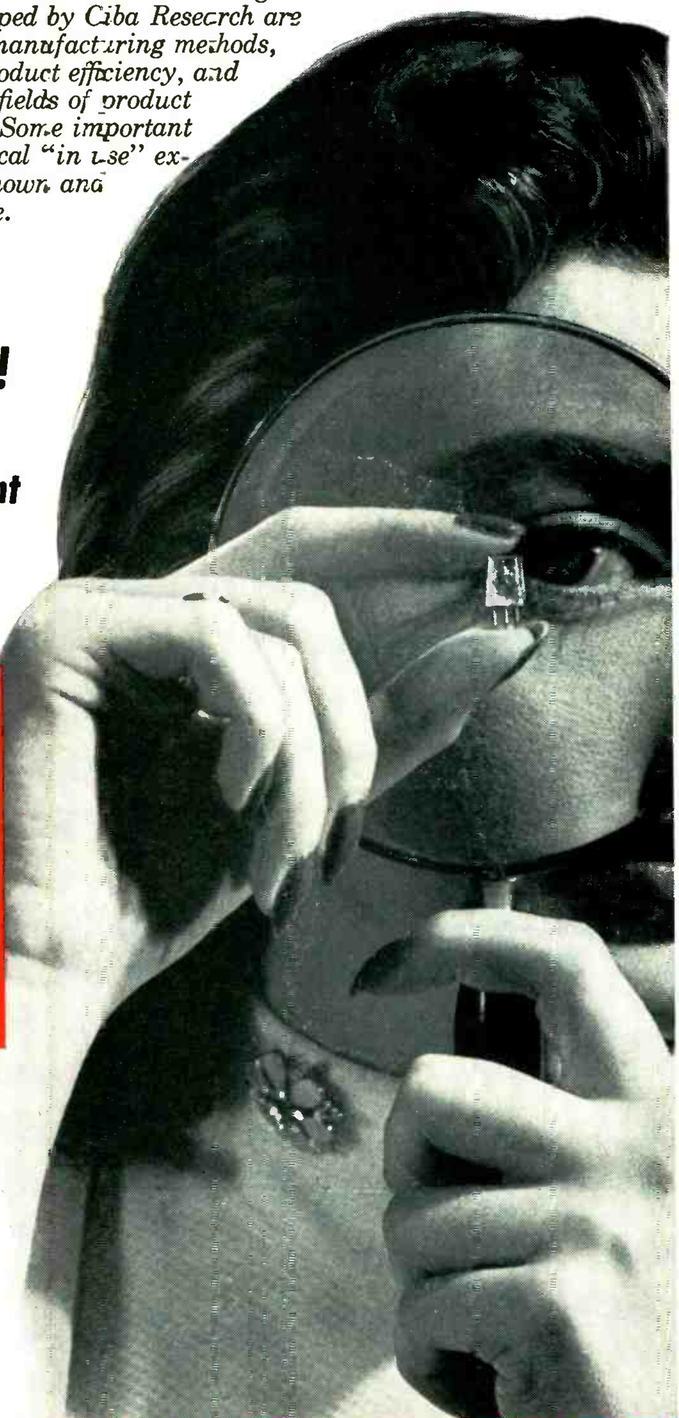
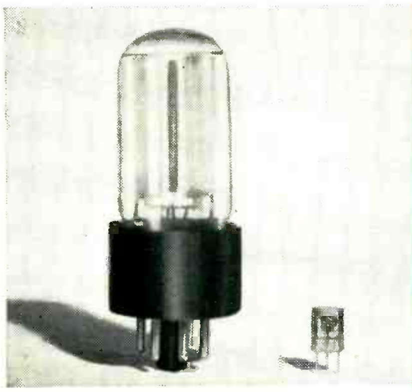
ARALDITE Bonding, Casting, Coating Resins and ARDUX* Bonding Resins developed by Ciba Research are simplifying manufacturing methods, improving product efficiency, and opening new fields of product development. Some important new and typical "in use" examples are shown and described here.*



"ELECTRONIC REVOLUTION"!

says the Nation's Press

ARALDITE RESINS specified as important component of this newest advance in "Electronic miniaturization."



DAVID and GOLIATH

The tiny but tough "Transistor" (right), is actually an electrical amplifying unit cast in ARALDITE RESIN, and reportedly does the work of electron tubes of the type shown at left.

ARALDITE CASTING RESINS have remarkable fluidity and exceptional penetration which along with their high dielectric strength, arc, corrosion and humidity resistance, affinity for metals, etc. have established their selection for filling and embedding a wide range of electrical apparatus, large and small.

ARALDITE BONDING AND COATING RESINS are similarly outstanding for their respective properties. All Araldite Resins harden practically without evolution of water or volatile matter, are economical and easy-to-use.

SEND THIS COUPON . . . or write us on your Company letterhead . . . for latest technical bulletins on physical properties and recommended procedures for use of Araldite Bonding, Casting and Coating Resins.

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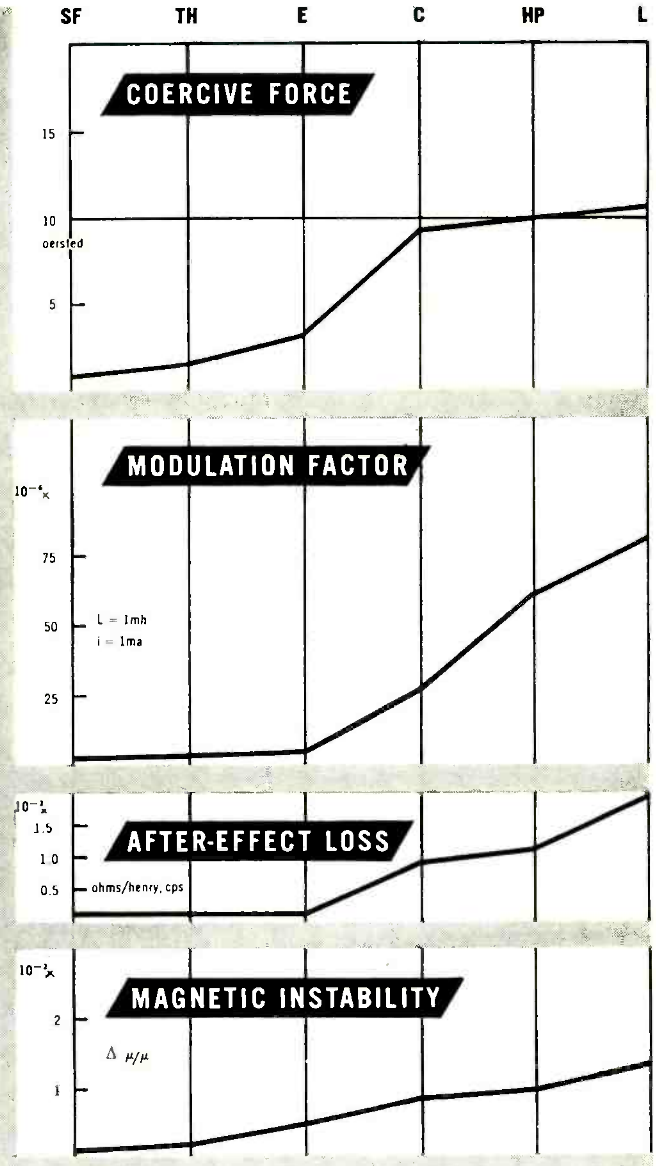
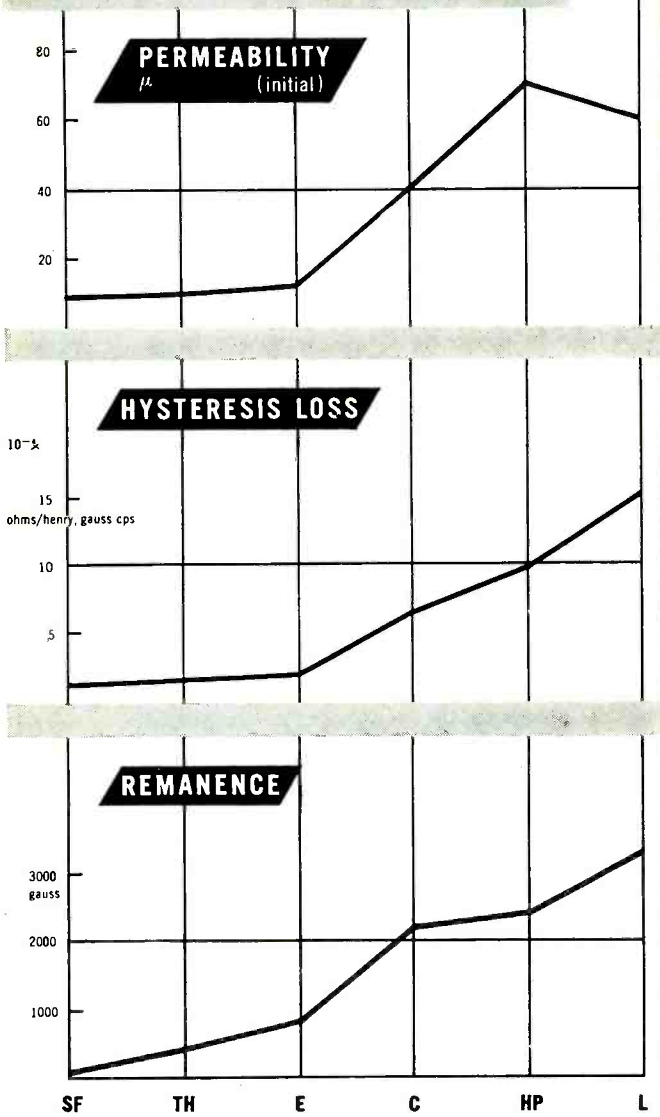
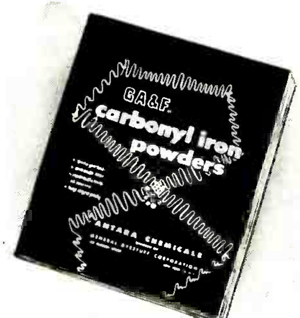
MAGNETIC CONSTANTS of the 6 STANDARD TYPES of GA & F® Carbonyl Iron Powders





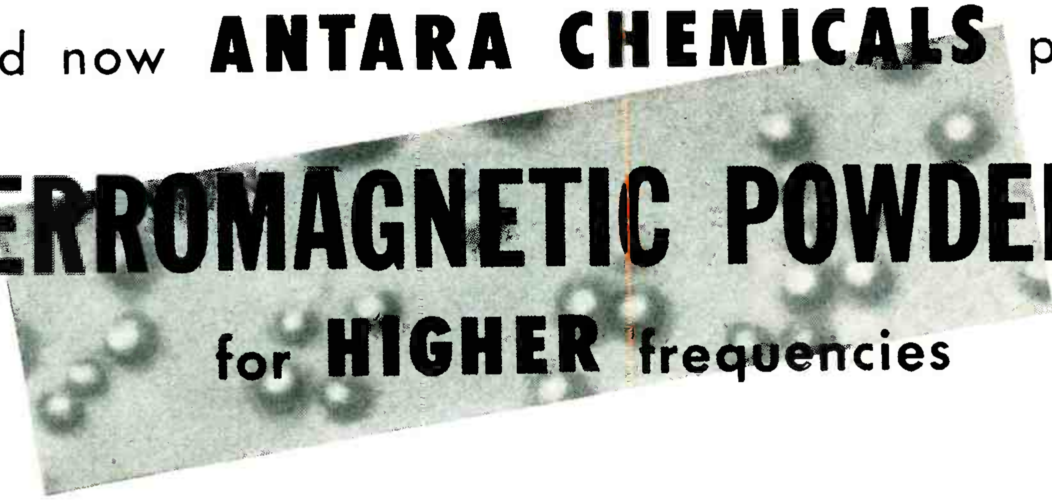
The above graphs show typical values. While the values of HP and L are close to those usually obtainable only with a good, high-purity iron powder, the values of the other types make them more favorable for the usual applications—IF, filter, pupin, etc.

THIS WHOLLY NEW 32-PAGE BOOK *offers you the most comprehensive treatment yet given to the characteristics and applications of G A & F Carbonyl Iron Powders. 80% of the story is told with photomicrographs, diagrams, performance charts and tables. For your copy—without obligation—kindly address Department 23.*



G A & F® Carbonyl

And now **ANTARA CHEMICALS** presents



FERROMAGNETIC POWDER "J"

for **HIGHER** frequencies

This powder is made from a new alloy — by the same carbonyl process which has already furnished a number of widely used ferromagnetic powders.

"J" Powder was developed in our laboratories — designed for high Q cored coils at VHF. It has the lowest losses for its relatively high permeability. Its properties compare favorably with those for the long-established Type SF. (Note the graphs on the left-hand page. These are not included in the Manual described beneath the graphs.)

Here are approximate comparisons between "J" Powder and Type SF . . . . .

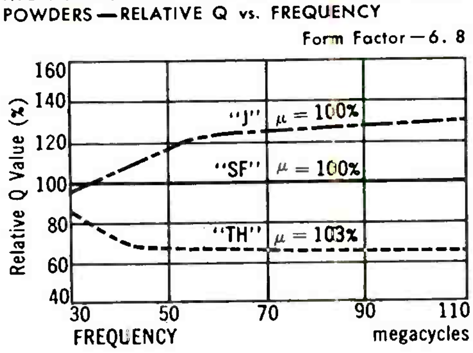
Permeability: same as SF (packing fraction being equal) or 6% higher than SF (densities being equal). *Q Values:* above 30 mc: equal or better than SF. *Loss factors:* eddy current — lower than SF; after-effect and hysteresis — higher than SF, TH or E. *Particle density:* slightly lower than SF. *Apparent density:* slightly lower than SF. *Compressibility:* same as SF. *Density ratio:* same as SF. *Stabilities* against temperature changes, humidity, long time periods, magnetic shock and chemicals: excellent, as with all G A & F Carbonyl Iron Powders.

"J" Powder is now available in quantity. We invite you to write for further details and samples — and to test it for new applications.

* * *

Collectively, G A & F Carbonyl Iron Powders blanket a wide range of applications — in electronic cores over the whole frequency spectrum, in metallurgy, in chemistry, in pharmacy and in magnetic fluids. The particles may be large, soft crystals — or extremely small, hard crystals arranged in concentric spherical-shell layers. The surfaces are free and active. The purity is invariably high, with non-ferrous metals in traces only; some grades contain beneficial small amounts of carbon, nitrogen and oxygen.

HIGH-FREQUENCY G. A. & F. CARBONYL IRON POWDERS—RELATIVE Q vs. FREQUENCY



We urge you to ask your core maker, your coil winder, your industrial designer, how G A & F Carbonyl Iron Powders can increase the efficiency and performance of the equipment or product you make, while reducing both the cost and the weight. Let us send you the book described on the left-hand page.

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Iron Powders. . .

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This is the unique two-spot feature described under feature 4 below.

Calibrating the reference junction coils for potentiometers is typical of the measurements in which we use the compact Type E Galvanometer in our own plant. This routine measurement formerly required a wall-type galvanometer with separate lamp and scale.

"E" Galvanometer Saves Space and Time

This L&N Type E Galvanometer is the right answer—in sensitivity and speed—for handling a variety of null measurements. Simply set the instrument down wherever convenient, plug into a standard outlet, and it's ready for accurate, dependable use.

Compact and self-contained, Type E has the following features:

1. It is easily placed at *any* eye level;
2. Spots show brightly on recessed scale. No scale-shade is required.
3. Zero is adjusted by simply turning the knob;
4. Unique two-spot design virtually eliminates "spot-chasing". The larger square primary spot moves with full sensitivity. The smaller but brighter spot appears at the top center of the larger spot in the illustration above. It is geared down to a fraction of the larger spot's sensitivity and moves so slowly that the user can see direction of unbalance; hence restores balance without hunting.

Type E sensitivity per mm. can be 0.5 microvolt (total circuit resistance 67 ohms); 0.005 or 0.0005 microampere—with periods of 3.0, 2.5, and 3.0 seconds respectively. The moving systems which determine sensitivity are interchangeable. Thus, a *single* Type E, with two additional systems, makes available the full range of characteristics.

This instrument is described in Catalog ED Sec. 1, which we will send on request. Write our nearest office, or 4979 Stenton Ave., Philadelphia 44, Pa.

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Nothing destroys the efficiency of most electrical insulations as quickly and surely as HEAT! With effective electrical insulating materials, smaller sized electrical equipment will deliver efficient service at higher temperatures.

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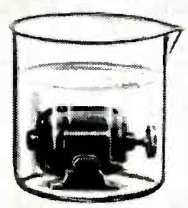
For example, Fiberglas-braided instrument wire resists high ambient temperatures, is unaffected by soldering heat. Fiberglas tapes, varnished cloths, sleeving and tubing, cords, and laminates, as used in electrical apparatus, resist high heat . . . deliver top service far longer than conventional materials.

So, if you're a maker or user of electrical equipment, remember to specify FIBERGLAS.

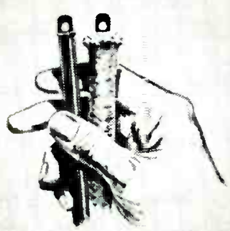
Electrical Sales Division, Owens-Corning Fiberglas Corporation, Dept. 860, 16 East 56th Street, New York 22, New York.

FIBERGLAS YARNS ALSO GIVE YOU THESE COST-SAVING ADVANTAGES

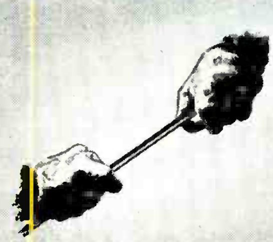


MOISTURE RESISTANCE
Wire, cable, and apparatus resist moisture better, if they're made with Fiberglas materials.

OIL AND ACID RESISTANCE
Fiberglas insulating materials resist the ravages of oils and acids.



EXCELLENT SPACE FACTOR
Tough, small-diameter Fiberglas yarns permit design of smaller, lighter electrical equipment.



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Even in small diameters, Fiberglas yarns have higher tensile strength than any other insulating textile.

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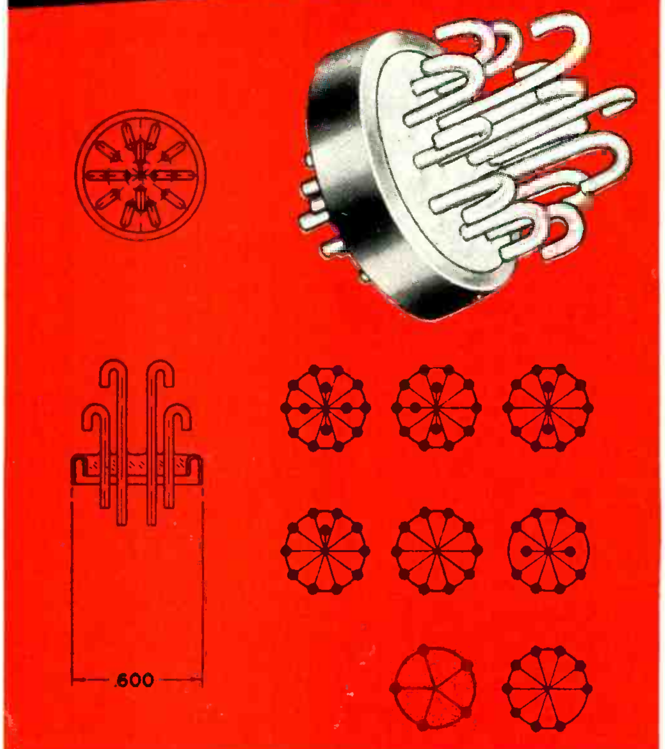
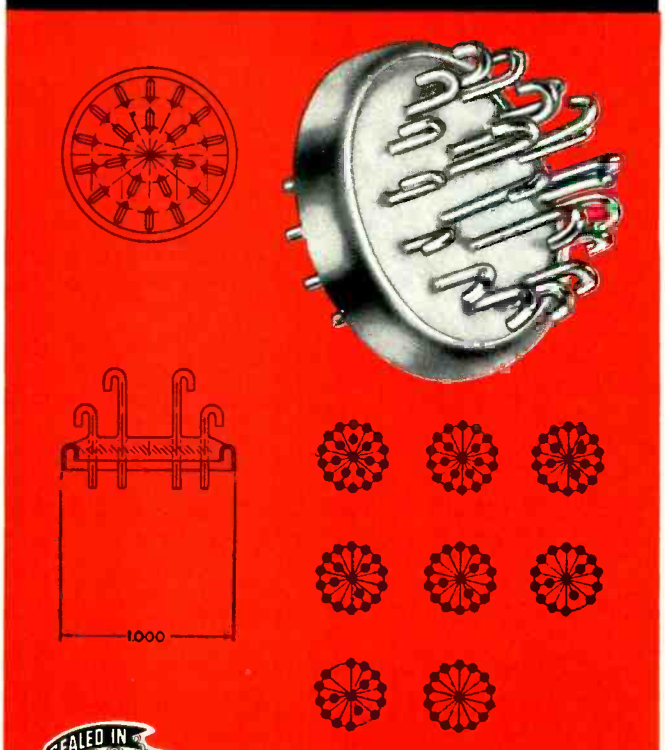
HERMETIC Leads the Field in its Miniaturization Program



Terminals and Headers are Available in RMA Color Code.



A MAJOR ACHIEVEMENT in *Electronic Applications*

Multi-Terminal Headers from .600" to 1.000" Outside Dimension

HERMETIC's new multi-terminal headers 600 Series with 14 terminals and 1000 Series with 21 terminals, both utilizing the same configuration, are models of precision electronic engineering.

600 Series has 14 terminals; 10 on a pitch circle of .350" dia. and 4 on a pitch circle of .140" in an outside dimension of .600" in any configuration shown.

1000 Series has 14 terminals in the outer pitch circle of .656" and 7 terminals on the inner pitch circle of .312" in an outside dimension of 1.000" in any configuration shown.

These new units join HERMETIC's already well-known ceramic-metal, multi-terminal headers: 750 Series, 800 Series and 900 Series. All of units listed are also available in standard or special tubular arrangements.

In addition to their exclusive design features, they will withstand mass spectrometer leak tests, -55° F. sub-zero conditions, swamp test, temperature cycling, high vacuum, high pressure, salt water immersion and spray, etc. They are the only headers you can hot tin dip at 525° F. for easy assembly soldering for a strain and fissure-free sealed part with resistance of over 10,000 megohms.

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Where you will find THE REAL REVOLUTION

"If we keep in mind the values of opportunity, competition, democracy, productivity, then it is our capitalist society which is the truly revolutionary one – the only society which offers true hope to the masses for release from the long nightmares of tyranny. It is we, not the Marxists with their reactionary ideas of the good dictator, who have the truly constructive, the truly revolutionary ideal."

– from "Capitalism" by David McCord Wright.

If we can only win recognition of this truth, we shall win the struggle of free men against communism. This editorial discusses some of the hurdles that must be cleared.

To win the needed recognition that "our capitalistic society... is the truly revolutionary one," we must keep pounding away both abroad and at home. That is because the communists simultaneously attack us on an international front and try to undermine us from within.

The present drive to rearm ourselves and our allies is crucial to our self-protection on the international front. We must be prepared to meet the armed force of aggressive communism with armed force if we are to secure our physical freedom.

Arms are not enough

But to re-establish parity in arms is only half of the battle. In the last analysis it is not the more important half. To be effective, our arms must be backed by loyalty of men to our ideals. So, both abroad and at home, we must win men to the faith that we do have "the truly constructive, the truly revolutionary ideal."

On the international front, the effort to win adherence to such faith in our capitalist society meets tough going. That arises from the fact that in some of the countries that are allied with us in the fight against communism, capitalist society has offered to its people no such ideal. In varying degrees "the values of opportunity, competition, democracy, productivity" – those key aspects of American capitalism—are either absent or subordinated in their economic life. Indeed, the *Wall Street Journal* recently remarked that "to the European, capitalism has become synonymous with cartels – and with the disregard cartels foster for the consumer, the worker and the over-all well-being of the nation's economy."

No Simple Solution

Nonetheless, many European labor and governmental leaders sincerely believe that cartels are essential to their economic salvation. They believe that without such restrictions in congested European markets there would be intolerable cut-throat competition and instability of employment. Thus, when we point out that the cartel capitalism so prevalent in Europe lacks the constructive qualities of competitive American capitalism, we may offend European leaders whose wholehearted cooperation we need in the fight against communism.

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But, if we soft-pedal that contrast, we sacrifice the opportunity to win understanding and loyalty from millions of Europeans who have had no chance to learn that capitalism can be the constructive and liberalizing force that it is in the United States. Indeed, when many of these millions embrace socialism it is not because they love it. They are rather desperately seeking a tolerable middle course between what they consider the hateful extremes of communism and the undesirable aspects of capitalism as they understand it.

New name not the answer

We know that there is no easy way to handle the problems created by such misunderstanding of American capitalism. Neither do we share the belief that much of the difficulty would be overcome if we were to call American capitalism by some other name. By doing that, the argument runs, we shall relieve it from the unpleasant connotations that are attached to the word capitalism in some other parts of the world. But, after all, if we are to give up all the terms that have come to mean something else in other parts of the world, we must begin by ditching the term "democracy" which, in the official jargon of the Kremlin, seems to mean what we call dictatorship.

In spite of the difficulties, however, we must stick to this job of exporting the truth that our capitalist system does offer opportunity, competition and democracy. We must let the rest of the world see that it means a continuous drive for increased productivity, and the search for profits by increasing sales and consumption, not by trying to sell less for more.

Export alone not enough

The spreading of truth about American capitalism will not be effective if it is merely directed abroad. Unless it is carried on at home also, it will lack the driving faith that is essential to any convincing export of this type. Nor will export alone come to grips with the communist attack on our country from within—an attack that gets too much help from loyal Americans who short-sightedly repudiate the basic principles of our institutions in their efforts to reform some of their deficiencies. For success both at home and abroad, we must have right here at home a much more militant recognition that it is in fact our capitalist society which offers "the truly constructive, the truly revolutionary ideal."

Here at home, too, this raises difficult complications. Businessmen who are among the leaders and principal practitioners of capitalism, have generally been catalogued as conservatives. Hence, many people must stretch their imaginations a bit to see that businessmen are leaders of a development which has so greatly and so rapidly improved the lot of free men in America that it is truly revolutionary.

These difficulties of definition, however, are relatively superficial aspects of the problem of seeing our capitalist society clearly. The basic facts are that:

American capitalism is leading free men to an ever higher material standard of living while respecting their spiritual, social and political freedom.

Communism is leading its people back into a life of servile regimentation under dictatorship.

American capitalism advances to high ground never before attained by free men. Communism retreats to ground that men with an appetite for freedom throughout the ages have sought to escape. If we can establish this truth firmly, around the world, we shall no longer need to worry about communism. It will be hopelessly sunk.

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A Guide—for MAGNET WIRE Insulation Removal

TYPES OF WIRE AND STRIPPING METHODS

Type of Winding	DCC	Glass	EC	Formvar-Cotton	PE	HF	HNC	Method of Stripping
Motor Stators	x	x	x	x	x	x	x	Brushing
			x	x	x	x	x	Brushing & Burning
	x		x	x	x	x	x	Welding
						x	x	Chemicals
	x	x	x	x	x	x	x	Scraping
Wound Armatures Wire sizes 8-20 AWG	x	x	x	x		x	x	Brushing
				x		x	x	Burning & Brushing
						x	x	Chemicals
						x	x	Scraping
Wound Armatures Wire sizes 21-30 AWG					x	x	x	Brushing
						x	x	Burning
						x	x	Hot Solder
					x	x	x	Chemicals
Wound Armatures Wire sizes 31-40 AWG					x	x	x	Brushing
						x	x	Burning
						x	x	Chemicals
					x			Sanding

Type of Winding	Paper DCC	Glass	°HNC Farm. Cotton	PE	°HNC HF	*Nylen *Celen	Nylon Celanese Over *Nylen *Celen	Nylon Celanese Over HF-°HNC	Silk Over HF-°HNC	Silk Over PE	Method of Stripping
Transformers (large) & Solenoids (large)	x	x	x	x	x						1. Brushing
			x		x						2. Burning & Brushing
	x		x		x						3. Welding
					x						4. Hot Solder
				x	x						5. Chemicals
				x	x						6. Scraping
Transformers (small) & Solenoids (small)				x	x			x	x	x	1. Brushing
					x						2. Burning & Brushing
					x			x			3. Hot Solder
						x	x				4. Soldering Iron
				x	x						5. Chemicals
				x	x						6. Scraping or Sanding

*Nylen = Nylenamel
EC = Enamel Cotton

*Celen = Celenamel
HF = Formvar

° HNC = Nylclad a Formvar-Nylon coated wire
PE = Plain Enameled Wire, Beldenamel

Hot Solder:—This method is well adapted in many applications for removing Nylclad or Formvar films with or without nylon or celanese textile covering. The leads are tinned and ready to solder after this operation. Sizes 21 to 30 AWG represent a range that is best adapted for this method. The high surface tension and temperature of the hot solder, the tendency for the solder to amalgamate and reduce the size or embrittle fine wire leads usually limits the usefulness of this method to the intermediate wire sizes shown.

A 50-50 lead-tin solder bath is used generally, at a temperature of approximately 500°C or higher. The tin percentage, after the bath has been used for sometime, will decrease. Tin additions must be made therefore from time to time as dictated by experience.

Some formulations of Formvar films are not uniformly removed by the hot solder method and erratic results sometimes are encountered. Formvar nylon combination coatings such as Nylclad can be removed consistently.

Brushing:—For large wire sizes with insulations such as cotton glass (with or without plain enamel, Formvar, Nylclad), Formvar, Nylclad, plain enamel, revolving steel wire brushes are in general use for stripping apparatus leads.

For finer film coated wire, glass fibre brushes are being increasingly used. In the case of fine wires, steel wire brushes tend to scratch the copper and embrittle the leads whereas glass fibre brushes remove the insulation with a burnishing action and have practically no injurious effect on the copper itself.

Burning:—Equipment has been developed and is being used especially for stripping wound motor armature leads that first removed the insulation by burning. Copper oxide thus formed is next removed by brushing.

Welding:—Lead wires and coil leads frequently are welded. A small high-temperature gas flame is applied to heat the spliced lead to a temperature that just melts the copper. This method is used extensively for medium and large motor stator coils. In this operation, of course, all the film coating and textile is burned off.

Chemicals:—There are many proprietary compounds in general use for stripping film-coated magnet wire. They have one property in common. All are evil smelling and injurious to the skin. Care must be exercised therefore in handling these materials, and for some the use of a ventilated enclosure or hood is mandatory.

Soldering Iron and low-temperature solder pots:—Celenamel and nylon film-coated wires are in general use, particularly in the radio and television industry. Both materials being thermoplastic can be removed by using a rosin alcohol flux and the application of a soldering iron, or dipping in 650°F lead-tin solder.

Reprints of this table for shop use available on request.

Belden MAGNET WIRE

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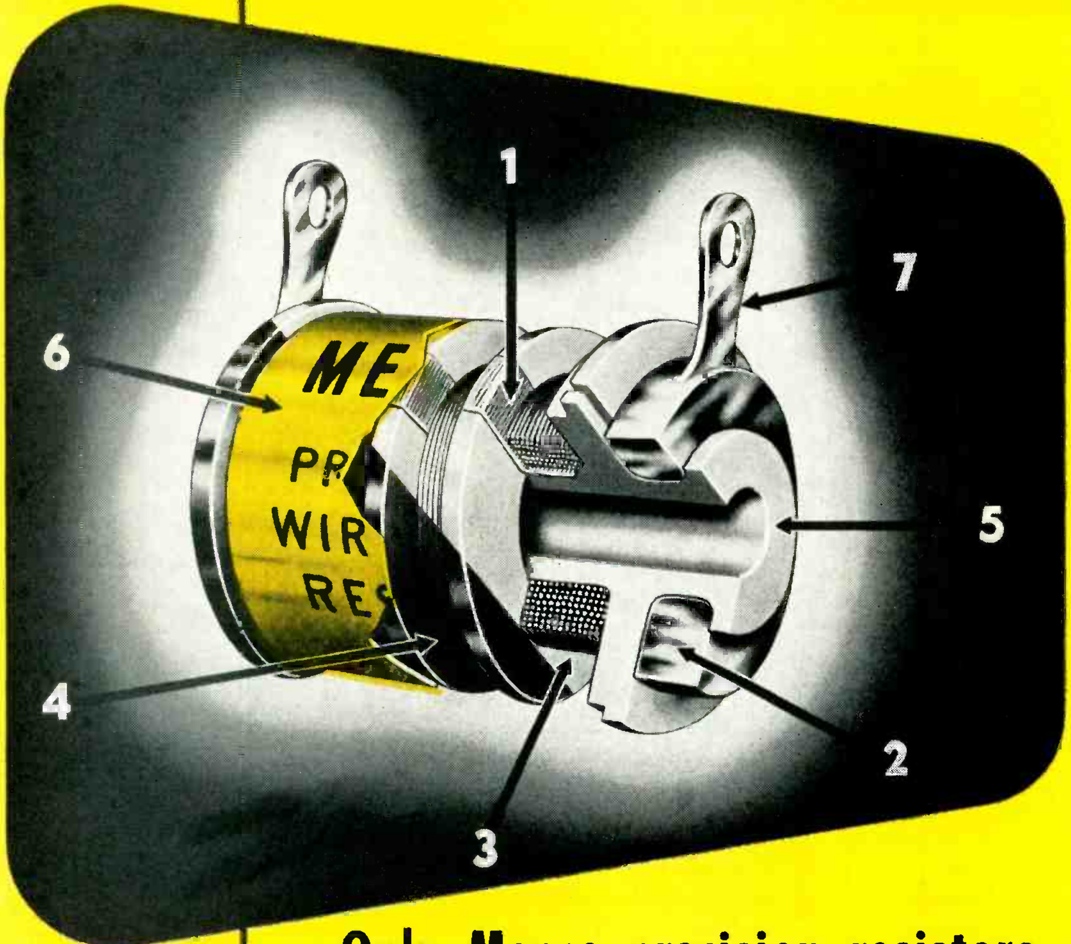

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6. Protective fungi resistant acetate label.
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Sensitive Wide Band Electronic Voltmeter

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1 millivolt to 1000 volts

from . . .
15 cycles to 6 megacycles

with accuracy of . . .
3% to 3 mc; 5% above

with input impedance . . .
6 mmfds shunted by 11 megs

When used without probe, sensitivity is increased to 100 MICROVOLTS but impedance is reduced to 25 mmfds and 1 megohm

MODEL 314
Price $265

Featuring customary Ballantine

SENSITIVITY — ACCURACY — STABILITY

- Same accuracy at *ALL* points on a logarithmic voltage scale and a uniform DB scale.
- Only *ONE* voltage scale to read with decade range switching.
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- Stabilized by generous use of negative feedback.
- Provides a 60 DB amplifier flat within 1 DB from 50 cycles to 6 MC.

Specifications on other Ballantine Electronic Voltmeters

MODEL	FREQUENCY RANGE	VOLTAGE RANGE	INPUT IMPEDANCE	ACCURACY	PRICE
300	10 to 150,000 cycles	1 millivolt to 100 volts	1/2 meg. shunted by 30 mmfds.	2% up to 100 KC 3% above 100 KC	$210.
302B Battery Operated	2 to 150,000 cycles	100 microvolts to 100 volts	2 megs. shunted by 8 mmfds. on high ranges and 15 mmfds. on low ranges	3% from 5 to 100,000 cycles; 5% elsewhere	$225.
305	Measures peak values of pulses as short as 3 microseconds with a repetition rate as low as 20 per sec. Also measures peak values for sine waves from 10 to 150,000 cps.	1 millivolt to 1000 volts Peak to Peak	Same as Model 302B	3% on sine waves 5% on pulses	$280.
310A	10 cycles to 2 megacycles	100 microvolts to 100 volts	Same as Model 302B	3% below 1 MC 5% above 1 MC	$235.

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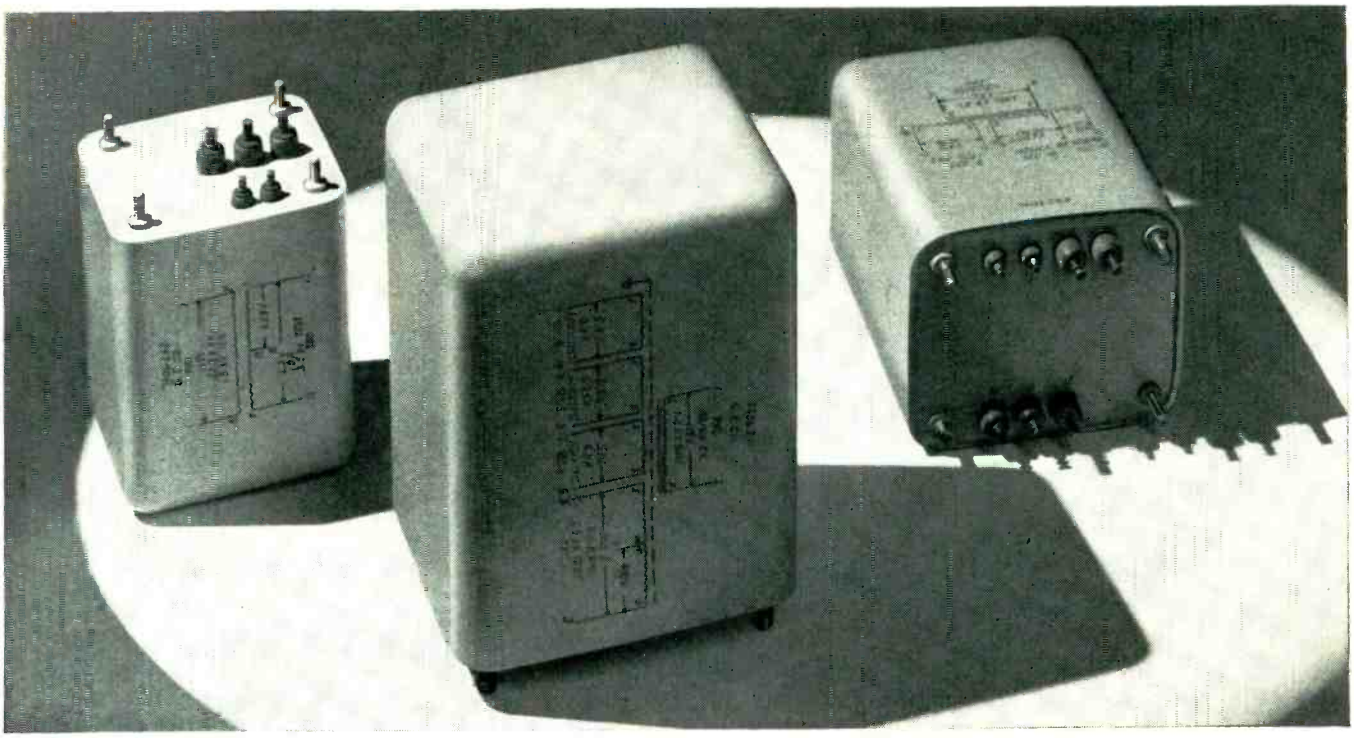

New silicone bushings and drawn-steel case mean longer life, better seal.

New G-E hermetic transformers available for immediate shipment

Transformer covers are press-fitted to case for strength, then solder-sealed against dust and moisture on this induction heater.

Enlarged production facilities, rigid quality control mean more units built to MIL-T-27 specs

Uninterrupted supplies of General Electric's new hermetically sealed MIL-TEE transformers are helping speed production of electronic equipment to meet record military demands. These compact, newly designed units withstand extreme operating conditions. Streamlined drawn-steel cases have only one soldered seam. Tough, shockproof silicone rubber bushings effectively resist corrosion and temperature excesses.

To simplify equipment design and to reduce costs, this new line is standardized in 11 case sizes. Your G-E representative can give you full details. And to learn why these transformers more than meet MIL-T-27 Grade 1 performance requirements, send for new Bulletin GEA-5778. *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

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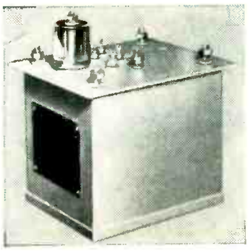
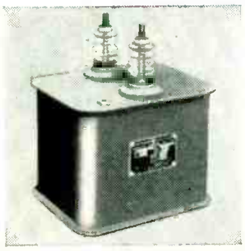
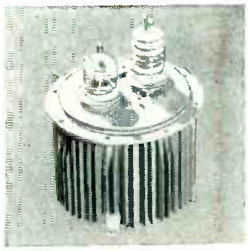
DIGEST

TIMELY HIGHLIGHTS ON G-E COMPONENTS


Rectifiers


Reactors


Transformers

Compact high-voltage components offered in wide range of ratings

G-E high-voltage components—designed for applications 5000 volts and higher where corona must be kept to a minimum—are available tailored to meet your needs.

All are oil filled and hermetically sealed to resist moisture, dirt, and dust. Conforming to MIL specs for military electronic equipment, these components are sturdily designed for reliable service under severe operating conditions, including mechanical shocks and widely varying temperatures.

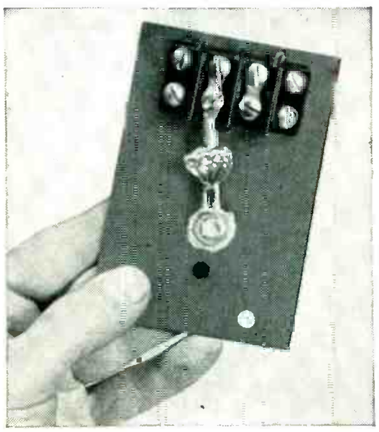
In sending your design inquiries, include all functional requirements, limiting dimensions, and expected quantities. Write to *General Electric Co., Sect. 667–20, Schenectady 5, N. Y.*

Germanium rectifiers in industrial ratings!

For use where size and weight are important, new G-E industrial germanium rectifiers offer:

- lowest forward drop per amp—for best regulation
- highest output voltage per cell
- best current output
- smallest size per watt output
- lightest weight per watt output
- instantaneous rectification

For ratings and operating characteristics, see new Bulletin GEA-5773.



New hermetically sealed relay resists breakdown

G.E.'s new hermetically sealed aircraft relay for use in exposed locations has extra protection against permanent breakdown due to voltage surges. Special polyester compound used to mold contact arms into stack insulation is non tracking, provides greater arc resistance. More powerful magnet structure yields higher tip pressures for surety of make. Rated 28 volts d-c, 3 amp. See Bulletin GEA-5729.

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A partial list of the thousands of items in the complete G-E line. We'll tell you about them each month on these pages.

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Transformers	Control switches
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Delay lines	Selsyns
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☐ GEA-5729 Hermetically sealed Relays
☐ GEA-5773 Germanium Rectifiers
☐ GEA-5778 MIL-T-27 Transformers

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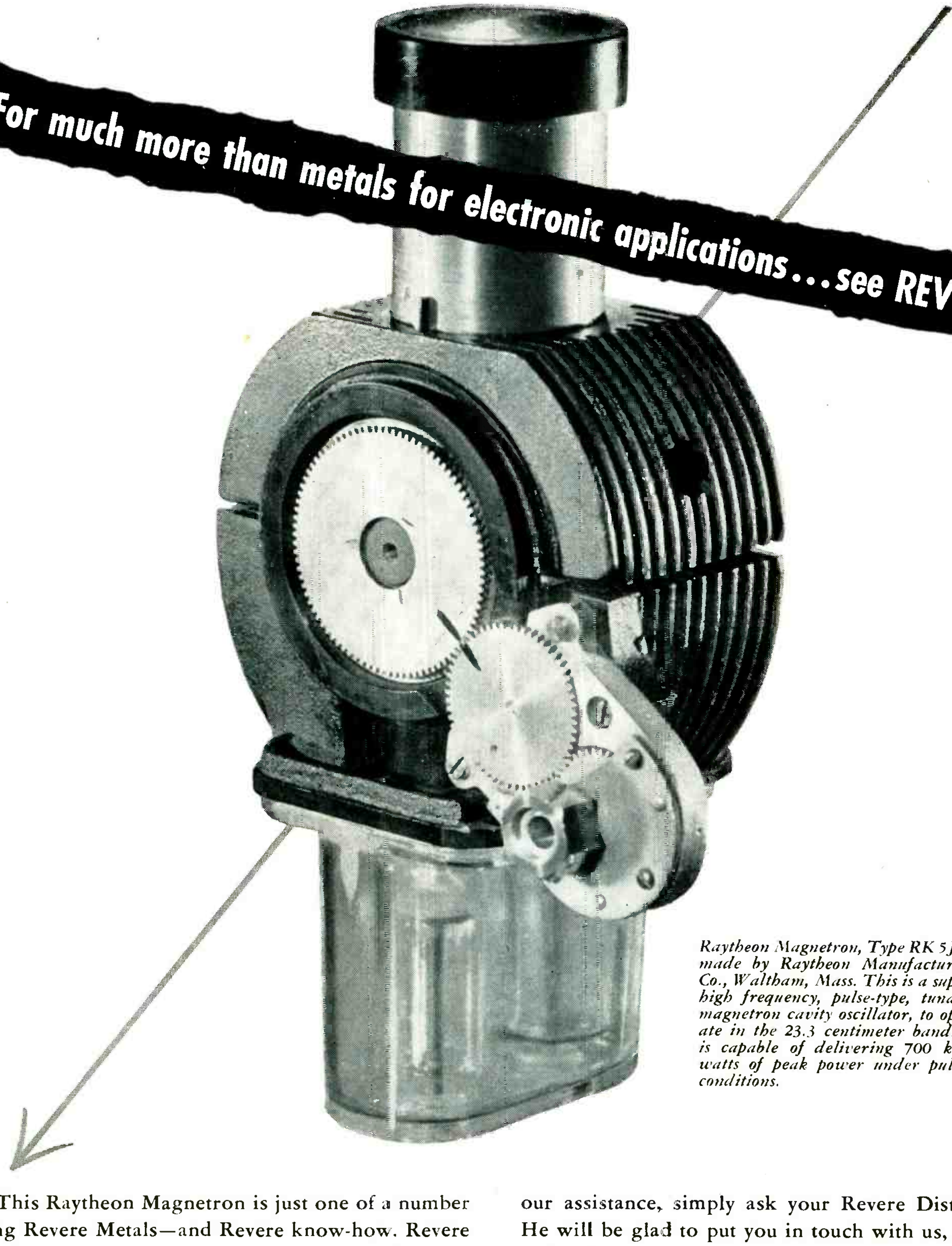

Raytheon Magnetron, Type RK 5J26, made by Raytheon Manufacturing Co., Waltham, Mass. This is a super-high frequency, pulse-type, tunable magnetron cavity oscillator, to operate in the 23.3 centimeter band. It is capable of delivering 700 kilowatts of peak power under pulsed conditions.

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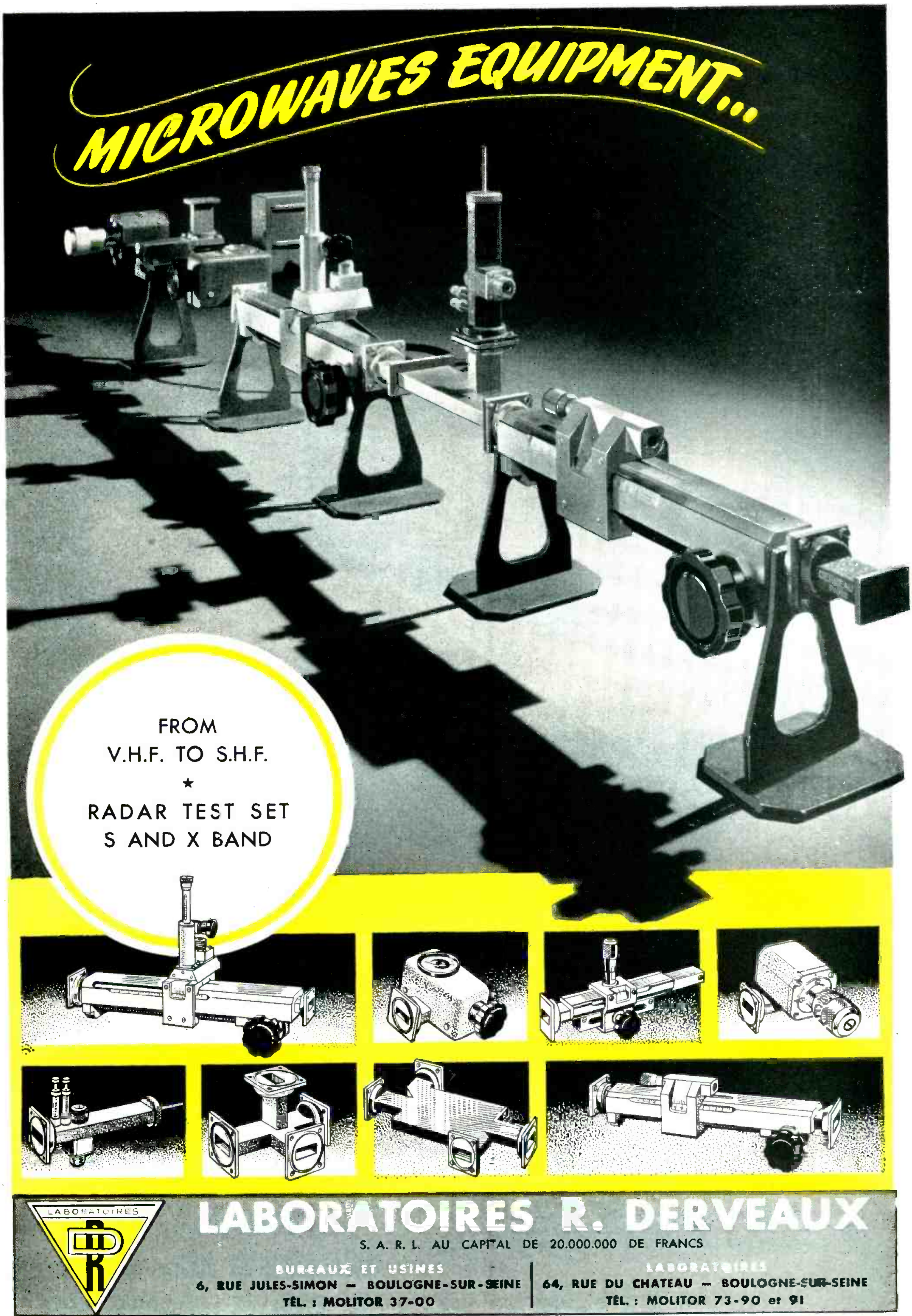

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PROBLEM:

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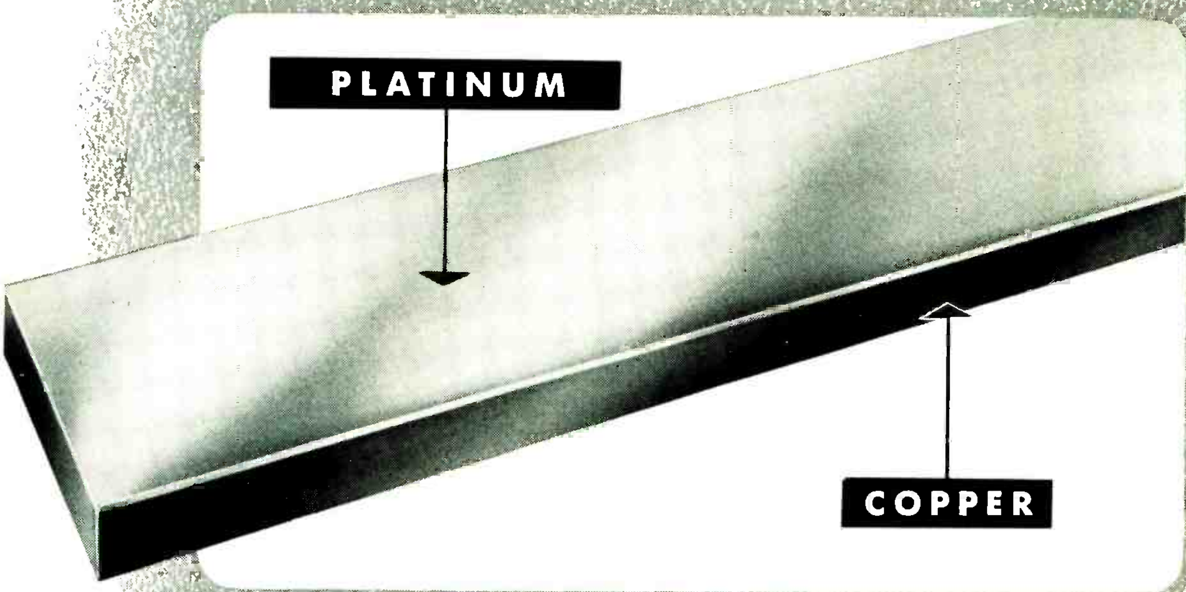

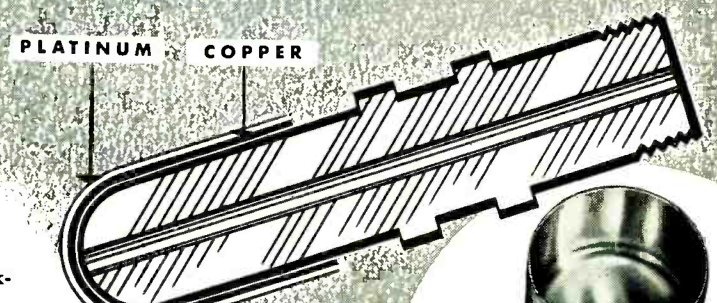

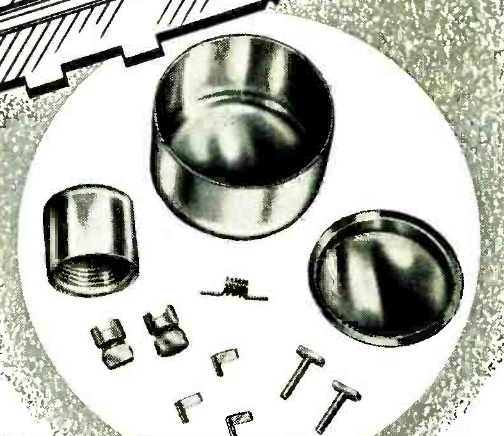

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The result was a General Plate composite material that gave the performance of pure platinum, and reduced costs considerably.

In addition, General Plate was able to fabricate the complete assembly providing the manufacturer with further savings.

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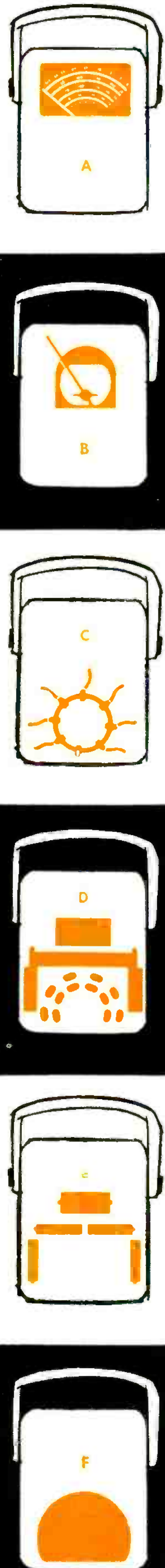

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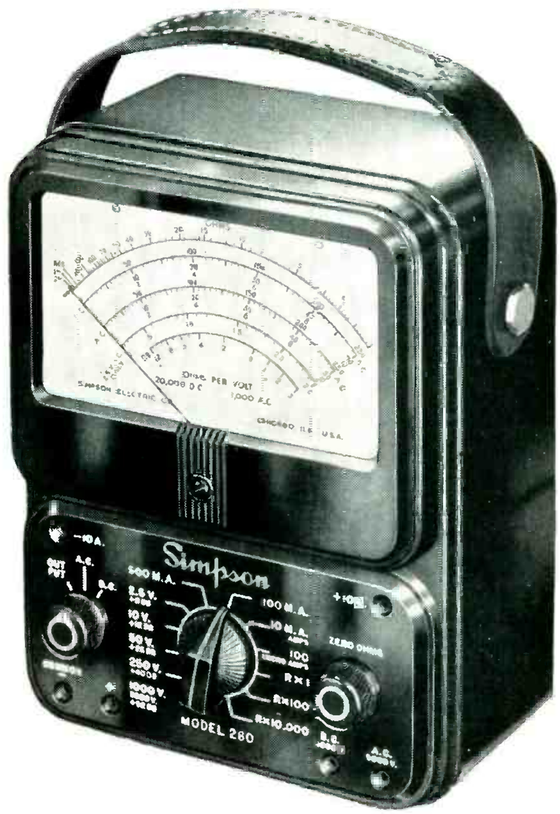
20,000 Ohms per Volt DC,
1,000 Ohms per Volt AC
Volts, AC and DC: 2.5, 10, 50, 250, 1000, 5000
Output: 2.5, 10, 50, 250, 1000
Milliamperes, DC: 10, 100, 500
Microamperes, DC: 100
Amperes, DC: 10
Decibels (5 ranges): —12 to +55 DB
Ohms: 0-2000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms (120,000 ohms center)

prices

Model 260 $38.95; With Roll Top $46.90. Complete with test leads and operator's manual. 25,000 volt DC Probe for use with Model 260, $9.95.



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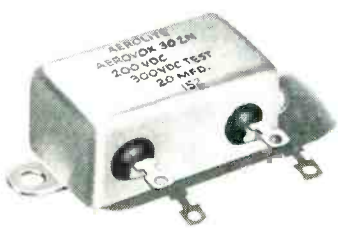
high-temperature metallized-paper capacitors

Series P92ZN Aerolene-impregnated metallized-paper capacitors are modified plastic-tubular duranite-end-sealed units in paper cases. Operating temperatures of −30°C. to +100°C. 200, 400 and 600 V. D.C. 0.01 to 2.0 mfd.

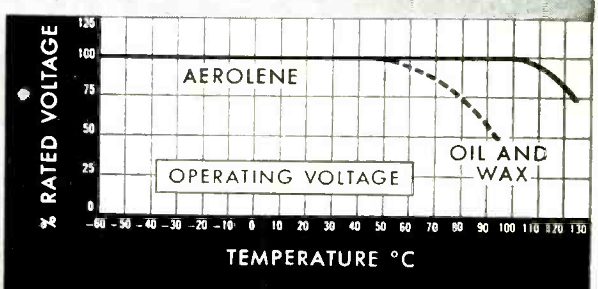
Series P123ZNG Aerolene-impregnated metallized-paper capacitors housed in tubular metal cases with vitrified ceramic terminal seal. Operating temperature range of −55°C. to +100°C. at full rating: to +125°C. at 75% of voltage rating. 200, 400 and 600 V.D.C. .0005 to 2.0 mfd.



Series P30ZN Aerolene-impregnated metallized-paper capacitors housed in "bathtub" metal cases with vitrified or glass terminal seals. Operating temperature range of −55°C. to +100°C. at full rating; to +125°C. at 75% of voltage rating. Capacitances available from 0.1 mfd. up to 15.0 mfd. at 150 V. D.C., and up to 3.0 mfd. at 600 V. D.C.

Once again, Aerovox is privileged to blaze the capacitor-development trail. For these high-temperature metallized-paper capacitors are definitely Aerovox "firsts" in *conception, production* and *application*.

Their truly phenomenal acceptance is due to (1) The *Space Factor*, especially when *miniaturization* is a prime consideration; (2) *Reliability*, particularly in meeting voltage peaks or surges, by taking advantage of their self-healing characteristics; and (3) *Wide Operating Range*, from sub-zero to elevated temperatures.



Let us quote on your metallized-paper capacitor needs. Or if you are not already familiar with metallized-paper advantages, our engineers will gladly show you how they can fit your functions and circuits.

AEROVOX capacitors

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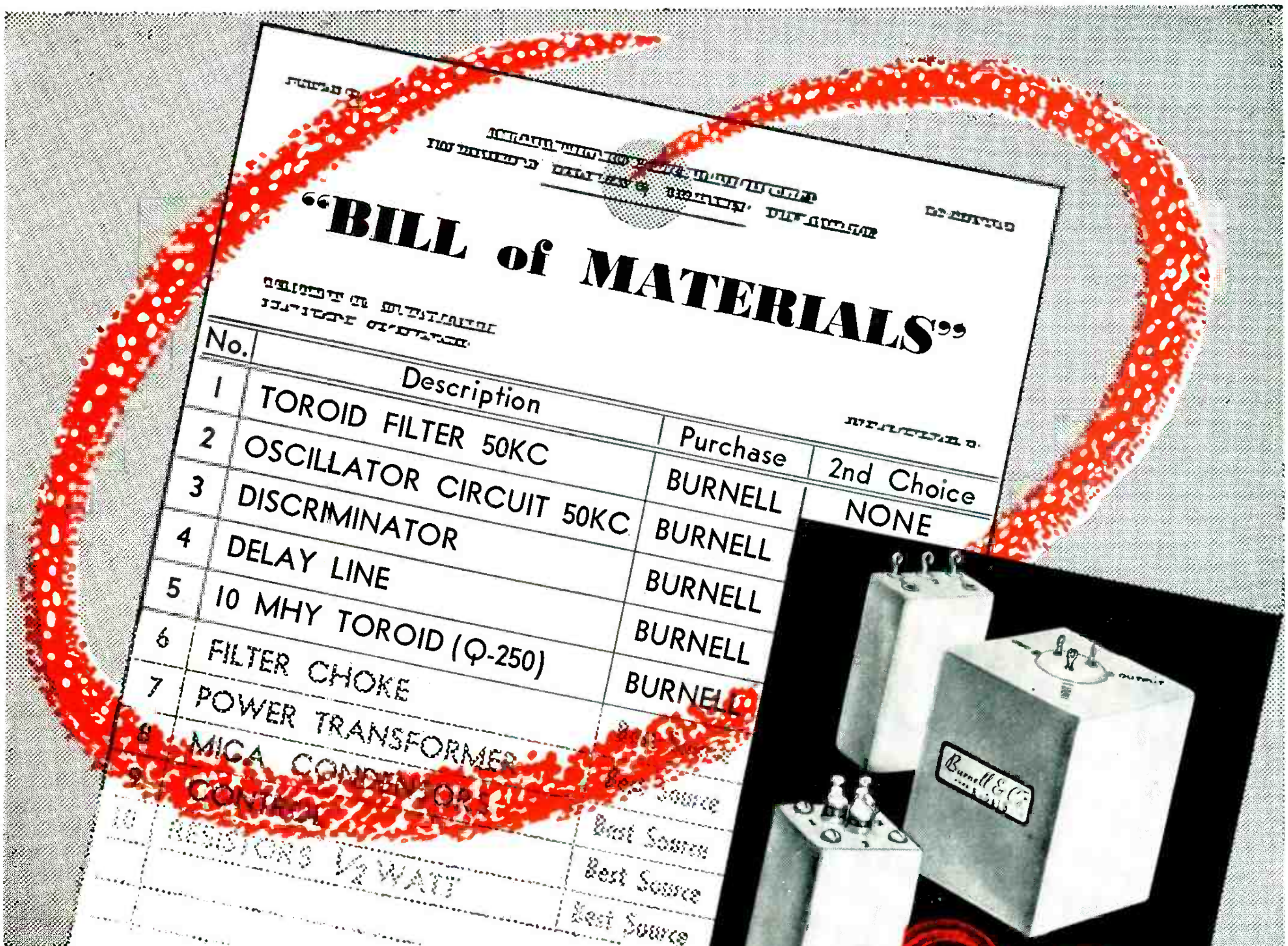

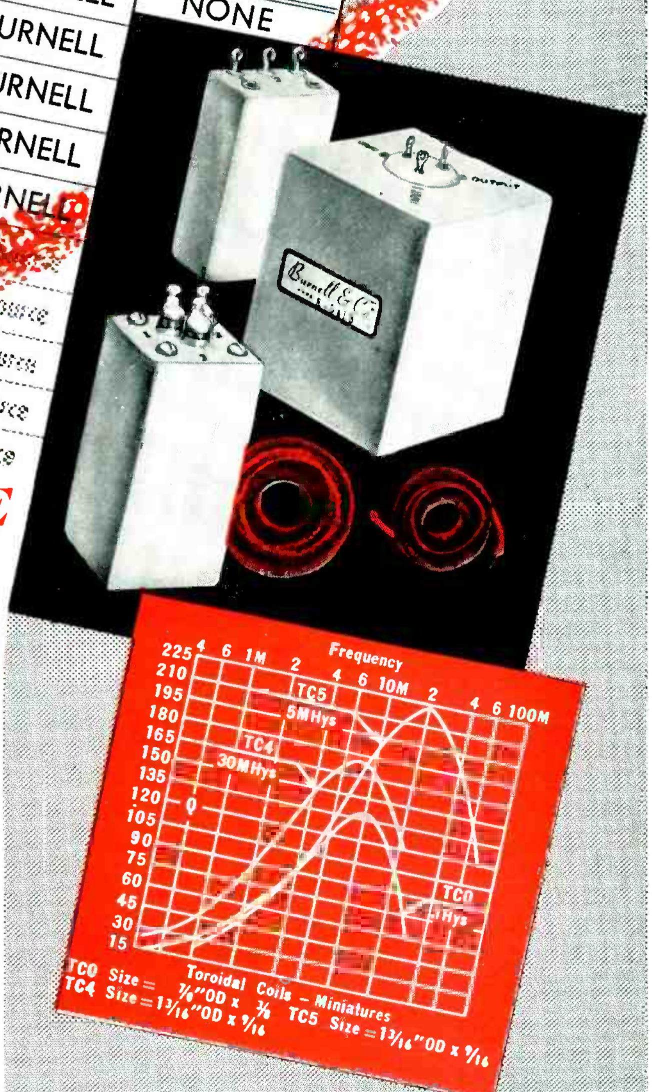

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For every "Burnell" toroid or filter specified in the bill of materials for Electronic equipment, we chalk up another credit for our "Burnell Customer Service."

In this highly specialized and technical field, individual attention to the customer's problem assures him of obtaining the best filter for his application. It is the job of our engineering sales department to thrash out every detail of the customer's problem until it is sure that the specifications will guarantee correct performance.

The next step would be to choose from our file of thousands of designs, one which meets the requirements. In many instances, of course, it is necessary to create an original design but *at no extra cost to the customer.* In either case, we can state unequivocally, that the result is invariably one of customer satisfaction. This is why Burnell has been the "preferred source" with so many engineers.

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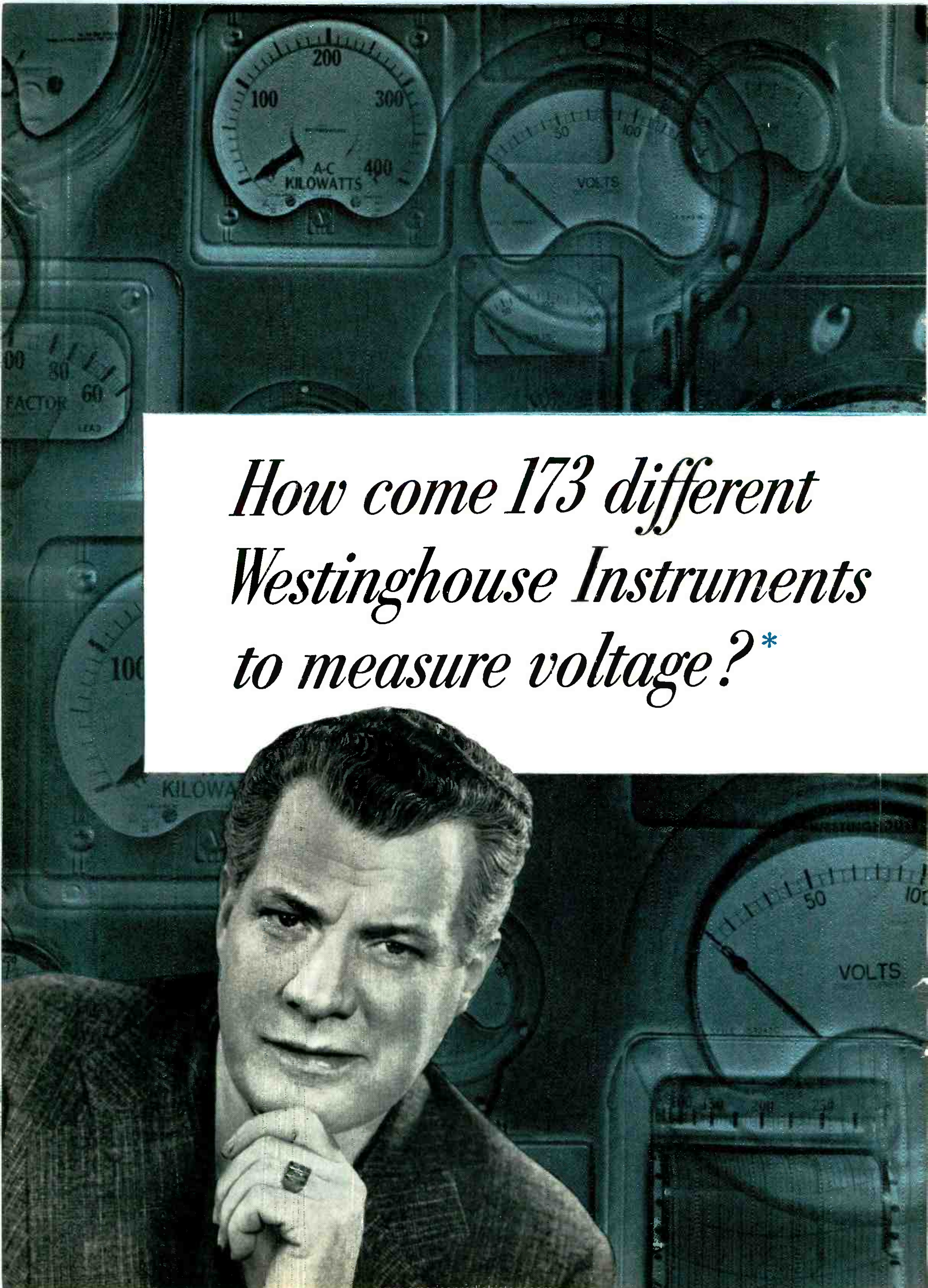

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the proper instrument

Whether you want to measure amperes, volts, watts, vars, frequency, power factor or synchronism—you can always get the *right* instrument when you specify Westinghouse. It's the most complete line of electrical measuring instruments in the industry! The line also includes many types to measure position, time, temperature and speed.

properly engineered

For any instrument application, you want sustained accuracy . . . easy readability. Westinghouse designs are the result of over 60 years of instrument engineering aimed at giving you the ultimate in these essentials of fine instrumentation. The performance of all Westinghouse Instruments meets ASA Standards.

properly applied

You save engineering time and expense . . . gain more effective use of instruments when you have manufacturer's assistance in their application. A team of highly trained Instrument Application Engineers is available to work with you in applying all Westinghouse Instruments.

registers an advantage for you!

The experience of a large eastern manufacturer provides an example. By applying standard Westinghouse GY-40 Recording Wattmeters to predetermine load on mixers, they obtained a 15 percent saving in mixing cycle time! A typical pay-off when the proper instrument, properly engineered is properly applied! Next time, specify Westinghouse!

J-40418

* The extensive coverage of Westinghouse voltage measuring instruments is further emphasized by the fact that there are 36 different instruments just to measure d-c millivolts.

For complete information about all Westinghouse Instruments, wire for Booklet B-4696. Address: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

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INSTRUMENTS

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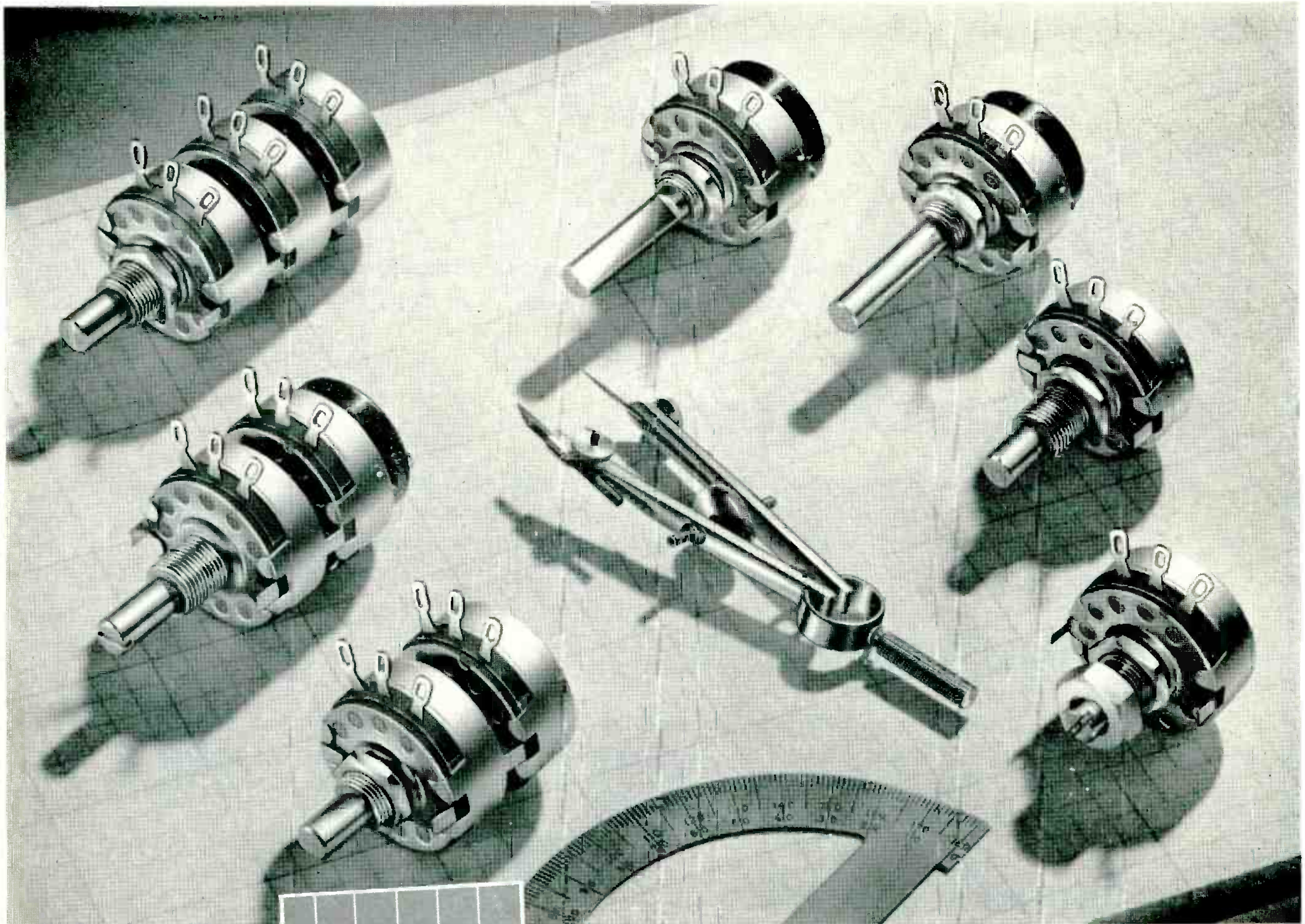
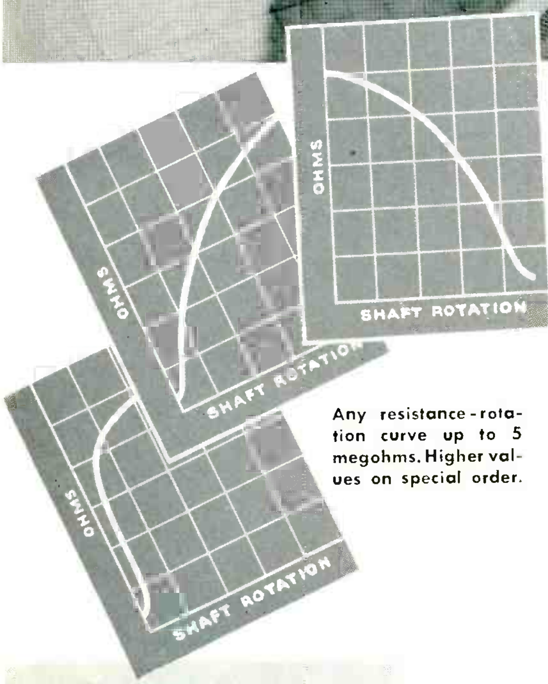




Any resistance-rotation curve up to 5 megohms. Higher values on special order.

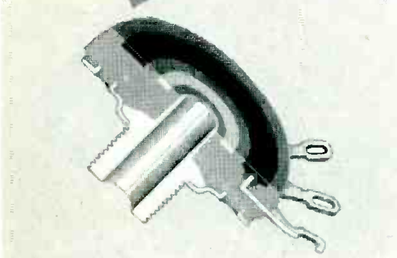
ADJUSTABLE RESISTORS

Unaffected by Heat, Cold, Moisture, or Long Use

For circuits requiring a top quality adjustable resistor not affected by moisture, heat, cold, or age . . . the Allen-Bradley Type J Bradleyometer is the ideal unit.

The resistor element is molded as a single piece. It is not a film or paint type of resistor. Because of its nature, the resistor can be built up to satisfy any resistance-rotation curve. After molding, the resistor is no longer affected by heat, cold, moisture, or age. There are no rivets . . . no welded or soldered connections . . . and the shaft, cover, faceplate, and other ferrous parts are made of corrosion-resistant metal. Let us send you the latest Bradleyometer data.

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



Bradleyometer resistor has terminals, faceplate, and bushing molded in the plastic body.

A·B Quality

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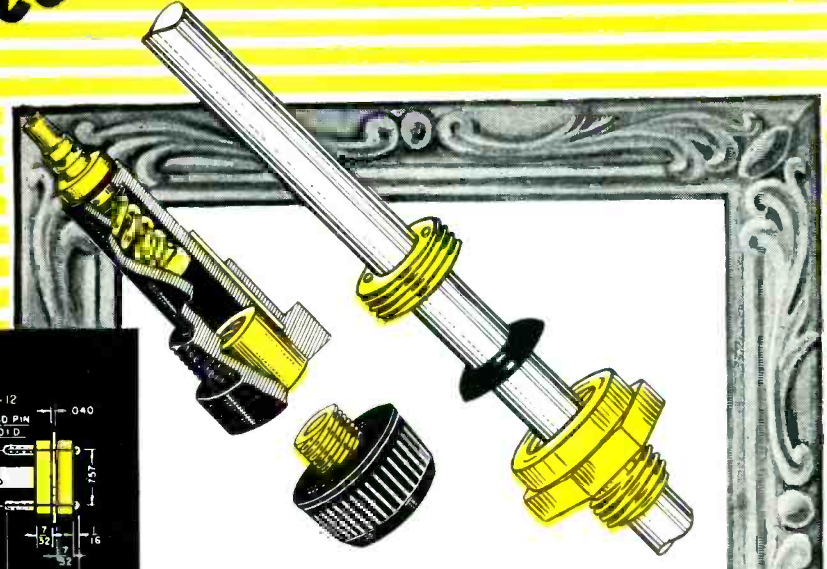
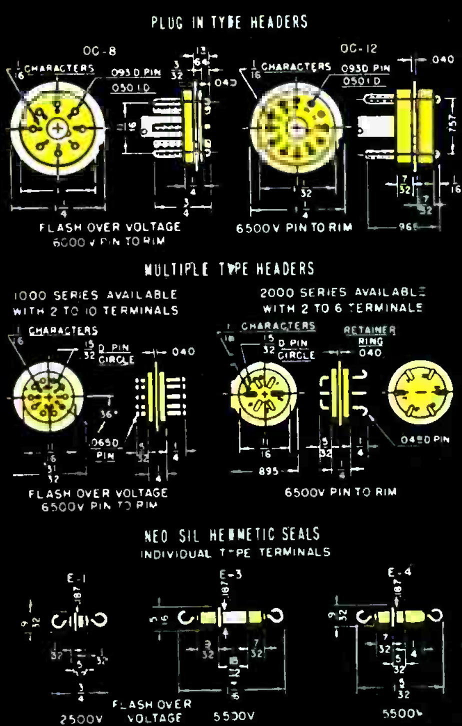


HERMETIC SEAL FUSE HOLDER

"Hermetically Sealed Fuse Holders are available for 3-AG and 4-AG fuses. These units are completely sealed from moisture with or without the cap or fuse inserted and are applicable for use on vacuum or gas filled units."

¼" SHAFT WATERSEAL BUSHING

"Rotary Waterseal Panel Assemblies, with GRAF-SIL Packing Glands, have an excellent five year customer history on gas filled pressurized components. They are available for ¼" shafts and for potentiometers and switch bushings."



TEST DATA

The result of the Electrical Testing Laboratories Inc., Report #330655, dated March 18, 1949 on this material shows the following:

Volume Resistivity at 800 Volts d-c

Room Temperature 25°C	R.H. 30 percent
Megohm-inches	*ohm-centimeters*
1.4×10^6	3.5×10^{12}

Dielectric Constant and Dissipation Factor

Dielectric Constant	*Dissipation Factor*	*Loss Factor*
	@ 60 cycles per second	
9.22	.058	5.32
	@ 1 megacycle per second	
6.17	.0455	.28
	@ 50 megacycles per second	
5.35	0.20	1.1

Dielectric Strength at 60 cycles
Volts per mil — 370

Durometer Average — 80 ± 5

Temperature — Rated as a Class A material conservatively + 175° to —70° centigrade.

The Flashover Voltages indicated were taken at a temperature of 68° Fahrenheit, and 47% Relative Humidity.

"NEO-SIL'S proven Hermetic sealing components are pressure checked at 25 psi—to meet military requirements and as applied to our units, NEO-SIL rubber will resist abusive temperature cycling, salt water, most acids and alkalies, and withstand high pressures and vacuums."

"In addition to the items illustrated above, NEO-SIL offers many other components, such as E Series terminals, Octal Type Plug In Headers, Multiple Pin Headers, Hermetically Sealed Cables, Hermetically Sealed Line Cords With Plugs For European use, Meter Gaskets, Panel Gaskets, Adapters (U. S. to Continental), Coil Forms, Crystal Contacts and other molded bakelite and NEO-SIL rubber units."

Your special problems are solicited.

NEO-SIL CORPORATION

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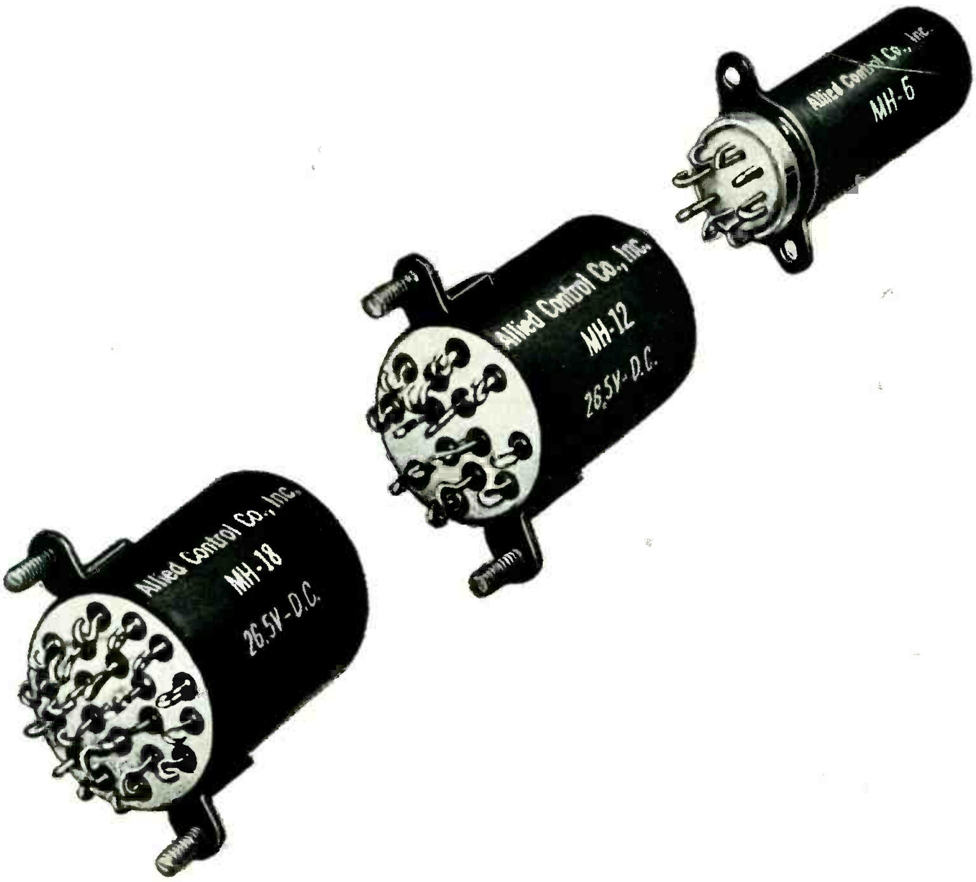

ALLIED'S NEW 50G SUB-MINIATURE RELAYS

Developed specifically to meet the rigid requirements of U.S.A.F. Spec. MIL-R-5757A, the new Allied line of sub-miniature double throw relays includes the MH-18 (6-pole), the MH-12 (4-pole), and the MH-6 (2-pole) will follow.

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.

Complete details in Bulletin 1002.

1ST

Sub-miniature relays to be developed

ALLIED CONTROL COMPANY, INC., 2 EAST END AVENUE, NEW YORK 21, N. Y.

AL 147

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Erie High Voltage TV By-Pass *Capacitors*

10 KV

ACTUAL SIZE

Style 414
10 KV
500 MMF

20 KV

Style 412
20 KV
500 MMF

ERIE STYLES 412 and 414 High Voltage Ceramicons are designed primarily to supply high voltage power supply filtering for television receivers. Conservative designing has been followed by months of proving-in tests before placing these new styles on the market.

Style 412, rated at 20 KV, and Style 414, rated at 10 KV, are both available in various combinations of terminals, threaded internally, externally, and plain; and are made to individual manufacturer's requirements.

Case insulation, of low loss molded thermo-setting plastic, provides a moisture seal of proven superiority. Ring convolutions, molded into the surface of Style 412, assure a positive check against surface leakage resulting from conductive deposits in ordinary handling. Effective creepage path is at the same time increased in length by more than 14%.

SPECIFICATIONS

	Style 412	Style 414
Capacitance: at 1KC, 1 to 5 volts rms	500 mmf +50%; −20%	500 mmf +50%; −20%
Power Factor: at 1KC, 1 to 5 volts rms	1.5% max.	1.5% max.
Leakage Resistance:	50,000 meg.Ω min.	50,000 meg.Ω min.
Dielectric Strength:	30,000 D.C.	18,000 D.C.
Life Test, 1000 hours at 85°C	21,000 D.C.	12,000 D.C.
Rated Voltage:	20,000 D.C.	10,000 D.C.
External Creepage Path:	2 inches	1 1/4 inches

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Electronics Division

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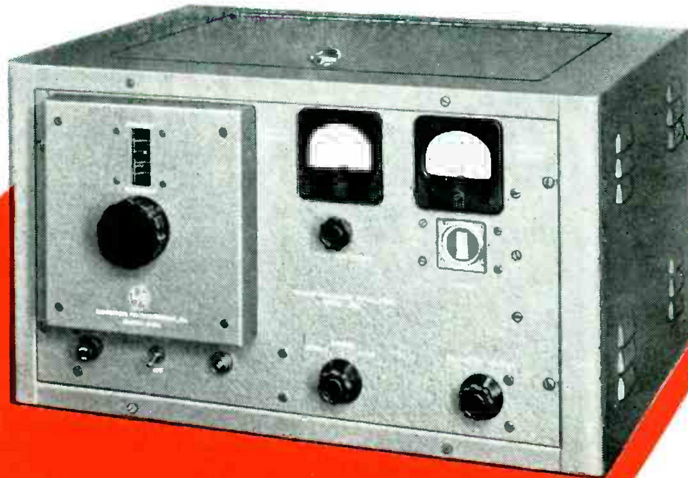
New Model 802 Stable Microwave Oscillator



provides a highly stable source of microwave signals

The LFE Model 802 Stable Microwave Oscillator provides a source of highly stabilized microwave frequencies suitable for use as a local oscillator for microwave measurements, or in any other applications where a high degree of stability is required. A dial accurately calibrated directly in frequency is an important feature. The main elements of the unit are a klystron oscillator, a stabilizing monitor loop which consists of a calibrated dual-mode reference cavity, a feedback amplifier and a self-contained power supply.

SPECIFICATIONS

Frequency Coverage
Model 802-X1: 8950 – 9325 Mc
Model 802-X2: 9300 – 9650 Mc
A range of frequencies can also be supplied in the S band or above 9600 Mc in the X band.

Frequency Stability
During short time intervals: One part in 10^9
Long term drift: Less than 100 Kc from original frequency setting.

Dial Calibration
Calibrated directly in frequency – 5 Mc per division.

Power Output
5 milliwatts
Output connection – ½" x 1" waveguide.

Power Consumption
150 watts

Size
12⅜" high x 21¾" wide x 15¼" deep.
The front panel is 10½" x 19" and is designed for rack mounting.

Weight
75 lbs.

For complete information, see your LFE engineering representative or write direct.

L/E

LABORATORY for ELECTRONICS, INC. 43 LEON STREET BOSTON 15, MASS.

PRECISION ELECTRONIC EQUIPMENT • OSCILLOSCOPES • MAGNETOMETERS • COMPUTERS • MICROWAVE OSCILLATORS • MERCURY DELAY LINES

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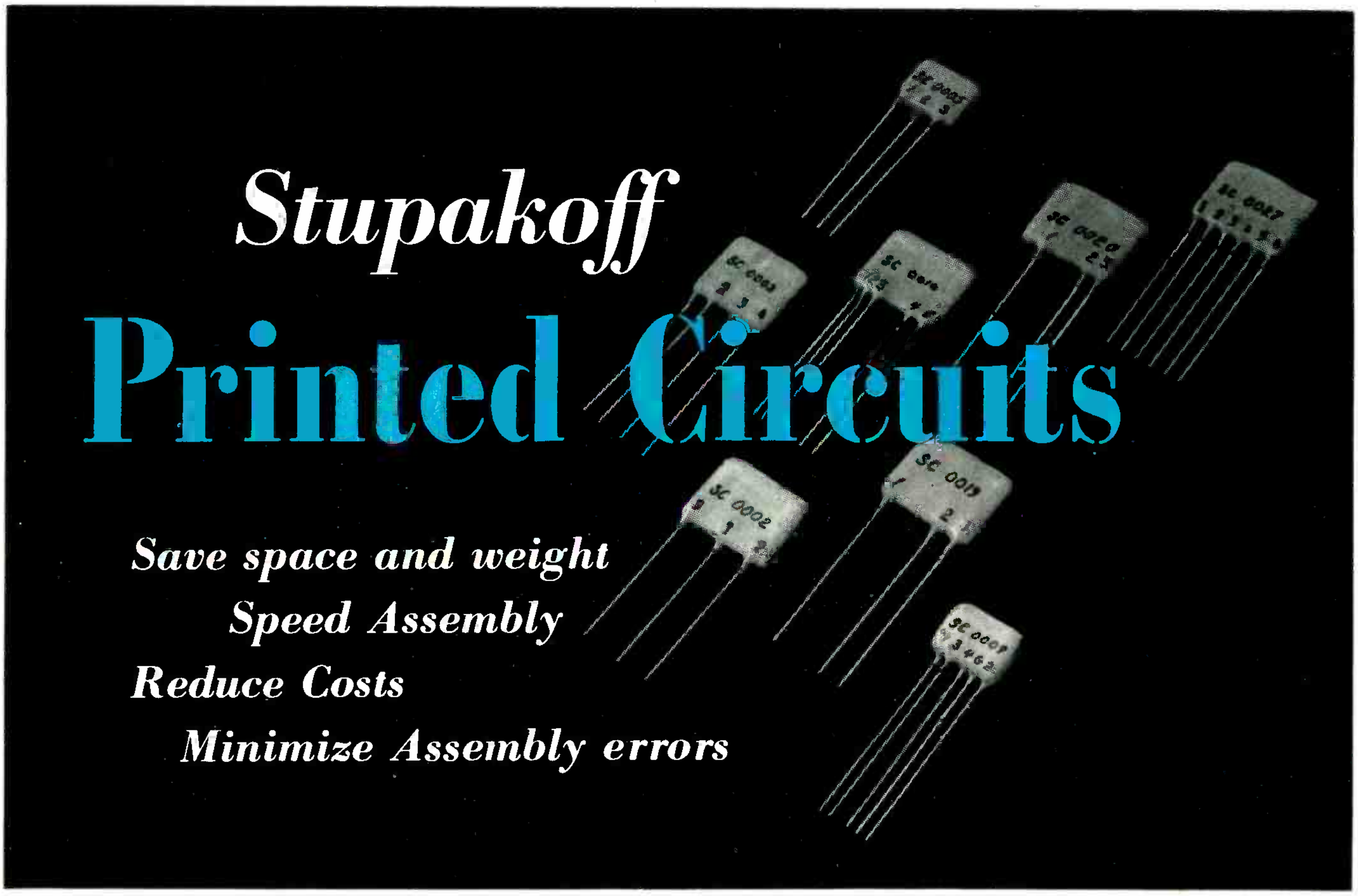

Soldered connections are reduced by 25% to 80%, assemblies are lighter and more compact, your production time is reduced and better products are made when Stupakoff Printed Circuits are used. These sturdy, compact, accurately produced units combine resistors and capacitors of precision values, in circuits designed in accordance with the requirements of individual applications. One Stupakoff Printed Circuit will replace many individual components, with consequent simplification of the assembly and reduced costs.

Send for Bulletin

Contains complete specifications of a number of typical standard circuits and detailed information on the design and construction of Stupakoff Printed Circuits. *Ask for Bulletin 1151.*

STUPAKOFF *Products for Electrical and Electronic Applications*

ASSEMBLIES—Metallized ceramic induction coils and shafts; metallized plates for fixed rigid assemblies; ceramic trimmer condensers.

CERAMICS—Precision-made ceramic products for electrical and electronic applications, all voltages, frequencies and temperatures.

RESISTOR CERAMICS—Used for temperature indicating or measuring equipment, for infrared light source and for heating elements. Complete with terminals, in the form of rods, tubes, discs, bars, rings, etc.

CERAMIC DIELECTRICS—For by-pass, lead-through, blocking, stand-off and trimmer applications. Temperature compensating Ceramic Dielectrics and high K materials. Tubes, discs and special shapes, plain or silvered.

STUPALITH—Will withstand extreme thermal shock. May be made to have zero, low-positive or negative expansivities. Safely used at temperatures up to 2400° F.

SEALS, KOVAR-GLASS—Terminals, Lead-ins; Stand-offs—for hermetically sealing and mechanical construction in radio, television, electronic and electrical apparatus. Single or multiple terminal units, in a wide variety of sizes and ratings.

KOVAR METAL—The ideal alloy for sealing to hard glass. Used for making hermetic attachments. Available as rod, wire, sheet, foil—or as cups, eyelets and other shapes.

STUPAKOFF CERAMIC & MFG. CO., Latrobe, Pennsylvania

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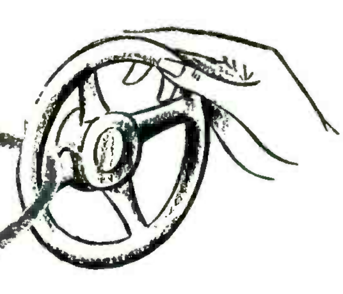
At your Fingertips



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STABILIZED — any setting of output voltage is not affected by changes in magnitude of the incoming a-c line voltage.

REGULATED — any setting of output voltage remains constant regardless of changes in the output load current.

Engineers, technicians, production test men and many others in the chemical, electronic, nucleonic and allied industries are discovering that the VARICELL is the ideal answer to the need for a precisely controlled, multiple range of low d-c voltages. Simply rotating the handwheel provides any desired output voltage in a range of 0 to 30 volts with a maximum allowable current of 15 amperes. A cord-and-plug assembly provides easy connection to any convenient a-c output receptacle.

For any output voltage setting from 6 to 30 volts, the R.M.S. ripple voltage never exceeds 0.1 volts, and stabilization and regulation is $\pm$ 0.25 volts. A-C input is 95-135 volts, 60 cycle, single phase. D-C output is 0-30 volts, 15 amperes.

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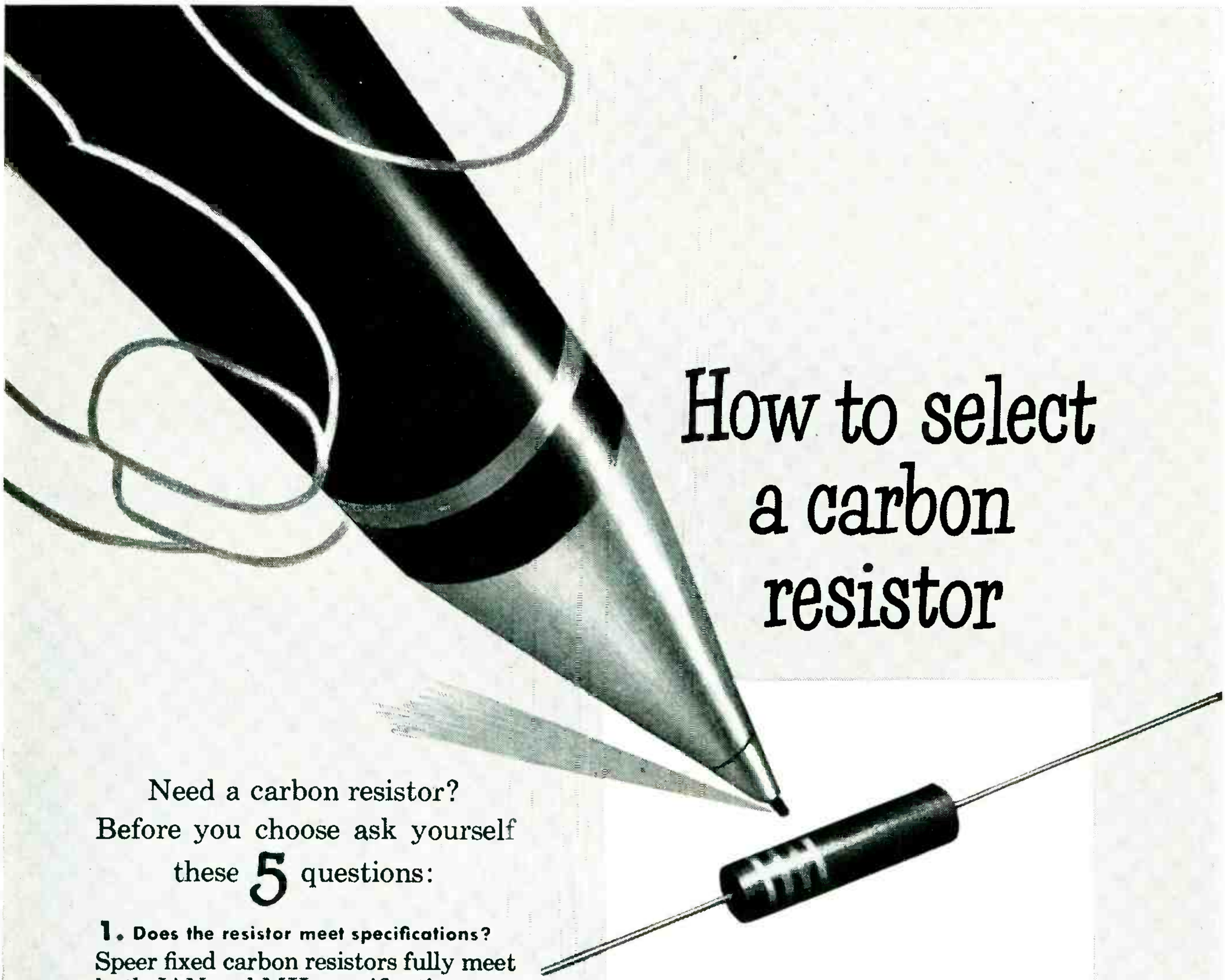

How to select a carbon resistor

Need a carbon resistor?
Before you choose ask yourself
these **5** questions:

1. Does the resistor meet specifications?
Speer fixed carbon resistors fully meet both JAN and MIL specifications.

2. Is there a wide range available?
Speer resistors come in ½, 1 and 2 watts in all standard values up to 20 megohms.

3. What is the ambient temperature?
Speer resistors operate up to 40° C ambient.

4. Is the resistor well made?
Speer resistors are carefully controlled at each manufacturing step. They have a carbon core sealed with an outer cover of phenolic resin to give maximum protection.

5. Is the resistor thoroughly tested?
All orders of Speer resistors are given numerous tests for resistance rating, and are backed by an accelerated ten day test for humidity.

Write today for information on specifications.

SPEER RESISTOR

SPEER Resistor Corp.

St. Marys, Pennsylvania
A Subsidiary of Speer Carbon Co.
Other subsidiaries: Jeffers Electronics, Inc.
International Graphite & Electrode Corp.

Other Speer Products for the Electronics Industry
anodes · contacts · molded notched* coil forms
iron cores · discs · brushes · battery carbon
graphite plates and rods
also
R. F. Coils · ceramic capacitors · capristors · high
voltage condensers · disc capacitors · chokes
made by
Jeffers Electronics, Inc.

*Patented

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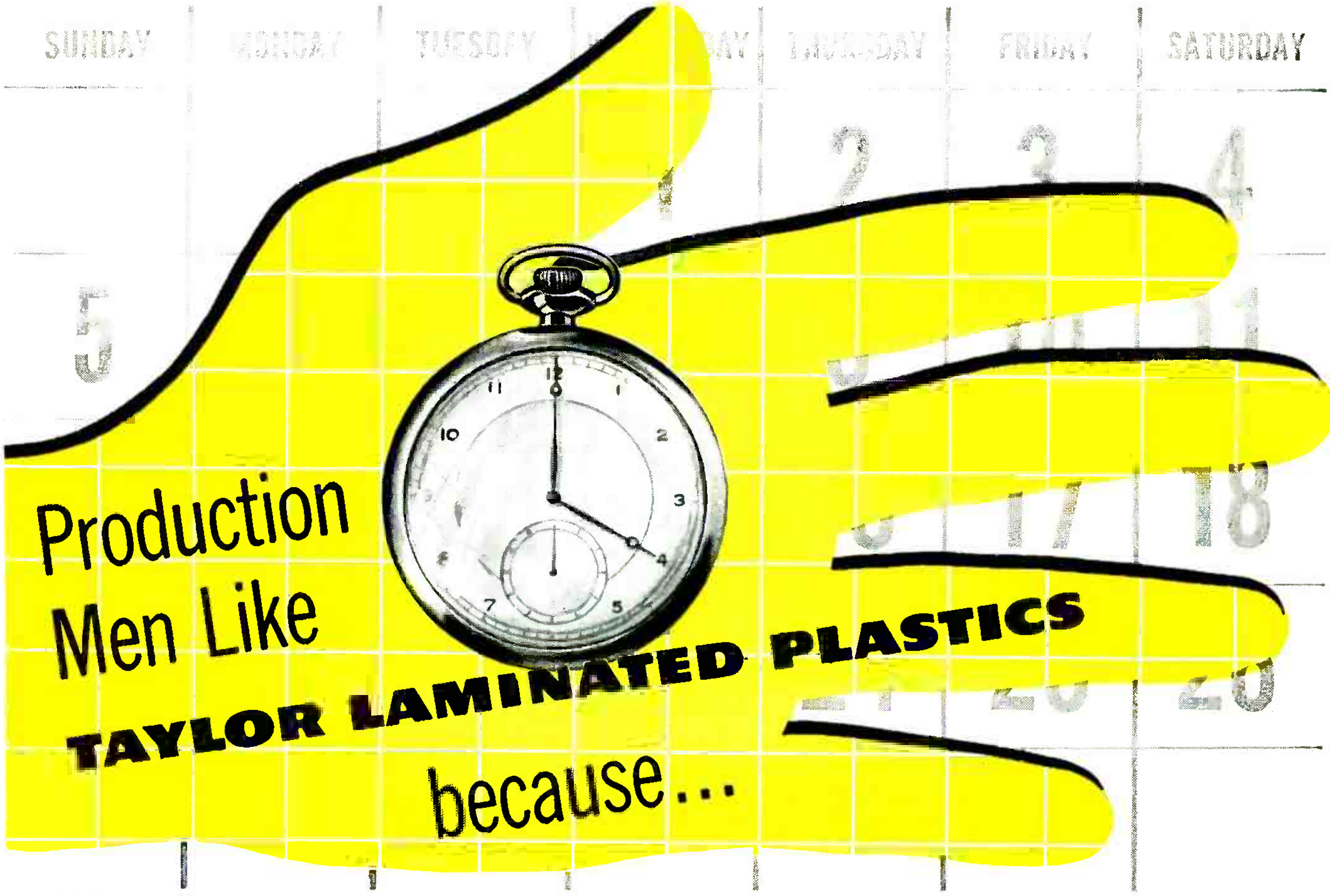

In the electrical industry . . .

Taylor Laminated Plastics are used in components of thousands of electrical products—from switchgear to sanders, from generators to table appliances. What can these versatile materials do in your product?

This comprehensive 24-page booklet literally brings the entire Taylor Organization to your fingertips . . . tells in words and pictures how the many Taylor Laminated Plastics are made . . . shows you how you can use these basic materials to make your product better, at lower cost. Write today for a copy of Booklet F5.

They are versatile phenol, melamine and silicone laminates whose unsurpassed electrical characteristics and easy machineability make them real time-savers on the production line.

Availability of these materials in many forms, such as sheets, tubes, rods, strips and coils, makes them easily adaptable to numerous production operations.

And when production processes call for laminated parts fabricated to specifications, Taylor's Fabricating Service turns out precision-made parts having all the physical, mechanical, electrical and chemical characteristics required.

So if you're a production manager looking for ways to make products or parts better, more efficiently and at lower cost, investigate Taylor Laminated Plastics today! Write for complete data. Ask, too, about Taylor Vulcanized Fibre and Taylor Insulation.

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LAMINATED PLASTICS

TAYLOR FIBRE CO.
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CUTS SPLICING TIME AND COST

- NO STICKY ADHESIVES . . . EASY TO APPLY IN CLOSE CLEARANCES
- NO RIGHT OR WRONG SIDE . . . BOTH SIDES USABLE
- NO TACKY SURFACES TO PICK UP DUST OR FOREIGN MATTER
- WILL NOT TANGLE OR STICK TOGETHER
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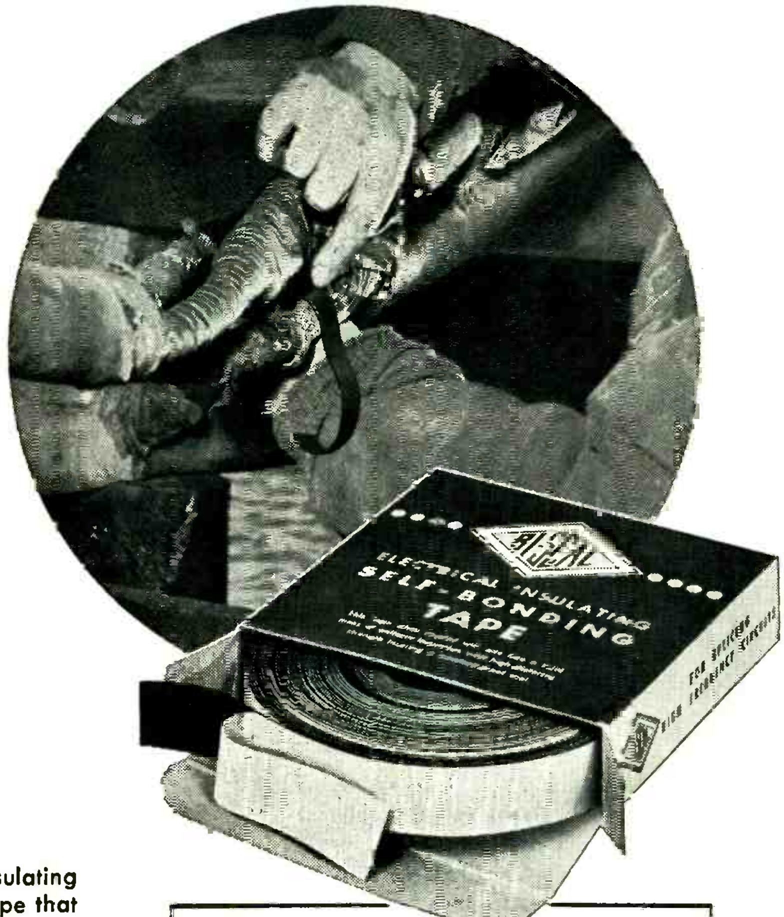

Here is the *multi-purpose* electrical insulating tape for wire or cable splicing . . . the tape that meets your strictest requirements for many unusual as well as innumerable ordinary applications. BI-SEAL offers you complete and lasting protection against moisture, acids, alkalies, sunlight, corrosion, fungus and ozone. These outstanding characteristics, plus Bi-Seal's excellent electrical properties, make it ideally suited for a broad range of applications in the Communications, Electronics, Public Utilities, Electrical Contracting and Electrical Maintenance fields.

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CHECK THESE BI-SEAL FEATURES:

- Self Bonding
- Moisture Resistant
- Outstanding for Low Temperature Application and Performance
- High Dielectric Strength
- Superior Aging Properties
- Conforms to Irregular Shapes
- Corrosion and Chemical Resistant
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"Manufacturers of Electrical Insulation Since 1847"

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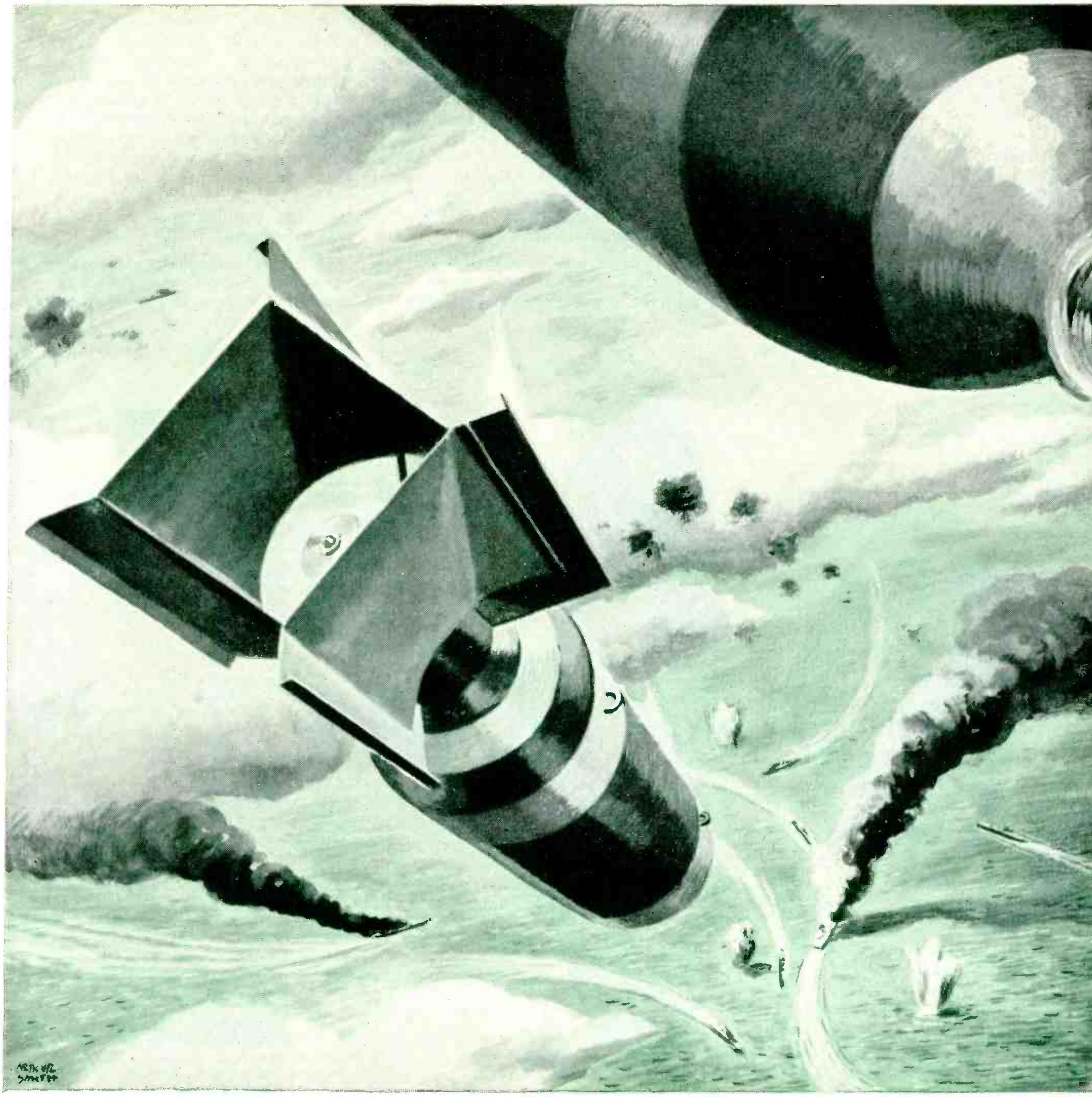

Pin-pointed for its target...

Increasing air speeds and higher level flight pose ever tougher problems for bombing accuracy. Finer and faster target pin-pointing requires bombing mechanisms of extraordinary precision and almost instantaneous action—yet they must function flawlessly under the most rigorous conditions. Not only engineering ingenuity but precision manufacture—to ultra-fine tolerances—is essential. Such are the skills that Arma provides in close collaboration with our Armed Forces in designing, developing and producing the complex instruments that strengthen our defensive striking power. *Arma Corporation, Brooklyn, N. Y.; Mineola, N. Y.; Subsidiary of American Bosch Corporation.*

ARMA ADVANCED ELECTRONICS FOR CONTROL

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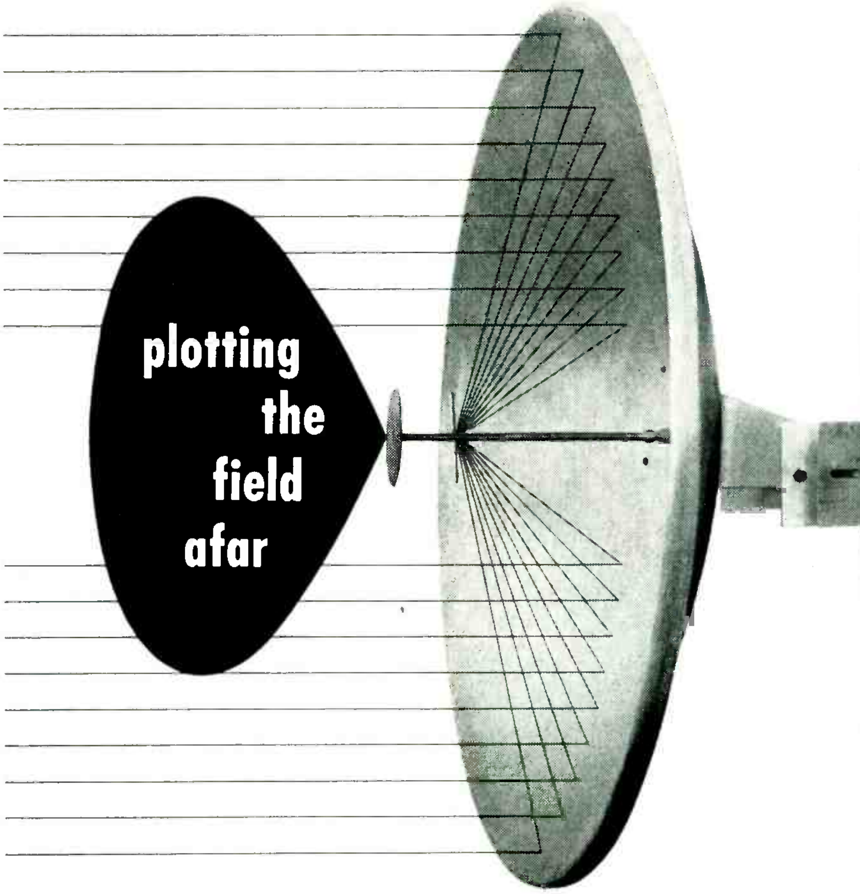
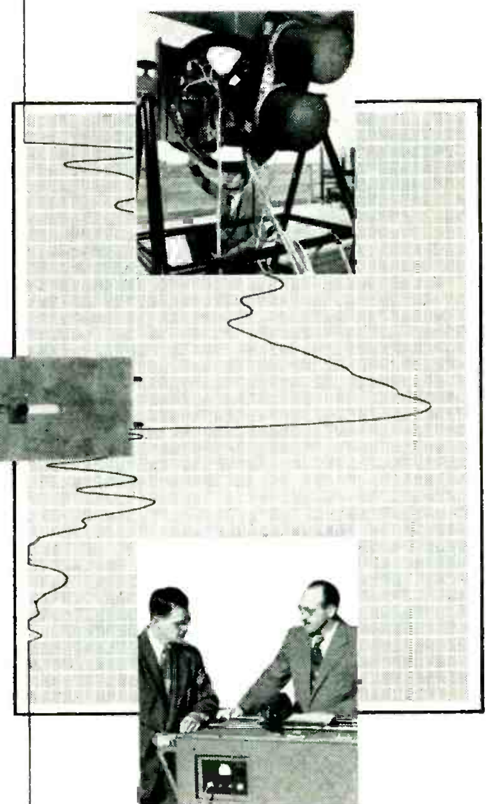
plotting the field afar



Plotting the radiation pattern of a microwave antenna is typically time consuming and laborious. For some time, workers in this field have felt a need for a continuous non-manual means of performing this operation. The extensive microwave activities of its Research and Development Laboratories have created at Hughes a special interest in such automatic pattern-measuring equipment.

The first automatic machines that were at all accurate were of the fixed location type and weighed nearly a ton. The new Hughes recorder weighs just one hundred pounds, is more accurate, and has higher writing speeds than the earlier machines. Its recording range covers 80 decibels in the audiofrequency spectrum. The writing speed is approximately 25 inches per second, with an 8″x 11″ plot, and the abscissa or angle scale is controlled by an electrical take-off system.

In the field of microwave measurements, this machine assists in determining many things—such as the correct shape of reflectors and the proper location of feeds. The development of such improved laboratory tools is an interesting by-product of a large research activity, such as that conducted by the 3500 men and women of the Hughes Research and Development Laboratories.



Plotters. O. A. Tyson (l.) and Dr. L. C. Van Atta worked together in developing this new machine at Hughes.

The growing requirements of both the commercial and military electronics programs at Hughes are creating new positions within the Hughes Research and Development Laboratories. Physicists and engineers who are interested are cordially invited to address correspondence to:

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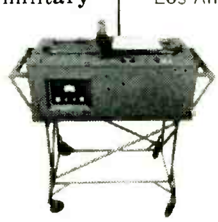

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for units which must operate in temperatures from minus 40° C. to plus 105° C.

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HIGH TEMPERATURE PROPERTIES

The melting point and cold flow temperature ranges of these waxes are above 122° C, and both materials exhibit unusually good sweat resistance at high temperatures.

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ELECTRICAL PROPERTIES

Low power factor and dielectric constant of the 3797 type waxes recommend their use on high frequency electrical components.

3797 APPLICATIONS & PROPERTIES

Particularly recommended for:

a — Plunge dip coating applications in which relatively thin semi-transparent coatings are required.

b — Impregnations at atmospheric pressure when rapid penetration and minimum residual surface excess is sought.

Melting Point (Drip)	260/265 F
Flash Point	480 F
Fire Point	530 F
Viscosity, Brookfield, 325 F	8-10 cps
Penetration, 77/100/5	18-22
Power Factor, 77 F, 1 mc	0.003 max.
Dielectric Constant, 77 F, 1 mc	2.5

3797-B APPLICATIONS & PROPERTIES

Medium high viscosity and recommended for:

a — Plunge dip coating units which demand a moderately heavy protective coating.

b — Vacuum impregnations in which complete fill of internal voids as well as saturation of porous insulation is desired. (A data sheet for this application is available.)

Melting Point (Drip)	260/270 F
Cold Flow (M-R)	255/265 F
Penetrations: 32/200/60	12-15
77/100/5	17-21
115/50/5	25-33
Color	Tan
Application Temperature	290/340 F
Specific Gravity	0.94
Flash Point	480 F
Brookfield Viscosity	
@ 305 F	208 cps Ave.
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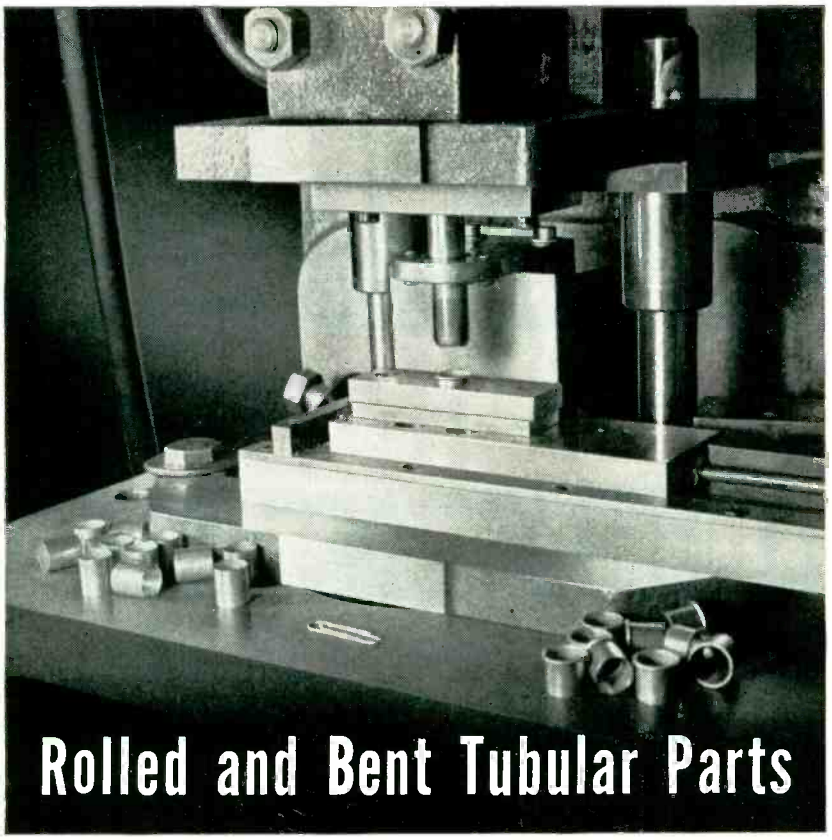

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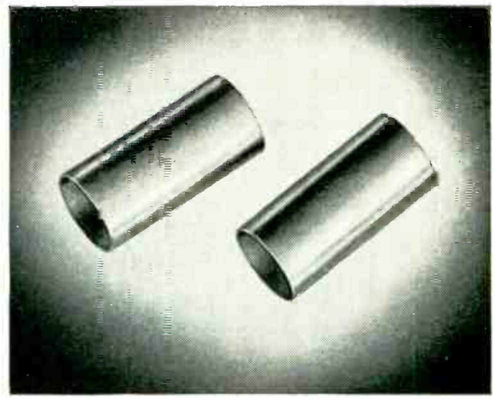

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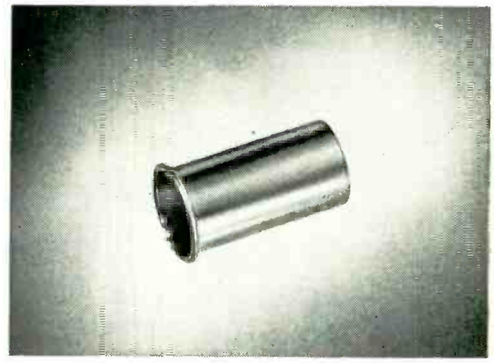

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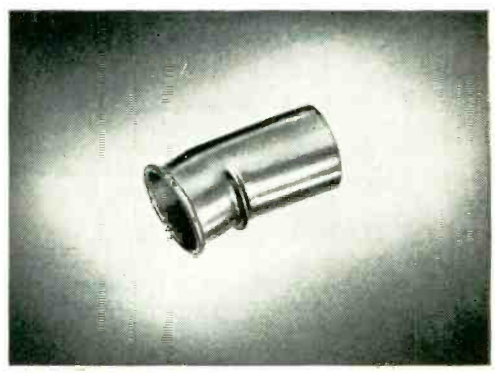

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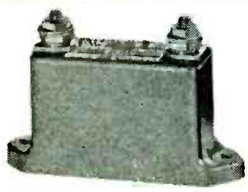

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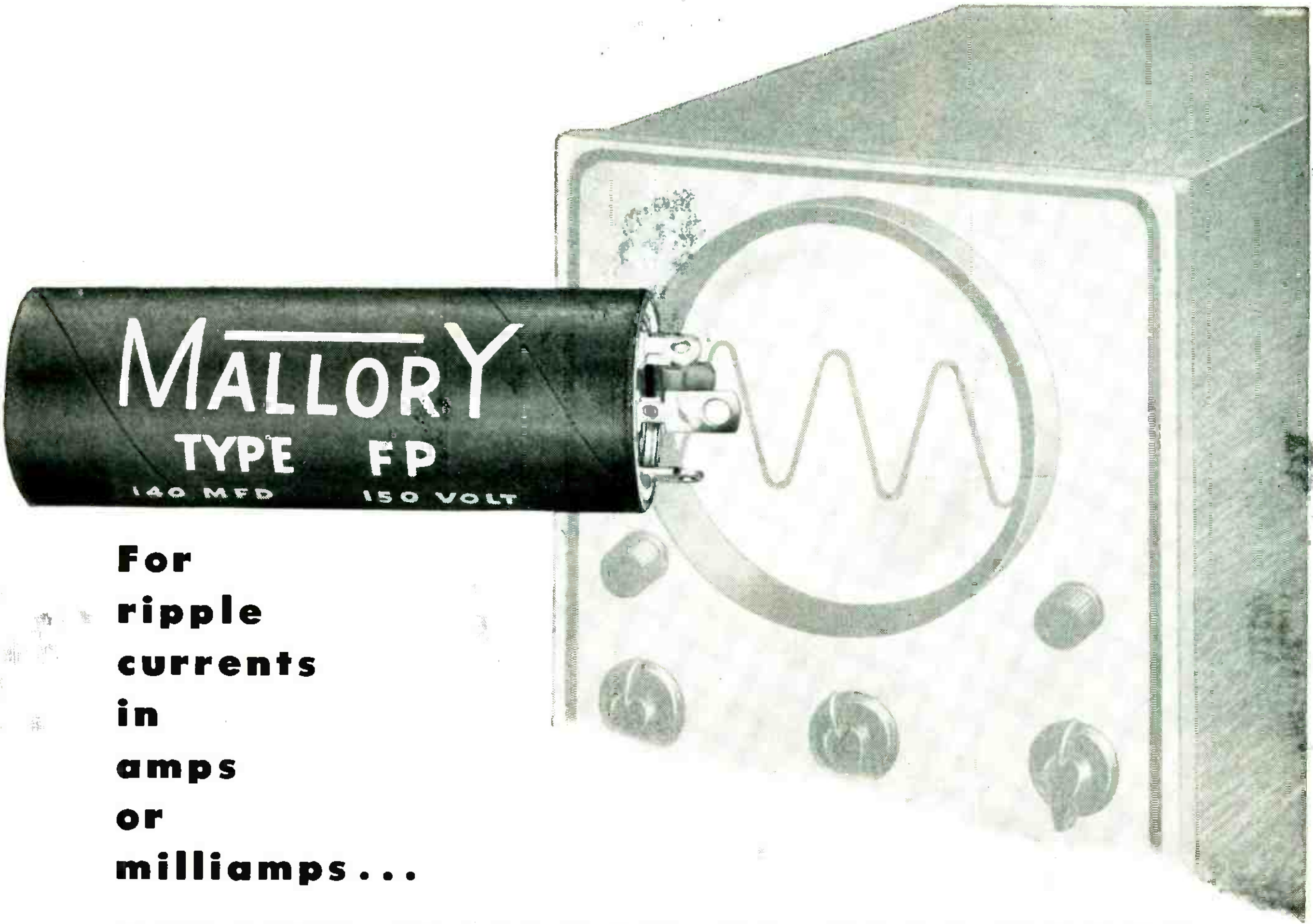

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CROSS TALK

▶ **MEDICOS** . . . Dr. H. I. Kantor, who wrote "Electronics Engineering Needed in Medicine" in our February, 1952 issue, reports having received nearly 50 letters from readers expressing deep interest in this subject and asking many questions. It has long been a trade secret in publishing circles that any article in a technical journal that draws 10 such letters rates high, so Dr. Kantor's opus is, from the editor's point of view, pure gold. Readers who missed it are urged to dig back in the file of old issues (any issue published three months ago is old in this business) and spend half an hour with it.

We have a brief further contribution to make on this subject. Dr. Albert Faulconer of the Mayo Clinic, speaking before the AIEE last January, had this to say: "History indicates that progress in surgery often parallels or is dependent upon progress in the field of anesthesiology. It is more true now than ever before that . . . further progress in surgery is dependent upon our ability to observe and regulate the physiologic changes caused by anesthesia and surgery. The interpretation of these changes often depends upon quantitative estimates of signs beyond the ken of our natural perceptions. Many of these estimates are possible with existing instruments, *awaiting only the application of engineering skills* that they may be put to daily use in rendering anesthesia and surgery more safe".

The italics are ours. We *know* that the "engineering skill" required is possessed by several dozen readers of this magazine, perhaps by hundreds, not now engaged in medical electronics. So, we say again, read Dr. Kantor's article. If the interest of even one qualified man is thereby captured and deflected from more mundane pursuits the benefit to society may be great indeed.

▶ **BELGIUM** . . . We have just returned from a short trip to Brussels, having served as a consultant to the Ministry of Communications on the question of standards for the Belgian tv service. The standards, promulgated by King Baudouin last January, are a curious mixture of the 819-line French system and the so-called Gerber 625-line system adopted by most other European countries. Belgian receivers will be built to operate both on 625 lines and 819 lines. The French system is followed in the use of amplitude modulation for sound and positive modulation for the picture. The Gerber system is followed in the use of a 7-megacycle channel and serrated vertical pulses with equalizing pulses.

The consultancy was arranged to examine whether this combination of standards would in fact constitute a workable system, particularly in view of program exchanges with Belgium's neighboring countries (France, Holland, Germany). The latter requirement posed some rather tricky questions in sync-pulse conversion which turned out to have a solution. So the Belgians have a workable system, albeit one whose parents certainly were not married.

Engineers outside Belgium have been inclined to scoff at this choice of standards as unnecessarily complicated. It would certainly appear that one system or the other should have been adopted, rather than parts of both systems. But the scoffers scoff without knowledge of Belgian history since that country gained independence in 1830. Since then the Flemish (Dutch-speaking) and the Walloon (French-speaking) parts of the country have been held together only by the development of a positive genius for compromise. There appeared to be no way to avoid a schism (and television is recognized there no less than here as a vital political force) unless programs in either language, including programs originating in Holland and France, could be made available to the whole Belgian population. So the conflict was adjudicated to equalize program availability and cost to both political groups.

Your correspondent returned with warm sympathy for Belgium, a country which has learned so well to deal with the toughest of all political barriers, language. And with equally warm appreciation of the blessings we enjoy in these United States.

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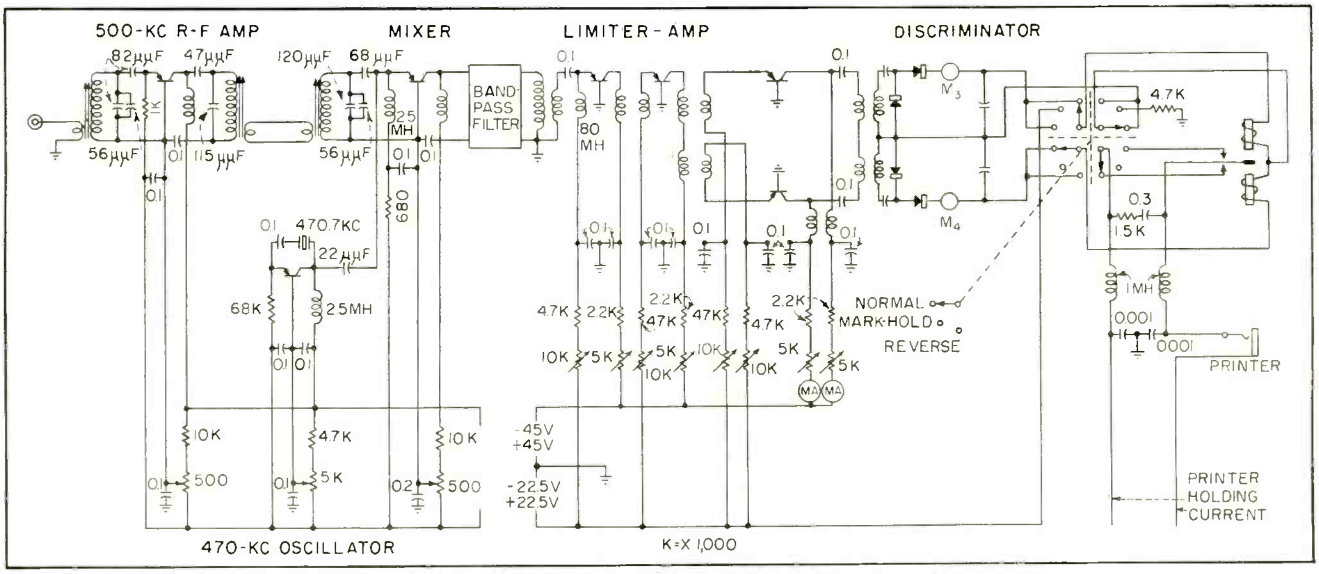

Schematic drawing of the complete frequency-shift teletypewriter converter using all transistors and no vacuum tubes

TRANSISTORIZING

Design problems encountered are discussed fully, providing practical information on transistor circuit difficulties and how to solve them. Many conventional r-f circuits are included in this complete circuit analysis of a frequency-shift converter using transistors

TRANSISTORS ARE USED throughout the frequency-shift teletypewriter converter to be described. The converter transforms frequency-shift signals from the i-f amplifier of a radio receiver to d-c pulses for operation of a teletypewriter printer.

No claim is made by the authors that this equipment is at present an optimum piece of equipment from the standpoint of circuitry or military usage. Many of the design problems that arose during development of the converter are given.

Initial Design

It was decided to develop the converter using essentially the same functional design as the converter shown in block-diagram form in Fig. 1, less the afc circuit. The original converter used vacuum tubes; the converter derived from it uses all transistors and no vacuum tubes in the circuits.

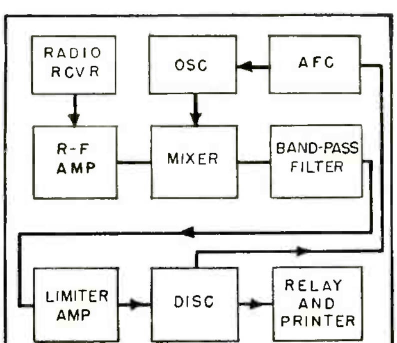

FIG. 1—Block diagram of the original vacuum-tube converter

Transistors used in the final writer-converter equipment are the Western Electric point-contact types M1768 and A1698.

Certain parts for the vacuum-tube converter were desired for use in the transistor convertor due to the difficulties of redesign and subsequent manufacture. These parts were the band-pass filter, discriminator and the relay between the discriminator and printer. However, the discriminator was later discarded and a new one designed for reasons to be given later in this paper.

The converter was selected as the first piece of military communication equipment for two reasons. First, a radio-teletypewriter converter operating from a vehicular power source was desired and sec-

This paper was presented at the March 1952 IRE National Convention.

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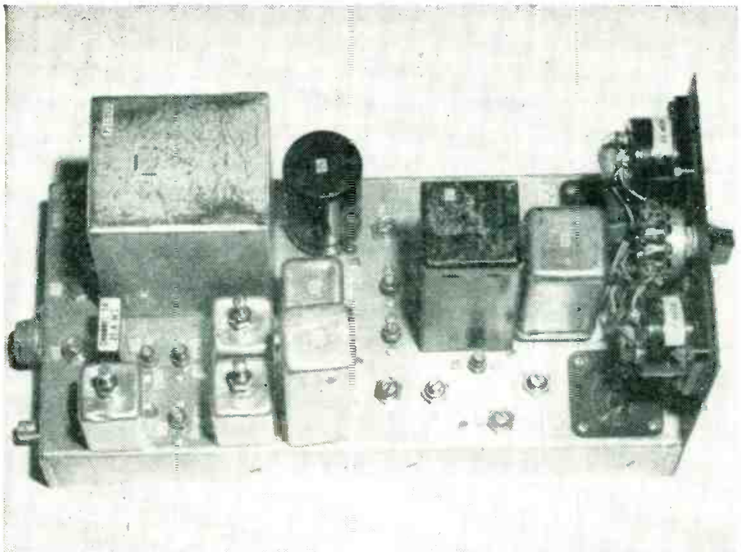
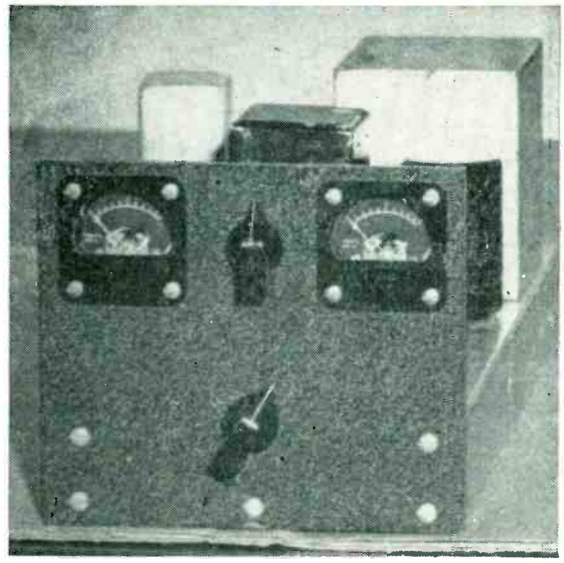


Chassis view of the transistorized communication equipment



Front panel view of the converter

Communication Equipment

By GERALD S. EPSTEIN, JOHN A. BUSH and BOYD SHELLHORN

Captain, Signal Corps — *Electronics Engineer* — *Electronics Engineer*

Signal Corps Engineering Laboratories
Fort Monmouth, New Jersey

ond, it seemed to offer possibilities for success. The frequencies involved, 500 kc and 30 kc, were within the feasible operating range of transistors as produced today. Power requirements were not high, although it was not known whether or not the power available from transistor amplifiers would be sufficient.

The vacuum-tube converter, as is the case with most modern and compact communications equipment, was quite cramped and the temperature inside the package was quite high due to the filament power dissipated. This difficulty is immediately eliminated with the use of transistors.

Circuit Analysis

The circuit finally evolved is shown in the large drawing. The remainder of this article discusses the derivation of this circuit.

The relay used is a polar relay which will operate on approximately one-ma current differential in the windings. Electrical characteristics of the relay are inductance, 35 millihenrys, and d-c resistance, 220 ohms.

It was thought at first that the switching properties of the transistor could be used to drive the relay. However, a transistor switch is not used at present due to certain difficulties encountered. If the transistor is connected as shown in Fig. 2, the device exhibits certain electrical characteristics as shown in Fig. 3.

A negative resistance characteristic appears, Fig. 3, which is postulated by some authors as the common property of all switching devices. If this device has a load source or sees a load looking backward from the emitter of a magnitude as shown, it would be a bistable device. The middle intersection of the load line and the electrical characteristic of i_e versus V_e can be shown to be an unstable point of equilibrium.

If the device is at equilibrium point 1, Fig. 3, then an increase in V_e of an amount $\triangle_1$ will put the device in equilibrium at point 2. Similarly, if the device is at point 2, then a decrease in voltage V_e of amount $\triangle_2$ will put the device into position 1.

If the load R_L were a primary winding of a relay, for sake of discussion considered purely resistive, the relay would open or close and stay in the positions mentioned depending on whether a mark or

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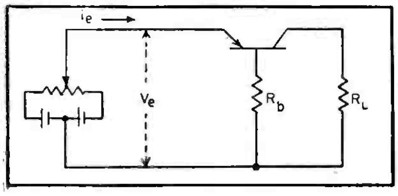

FIG. 2—Transistor circuit connection for driving a relay

space voltage were delivered from the discriminator source. The printer would thus be able to be operated in a neutral operation, 60 ma on the line for a mark pulse and no current on the line for a space pulse.

Discriminator

The discriminator used in the original vacuum-tube converter operated in the frequency range from 27.3 to 31.3 kc. Its circuit is shown in Fig. 4. This circuit is composed of parallel-type resonant circuits which present a very high impedance to the switching transistor input. Therefore, the correct load line for bistable operation, Fig. 3, is not obtained.

Another way of looking at the problem is that the discriminator normally works into a vacuum tube which, in the frequency range mentioned, presents practically an infinite input impedance. The transistor input impedance is in the neighborhood of 200 ohms. Therefore, using this type of discriminator with a transistor will permit practically no voltage whatsoever to be developed across the output terminals.

A new discriminator was developed using series-resonant circuits and is shown in Fig. 5. The center frequency here is again 29.3 kc but the impedance Z is now quite low. With this development, the discriminator becomes essentially a power device.

For mark condition, the current I_1 of Fig. 5 is approximately seven ma and I_2 is about four ma and vice-versa for a space condition. The current differential is now sufficient to drive the relay directly for a standard frequency difference of ± 425 cps. In fact, the current differential is great enough to operate the relay down to ± 250 cps.

The only advantage to a switching circuit would be in providing for keying at a still smaller frequency shift and hence smaller discriminator outputs. This feature may yet be desirable and will possibly be incorporated in some future developments.

Difficulties encountered in a design of the discriminator may be explained with the aid of the diagram shown in Fig. 6. The direct voltage developed across the discriminator appears approximately as shown in Fig. 6A. However, if the two curves as shown in Fig 6B are not duplicates, Fig. 6A will not be symmetrical but will show different voltages for the same frequency difference about the center frequency. Therefore, different coil Q's, difficult to avoid with different amounts of inductance, and differences in the 1N69 diodes, will produce different shaped curves in Fig. 6B.

Limiter-Amplifier

It was estimated that the output from the front end through the band-pass filter would be approximately 100 mv. The limiter-amplifier also had to be capable of limiting at least 60 db. After the point of limiting occurred, the input signal could be increased at least 60 db with no variation in the output.

Since all the selectivity was to be obtained in the front end of this equipment, no selective circuits were needed in the limiter-amplifier section. Signal distortions were no problem because limiting was desired in any case. The intelligence is derived merely from the shift in frequency and, hence, the output wave shape is of little or no importance.

Various circuits were tried with the optimum transformer ratios being determined on a cut and try basis knowing that the maximum power transfer would be obtained by matching impedances. Counting the input and output impedances of the various stages and starting from there, various transformers were tried. The transformers finally used provided maximum d-c power output as indicated by meters in the load circuit of the discriminator stage.

A push-pull final amplifier stage was employed when it became apparent that a single-ended stage would not provide sufficient power to operate the relay in a reliable manner. Two single-ended stages are necessary to provide amplification from the 100-mw maximum input.

Limiting is obtained inherently in these devices. Actually, the limiting does not take place as in the normal vacuum-tube practice by plate saturation and grid clipping. What happens is more akin to compressor action wherein the wave shape remains unchanged or undistorted. It is believed that this occurs because the operating point changes due to the rectification in the emitter circuit of the incoming signal and the fact that the load line is a curved reactive line instead of a resistive straight line. The same action as is obtained with a variable G_m tube is also obtained here.

In general, the transformers present approximately a 9,000-ohm impedance to the collector circuit and about a 200-ohm impedance to the following emitter circuit. No appreciable difference was found in the method of supplying the collector and emitter voltages. These voltages may be supplied either in series through the transformer winding or in shunt with the transformer winding using an r-f choke in the supply leads.

An appreciable difference was found between the use of Litz wire and the enamel single-strand wire-wound transformers in the amount of power output as indicated by the d-c ammeter readings in the relay windings. The a-c losses, while small in the enamel wire at these frequencies, are still an appreciable part of the total power transferred from one transistor amplifier stage to another when the total power

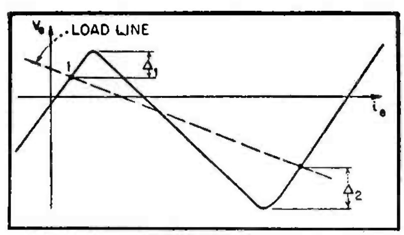

FIG. 3—Electrical characteristics of the circuit of Fig. 2

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available per transistor is about 60 to 100 mw.

The filter used originally had a band-pass characteristic of 1,500 cycles wide at the ±3-db points with a center frequency of 29.3 kilocycles.

R-F Amplifier

The r-f amplifier selectivity circuits are operated in parallel resonance with impedance matching to the transistor. The use of series resonance circuits as recommended in published data were not found as satisfactory as parallel resonant circuits due to the tendency of the transistor to oscillate because of the inherent feedback element (base resistance) in the transistor. This phenomenon also occurs in vacuum-tube amplifiers as the signal frequency is detuned from resonance.

Impedance matching has been determined by experimental methods. A compromise must be made between the antiresonant resistance R_{ar} of the parallel resonant circuit, which should be small, and the input resistance of the transistor which is effectively coupled in series with the tuned circuit, the sum of which may be called R_x. The reactance X_L must be many times larger than the resistance R_x if the same selectivity is to be maintained as in the vacuum-tube amplifier.

The capacitive component of the resonant circuit is determined by the 138-μμf capacitor in parallel with the series combination of the 82-μμf capacitor and the resistance $R_{total} = R_5 + R_{11}$ (input resistance). The 82-μμf capacitor determines the coupling between R_{ar} and R_{total}. If the coupling 82-μμf capacitor is changed for a given value of R_{total} and approximately a given value of R_{ar} as the circuit is maintained in resonance, an optimum value of coupling will be achieved. For the input circuit, a value of 82 μμf was obtained and was determined by experiment to be an optimum amount of capacitance.

If the 1,000-ohm resistor in parallel with the input resistance R_{11} of the transistor is changed for a given value of R_{ar} and coupling, an optimum value of resistance will be determined for a given coupling. If the optimum resistance is placed in the circuit and a redetermination of the coupling capacitance is made, a new optimum value of coupling capacitance will be found that results in a greater energy transfer or gain in that stage.

If the value of R_{ar} is changed, new values of coupling capacitance and resistance in parallel with R_{11} are obtained. By trying various values of R_{ar}, one may obtain a value which permits the maximum energy transfer or gain of the stage and yet maintains the selectivity equal to that of a conventional vacuum-tube amplifier.

The output circuit parameters have been determined in the same manner as the input circuit except for the r-f choke. The position of the r-f choke in the circuit requires a high impedance to r-f and a low resistance to d-c. Because the equipment must operate from 28 direct volts and the magnitude of the current drawn by the collector is approximately five milliamperes, a resistor in this position can not be used.

Output Circuit

At first it was believed that a low-Q resonant circuit should occupy the output position. This did not operate very well and would result in a triple-tuned circuit requiring that the Q of the input and output circuit be one-tenth or less than the Q of the middle circuit.

If a triple-tuned circuit were used, the selectivity characteristics would not duplicate the selectivity characteristics of the vacuum-tube circuits which were being duplicated. From these considerations, it was decided to use the r-f choke which permitted the greatest circuit gain. The inductance of the choke is one millihenry. No effort has been made to determine optimum value of inductance for this position.

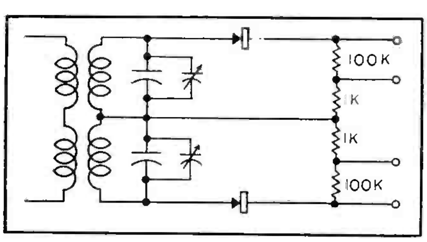

FIG. 4—Circuit of the discriminator in the original converter

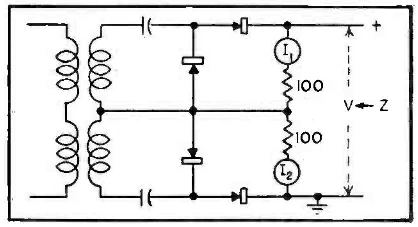

FIG. 5—New discriminator circuit using series-resonant circuits

The d-c resistance between the supply voltage and the collector of the transistor must be small and have a high impedance to r-f. To satisfy this requirement, a low-Q resonant circuit tuned to 29.3 kc was used. The output resistance of the transistor R_{22} is across this tuned circuit and it lowers the Q still further. The output impedance of the transistor R_{22} in parallel with the antiresonant resistance R_{ar} of the tuned circuit is the generator impedance now used to drive the filter.

Selective Circuits

Some additional considerations and notes in operating transistors in selective circuits are as follows: If oscillations are to be avoided, the circuit looking either from the emitter or collector must be broad-band resistive. If other transistor circuits are coupled to the resistive side (either emitter or collector circuit) it should remain broad-band resistive with very little and preferably no reactive component whatsoever. This rule has been practically satisfied by the 1,000-ohm resistor from emitter to base in the r-f amplifier stage, and by the 680-ohm resistor in the mixer stage.

It was interesting to note that the mixer will oscillate when the input 500-kc series resonant circuit is connected to the emitter and a 29.3-kc parallel resonance circuit is connected to the collector. This condition is not encountered in vacuum tubes.

Another rule for note is that no additional coupling should be placed between the collector and emitter. This additional coupling is positive feedback for the grounded-base connection and causes the transistor to oscillate. Capacitors in the order of five μμf additional to the transis-

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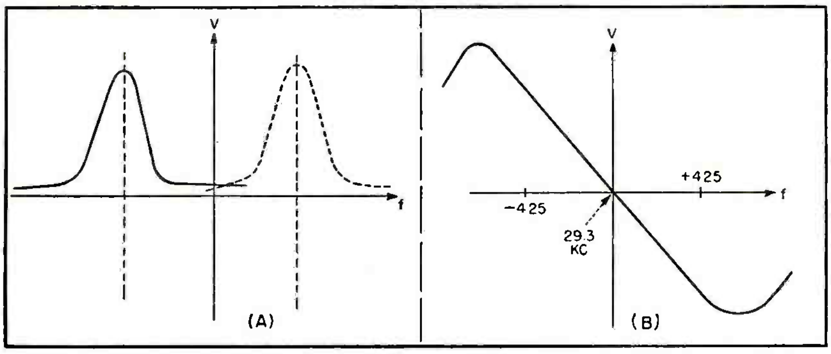

FIG. 6—Discriminator design curves which are discussed in text

tor and socket capacitances are sufficient to cause oscillations in the circuit.

By experiment it has been determined that in the design of the r-f amplifier and mixer the potential on the collector be in the order of 23 volts. The current is then about five ma. When adjusting the emitter current for maximum gain of the stage, it was found that when the emitter current is much lower than the recommended value, a greater gain is achieved. This results in a potential on the emitter in the order of -0.2 volt to $+0.1$ volt and a current in the order of 0.2 to 0.4 ma. The supply voltage for the emitter is positive in polarity. Adjustment of emitter voltage is made with the potentiometer in the bleeder circuit across the battery. The potentiometer is adjusted to give maximum gain for the stage.

Crystal Oscillator

The crystal oscillator was built using resistors from emitter to base and collector to base and a crystal connected between collector and emitter. This is the type of crystal oscillator shown in published data. It was found that this type would self-oscillate and may or may not be stable. Further investigation revealed that the self-oscillation was at a much lower frequency than the crystal frequency.

By adjusting the emitter or collector current, the frequency of self-oscillation could be changed. When one of the harmonics of the self-oscillation frequency became coincident with the crystal frequency, synchronism would take place and the self-oscillation frequency had crystal-controlled stability. Changing the emitter or collector current would cause the self-oscillation to lose synchronism with the crystal and result in an unstable frequency and no signal at the crystal frequency.

It was concluded that by making the amplifier deficient except at the crystal frequency, if self-oscillation were to occur it would be at or near the crystal frequency. The circuit was altered to make the amplification deficient at all except the crystal frequency by placing a low-Q tuned circuit between the collector and base.

Further experiments show that the 68,000-ohm resistor in the emitter circuit serves the same purpose as the grid leak in a vacuum-tube oscillator and its value should be made large.

The crystal-oscillator circuit shown in the large circuit diagram is free from self-oscillation. It oscillates only when the crystal is in the socket and only at the frequency of the crystal. Changing the emitter and collector current does not change the frequency but affects only the power output of the circuit.

By experiment it has been found that a collector voltage in the order of -5 volts is near optimum. Raising the collector voltage or current to the same value, -23 volts, as in the r-f amplifier and mixer circuits results in excessive dissipation in the transistor and the output is erratic.

The potential on the emitter is in the order of -0.2 volt to $+0.1$ volt for best performance of the oscillator. The potentiometer in the bleeder circuit is adjusted for maximum power output from the oscillator. The oscillator signal is coupled in parallel with the incoming signal in the mixer.

The method of determining the value of coupling capacitor, 22 $\mu\mu$f, is the same as that used for determining the coupling capacitor in the input circuit of the r-f amplifier.

Increasing the input signal strength causes a linear increase in output over a large range. Any further increase in input results in a decrease in output. Bandwidth exclusive of band pass compares favorably with the bandwidth of the same circuit types used in the vacuum-tube amplifier. Bandwidth measurements have not been recorded for either the transistor or vacuum-tube amplifier.

Conclusions

The use of transistors in this and similar low-frequency low-power amplifications is definitely feasible. While a rugged piece of military equipment is not presently on hand, there are definite possibilities of obtaining one.

The advantages of power drain of approximately 1.5 watts and a total weight of six pounds make this equipment particularly desirable. The low voltage supply is also an advantage for vehicular use, although with the extremely low power drain, dry cells could be used if necessary for higher voltages. The use of a separate power supply such as dry batteries may be desirable since a constant-current source is needed and the vehicular battery may not be able to meet this requirement.

Present equipment could probably be ruggedized quite easily since transistors have been known to withstand shock of approximately 20,000 G.

The major disadvantage of transistor equipment at present seems to be the ambient temperature limitations. While the ambient temperature within the transistor equipment is reduced greatly by the elimination of heating filaments, the use of this equipment under conditions of greatly varying temperatures or temperatures above 125 F seems, with the present state of the art, precluded.

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Phase-Linear Television Receivers

Production receivers can be designed with narrow bandwith and linear phase shift for sharpened pictures without smear. Improved signal-noise in intercarrier-sound sets embodying this method results in much better fringe-area reception

By HERBERT KIEHNE and STANLEY MAZUR

Emerson Radio and Phonograph Corp.
New York, N. Y.

PHASE LINEARITY—phase shift proportional to frequency—produces a tv picture most faithfully resembling the original. This simple criterion does not take into account aperture distortion in present-day picture tubes nor the distortion inherent in focusing systems. Since absolute phase linearity is commercially difficult to obtain, this article deals with permissible tolerance throughout the entire video system.

Consider a 15-inch horizontal sweep. A 15,750-cycle signal impressed on a kinescope with a 15-in. sweep would produce a solid bar half way across the tube face. Similarly, a 1.5-mc signal would produce a picture element of 0.078 in. on the tube face. If both these signals are introduced into a system in the same relative phase, and the high-frequency signal is delayed by 0.1 μsec at the output, the 1.5-mc picture element will be displaced 15 percent or 0.0118 in. in the direction of the sweep.

This will produce a smear that shows up as a ragged edge on a sharp line. At low signal frequencies, a larger change in delay can be tolerated since the percentage displacement will be smaller. For example, at 150 kc a delay of 0.1 μsec would produce a displacement of 1.5 percent in a picture element of 1.57 in.

Since the eye is more sensitive to smear than to loss of high-frequency detail, a narrow-bandwidth system was considered because it is relatively easy to achieve nearly linear phase shift with a lower cutoff such as 2.5 mc. The sharpened picture with linear phase shift more than offsets the greater detail present in the wide-band system.

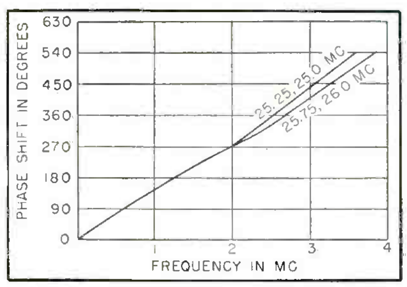

FIG. 1—Phase shift vs frequency by setting carrier at point *A* of Fig. 2

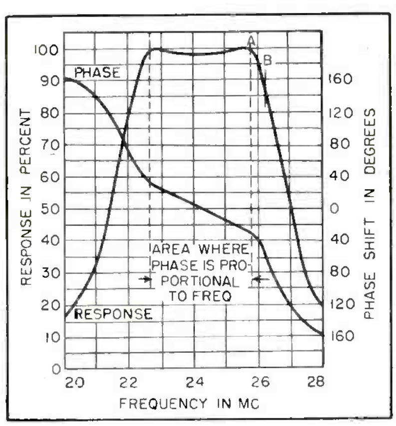

FIG. 2—Overcoupled video i-f amplitude and phase response vs frequency

In addition, present-day transmission is at best 3.5 mc as verified with several tv transmitting-station engineers. Coaxial intercity lines are 2.7 mc. Therefore, a wide-band system introduces into the picture all phase distortion and ringing present beyond the transmission cutoff frequency.

Video I-F Amplifier

Any video i-f system that has the proper amplitude response and with the picture carrier 50-percent down (0.75 mc from the flat top) can be designed to have negligible phase shift within its passband up to cutoff. The prerequisites follow. In all stagger systems it is necessary to design around the formulas outlined in Wallman and Valley, "Vacuum Tube Amplifiers". These formulas are based on minimum phase shift.

A three-stage amplifier including the converter was successfully constructed. Variation from linear phase response of the video i-f when measured with a 3.3 K diode load (no peaking) was negligible

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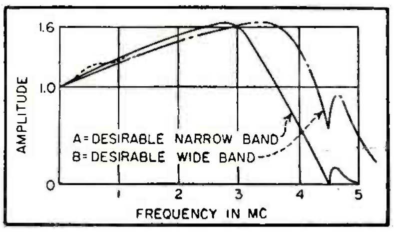

FIG. 3—Detector characteristics in terms of normalized amplitude vs frequency

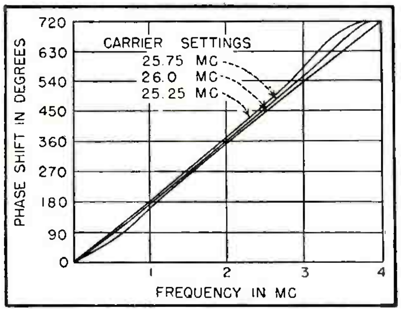

FIG. 5—Phase-frequency response of an i-f amplifier (Fig. 1) and detector (Fig. 4A)

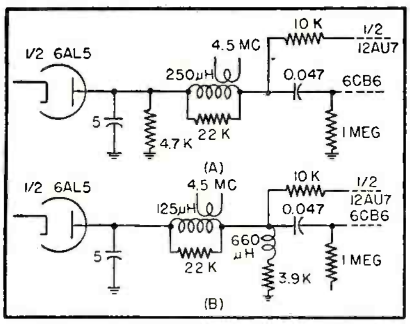

FIG. 4—Preferred wide-band peaking networks for best phase response

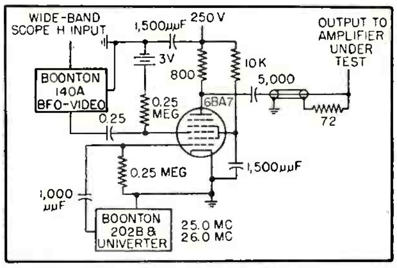

FIG. 6—Mixer used to modulate i-f with video

up to cutoff when the picture carrier was set 50-percent down. Total phase shift was calculated to be 360 degrees up to cutoff at 2.75 mc and confirmed by measurements as shown in Fig. 1.

With intercarrier sound, it is possible to tune up and down the slope and adjust the picture carrier for best picture without loss of sound. This is desirable in fringe areas, since tuning the picture carrier as high as possible improves contrast and signal-to-noise ratio and still retains some sound. It adds a requirement to the design of intercarrier sets that there be very little or no phase shift at all when tuning the picture carrier to the top of the response curve, in our case between 26 and 25 mc.

Despite loss of picture detail owing to narrower bandwidth and loss of highs, the signal-to-noise ratio is improved. Any i-f system can be so designed as will be shown.

In another experimental receiver the video i-f consisted of a flat-staggered triple and a synchronous, double-tuned, link-coupled video i-f from the tuner to the first video i-f tube. The flat-staggered triple is designed according to specifications from "Vacuum Tube Amplifiers," page 186, and offers no difficulties.

The tuner i-f, being slightly overcoupled and having a phase-shift of approximately 150 degrees over its 3-db pass band, must have the picture carrier set within the flat part of its pass band as shown in Fig. 2, point *A*. This places the picture carrier in a region where phase shift is proportional to frequency when the oscillator fine tuning control is varied.

If, instead, the picture carrier is set 10-percent or more down the slope as shown at point *B*, and the picture carrier is now moved up the slope past *A*, the deviation from linear-phase response is apparent.

Detector Operation

It has been found empirically that the correct detector characteristic to obtain best phase response is the continuously rising curve *A* of Fig 3. A wide-band peaking network should follow curve *B* with a 4.5-mc trap superimposed. The circuits are shown in Fig. 4.

An amplitude ratio as high as 2 to 1 is sometimes necessary to obtain good compensation. Figure 5 shows the resultant phase response. An additional phase shift of 90 degrees can be seen at 2 mc after insertion of a peaking coil. The use of series-shunt peaking is justified only when a wide-band, sharp cutoff detector characteristic is desired. It must also be noted that it is difficult to compensate for excessive detector loading, that is, sync, video, sound, and on occasion agc, with this type of peaking.

When the video detector is fairly clean, with only the video loading the circuit, it is possible to use shunt peaking only to get the desired phase-amplitude response.

Test Setup

The measurements and curves indicated were made by a method suggested in RCA License Bulletin 442 on phase-shift measurement. The circuit of Fig. 6 was used to mix i-f and video. In the actual measurement, care must be taken to establish the exact frequencies at which zeroes and poles occur through the pass band. When they fall at a constant-frequency difference within this band, the most linear phase response can be expected.

Although phase linearity is stressed, some deliberate phase distortion has been successfully used. This can best be achieved from the i-f viewpoint by lowering the picture carrier from 6 to 8 db to produce an overshoot and sharpen the picture. Care must be taken in the overall video design that this does not introduce excessive transient noise.

Video Amplifier Design

The phase-frequency response of video amplifiers, amply investigated in the past, requires some reconsideration with intercarrier sound. The general phase requirements for a video amplifier are linear phase shift throughout the transmission, attenuation and, if possible, the cutoff regions. Systems were therefore designed with bandwidths far in excess of the standard transmission.

Low-frequency compensation by decoupling filters was used. In this manner, none of the signal deterioration that normally occurs at the filter cutoff appears in the picture. Ringing and high-frequency phase shift were the primary targets of this approach.

To achieve such bandwidth, a

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sacrifice in gain was necessary and two or more stages of amplification furnished, at resultant high cost. This worked well for split-sound, but low B+ intercarrier sets permit no excessive response at 4.5 mc and no low-frequency decoupling. Excessive response at 4.5 mc cannot be tolerated because it would appear as noise in the picture.

This is conveniently covered in a split-sound set by the high sound-carrier attenuation in the i-f, an impractical approach in intercarrier sets if we are to have any sound. Low-frequency decoupling is, of course, difficult with a low B+ supply. All attention must be concentrated on the output network or networks.

A typical case would be the 6CB6 video amplifier in common use today. The object here is to produce a phase-linear amplifier with the characteristics of Fig. 7. The output level for an a-c coupled system would be 95 v p-p or d-c coupled, 55 v p-p. This circuit characteristic is desirable for several reasons. The gaussian character of its cutoff is ideal for good transient response. The slightly rising amplitude response below 2 mc adds some necessary aperture correction. The phase response is linear throughout the transmission and cutoff regions.

Note that the ratio of cutoff frequency-phase increment to the transmission phase increment is 1.5 to 1. A frequency of 4.5 mc is the first of theoretically infinite attenuation, precluding the need for a special trap with its resultant distortion of high-frequency signals.

Practical Circuits

Such a response can be approached in several ways, two of which are described. The first requires a capacitance ratio of 2 to 1 between output and input of the amplifier filter. Since the plate-to-ground capacitance of the 6CB6 in the socket is 5 $\mu\mu$f, the required output capacitance is 10 $\mu\mu$f. This poses some difficulty since one foot of No. 22 stranded wire, the socket, and cathode-to-ground capacitance of the kinescope total 10 $\mu\mu$f. Elimination or extreme shortening of the lead, however, will keep this

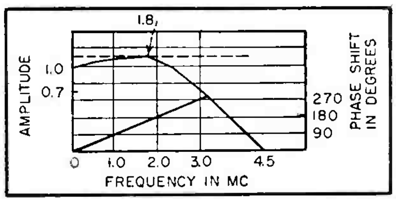

FIG. 7—Recommended amplitude-versus-frequency response of the video amplifier

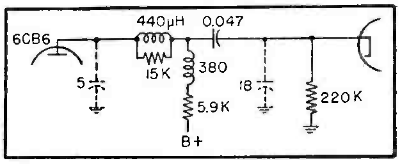

FIG. 8—Calculated constant-*k* filter

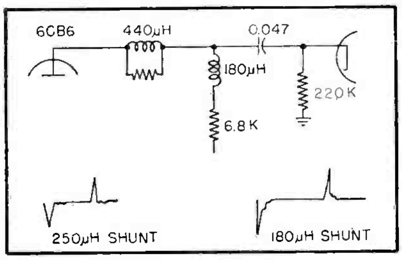

FIG. 9—Practical video circuit for cathode feed. Differentiated square-wave response for two different values of shunt

parameter within limits. Careless lead dress will greatly increase the detributed capacitance.

In one case an increase from 10 $\mu\mu$f to 16 $\mu\mu$f was recorded by placing this lead as it is placed in general production. However, if the capacitance ratio can be held, a circuit can be designed for 3-mc cutoff utilizing a 5,600-ohm load resistor following the method of R. B. Dietzold, of Bell Telephone Laboratories. This circuit displays high-speed, linear phase response, and very small overshoot.

Another method uses standard layouts where capacitances occur as illustrated in Fig. 8. A multiple attack using network synthesis, square-wave analysis and sweep measurements is recommended. Network synthesis was used to determine the overall circuit proportions of a constant-*k* network. Sweep measurements were used to determine the rate of rise of the amplitude response. The square-wave analysis was used to calculate the speed and phase response of the amplifier. Resort was made to a differentiation method to evaluate

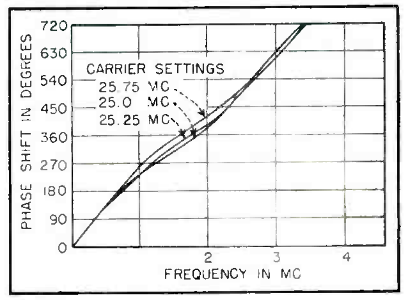

FIG. 10—Phase vs frequency of unmodified set for overall i-f and video. Three carrier settings are shown

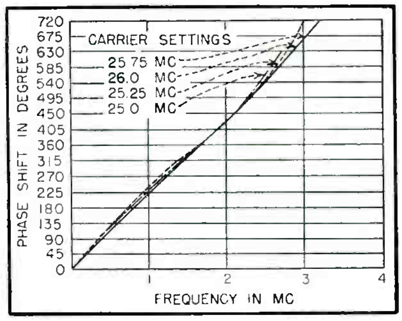

FIG. 11—Phase vs frequency characteristic for receiver with modified i-f and video circuits

the functions properly and easily.

The square-wave output of the amplifier was differentiated in a fast circuit whose capacitance represented the kinescope and socket. Lead capacitance was replaced with oscilloscope probe capacitance. The results are indicated in Fig. 9. If the shunt inductance is increased, the ringing phenomenon is masked by the overshoot as indicated. Rise time for both circuits is below 0.2 microseconds.

End Results

The end results are shown in Fig. 10 and 11. These are overall phase characteristics measured on two experimental receivers. Note the improved linearity of phase response which resulted in a sharper picture with more apparent detail than before modification.

In addition, freedom was obtained to tune this receiver up and down the i-f slope without any bad effect except loss of bandwidth, thus realizing picturewise some of the inherent advantages of the intercarrier system.

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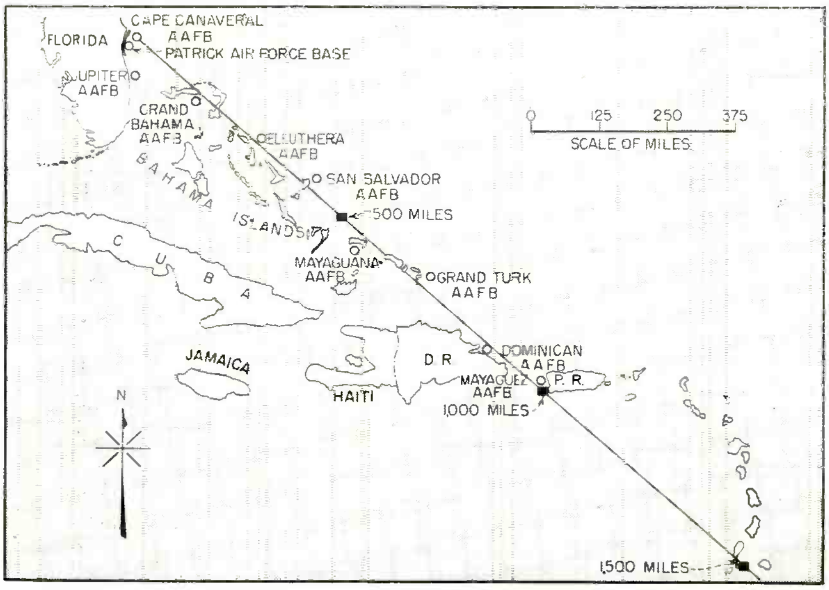
Guided Missile Test Center

Equipment used at Air Force 1,500-mile missile test center in the Caribbean is described. Sixteen basic channels are used on a single carrier. Six of these may be used on time-sharing basis to provide up to 172 channels of information



Location of Air Force Missile Test Center provides direct line of 1,500 miles for studying aircraft and projectiles but tough problems for telemetry engineers in way of tropicalizing and maintaining equipment

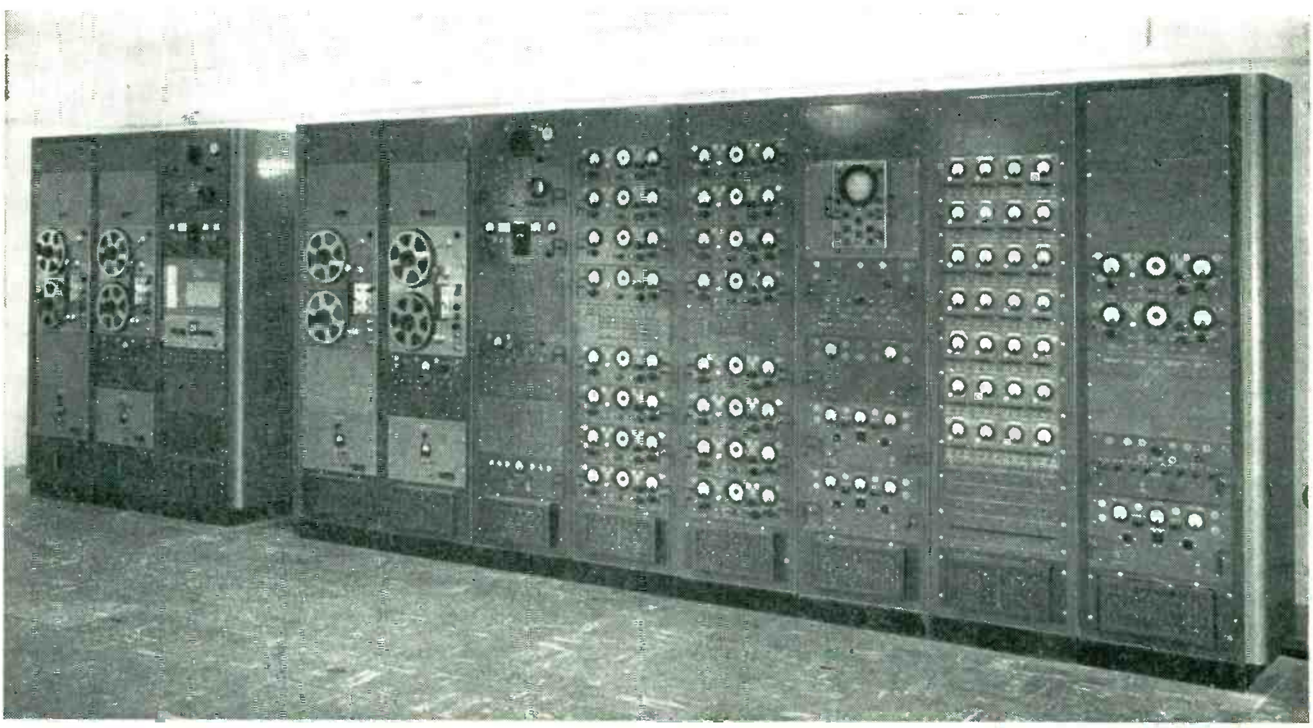
By JAMES B. WYNN, Jr.
Chief, Telemetering Section

and SAM L. ACKERMAN
Chief, Internal Electronic Engineering Branch

Technical Systems Laboratory
Air Force Missile Test Center
Patrick Air Force Base
Cocoa, Florida

As THE structural flight testing of military aircraft became more rigorous and scientific, and the guided missile program emerged, it became necessary to improve the overall art of radio telemetry. The missile program quickly assumed the top role in the telemetry field because of its high military priority.

The system to be described was adopted as standard for tests on missiles fired at the Air Force Missile Test Center.



Inside view of permanent telemetry station. Eight racks at right comprise complete station, while three at left suffice for along-the-route substation

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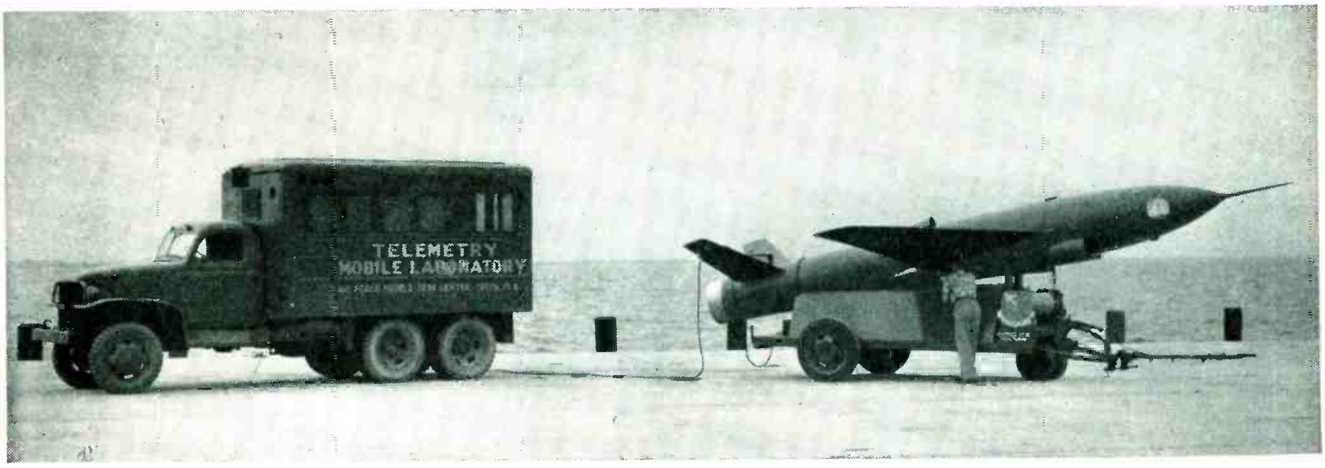
Telemetering System



Missiles are checked out prior to launching by mobile test laboratory that indicates last-minute adjustments of instruments

The locations chosen for telemetry receiving sites over the present sea test range extend from Cape Canaveral, Florida, to Mayaguez, Puerto Rico. A map of the course is shown on page 106. The stations in between are situated on various islands with an average separation of approximately 175 miles. Nine such sites are provided in the chain. Although presently located in vans, these stations will eventually be housed in permanent air-conditioned buildings.

AFMTC Equipment

The airborne equipment is capable of transmitting sixteen continuous channels of information. As many as six of them may possibly be multiplexed to carry twenty-seven channels each of commutated information. This amounts to a total data capacity of 172 separate functions for a single radio link. Additional radio links may be operated simultaneously by providing about 1-mc separation between transmitter frequencies. The rate of change of the measuring quantities can vary from a steady state function up to 120,000 fluctuations per minute.

The information is transmitted as the f-m modulation of an f-m radio link. The ground station records and presents the data instantaneously. In propagation tests and missile launchings, the airborne system has demonstrated an effective useful range of 200 miles at 30,000 feet.

The overall system is normally calibrated from the missile through the airborne equipment, excluding the pickups. This is accomplished by injecting precise incremental input changes throughout the calibrated range of the pickup limits. A more accurate method, which is time consuming and often infeasible, consists of activating the pickup over its range in steps that can be checked by precision field test quipment. The first method is most widely used and can easily be modified for an in-flight calibration system. This basically consists of periodically interrupting the data channels in sequence through a time-actuated stepping switch to inject a calibrated step variation.

Helical antennas, operating in the beam mode and broad enough to be useful over the 215 to 235 megacycle range, are utilized for all ground receiving stations. This type is most desirable because of its circular polarization which permits satisfactory reception even when the missile rolls.

The receiver is basically a double-conversion superheterodyne and is tunable over the frequency range of 215 to 235 mc.

The complex frequency-modulated output from the receiver is made available, generally speaking, to feed three sources: a magnetic tape recorder, the subcarrier discriminator channels, and the submarine cable. From a station standpoint, the tape recorder constitutes only a small break in the continuity of the circuitry flow description, so it is advisable to divert and complete this group of assemblies.

Recording and Timing

Precision magnetic tape recorders provide storage of raw data from the 400-cps channel up to and including the 70,000-cps channel. Tape speeds provided are 15, 30 and 60 inches per second. The playing time provided by these speeds are 33 to 8 minutes, respectively. To obtain the maximum frequency response, it is necessary to operate at 60 inches per second.

The recording medium consists of an iron oxide coating uniformly dispersed on a plastic base ¼ inch wide, which is obtained in 2,400-foot lengths wound on standard 10½-inch reels and broadcast type hubs. To assure the finest quality and uniformity, preselected, nodule-free tape is being utilized for all missile flights. Dual units with dual heads are standard at each station to permit continuous coverage.

Unfortunately, the tape recorders and tapes presently available on the market are not satisfactory for telemetry use without proper error-

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Typical installations such as these are to be replaced by permanent buildings

correcting facilities. The slightest irregular motion of the recording medium, vibrations of the recording and reproducing devices, speed changes and elastic deformation of the tape result in flutter and wow.

Considerable development has gone into the design of equipments to reduce the error introduced by magnetic tape recording. Speed variations have been reduced to a negligible amount by utilizing a precision, temperature-compensated, tuning-fork-controlled, high-power amplifier to run the drive motor. Frequency accuracy of the power to the synchronous-drive motor is better than 0.01 percent and thus errors are avoided which might be produced by power line frequency variations.

Another assembly which considerably reduces the error factor is the electronic f-m/f-m playback compensation equipment. The principle of electronic compensation basically consists of simultaneously recording an accurate reference frequency on the tape with the complex telemetry information. During the playback process the reference signal is separated from the data signal and fed through a frequency-sensitive circuit which accurately determines how much change has been produced in the reference frequency. This frequency shift, proportional to the change in tape speed, is used to produce an error correction voltage of proper phase and amplitude and to cancel the error incurred through use of magnetic tape recording.

One reference generator is located at each telemetry site or mobile unit and is sufficient for use with as many as ten magnetic recorders. The frequency utilized is 40 kc and accuracy of $\pm$ 0.005 percent is achieved by providing a precise oscillating network.

The crystal that controls the reference frequency operates at 120 kc and is placed in one arm of a variable resistance bridge to provide amplitude and frequency stability. An 80-kc tuned circuit is shock excited from the 120-kc oscillator and the two signals fed into a pentode mixer to produce the desired 40-kc signals. This 40-kc reference frequency is connected to one of the inputs of a three-channel recorder mixer.

To correlate events, and for ease of reading records, an accurate time base, a binary coded signal, is generated at the launching area for use throughout the AFMTC sea test range. Unfortunately, this timing signal consists of pulses which are not suitable for direct recording onto the magnetic tape. However, the pulses are easily applied to the 52.5-kc carrier channel which is then varied by the timing and code pulses and fed directly to the second input of the mixer.

This system has the disadvantage of requiring the use of one of the 52.5-kc telemetry channels. A recent development will permit the direct recording of the timing pulses onto the magnetic tape by utilizing a separate track for this purpose.

Telemetry Data

The third input to the mixer consists of the complex telemetry data. At this point it might be well to indicate that this mixer provides a means for properly matching, mixing, and amplitude-adjusting the various information channels being recorded on the magnetic tape.

Actually, the signals are not fed directly to the record head or taken directly from the playback head but passed through record and playback amplifiers having the proper equalization characteristics.

When playing a tape recording back for the purpose of reproducing a record, the signal is fed to the sixteen telemetry data discriminators, a reference discriminator assembly, and a time pulse discriminator assembly.

The front end is somewhat conventional when compared with the other discriminator assemblies in the stations; namely, an input attenuator, band-pass filter, class A amplifiers and flip-flop limiters. However, due to the output load, a Travis discriminator circuit with push-pull cathode-follower output is required. This output is connected to two eight-channel phase and amplitude adjustment assemblies in parallel. They provide a phase and amplitude adjustment for the sixteen error-correction signals, one of which is fed into the output circuitry of each telemetry data discriminator assembly.

The timing pulse discriminator assembly is similar to the telemetry data discriminator assemblies and will thus be covered more thoroughly later. However, since this unit is associated with the magnetic tape playback function, it is installed in the rack along with the magnetic recording compensation equipment.

If the equipment is utilized to the fullest extent, the full sixteen channels of the telemetry systems

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would be mixed as a composite signal at this point. The channels utilized are shown in Table I.

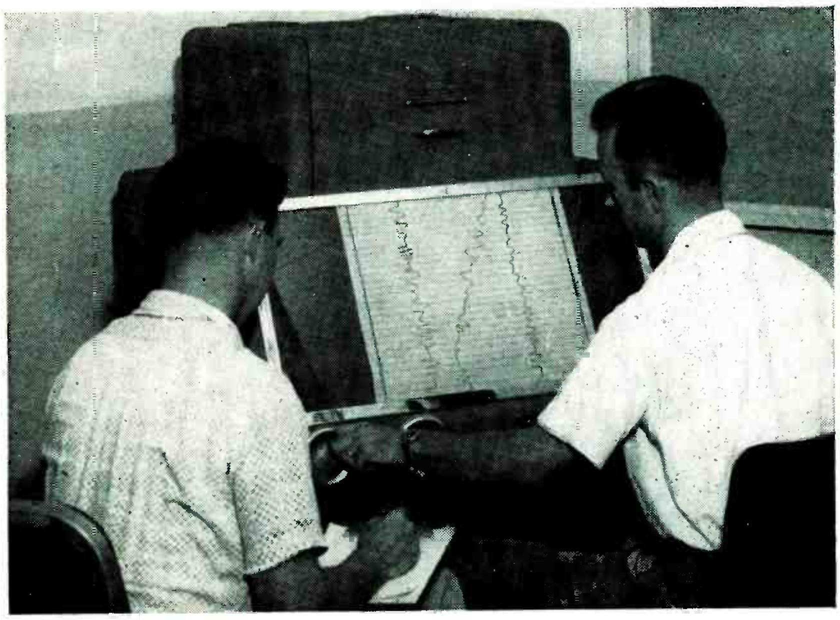
Since there is a maximum of 16 continuous data channels available at the test center, 16 discriminator channel assemblies are also required.

Three stages of class A amplification and a cathode follower are used to drive a diode clipper. The square wave produced by the clipper is then amplified and differentiated to form a suitable pulse for triggering the flip-flop limiter. The constant amplitude square-wave output of the flip-flop limiter is then passed through a cathode follower into the plug-in low-pass filter to reshape the wave form into a constant-amplitude sine wave. The constant-amplitude varying-frequency sine wave is fed to the grids of two cathode followers operating in parallel to drive the two sections of the plug-in parallel-T discriminator and their linearizing network.

The two signals at this point are of a low level so that it is first necessary to pass through cathode followers with plug-in pass filters in the cathode circuits to reduce distortion and then through several stages of amplification. The signal is then rectified and fed to two pairs of cathode followers for push-pull outputs. One pair furnishes a high current output for driving a pen recorder or a high-frequency galvanometer, and the other pair of cathode followers furnishes a low-current output suitable for driving low-frequency galvanometer elements, the pulse selector, or automatic data-reduction units.

Meter Indications

Front panel meters or indicators useful in setting up the discriminator channel consist first of a meter to indicate that the proper input level has been established, a neon indicator lamp to show that limiting is taking place and a meter of 270-degree movement to indicate the deviation of the subcarrier from center frequency. It is interesting to note that the deviation meter can be marked to indicate directly in terms of the function to be measured for real time data presentation. The third meter is connected with a selector switch to aid in monitoring the supply voltages and to assist when trouble shooting.



Semiautomatic machine scans photographic recordings of telemetered data. Points are read by manually positioning x and y cross hairs and reading coordinates on mechanical counters

The output of each of the 16 discriminator channels appears as a steady or fluctuating d-c voltage or current which is a function of the frequency of the respective channel. Since the corresponding subcarrier oscillator in the missile which originally generated the signal was varied in frequency in proportion to the quantity being measured, the output of the discriminator is an accurate indication of the magnitude or condition of the function being measured in the missile.

Time Sharing

When low-frequency response measurements are being made, about eight of the subcarrier channels can be utilized, if desired, as a time division system. This type of signal is generated in the airborne assembly by mechanically commutating the desired continuous channels with a 3-ring, 30-segment commutator. Actually, three of the segments are utilized for producing a synchronizing pulse for automatic data separation, and the remaining 27 used for data intelligence.

The transducers in the missile are connected to segments providing a 95-percent on, 5-percent off duty cycle. A gating circuit provides a 50-percent duty cycle of the information to reduce the error introduced by variations in dynamotor speed.

A commutated channel produces an output from the discriminator channel which is suitable for recording on a multichannel recording oscillograph but somewhat difficult to analyze. An electronic means of separating the commutated data was developed. Since its conception, it has also proved most useful in furnishing a signal which is satisfactory for real-time remote meter data presentation and adequate for feeding automatic data reduction systems.

The separation process has come to be generally known as decommutation. This process of separating the time division multiplexed continuous channel automatically is presently accomplished by the use of a pulse selector and 27 associated gate channels.

The pulse selector receives the commutated pulse train from the output of the discriminator channel to which it has been patched. From this single input, it is necessary to produce the output which (a) is of sufficient amplitude to satisfactorily deflect the recording galvanometer, pen recorder element, remote meter or automatic data reduction system, (b) will develop a master pulse to start the sequential triggering of the gate channels, (c) will develop

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Table I—Frequencies and Performance of Telemetering System Now in Use at Air Force Missile Test Center

Channel Number	Center Freq. (cps)	Lower Freq. Limit (cps)	Upper Freq. Limit (cps)	Deviation (Percent)	Freq. Response (cps)
1	730	675	785	± 7.5	11
2	960	888	1,032	± 7.5	14
3	1,300	1,202	1,398	± 7.5	20
4	1,700	1,572	1,828	± 7.5	25
5	2,300	2,127	2,473	± 7.5	35
6	3,000	2,775	3,225	± 7.5	45
7	3,900	3,607	4,193	± 7.5	60
8	5,400	4,995	5,808	± 7.5	80
9	7,350	6,799	7,901	± 7.5	110
10	10,500	9,712	11,288	± 7.5	160
11	14,500	13,412	15,588	± 7.5	220
12	22,000	20,350	23,650	± 7.5	330
13	30,000	27,750	32,250	± 7.5	450
14	40,000	37,000	43,000	± 7.5	600
15	52,500	48,560	56,440	± 7.5	790
16	70,000	64,750	75,250	± 7.5	1,050
OPTIONAL BAND OPERATION					
12	22,000	18,700	25,300	±15	660
13	30,000	25,500	34,500	±15	900
14	40,000	34,000	46,000	±15	1,200
15	52,500	44,620	60,380	±15	1,600
16	20,000	59,500	80,500	±15	2,100

NOTE: When using 15 percent deviation, consecutive channels cannot be used due to overlapping

a switching pulse to consecutively trigger the gate channels, and (d) will develop a false switching pulse or pulses to provide continuous operation in the event of a partial loss of the synchronizing signal.

The signal fed to the pulse selector is push-pull balanced to ground so a differential amplifier follows the input attennuator. Following the differential amplifier is a conventional d-c amplifier and a cathode follower to furnish the information signal of sufficient amplitude.

To produce the required master and switching pulses, a constant amplitude square-wave pulse train is generated which has the leading and trailing edges coincident with the leading and trailing edges of the commutated information signal. The information signal is tapped off to furnish a signal to a twin diode to clip out a portion approximately midway on the information pulse. This clipped signal is amplified sufficiently to accurately trigger a flip-flop stage simultaneously with the information pulses. The output of this stage is used to feed the master pulse and switching pulse circuits.

A twin triode receives the input to the master pulse circuitry and performs the dual function of a time delay stage and a synchronizing pulse separator. The low-amplitude signal derived from the twin triode is amplified and utilized to trigger a flip-flop for producing the master or initiating pulse. To provide proper isolation and matching, a cathode-follower output stage is used for driving the first gate channel.

Switching Circuits

The switching pulse circuitry is somewhat simple and brief. The output of the shaping circuit is differentiated and the positive pulse removed by use of a diode clipper. A power cathode follower drives all the gate channels in parallel.

The false switching is produced by the combination action of one-shot and free-running multivibrators. The regular switching pulse fires a one-shot multivibrator which has an on time of approximately 20 percent of the pulse duration. The off period, a negative pulse, is determined by the time excursion to the next switching pulse. A cathode-coupled time delay and pulse width separator produces an output when the longer off period occurs due to a missing switching pulse. Thus, a pulse had been produced by the absence of the switching pulse.

The pulses are amplified to trigger a flip-flop. This square wave is differentiated and injected with the time-switching pulses to form a continuous train for triggering the gate channels and triggering the one-shot multivibrator to end the off time.

The gate channels, when properly triggered, utilize the outputs from the pulse selector to produce a separated continuous output for each of the commutated data channels. The amplitudes of the information pulses are suitable for driving the recording oscillograph galvanometers, pen recorder elements, remote meters or automatic data-reduction equipment. Thus, the output of a missile transducer sampled repeatedly produces an output compatible to the measurements made continuously and furnished from the discriminator channels. Normally, commutated data consists of information varying in rate between 2 to 5 cycles per second.

The master pulse generated in the pulse selector is fed to the first gate channel only. This master pulse is differentiated and the negative spike caused by the trailing edge triggers the normally saturated portion of a flip-flop. The multivibrator is cut off by the switching pulse being injected on the other grid of the twin triode flip-flop. The output of the first side forms the master pulse for triggering on the next channel and so on through the consecutive gate channels.

The information pulses are fed to all gates in parallel. However, each gate separates only the proper information pulse by the master-pulse-triggered flip-flop driving a tube to saturation. Another triode

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being driven simultaneously by the master pulse functions as a variable resistor and switch in the cathode of the information input charge-tube to trigger a diode in series with the integrating data-holding capacitor. The separated information pulse is used to produce the data signal. The signal at this point can be selected by use of a toggle switch to directly feed an isolation cathode follower or selected from a holding circuit to eliminate spikes caused by the integrating capacitor being returned to zero level between data pulses.

Two cathode-follower output stages are used, one for furnishing a signal suitable for driving a low-current galvanometer, panel meter and/or a remote indicator output, while the other furnishes a signal suitable for driving a pen recorder or a high-current galvanometer.

Supplemental equipment utilized consists of the panoramic adapter, patch panels and specially designed power supplies.

Data Presentation

The recording oscillographs provide a means of displaying the information so that an experienced reader can tabulate the data in a numerical form. Presentation of the data is in the form of a thin trace or line along the surface of photo-sensitive paper. Measurement of the data intelligence is in the form of deflection from a standard reference. Motion of the paper provides a time-base reference.

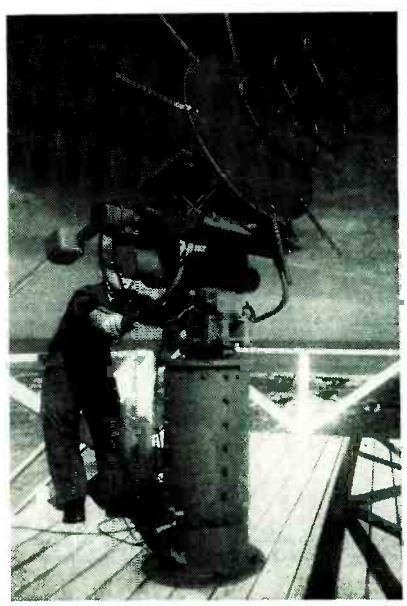
The deflection characteristic is usually most important and may be measured to within 1/100 inch with total deflection not exceeding 4 inches. The recording oscillograph is accurate to within 1 percent so this is an accurate means of obtaining reduced telemetered data.

Oscillographs in use at AFMTC are multiple units each containing eighteen separate galvanometers. This large number of galvanometers helps to improve the flexibility of setting up instruments quickly for various flight conditions. Between 6 or 7 traces, on the 7-inch-wide recording paper, can be utilized for data presentation without extreme complexity and reading fatigue when reducing the records. To record all the data simultaneously, banks of these instruments are used on a single station. To aid in recording and improve accuracy, both static reference traces and the test range binary-coded time base, along with the internal time-generated lines, are recorded on the oscillograph records. Linearization of nonlinear functions or transducers can be provided prior to recording.

The commercially available instruments employ ranges from d-c displacement up to 2,000 cps flat-response galvanometers damped 64 percent of critical. Visual observation of the traces is available during setup and recording. This is presented full scale on a calibrated ground-glass scale by use of a separate optical system and rotating polygon mirror.

The recording oscilloscope is actually a delicate precision laboratory instrument that is ruggedly constructed and shock-mounted for permanent, mobile or portable use. The main disadvantage of the recording oscillograph is the tedious process and large number of man hours required for reading or reducing the data.

The electronic data-reducing equipment presents the information in a numerical tabulated form at the rate of 15 points per second.



Helical antennas used at ground receiving stations provide good reception despite missile roll

This is a decided advantage over any type of oscillograph record reading at some slight sacrifice of accuracy.

Direct-writing recorders, which are commonly classified as instruments converting electrical phenomena into instantaneous visual presentation, are also required and installed throughout the range. Requirements are such that some of the data must be monitored immediately during flight or within a short while after flight time. The processing of photographic data consumes considerable time and consequently renders any such method prohibitive.

High-frequency data recording from 2,000 to 10,000 cps is provided by the oscilloscope-camera combination. It is understood and recognized that such responses cannot be obtained from the f-m/f-m system with standard deviation ratios and response characteristics, but, when the paramount requirement is frequency determination, other advantages of the system can be neglected.

Future Work

The telemetering system described does not represent the Air Force Missile Test Center's entire program. Already, there exist requirements for pulse-duration modulation equipment which, because of its inherent simplicity and greater accuracy, represents a real solution to those problems requiring multichannel operation of low-frequency data.

The challenge in all of the development and engineering effort is that of providing reliable and complete facilities with the minimum amount of equipment, and operation and maintenance personnel.

The logistic problem of supporting large teams, over an area which is thousands of miles long, is so vast as to be the deciding factor in determining the eventual extent of the range. The environmental conditions encountered are those normally found in subtropical regions, and range from high humidity and temperature to the corrosive action of salt and fungus.

There remains much to be done to achieve the above aims.

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MONTREAL CBC

Largest broadcast master control in North America can be operated by one man exeept during extraordinary periods. Canadian in concept and design, it uses telephone crossbar switches, multiconductor audio cabling and other features available to U. S. broadcasters

By ROBERT H. TANNER

Audio Engineer
Northern Electric Co., Ltd.
Belleville, Ontario
Canada

For more than a year, the Canadian Broadcasting Corporation has been operating in its new studio center at Montreal a master control system that contains many novel features of circuitry and operational design. This has been demonstrated by the fact that it has been found possible, except during exceptionally busy periods, to leave the whole of this complex system under the charge of a single operator.

The master control equipment handles the outputs of twenty-four studios, seven incoming network lines and a large number of remote pickup points. The latter are switched by means of a jackfield and patch cords. From the switching system, programs may be fed to eight outgoing networks, five main transmitters (with provision for feeding auxiliary f-m and short-wave transmitters and wired-music facilities) and fifty program lines to both the recording and house monitoring switching systems that are included as an integral part of the complete installation.

The recording system gives fourteen recording machines an instantaneous choice of any of these fifty programs, with a lamp indication that the correct connection has been made. This, incidentally, is believed to be the first application of the telephone crossbar switch to the broadcast field. The house monitor system serves fifty loudspeaker stations around the building, with switching controlled by dials and telephone-type selectors.

Additional features include a complete radio-receiver setup for monitoring off the air, a cue selector for feeding any one of twenty-four different programs back to thirty-three studios and foreign-language booths, and a system using two volume indicators and three loudspeakers to provide monitoring over a choice of sixty different locations within the complete system. Provision has been made for increasing the number of incoming networks to nine, outgoing networks to twelve, recording positions to twenty and house-monitoring stations to one hundred.

Master Control Position

The main control panel, together with the racks carrying all the amplifiers, jackfield, receivers and test equipment extends from wall to wall of the master control room as illustrated. Since the control room is on the second floor of the build-

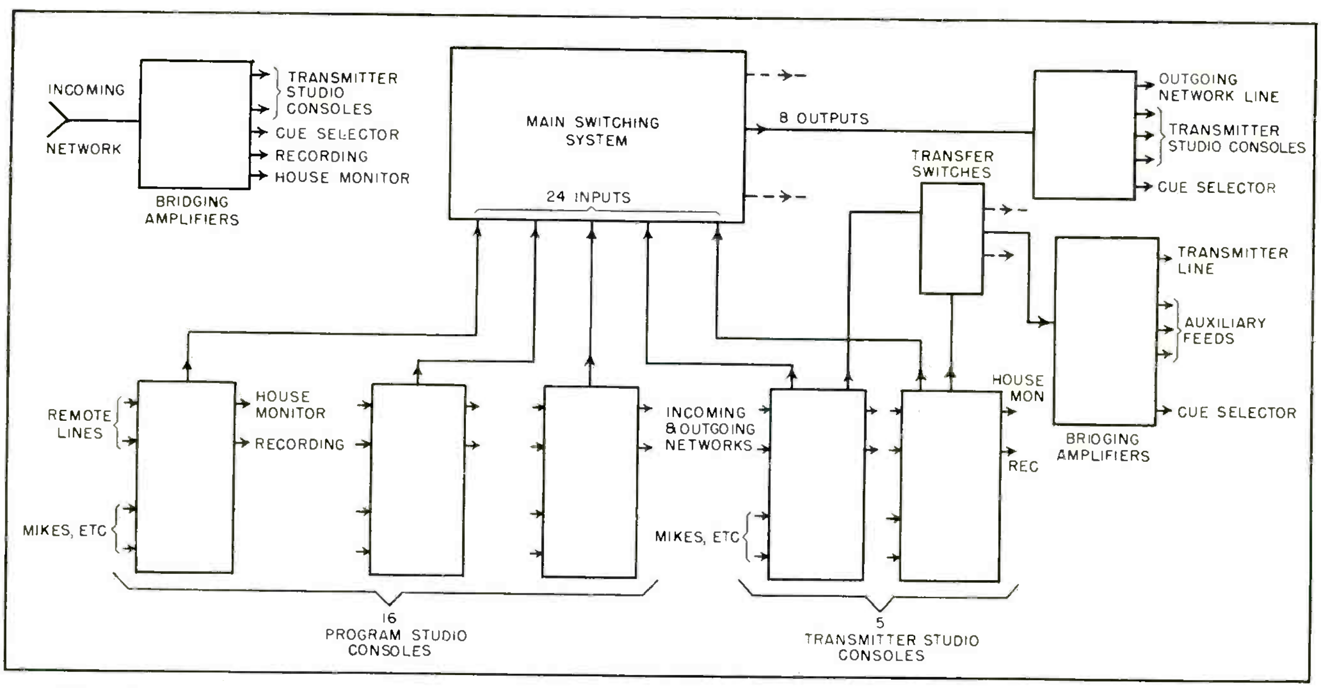

FIG. 1—Elemental layout of the main program circuits and switching systems employed at Radio Canada master control

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MASTER CONTROL

Master control board stretches the width of the room, but the most important switching circuits are under the direct control of a single operator who sits or stands before v-i monitors at center

ing, the equipment is as light as possible. A new design of folded-sheet-metal rack combining low weight with great strength forms the basis of the entire mechanical design. The main control panel, centrally located, is set back from the main line of racks to provide two accessible wings on either side for mounting auxiliary controls. The whole central position is tied together by a table with three large glass-covered cavities for schedules and log sheets.

In the equipment room, immediately below the control room, is located a standard telephone-type distribution frame to which all the external connections are brought. In addition, many of the internal connections, including the inputs and outputs of all the amplifiers, are brought down to this frame so that if and when it becomes necessary to reallocate circuit functions, this can be done by altering the jumpering, rather than by disturbing the wiring behind the jackfields.

A point of interest here is that almost all the program wiring throughout the entire equipment is carried out in multiconductor telephone cables, with practically no shielded wire. While this represents a tremendous saving in installation time and space required, it results in a very considerable problem in the avoidance of crosstalk and noise, which has been overcome by sound engineering and careful circuit design.

Fundamental Layout

The layout of the main program circuits is shown in block schematic form in Fig. 1. It is CBC practice to take all incoming-line programs through a studio console for monitoring before feeding them to the switching system and thus to the outgoing networks. For this purpose the consoles of the transmitter studios are used.

These are studios set aside primarily for feeding the local transmitters (including in this case the international short-wave transmitters at Sackville, New Brunswick, some hundreds of miles from Montreal). It is from these studios that such items as station breaks, local newscasts, and commercials originate. Groups of bridging amplifiers are connected across each incoming network line, with their outputs fed to console-line inputs, as well as to the cue selector and recording and house-monitoring systems.

One output of each studio, whether program or transmitter, is taken to the input of the main switching system that consists of a bank of relays, one for each switching crossover, together with certain extra guard relays providing the necessary electrical interlocks. The eight outputs are taken to further groups of bridging amplifiers, one of which feeds the network line, while others are connected in a similar manner to the incoming network amplifiers.

The transmitter studio consoles are all equipped with second outputs, which, after passing through transfer switching that allows any

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studio to be associated with any transmitter, are fed to more amplifier groups. These in turn feed the main transmitter lines, f-m auxiliary transmitters and cue selectors.

The main switching system is controlled from a large panel, a portion of which is illustrated. In the design of this system, the problems of the operator have been kept clearly in mind. He is faced, usually alone, with the supervision of the whole equipment and it is important that even his thinking should be kept as simple as possible. For example, in nearly all the recently constructed master control rooms of any appreciable size, the switching is arranged on an output basis. There is a separate panel provided for each output, with some means of deciding which input it shall be fed from.

This means that before any program change, the operator must consider each output in turn, deciding whether its source changes or not. Thus, there is a considerable amount of negative thinking to be done. On the other hand, the switching in the CBC system is arranged on an input basis, with a separate panel for each of the 24 studios. In this case, before a program change, the operator sees from his schedule that a certain show is starting up in studio X, and is to be fed to such and such outputs. His attention is thus concentrated on the studio X panel, and by pressing the necessary output buttons, the presetting is accomplished.

Pushbutton Memory

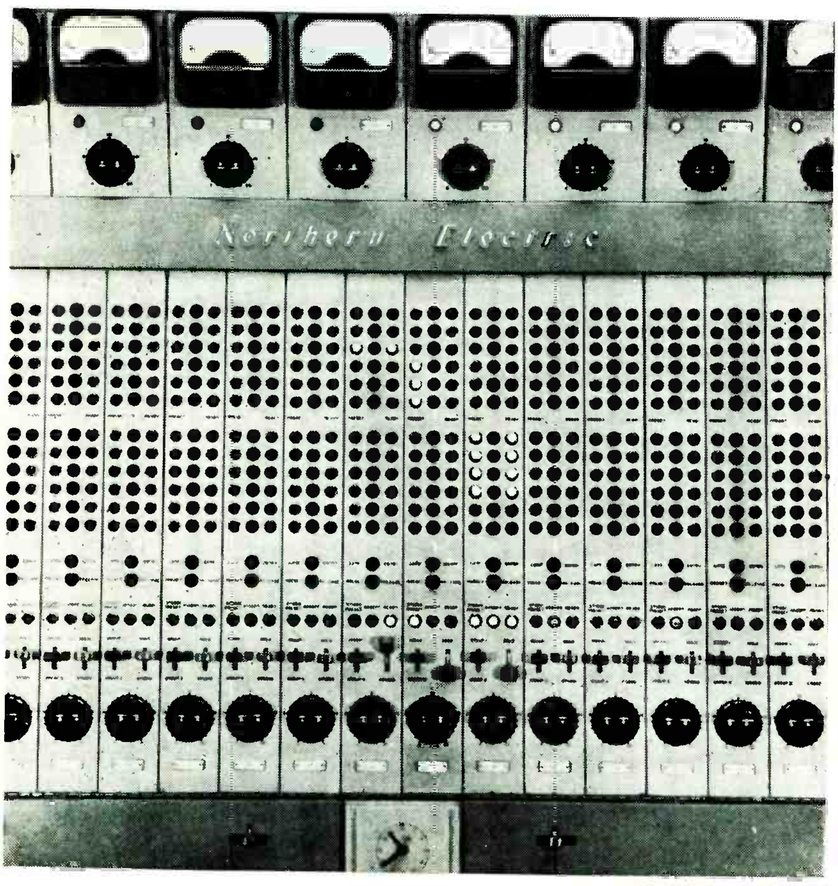
The system employs an unusually small number of relays for its size, the total number being 224. The main reason for this lies in the use of what are known as cumulative-locking pushbuttons to provide the preset memory. These buttons are a type such that each one pressed down remains down until they are all released by a separate release button. The former systems generally employed nonlocking buttons that operated what may be called a memory bank of relays equal in number to those required for performing the actual switching.

Operation of this system is briefly explained below. At any time prior to the commencement of a particular program, the buttons corresponding to the desired outputs are depressed on the panel of the studio concerned. Then at the correct moment, the buttons are energized either by throwing a key on the panel itself, or, at the discretion of the master-control operator, by the operation of the output key on the studio console. When this is done the corresponding relays operate and lock up over their own contacts. After a period of some five to ten seconds, a slow-acting relay deenergizes the pushbuttons, leaving them free for further presetting.

The program relays, however, remain operated until the key, either in the master control or in the studio, is returned to its off position. In general, control is always extended to the studio, leaving the master control operator completely free at program changes. Needless to say, electrical circuits are included to make it impossible to connect one output to two or more inputs. The exact status of the switching at any moment and on any panel is clearly indicated by lamps.

To assist the operator in his complex task of monitoring the various programs passing through the board, an auxiliary switching system allows him to connect two volume indicators and three monitor amplifiers to any of sixty selected points throughout the system. This is done by means of three telephone-type crossbar switches controlled by the pushbuttons shown in the top left-hand corner of Fig. 2. The operation of the crossbar switch is unfortunately beyond the scope of this article, but in general it can be said that each switch takes the place of 100 relays.

To monitor any circuit, the operator need only depress the tens and units buttons corresponding to the circuit code, followed by the operate button of the par-



Portion of the main switching system for Radio Canada. System permits selection of inputs from which program is connected to one or more outputs. Novel pushbutton-relay arrangement allows presetting connections and control to network either by master or studio

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ticular monitoring device required. The connection is instantaneously made and recorded by a light indication to the right of the pushbutton panel.

Cue Selector

One very necessary feature of a master control system of this size is a device to feed to a studio that is shortly to go on the air the preceding program to act as a cue. This cue selector occupies the lower half of Fig. 2 and handles 26 inputs and 33 outputs. This it does in a very direct fashion, as each input is taken to one of the bars of what may best be described as a flat commutator. Mounted above this, and at right angles to the bars are rods, one for each output, carrying sliding contacts that may be moved to connect with any input bar. Numbers on the rods, as well as a detent action, assist in making selection.

Needless to say, in an installation in which so many different switching systems depend on a two-digit code, a careful choice of numbering system had to be made to avoid conflicting allocations. The one finally selected has proved completely satisfactory and workable.

While most of the apparatus associated with the switching facilities is of a straightforward nature, certain units call for comment. The complete equipment includes 180 program amplifiers, all of which are of the same type. A new small-size unit of high performance was developed especially for this job. Although only 8 inches long and 2¼ inches wide, and requiring only 14 ma plate supply, this unit is rated for an output of +24 dbm at which level it meets with great ease the requirements of RTMA Specification TR105B.

The average distortion at full output is well under 0.5 percent. A maximum gain of nearly 60 db is available, using three stages of amplification from a 12AX7 double triode and a 6AH6 pentode. Feedback is applied from a tertiary winding on the output transformer to the cathode of the second stage. The signal-to-noise ratio at full gain and full output is better than 75 db, with a-c on the program amplifier heaters.

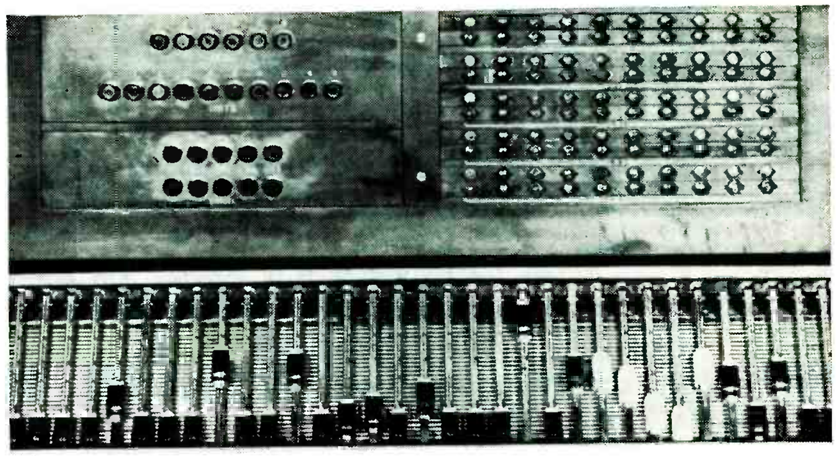

FIG. 2—Crossbar switches actuated by pushbuttons (upper left) dial up monitor speakers or volume indicators for any one of sixty program sources. Slides at bottom are cue selectors as explained in text

Another interesting component is the extended-range volume indicator of which seven are used for general monitoring throughout the equipment. These instruments each consist of a standard v-i, a very stable small amplifier, a variable attenuator giving a maximum of 60-db loss in 2-db steps and a bridging input transformer.

Volume Monitor

The amplifier in many ways resembles the program amplifier already described except that it does not include an input transformer and has only two stages equipped with 6AK5 and 6AU6 tubes. The whole arrangement forms a versatile v-i capable of giving standard meter deflection on any program level from —30 vu to +30 vu.

The equipment includes a number of jackfields, all differing in size and arrangement. An unusually neat appearance results from the use of a unitized system that allows any size or layout to be readily achieved. Following the example of the BBC in England and CBS in the United States, single jacks are used throughout, with a consequent saving in space and cost. It is interesting to note that the jacks were manufactured in the U.S. and the plugs in England, both perfectly standard parts. It is one of the few instances of international interchangeability.

The recording switching system is identical in principal with the monitor and v-i selector already described. Each crossbar switch serves two recording positions giving each of them a choice of 50 programs. Selection is made by means of two rotary switches, one for the tens, the other for the units and the same lamp indication is provided.

As the recording room is some two hundred feet from the recording switchgear, it was desirable to keep to a minimum the number of interconnecting wires. The number was restricted to 20 per panel, 16 of which are required for the lamps alone. This system removes a great load from the master control operator, since the recording technicians can perform their own program selection in all except the most unusual cases.

Dial Programs

In the house monitor system, with control stations scattered all over the building, it was even more imperative to reduce the number of control wires. Since no lamp indication was required, it was found possible by the use of a dialing system to restrict the control circuit to two wires and a ground.

Operation has been reduced to the simplest possible procedure. To obtain a given program dial two digits; to change the program, dial two more digits. To silence the loudspeaker, press the cancel button. If a mistake is made in the first digit, press the cancel button and start again. If a steady tone is heard, dialing is incomplete; either dial another digit, or press the button and start again.

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High-Speed Printer for Computers and Communications

Converts binary-coded information to typewritten copy in 80 columns on plain paper at a rate of 5 lines per second or more. Single type wheel rotates at 300 rpm, and 80 solenoid-controlled hammers strike at appropriate time to form lines of text

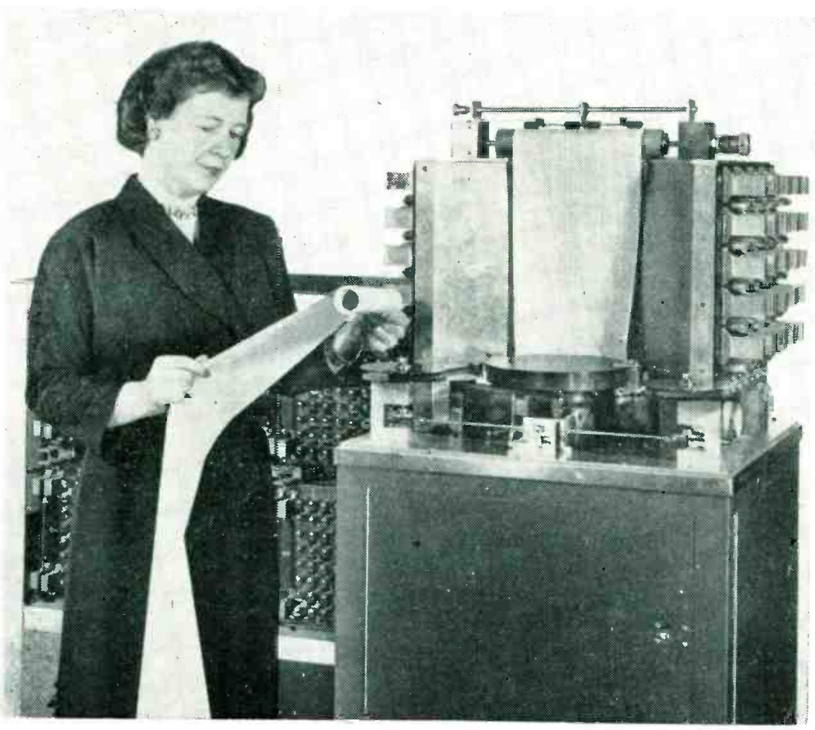
By JOHN J. WILD

Vice-President
Potter Instrument Co.
Great Neck, New York

DIGITAL computer data-handling devices have by now become familiar to a large segment of the electronics industry, business firms and government. A general realization exists among those having studied the problem that one important element of a complete high-speed system is lacking, namely an output printer capable not only of high-speed operation but also of handling data in the form presented by systems other than punched cards and tapes.

The presently available line-at-a-time printers are geared to operate from punched cards and their use involves an oftentimes unnecessary step in creating punched cards to feed a printing tabulator.

Digital computer and data handling machine designers have been forced in some cases to use banks of electrically-operated typewriters or telegraph machines to produce data at a reasonable output speed.



"Flying Typewriter" produces typewritten copy at speeds up to 900 lines per minute from digital computers or binary-coded communications circuits

Flying Typewriter

The machine shown on this month's cover, and in the accompanying photographs, is capable of turning out printed information at high speeds from electrical information supplied it from digital calculators or other sources of binary-coded signals.

A single type wheel having hardened steel type slugs mounted about the periphery creates all the characters needed for 80 columns of print. A line of information is printed at each pass of the characters. The control system automatically distributes the printing of the characters in the proper order during the pass, although the order of printing the characters is not necessarily in positional sequence around the wheel.

The single-type-wheel printer shown in the photographs can print 300 lines a minute. The same printer with additional electronic storage can print 600 lines per minute. It has been experimentally operated at 900 lines per minute without serious degradation due to side blurring. At speeds over 900 lines a minute the limitation comes from an unexpected source—that of the paper feed. It is not felt necessary at the present to develop higher speeds since it is economical to use two or more printers.

The hammers are designed to have the correct resilience to permit

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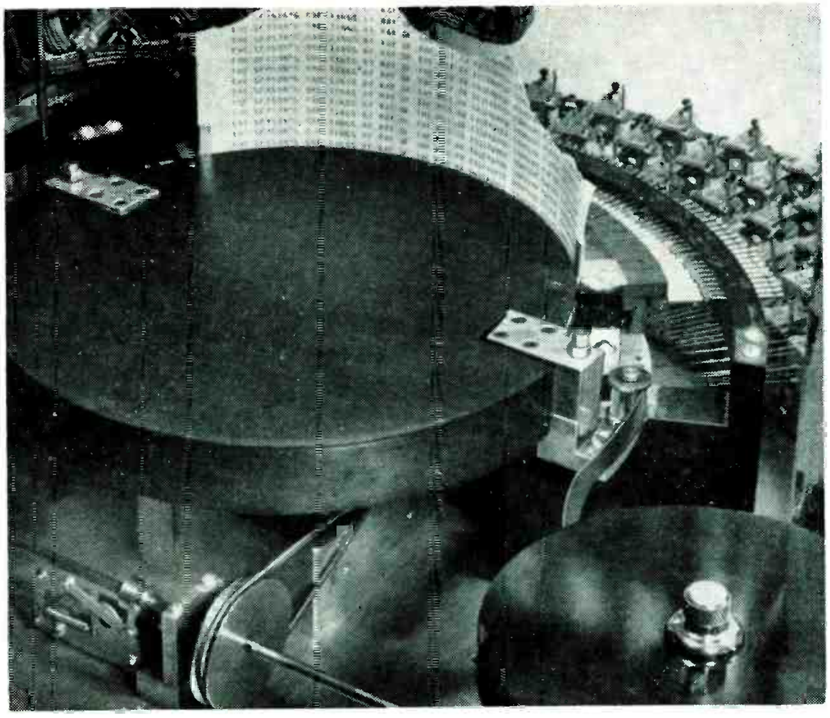
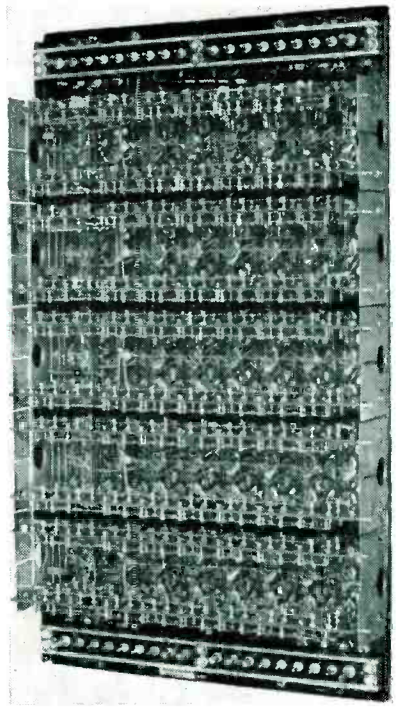


Eighty solenoid-controlled hammers, one for each column, strike type face through ink ribbon and paper to form letter impressions



Rear view shows wiring of one of the eight banks of miniature tubes used

them to bounce back after striking the type. The actual time of contact of the hammer and the type face is under 0.1 millisecond, which results in no appreciable side blur even at the highest rates of print. The time of operation of the hammer is about 2.5 milliseconds. By phasing or timing the operate pulses with a predetermined lead time of 2.5 milliseconds, the type character can readily be struck in the center. The characters created are equivalent to the results of a good typewriter.

Control Circuits

Each of the 80 hammers is instructed to strike at the correct instant by control circuits, from information set into a trigger tube storage called a PASS (printer actuator serial storage) unit. A motor-driven notched disk and phototube arrangement provide synchronizing pulses to operate the machine. The PASS unit has 80 columns of 6 binary digit storage with shifting circuits for loading and emptying and special gating circuits for driving the printer. The storage unit may be loaded a column at a time (parallel) using a 6 binary digit code, or it may be loaded a pulse at a time (serially). Each of the 80 columns can be used as a scale of 10 or 64 counter and can be fed individually as required for parallel type digital computers. In fact the whole PASS unit may be used as an accumulator and shift register in a computer for addition, subtraction, division, and multiplication.

Each character to be printed is represented by a 6 binary digit number. As each character is fed into the last column of storage, the preceding characters are advanced into the adjacent columns. After 80 such characters (including spaces between words) have been loaded into the PASS unit, pulses from the photoelectric disc generator on the print wheel shaft are fed into the columns of storage to drive the information out to the mechanical part of the printer.

Operation

To make this operation clear it is best to consider the first column of storage and its associated hammer: Assume that the character G has been loaded into this storage column and is represented by the binary count of 57. The storage column, which is in essence a scale of 64 binary counter, has therefore been preset to the count of 57.

When 7 pulses (64−57) are added to the counter, an output pulse will be generated. This pulse is used to fire a thyratron which in turn energizes a solenoid-controlled hammer. The characters around the wheel and the photoelectric disc are phased so that at this instant the character G is opposite the hammer. The hammer strikes the back of the paper and the front of the paper receives the impression from the type through the inked ribbon as indicated in Fig. 1.

The remaining 79 columns of storage and hammers operate in the same manner except that means must be provided to compensate for the distance between the first hammer and the others. This is accomplished by preventing the first photoelectric timing pulse from entering all 80 storage counters simultaneously. By using ring-counter-operated gate circuits for each column input, the first photoelectric generated pulse enters only the first counter, the second pulse enters only the first and second counters, the third pulse enters

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only the first, second, and third counters and so forth. As the type wheel advances, each input counter gate is opened in sequence and the characters are precessed out of the counter storage.

The characters across the line are not necessarily printed in sequence. For example, if all A's were loaded into storage, as the A on the type wheel progressed in front of each of the 80 hammers it would be hit by each of the hammers in sequence. However, in printing the word CAT, the A would be printed first then the C and then the T.

The dual functions of the electronic storage columns in the PASS are effected with reliable, low-cost standard components.

The basic system is fortuitously simple. While loading the storage unit as a serial transfer register, no counting is done. Conversely while the columns are serving as adders to sequence the print hammers, no new information is loaded. Furthermore, not only are the information input and counter inputs from different sources, but the 479 interstage transfer circuits are fundamentally different from the 400 interstage counter couplings. It was found feasible to use simple interstage coupling circuits for each purpose without disconnecting or gating out those required for the other.

PASS Circuit

The PASS unit, while comprising most of the electronic portion of the system, is merely a cascade of 80 identical electronic columns like the two diagrammed in Fig. 2. Each column includes six trigger pairs for holding the binary coded information and telling that column's hammer which one of the 64 possible characters in the rotary type font it should strike.

In Fig. 2, each trigger pair (shown symbolically) has two mutually symmetrical sets of equilibrium potentials. The one obtained by driving the reset bus negative is used to indicate a zero for the corresponding binary digit. The alternate condition is obtained by an impulse discharge of the associated advance capacitor C_a through the advance triode connected thereto. This is the ON condition indicating that the corresponding binary digit is a one. Each of the six triggers in a column indicates the coefficient (0 or 1) of a different power of 2, from 0 to 5.

The components C_c and R_c connect each stage to the next in the column to make the six stages in the column operate as a scale of 64 binary counter for the printer's actuation after the information has been loaded into the columns.

To enable the loading of the six storage triggers of each of the eighty columns from a single input channel, the process is made completely serial. The 6 binary digits (111001 representing the sum of 1×32, 1×16, 1×8, 0×4, 0×2, and 1×1 or 57) for column 1, followed by the same order of 6 values for column 2 and so on through the 80 columns, are placed one at a time into the end trigger and transferred forward. Thus, as the second digit enters trigger 1 in column 80, the first is transferred to trigger 2. Four transfers later, column 80 is loaded with the 6-place binary number intended for column 1. On the entry of the seventh digit of the series, the 1st is transferred from the 32's place of column 80 to the 1's place in column 79, and so the transfer process continues until the 480th digit is finally loaded properly in the 1's place in column 80 and the 1st digit similarly is in its 32's place in column 1.

The circuitry by which the storage triggers become a serial transfer register excludes C_c and R_c but includes R_r, R_a, C_a, and the advance triodes. All advance triode cathodes are held at a potential sufficiently positive so that no appreciable plate current can be drawn so long as the plate potential to which C_a has been charged through R_a is near the value obtaining for the output plate of a trigger in the off condition.

All advance triodes furthermore are biased beyond cutoff for plate potentials as high as that of the output plate of a trigger in the on condition, some 60 volts higher than for the off condition. Then each trigger has its R_a connected to the output plate of the trigger whose past condition it is meant to assume on the occasion of a transfer. Such occasion is marked by the application, simultaneously to all triggers in the register, of a reset signal, followed (after a delay not substantially greater than the product R_aC_a.) by a positive pulse to the grids of all advance triodes coupled to the register.

No advance triode plate whose R_a connection is to the output plate of a trigger that was off prior to the reset signal could draw current when its grid was pulsed, so all triggers C_a-coupled to such plates, remain reset or off, just like their R_a-connected triggers had been prior to the reset-advance signal pair. However, some 60 volts more positive potential prevailed

DEMONSTRATION COPY FROM THE POTTER INSTRUMENT FLYING TYPEWRITER 5 LINES A SECOND
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at any advance triode plate whose R_a connection is to the output plate of a trigger which had been on prior to the reset signal. Although the reset started an exponential decay of that potential, enough was left at the instant of the advance signal to enable the resultant advance plate current impulsive discharge of C_a to turn on the connected trigger.

Pulse Progression

Each trigger output plate may be considered the transfer load output or TLO terminal, and the end of the R_a connecting thereto would be the transfer load input or TLI terminal for the next trigger in the line of transfer.

Figure 3 shows the potential variation with time at the originating TLI of the PASS (TIL 80-1) when starting to load the binary digits 1110010 —. This would be the case if binary 111001 (57) were to be finally loaded into col. 1, and a binary number starting with 0×32 were destined for col. 2. To illustrate the time progression of these binary digits through the transfer register, the voltages resulting at the other triggers along the line of transfer are shown on the same time base.

The value of R_a is sufficiently great, that the transfer circuitry between stages has no effect on the counter operation. The latter is obtained via C_c and R_c whose ratio is as low as will safely effect counting, and whose product is less than the duration of the reset signal. During transfer, the reset signal maintains final control over the spurious signals produced by the counter coupling C_c and R_c when an on place is reset.

It may be seen in Fig. 3 that whenever 1 is loaded into a trigger, its next response to a transfer signal pair includes a negative pulse. Whenever a 0 is loaded, the next transfer response contains no such negative pulse.

Any voltage pattern at one stage is duplicated in the next stage one transfer signal pair later. It is generally known that triggers of the common grid return type count negative input pulses, ignoring positive pulses of similar amplitude.

Before the circuits were described in detail it was stated that a ring counter and associated gates serve the purpose of counting phototube pulses into each column beginning one pulse later than in the preceding column. This in function is true and was at the time the clearest way of conveying the idea. It may be seen now, however, that a series of 80 triggers arranged in serial transfer fashion will quite simply serve the same printer commutator purpose.

The printer (commutator) load input potential at PLI is maintained positive by a predetermined counter for only the first 64 pulses from the phototube unit which supplies printer commutator signal pairs until the last trigger in the commutator (col. 1) has received its 64th 1 and a clearing 0. Then the predetermined counter is reset automatically for the next line.

Practical Aspects

Usually less than 64 characters are required in the type font, which typically comprises 47 alphanumeric symbols. In this typical case, these characters may be coded from 63 down to 17 inclusive, and the space (no character to be printed) may then be assigned the code 16 or any lower value. The predetermined counter controlling the number of 1's loaded into the print commutator will be set at 47. This provides for energizing the hammer in any column coded from 63 (energized by the $64-63=1$st pulse) down to 17 (energized by the $64-17=47$th pulse), and fails to energize the hammer in any column coded 16 or less (requiring $64-16=48$ or more pulses to produce the hammer energizing 64th or turn-over count in such column).

It is not necessary to encode the characters in contiguous sequence from 63 down. Any values or groups of values may be skipped so long as corresponding skips are made in spacing the characters in the type font about the print wheel. The leading space, as the wheel rotates, is assigned the value 63, and the following spaces each one less. To secure the ability to withhold printing where a space in the printed line is wanted, it is only necessary that the code value zero be unassigned to any character, thus leaving 63 spaces where 63 or less characters may be coded in any order whatsoever, with the location of blanks wherever desired.

This gives almost unlimited lati-

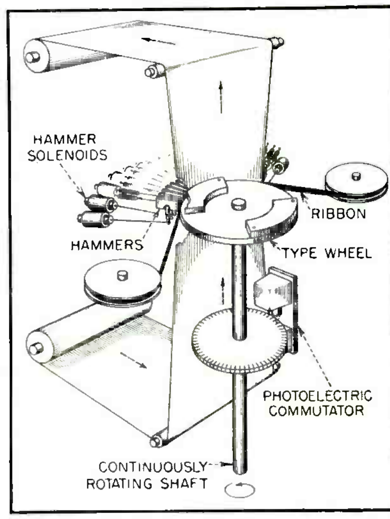

FIG. 1—Artist's drawing of printer shows positions of type wheel and printing hammers. Photoelectric pulse generator disk is beneath type wheel

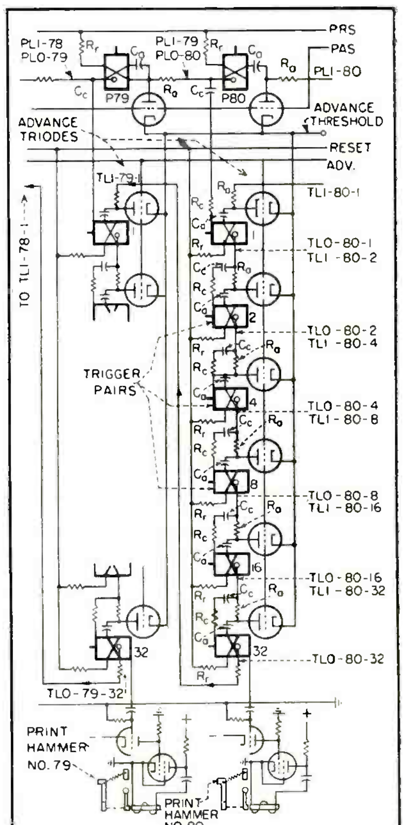

FIG. 2—Simplified schematic of two of the eighty 6-stage counters. Note use of abbreviated symbol for double-triode trigger pairs

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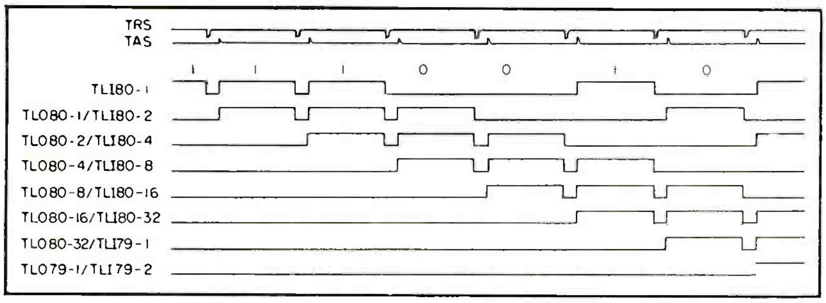

FIG. 3—Timing diagram shows spacing and duration of pulses in a typical section of control circuit

tude to the encoding, permitting use with systems in which codes are already assigned. It permits use of codes designed for various checking or automatic verification methods as in computers or business machines. The code may be changed as often as desired for maintaining privacy, as in terminal equipment for a high-speed radio link; it is only necessary to change print wheels for each change in code.

Parallel Input

It will be recalled that PASS stands for printer actuating serial storage. The unit loads completely serially from a single input channel. Of course, if a 6-channel input is available, these six inputs may be transferred broadside, instantaneously, to six triggers whose content is then scanned out serially under control of a chain-of-6 pulse generator fast enough to complete the scan before the next broadside signal. Such a 6-parallel-input-to-serial-transfer-output converter has been used for some time to load a PASS unit from 6-level perforated tape.

Conversely, a printer-actuating parallel storage may as easily be made with 6 TLI terminals for transferring the binary 1's straight across, column to column, and the 2's, 4's, 8's, 16's, and 32's similarly, each from its own TLI, and all six at the same time. This unit would be adapted to single channel input by the converse of the converter mentioned above. The single channel would serially load six triggers whose content, under control of a 6-scalar, would be instantly transferred broadside to the six TLI's, in time to permit the six triggers to resume uninterrupted reception over the single input.

An inherent property of the PASS unit that contributes to its versatility is that it has no speed or frequency of its own. Information can be transferred in or out under timing control of any external device. A single transfer can be made (information shifted one binary digit), or six transfers (information shifted one column), and the process suspended indefinitely. Or the 480 binary digits may be loaded serially in less than fifty milliseconds. In the case of a unit with six parallel inputs, the loading time would be less than ten milliseconds.

Although the system will work with just one set of type, two identical sets are used to provide additional time for loading the electronic storage. One set of type is used to print the first forty columns of information and the other set is used to print the second forty columns; therefore one-half of the electronic storage can be loaded while the other half is printing out. A complete line of 80 characters is printed in less than one revolution of the type wheel and the paper is then indexed upward for the next line during the rest of the turn.

Faster as well as slower versions are being considered. Among these is a printer which can print two or more lines at a time. This would require two or more type wheels and two or more rows of hammers spaced a line apart. In a slower character-at-a-time version, the rotating type wheel can be made to advance from one edge of the paper to the other being struck through the paper and inked ribbon by a single hammer advancing with it. In another version the paper moves from side to side on a carriage past the rotating type wheel.

The principle described promises to find wide application in the fields of communication, computation, data handling, magazine addressing, and business form preparation.

In the communication field it can be used on a standard telegraph line circuit or narrow-band radio channels. Many radio communications can be sent only at certain times because of tropospheric conditions and therefore require an uneconomical amount of equipment to meet these peaks. These messages can now be recorded on magnetic tape, transmitted at extremely high speeds, and received by the "Flying Typewriter."

Modern-day, high-speed computers can digest data and compute at fantastically high rates but overall efficiency has been seriously limited by the need for high-speed output devices. The Typewriter will meet this need and its associated electronic storage should find wide application in arithmetic and format programming.

The new printer in combination with magnetic storage systems will make it possible to keep magazine subscription lists up-to-date and prepare the address strips at the high rates necessary.

Development of the printer is part of the evolution which engineers and businessmen alike predict will soon bring everyday application of electronic data handlers to problems in industry, business, and government. In the next industrial revolution—the office revolution — all clerical handling problems will become automatic. Computers coupled with high-speed printers will soon keep business accounts, run continuous sales records, handle entire payrolls, compute and send out bills, keep running inventories, schedule production, and serve as vast filing systems.

The flying typewriter principle was conceived by John T. Potter. The principal engineering was performed by P. C. Michel, Director of Research at Potter Instrument Company.

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Voltage-Limiting Circuit

High-gain d-c amplifiers with large negative feedback provide very rapid switching for this precisely controlled limiting circuit. Developed for limiting variable voltages to specific ranges in the REAC computer, the circuit has general applications

By FRANK R. BRADLEY and RAWLEY P. McCOY

Reeves Instrument Corp.
New York, N. Y.

THE LIMITING property of the circuit to be described depends upon two factors, the action of a high-gain phase-inverting d-c amplifier in holding its input grid at a virtual ground, and the one-way current carrying capability of vacuum tubes.

In analog computer applications it is desirable to have extremely sharp and precise limiting circuits to enable the simulation of discontinuous phenomenon such as a control coming against a stop or a gust of wind.

Consider Fig. 1. If e_g goes slightly positive, V_o goes highly negative because of the high gain and phase inversion of the amplifier. The resultant voltage division of V_o and V_i across R_{in} and R_f drives e_g in a negative direction, back towards zero. In the same fashion, if e_g goes slightly negative, V_o goes highly positive, again driving e_g back towards zero by the voltage division across the feedback and input resistor. Thus the output voltage rides at the d-c level that results in essentially zero voltage at the input grid. The amplifier may be considered as a voltage servo that maintains a null at its input grid by virtue of current feedback.

If in a parallel circuit such as is illustrated in Fig. 2, two people are told to manipulate the potentiometers R_1 and R_2, one so that the output potential is more positive than +200 volts and the other one so that the output potential is less positive than 200 volts, the operation trying for the less positive potential will be successful. This is true because it is necessary to decrease the total current through the load resistor to increase the output potential and it is impossible to reverse the current flow in either tube.

Thus the operator who is trying to reach the higher voltage will reduce plate current flow through the tube he controls and in the limit will cut the tube off, in which condition the other operator will still be able to cause sufficient plate current flow through his tube to drop the output voltage to the desired value.

Negative Limiting

Two feedback amplifiers, as shown in Fig. 1, may be used to perform the sensing function of the operators described in Fig. 2. Consider the circuit shown in Fig. 3. Amplifier 1 and tube A form a three-stage amplifier as do amplifier 2 and tube B. From the previous description of feedback amplifiers it is evident that both amplifiers will attempt to maintain their respective input grids at zero potential. There are two operating conditions of this circuit; either E_1 is positive with respect to E_2 or vice versa.

Consider the case in which E_1 is more positive. Tube A, by virtue of the feedback action, conducts reducing E_p sufficiently to hold e_{g1} at virtual ground. Tube B attempts to increase E_p to hold e_{g2} at ground. However, it can only conduct in one direction. Even with tube B plate current cut off, Tube A, by itself, drives the plate voltage negatively as required to hold e_{g1} at zero.

Thus, as long as E_1 is positive with respect to E_2, the E_1 input controls E_p. When E_1 is negative with respect to E_2, by the same action E_2 controls E_p. The transfer of control from one input to the other takes place over a very small change in voltage difference between E_1 and E_2 because of the high gain of the amplifiers. The switching voltage difference is approximately the maximum amplifier voltage swing divided by the amplifier voltage gain.

This then provides a mechanism

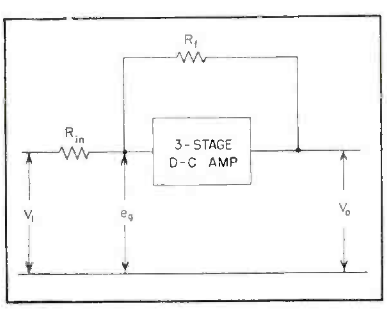

FIG. 1—Basic circuit showing how e_g tends towards zero voltage

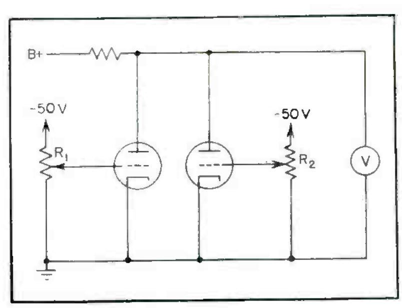

FIG. 2—Operator trying for lowest voltmeter reading will be successful

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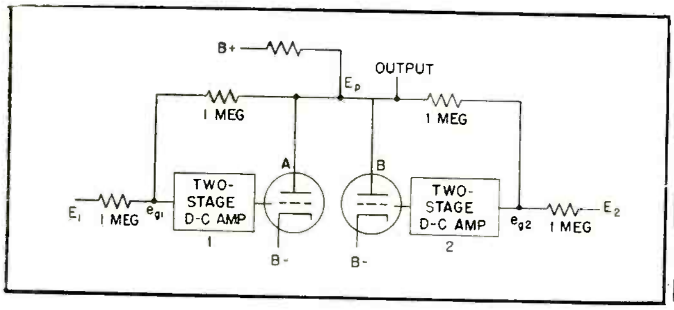

FIG. 3—If E_1 is more positive than E_2, E_1 controls E_p

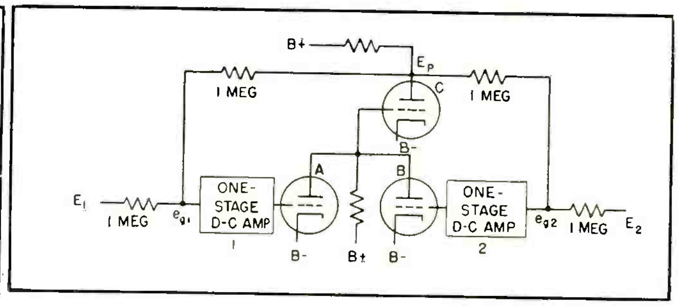

FIG. 4—If E_1 is more positive than E_2, E_2 controls E_p

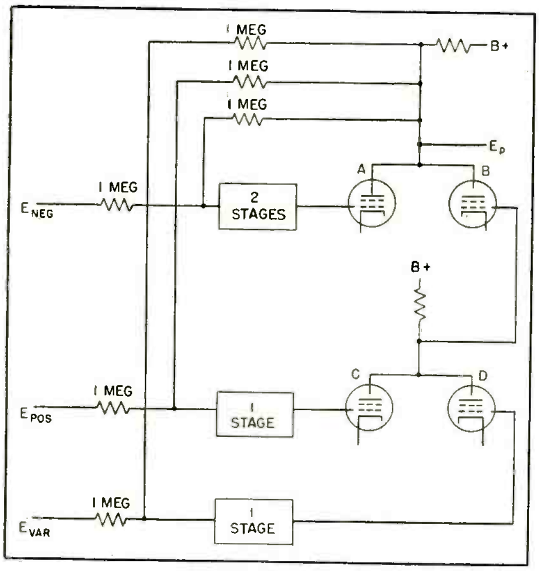

FIG. 5—Combined positive and negative limiting

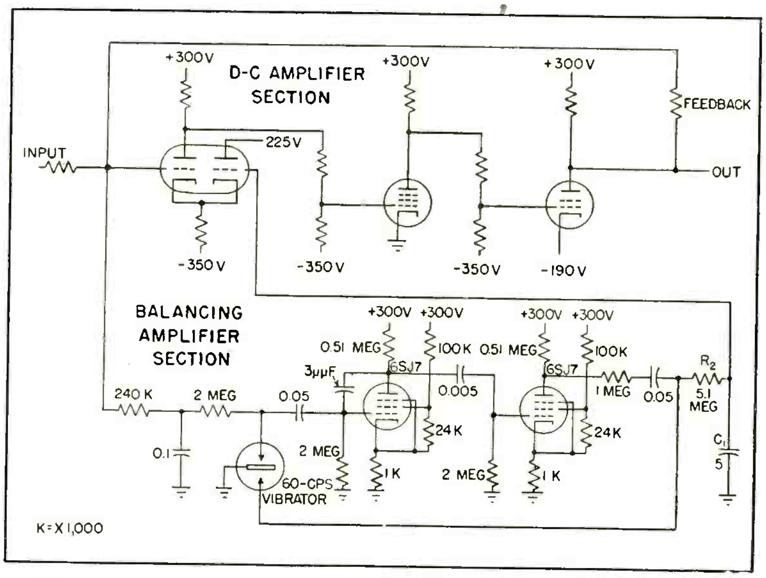

FIG. 6—A zero-drift balancing amplifier is used for greater precision

of negative limiting. The negative limit is applied at one input and the variable voltage to be limited at the other. When the variable voltage is more positive, it controls the output, E_p. When the variable voltage is more negative, the limiting voltage controls the output. Note that there is no requirement that the limit voltage be a fixed voltage.

Positive Limiting

A variation of the circuit that provides positive limiting is shown in Fig. 4. Again the circuit consists of two three-stage d-c amplifiers with feedback resistors connected from the output back to the input grids. In this case, however, the amplifiers have a common third stage and a common load resistor for the second stage. Again there are two possibilities that either E_1 or E_2 may be the more positive voltage. Consider the case where E_1 is positive with respect to E_2.

The three-stage amplifier consisting of amplifier 2, tube *B* and tube *C* function to hold e_{g2} at virtual ground. The remaining three-stage amplifier consisting of amplifier 1, tube *A*, and tube *C*, if independent, would attempt to hold e_{g1} at zero. But because of the first amplifier, E_p is not sufficiently negative to buck out E_1.

The voltage e_{g1} is therefore positive and the input to tube *A* accordingly negative (relative to the input to tube *B*). Tube *A* draws less current through the common plate load. However tube *A* can only be cut off and tube *B* can still draw enough current to drop the input to tube *C* as required to drive E_p sufficiently positive to buck out E_2. The output voltage E_p is thus completely controlled by E_2. When E_2 is positive with respect to E_1, the condition reverses and the output voltage is controlled by E_1.

Both positive and negative limiting depend on the fact that the conducting member of the paralleled pair of tubes can draw sufficient plate current to drive the common output voltage as required to buck out the input voltage controlling the conducting tube. The input voltage that is not in control, however, can only cut off its member of the paralleled pair as the high-gain amplifier attempts to maintain its input grid at zero.

Output Control

Thus in this circuit the negative voltage controls the output voltage. The positive limit is applied to input and the variable voltage to be limited at the other. When the variable voltage is more negative it controls the output, E_p. When the variable voltage is more positive, the limiting voltage controls the output. Again, as in the case of negative limiting, the limit voltage need not be fixed voltage.

The positive limiting circuit and the negative limiting circuit may be combined as shown in Fig. 5

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to provide both positive and negative limiting. The voltage to be limited, E_{var}, controls the paralleled output of tubes C and D when it is negative with respect to the positive limit, E_{pos}. The output of the paralleled tubes A and B is in turn controlled by the output of C and D when it is positive with respect to the negative limit E_{neg}. Thus when E_{var} lies between E_{neg} and E_{pos}, the output voltage E_p is controlled by E_{var}. Outside of these limits it is controlled by either the positive or negative limit.

Zero-Drift Limiting

For more precise limiting, a zero-drift amplifier may be used. This circuit, shown in Fig. 6, uses a chopper in conjunction with an auxiliary a-c amplifier. Any voltage existing at the input grid is chopped into a 60-cycle signal and amplified. The output is half-wave rectified by the same vibrator and the filtered output coupled to the first stage of the d-c amplifier proper where it is added to the direct-coupled input signal by means of the common cathode resistor.

The auxiliary amplifier has a d-c gain of about 1,000. Since it is in series with the basic amplifier, between the junction of the input and feedback resistor and the basic amplifier, the combination has a d-c gain that is the product of the gains of the two amplifiers (about 30×10^6). Moreover the auxiliary amplifier is drift free so that the drift voltage is less by a factor of 1,000. This circuit always holds the drift voltage at the input to less than two millivolts, and usually less than one millivolt.

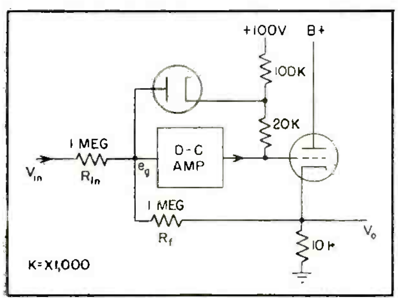

FIG. 7—Cathode follower avoids long-time discharge of C_1

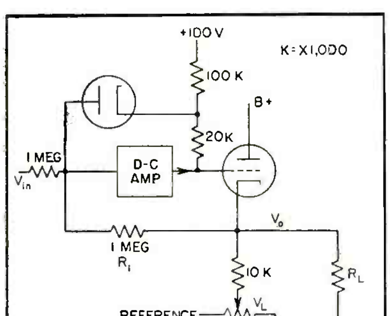

FIG. 8—Change of limit potential can be provided

Frequency Response

Use of this amplifier for limiting introduces a problem of long recovery time from a limit condition. It is therefore impractical to use this amplifier directly for limiting. Two of the three amplifiers in the limiting setup (Fig. 5) have an appreciable voltage at their input because the output voltage holds only the input grid of the amplifier that is controlling it at zero. The output of the balancing amplifier section of two of the amplifiers is a large d-c voltage that charges C_1 (Fig. 6) accordingly.

The time constant of R_2 and C_1 is 25 seconds for stability so that when the variable voltage crosses a limit, there will be a long delay while the limiting amplifier capacitor discharges before it effectively maintains the limit. The variable voltage amplifier has the same difficulty when the variable voltage crosses the limit in the opposite direction, going again into its permissible range.

Cathode Follower Added

This difficulty is obviated by using a cathode follower and diode connected with the basic amplifier as shown in Fig. 7. The additional cathode follower produces no change in the amplifier action as the input grid is maintained at a virtual ground by the high-gain action feedback resistor. However the cathode follower can only provide positive output voltage (since its cathode is returned to ground). Thus the output voltage has, as its negative limit, ground potential, at which output the cathode follower is cut off.

If a more negative output voltage is required, the input to the grid of the cathode follower tends to go more negative than the cutoff voltage of the triode. However when the d-c amplifier output goes more than 20 volts negative (as it will if the feedback current via R_f cannot hold e_g ground) the cathode of the diode goes below ground and it starts to conduct. This provides an alternate feedback path for the d-c amplifier, which adjusts its output voltage so that the current flow through the diode and 20K resistor hold e_g at ground). Thus the output voltage is limited at ground while e_g is maintained at zero by the alternate feedback path that becomes operative when the limit is reached. This prevents C_1 from accumulating a large charge.

Sharper Limiting

The circuit of Fig. 7 gives sharper limiting than that of Fig. 3 because the amplifier gain is greater by a factor of 1,000 and there is no transition while one tube is cut off and the other starts to conduct. Limit voltages other than zero can be obtained by returning the cathode follower to the desired limit potential as shown in Fig. 8.

There are some loading considerations in this case since the output stage ground return is completed through the limit-setting potentiometer. First, in operation, when V_o is not being limited, potentiometer loading is not a problem since V_o is automatically maintained at the correct value by virtue of feedback through R_1. In the limiting condition the tube is cut off and the limit voltage supplied from the potentiometer.

In this case the source of V_L has an impedance of between 10 and 11.25K (assuming negligible impedance in the reference voltage supply). In the REAC application, R_L is of the order of 1 megohm as is R_1. Note that R_1 is returned to the amplifier input, which is essentially ground. This means that a 10K source is working into a 500K load. The value of V_o is accordingly slightly different from V_L. This presents no difficulty however since in operation V_L is set for limiting at the desired value of V_o.

The use of a diode to provide an alternate feedback path in the manner of Fig. 7 was developed by R. Ragan of the Instrumentation Laboratory of the Massachusetts Institute of Technology.

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SLOPE CONTROL

Technique reduces rejects, reduces machine maintenance and speeds up work. Back-to-back thyratrons serve as automatically varying resistor across heat control of welder to make the a-c welding current increase gradually from its initial value to the final value

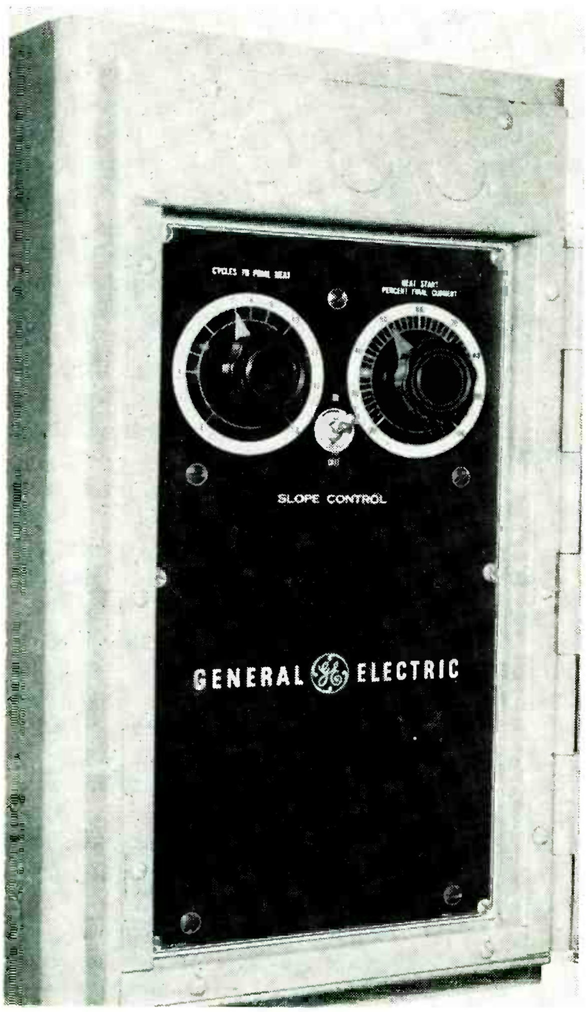
By W. B. HILLS

Control Divisions
General Electric Co.
Schenectady, N. Y.

By reducing rejects or reducing machine maintenance, slope control in resistance welding has made many difficult production welds possible. Primarily, where the initial resistance of the weld is high or inconsistent, such as in spot-welding aluminum or in projection welding generally, the gradual increase of welding current improves welding consistency and quality.

Increasing the welding current gradually from its initial value to its final value produces a slope on the envelope of the current wave, as indicated in Fig. 1A. Adjustments for the welding cycle are the overall weld time, initial and final heats, and the time of rise to final heat (slope time).

The slope control circuit is applied to the phase-shift heat control. By controlling the firing of the power tubes in the contactor, the magnitude (rms) of the welding current can be varied from its full sine-wave value (100 percent) to 20 percent of this value. (This is a change in heating of from 100 percent to 4 percent.) This controlled firing is generally obtained by phase-shifting the triggering voltage of each power tube with respect to its anode voltage.



Slope control panel has three adjustments, labeled CYCLES TO FINAL HEAT, IN-OUT and HEAT START—PERCENT FINAL CURRENT

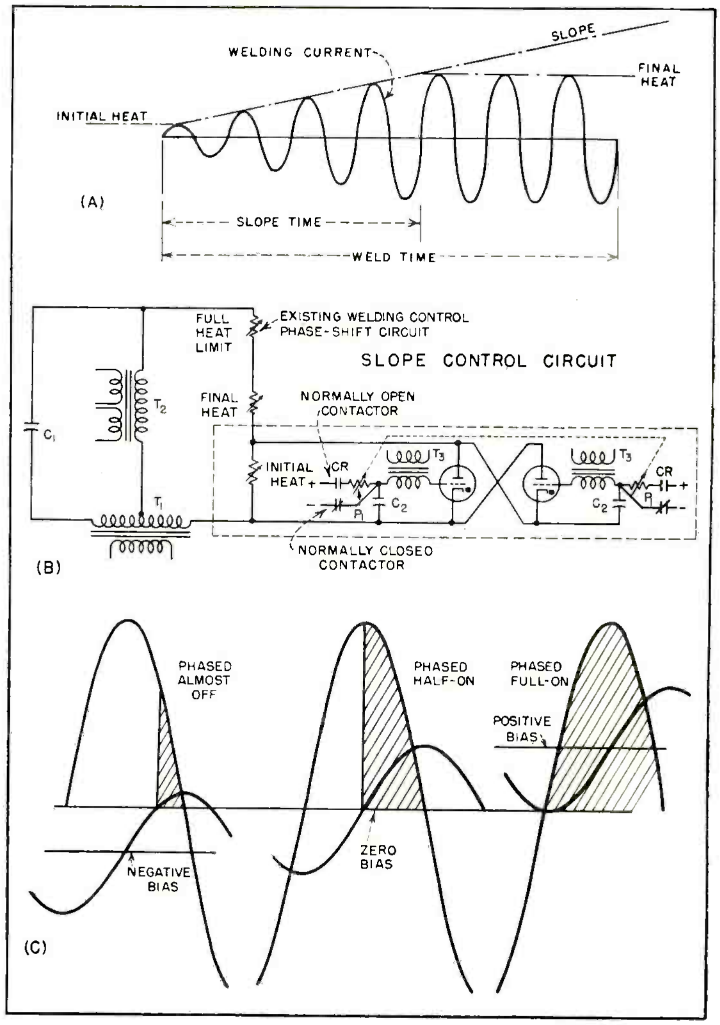


FIG. 1—Waveforms and circuit of new accessory control for standard synchronous and nonsynchronous electronic controls for resistance welding of difficult or heretofore impossible jobs

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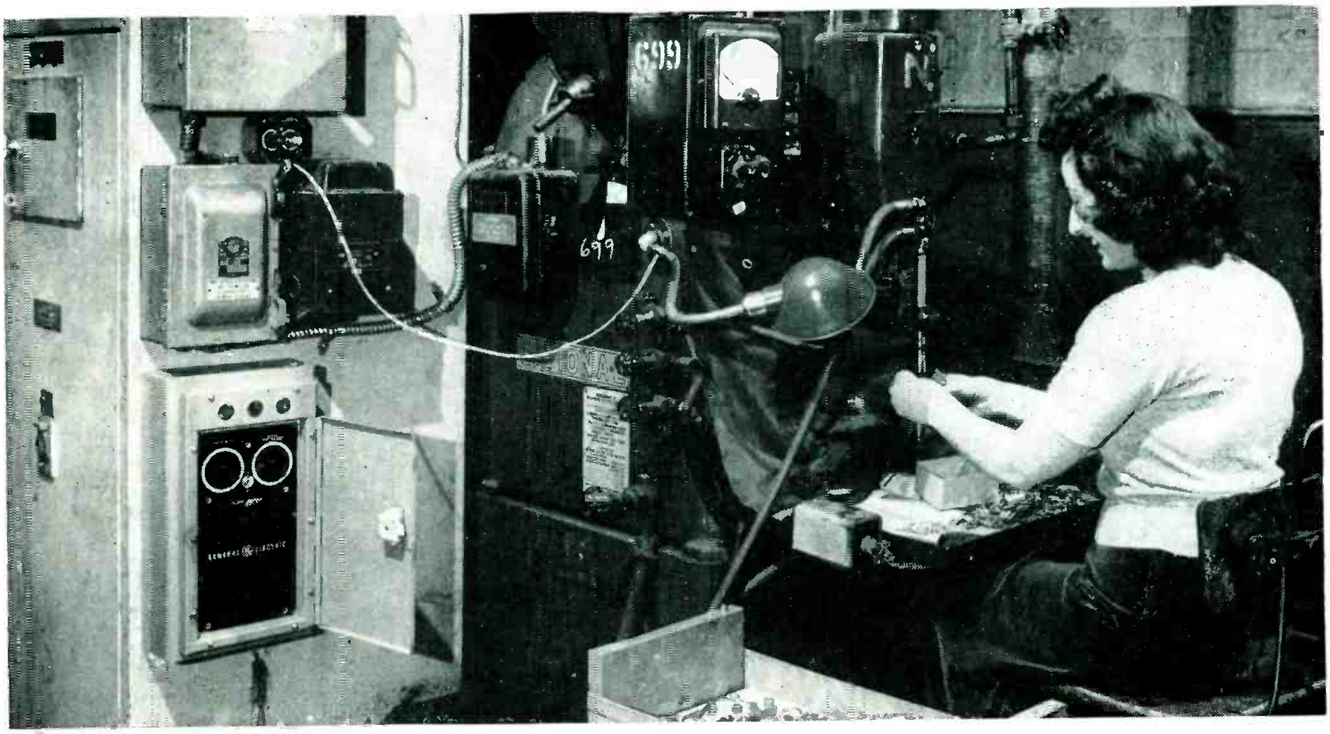
for Resistance Welding



Slope control unit at lower left, incorporated in welding control cabinet, here permits welding chrome-plated beryllium-copper spring strip to steel-backed silver contact, meeting Navy specifications that the chrome plating be undisturbed by welding. This installation is in the Schenectady plant of the G-E Control Divisions

In the basic phase-shift heat control circuit of Fig. 1B, transformer T_1 is in phase with the anodes of the power tubes. Transformer T_2, which does the triggering, is phase-shifted by C_1 and several variable resistors in series for control of the final heat, the full heat limit (the final heat calibration or power factor adjustment) and the initial heat adjustment of the slope control circuit. In this circuit, increasing resistance delays firing and reduces the current (heat).

The slope control circuit can be thought of as a resistance that is varied automatically from its initial resistance to essentially zero resistance. This effect can be produced by varying the current through the back-to-back thyratrons across the initial heat resistance. Impressed on the grid of each tube is the combined a-c voltage of T_3 and the d-c bias of C_2. The voltage of T_3 is fixed at 90 degrees lagging the anode voltage, while control is obtained by varying the d-c bias of C_2 from negative to positive.

With a negative bias the thyratron is phased almost off as in Fig. 1C, thus passing very little current and being equivalent to a high resistance in the phase-shift circuit. As the bias is made more positive, the thyratron turns on earlier and earlier in the cycle and the effective resistance in the phase-shift circuit decreases to essentially zero.

In the circuit of Fig. 1B the normally closed contact of relay *CR* keeps C_2 charged negatively. At the beginning of the weld, relay *CR* picks up and C_2 is connected to a positive source through potentiometer P_1. The time for C_2 to change its charge from the negative (thyratrons phased off) to the positive (thyratrons phased fully on) condition is the slope time and is determined by the time constant of P_1 and C_2, hence P_1 adjusts the slope time.

EXAMPLES OF COST-CUTTING APPLICATIONS

1. At Lynch Brothers plant in Pine Meadows, Conn., the need arose to weld two pieces of soft 0.064-inch 24-SO aluminum. Using standard single-phase welders with synchronous control but without slope control, only 52 welds could be obtained without cleaning the electrodes. Addition of slope control increased this to a minimum of 800 spots between cleanings.

2. In a GE machine shop it was necessary to seal off a ¼-inch diameter stainless steel tube having 40-mil wall thickness. The sealed end had to be gas-tight and successfully hold less than 1 micron of vacuum. With other welding procedures the reject rate was over 50 percent, but addition of slope control gave successful welds with less than 5 percent rejects.

3. The City Auto Stamping Co. in Toledo produce engine hoods requiring projection welding. Because of weld splatter, three men had to polish the parts to get acceptance by International Harvester. Slope control reduced metal expulsion so greatly that polishing was no longer necessary.

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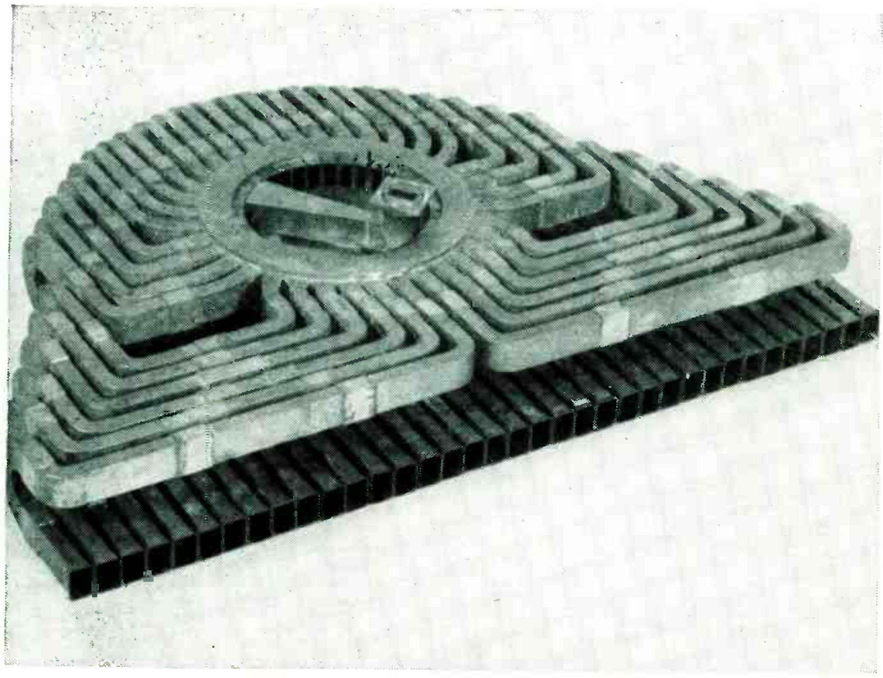
ORGAN-PIPE



Experimental model of the organ-pipe scanner

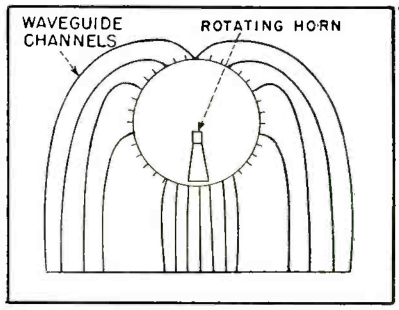


FIG. 1—Source motion produced by feed-horn rotation

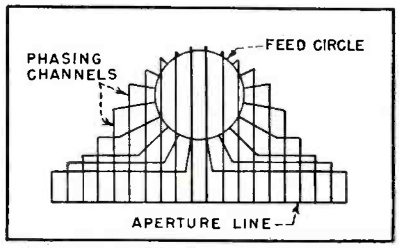


FIG. 2—Convolution of the channels

MANY RADAR systems require a means for rapidly scanning the antenna beam over a volume in space. One of the solutions to this problem in the microwave field is known as an organ-pipe scanner.

A feed horn, a transition region and an aperture are the three fundamental components of an organ-pipe scanner. Energy is introduced into the feed horn, passes through the transition region and appears at some point on the aperture. Different portions of the aperture are used and apparent motion along the aperture is achieved by means of a rotation of some element in the system. Scanning of the antenna beam takes place when the aperture is made to coincide with a curve on the focal surface of an objective.

Experimental Model

It was decided to use a rotating horn system for rapid scanning. The principle of the rotating horn is shown in Fig. 1. Design of the scanner made use of 36 standard 1 by ½-in. waveguide channels. The completed experimental model is shown in Fig. 2 and the above photograph.

Referring to Fig. 2, the channels in the middle, closest to the aperture line, are carried to the edges of the aperture and the others fill in as shown. The guides can be crossed only if the feed circle and the aperture line are in different planes. This convolution simplifies the phasing problem and offers no great mechanical difficulty.

To permit a correction of path length in each channel, a 180-deg H-bend was used making it feasible to vary path lengths in the course of experiments.

Despite the bulk and apparent complexity of the system, the organ-pipe scanner can be constructed simply and is lighter and more mechanically feasible than other existing feed systems. It has good impedance qualities as well as a small amount of dead time. Moreover, during dead time, the scanner still offers a good impedance match to the magnetron.

Experimental data showed that the main beam from the scanner did not vary with feed-horn rotation when the horn dimension was equal to three and to four-channel widths. This beam did change slightly when only two elements were fed. In all cases, the beam width was equal to that which could be obtained from standard horns whose apertures were equal to the energized parts of the scanner apertures.

Flared H-Plane

Because the aperture dimension in the H-plane is equal to the guide width, it is too small to illuminate the objective adequately for most applications. The aperture dimension may be increased by making each channel flared in the H-plane or by adding a single flare to the entire array of elements.

Some improvement in the beam width and the side-lobe level of the E-plane pattern results from the addition of the H-plane flare to the three elements.

It has been determined experimentally that the production model

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RADAR SCANNER

Device is lighter and more feasible mechanically than other available methods for scanning an X-band antenna beam. Mechanical motion is transformed to apparent motion along the required curve on the focusing reflector by means of a rotating horn and waveguide elements

By K. S. KELLEHER and H. H. HIBBS
Naval Research Laboratory
Washington, D. C.

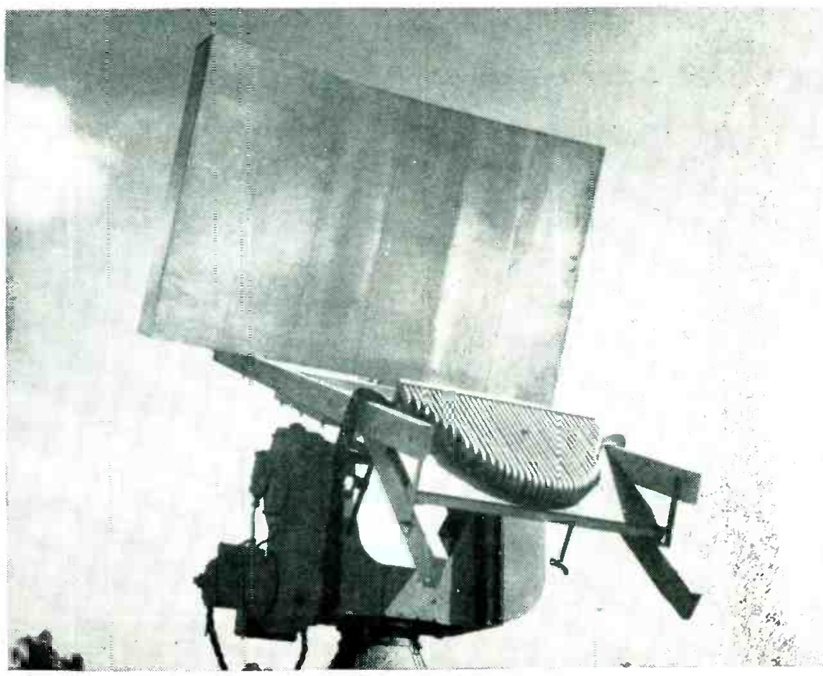
of the organ-pipe scanner should have a channel-wall thickness of about 1/32 in. to reduce impedance mismatch at the horn-to-waveguide interface. In the prototype of the organ-pipe scanner the channel-wall thickness was as great as 1/8 in.

Secondary Patterns

To study secondary patterns, a six-foot parabolic cylindrical section of 57.6-in. focal length was constructed upon a frame. The reflector, together with the organ-pipe scanner, is shown in one photograph. Secondary patterns from this arrangement had good beamwidth and side-lobe characteristics. Addition of the H-plane flare produced an improvement in the side-lobe level.

The magnetron does not have to be blanked out between scans because the impedance does not change appreciably throughout the entire scan. Dead time, therefore, is determined solely by the usefulness of the secondary pattern from the objective. This radiation pattern changes very little until the beam reaches one end of the scanner aperture. At this crossover point, the energy appears at both ends of the aperture, so that two beams are found in the secondary pattern. The system has a dead time during this period of ambiguity. Dead time for the model is equivalent to rotation past two of the 36 elements when three elements are fed, therefore the scanning system is inoperative only for 5.6 percent of the time.

Experimental model with single H-plane flare



Scanner with six-foot cylindrical reflector

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Automatic

By **JOHN M. CARROLL**
Assistant Editor
ELECTRONICS

REMINDER

- The *critical frequency* is the highest that a given layer of the ionosphere can reflect to earth when the ray enters the ionosphere with vertical incidence.
- The *virtual height* is that which a wave would reach if it traveled in a straight line through the ionosphere and were reflected from a mirror surface. Actual layer height is somewhat less.

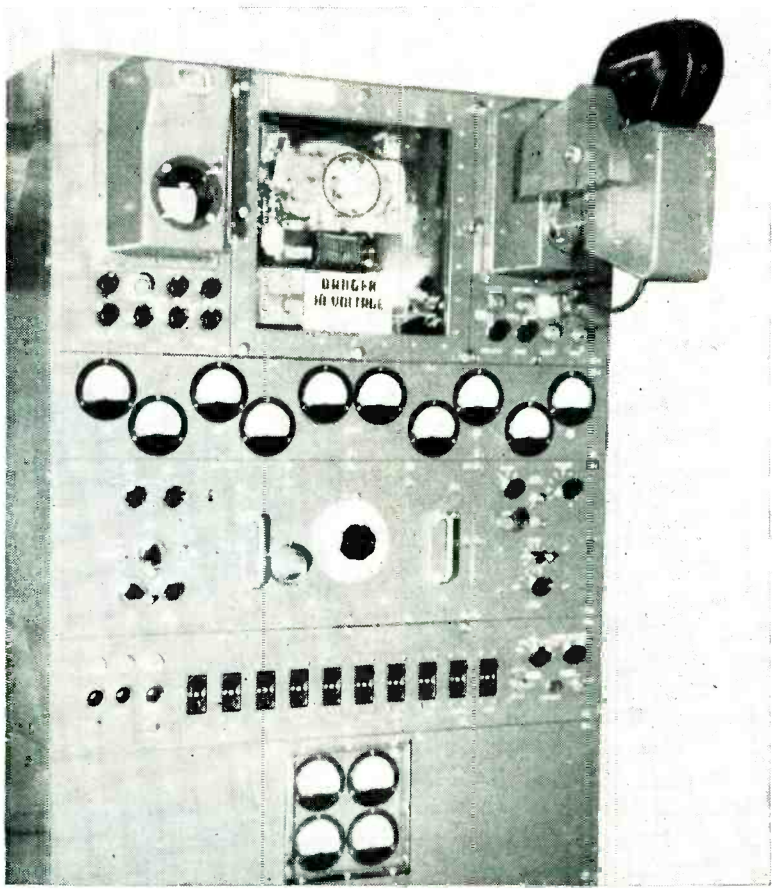
THE automatic ionosphere recorder Model C-3, shown in the photograph, is used by Central Radio Propagation Laboratory, National Bureau of Standards, to measure at vertical incidence the virtual height and critical frequencies of ionized layers of the upper atmosphere. Pulses of radio-frequency energy are alternately transmitted and received over the frequency range from 1 to 25 mc. The time interval between the transmitted and received pulses gives a measurement of the virtual height. This interval is automatically plotted against frequency and displayed simultaneously on monitoring and recording oscilloscopes.

A functional block diagram of the equipment is shown in Fig. 1. The pulse generator supplies pulses that key the transmitter and the 30-mc fixed-frequency oscillator, and synchronize the sweep and height-marker generators. The 30-mc fixed-frequency oscillator voltage is applied to the balanced mixer stages in the form of pulses that beat with the 31-to-55 mc variable-frequency oscillator to give carrier frequency varying from 1 to 25 mc. The resultant pulsed carrier is amplified by a pair of 6L6's and three pairs of 715C's before being applied to the antenna. The transmitter consists of two balanced amplifier channels feeding a balanced antenna.

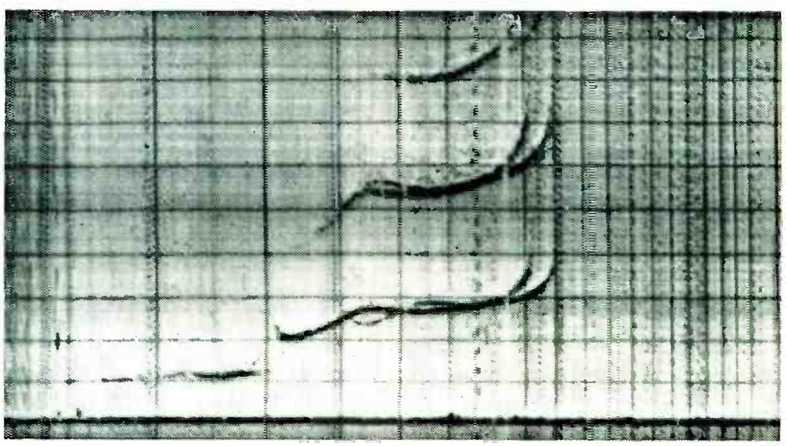
Dual-Conversion Receiver

The receiver shown at the left of Fig. 1 is a dual-conversion type. The antenna input is mixed with the vfo frequency to produce the 30-mc first i-f while a second i-f of 1.4 mc is produced by use of a 28.6-mc fixed-frequency oscillator. After passing the video detector, the video signal is differentiated and limited for control of interference and then fed to the oscilloscope units.

The frequency-marker channel shown to the left of the receiver



Complete transmission-recorder with 35-mm camera in use at upper right



Record of propagation conditions showing stratified E layer at 100 km and critical frequency of 3 mc. The F_1 layer has a virtual height of 200 km. In absence of a definite cusp, the critical frequency cannot be read. The F_2 layer at 260 km will support 8.2 mc at vertical incidence

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Ionosphere Recorder

Five stations in the Arctic use the latest equipment to measure virtual heights and critical frequencies of ionospheric layers. Continuous motion pictures or selected stills are made of pulse response from 1 to 25 megacycles

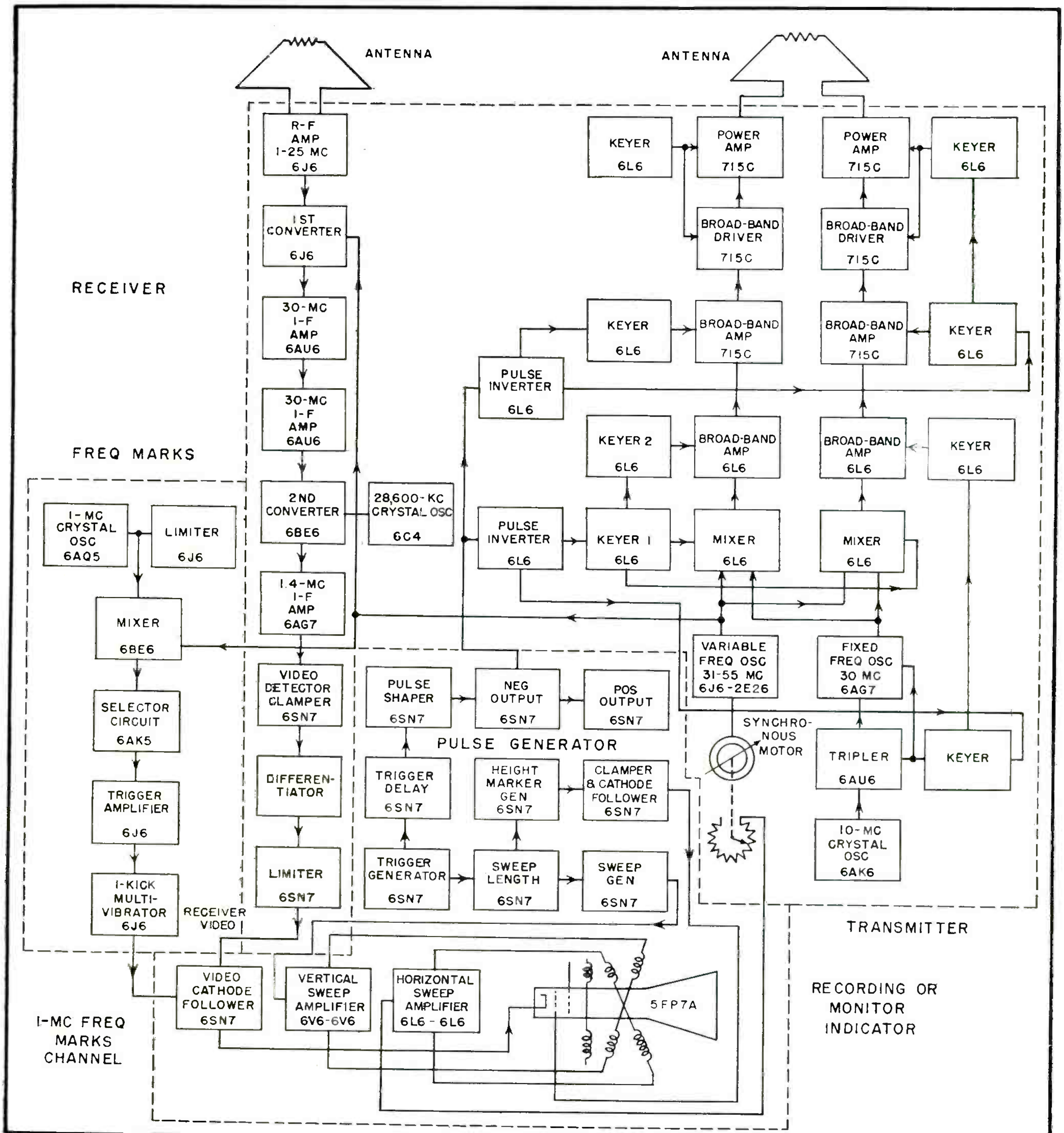

FIG. 1—Pulse generator, transmitter, receiver and recorder elements that make up the complete ionosphere recorder

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contains a 1-mc oscillator whose harmonics beat with the vfo output voltage to produce a frequency-marker pulse every megacycle. The vfo frequency is varied logarithmically from 31 to 55 mc by a motor-driven, cam-operated, variable capacitor.

A potentiometer, mechanically coupled to this system, is used to provide linear horizontal sweep voltage synchronized with the frequency sweep. The monitor scope uses horizontal sweep voltage derived from this source and the vertical sweep from the sweep generator. The recording scope uses only a horizontal sweep voltage from the sweep generator while the other dimension on the film is produced by motion of the film past the camera lens during the sweep.

Horizontal sweep voltage to produce the other dimension of the two-dimensional sweep is provided by a conventional sweep-generator circuit whose action is initiated by the trigger-generator multivibrator. The trigger-generator pulse also starts the marker pulses that are applied to the oscilloscope grids to provide either 50 or 100-km height markers on the cathode-ray screen.

Basic Pulse Generator

The pulse generator, as shown in block diagram Fig. 1, contains the basic trigger generator that initiates the outgoing pulses with variable delay, the sweep generator that produces the sweep voltage for both scopes in synchronism with them and the height marker channel.

The basic trigger generator is a standard free-running multivibrator whose frequency may be adjusted over two ranges. The lower range provides pulse repetition rates from 10 to 30 pulses per second while the other permits rates between 30 and 90 pps. Synchronism of the prr to the power-line frequency may be accomplished by feeding a suitable voltage to the pulse generator.

The outgoing trigger pulse is delayed to allow the oscilloscope sweep to get started. This delay is accomplished by a one-kick multivibrator circuit. The delay time is variable to permit the alignment of the leading edge of the transmitted pulse with the first 100-km height marker, thus providing a zero-reference height line.

The pulse-shaper circuits perform differentiating, amplifying and squaring functions and determine the length of the outgoing pulse. Pulse lengths of 50 or 100 μsec may be selected. The negative output pulse is taken off a cathode follower. An inverter stage also provides a positive output pulse.

The sweep-length circuit consists of a one-kick cathode-coupled multivibrator activated by the trigger generator to produce a square pulse, the duration of which depends upon the sweep time selected by the height-range switch. Amplified, this pulse is used to cut off the sweep-generator tube. During cutoff time, the sweep capacitor charges through a large resistor at an approximately linear rate.

Sweep capacitors corresponding to height ranges of 500, 1,000, or 4,000 km can be selected. Since the recording and monitoring oscilloscopes employ magnetic deflection systems, a pedestal voltage derived from the sweep-length multivibrator is added to the sawtooth output of the sweep generator to increase the sweep linearity.

The height-marker generator is keyed on by the square wave from the sweep generator and thereby produces oscillation only during the sweep. Circuit components in the marker oscillator may be chosen to provide either 50 or 100 km height markers. The height-mark pulses are differentiated and clamped before being applied to the oscilloscope grids.

Transmitter Keyer Tubes

Eight keyer tubes are used to key simultaneously the mixer, fixed-frequency oscillator and transmitter amplifier stages. They are arranged in two sets of four keyer tubes, each set with its master keyer tube or pulse inverter. The keyer circuits consist of cathode followers driven from the pulse inverters that are, in turn, fed with negative pulses from the pulse generator. Keyer 1 and keyer 2 of the left transmitter channel are shown schematically in

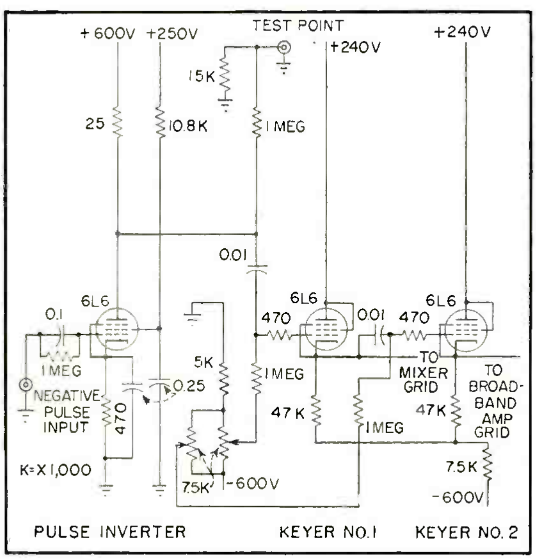

FIG. 2—Circuit of typical pulse inverter and cascade cathode-follower keyers used in Fig. 1

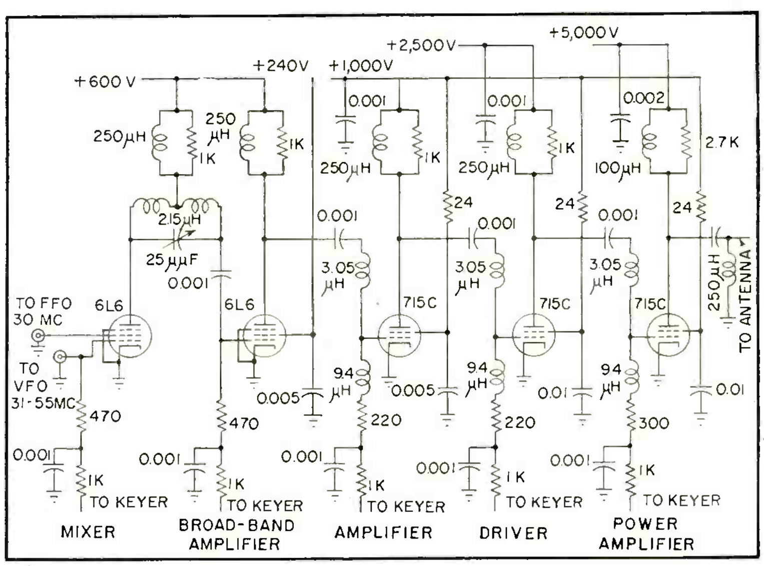

FIG. 3—Broad-band amplifiers used over the range 1 to 25 mc without band switching

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Fig. 2 with their associated pulse inverter.

Application of the keying pulse has the effect of bringing the d-c potential on the broad-band amplifier grids instantaneously from approximately −500 volts to zero or above. The bias level of the r-f stages may be adjusted by the potentiometers shown in the grid circuits of the keyer tubes.

The cathode-follower keyers are coupled directly to the amplifiers through isolating r-f filter networks. Additional protection from feedback is afforded by driving the cathode followers in cascade and by two master keyers or pulse inverters rather than from a common input source.

Broad-Band Transmitter

The transmitter consists of a balanced broad-band amplifier and a 30-mc fixed-frequency oscillator. The ffo crystal oscillator generates a 10-mc signal that is multiplied in a 6AU6 tripler and amplified in a 6AG7 tube to produce a balanced output. The last two stages of the ffo are keyed to provide a 30-mc pulsed signal.

The left channel only of the balanced transmitter is shown in Fig. 3 since both halves of the transmitter are identical. The 30-mc pulsed signal from the ffo is applied to the mixer screen grids while the 31-to-55 mc varying frequency voltage from the vfo is applied to the control grids. The difference frequency, 1 to 25 mc, is amplified by a second pair of 6L6's. A 30-mc band-rejection filter is included in the mixer plate circuits. The difference frequency is further amplified by three broad-band amplifier stages, each employing a pair of 715C pulse-type amplifiers. The amplifiers are designed to cover the range from 1 to 25 mc. Series and shunt peaking coils and very low values of load resistors are used in the amplifier circuits to obtain this broad response. The final stages are capacitively coupled to the delta-type, balanced-input antenna.

Pulse Receiver

The incoming signal from the receiving antenna is applied to the converter through a broad-band amplifier. A 30-mc band-rejection filter in the input circuit tends to minimize pickup at the intermediate frequency. The output of the vfo is also applied to the converter. The process of mixing these voltages and selecting the difference frequency will always produce a 30-mc i-f signal. This difference frequency is amplified by two 30-mc i-f amplifiers. These stages include six tuned circuits designed to eliminate spurious components, particularly those produced by feed-through from the vfo.

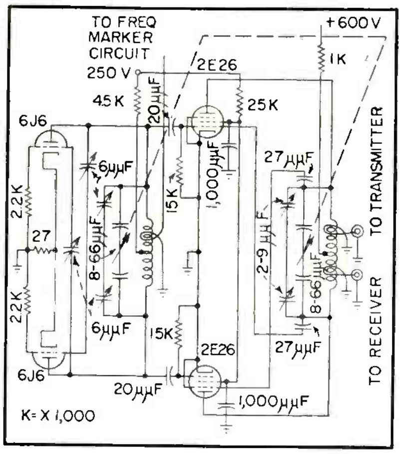

FIG. 4—Push-pull mopa variable-frequency oscillator is temperature controlled

A second i-f of 1.4 mc is obtained by beating the 30-mc first i-f signal against the output of a 28.6-mc crystal-controlled oscillator. The second i-f is amplified, rectified in a standard video detector circuit and the pulse output differentiated. A limiter follows this and is employed to improve the signal-to-interference ratio. Five different time constants can be selected in the differentiating circuit to give optimum interference control.

Variable-Frequency Oscillator

The variable-frequency oscillator shown in Fig. 4 comprises a master oscillator and power amplifier in a temperature-controlled oven for optimum accuracy and output frequency stability. The oscillator consists of a 6J6 connected in a push-pull circuit. The amplifier uses two 2E26's in push-pull. Butterfly-type variable capacitors are used in the tuned circuits of the two stages to provide full coverage from 31 to 55 mc with only 90 degrees rotation of the cam-follower shaft.

With a 4-rpm drive-motor, sweep times of 7½, 15 and 30 seconds are available using a gear-changing system.

Separate slug-tuned inductances and capacitance trimmers permit adjustment for optimum coverage of the desired frequency range. The vfo supplies r-f voltage to three units: transmitter, receiver, and frequency-marker unit. Energy to the transmitter and receiver is coupled from the power-amplifier tank while the output to the frequency-marker unit is fed from the oscillator tank. This isolation obviates any tendency for the transmitter to trigger the frequency-marker unit.

The frequency-marker unit produces a 0.1-sec pulse that is applied to the scope video channel cathode follower and is used to blank out a few height-sweep traces each megacycle thus producing a dark line on the scope face. The one-kick multivibrator that produces the blanking pulse is triggered by the audio beat note between the vfo voltage and the harmonics of a 1-mc crystal-controlled oscillator contained in the frequency-marker unit. Thus very accurate frequency marks are produced each time the vfo frequency sweep goes through an exact megacycle value.

Additional features incorporated in the ionosphere recorder include provisions for taking continuous 16-mm motion-pictures and routine 35-mm records at preset sweep times using the two scopes simultaneously. Each scope is provided with independent control of the face display. Automatic sweep speeds of 7.5, 15, or 30 seconds can be achieved with one motor or speeds of 30, 60, or 120 seconds with another.

Acknowledgments

The author is indebted to Alvin H. Morgan of NBS for supplying the material around which this article was written and to E. J. Wiewara and F. J. McCarthy for photographs.

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Magnetic Amplifier

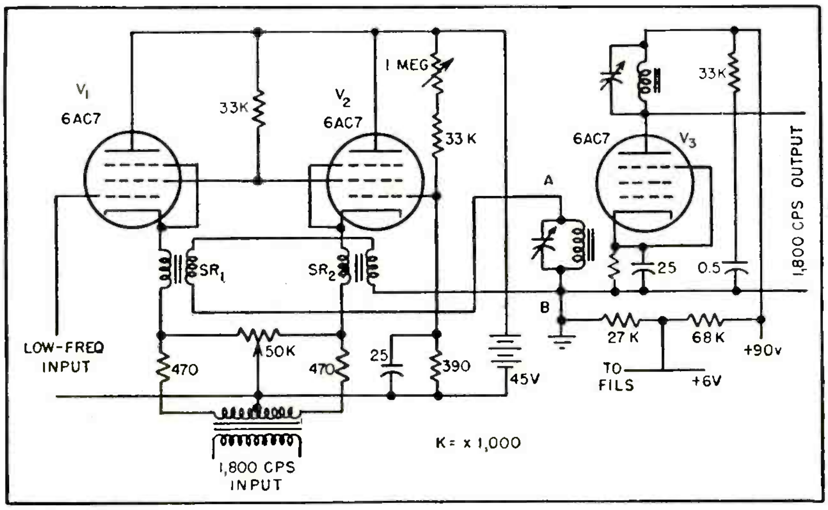

FIG. 1—Saturable reactors are used in cathode-follower circuits to obtain high stability and good low-frequency response with high input impedance

By GEORGE M. ETTINGER
New York University
New York, N. Y.

SATURABLE REACTORS have found numerous applications as tube substitutes. In some cases tubes and magnetic devices are used together to take advantage simultaneously of the desirable characteristics of both.

A typical application of this type is the modulator shown schematically in Fig. 1. This modulator was designed to act as preamplifier for an ocean wave recording system.* The input signal was obtained from a thermopile unit submerged under the ocean; the output was displayed on, and continuously photographed from, a cathode-ray tube.

A normal input of the order of one millivolt at frequencies extending from zero to about one cycle per second was to be amplified. This, in itself, presented no great problems, but it was a further requirement that the input resistance be greater than one megohm, and the stability such that the instrument could be left unattended for several days.

The stability requirements, and the low frequency of the input signal, immediately suggested an application for the magnetic amplifier. However, the high input impedance specified ruled out all magnetic amplifier circuits known to the author. A circuit was therefore devised which employed a vacuum tube as impedance transducer, followed by a pair of saturable reactors to convert the very-low-frequency input signal into an audio-frequency alternating current that could be handled easily by a tuned vacuum-tube amplifier.

Circuit Description

The instrument consists essentially of a pair of push-pull 6AC7 cathode followers having Supermalloy saturable reactors connected in their respective cathode circuits, as shown in Fig. 1. The bias on V_2 is adjustable to compensate for any steady signal which may be superimposed on the input to the first tube. The 1,800-cps carrier is introduced through a center-tapped transformer, half the voltage being applied to each saturable reactor.

When the potentials at the grids of the two tubes are the same, so that the two saturable reactors are subject to the same d-c bias or premagnetization, the inductances of these reactors will be the same (assuming perfect balance between the tubes, and between the cores), and, therefore, the same fraction of the 1,800-cps carrier will be developed across each of the reactors. The balanced secondary windings are connected in opposition with respect to the fundamental, so that the output between points A and B is zero in the absence of signal input to V_1.

When the input voltage changes, the inductance of SR_1 will no longer be equal to that of SR_2, since their premagnetizations are now different. Hence a voltage will appear between grid and cathode of the amplifier stage. It is clear that even harmonics will add when the reactors are connected for cancellation of fundamental. Therefore it is necessary to provide sharply-tuned circuits to eliminate these harmonics. In the present design, two tuned circuits, each having a Q of approximately 30 at 1,800 cps, are employed—one in the grid circuit, the other in the plate circuit of the amplifier.

It is almost impossible to obtain perfectly-balanced cores with high permeability. Furthermore, the winding resistances and capacitances, with nominally equal numbers of turns, can hardly be made quite identical. A balancing adjustment is therefore required. This takes the form of a potentiometer connected across the secondary of the excitation transformer. The slider of this potentiometer is connected to the center tap of the transformer, so that the loading on the two halves of the transformer can be differentially adjusted.

A variable resistance across an inductance permits the phase angle of the combination to be varied, so that this control affects inductance and resistance balance simultaneously. Since another amplitude

* The work described in this article was done under contract W-49-051-eng 1 approved by the Beach Erosion Board, Corps of Engineers, United States Army, and administered by the Research Division of New York University. This article is based on a paper, presented at the 1951 National Electronics Conference, which will appear in the *NEC Proceedings*. The author is now at Standard Electronic Research Corporation, New York, and Columbia University.

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Has High-Impedance Input

Desirable characteristics of vacuum tubes and saturable reactors are combined in an instrument capable of handling frequencies from zero to fifteen cps with good long-term stability, fair transient response and an input impedance of two megohms

control is, in effect, provided in the form of the bias potentiometer at the grid of V_2, successive adjustment of the two controls allows complete balance to be achieved. The slope of a magnetic amplifier characteristic is zero when the two cores are exactly balanced. Hence it is necessary to shift the operating point along the characteristic by providing some unbalance initially.

Performance

The magnetic modulator was not designed for extremely high gain, since this could be obtained without difficulty from readily obtainable vacuum-tube amplifiers of conventional form. The power gain of the complete modulator is of the order of 80 db.

The response of the instrument was found linear for a range of inputs from 1 to about 300 mv. Some curvature was apparent at inputs below 1 mv. Input-output characteristics are shown in Fig. 2, while Fig. 3 indicates the response to a stepped input signal which jumps from 0 through 1, 2 and 5 mv.

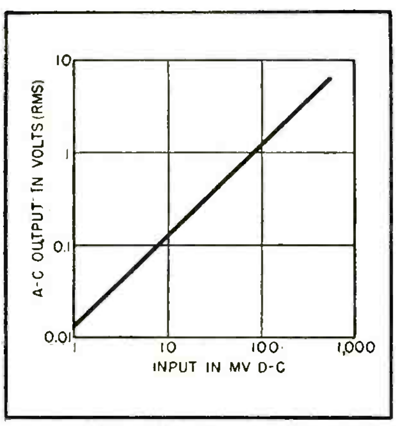

FIG. 2—Curve shows excellent linearity between d-c input and a-c output

Noise was measured by noting the perturbations of the 1,800-cps envelope. The smallest step function (Fig. 3) represents an input of 1 millivolt d-c into the modulator, which has an input resistance of 2 megohms. The amplifier draws 5×10^{-13} watt from the source with 1-mv input. The perturbations correspond in amplitude to about 0.1 millivolt input, or to a power of 5×10^{-15} watt.

Harmonic analysis of the noise, using a spectrum analyzer, showed the power spectrum to be almost flat from zero to 15 cps.

The instrument was adjusted for maximum sensitivity, and the amplitude of the trace on the oscilloscope noted. The change of amplitude after 30 minutes, 1 hour, 3 hours and 6 hours was recorded, and is expressed in the following table as equivalent voltage and power at the input.

Time (hours)	Drift from last reading	
	(input mv)	(input watts)
0.5	2.0	2×10^{-12}
1.0	1.0	5×10^{-13}
3.0	0.5	1.25×10^{-13}
6.0	0.5	1.25×10^{-13}

The input impedance is that of a 6AC7 cathode follower with approximately 500 ohms resistance in the cathode. It may be expected that the input impedance will be $(1 + g_m R_k)$ times the input impedance of a straight amplifier. In the present case, this factor is approximately equal to 3. Measurements showed the d-c input resistance to be of the order of two megohms, while resistance to ground, due largely to heater-cathode leakage, was about 200,000 ohms.

The magnetic amplifier has an appreciable time constant since it is a highly inductive device. Hence its response cannot be very rapid because it depends largely on the L-to-R ratio of the input winding. Figure 4 shows the response of the system to 3-millivolt square pulses at various repetition rates.

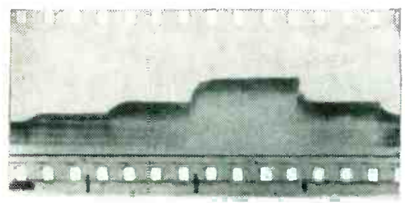

FIG. 3—Oscillogram shows response to 1, 2 and 5-mv steps

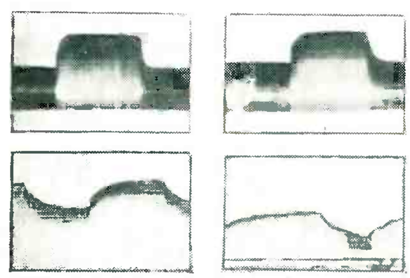

FIG. 4—Oscillographic representation of system response to 3-mv square pulses at repetition rates of 10, 5, 2 and 1 second

These oscillograms show a rise from 10 to 90 percent of full amplitude in about 0.15 second. This corresponds to a half-power point on the steady-state basis at approximately 15 cps. Measurements of steady-state response were not made directly, since no very-low-frequency sine-wave generator was available. The transient response can be improved by employing a tube of high mutual conductance or low internal resistance.

Acknowledgments

Thanks are due W. J. Pierson and S. G. Lutz, both of New York University, for their valuable advice and criticism.

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HOW TO DESIGN R-F Coupling

Handy charts and experimentally-derived rules aid in selection of circuit and components for coupling output of an r-f amplifier to any antenna, transmission line or other load, resistive or complex. Typical problems are solved as examples

COUPLING an r-f power amplifier to an antenna or transmission line has long been more of an art than a science. Many articles appear in the literature describing pet circuits and ways for determining component values and predicting performance. To study all available means, one must consult a wide variety of publications and weigh the various factors pertinent to his particular design problem.

This article is a collection of engineering design information on the more commonly used systems. It provides a practical means for designing and adjusting circuits. A brief review of necessary preliminary calculations is presented for completeness, so that all the designer needs is a problem to work and a slide rule.

Tank Circuits

The basic problem is represented schematically in Fig. 1A. In this figure R_L is the required load resistance and Q is the circuit Q. Except for very low values of circuit Q the approximation $X_L = X_C$ is nearly exact. Low-Q values are treated later in this paper in connection with the L-section design curves. The value of R_L may be determined approximately by the following methods. For Class-C amplifiers, assume the peak plate voltage swing to be $0.8E_b$, where E_b is the d-c plate voltage. For high g_m tubes at maximum plate voltage this figure may be as high as 0.9 and for ordinary triodes with low plate voltages, it will be less than 0.8.

Since the power output is known, R_L can be computed from

$$R_L = \frac{e_{peak}^2}{2P}$$

Now knowing R_L, X_C can be found by choosing Q and using the equation

$$X_C = \frac{R_L}{Q}$$

The actual value of capacitance can now be calculated or read off a reactance chart.

Preferred values of plate tank circuit Q lie between 10 and 20. The harmonic attenuation decreases rapidly below 10 and below 5 the amplifier plate efficiency falls off. Above 20 the tank circuit losses become high unless very high-Q tank coils, or high-Q resonant-line tank circuits are used. Another consideration is that on frequencies below 1 mc the Q may have to be kept low to avoid attenuating the high audio-frequency sidebands.

A point of major importance in the design of class B or C amplifier circuits is that a low-impedance capacitive path from grid to cathode and from plate to cathode be provided for the harmonic components of the grid and plate currents. Failure to do this results in poor tube efficiency and high high-frequency harmonic output.

The power loss in a simple tank circuit is given by the ratio of circuit Q to the coil Q

$$\% \text{ loss} = 100 \frac{Q_{ckt}}{Q_{coil}}$$

It should be noted that the resistance in the circuit Q includes the r-f resistive component of the inductor.

Circuit Elements

The d-c blocking capacitor between the tube and the tank circuit should have at least as much capacitance as a tank capacitor for a Q of 10. The maximum capacitance is limited to the amount of capacitance loading the modulation transformer can stand.

The best r-f chokes for use up to 30 mc, where the plate voltage is only several hundred volts, seem to be the very common 4-pi chokes rated at 2.5 mh and 100 ma d-c.

Plain solenoid-type r-f chokes are the only satisfactory kind for use across high r-f voltages and over a wide frequency range. They are usually wound with a length equal to 5 to 10 times their diameter and as small physically as the d-c current and the r-f voltage across the choke will allow. This is to keep the field of the choke as small as

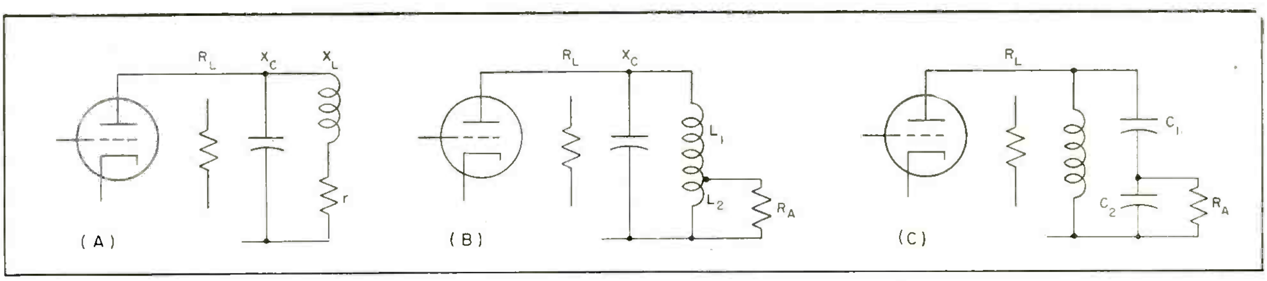

FIG. 1—Basic circuits for matching high-impedance plate to low-impedance load

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Circuits

By WARREN B. BRUENE
Collins Radio Company
Cedar Rapids, Iowa

possible, because shields and other objects in the field of the choke reduce the series self-resonant frequency and also broaden it. They must have sufficient inductance for use on the lowest frequency of operation and have their lowest series self-resonant frequency above the highest frequency of operation.

If a suitable compromise cannot be made, it is necessary to use more than one choke to cover the frequency range.

For higher voltage circuits, pi-wound commercial chokes often can be used in the amateur bands but they usually have holes between bands and would burn up at these series self-resonant frequencies.

In direct capacitance-coupled exciter stages, the load resistance is presented directly to the tube. The load on the tube also includes the losses in the tank circuit which are very appreciable on frequencies where the circuit Q is high which may be due to high circuit capacitances.

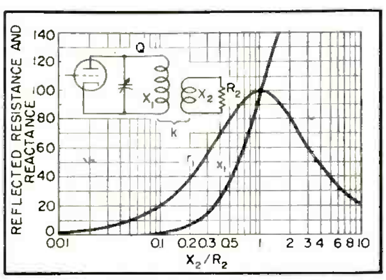

FIG. 2—Resistance and reactance reflected into tank coil are shown as percent of maximum possible reflected resistance for various values of pick-up coil reactance to load resistance ratio

The tap on the tank coil method (Fig. 1B) may be used to match the tube to any resistive load R_A which is lower than R_L. When the coil is tapped, there is a mutual inductance between the tapped portion and the untapped portion which must be considered. The equation of impedance match for this circuit is

$$\frac{R_A}{R_L} = \left[\frac{L_2 + k\sqrt{L_1 L_2}}{L_2 + L_2}\right]^2$$

For a given R_A the load on the tube increases as the tap is moved up the coil.

Capacitance division (Fig. 1C) may be used to match a low-impedance grid load to a high-impedance driver tube, since a capacitive return to ground is provided for both plate and grid. For a fixed impedance match the ratio of C_1 to C_2 must remain constant. When the circuit Q is high

$$\frac{R_A}{R_L} = \left[\frac{X_{C2}}{X_{C1} + X_{C2}}\right]^2$$

and the voltage transformation ratio is

$$\frac{E_A}{E_L} = \frac{X_{C2}}{X_{C1} + X_{C2}}$$

Inductive Coupling

When the load is coupled into the plate tank circuit by means of a link or pick-up coil, both resistance and reactance will be reflected in series with the tank coil. Figure 2 shows how the loading changes when the number of turns in the pick-up coil is varied. The loading is maximum when the reactance of the pick-up coil equals the resistance of the load. The ohms of reactance x_1 reflected into the primary equals the resistance r_1 for this condition.

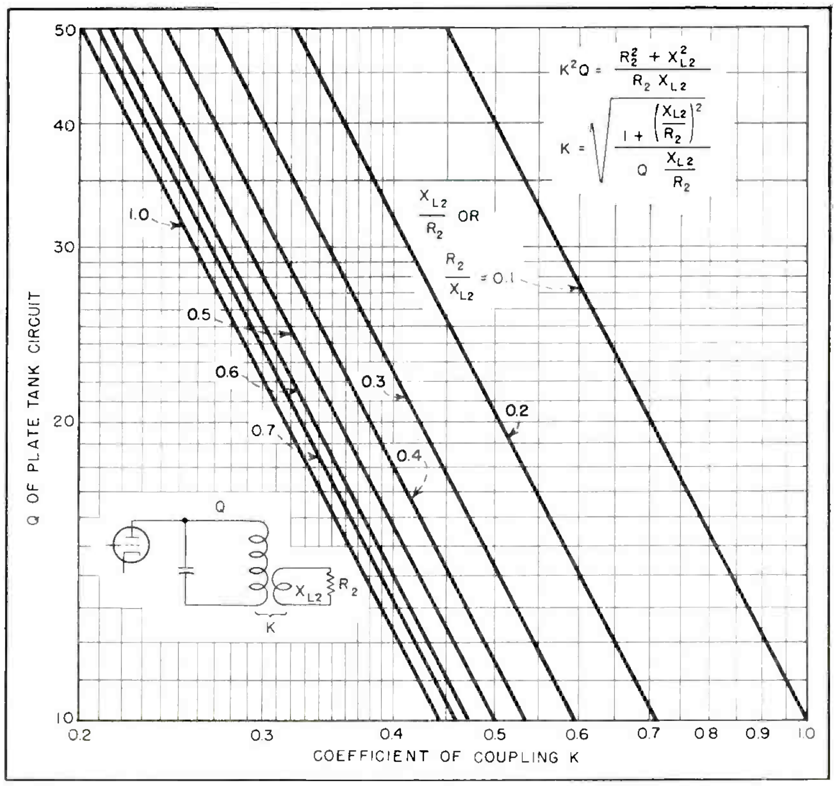

FIG. 3—Relation of k to Q for untuned coupling coil

The reflected reactance drops rapidly as the pick-up coil reactance X_2 is decreased. This means that, if sufficient loading can be obtained with less pick-up coil inductance, the detuning of the plate tank circuit will be less when the coupling is varied. The reflected reactance is tuned out when the final plate current is dipped after any other change is made.

The equations for this circuit are as follows: Resistance and reactance reflected into primary are

$$r_1 = \frac{(\omega M)^2}{R_2^2 + X_2^2} R_2$$

$$x_1 = \frac{(\omega M)^2}{R_2^2 + X_2^2} X_2$$

$$(\omega M)^2 = k^2 X_{L1} X_{L2}$$

A fact which may not be obvious

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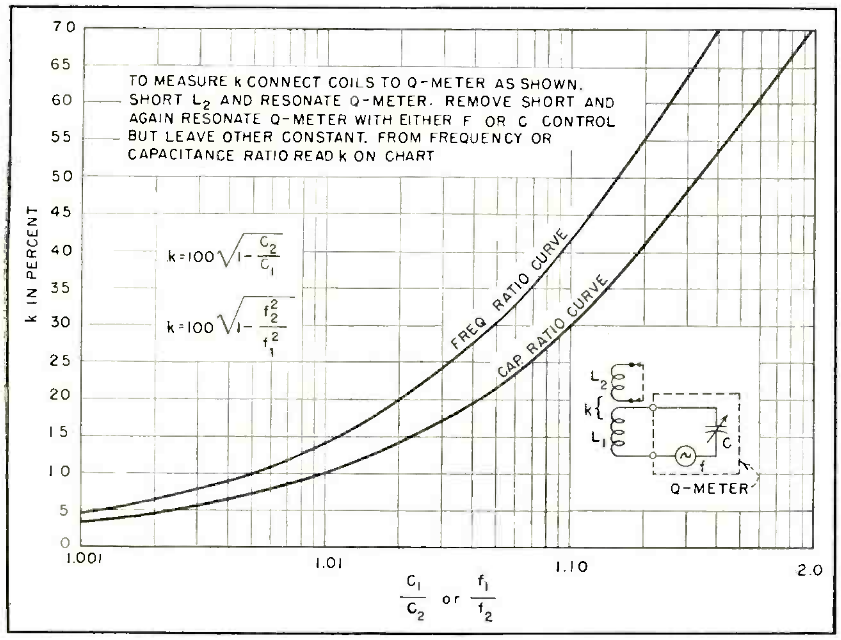

FIG. 4—Chart explains method for determining coupling coefficient using Q meter

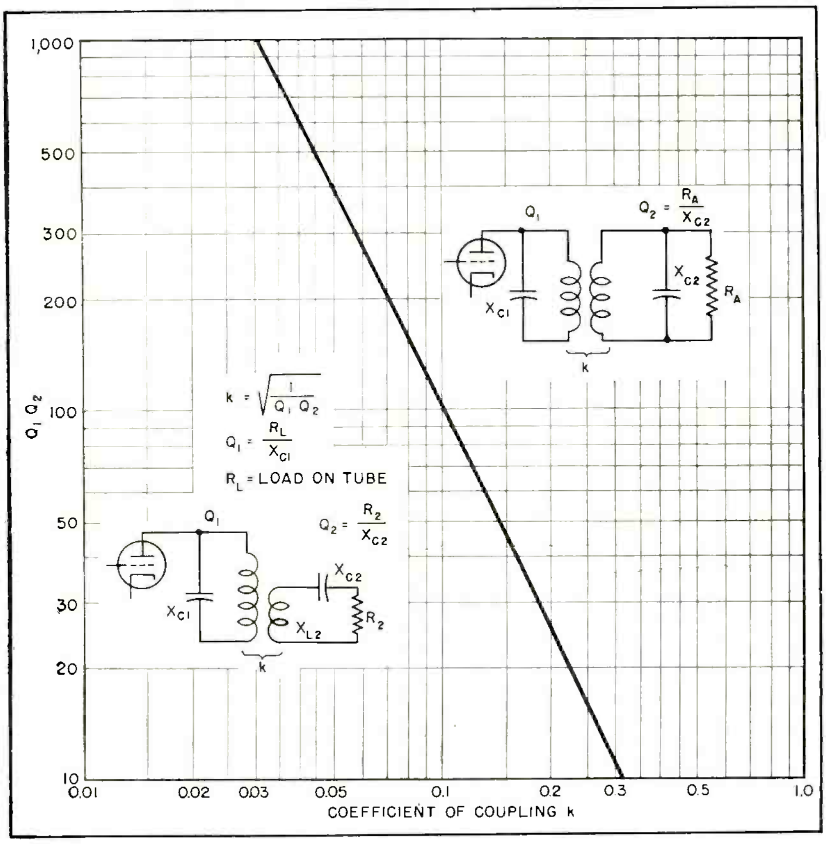

FIG. 5—Relation of k and Q for tuned coupling circuits

is that the reflected resistance and reactance are independent of the magnitude of the load resistance and pick-up coil reactance, but depend only on the ratio X_2/R_2 and the coupling.

For example, if the load R_2 is 600 ohms, the inductance required in the pick-up coil may actually be greater than the inductance of the plate tank coil, whereas for a 50-ohm load the inductance of the pick-up coil will be very small.

Values of k

Figure 3 shows the relationship between k and Q for various values of X_{L2}/R_2 when the coupling coil is untuned. Since maximum practical values of k are around 0.35, this shows that the pick-up coil must be near optimum or the plate tank circuit Q will become very high.

In most of these tank circuit designs it is usually necessary to know the coefficient of coupling obtainable from a given physical arrangement. Sample coils can be wound and the coefficient of coupling quickly determined by use of a Q-meter and the coefficient of coupling chart shown in Fig. 4. The procedure is given on the chart.

In commercial types of plug-in tank coils, the maximum k where the link is in the center of the tank coil is approximately 0.35 to 0.37. When the link is over the end of the coil it is approximately 0.3. When the link is the same diameter as the tank coil and spaced from the end of it slightly, k is approximately 0.2. When long coils are coupled together, k may be very low since little coupling exists in any but the few turns on each end of the adjacent coils.

There is little reduction of k if the link in the center of the tank coil is wound over it on a larger diameter form. When the link in the center of the tank coil is wound on a smaller diameter, k decreases proportionally to the reduction in diameter.

Tuned Secondary Circuits

Figure 5 shows the relation of k to tank circuit Q for circuits having tuned secondaries. The coefficient of coupling k required is a function of the product of the two circuit Q's. This chart holds true for all values of Q, even those less than unity, and for both series and parallel-tuned circuits.

For example, if the plate tank circuit Q is 10 and the maximum k obtainable is 0.15, what must be the minimum Q of the antenna tank circuit? To solve this, follow the 0.15 line up to the curve (Fig. 5) and then read Q_1Q_2 of 45 at the left. Since Q_1 was given as 10 then Q_2 must be 4.5 or greater.

It is interesting to note that when one circuit is parallel resonant and the other series resonant and both are capacitance tuned, they can be tuned across a frequency

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band and still maintain constant Q_1Q_2 and constant k.

Link Coupling

Link coupling is often used to couple two circuits together which are physically separated some distance, as shown in Fig. 6. When the transmission line is very short and can be neglected, the effective coefficient of coupling between the two tank circuits is

$$k_{eff} = \frac{k_1 k_2}{\sqrt{\frac{L_3}{L_4}} + \sqrt{\frac{L_4}{L_3}}}$$

From this equation it is found that the maximum effective coefficient of coupling is realized when the two links have the same inductance. This means that the link inductances should be equal regardless of the inductance of the tank coils or their circuit Q's. When $L_3 = L_4$, the equation reduces to

$$k_{eff} = \frac{k_1 k_2}{2}$$

To realize maximum coupling, the inductance of the links should be larger than the inductances of the short transmission line. If one link is variable, it should be located on the input end of the link circuit to keep circulating current in the link circuit down.

When the transmission line between the links becomes an appreciable part of a wavelength long, it becomes a difficult transmission-line problem to solve. It appears impossible to realize a very low standing-wave ratio in most circuits. For this reason, it is recommended that some form of direct coupling be used on the load end so that a low standing-wave ratio on the line can be realized.

Harmonic Attenuation

Harmonic attenuation charts for four different types of tank circuits are shown in Fig. 7. The actual harmonic output from a Class-C amplifier is shown for the second and third harmonics. For 120-deg plate current flow, the second harmonic output is 3 db lower and the third harmonic is 9 db lower than the actual attenuation of the tank circuit.

These charts give the maximum attenuation that can be expected, as stray capacitance coupling, and other secondary effects, may lower these attenuations appreciably. Also these charts will not be accurate when Q_1 and Q_2 become less than approximately 10 and 3 respectively.

To calculate the harmonic attenuation of any tank circuit proceed as follows:

(1) Find the fundamental current through R_L from $I = \sqrt{P/R_L}$. (2) Determine the fundamental current in the load resistance in the same manner. (3) Determine the reactance of all components at the harmonic frequency. (4) Now assume a harmonic current input equal to the fundamental current through R_L and calculate the current that flows in the load resistance. Take short cuts by neglecting resistance terms in each branch as the difference will be only a db or two. (5) Use the ratio of fundamental current in the load from step 2 to the harmonic current calculated in step 4 to calculate the db harmonic attenuation of the circuit.

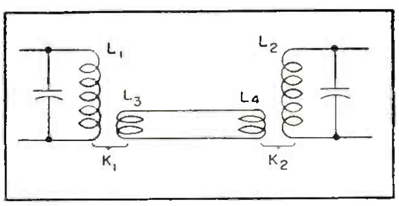

FIG. 6—Basic circuit of link-coupled tuned circuits. Maximum effective coefficient of coupling is realized when two links have same inductance

The L-Network

The L-network is a very simple circuit, yet it is the most efficient impedance-transforming circuit available. The L-section design chart shown in Fig. 8 is extremely useful in solving nearly all kinds of direct-coupled tank problems.

Example 1: Problem: Find the values of X_C and X_L required to match 40 to 200 ohms resistance.

Solution: Find 40 ohms at the bottom of the chart and follow this line up to the intersection of the 200-ohm line extending over from the left-hand scale. The X_C curve (dashed) through this point is 100 ohms and the X_L curve (solid) is 80 ohms which is the solution.

Example 2: Problem: Find the value of X_C that will give a Q of 10 in a tank circuit when the load on the tube is 3,000 ohms.

Solution: The tube load corresponds to R_2 on the chart as it is across the capacitance. Find 3,000 ohms on R_2 scale and follow across to the diagonal line labeled Q = 10. The X_C curve passing through this point is 300 ohms which is the solution. It can also be noted that the equivalent resistance in series

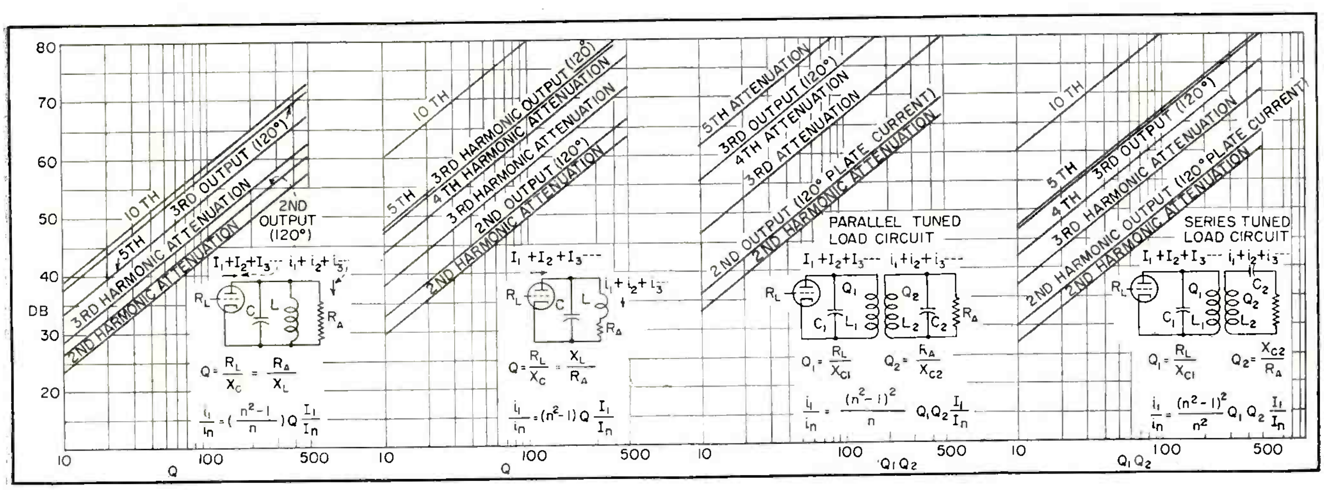

FIG. 7—Curves show harmonic attenuation and output associated with four basic coupling methods

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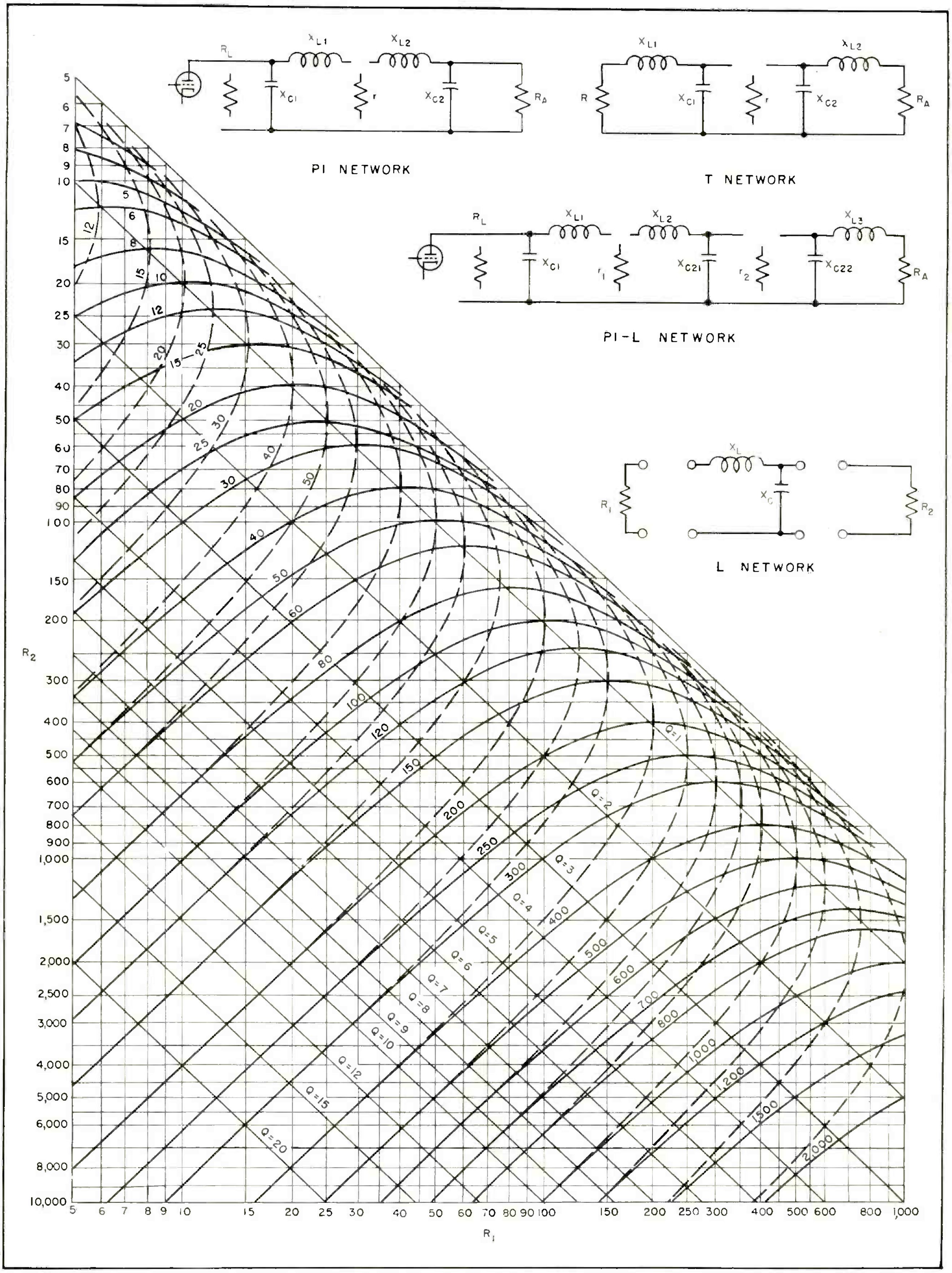

FIG. 8—Design chart for determining optimum component values for L. T. pi and pi-L networks. Inductive-reactance curves are shown solid. Capacitive-reactance curves are dashed. Use of chart is explained in text

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with the tank coil must be 30 ohms.

The L network can be used to match impedances which contain both resistance and reactance. If a low-impedance reactive load is to be matched to a high resistance, the procedure is as follows:

Example 3. Problem: Find the values of X_L and X_C required to match $40 + j50$ to 200 ohms resistance.

Solution: Match 40 ohms to 200 ohms as in the first example. The reactive component is in series with X_L so X_L must be corrected by this amount, so $80 - 50 = 30$ ohms for X_L; X_C remains at 100 ohms. If the reactive component had been $-j50$ then the corrected X_L would be $80 - (-50) = 130$ ohms.

If a low resistance is to be matched to a high-impedance reactive load, the procedure is to convert the reactive load to its equivalent parallel resistance and reactance.

Using lower case letters for series components and capital letters for equivalent parallel components, equations for this conversion are

$$R = \frac{r^2 + x^2}{r}$$

$$X = \frac{r^2 + x^2}{x}$$

The network reactances are then found on the chart which match the two resistances. The equivalent parallel reactance is combined with X_c to get the corrected value of X_c.

Example 4. Problem: Find the values of X_L and X_C required to match 40-ohms resistance to $100 + j100$.

Solution: The equivalent parallel components of $100 + j100$ are $R = 200$ and $X = 200$ ohms inductive. Now find X_L and X_C for matching 40 to 200 ohms. In this case X_C is found to be 100 ohms and this must be corrected to match or tune out the inductive component of the load. Corrected X_C =

$$\frac{100 \quad (200)}{100 + 200}$$

= 67 ohms. If the reactive component had been capacitive then it replaces part of X_C and the corrected X_C would be

$$\frac{200 \quad (100)}{200 - 100}$$

equals 200 ohms.

The pi network can be used to perform the combined functions of a plate tank circuit and an antenna matching circuit and accomplishes this with a minimum number of circuit elements. It can match a tube to a wide range of load impedances and still maintain the desired values of plate tank circuit Q. They should only be used in unbalanced grid or plate tank circuits. When only used for impedance matching or harmonic attenuation, they may be used in balanced form. For a thorough understanding of the behavior of the pi network the reader is referred to an article "Pi-Network Calculator" by the writer in May 1945 ELECTRONICS.

The conventional pi network has certain impedance-matching limitations and will not always efficiently match a tube to "just any old piece of wire for an antenna." The lowest load resistance that can be matched is approximately

$$R_A = \frac{R_L}{Q^2} = \frac{X_C{}^2}{R_L}$$

Other limitations depend on the choice of inductance and loading capacitor.

Pi Network Treatment

A simple method of determining the values of inductance and capacitance is to treat the pi network as two separate L-sections each matching into a common imaginary resistance r as shown in Fig. 8. The values of R_L and R_A must be known or found first, then Q is chosen. Now all four capacitive and inductive reactances are found on the L network design chart as explained previously. Add the inductive reactances together since actually a single inductor is used. Knowing the reactances of these elements their actual inductance and capacitance can be determined in the usual manner.

Example 5. Problem: Find the values of inductance and capacitance required to match a tube load of 2,000 ohms to a 300 ohm flat transmission line at 7 mc for a plate circuit Q of 10.

Solution: Find the intersection of 2,000 ohms and Q = 10, then read $X_{C1} = 200$, $X_{L1} = 200$, $r = 20$. Now match this r of 20 ohms to 300-ohm load. From intersection of 20-ohm and 300-ohm lines read $X_{C2} = 80$ and $X_{L2} = 75$. Find total X_L by adding X_{L1} to X_{L2} and get 275 ohms. Now use reactance charts or a slide rule to determine $C_1 = 113\ \mu\mu f$, $L = 6.25\ \mu h$, $C_2 = 285\ \mu\mu f$.

When the load impedance contains a reactive component, it must be converted to its equivalent parallel resistance and reactance. Then find the values for matching to this equivalent parallel resistance. Correct X_{C2} to tune out the equivalent parallel load reactance and the pi network values are solved.

The T-Networks

Simple T networks are often used to match one low impedance to another because the values of inductance and capacitance required are of more practical sizes. Also they are often inserted in series with a low-impedance transmission line to provide additional harmonic attenuation. In broadcast station service they are designed by choosing a suitable value of fixed capacitance and using adjustable taps on the two coils for proper matching. The T network problems are also easily solved by considering them as two L sections (Fig. 8) and then combining the capacitances.

When using T networks for impedance matching only, keep the Q of the sections as low as practical to avoid unnecessary circuit losses. For harmonic attenuation, use Q's of around 5 or 6 in each L section. Higher Q's do not give much more harmonic attenuation, but do increase the losses proportionally.

The Pi-L Network

This circuit is becoming increasingly popular for the final tank circuit when the load is a coaxial transmission line. It makes economical use of the components required and in general provides more harmonic attenuation than other circuits and less circuit loss. The second harmonic output from a class-C amplifier stage will be approximately 50 db down from the carrier.

To determine the component values of this circuit, break it down into L-sections as shown in Fig. 8 and proceed as explained in the preceding sections.

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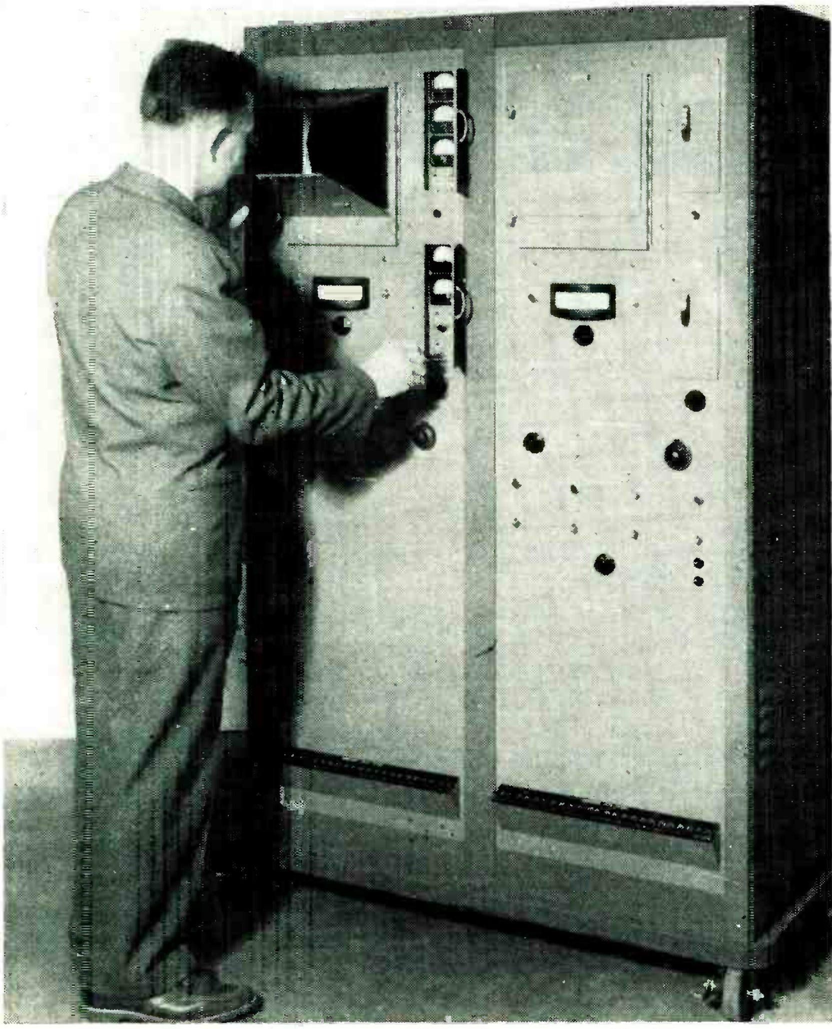
Precise



Complete instrument contains two function generators. Specimen sheet is placed behind hinged door and crt spot focused by viewing on ground glass in folding hood

OUTPUT VOLTAGE, representing a drawn function, may be fed to commercially available analog computers from the instrument shown in the photograph. Light from a flying-spot scanner crt is focused on the function, which is drawn in white on a contrasting chart. The spot is constrained to follow the drawn function by a Y-deflection feedback loop with multiplier phototube transducers providing the error signal. A multivalued curve representing the letter A is shown in the photograph.

To date a number of function generators have been designed and have given quite satisfactory performance within their design limitations.[1] The principle objections to these systems has been their sluggishness of response, time consuming and troublesome methods of function specimen preparation, or lack of precision in generating the desired function.

The main features of the function generator to be described are: high accuracy, ±0.5 percent; rapid response, amplitude and phase characteristics essentially flat beyond 100 cycles; and ease of function specimen preparation. The desired function is drawn with commercial white ink on a 7 by 7-inch contrasting graph sheet.

Principle of Operation

The operation of the function generator is illustrated in Fig. 1. The cathode-ray tube generates a spot of light which is optically projected onto the graph specimen. A bias voltage is supplied to the vertical deflection circuits of the crt which by itself is sufficient to drive the spot of light to the bottom of the tube. However, light reflected from the white portions of the graph is picked up by a bank of multiplier phototubes and fed back to drive the light spot toward the top of the tube.

If there exists a sharp line of demarcation between white and dark portions of the graph sheet, the spot of light will reside so that the line of demarcation will divide the spot permitting just sufficient light to reflect from the white portions of the graph sheet to sustain its position. In this way the spot of light is made to follow a white line on a dark-background graph sheet. An input voltage controls the horizontal or X-position on the graph sheet, and the vertical or Y-position output voltage is taken off the vertical deflection amplifier.

Technical Details

The optical system for the function generator consists of a 5WP15 flying-spot scanner cathode-ray tube[2] as a light source which provides a small spot of light movable within a plane, a projection lens to provide an image of the spot on the plane graph, a graph which reflects more or less light depending upon the position of the spot on or off the graph line, and a light collecting system to gather light reflected from the graph and present it to the cathodes of multiplier phototubes to generate an electrical signal indicating whether the spot is on or off the graph line.

Assume that electrical control of spot position on the cathode-ray tube face is faultless since actual problems of electrical control of spot position are discussed later. The task of the optical system is to project the spot onto the graph and receive light from the graph in such a way that electrical output from the multiplier phototubes is a reliable and useful indication of whether the spot is on or off the graph line in any portion of the graph area.

The desirable characteristics of the 5WP15 crt which dictated its

Presented at the 1951 National Electronics Conference in Chicago. The Conference paper will appear in the *Proceedings*.

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Function Generator

Rapid response, accuracy better than one percent with simple preparation of function specimen are provided by equipment using flying-spot scanner. Phototube feedback loop forces crt trace to follow curve drawn in white on black graph sheet

By C. N. PEDERSON, A. A. GERLACH, and R. E. ZENNER

Armour Research Foundation
Illinois Institute of Technology
Chicago, Illinois

use in the function generator application may be listed as: the face of the tube is sufficiently flat; the spot stays in sharp focus throughout a 2½-inch square area centered on the face of the tube; light output and angular distribution from the spot is substantially constant for any spot position in this area; the spectral distribution of the light is satisfactorily matched by the spectral sensitivity of type 5819 multiplier phototubes used for reception; in the newer, nonbrowning model of the 5WP15, a stationary spot of adequate brightness for this application does not shorten tube life appreciably; the phosphor decay rate is fast compared to spot velocities used in this application.

Undesirable effects of the crt are the halo and general glow resulting from internal reflections between the glass interfaces and the phosphor.

The objective lens selected for the function generator is an 88 mm, f/2.8, Carl Zeiss Tessar. Resolution in this lens is better than needed for the cathode-ray spot size, and distortion is negligible. It was determined that this lens operated at an aperture of f/4 constituted good design as a compromise between high light intensity and uniform intensity over the usable area of the crt.

To facilitate compact mechanical design, a front-silvered mirror is employed between the projection lens and the graph to turn the optical path through 90 degrees.

The graph must meet dimensional stability, ease of preparation, and convenience of handling requirements. In addition it must provide a sufficient change in light received by the multiplier phototubes as the projected spot moves on or off the graph line, in any part of the graph area.

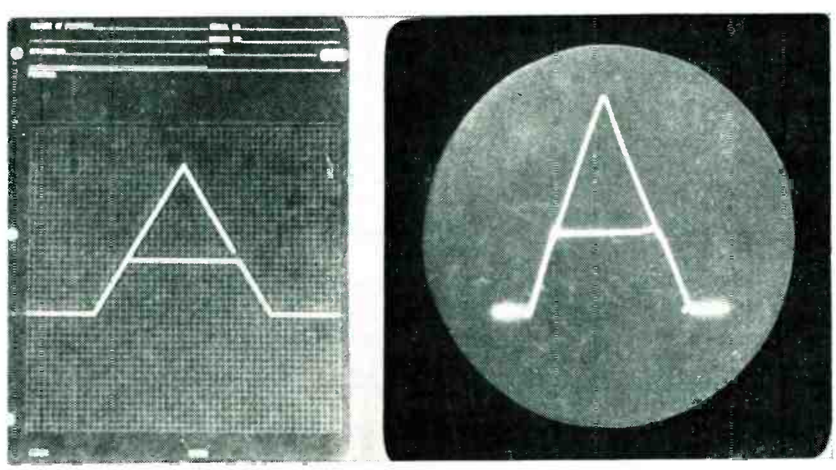
A number of commercial opaque papers were tested for dimensional stability under varying conditions of temperature and humidity, and all those tested changed more than 1 percent when subjected first to 70 F at 40 percent relative humidity and then to approximately 100 F at 90 percent relative humidity. Since an overall accuracy of ½ percent was required, none of these papers was acceptable.

Experiments run with various opaque and translucent materials with black ink lines revealed typical light-to-dark ratios for opaque white papers and reflection systems averaged about 5 to 1, and transmitted light systems using an opaque line on translucent materials averaged about 6 to 1 in light-to-dark ratio. For both these situations there is a serious masking problem in that stray light from the cathode-ray tube, general glow and halo, can readily reach the multiplier phototubes.

A great improvement is found when the graph is reversed, using a white line on a dull-black background for a reflected light system. Light-to-dark ratios in excess of 10 to 1 can be obtained. In a transmitted light system a transparent line in an opaque graph sheet should show an excellent light-to-dark ratio. However, no suitable materials for such a system have been found.

Aluminum Graph Sheet

The material finally selected to meet all the requirements is an aluminum graph sheet 0.025-inch



Multivalued functions may be handled by generator. Graph input of desired function at left may be compared with generator output as displayed at right on externally-connected oscilloscope

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thick, anodized and painted a dull black over its entire surface. It is overprinted with a guide-line grid in red, which is visible to the eye but reflects little light in the range transmitted by the cathode-ray tube and received by the multiplier phototubes. A title box is also overprinted in white outside the 7 by 7-inch graph area. See Fig. 2. The graph sheet has holes to facilitate loose-leaf binding and location in the function generator.

The graph line may be drawn with Johnsons' special grade or Keuffel and Esser number 3011 white drawing ink, and ordinary drafting pens. The upper edge of the line should be located accurately to represent the desired function of X and Y. A line $\frac{1}{32}$-inch wide is sufficient for control of the spot if both X and Y vary slowly. Where the component of velocity normal to the graph line may be high, due to rapid changes in either X or Y, the line should be thickened on its lower side by applying additional white ink with brush or pen. No great care is required in this operation except to avoid applying ink above the top of the original accurate line. A $\frac{1}{8}$-inch wide line is sufficient to stop the spot in free vertical fall.

The projected light spot strikes the graph at normal incidence only in the center of the graph, and angle of incidence decreases to 67 degrees in the corners. Reflection from the graph line is more diffuse than specular but the intensity is greatest in the specular reflection direction.

Attempts to design mirrors which would converge satisfactorily a large part of the reflected light from any point on the graph area upon a single photocathode were not successful.

A reflector design utilizing four photocathodes was designed by trial and error methods. The sum of the outputs of the four photocathodes is constant within 10 percent for any position of the spot in the 7 by 7-inch graph area.

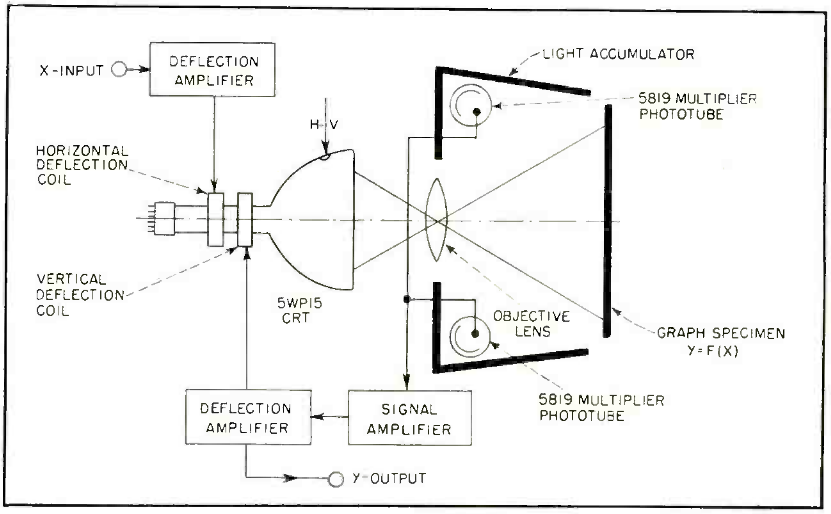

FIG. 1—Block diagram illustrates how phototube feedback loop forces crt trace to follow drawn curve of desired function

Photoelectric Transducers

Characteristics of various photocells were studied, and the end-on type 5819 was selected as most suitable for this application. It has a large cathode conveniently placed at the end of the tube, high gain, and reasonably satisfactory stability, noise level, and uniformity.

Each 5819 must be shielded magnetically, since stray magnetic fields deflect the electron stream, producing great variations in gain. Mumetal shields are built into the multiplier phototube and reflector mounting. It is necessary to adjust the gain of each of the four multiplier phototubes separately, so that when they are used in parallel in the reflector system the light-to-dark ratio will be constant for all portions of the graph.

Deflection Circuits

The main components of the electrical system are the Y-deflection or feedback loop circuit, the Y-output circuit, and the X-deflection circuit.

The magnetic deflection circuit for the 5WP15 consists of a square laminated-iron yoke upon which are wound the vertical and horizontal deflection coils. For magnetic deflection symmetry, the yoke is constructed of I laminations lapped at the four corners. Instead of using short I laminations butt joined with the regular I laminations at the corners, it was found to be more satisfactory to use plastic filler strips.

For circuit simplicity two windings have been placed on each side of the square iron yoke. This allows a balance of two non-zero currents in the two windings to produce a zero magnetomotive force. For linear deflection it is essential that the two windings on each side of the square be very closely coupled. It is also desirable to have low capacitance from winding to winding. Two coils wound side by side or one atop the other have inadequate coupling, resulting in nonlinear deflection. Bifilar windings produce adequate coupling, but samples so wound had 0.028-μf capacitance between windings, which produced severe hunting in the Y-feedback loop.

A successful winding method is to assign the odd layers to one winding, and the even-numbered layers to the other winding. This results in 0.0004-μf capacitance which is about the maximum which can be tolerated. Each winding has 1,180 turns of number 32 Formex wire. Inter-layer insulation 0.001-inch thick is used.

Y-Deflection Circuit

Type 807 tubes were selected to control the deflection currents. They are connected in push-pull with one deflection winding between each cathode and ground, and one deflection winding between each plate and B plus. The windings are chosen so that the largest stray capacitances appear from one plate to the opposite cathode rather than plate to plate, and so that equal currents in the two 807 tubes result in no vertical deflection, spot centered vertically.

Cathode followers drive the two

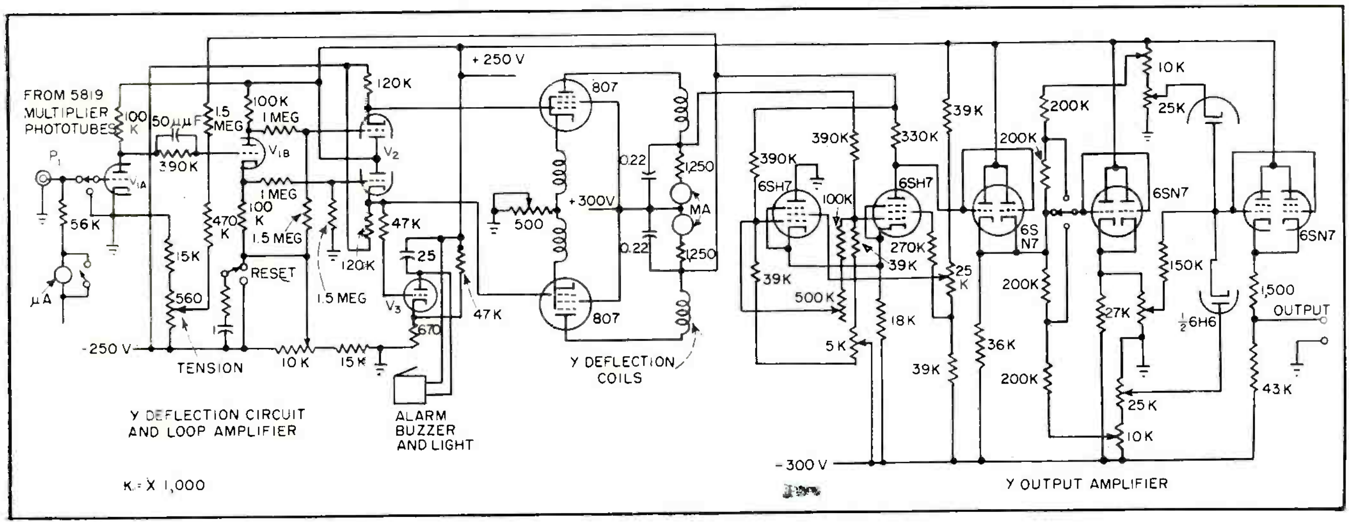

FIG. 2—Phototube transducers supply error signal to Y-feedback loop. Waveform taken from Y-deflection coils through output amplifier corresponds to desired function

807 grids as shown in Fig. 2, primarily to insure against excessive 807 tube currents during warmup, which occurred in some other d-c coupled circuits which allowed B plus to appear on the 807 grids if earlier stages were not conducting their normal plate currents. The cathode followers are preceded by a phase splitter of the split-load variety, with resistor networks connected to low potentials to obtain desired bias conditions on the cathode followers.

The phase splitter is preceded by a triode amplifier stage, which gets its grid signal from the common load resistor of the four 5819 multiplier phototubes.

One of the big problems in any closed-loop system is to maintain rapid response without endangering stability. In the present instance it should be noted that the maximum change in voltage fed back occurs with a vertical movement equal to the diameter of the spot as projected on the graph. Therefore, at frequencies for which the phase shift around the open loop approaches 180 degrees, the gain around the loop must be sufficiently attenuated so that the maximum voltage change produced by black to white movement of the spot produces considerably less than one spot diameter of deflection. Since the same amount of voltage change must produce considerably more than 7 inches deflection at zero and low frequencies, it is apparent that great attenuation is required at the frequencies where phase shift approaches 180 degrees.

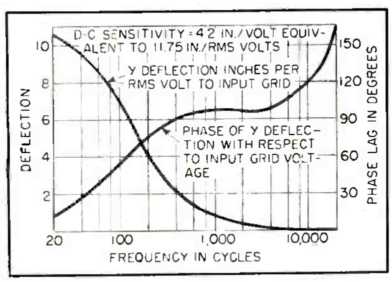

FIG. 3—Sensitivity and phase characteristics of Y-axis open loop deflection

Reactance Effects

The elements which produce the greatest phase shift effects are the deflection coil reactances. To maintain satisfactory stability conditions, it was advantageous to split the deflection coil windings so that two windings were between the cathodes of the 807 tubes and ground and the other two were in the plate circuits. The coil connections were arranged so that the large stray capacitances appeared from plate to opposite cathode rather than from plate to plate. Further advantage was gained in attenuating the every high frequencies by placing a copper cylinder over the cathode-ray tube neck inside the deflection yoke.

The effect of these expedients to reduce deflection sensitivity at high frequencies to achieve stability is apparent at a few hundred cycles, but speed of response is still adequate to meet the specifications.

Open-loop deflection sensitivity and phase characteristics are shown in Fig. 3. Phase was determined by observing multiplier phototube output versus sinusoidal Y-input, using a graph whose upper half was black, and whose lower half was white.

The Y-loop amplifier shown in Fig. 2 also contains an alarm circuit to sound a buzzer in case the spot should escape the graph line and come to rest below the graph area. A switch and capacitor are also provided, so arranged that pressing and releasing the switch, momentarily changes one of the 807 grid potentials, lifting the spot to the top of the graph area and allowing it to settle down on the graph line.

Due to the deflection coil reactances, there is no point in the Y-loop circuit which inherently has a voltage corresponding to Y-position of the spot under dynamic conditions. The current through the deflection coils does indicate Y-position correctly, and it is therefore necessary to insert a network which will develop a voltage proportional to this current from d-c to above 100 cycles. The two 1,250-ohm resistors and 0.22-μf capacitors in the 807 plate circuits fulfill this requirement.

The push-pull voltage across these two R-C combinations is a good representation of vertical spot position, but either voltage taken alone has even-order harmonic components. It is therefore necessary to use a circuit which combines

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push-pull inputs to furnish a single-ended output. This is accomplished by using one of the push-pull inputs as a grid-to-ground drive and the other input as a cathode-to-ground drive on a single pentode. The circuit is shown in Fig. 2. The remainder of the circuit shown provides the cathode followers, gain switch, limiters, and attenuator which are employed to permit convenient output polarity and sensitivity adjustment.

X-Deflection Circuit

The X-deflection coils are identical to the Y-deflection coils, and are supplied current from a pair of 807 tubes as shown in Fig. 4. Cathode followers are used to supply grid drive to avoid positive grid voltages during warmup and also to prevent drift by providing a low-impedance grid circuit for the tubes. The cathode followers are preceded by a split-load phase splitter, an input cathode follower, and switches and resistance networks to accommodate the specified kinds of input signals, and for calibration.

Unlike the Y-loop amplifier, the X-amplifier must provide deflection currents in phase with the input voltage from d-c through 100 cycles. Phase-shift effects from the X-input to the 807 grids, due to stray capacitance, are compensated for by the capacitor C_1, and in the 807 tube circuits C_2 is connected cathode to cathode to compensate for deflection coil reactances, thus permitting the deflection currents to be in phase with the input and 807 grid voltages.

The large X-input voltage available permits large amounts of degeneration in each stage of the X-amplifier, thus permitting very stable operation.

Curves for deflection amplitude and phase are shown in Fig. 5. Phase observations were made by deflecting the beam sinusoidally in the X-direction, crossing a centered vertical line on the graph. The X-input voltage was applied to the horizontal deflection plates of a laboratory d-c oscilloscope, and the output of the multiplier phototubes was applied to the vertical plates of the same oscilloscope. The Y-loop circuit was not otherwise connected.

At frequencies high enough to produce phase shift between input voltage and X-beam deflection, two separate pips occur as the beam crosses the vertical white line, and phase shift can be readily calculated from the pip displacement.

It is significant to point out that successful operation is not limited to single-valued functions. There are many multivalued functions which may satisfactorily be reproduced by the machine. The criteria which determines which branch of the function is traversed from the singular point is determined by the method of breaking the curve at the singular point.

A double-valued curve describing the letter A is shown in the photograph. If the singular point, junction point of the horizontal bar of the A with the inverted V, on the right is broken slightly on the top, the branch describing the inverted V will be traversed as the independent variable increases from the extreme left to right, and the branch describing the vertical bar will be traversed as the independent variable decreases from right to left.

If, on the other hand, the continuity of the graph had been slightly broken at the singular point on the left the writing procedure would be reversed. By this process one may readily see the many possibilities for handling multivalued functions should their necessity arise in the solution of a problem.

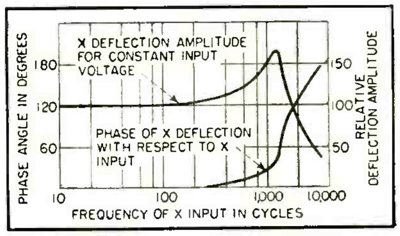

FIG. 5—Amplitude and phase of X-axis deflection as functions of input frequency

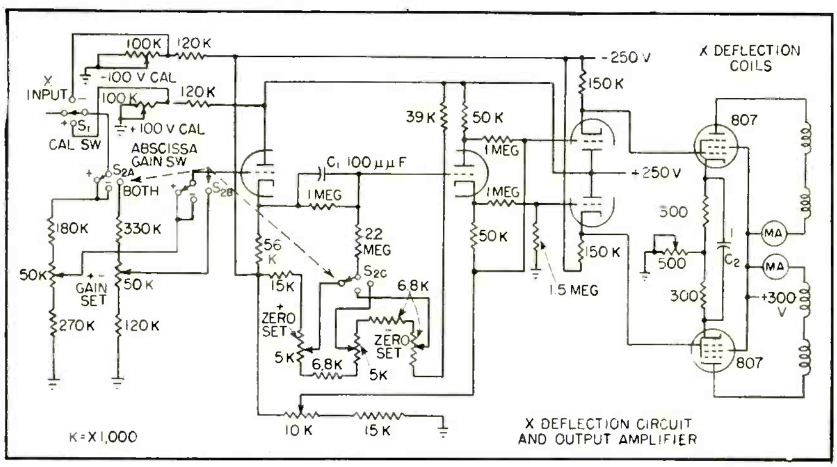

FIG. 4—Circuit for X-axis deflection must provide currents in phase with input voltage

Acknowledgments

The authors acknowledge the following individuals who made major contributions to the development, design and construction of the final unit.

Credit is due: to H. T. Betz, E. L. Perrine, and members of the optics section of Armour Research Foundation for their contributions to the development and design of the optical system; to J. H. Wray for contributions to the mechanical layout and design; to J. N. Van Scoyoc for development and design of circuitry in the output amplifier, and to H. Deptolla, L. A. Lembach, P. D. Padva, E. F. Bishop, and M. Markarian for their contributions to the construction, assembly, and testing of various electrical components.

The authors appreciate the cooperation and many fine suggestions of the members of the Armament Laboratory of the Air Development Force, Wright-Patterson Air Force Base, who sponsored this work.

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Computer-Recorder for Ratio Measurements

Multivibrators and modified commercial recorder measure and record ratio between recurrent rates of pulses from two sources. Simplified version of system may be used to record ratio between any two phenomena, such as two d-c voltages

By A. A. GERLACH and D. H. PICKENS
Armour Research Foundation
Illinois Institute of Technology
Chicago, Illinois

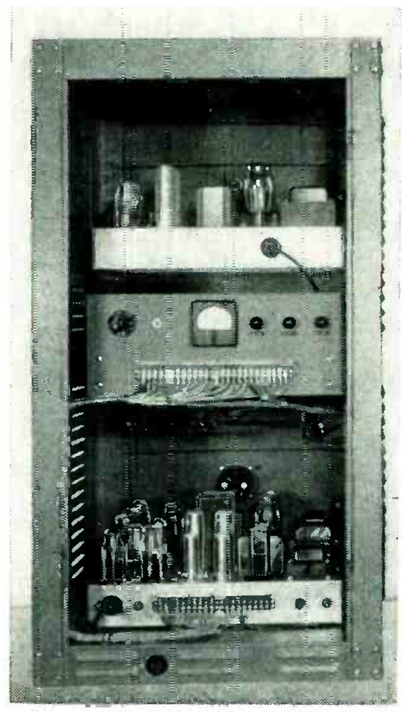
PULSED SYSTEMS have proved to be exceptionally versatile tools for instrumentation of count-rate phenomena. In many cases the desired information is contained in a galaxy of similar phenomena which occur at random or according to some well-established distribution characteristic. The major problem in most cases is the recovery of the desired information from the intelligence that is supplied to the decoding equipment. In many cases this will involve correlation between two or more inputs to the decoding instrument.

The equipment shown in the photograph was designed to accept inputs from two sources of pulse rate intelligence where the desired information is the ratio between the recurrent rates of the two sources.

Principle of Operation

The basic idea of the ratio computer and recorder is illustrated in Fig. 1. The computer has two separate inputs providing voltages which are a function of the average pulse count, x and y, of the two inputs. These inputs are caused to trigger two monostable multivibrators which produce a fixed rectangular output for each input pulse in the respective channels. These rectangular pulses are then time averaged through filter networks to produce an output voltage proportional to x in the one case and $-y$ in the other.

A certain fraction h/l of the x voltage is combined in a summing circuit with the negative y voltage to feed a closed-cycle servo system which seeks a zero input to the servo amplifier by means of the ratio potentiometer. Under equilibrium conditions then it is seen that the fraction, h/l will be proportional to the ratio y/x. The servo motor is coupled to the pen drive of the recorder so that this ratio is continuously plotted on a moving graph paper with time acting as the independent variable. In this way the ratio of the recurrent rates of two independent count phenomena may be plotted as a function of time, or possibly of a third variable with time acting as a parameter.



Rear view of ratio computer and power supply. Top shelf contains test generator

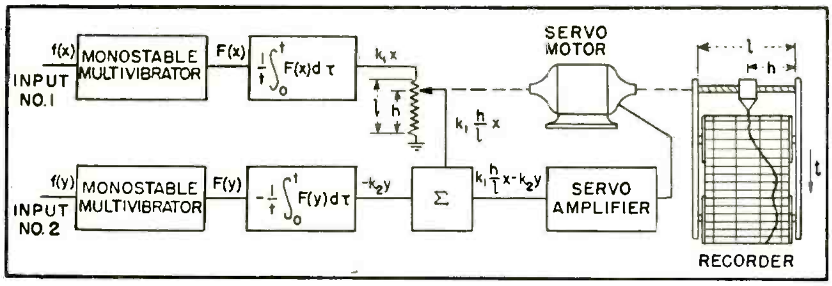


FIG. 1—Block diagram shows setup for determining ratio between recurrent rates of pulses from two different sources

In the proposed application the motor-driven potentiometer was assumed to be linear, thus creating a linear ordinate for the recorder. For a more general application this need not be the case. In a broader sense the input to the servo amplifier (Fig. 1) will be

$$k_1 \frac{R}{R_o} x - k_2 y \quad (1)$$

where R_o is the total resistance of

the ratio potentiometer and R is the resistance between the center arm of the potentiometer and ground. The ratio h/l will depend upon the method of winding the potentiometer. Since the servo amplifier seeks a zero input then

$$R(h) = R_o \frac{k_2}{k_1} \frac{y}{x} \qquad (2)$$

The ordinate scale of the graph may be distorted in any manner desired by winding the potentiometer properly. As an example of this consider a potentiometer which is square-law wound so that the resistance R is proportional to the square of the distance h. In this case Eq. 2 reduces to

$$h/l = \sqrt{\frac{k_2 y}{k_1 x}} \qquad (3)$$

By the proper choice of the constants k_1 and k_2 the system may be made to perform satisfactorily for ratios of y/x greater than unity. It may be seen from the diagram that the potentiometer output can never exceed the value $k_1 x$. Therefore, the ratio k_2/k_1 must be such that $k_2 y$ never exceeds $k_1 x$. When the maximum value of y/x is known this is a simple matter of choice of circuit parameters.

For greater flexibility, where there may exist a wide range of values for y/x, a simple switch arrangement may be incorporated to change the ratio k_2/k_1 in steps of 10 or 20 db; the ratio k_2/k_1 behaving merely as a constant multiplier on the ordinate scale of the graph.

The object of the ratio computer and recorder is to accept two recurrent pulse inputs, to process and compute the ratio of their recurrent rates, and to record this information as a function of time. The equipment was designed to handle recurrent rates from ten to ten thousand pulses per minute, where the maximum recurrent ratios never exceed ten to one. To handle this wide range of input variation and still maintain a high degree of accuracy the circuitry has been designed to provide this range in three steps by employing a range selector switch. The details of the circuitry are illustrated in Fig. 2.

Circuitry

Referring to Fig. 2, the x input and the y input enter on two identical channels. These inputs may be in the form of random positive pulses of sufficient amplitude to trigger off the monostable multivibrators consisting of both halves of V_1 and V_7. The purpose of the differentiator and rectifier in the input networks is to limit the width of the input pulses so that they do not influence the output in any way.

The output of the multipliers is a 550-volt pulse of width depending on the particular range of input pulse recurrent frequencies. For input pulse recurrent frequencies of 10 to 100 ppm, 100 to 1,000 ppm, and 1,000 to 10,000 ppm, the output pulse widths in the x channel are 12, 1.2, and 0.12 milliseconds respectively. The choice of pulse widths is such as to allow only two percent dead time for the maximum pulse recurrent frequency in a given range. The pulse widths in the y channel are one tenth as long as the respective pulse widths in the x channel. In this way the y pulse recurrent frequency may exceed the x pulse recurrent frequency by as much as ten times without the averaged y output exceeding the averaged x output.

The outputs of the monostable multivibrators are fed into cathode followers (V_2 and V_8) which act as buffer stages to isolate the multivibrators from their respective time averaging circuits. These tubes are normally cut off and conduct only during the pulse time of the multivibrators. The time-averaging circuits consist of a simple low-pass R-C filter whose time constant is just sufficient to reduce the discrete undulations to a tolerable level. The time constants of these filters are switched according to the range of input pulse recurrent frequencies to allow as rapid a response as possible without excessive undulation.

The x output is coupled through the cathode follower V_3 to the driven potentiometer P_4 which is an integral part of the servo-recorder. Tube V_6 acts as a ballast to balance out the quiescent voltage of V_3. The output from potentiometer P_4 and the y output from V_5 are fed into the cathode followers V_4 and V_7

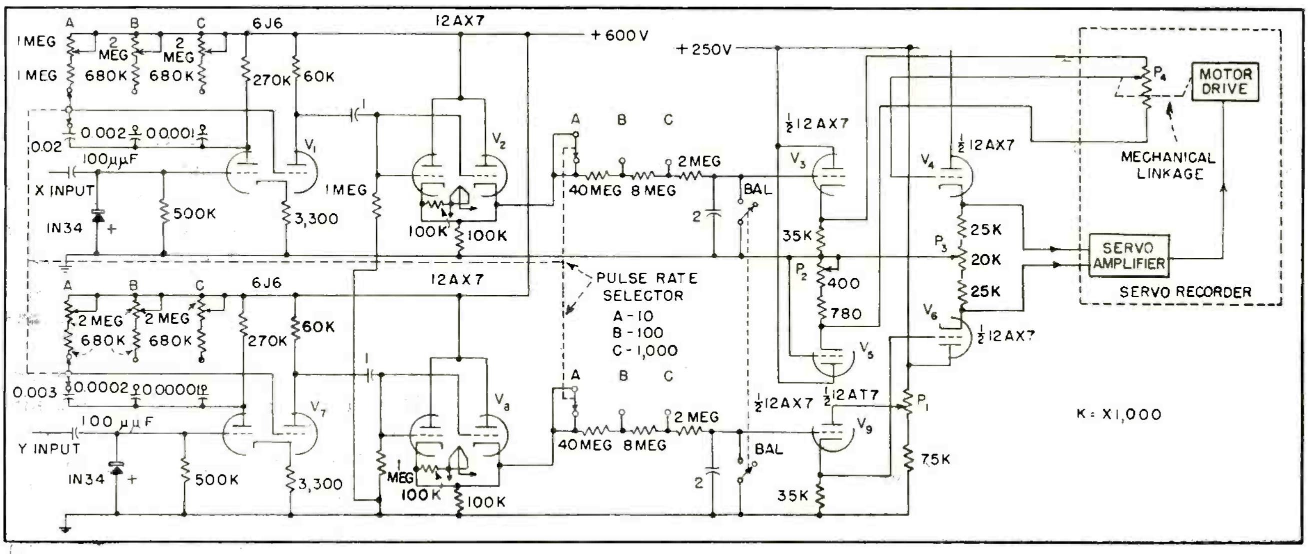


FIG. 2—Ratios between pulse rates from ten to ten thousand per minute are determined in three ranges. Note unconventional use of recorder

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whose output is directly connected to the null-seeking amplifier of the servo recorder. In this way the center arm of P_4 is automatically adjusted to provide the ratio of the y output to the x output as explained in the preceding section.

The completed ratio computer with its associated power supply is shown in the photograph. The only operating control, other than the on-off switch, is the pulse recurrent frequency range switch which is located on the front panel. Initial balance controls which may be set prior to operation of the equipment are located at the rear of the unit. There are three initial balancing controls, two of which equalize the quiescent voltage at the cathodes of V_3, V_6, and V_9 (Fig. 2), through the settings of P_1 and P_2. The third balance control is to zero the input to the servo amplifier by means of potentiometer P_3. A pushbutton switch is provided to discharge the nonpolarizing filter capacitors C_1 and C_2 prior to the balancing operations.

Recorder

The choice of recorders to be used as a part of the ratio computer is somewhat arbitrary since many companies manufacture a servo-type recorder. The only requirements are the time of response and amplifier sensitivity as dictated by the system on which it is to be used. In this particular computer a modified Brown Electronik Strip Chart Recorder was used. The recorder was stripped of all standard fixtures except the chart drive mechanism, the servo amplifier, and the pen gear and drive system.

The potentiometer used was a 50,000-ohm, ten-turn Helipot with a resistance tolerance of 5 percent and a linearity tolerance of 0.5 percent.

No definite procedure for adapting the recorder to the computer can be given since it is dependent upon the number of teeth on the pen drive bull gear, the amount of pen deflection required, and the number of turns of the potentiometer for full-scale movement of the pen.

The potentiometer was mounted in the recorder with a gear drive from the pen drive bull gear such that the potentiometer shaft was given its full ten turns for full scale movement of the pen. As in the case of most recorders no standard gears could be used and it was necessary to make the gears. In making the gears it is important that as much backlash and overtravel be eliminated as possible since these mechanical inaccuracies add to the overall error of the computer. With reasonable preciseness in the machine operations, gears of suitable tolerances were made without any special machining required.

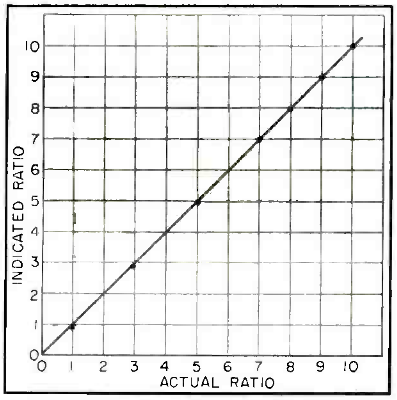

FIG. 3—Performance of ratio computer is illustrated by close adherence of ideal straight line and actual measured points

The remaining adjustment that is necessary is to adjust the gain of the servo amplifier to be compatible with the levels at which the computer will operate. The amplifier is provided with a screwdriver gain adjustment. At the maximum gain setting only 8 microvolts input to the amplifier is required for full-scale movement of the pen. On systems of the type with which this computer is used, this degree of sensitivity cannot be tolerated. If the voltage across the potentiometer is of such a magnitude that the voltage across the individual convolutions is sufficient to drive the pen full scale the recorder will oscillate between the individual convolutions of the multiturn potentiometer. For this reason it is necessary to decrease the gain of the amplifier to the point where no such oscillations occur.

Another reason for reducing the gain of the amplifier is so that no stage of the amplifier will saturate with the maximum input signal. As may be expected, reduction of the gain below the point of oscillation will place the signal required for saturation above that required for full-scale pen movement.

Performance Tests

The ratio computer was subjected to many laboratory tests for accuracy, stability, and degree of resolution. Throughout the entire test procedure the response of the circuits was found to be linear to a degree which was smaller than the expected error in laboratory measurements. With constant input pulse rates it was found that no visible variation in the indicated ratio occurred over a period of six hours. Figure 3 is a curve showing the computing characteristics of the ratio computer wherein the overall accuracy of the computer may be established. Analysis of this curve will reveal that maximum error occurs at the lower portion of the range and is of the order of 1 percent of full scale while the error in the remaining portion of the scale is better than 1 percent absolute.

Although the equipment described was intended for a particular telemetering application the performance may be modified in many ways by suitable changes in the circuit parameters. For example by eliminating the pulse-generating and averaging circuits the equipment may be used directly to record the ratio between two electrical voltages.

In all cases, however, the one restriction which the equipment is subject to is that the ratio can never exceed a certain prefixed value. Although this maximum ratio may be made as large as desirable it will be better to keep this value as low as possible since the absolute accuracy of the equipment will be proportional to this ratio. For improved accuracies at the lower ratios it is recommended that a switch (manual or automatic) be employed to change the scale of the recorder as the ratio decreases.

This work was performed under contract with the United States Department of the Air Force.

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Tube Comparison Chart

Rapid evaluation of similar types is provided by three-coordinate graph. Compares preferred and representative tube types in terms of plate resistance, transconductance and amplification factor

By J. R. HECK

Electronics Engineer
Westinghouse Electric Corp.
Baltimore, Maryland

ENGINEERS working with radio or television equipment are faced frequently with the problem of identifying the tubes used in electronic equipment. For some it will be enough to know that it is a triode or pentode or that it is an amplifier or a converter. This information may be found in published classification charts or in tube lists furnished by the manufacturers.

If it is necessary to compare the characteristics of two tubes, or to find a tube that differs from another in a particular way the job becomes harder.

Since one of the major vacuum-tube characteristics is the product of the other two, values of all three may be shown on straight lines by using log-log graph paper for the presentation. On the final form of the chart equal values of transconductance are horizontal. Equal values of plate resistance are shown in a vertical line and equal values of amplification factor fall on a slanted line.

Since each direction has a very specific meaning it is easy to compare two tube types by locating them on the charts. For example, a person familiar with a type 12AU7 may become interested in a 12BH7 tube. It is known to be similar, but not exactly like the older type tube. The published data on the two types makes them difficult to compare since one manufacturer omits plate resistance in one type and amplification factor in the other.

When the tubes are located on the chart, however, the comparison is immediately evident. The tubes have equal amplification factors since they are located on a sloping line of the chart. The 12BH7 has a higher transconductance and a lower plate resistance. These same facts are more difficult to grasp from a list of the characteristic values.

Instead of comparing two known types it is often necessary to locate for a given application a tube similar to one in use except to have a higher or lower value of one of the characteristics. By examination of the chart it is at once evident what tubes are available in the direction of the specific requirement.

For example, a tube is required similar to a 12AU7 except it must have a higher transconductance. On the chart we quickly find a 6J6 with practically the same plate resistance, but with a transconductance twice as high.

The types shown are located by published typical operating characteristics for Class A or Class A1 operation. On some types where widely separated points are given for different voltages or currents these points are connected by a line extended from the tube identification.

It is impossible to show all the possible variations of each tube since they vary widely with plate voltage and bias changes. At plate current cutoff every tube has zero transconductance. Three examples are given in Fig. 1 showing the way in which the characteristics of these typical tubes vary. The limits of Fig. 1 are the same as the main body of the chart. This shows the large variations of characteristics caused by voltage changes.

(Continued on page 150)

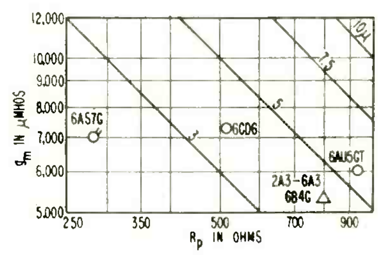

FIG. 1—Some typical tube types compared under varying conditions

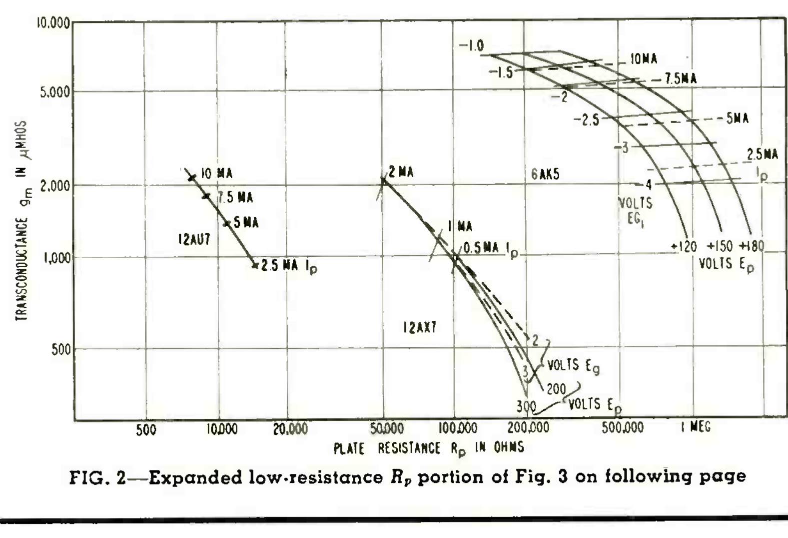

FIG. 2—Expanded low-resistance R_p portion of Fig. 3 on following page

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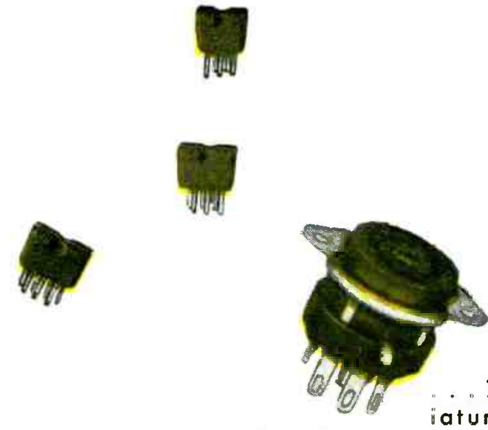
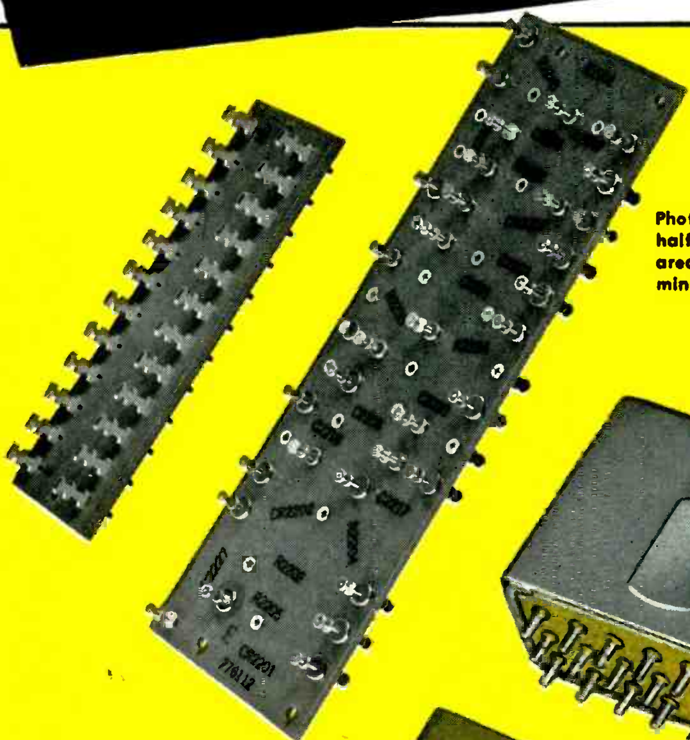
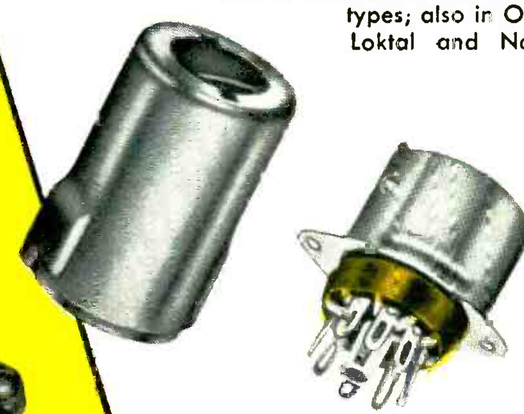


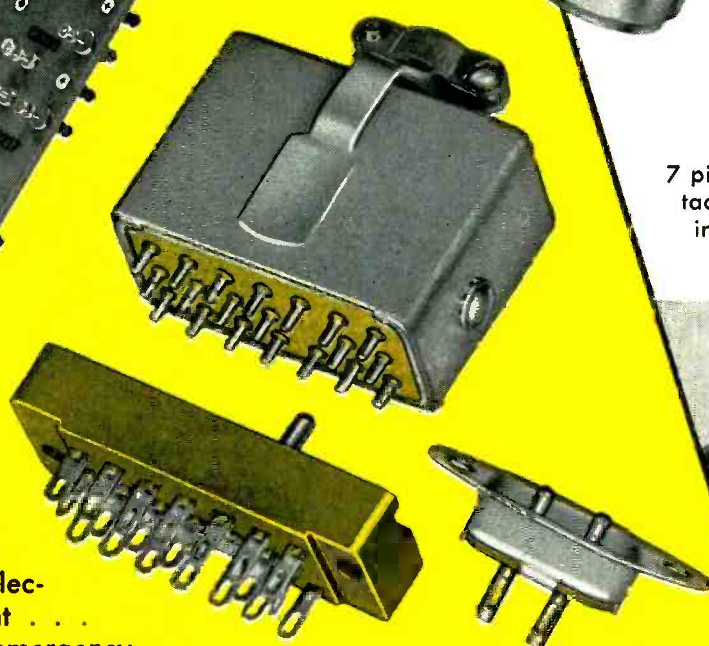
... 7 pin miniature Cinch-Erie *Plexicon* tube socket, available in commercial and military types; also in Octal, Loktal and Noval.



Photographs are one-half size, one-fourth area of original terminal boards.



Noval, and 7 pin miniature, molded socket attached base type, also available in chassis clinch and saddle type.



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Tube Comparison Chart (Continued)

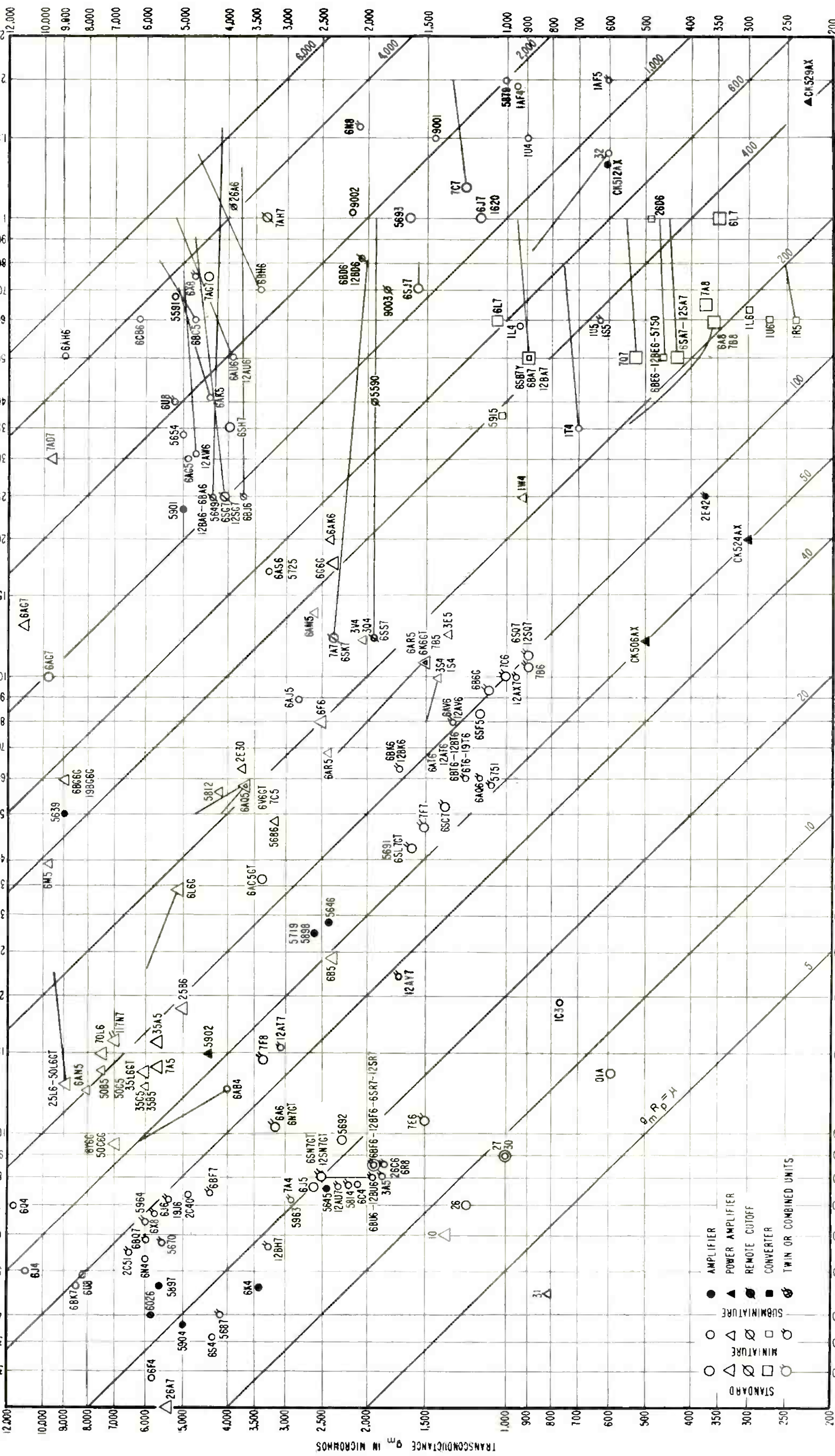

FIG. 3—Receiving tubes are compared according to three parameters under representative operating conditions

Tube Comparison Chart

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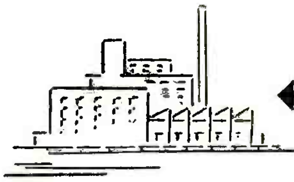

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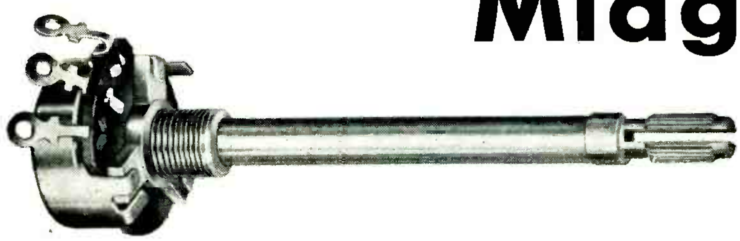

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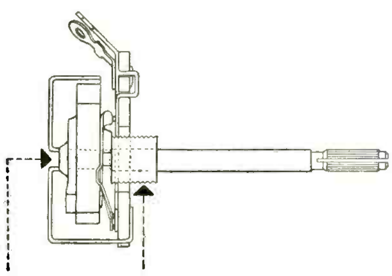

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ELECTRONS AT WORK

Including INDUSTRIAL CONTROL

Edited by RONALD K. JURGEN

OTHER DEPARTMENTS featured in this issue:

Decimal-Counter Electron Tube

BY D. L. HOLLWAY

Commonwealth Scientific and Industrial Research Organization
Sydney, Australia

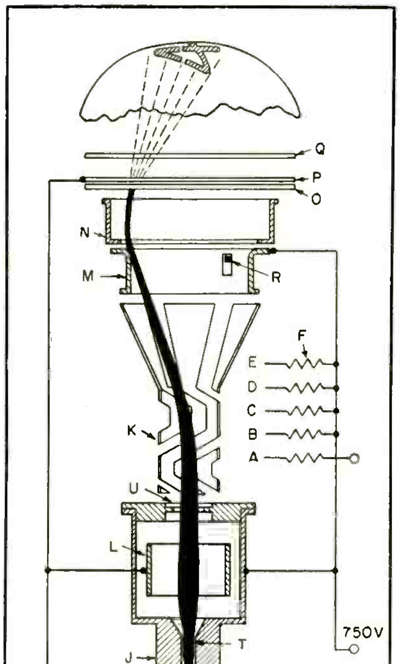


FIG. 1—Cross-sectional view of the electrodes of the scale-of-ten counter. Resistors connected to the collector plates A to E of Fig. 2 (F), grid (G), cathode (H), anode (J), five deflectors (K), focusing electrode (L), positive ring (M), trigger (N), front collector plates (O), suppressor (P), back collector plates (Q) and carry-over electrode (R)

A SCALE-OF-TEN COUNTER electron tube has been developed in which incoming signals are counted by triggering a single electron beam through a closed sequence of ten pairs of stable states.

In the complete counter tube, shown in Fig. 1, two sets of collector plates are used. The front group *O* is phased, with respect to the deflectors, for clockwise rotation and the back group *Q* is phased for reverse rotation. Ten pairs of radial slots are cut in the front collectors as shown in Fig. 2 so that the beam, wherever it falls on the front system, will move clockwise until part of the spot overlaps the radial leading edge of the slot and passes through to the back collectors.

The beam moves outward until it is partially intercepted by the inside of the tubular electrode *M*, Fig. 1, the positive ring which is connected to the final anode. Further movement reduces the current reaching the collectors so that the magnitude of the beam deflection is stabilized at the inside radius of the ring. The radial position is controlled only by the trigger electrode *N*, a short cylinder which receives the signals to be counted.

When a positive-going signal reaches the trigger, the spot moves

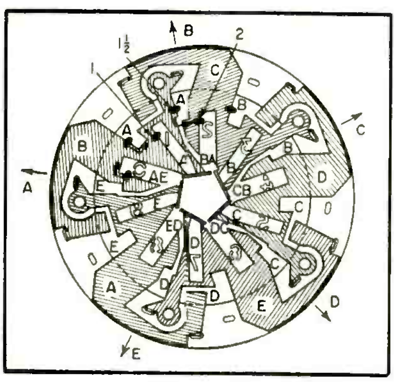
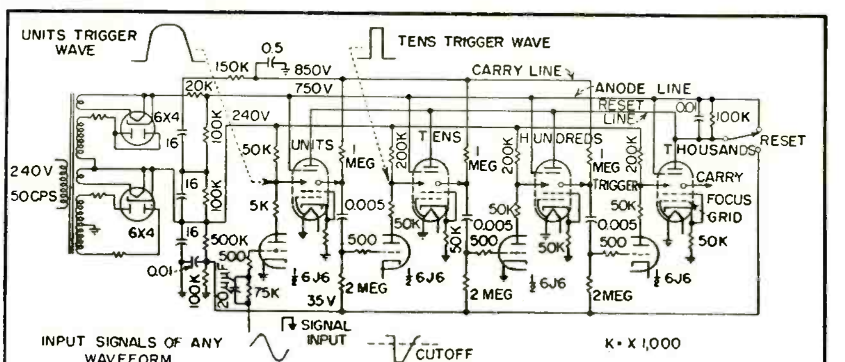


FIG. 2—Front collector plates showing the stable positions of the beam



Circuit diagram and check-point waveforms of a complete counter having four scale-of-ten stages

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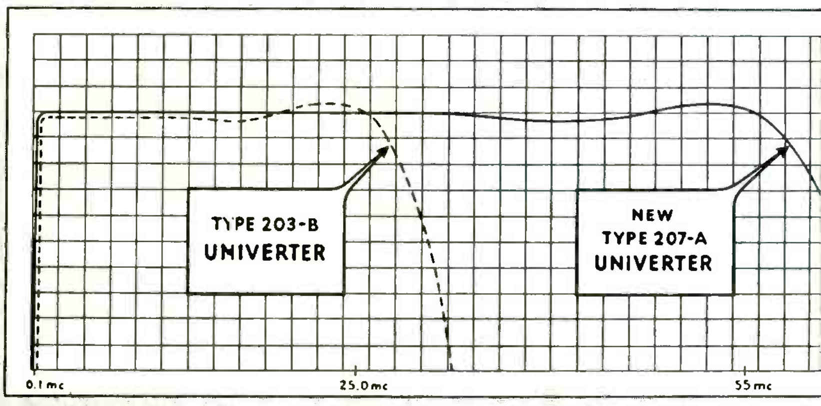

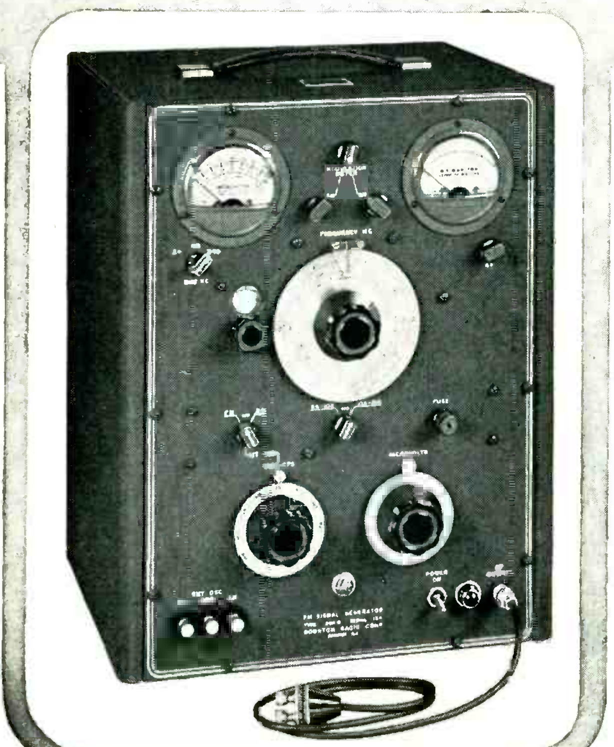

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- Univerter 207-A extends frequency range down to 0.1 mc. without change in signal level or modulation characteristics below.

SPECIFICATIONS:

RF RANGES: 54-108, 108-216 mc.
FREQUENCY DEVIATION: 0-24 kc., 0-80 kc., 0-240 kc.
FM DISTORTION: Less than 2% at 75 kc. deviation.
AMPLITUDE MODULATION: Continuously variable 0-50%.
RF OUTPUT VOLTAGE: 0.1 microvolt to 0.2 volt.

PRICE $975.00 F. O. B. BOONTON, N. J.

UNIVERTER

TYPE 207-A

The Univerter Type 207-A provides a continuous extention of the frequency range of the 202-B FM-AM Signal Generator down to 0.1 mc. The two instruments may be used over a continuous frequency range of 0.1 mc. to 216 mc. The Univerter Type 207-A subtracts 150 mc. from a signal obtained from the 202-B and provides outputs between 0.1 mc. and 55 mc. without change of signal level. Negligible spurious signals are introduced and modulation of the signal is unaffected. Small incremental changes can be made in frequency to allow the study of band pass characteristics of very narrow band receivers. A regulated power supply prevents change of gain or frequency with line voltage.

SPECIFICATIONS (*When used with 202-B*)

FREQUENCY RANGE: 0.1 mc. to 55 mc. (0.3 mc. to 55 mc. with 200 kc. carrier deviation).
FREQUENCY INCREMENT DIAL: Plus or minus 300 kc. calibrated in 5 kc. increments.
FREQUENCY RESPONSE: Flat within ±1 db over frequency range.
FREQUENCY ADJUST: Front panel control allows calibration with 202-B output.
OUTPUT: Continuously variable, at XI jack from 0.1 microvolt to 0.1 volt across 53 ohms by use of 202-B attenuator.
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No appreciable AM distortion at carrier levels below 0.05 volt and modulation of 50%.
SPURIOUS RF OUTPUT: At least 30 db down at input levels less than 0.05 volts.

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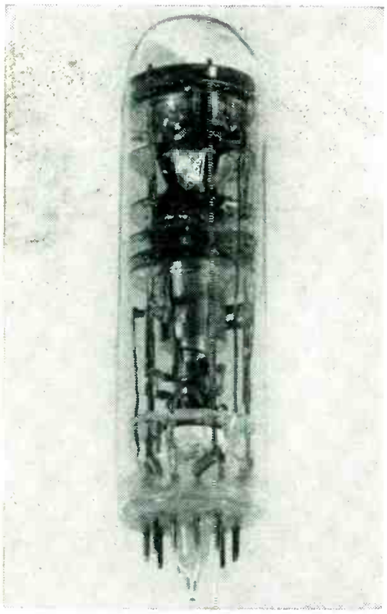

FIG. 3—Scale-of-ten counter tube. The tube is approximately four-in. long and 1 3/16 in. in diameter

FIG. 4—Four-tube counter at the count of 9351. The projected figures are half-an-inch high

radially outward from the position 1 until the outer edge of the slot is reached. Beyond this point, the anticlockwise restraint is reduced and the spot goes clockwise to the 1½ opening which is stable for this and higher trigger potentials. When the trigger signal drops, the spot moves from the inside edge of the 1½ position to 2. The beam makes one rotation for each group of inputs.

Input Signals

Because the intermediate states are stable, the input signals may be of any duration and amplitude above the minimum values needed to register a count. At the beginning of the tenth signal, the beam moves into the 9½ position where the positive ring current is transferred to the carry electrode *R*, Fig. 1, producing a negative-going pulse at the grid of a coupling triode and increasing the total stored in the following counter by one unit.

The openings in the suppressor *P*, Fig. 1, are shaped so that at the outer positions, the transmitted beam remains in focus but the inner openings are formed so as to diverge the beam sufficiently to cover areas of the back collector in which the figures 0 to 9 are cut, corresponding to the count positions. Electrons passing through the number openings continue to diverge and project the number image, enlarged eight times, on the fluorescent end of the bulb.

A scale-of-ten counter is shown in Fig. 3. The circuit diagram of a complete four-stage counter, 0 to 9,999, is shown at the beginning of this article.

In the circuit diagram four of the five collector resistances in each tube are connected to the anode line and the remainder, those connected to the 0 to 1 plates, are held at the same potential by the normally closed contacts of the reset push button. The value of the self-bias resistance in each cathode circuit is chosen to insure that some positive ring current flows at every stable position; the focusing electrode is connected to the cathode.

The coupling stages normally draw grid currents of 20 to 50 μamp through the grid resistances in order to suppress stray signals below a certain amplitude. The triode anodes are held below the lower changeover potential and the beams remain in count positions. When a negative-going signal is applied to the input terminals, the trigger of the units counter rises above the upper changeover point but cannot exceed the potential of the supply which is within the stable range of the intermediate stable positions.

Upon completion of the input signal, the trigger of the units counter falls, increasing the stored count by one unit. Because the radial and circumferential movements of the beam are independent, the speed at which the spot moves from one stable position to the next does not depend on the rate of change of trigger potential. Therefore, the carry pulse has a sharp wavefront and may be capacitively coupled to the following triode grid without setting a lower counting limit.

Reading

After the completion of a count the total is either read directly from the projected figures at the ends of the tubes, as shown in Fig. 4, or transmitted electrically as a combination of the collector potentials. When the reset pushbutton is pressed, the deflectors connected to the 0 to 1 collector in each tube are lowered in potential, moving all beams to the zero positions. The tubes may be used as a preset counter by interposing a ten-position switch between the five collector resistors and the anode and reset lines.

In this way, any even number may be set by reducing the potential of the appropriate deflector and any odd number by lowering an adjacent pair of deflectors. Carry-over pulses are often produced during resetting and these are suppressed by increasing, momentarily, the standing grid current of the triodes through a normally-open contact on the reset push button.

At present the highest counting frequency is in the region of 100 kc.

BBC Orchestral Studio

THE BRITISH Broadcasting Corporation recently modified one of its orchestral studios with a volume of 213,000 cubic feet to reproduce the natural acoustic setting of a concert hall.

The original studio was built inside a roller skating rink in 1934. BBC engineers decided that good tone and definition could be achieved in a hall only when the sound field was well diffused. They found that rectangular shapes were the most effective for reflecting the sound.

Appropriate reverberation time for the studio was found to be about

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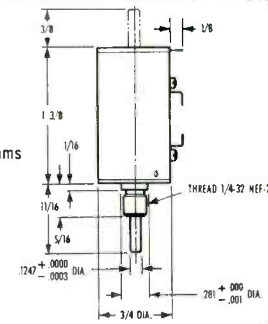
CONDENSED SPECIFICATIONS

Number of turns	10
Power rating	2 watts
Coil length	18″
Mechanical rotation	3600° + 12° − 0°
Electrical rotation	3600° + 12° − 0°
Resistance ranges	100 ohms to 50,000 ohms
Resistance tolerance	± 5.0%
Linearity tolerances:	
All values	± 5% (standard)
5000 ohms and above	± .1%
Below 5000 ohms	± .25%
Starting torque	0.75 oz. in.
Net weight	1.0 oz.



Miniaturization, weight reduction and circuit simplification are key design objectives in all airborne and many other electronics applications for precision potentiometers. Helipot's new Model AJ meets these needs with a compact potentiometer having over 12 times the resolution of conventional potentiometers of the same diameter . . .

- **SIZE AND WEIGHT: The AJ is only ¾″ in diameter (small as a penny)—1⅜″ long—weighs 1.0 oz. It requires only a minimum of valuable panel space!**
- **PRECISION, WITH CIRCUIT SIMPLICITY: On many applications the AJ replaces two conventional potentiometers, providing *both* wide range and fine adjustment in one unit. Its 18″ slide wire gives a resolution of 1/3000 in a 100 ohm unit—1/6550 in a 50,000 ohm unit!**
- **RELIABILITY: The AJ is rugged and simple, is built to close tolerances with careful quality control. Its performance and reliability reflect the usual high standards of Helipot quality!**

MANY IMPORTANT CONSTRUCTION FEATURES: If you have a potentiometer application requiring light weight, unusual compactness, high accuracy and resolution, be sure to get the complete information on AJ advantages . . .

Here is a "pot" with bearings at *each* end of the shaft to assure precise alignment and linearity at all times. In addition, each bearing is *dust-sealed* for long life and is mounted in a *one-piece* lid and bearing design for exact concentricity.

Either single or double shaft extensions can be provided to meet individual needs—also, special shaft lengths, flats, screwdriver slots, etc.

Tap connections can be provided at virtually *any* desired point on the resistance element by means of a unique Helipot welding technique which connects the terminal to only ONE turn of the resistance winding. This important Helipot development eliminates "shorted section" problems!

BUILT TO HELIPOT STANDARDS

Helipot—world's largest manufacturer of precision potentiometers—has built an enviable reputation for highest standards in all its products, and the Model AJ is no exception.

The resistance elements themselves are made of precision-drawn alloys, accurately wound by special machines on a copper core that assures rapid dissipation of heat.

Each coil is individually tested to rigid standards, then is permanently anchored in grooves that are precision-machined into the case. Slider contacts are of long-lived Paliney alloy for low contact resistance and low thermal e.m.f. . . . and precious-metal contact rings are used to minimize resistance and electrical noise. All terminals are silver plated and insulated from ground to pass 1,000 volt breakdown test.

LONG LIFE: Although Unusually compact, the AJ is built throughout for rugged service. Potentiometer life varies with each application, of course, depending upon speed of rotation, temperature, atmospheric dust, etc. But laboratory tests show that, under proper conditions, the AJ has a life expectancy in excess of one *million* cycles!

Helipot representatives in all major cities will gladly supply complete details on the AJ—or write direct!

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1.8 seconds, with the orchestra present. The most satisfactory reverberation frequency characteristic was found to be level up to about 3,000 cycles.

Any steep rise of reverberation time in the extreme bass was to be avoided because it would cause bass masking of the orchestra by the tympani.

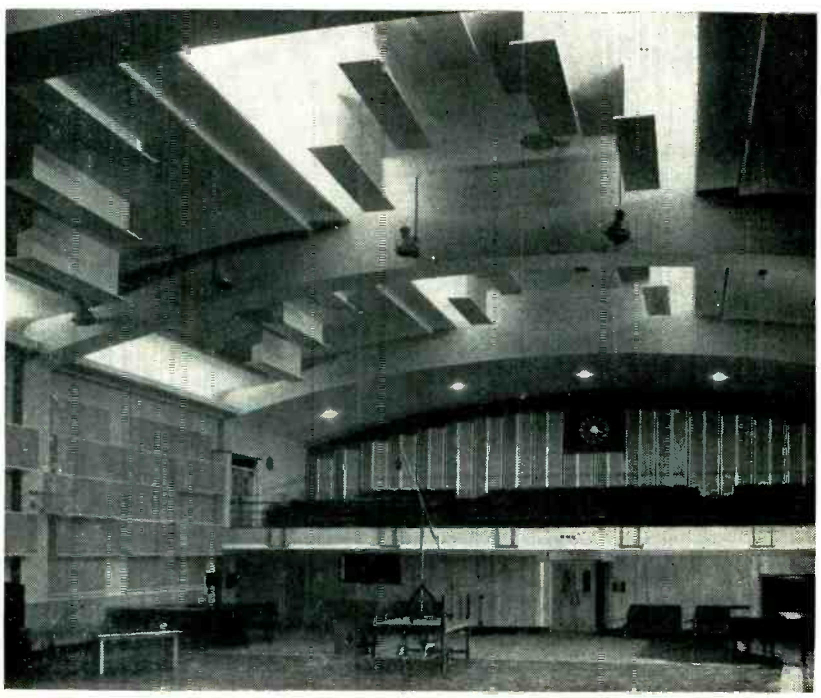
Final Construction

In the construction of the studio, roofing-felt membrane absorbers cover almost the whole area of the side walls and vary in depth from three to 18 inches. The absorbers reduce the reverberation time in the extreme bass. They also act as scattering elements at all frequencies above 90 cycles.

No absorbent materials were used on the ceiling but the highly reflective surface was broken up by introducing a large number of scattering elements consisting of flat rectangular plates supported on pedestals at distances varying between one and three feet from the ceiling.

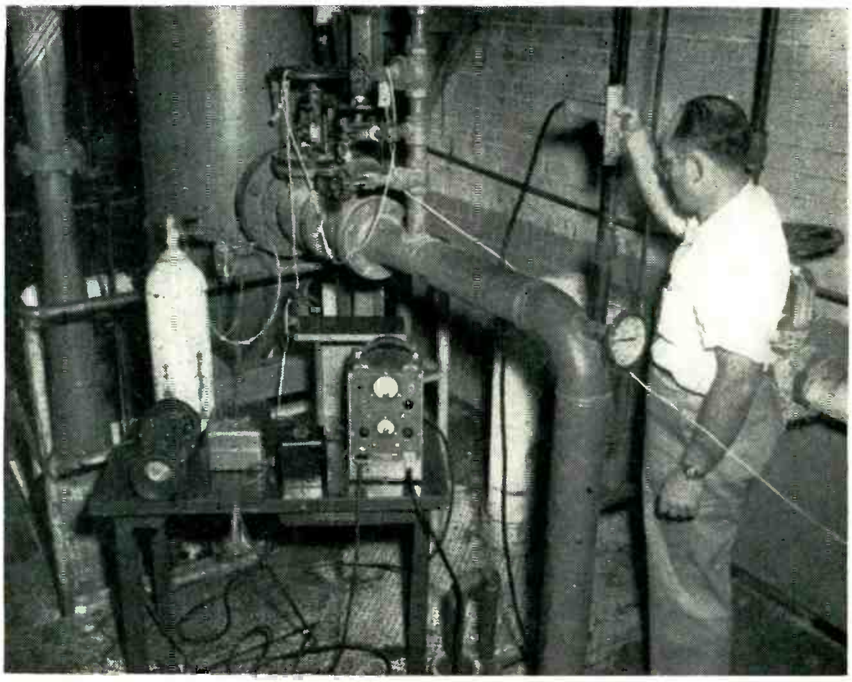
Composite absorbing units, making use of both porous and membrane absorption were installed in front of the rear end wall over the balcony. These units present a serrated wall form and prevent the sound from being reflected as a particularly strong echo.

To accommodate a choir, permanent seating was installed. The padded seats reduce the variation in reverberation time resulting from the occasional programming of a large chorus.



New BBC orchestral studio uses roofing-felt membrane absorbers

LEAK DETECTOR USES FREON



Operator is shown inserting a General-Electric leak detector in the exhaust pipe of a deodorization process in a food plant. Freon gas is sprayed over the system and a leak will suck the gas into the system and convey it to the detector. The detector records the leak (center) and sounds a horn (left). Position of the Freon sprayer determines the leak location

Power-Amplifier Klystron for Air Navigation

By VINCENT LEARNED
Engineering Department Head
Electronic Tubes
Sperry Gyroscope Co.
Great Neck, N. Y.

A POWER-AMPLIFIER TUBE, the SAL-39, has been developed for the 960 to 1,215-mc air navigation band which has power capabilities beyond those of the space-charge control triode and tetrode tubes. In this frequency range, the space-charge control tubes are rather small for high average-power applications, whereas klystrons are quite large in comparison.

Typical characteristics for the power-amplifier klystron are shown in Table 1. The tube is shown in the photograph. It is approximately 18-in. long and weighs about 30 pounds. Details of construction of the power-amplifier klystron are shown in Fig. 1.

A large oxide cathode focuses a beam through a gridded three-cavity interaction structure to a fin air-cooled collector structure. The output connector is a standard ⅞-in. coaxial line with input connector a BNC-type coaxial fitting. Each

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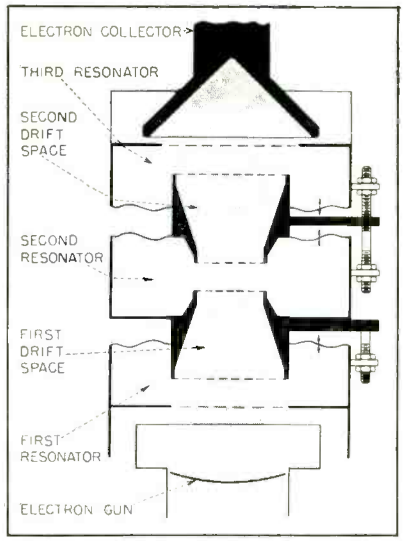


FIG. 1—Cross section of tube showing shape of cavities, drift tubes, gaps, cathode and beam

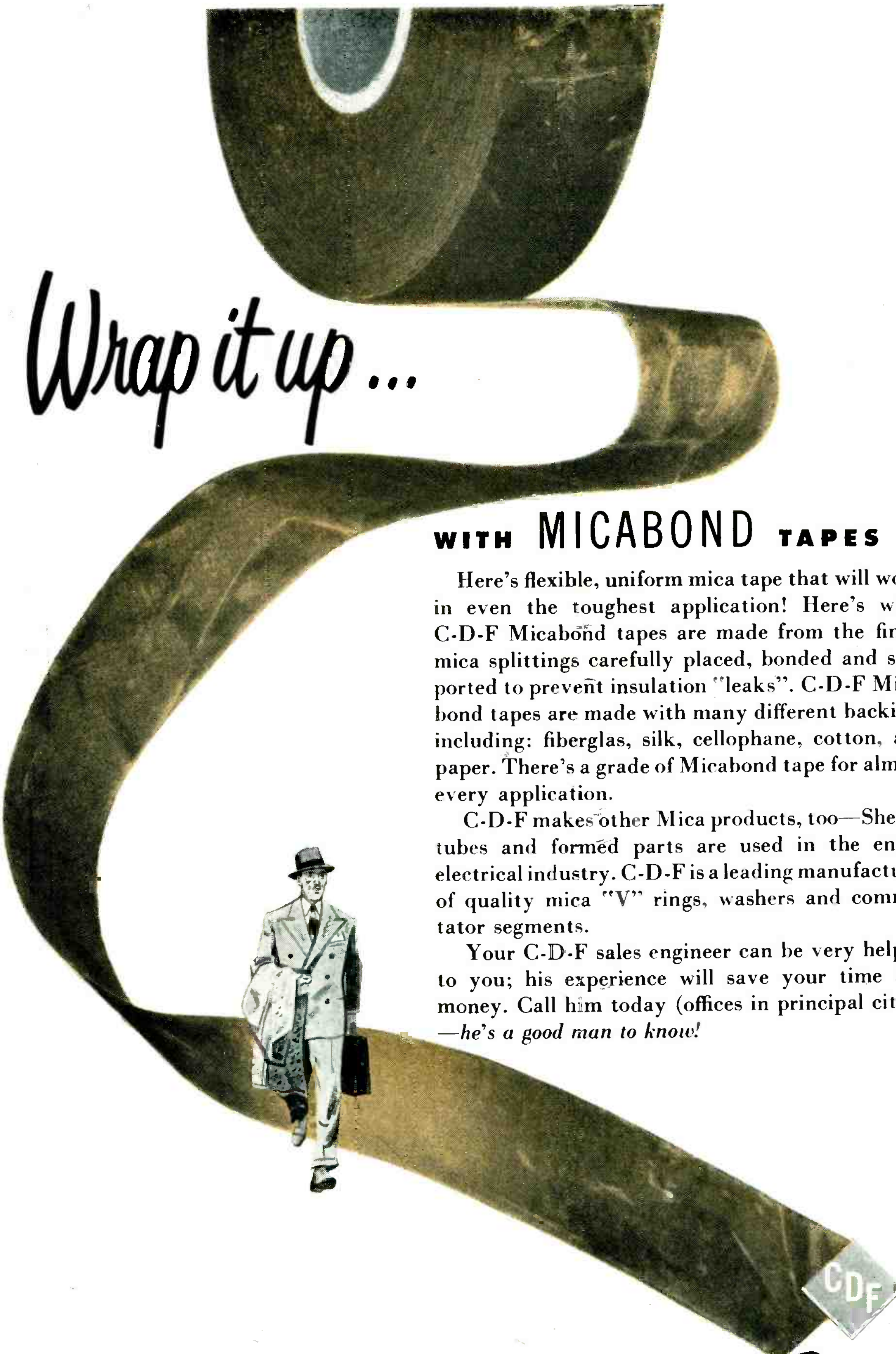
cavity is tuned by bolt and nut studs acting on a tuning ring which varies the gap spacing.

The electron gun produces a convergent beam which passes through the first interaction gap, converges to a minimum at the second interaction gap and expands again at the output gap and collector. The shape of the beam is dictated by the effect of space charge spreading forces.

The electron beam of uniform density and velocity becomes velocity modulated at the input gap by the voltage produced by the drive power. The electrons drift toward the middle cavity and are gradually density modulated. The a-c component of this current creates a larger voltage in the center cavity than originally introduced at the first cavity and further modulates the beam to a higher degree. Further density modulation develops in the last drift distance and maximum fundamental current is

Table I—Klystron Characteristics

Frequency range	960 to	1,215 mc
Beam voltage (peak)	20	12 kv
Pulse length	1 to 5	1 to 5 μsec
Duty cycle	0 to 1	5 percent
Beam current (peak)	8.5	4 amps
Heater voltage (ac or dc)	5.0	5.0 volts
Heater current	43	43 amps
Drive power	120	40 watts
Typical output power (peak)	25	10 kw



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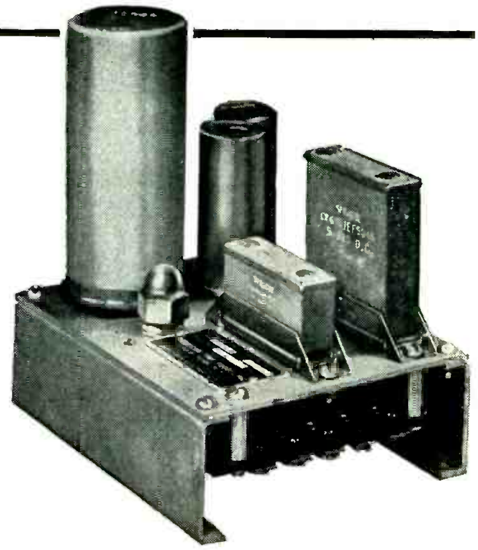

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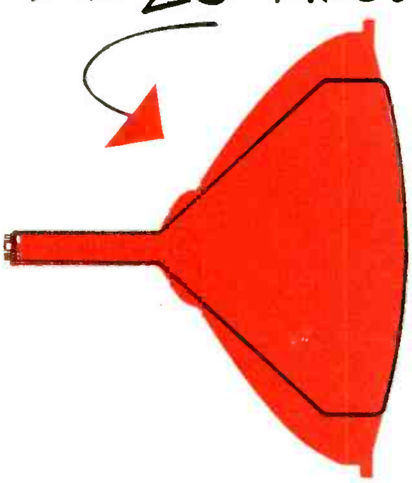
Actually shorter than 20" tube!



On March 3, Rauland unveiled the first "giant-screen" tube that makes attractive cabinetry possible.

This new 27" tube, with 390 square inch picture area, minimizes cabinet problems in two ways. First, it has the compactness of rectangular rather than round cone and face. Second, by means of 90° deflection, depth has actually been held slightly shorter than present 20" tubes!

The tube employs Rauland's usual "reflection-proof" filter glass face plate with maximum reflection of only 2½% of incident light. It uses the Rauland tilted offset gun with indicator ion trap. It is offered with either magnetic or low-focus-voltage electrostatic focus. Weight is held at minimum by use of a metal cone.

If you want a picture of really spectacular size that can be housed in acceptable furniture, here is your answer.

A picture actually more than 70 sq. in. larger than the center spread of a tabloid newspaper. Rectangular for minimum cabinet height and width. And actually permitting a small reduction in depth from today's 20" cabinets!

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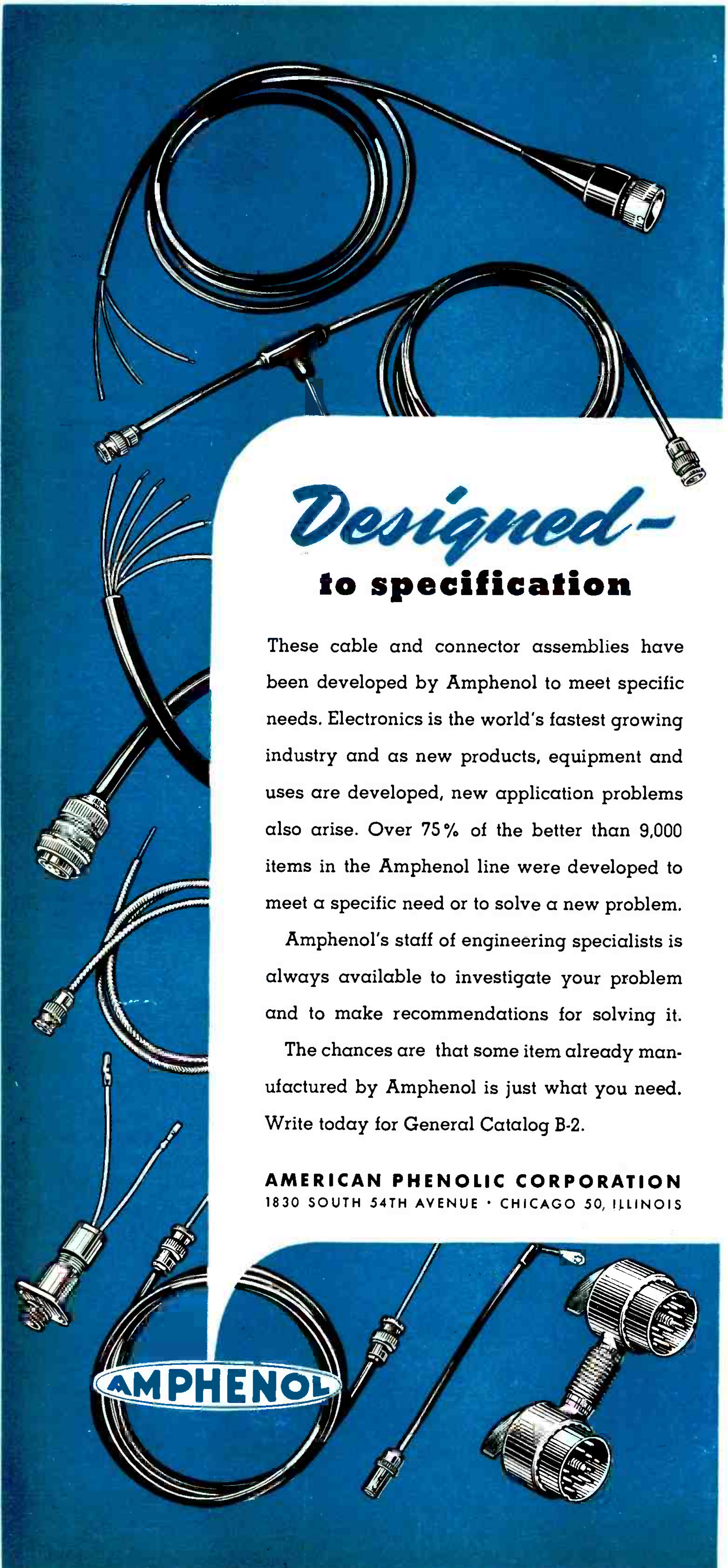

obtained at the output gap where the interaction develops useful power.

The cathode and beam dimensions are large for the power requirements involved so that conservative cathode densities are achieved. The grids are sufficiently large that no difficulty is encountered with grid overheating except at powers beyond the highest duty cycles.

In this tube structure, conventional gridded klystron construction techniques have been employed to

Pulse-amplifier klystron for the 1,000-mc navigation band

keep the weight to a minimum and construction as simple as possible. Careful attention has been given to thermal phenomenon to give adequate dissipation of heat without unduly affecting the frequency of the cavities.

The applications for which this tube was developed require essentially constant resonant frequency for the cavities over the range of zero to full power input. Mistuning would reduce the power output.

Heat paths have been sufficiently heavy to minimize the temperature differences between the klystron gap and the outer cooling surfaces and thus keep cavity mistuning small. The circuits are compensated for variations in body temperature caused by variable power and ambient changes.

The peak beam current obtained

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This starter switch for a refrigerator motor presents a tough assembly and inspection problem. The springs must be accurately bent and adjusted by hand—tolerances are close.

With the Kodak Contour Projector the whole operation—bending and checking—may be done at the same time and under the magnification that's most convenient.

Since the Kodak Contour Projector has provisions for surface illumination from the same lens that picks up the image, every detail of the switch is shown on the screen. A 45° mirror permits the part to be mounted flat for easy accessibility. Both to adjust the part and check tolerances, the operator simply compares the magnified image with a chart-gage laid on the bright screen.

Whether your interest is in large parts or small parts, simple parts or complex parts with many dimensions, a Kodak Contour Projector will do the job quickly, completely, and accurately. The operator can work in a lighted room unhampered by hoods or curtains. And little training is required to get the work out in a hurry.

For rapid, routine inspection and adjustment work, the economical, stripped-down Kodak Contour Projector, Model 3, will meet your requirements. For toolroom measurement, the versatile Model 2A is what you need. In your area there is an experienced field engineer who will be glad to discuss your own particular problems. You can get in touch with him by writing Eastman Kodak Company, Industrial Optical Sales Division, Rochester 4, N. Y.

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If you want to check precision spur and helical gears in action, write for information about Kodak Conju-Gage Instrumentation.

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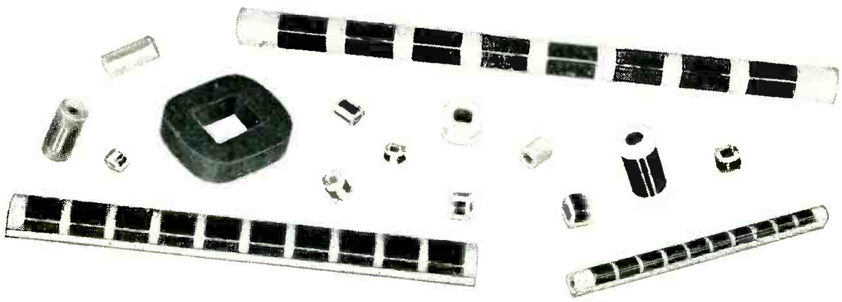

for winding *any* of these coils, accurately!

External Controls Reduce Set-Up Time and Speed Up Your Production

Do your winding schedules call for both long and short runs . . . for a wide variety of coil sizes?

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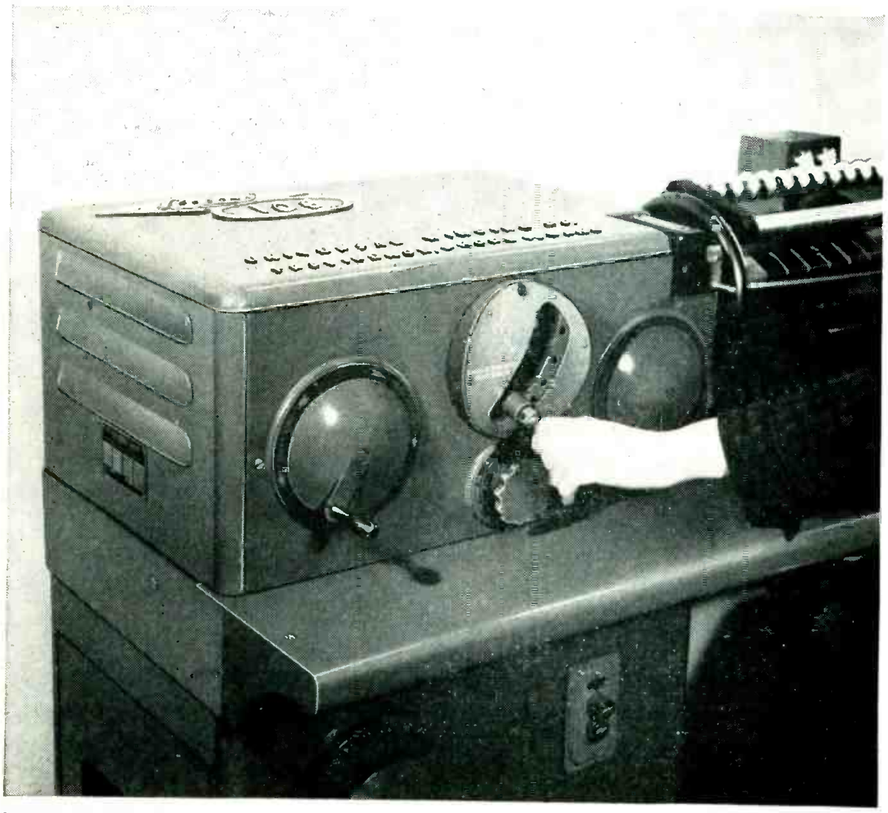
You get accurate coils, too . . . even with #44 wire. Leadscrew traverse and quick reversing clutch provide more positive control of wire layer and prevent crossed turns. Manual-feed paper shelf is adjustable up and down, in and out for more accurate insertion. Indicators help operators time paper feeding accurately even at high speeds.

Other new features speed up lead and tap preparation, marking and arbor transfer.

Bulletin 108-A describes all the ways this versatile Leesona No. 108 Coil Winder improves coil quality and increases production. Write for it today.



LEESONA NO. 108 COIL WINDER, award winner in the 11th Annual Product Design Competition sponsored by "Electrical Manufacturing," meets the demand for a modern manual paper feed machine for winding paper insulated coils in multiple or "stick" form. It winds coils from #20 to #44 (A.W.G.) in coil lengths from 1/4 in. to 3 5/8 in., in diameters, up to 5 in. round or square.

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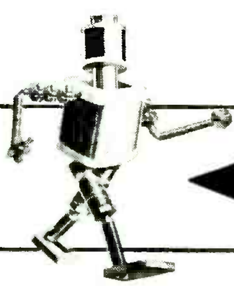

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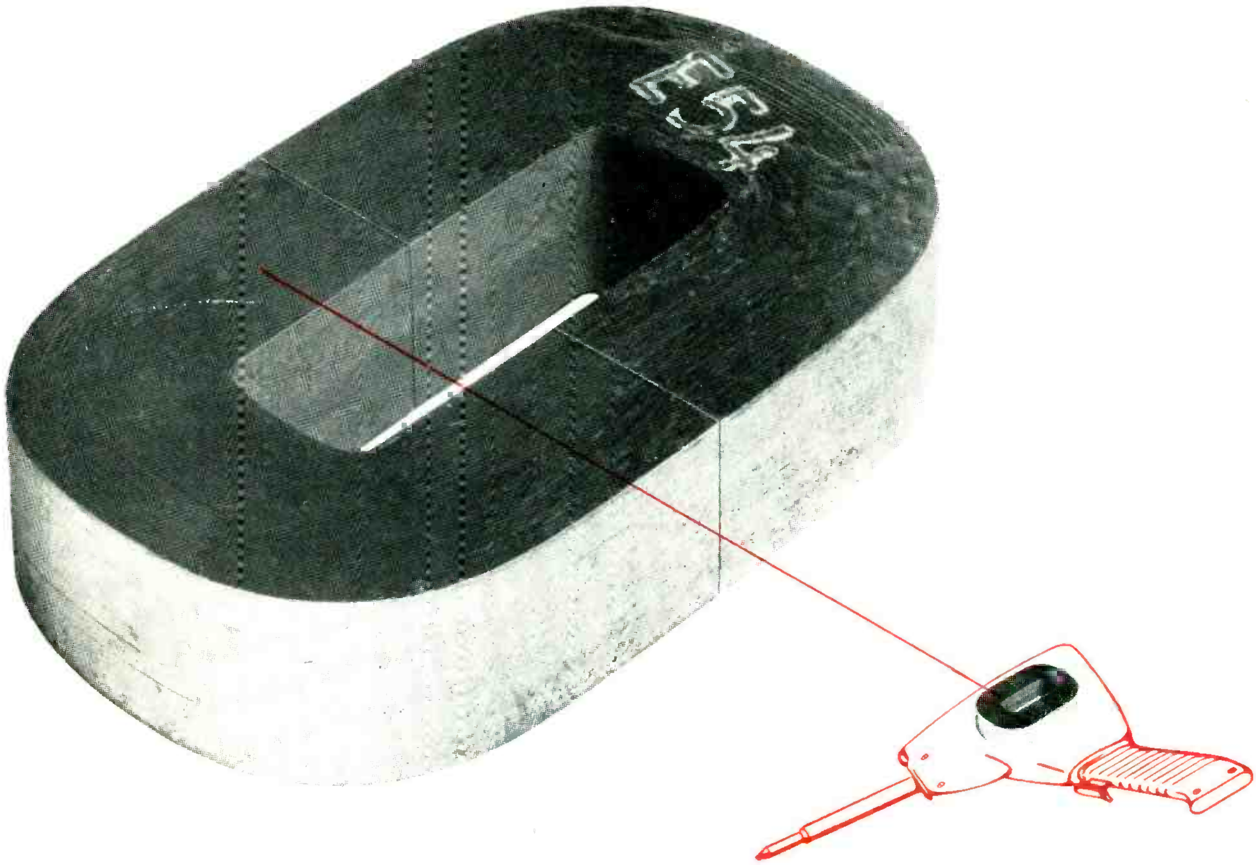

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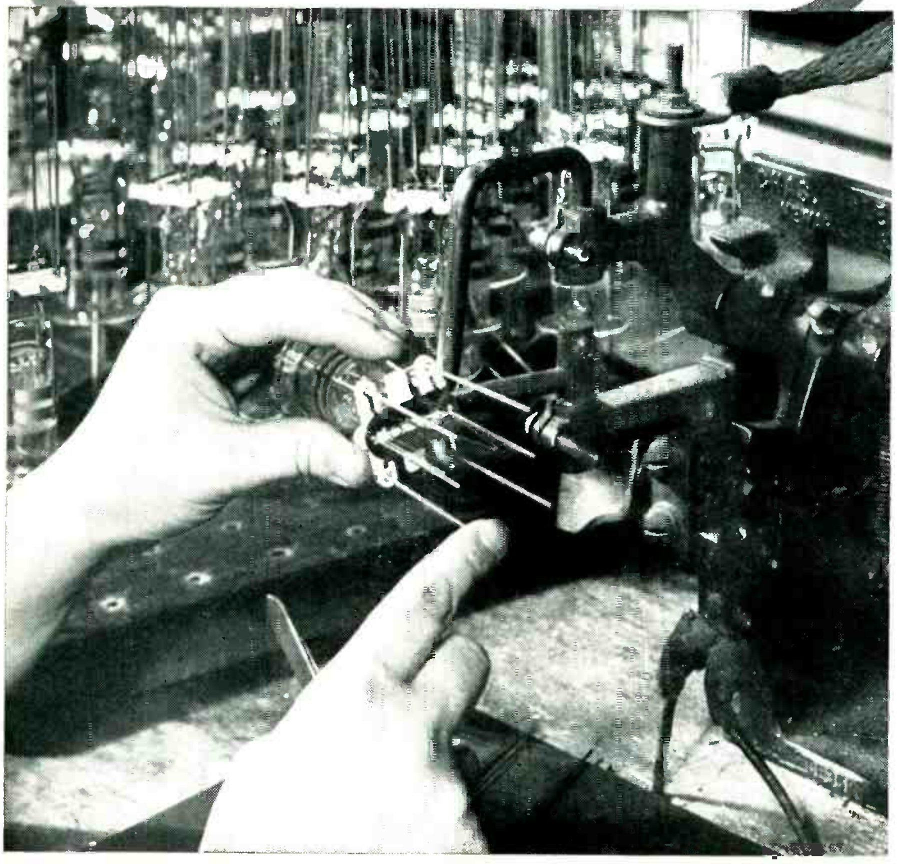

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as a function of beam voltage follows the usual three-halves power-law relation. At 10 kv, the beam current is three amperes, showing a micro-perveance of three. Since the beam current varies as the 3/2 law, the beam power varies as the 5/2-power law. The power output varies approximately as the cube-power law because the efficiency of the tube is improving slowly with beam voltage.

Full power output is obtained with the middle cavity tuned to the same frequency as the drive with only 10 watts of drive power. With the middle cavity tuned slightly to a higher frequency, 100 watts of drive power is required but the efficiency has been improved considerably.

Actual velocity modulation obtained is a mixture of modulation from the first and middle gaps, giving an improvement in bunching effectiveness which yields an overall beam efficiency of about 25 per cent. Useful gain of 20 to 30 db is achieved, depending on the operating conditions desired. Drive power is small enough to operate the tube conservatively from a disc-seal triode or tetrode operated as a frequency multiplier.

Radar Plotting Board Controls Air Traffic

IN-FLIGHT RADAR CONTROL furnished by the CAA's Skyatron at Washington National Airport constitutes the first large-scale application of military combat-information center techniques to civil air-traffic control.

Presently used only to control aircraft departures, the system has reduced lateral aircraft separation from 50 miles to four miles. Aeronautical details concerning application of the system to landing control are still being studied. It is anticipated that incoming planes will be stacked in motion for sequential approach with three minutes separation in contrast to the present practice of vertical stacking in holding patterns.

The radar control center is shown in Fig. 1. Planes entering the 70-mile terminal area are first detected

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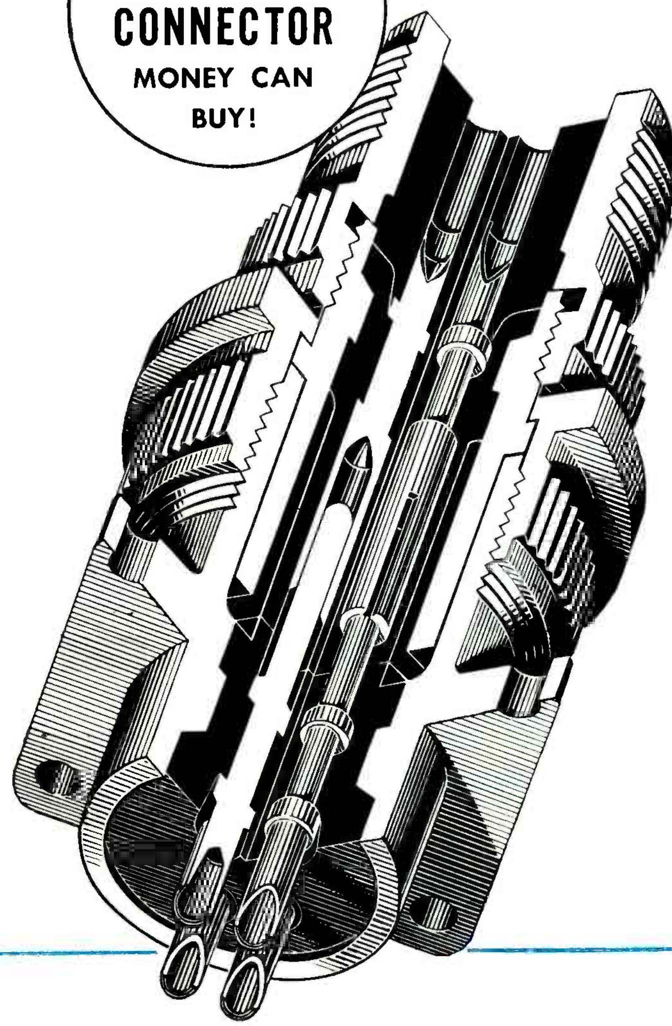

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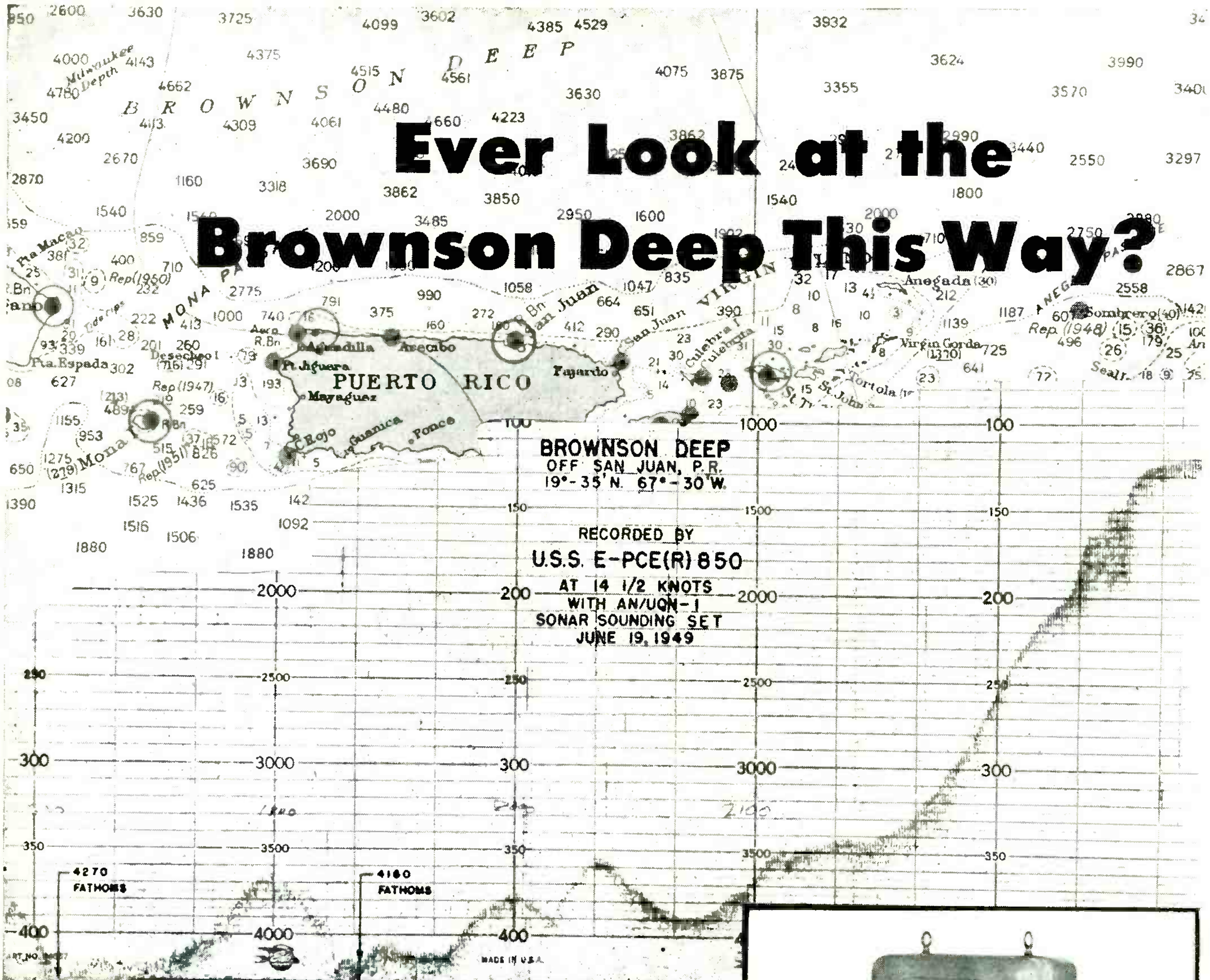
Ever Look at the Brownson Deep This Way?



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You may never have heard of it, but north of Puerto Rico lies the Brownson Deep, deepest part of the Atlantic, with its Milwaukee Depth 4780 fathoms down—more than 28,000 feet!

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Development of this new sonar equipment, with far greater range and accuracy than ever available before, makes possible the use anywhere of contour bottom readings for navigation and gives added safety for vessels operating in shallow water.

This is just one example of the leadership which Edo has displayed in applying electronics to the solution of many difficult problems in under water detection.

This is the Edo AN/UQN-1B depth sounder, designed and developed by Edo for the U. S Navy With a range of 6000 fathoms, it is the first practical depth sounder to give instantaneous, continuous readings at any depth

Only two and a half feet high, it is half the size and weight of previously used equipment. Depths up to 100 fathoms are indicated on a cathode ray tube for quick reference in shoal water Depths between 10′ and 6000 fathoms are recorded continuously on graph paper. (N.B. 4000 fathom graph illustrated used in earlier model.)

**Sound navigation and ranging*

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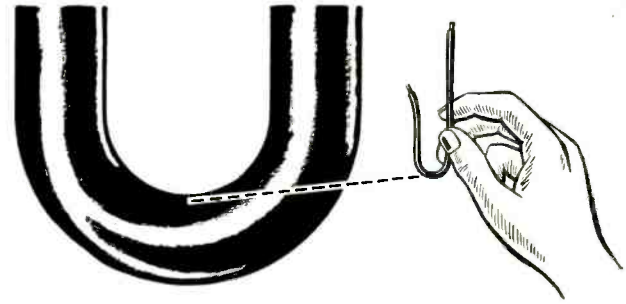
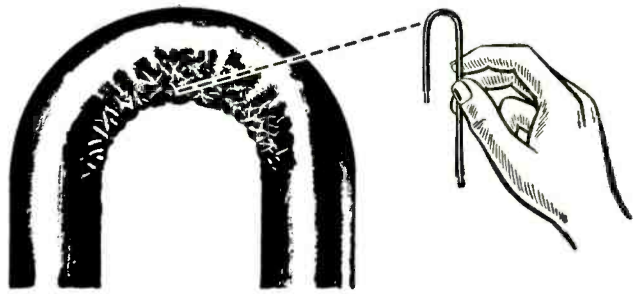


Insulating a bend?



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To simulate actual operating conditions, lengths of BH "649" Fiberglas Tubing, Grades A-1 and B-1, and Varnished Cotton-base Tubing, Grade A-1, were slipped over wires of the corresponding Awg size. The samples were bent to a "U" with an approximate ½" radius and then baked for 96 hours at 221°F. Visible failure occurred at the bend of the Varnished Tubing, none in the BH "649" samples.

Here is what happened when the samples were tested for dielectric strength:

	VARNISH COTTON-BASE TUBING A-1	BH "649" FIBERGLAS TUBING A-1	BH "649" FIBERGLAS TUBING B-1
AVERAGE ORIGINAL DIELECTRIC STRENGTH	12,200 volts	10,400 volts	6,200 volts
AVERAGE DIELECTRIC STRENGTH AFTER BEND TEST	1,000 volts	9,400 volts	5,200 volts

This is superior proof of only *one* BH "649" feature — there are many others — that's why you'll find BH "649" in equipment that must not fail, whether in appliances for consumer use or complicated electronic equipment.

BH "649" is permanently flexible. It will stand bending and mechanical abrasion without splitting, cracking or fraying. Resistance to oil, water and most chemicals is unusually high. Does not corrode metals. Age has no effect on its physical or dielectric properties. It will not ravel when cut — permanently rounded, it handles easily and speeds installation. Spreads to cover knobs, terminals and irregular objects.

BH "649" is only one of a family of electrical insulations, each designed to meet particular conditions in service. Give us a few facts about your requirements — product, temperatures, voltages — we will gladly furnish samples for testing purposes.

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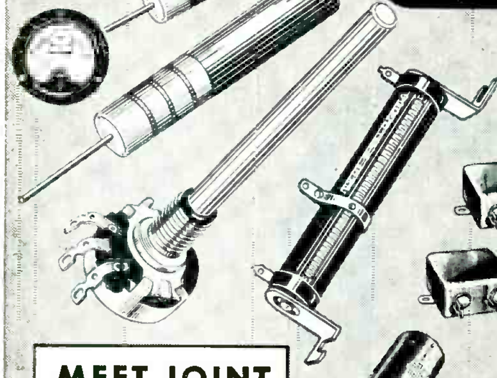

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FIG. 1—Air traffic control center showing aircraft plotted on Skyatron. Two sector-monitoring ppi scopes may be seen in background

on one of the four sector-monitoring ppi scopes. Planes within the 40-mile control area are represented by transparent markers plotted on the Skyatron as shown in the foreground.

The Skyatron is a Navy VG2 remote ppi of the type used in carrier cic rooms. A three-inch crt with deep-purple phosphor provides information which is displayed on the ground-glass plotting board using an optical system and 1,000-watt incandescent lamp.

The complete system incorporates two Skyatrons, one of which receives its video from a microwave early-warning radar set. The other,

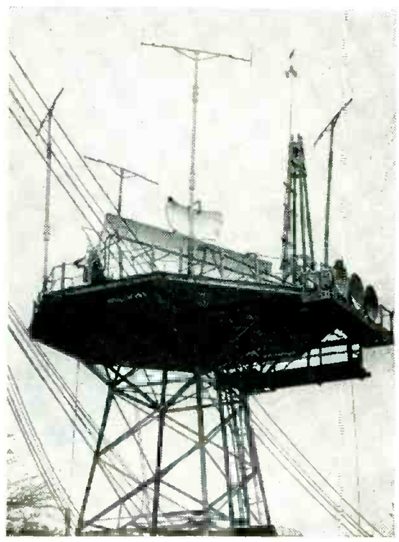

FIG. 2—Microwave early-warning radar antenna system includes high and low-beam antennas mounted back-to-back

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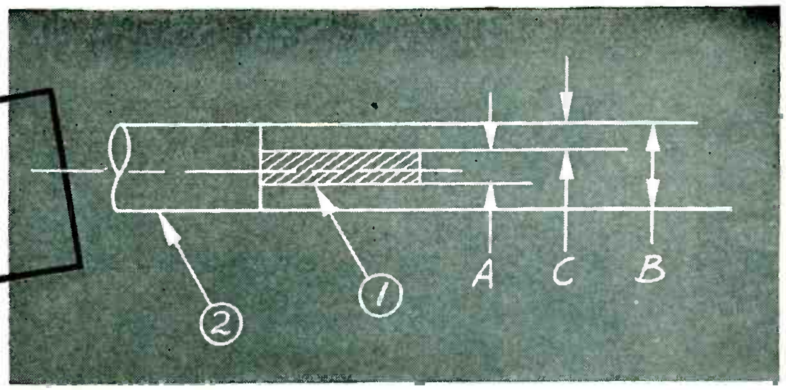

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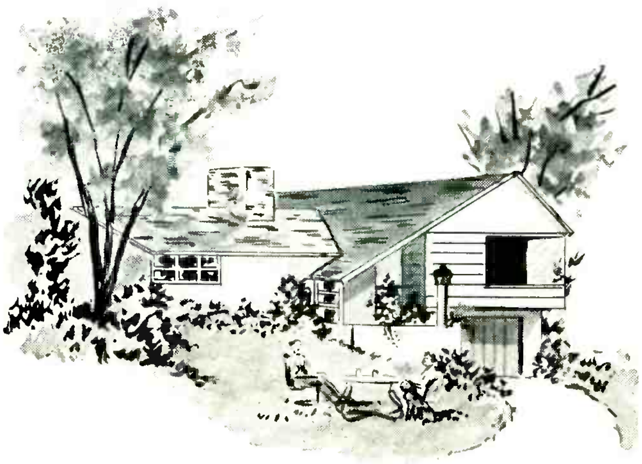

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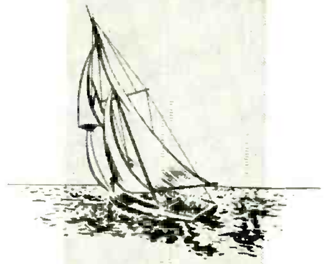

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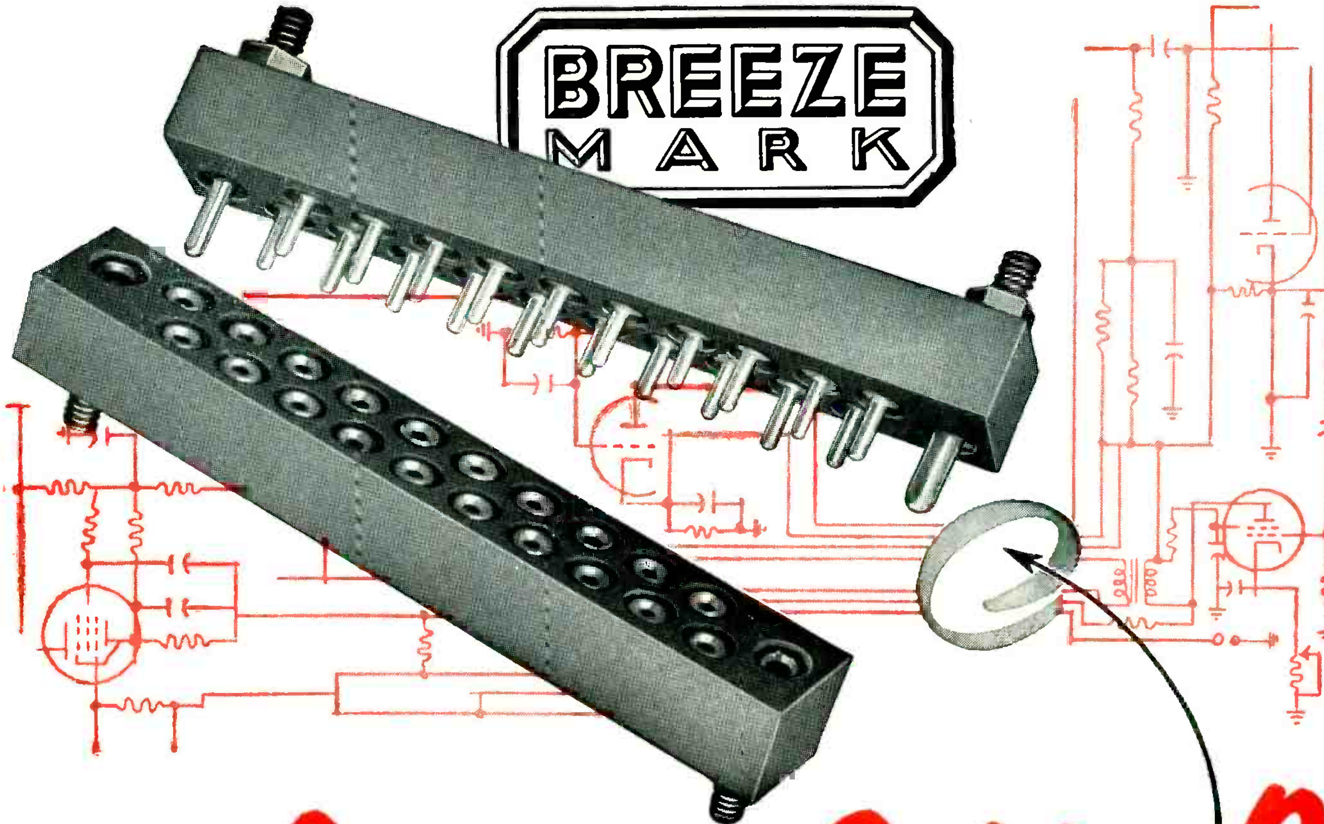

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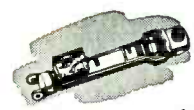
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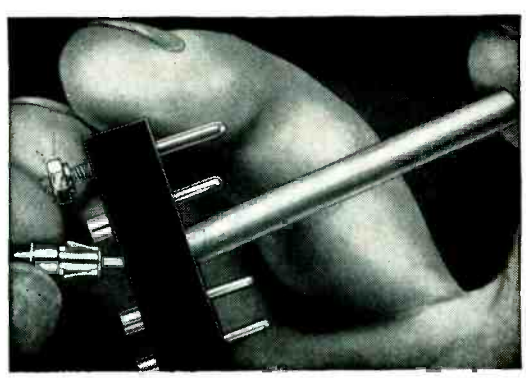
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FIG. 3—Airport surveillance radar provides a standby source of video for radar control system

a standby, receives its video from the airport surveillance radar.

The sector-monitoring consoles are components of the equipment. Thirty, 50 and 70-mile ranges are provided and the ppi trace may be set off-center to permit full sector coverage. An aeronautical chart is electronically superimposed on the ppi presentation. The sector-monitoring controllor may communicate directly with any aircraft in his sector using one of ten vhf aircraft working frequencies available. A neon bulb glows on the panel to the right of the console indicating which channel is in use.

The antenna shown in Fig. 2 consists of high-beam and low-beam cylindrical paraboloid antennas mounted back-to-back. The antenna of an S-band transponder beacon for identification of suitably equipped aircraft is mounted above the low-beam blade.

The antennas are driven by separate 4J35 magnetrons and hydrogen-thyratron modulators mounted on the tower near the feed points. The equipment operates on 2,700 to 2,900 mc with a peak pulse power of 600 kw. The equipment transmits a 1-μsec pulse at a pulse repetition rate of 900 pps.

The receiver incorporates a moving-target indicator to reduce ground clutter on low beam. High and low-beam ppi's are located at the transmitting site for monitoring. Video is supplied to the radar

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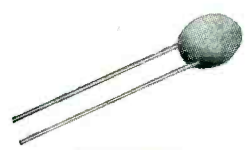

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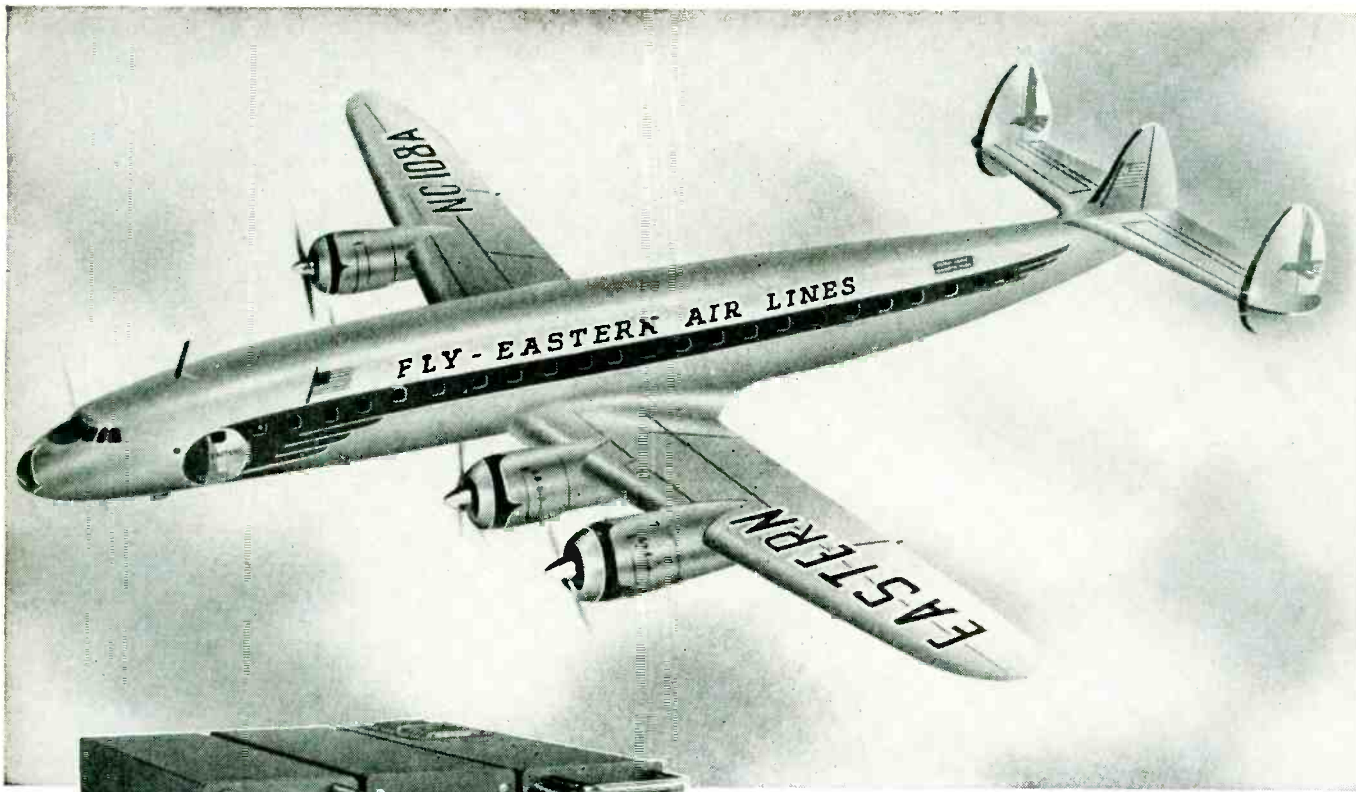

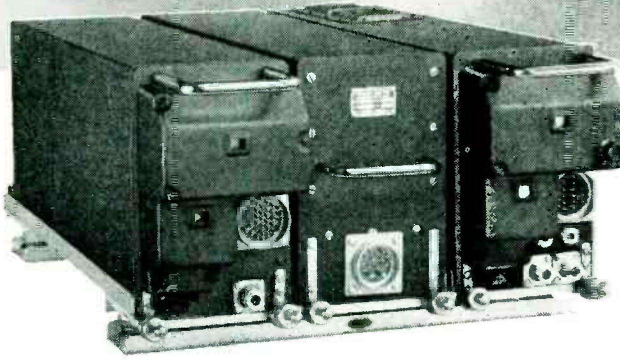

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The Kepco Model 700 features one regulated voltage supply with excellent regulation, low ripple content and low output impedance.

SPECIFICATIONS

OUTPUT VOLTAGE DC: 0-350 volts continuously variable.

OUTPUT CURRENT DC: 0-750 milliamperes continuous duty.

REGULATION: In the range 30-350 volts the output voltage variation is less than ½% for both line fluctuations from 105-125 volts and load variation from minimum to maximum current.

RIPPLE VOLTAGE: Less than 10 millivolts.

FUSE PROTECTION: Input and output fuses on front panel. Time delay relay is included to protect rectifier tubes.

POWER REQUIREMENTS: 105-125 volts, 50-60 cycles.

OUTPUT TERMINATIONS: DC terminals are clearly marked on the front panel. Either positive or negative terminal of the supply may be grounded. DC terminals are isolated from the chassis. A binding post mounted on the front of the panel is available for connecting to the chassis. All terminals are also brought out at the back of the chassis.

METERS:
Ammeter: 0-1 ampere, 4" rectangular.
Voltmeter: 0-500 volts, 4" rectangular.

PHYSICAL SPECIFICATIONS: Cabinet height 22¾", width 21¾", depth 15½". Rack panel height 21", width 19", color gray, panel engraved.

CONTROLS: Power on-off switch, H.V. on-off switch, H.V. control.

ADDITIONAL MODELS AVAILABLE IN THE 700 SERIES VOLTAGE REGULATED POWER SUPPLIES

Volts	Current	Model
0-350	0-0.75 Amp.	700
0-350	0-1.50 Amp.	710
0-350	0-2.25 Amp.	720
0-350	0-3.00 Amp.	730
0-600	0-0.75 Amp.	750
0-600	0-1.50 Amp.	760
0-600	0-2.25 Amp.	770
0-600	0-3.00 Amp.	780

FOR NEW POWER SUPPLY CATALOG — WRITE DEPT. #1

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plot over RG/9U coaxial cable. The microwave antenna rotates at 6 rpm while the airport surveillance radar antenna, shown in Fig. 3, rotates at 27 rpm.

The in-flight radar control program is a result of the joint efforts of the CAA, Airline Pilots Association, Aircraft Owners Association, the U. S. Navy and Air Force. It implements a recommendation of Special Working Group 5 of the Air Coordinating Committee.

Battery-Operated Cathode Follower

By LAWRENCE FLEMING

National Bureau of Standards
Washington, D. C. *

IN MEASURING VOLTAGE across high-impedance circuits, a cathode follower is a convenient accessory to the usual instruments.[1,2] When the source impedance is capacitive and the signal level low, as in the NBS piezoelectric accelerometer,[3] it is almost a necessity.

Considerations of portability and hum make a battery-powered cathode follower desirable but conventional battery-powered circuits suffer from low gain, typically of the order of 0.85. The gain A' is approximately

$$A' = \frac{A}{1 + A}$$

where A is the gain of the tube when operated as a resistance-coupled amplifier under the same conditions. With a-c operation, a high-mu triode is suitable with A about 50 and A' about 0.98.

Small filamentary tubes are not, however, available as high-mu triodes, because pentodes have considerably more gain at low plate-supply voltages. With cathode-follower operation of filamentary pentodes such as the 1U4, the screen voltage supply presents difficulties.

Figure 1 shows the conventional circuit. Load resistor R_L must be quite high in order for the gain before feedback, A, to be large. The d-c screen current flowing through dropping resistor R_D, however, must

* This work was done under a program on basic instrumentation at the National Bureau of Standards partially sponsored by the Office of Naval Research, the Air Force and the Atomic Energy Commission.

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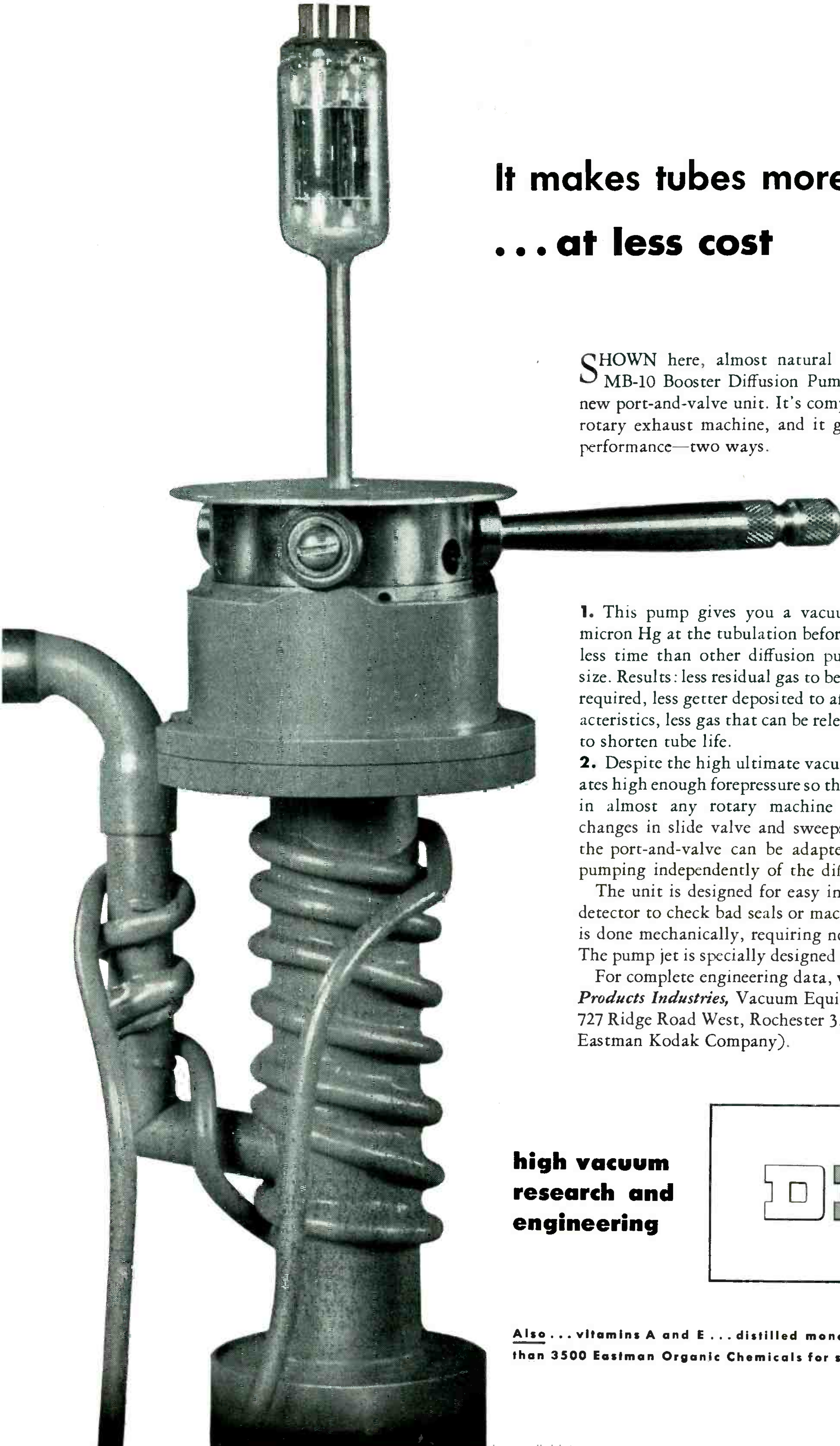

It makes tubes more reliable ...at less cost

SHOWN here, almost natural size, is DPi's new MB-10 Booster Diffusion Pump combined with a new port-and-valve unit. It's compact enough for any rotary exhaust machine, and it gives a big boost in performance—two ways.

1. This pump gives you a vacuum higher than 0.1 micron Hg at the tubulation before getter flash and in less time than other diffusion pumps of comparable size. Results: less residual gas to be gettered, less getter required, less getter deposited to affect operating characteristics, less gas that can be released from the getter to shorten tube life.

2. Despite the high ultimate vacuum, the pump tolerates high enough forepressure so that it can be installed in almost any rotary machine without extensive changes in slide valve and sweeps. For larger tubes, the port-and-valve can be adapted to permit rough pumping independently of the diffusion pump.

The unit is designed for easy installation of a leak detector to check bad seals or machine leaks. Valving is done mechanically, requiring no electrical circuits. The pump jet is specially designed for easy cleaning.

For complete engineering data, write to *Distillation Products Industries,* Vacuum Equipment Department, 727 Ridge Road West, Rochester 3, N. Y. (Division of Eastman Kodak Company).

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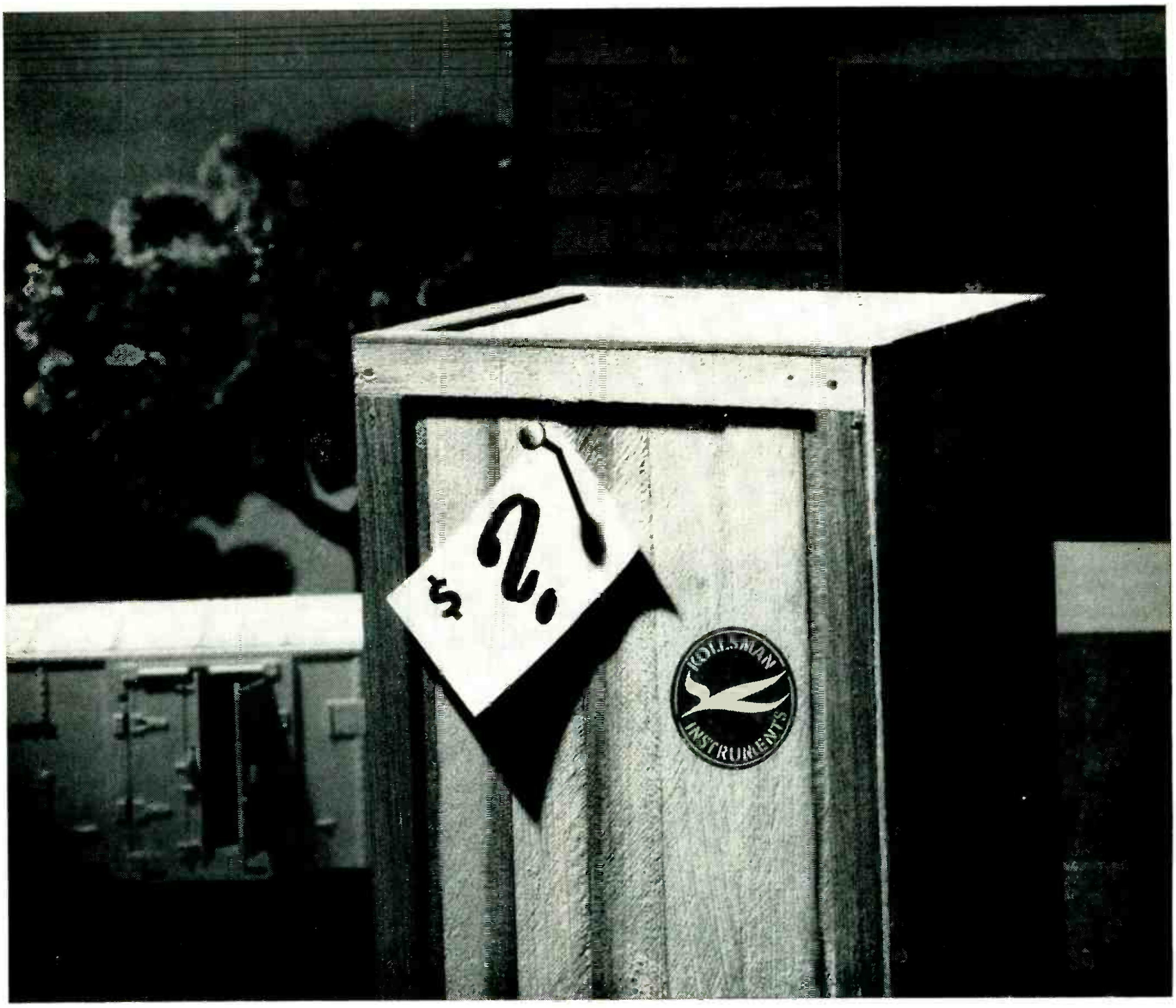

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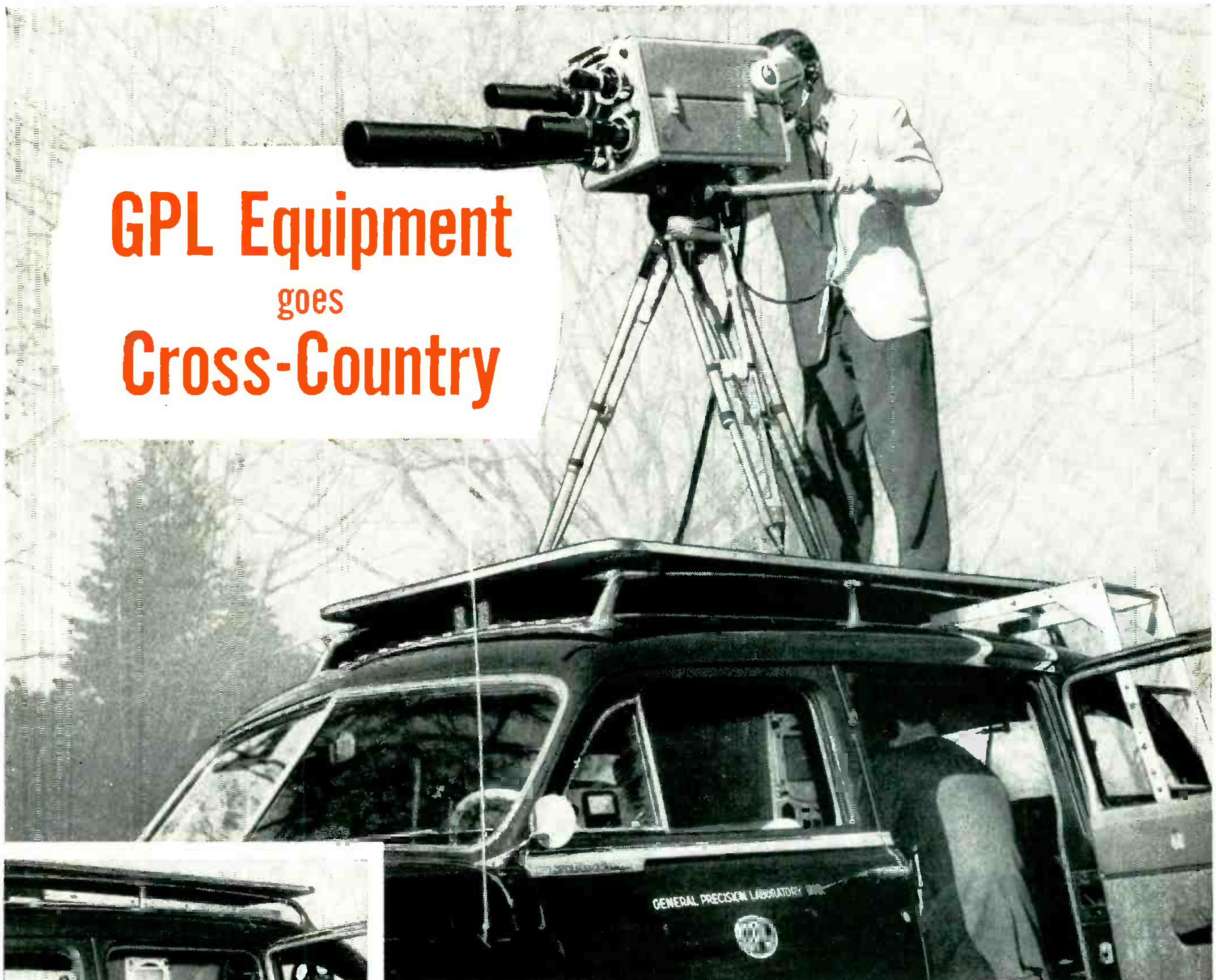
GPL Equipment goes Cross-Country



Included in cross-country demonstration unit is the GPL Utility Projector, with "3-2" intermittent which permits use with I.O. camera for film telecasting from remotes.

Compact GPL studio camera chain fits easily in station wagon, and may be operated from there, drawing power by cable from studio and returning signal to transmitter.

...to Drive its Story Home!

Stations all over the country will soon be able to see GPL TV equipment in operation right in their own studios. They can compare it with their present equipment, try it for compactness, smooth efficiency, flexibility, operational simplicity, and overall performance quality. Maintenance-minded engineers will examine its swing-up, swing-out panels. Camera and camera control men will note its many new operating features—pushbutton turret control, remoting of focus, turret and iris—all engineered for faster, smoother control.

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Designed for JAN-R-93, characteristic A, style RB11, these resistors are only 1⁹⁄₃₂" long x ½" diameter. Values up to 0.1, 0.3 or 0.4 megohms depending on alloy of windings. Hermetic sealing by a patented Shallcross process provides positive protection against humidity, fungus and salt water immersion.

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Practically any standard Shallcross Akra-Ohm resistor (including miniature types) can be supplied with glass fibre insulated wire and silicone impregnation to increase power rating from 2 to 4 times while retaining accuracy and stability. Ratings range from 1 watt for miniatures to 20 watts for the largest bobbin size. Glass insulated wire limits maximum resistance available on a given bobbin to lower than usual values as tabulated in bulletin R-3b.

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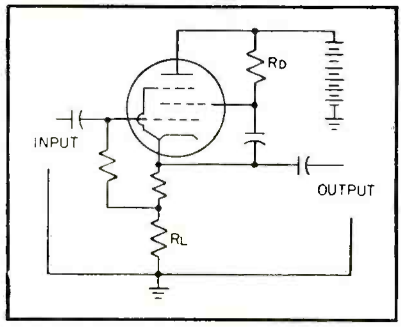

FIG. 1—Conventional cathode-follower circuit using a pentode

also flow through R_L. The additional voltage drop reduces the anode voltage and the gain A. This loss cannot be recovered except by increasing the plate-supply voltage. The only other appropriate expedient is a separate battery connected between screen and filament. This is undesirable both because of the extra complication and because of the loss in regulating action. With the screen voltage fixed, the static operating point is very sensitive to variations in tube characteristics and a manual bias adjustment is usually necessary.

Grounded-Plate

A simple inversion of the conventional circuit will remove the screen current from the load circuit and permit a battery-type pentode to operate as a cathode follower with full efficiency.

A practical circuit is shown in Fig. 2. The plate is made the terminal common to both input and output circuits; the "B" battery and the plateload resistor are interchanged as compared to the conventional circuit. Both the "B" and the "A" batteries are at signal potential with respect to ground, instead of just the "A" battery.

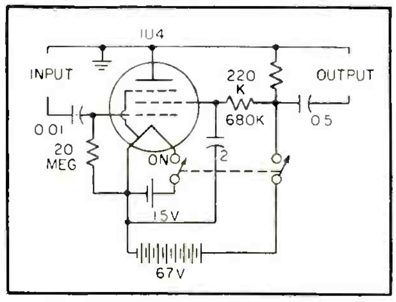

FIG. 2—Grounded-plate pentode cathode-follower circuit. Gain is 0.98

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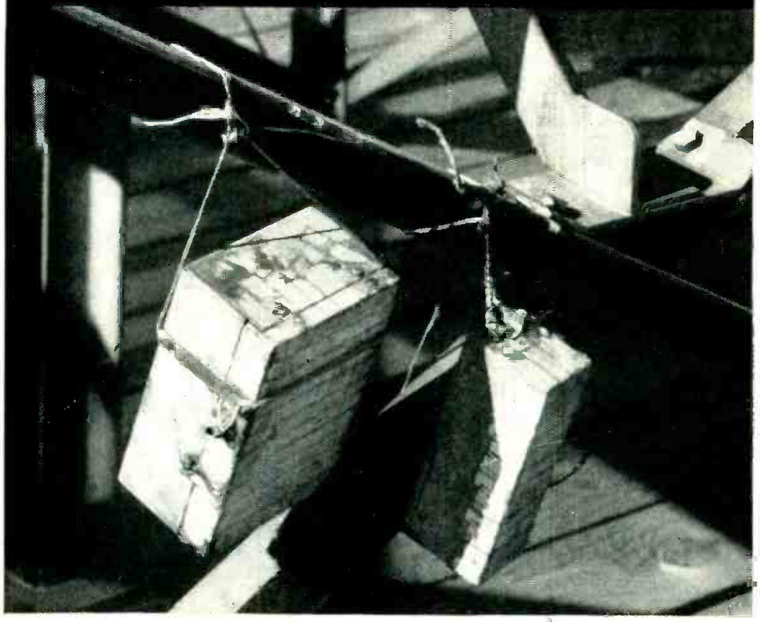
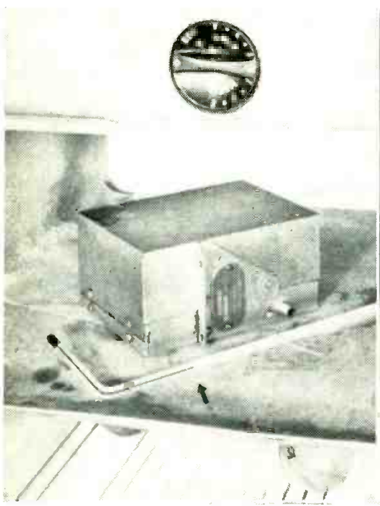
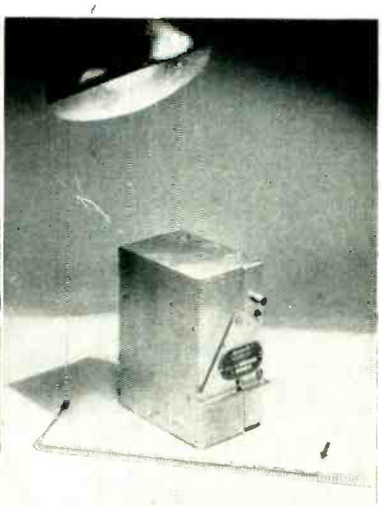


Weather Exposure

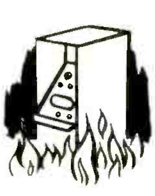
After eleven months of exposure, through one of the toughest winters on record, the two Permakay units (photographed on the roof of Motorola plant) showed no significant change in selectivity characteristic.



Thermometer reads —30° centigrade as the Permakay selectivity reading remains same as before this extreme cold test was started



In laboratory torture tests Permakay goes through blistering +90° centigrade test without effect on selectivity readings.



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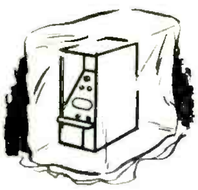
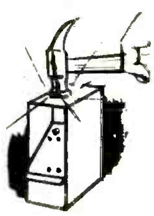


WATER AND COLD-PROOF



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In the exclusive *Sensicon* design of the Motorola *Permakay* wave filter, 15 nuisance tuning adustments are removed and permanent selectivity is guaranteed for the life of the set!

More tuned circuits and superior performance with *fewer* tuning adjustments in the SENSICON Receiver are achieved by using the PERMAKAY IF Wave Filter. The modified constant-K, m-derived band pass filter contains 15 tuned circuits . . . BUT . . . you are not burdened with field alignment and complex tuning adjustments. The filter, tuned and sealed during manufacture, requires no further adjustments . . . *ever*. This combination provides over 100 db signal rejection at the *edge* of the adjacent channel while providing a broad band-pass at 6 db for full modulation deviation acceptance.

Motorola's unique Permakay system of linear phase shift adjustment solves the problem of reflection and pulse noise control to provide maximum signal-to-noise ratio for the phenomenally high interference-rejection.

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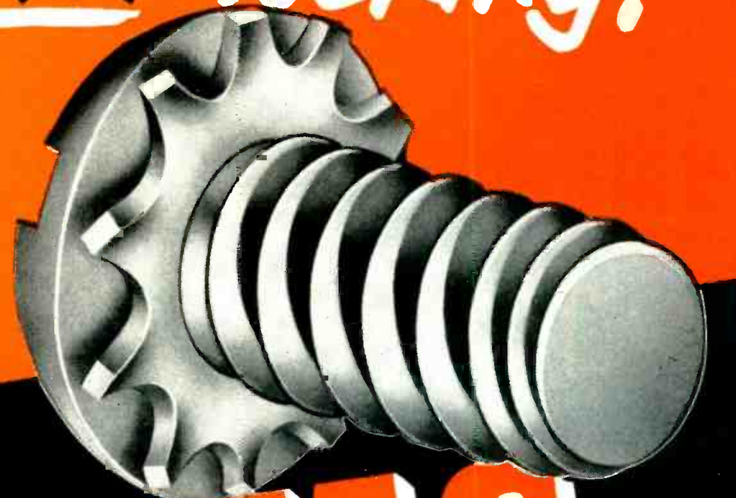

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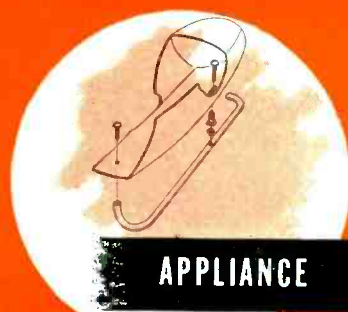

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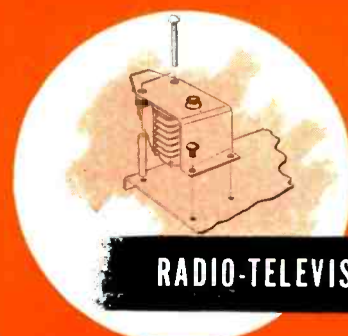
SEMS are ideal for use in almost every type of appliance assembly to protect performance. With SEMS, shown here holding a vacuum cleaner skid-runner in place, every screw is locked tight!



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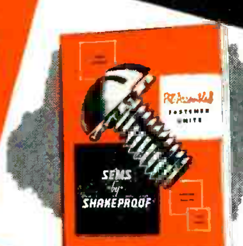

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Circuit characteristics are as follows:

Input resistance	200 megohms
Gain	0.98
Frequency range (within 5 percent)	2 to 55,000 cps
Output resistance	20,000 ohms
Maximum signal	10 v peak

REFERENCES

(1) J. F. Keithley, Stabilized Decade-Gain Isolation Amplifier, ELECTRONICS, p 98, Apr. 1949.

(2) C. J. LeBel, Developments in Cathode Followers, *Audio Engineering*, 33, Aug. 1949.

(3) L. Fleming, A Ceramic Accelerometer of Wide Frequency Range, *Instruments*, 24, p 968, July 1951.

(4) M. B. Kline, Cathode Follower Impedance Nomograph for Pentodes, ELECTRONICS, p 136, June 1947.

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A FREE-FLOATING buoy-type weather station, developed by the National Bureau of Standards for the Navy Bureau of Ships reports weather data by radio automatically and unattended.

The automatic weather station incorporates various weather-responsive devices to switch a radio transmitter on and off at rates that can be translated by a receiving station into temperature, pressure and wind data. Information is transmitted in predetermined sequence at intervals of three hours. Self-contained batteries provide sufficient power for reliable operation at over-water distances up to 400 miles.

The station consists essentially of a timing mechanism, several weather-responsive devices, a relaxation or keying oscillator, and a simple two-stage radio transmitter. The weather-responsive devices cause associated resistors to vary with changes in weather conditions. At three-hour intervals the timing mechanism, a modified automobile-type electric clock, turns the station on.

While a program selector switch inserts one weather resistor after another into the keying oscillator circuit in predetermined sequence, a relay in the plate circuit of the keying oscillator switches the trans-

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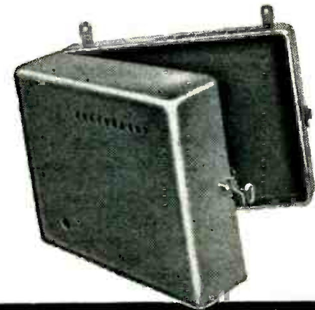

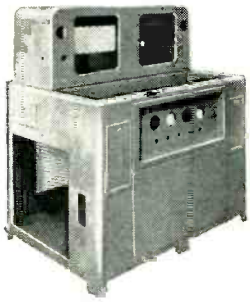

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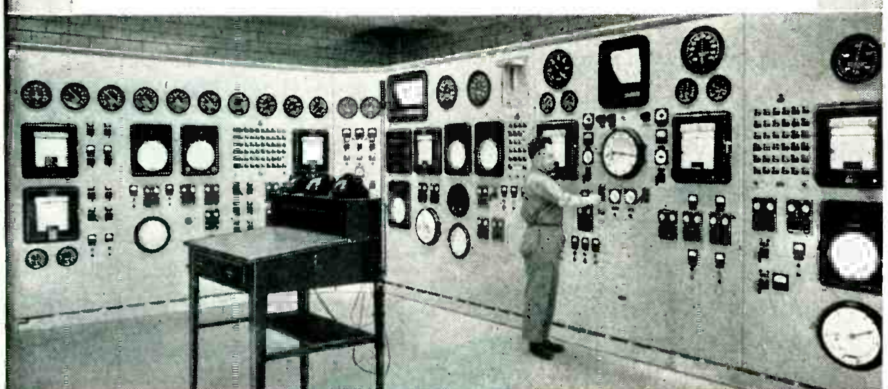

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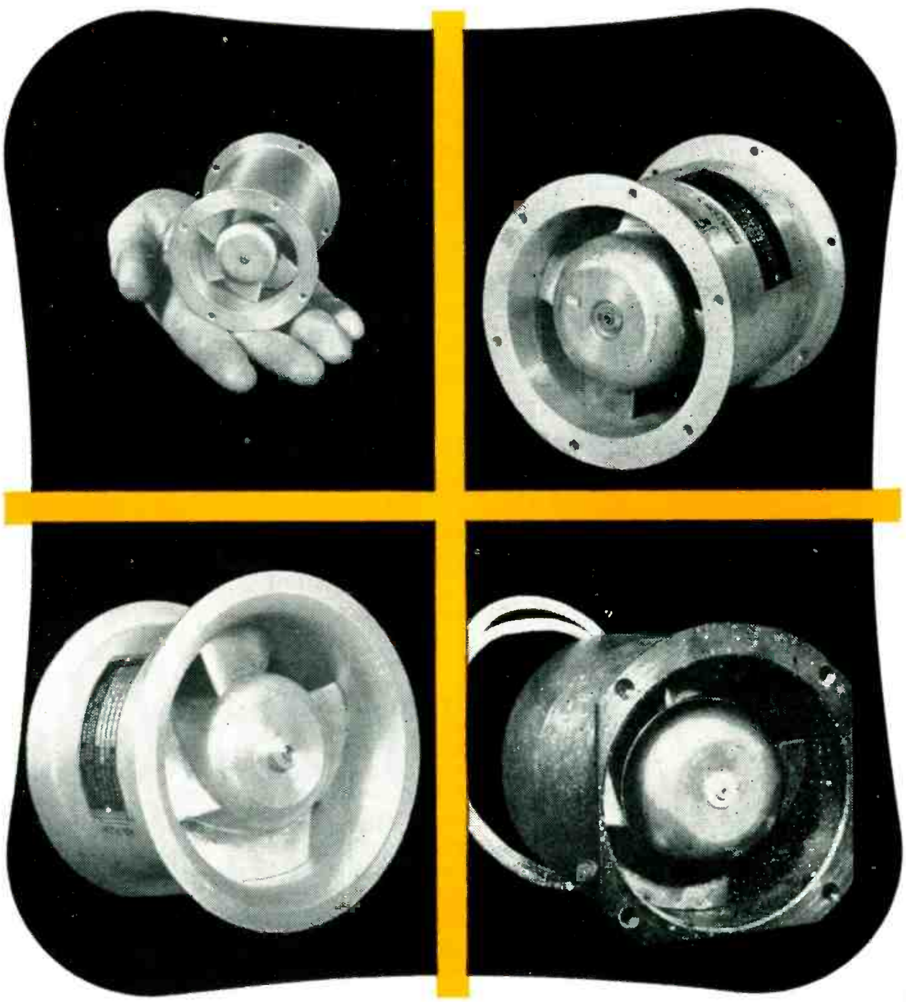

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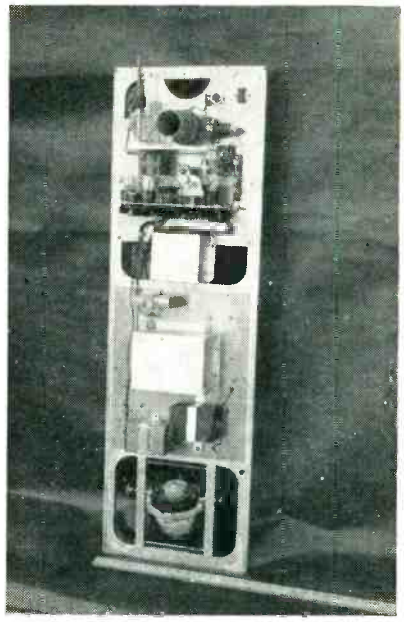

Main equipment panel of the weather station. Transmitter and keying oscillator are located at top and compass for indicating wind direction on bottom

mitter on and off at a rate proportional to the value of the particular resistor. Most of the components are mechanically simple and the electronic circuits are straightforward and conventional.

Each transmission lasts about ten minutes. First comes an attention signal, consisting of a series of rapid pulses easily recognizable by the listening station operator. Transmitted next is a reference signal; this will be of constant pulse rate in the absence of transmitter damage or aging, and any variation in pulse rate indicates a need for calibration corrections of the other signals. An identification signal follows, the rate of which is characteristic of the particular weather station.

All of the signals result from switching appropriate resistors into the relaxation oscillator circuit. The various meteorological signals are next transmitted. With completion of the program, the selector switch disconnects all elements and turns off the transmitter. The clock mechanism, however, continues to run and at the proper time starts the sequence again.

Five meteorological variables are reported by the standard model of the weather station: air and water temperature, air pressure, and wind speed and direction. Five different

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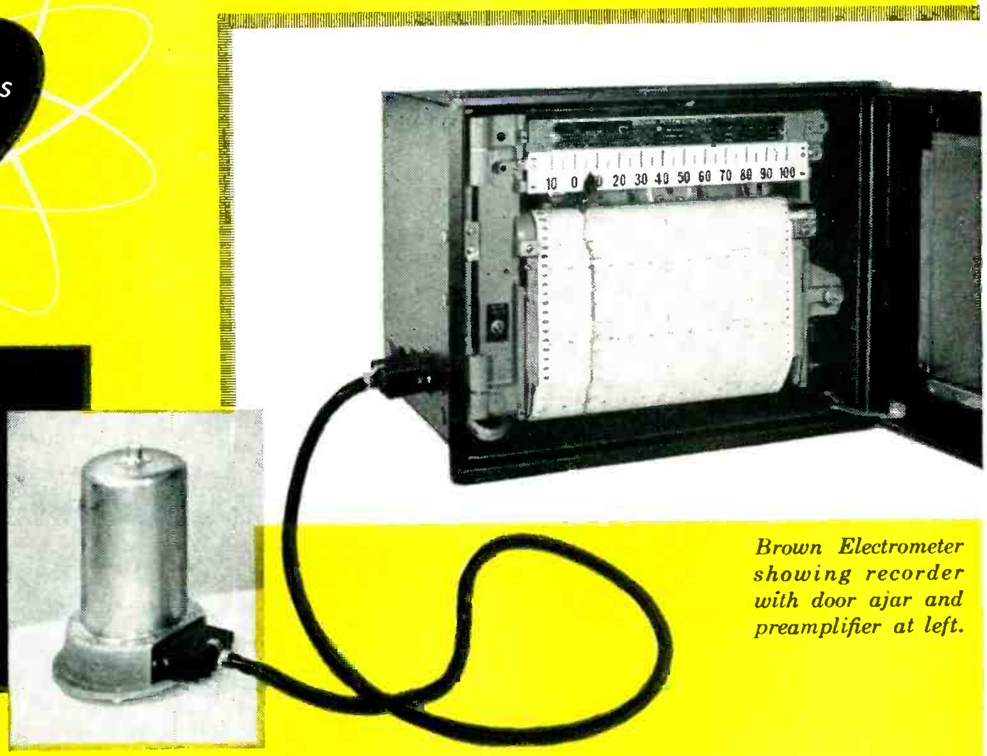
THE BROWN ELECTROMETER



Brown Electrometer showing recorder with door ajar and preamplifier at left.

for measuring and recording currents as low as 10^{-15} amperes

Electrical Characteristics

- Full Scale Current Ranges Available: 10^{-13} amperes with 10^{11} ohm resistor, and selector switch adjustment for full scale of 10^{-12} or 10^{-11} amperes. Using other resistors, full scale current ranges up to 10^{-7} amperes can be supplied with selector switch adjustment up to 10^{-5} amperes.
- Input Resistor: 10^{11} ohms for most sensitive current measurement. (Also supplied in values down to 10^{5} ohms.)
- System Accuracy: Approximately 1 per cent of scale.
- Zero Drift: Should not exceed 0.3 millivolt per day.
- System Noise: Approximately 5 microvolts.
- Instrument Speed of Response: Available for either 24, 12, or 4½ seconds full scale.
- Maximum Speed of Response Using 4½ Second Instrument Speed: 5 seconds for 90 per cent of change, with preamplifier located at source.
- Power Supply: 115 volts, 60 cycles. Also dry cell supplied in instrument.
- Power Requirements: 65 watts.

ACCURATE measurement of extremely small currents is accomplished in this instrument through the use of a null balance servo system and a-c amplifiers that prevent drift and consequent instability. It is the only such system that incorporates a recorder as an integral part of the circuit. Designed to measure and record minute currents in ionization chambers, the Brown Electrometer may be used in any application where currents as low as a billionth of a microampere are encountered.

Features of the instrument include a special power supply to prevent false measurements from stray signals which might originate in an a-c power source . . . vibration frequency carefully selected to prevent phase shift . . . and automatic standardization of voltage across the slide-wire.

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

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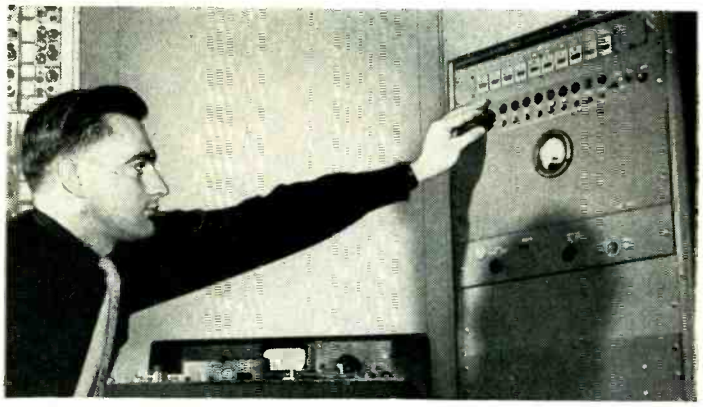
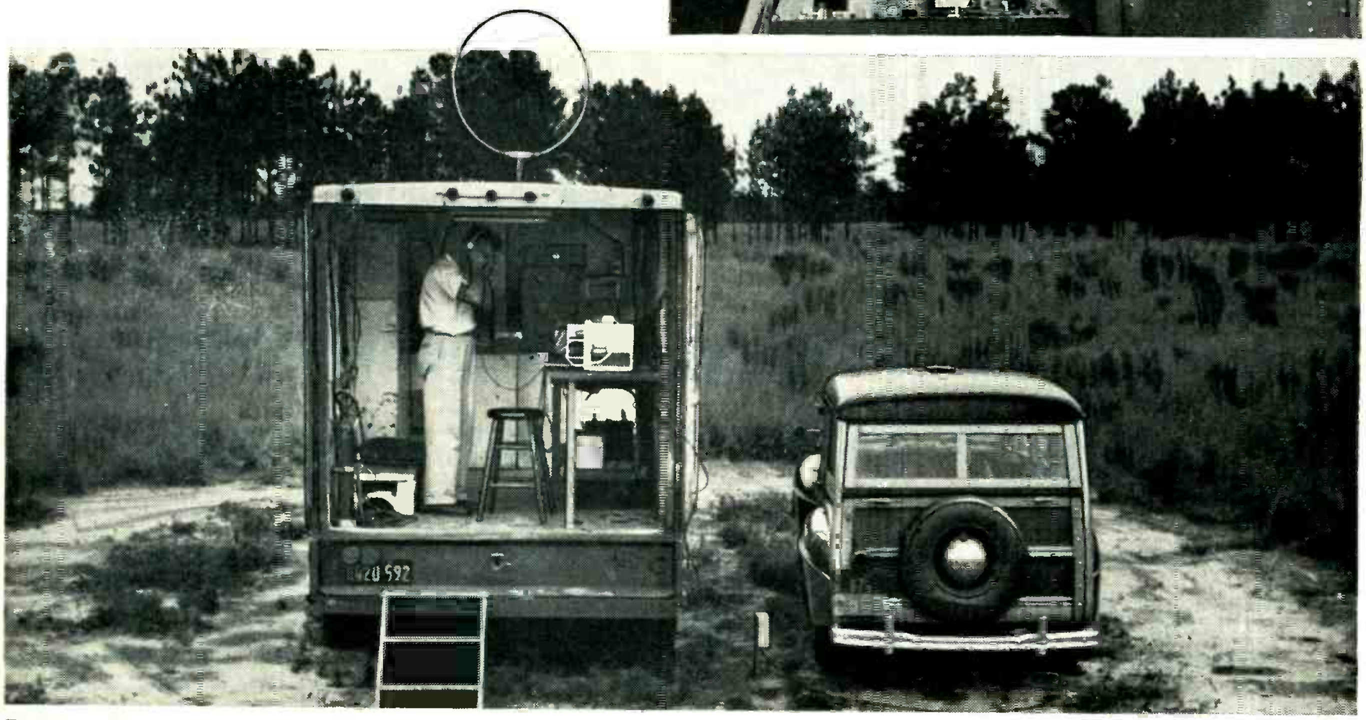
Thunder Hunters





Thunder hunting equipment on location near Madison, Florida. Loop antenna on truck picks up static. The engineer in top picture is watching the indication of a circuit which registers how often the static exceeds a given level.

Many new telephone circuits have two jobs to do—carrying your voice and transmitting signals to operate dial exchanges in distant towns. And an old-fashioned thunderstorm can interfere with both!

"Rolling static" comes from many storms over a wide area and can interfere with clear telephone talk. A nearby lightning flash makes "crack static" which, unchecked, plays hob with dial system signals.

So Bell Laboratories scientists go "Thunder Hunting" in the storm centers of the United States – "capturing" storms by tape recorders. Back in the Laboratories, they recreate the storms, pitting them against their new circuits. This method is more efficient and economical than completing a system and taking it to a storm country for a tryout. It demonstrates again how Bell Telephone Laboratories help keep costs down, while they make your telephone system better each year.

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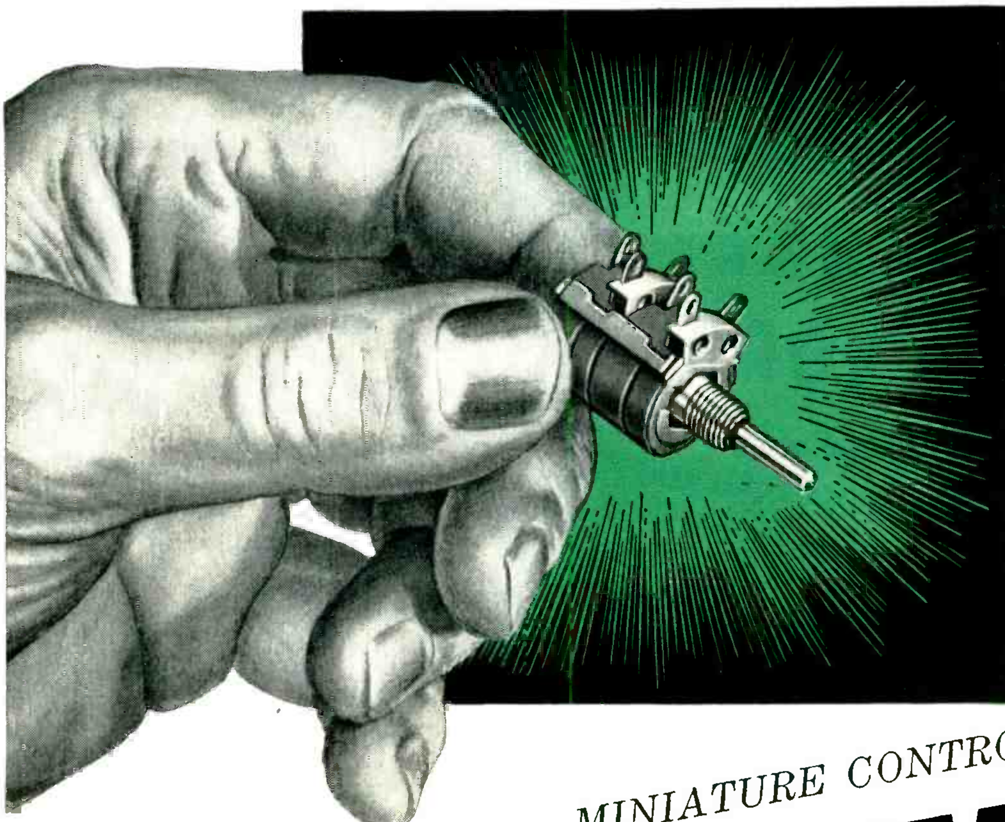

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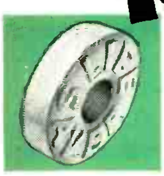

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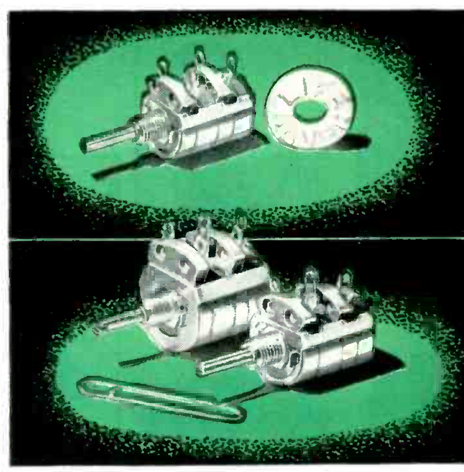
Housed in low-loss phenolic. Convenient terminal lugs.
Single and multiple sections, including combination of composition-element and wire-wound sections.



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devices, in combination with the relaxation oscillator, key the transmitter at rates corresponding to each of these variables.

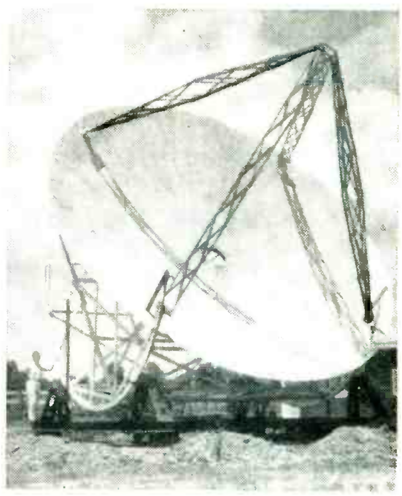
The radio transmitter and the one-tube relaxation oscillator are simple and conventional. A crystal oscillator drives a beam-power amplifier to give a radiated output of about 20 watts on a frequency near 5 megacycles. The battery pack provides power for 30 days' unattended operation.

Lunar Reflection of UHF Communications

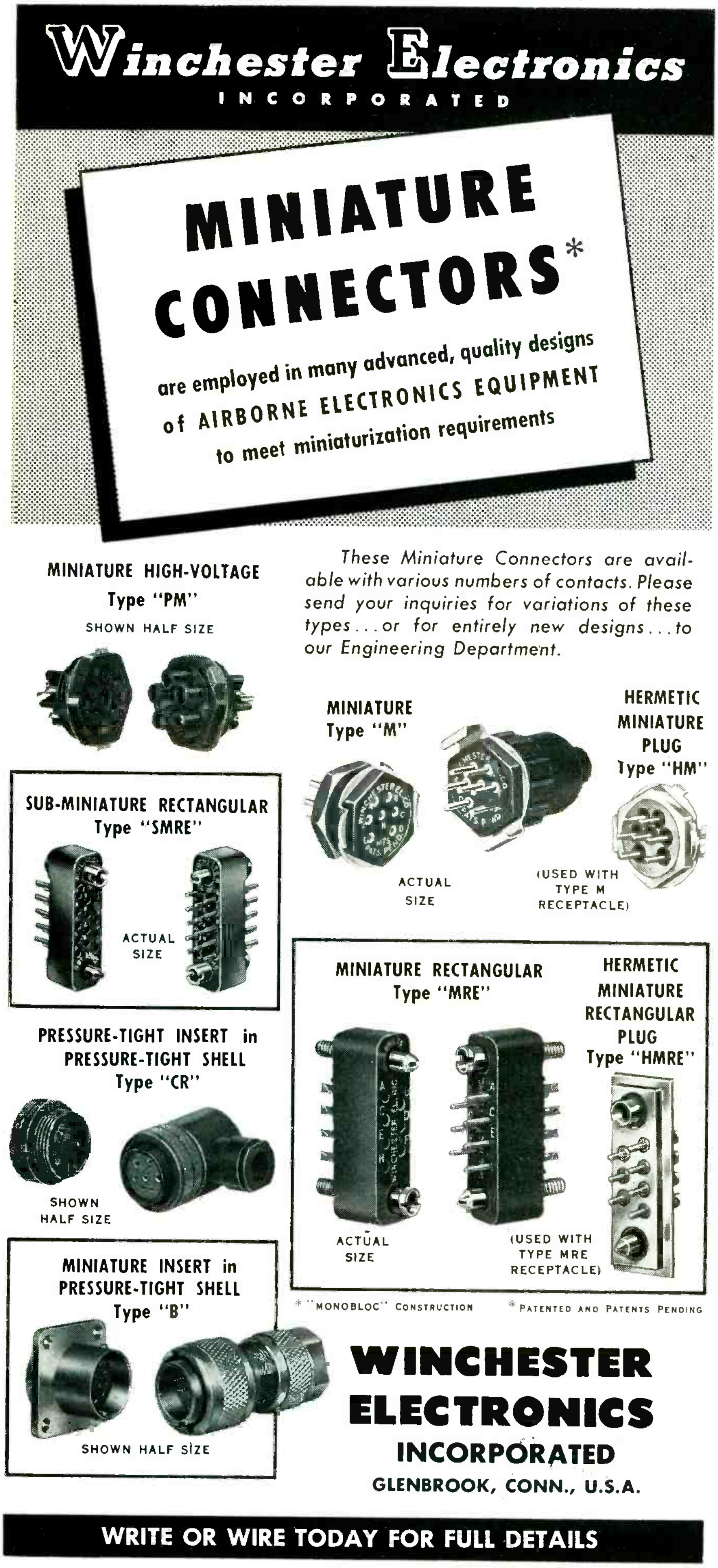
A RADIO MESSAGE was transmitted for the first time by lunar reflection during a recent cooperative experiment conducted by the National Bureau of Standards and the Collins Radio Company. Ultra-high-frequency signals that had been reflected from the moon were received by the NBS field station at Sterling, Virginia, after having been transmitted 775 miles away at Cedar Rapids, Iowa.

Operating frequency was 418 mc, generated by a 20-kw transmitter. Because the transmitting antenna in Cedar Rapids was a fixed structure, lunar reflection could be accomplished only while the disk of the moon was in the beam of radio energy (a period of approximately one-half hour). The antenna at Sterling could be rotated and turned in the direction of maximum signal strength.

Reflection of the signals appar-



Parabolic receiving antenna used in moon reflection experiment



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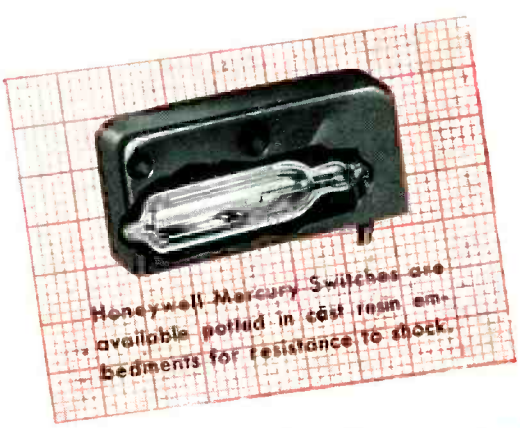

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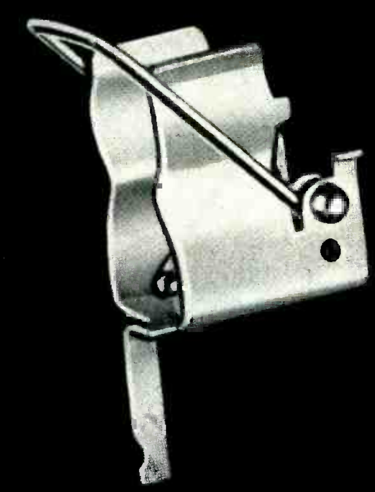

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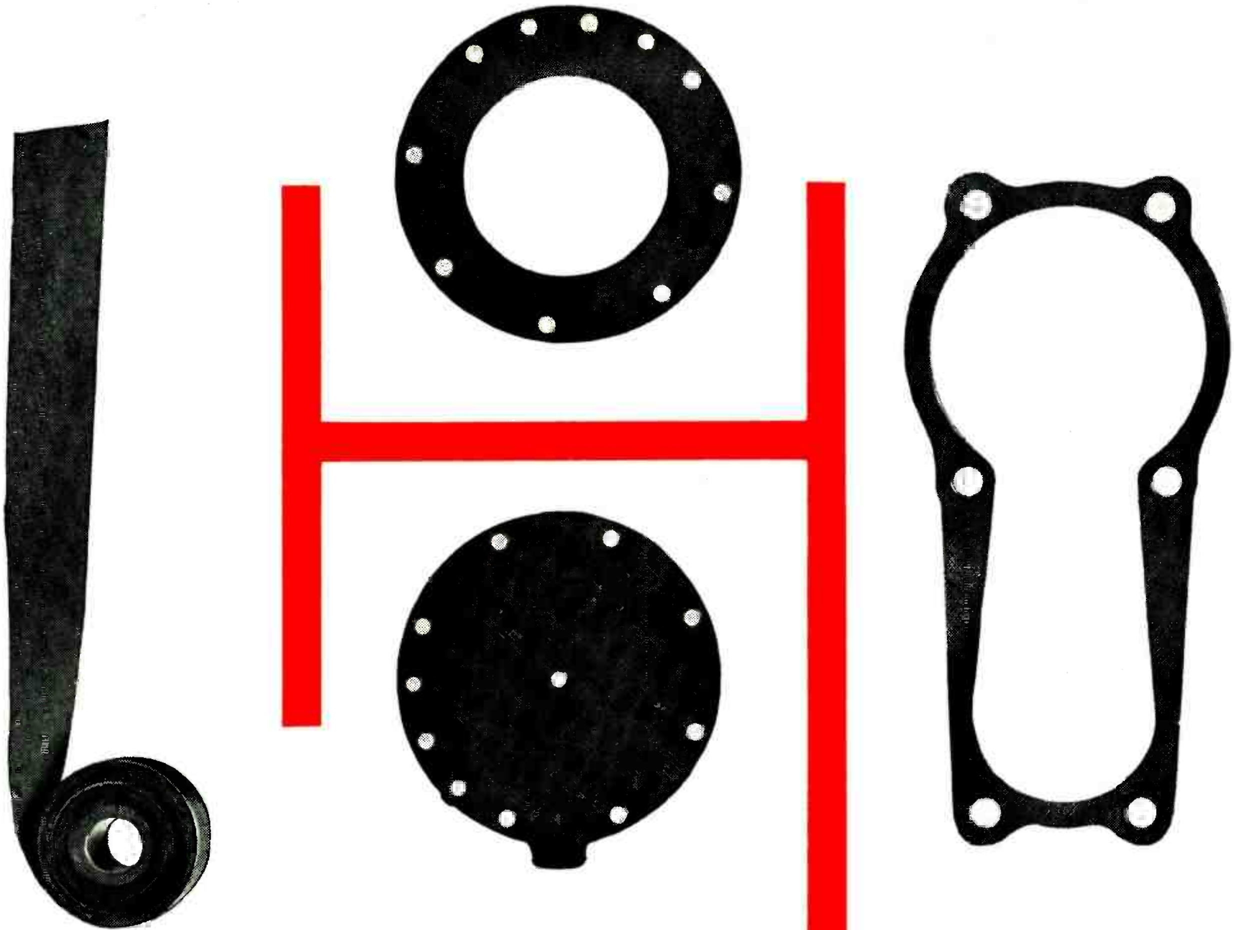

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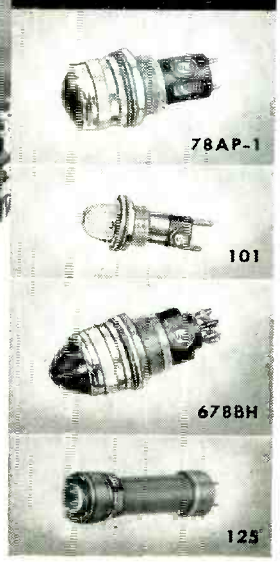

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ently began as soon as the leading edge of the lunar disk entered the radio beam. The receiving antenna was rotated until the maximum signal strength was obtained, in a position pointing directly toward the moon. As the moon continued to move across the radio beam, the received signal strength increased.

About ten minutes after the initial contact, the signal strength reached its highest value. The intensity remained at this maximum level for another ten minutes and then began to decrease as the moon passed out of the radio beam. The greatest signal strength received was about one millionth as strong as the signal received by most commercial television receivers.

To verify the fact that the signal was reflected by the moon, the actual transmission delay was compared with the theoretical value. This value was determined from the geometry of the experiment—the relative positions of the transmitter, the moon, and the receiver—and the known speed of radio waves. The 2.5-second time interval that was measured agreed approximately with the theory.

The experiment provides additional information confirming the possibility that the moon can be used as a reflector for short-wave radio transmission during those times it would be in the proper position for reflection. Use of the moon as a reflector would have the advantage that the transmissions would be free from interruption.

TV Tuner Covers 82 Channels

A NEW television tuner developed by Standard Coil Products Co. Inc. covers both the vhf and uhf bands in one unit. Channel selection is made by turning a dial until the desired channel number appears in the dial window.

The selecting dial consists of three superimposed knobs. To tune in a desired station, one knob is turned to the tens digit, another to the units digit and a third knob is used for fine tuning.

The tuner uses coils for tuning elements. The basic circuit is tuned to about channel 50. Capacitors are switched in parallel for lower-fre-

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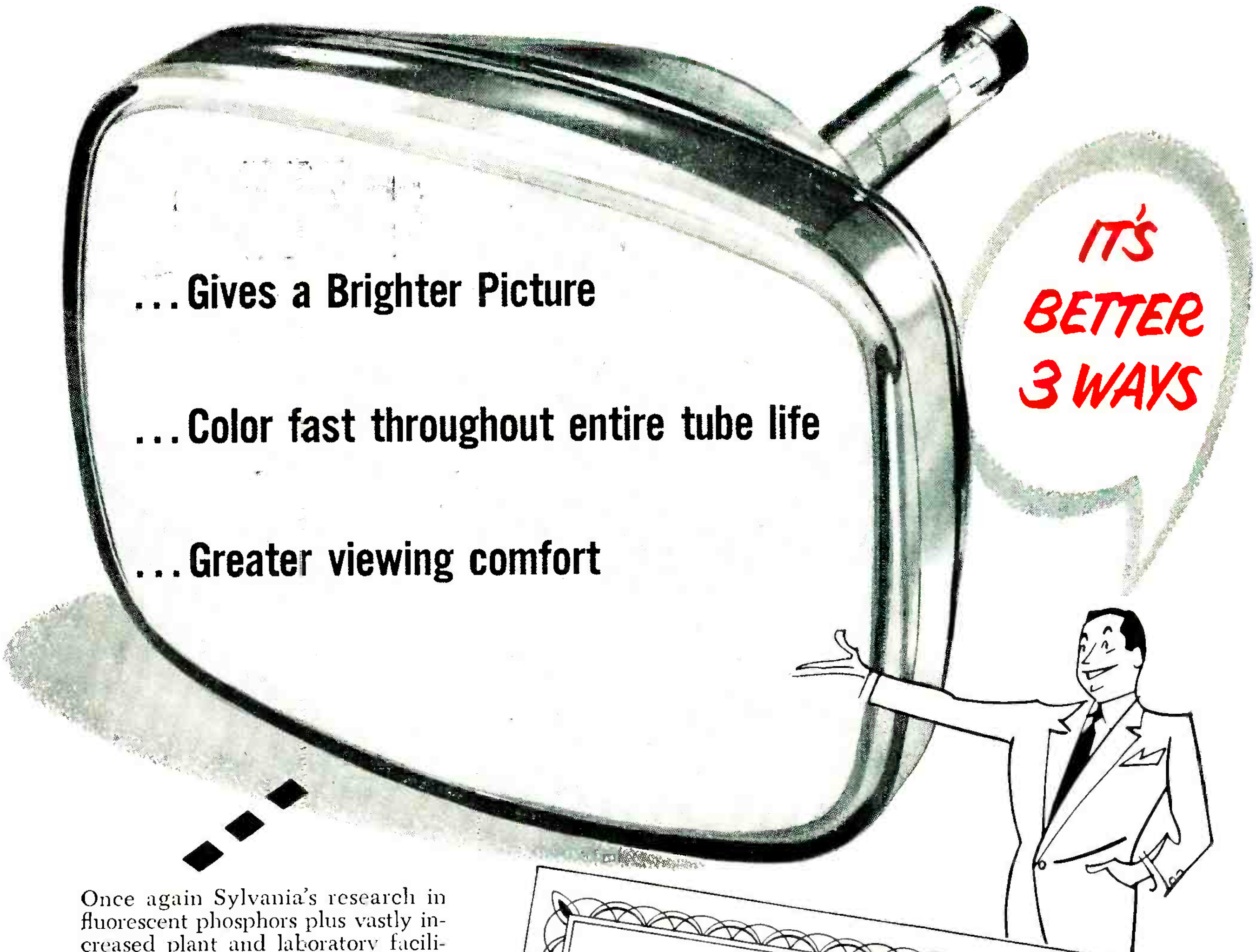
Another Sylvania Achievement

...an improved Picture Tube Screen



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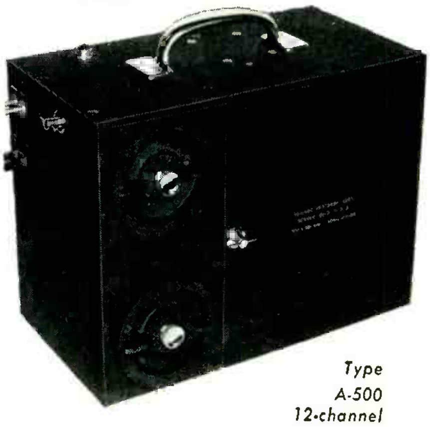

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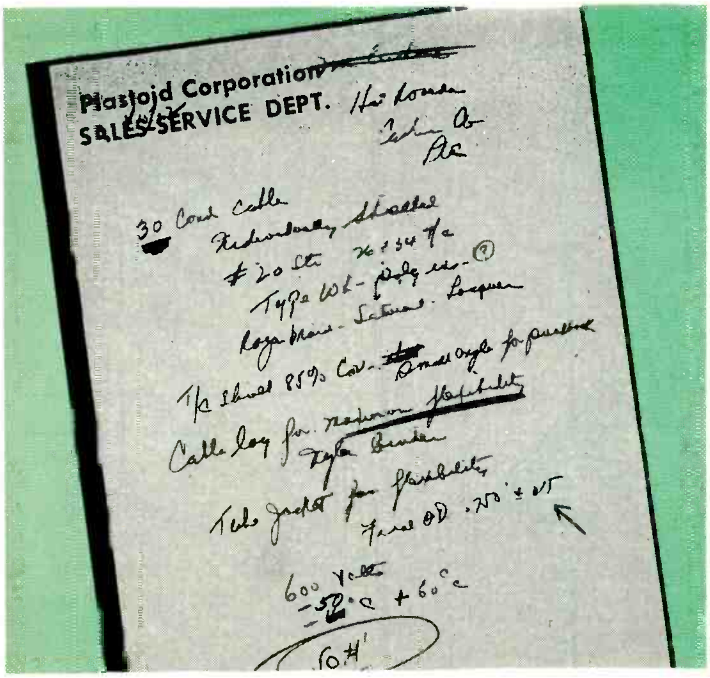

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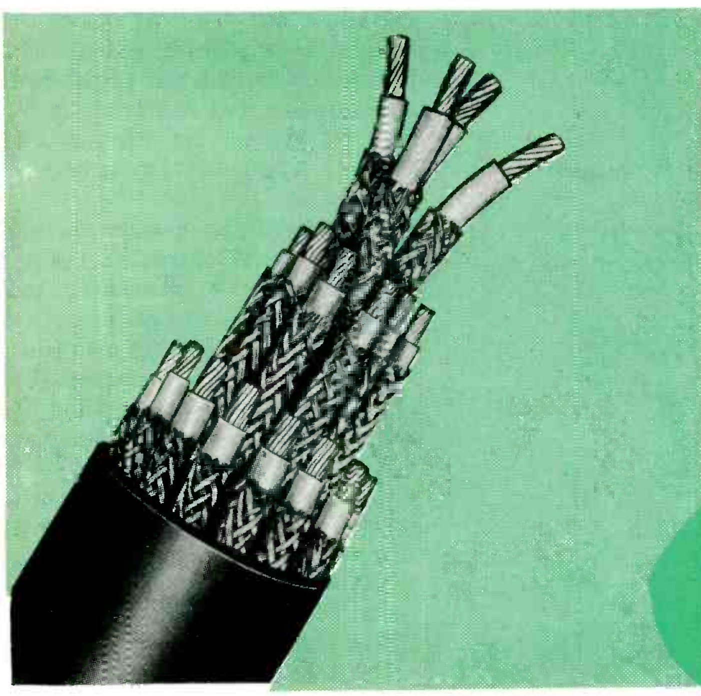

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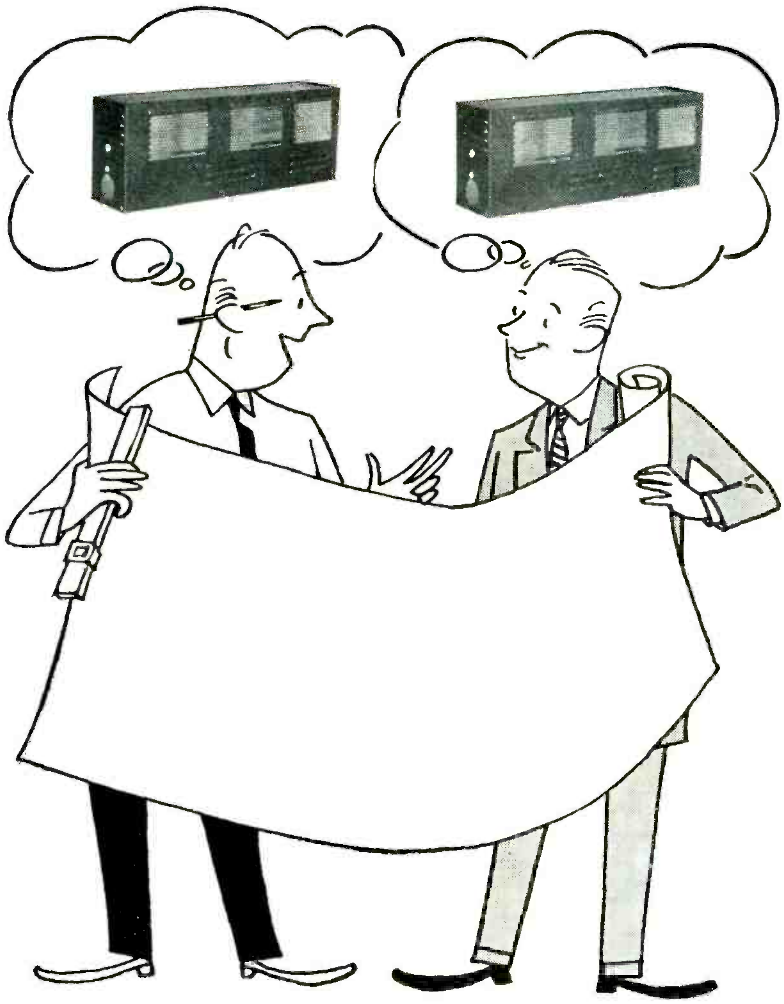

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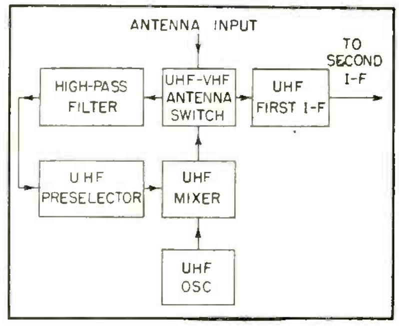


FIG. 1—Block diagram of the vhf-uhf tuner

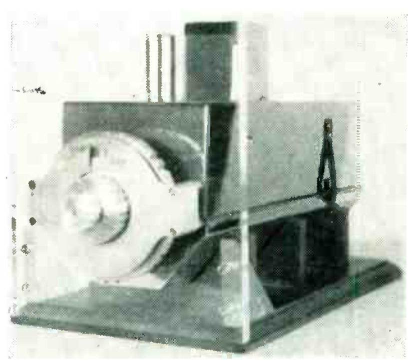
quency channels and more coils are switched in parallel for higher-frequency channels.

Block Diagram

A block diagram of the tuner is shown in Fig. 1. Frequencies in the uhf band are divided into eight parts, beginning at 470 mc and ending at 890 mc. The vhf acts as the first i-f in the uhf position. The tuner consists of a uhf preselector, a uhf mixer and oscillator, and a first i-f system for each of the bands. A cascode i-f system is used.

The r-f switch separates antenna feeds. For uhf operation, the antenna is fed to the preselectors and the output of the uhf mixer excites the vhf first i-f. For vhf operation, the antenna terminal is connected to the input of the vhf tuner and the uhf section of the tuner is inactive.

Figure 2 shows how the television frequency spectrum has been divided for operation of the tuner. Channels 14 to 19 are covered in the first band of uhf. The last uhf band covers channels 80 to 83. Three additional vhf channels are



The vhf-uhf turret tuner

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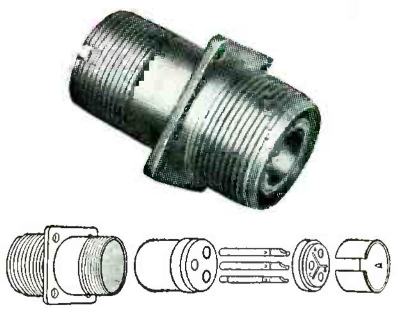

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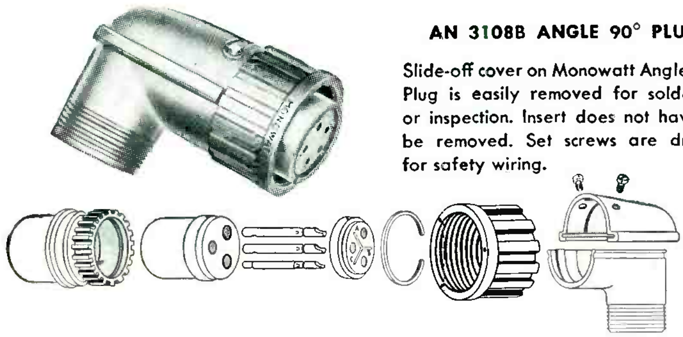

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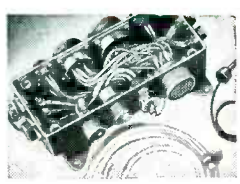

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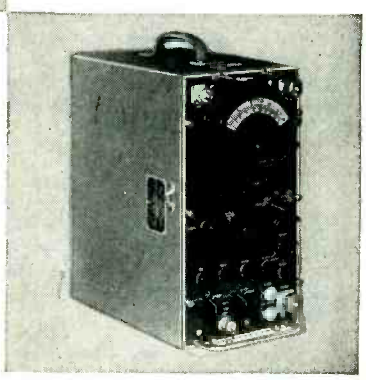

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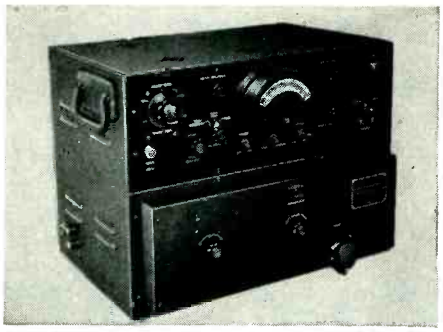

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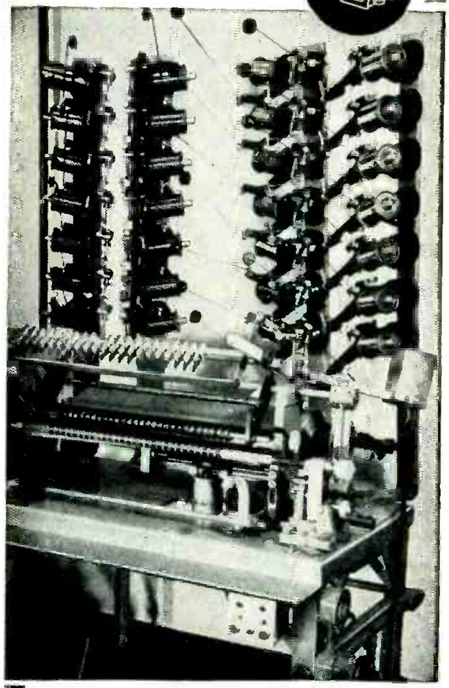

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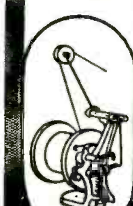

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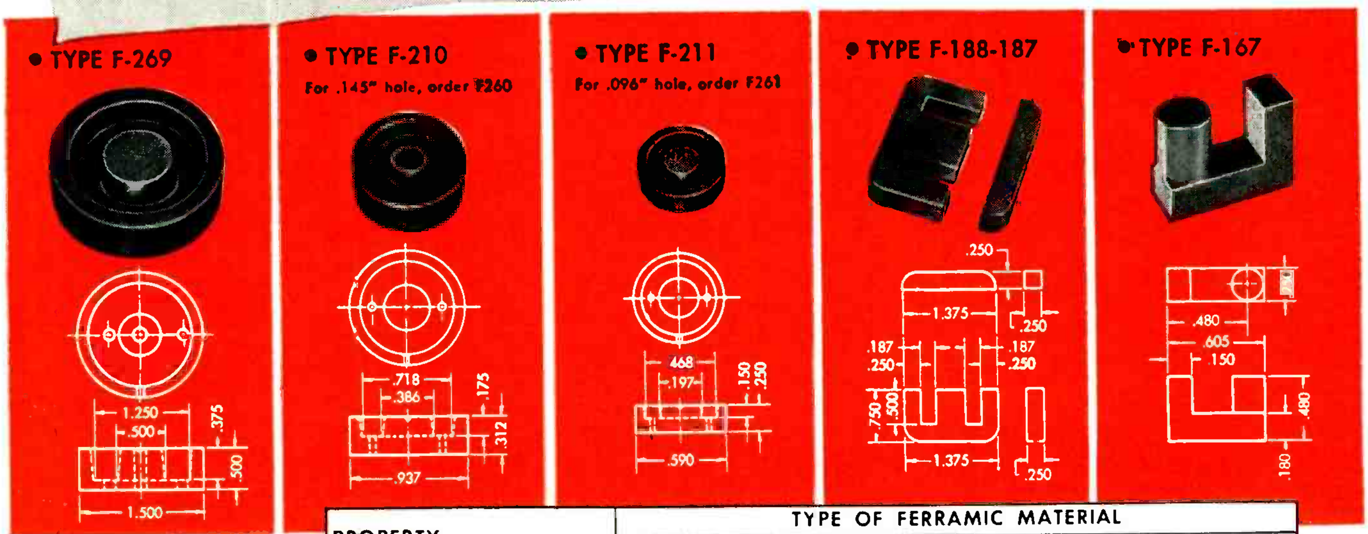

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Maximum permeability	—	183	1100	1710	4300	3000	750
Saturation flux density	Gauss	1900	4200	3800	3400	2000	2900
Residual magnetism	Gauss	830	2700	1950	1470	700	1600
Coercive force	Oersted	3.0	2.1	0.65	0.18	0.30	.80
Temperature coefficient of initial permeability	%/°C.	0.04	0.4	0.25	0.66	0.3	0.22
Curie point	°C.+	260	330	160	150	70	180
Volume resistivity	Ohm-cm	$2x10^5$	$2x10^3$	$4x10^5$	$1x10^4$	$2x10^5$	—
Loss Factor: at 1 mc/sec	—	.00016	.00007	.00008	.00030	.0003	.000055
at 5 mc/sec	—	.0011	.0008	.002	.00155	.005	—
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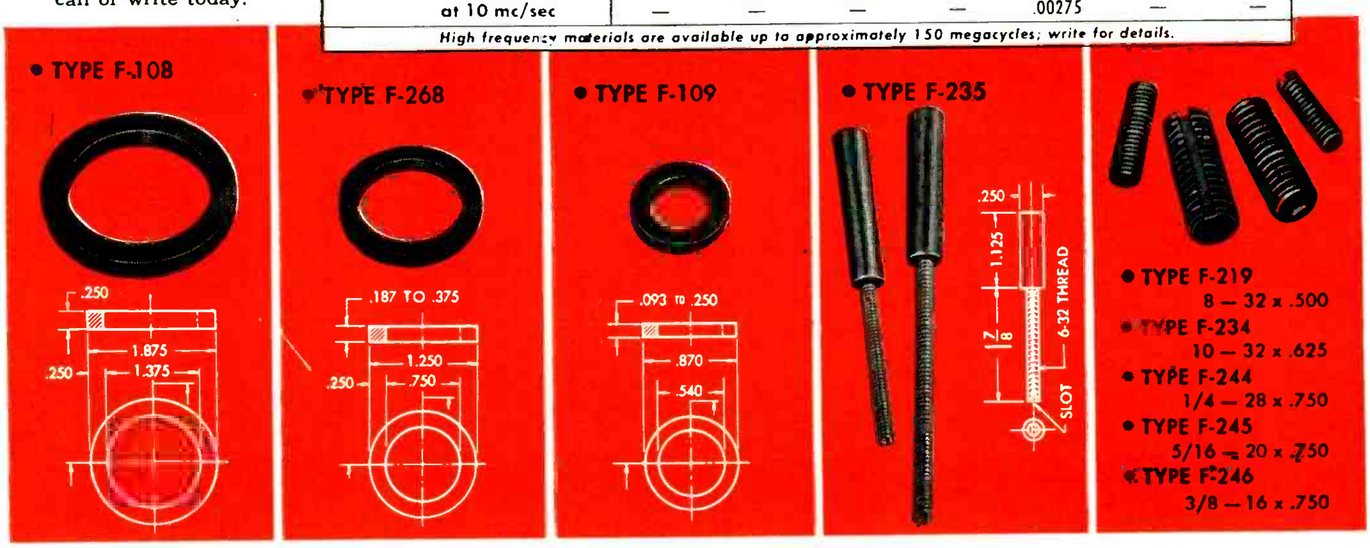

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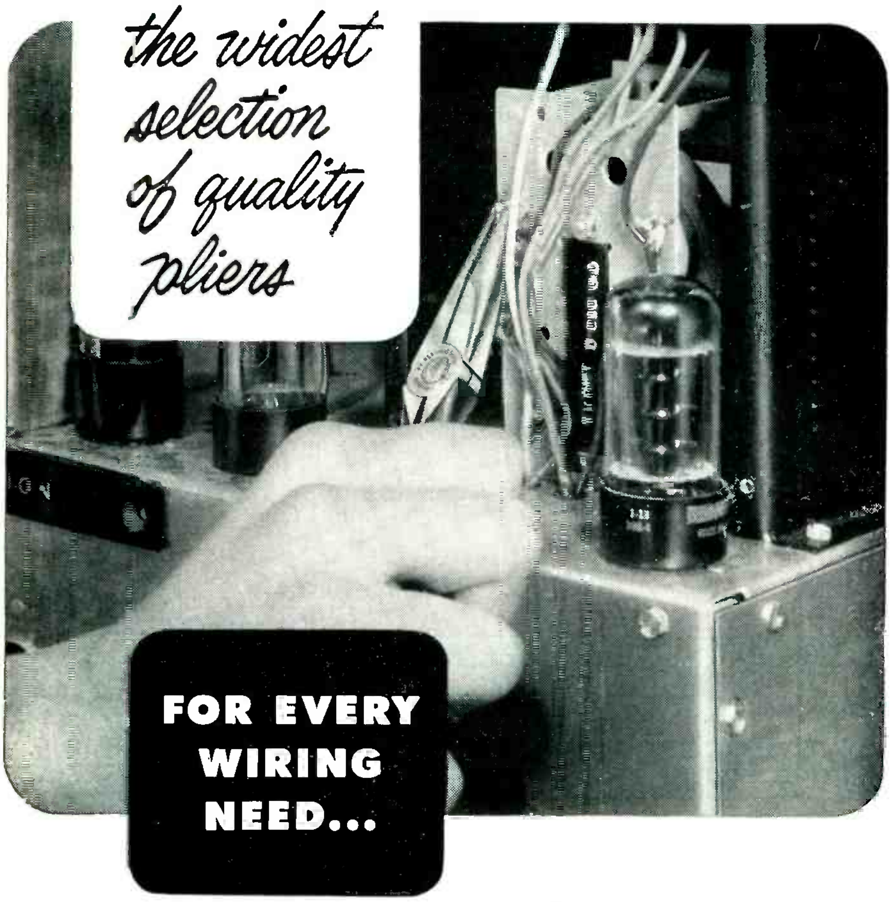

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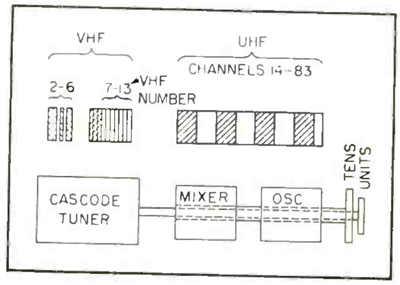

FIG. 2—Division of the television frequency spectrum

included in addition to the vhf channels in present use.

The three additional vhf channels result in a 15-position vhf section with ten channels spaced six-mc apart. These ten channels are used as the variable i-f for any setting of the uhf section of the tuner.

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By John M. Carroll
Washington, D. C.

Static electrification of textile materials, particularly synthetic fabrics, causes both discomfort to the wearer and soiling due to attraction of oppositely charged particles. New fabric finishes do much to improve surface conductivity and thereby reduce the tendency to accumulate charge. The electrostatic susceptibility meter, provides a means for evaluating proposed methods for improving fabric surface conductivity.

Quantitative measurements of both accumulated charge and rate of decay of charge are made by the instrument. Results may be reproduced with accuracies of better than 25 percent. Electrostatic charge is produced by friction between two fabric surfaces. A sample of the fabric to be tested is attached to the periphery of a rotating drum while a sample of scoured, untreated fabric, secured to a friction arm, is held in contact with the rotating sample.

Circuit Details

A triode-connected 6J7 with floating grid is used as the charge pickup tube. Its grid cap is fitted with a larger brass cap and placed in

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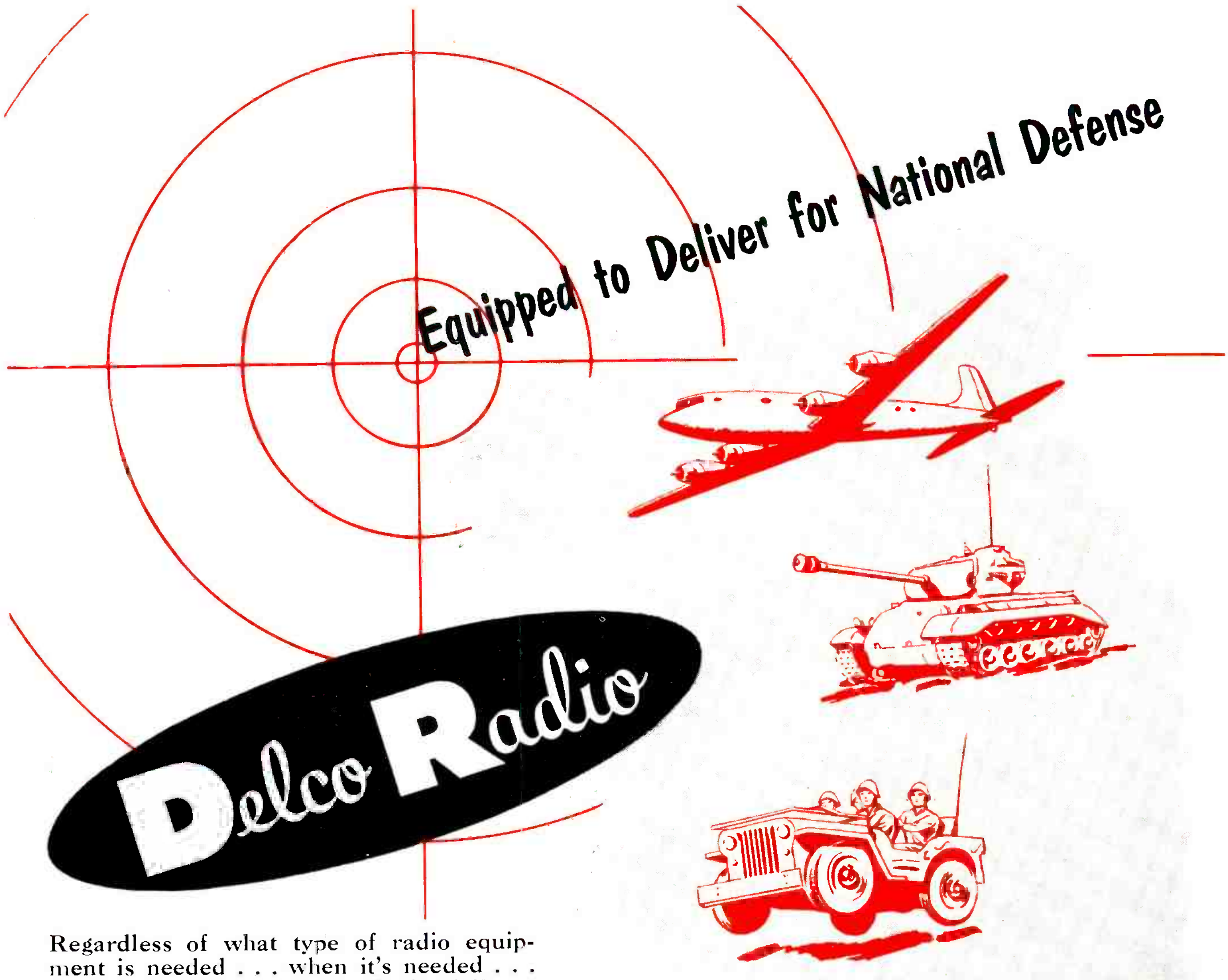

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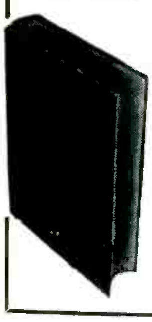

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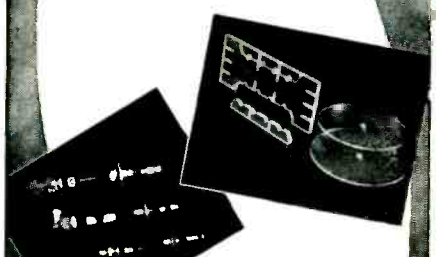

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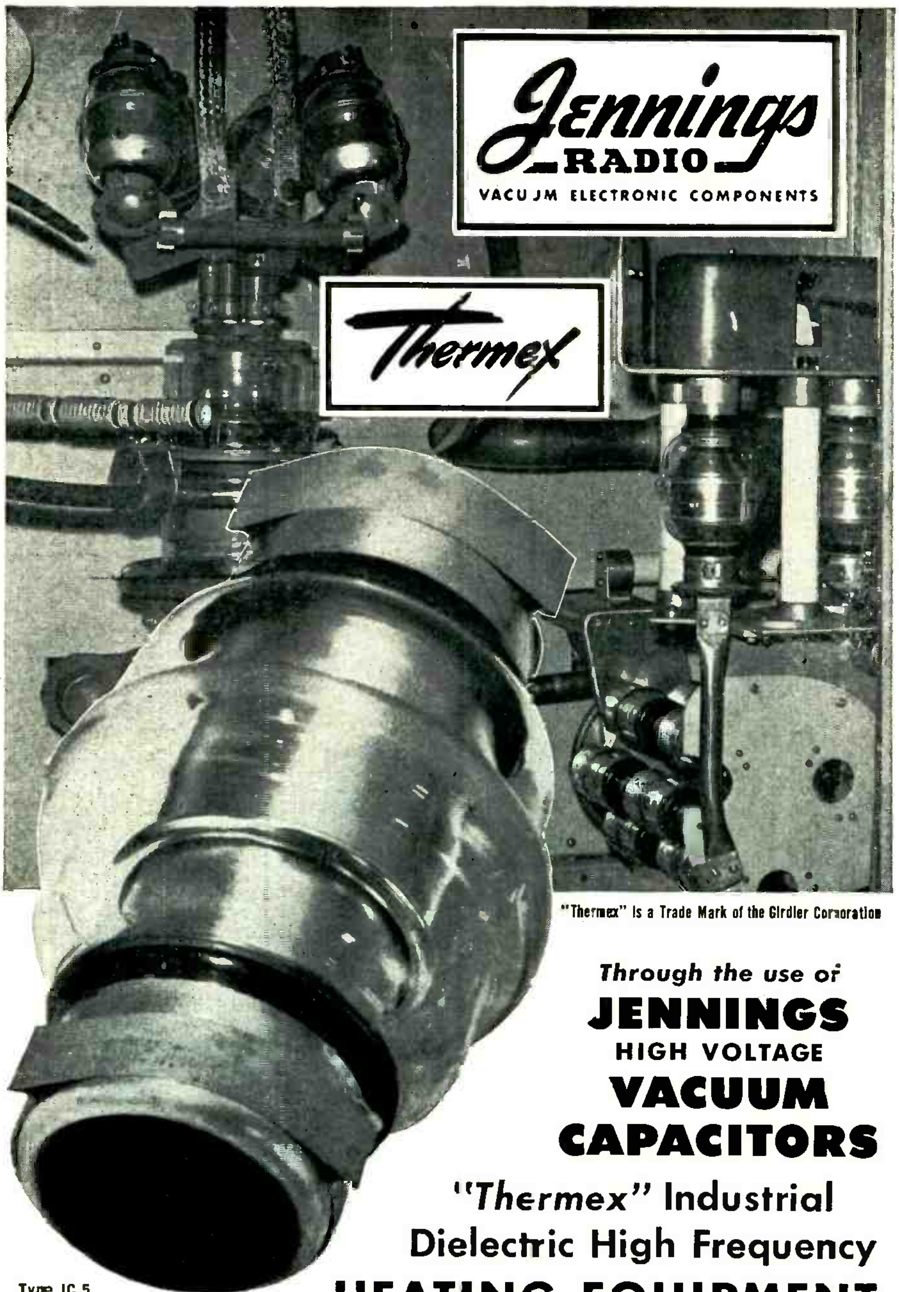

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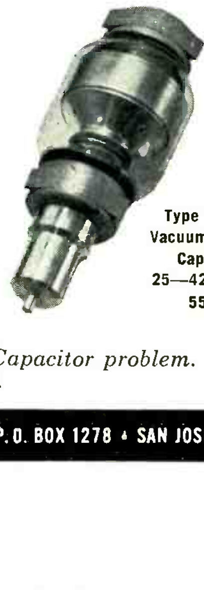
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close proximity to the rotating, charged samples.

The signal from the plate of the pickup tube is applied to the grid of a 6AH6 pentode voltage amplifier. Details of the amplifying and measuring circuits are shown in Fig. 1.

A 6AL5 dual-diode detector is connected in the amplifier plate circuit. The indicating microammeter reads detector current. The meter circuit includes a long time constant to achieve stable indication. The diode circuit returns to ground through a voltage divider network

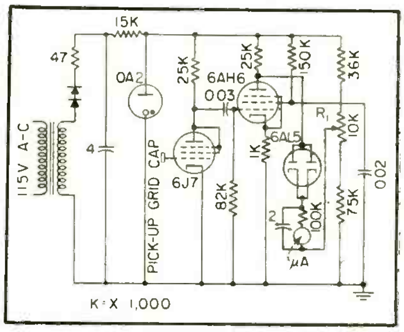

FIG. 1—Floating-grid amplifier picks up static charge. Diode meter furnishes indication of total charge and rate of decay

which includes R_1, the meter sensitivity control.

Special Application

An oscilloscope may be used with the meter to compare simultaneously the relative static electrification characteristics of five different fabric samples. Diode circuit pulses are applied to the vertical deflection plates. Using a suitable time base, one pip may be visualized from each sample. One of the six sample positions on the drum is left blank for identification purposes.

Humidity Control

Tests are usually conducted at room temperature. Fabric samples to be tested are placed within the plastic housing which is sealed before measurements are made.

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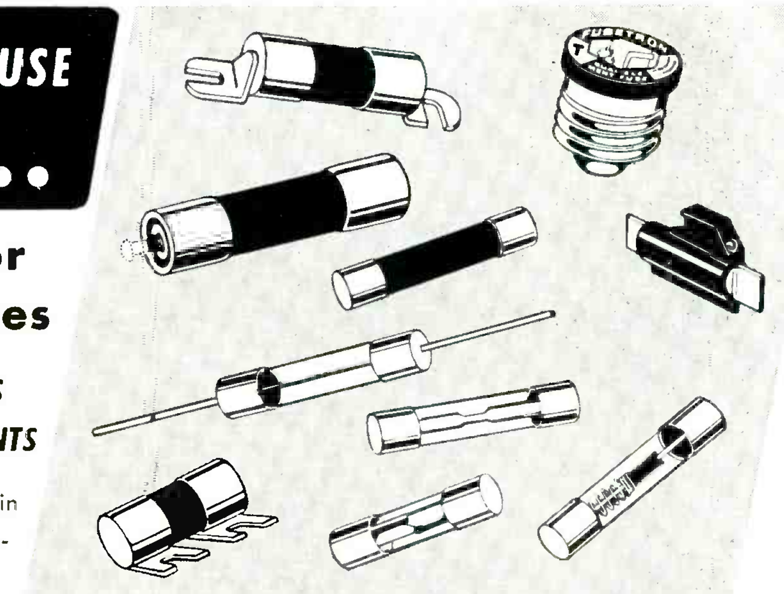

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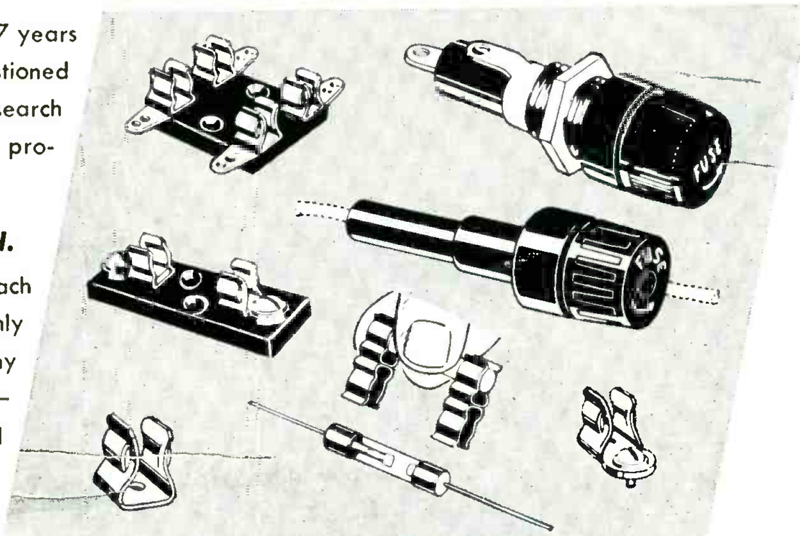

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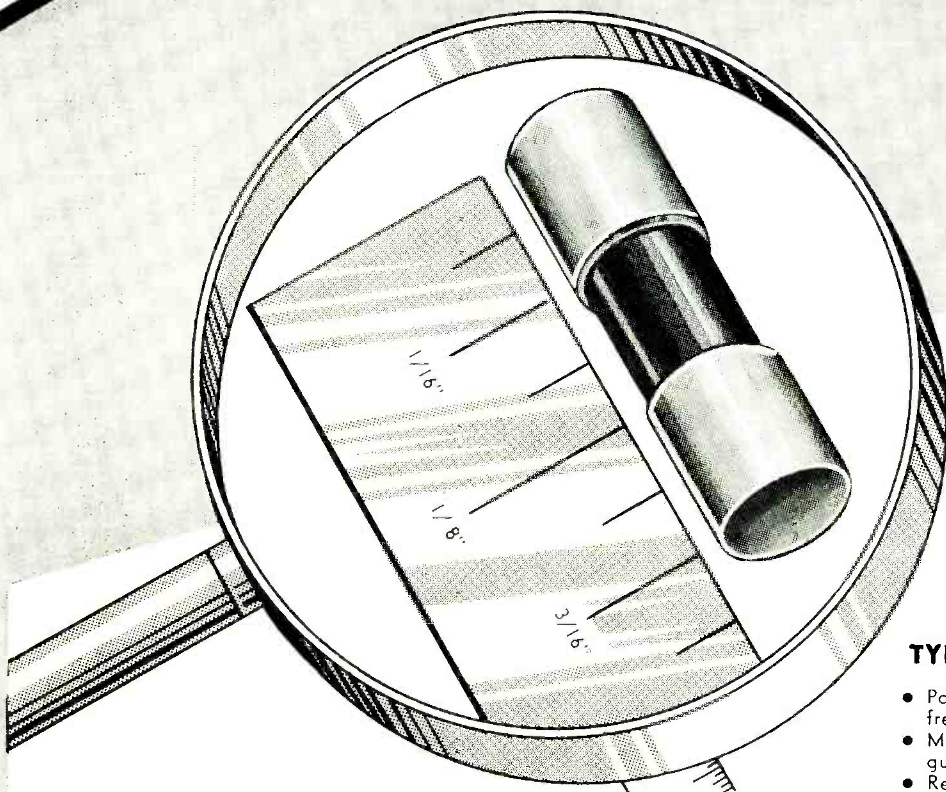

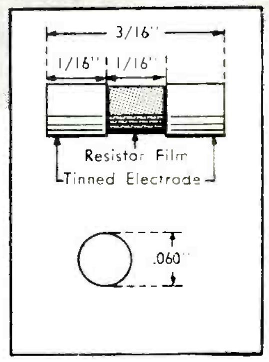

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- RF pads or attenuators
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- Impedance matching

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to the access holes to permit adjustment of the equipment while maintaining constant relative humidity.

The meter is manufactured by the American Instrument Company of Silver Spring, Maryland. The prototype of the instrument was developed by the du Pont Company's Jackson Laboratory. The author is indebted to R. E. Hadaday and W. Walton, both of the American Instrument Co., for furnishing much of the material around which this article was written.

REFERENCE

(1) M. Hayek and F. C. Chromey, Report 91, Jackson Lab., E. I. du Pont de Nemours and Co. (1950).

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Figure 1 shows the generator

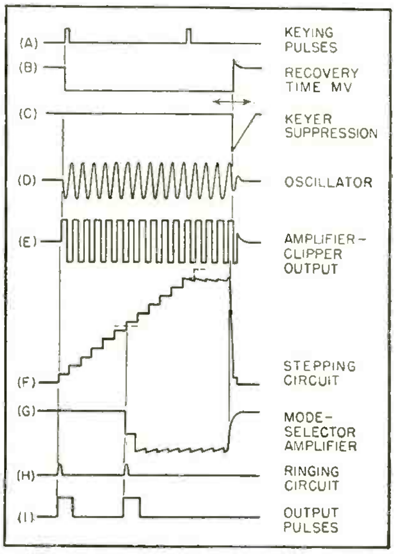

FIG. 1—Double-pulse generator waveforms

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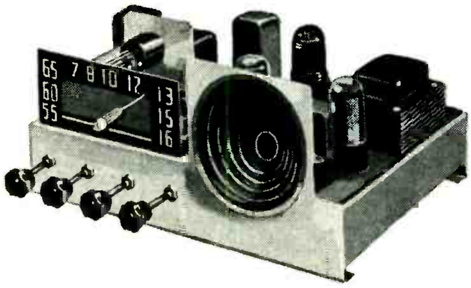
FOR RADIO 

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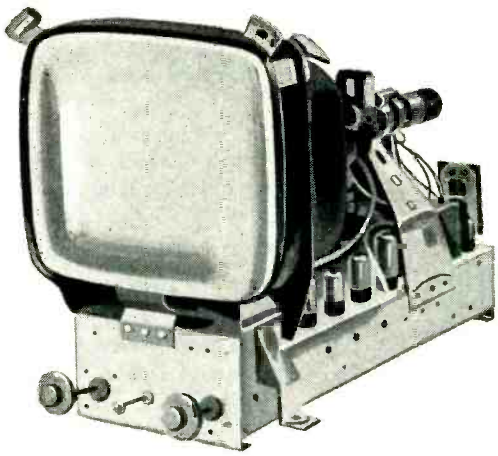
TV 

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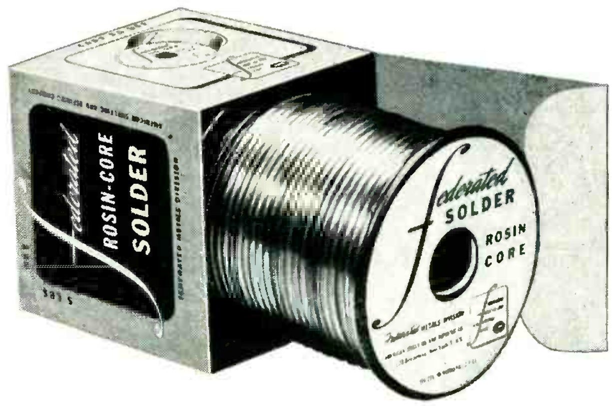
USE... 

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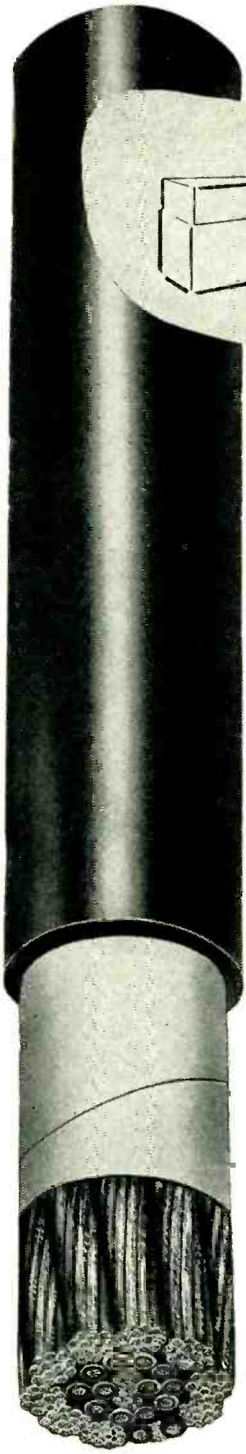

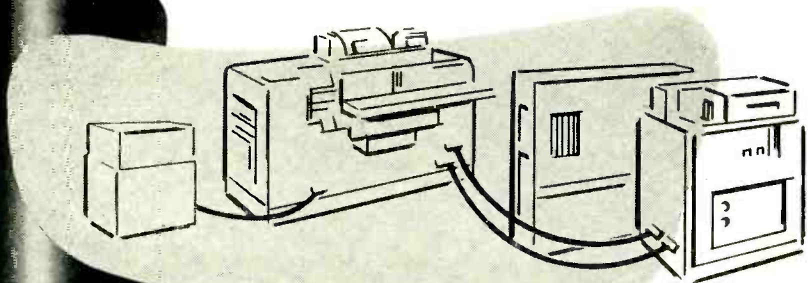

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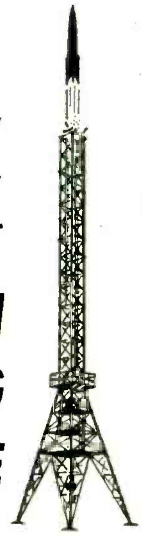

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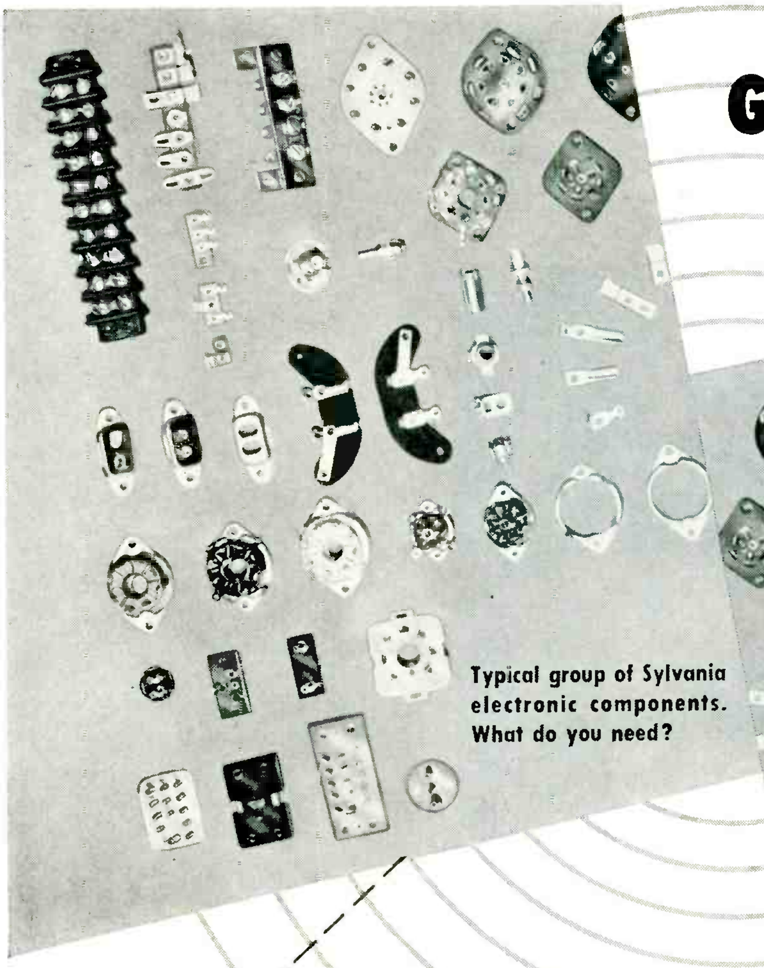

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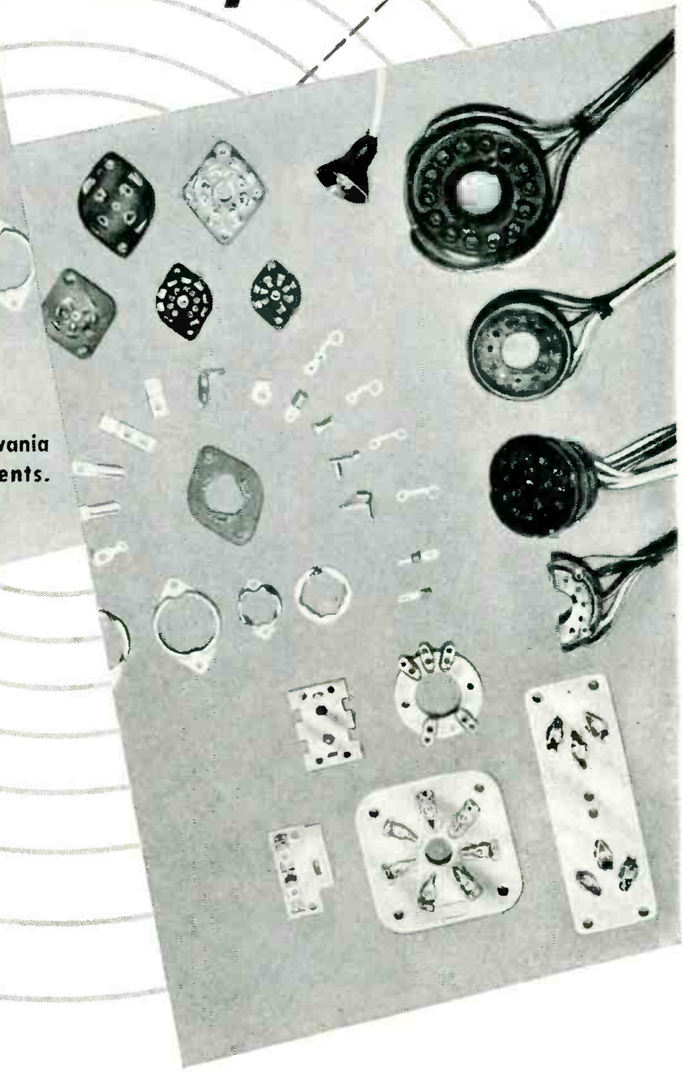

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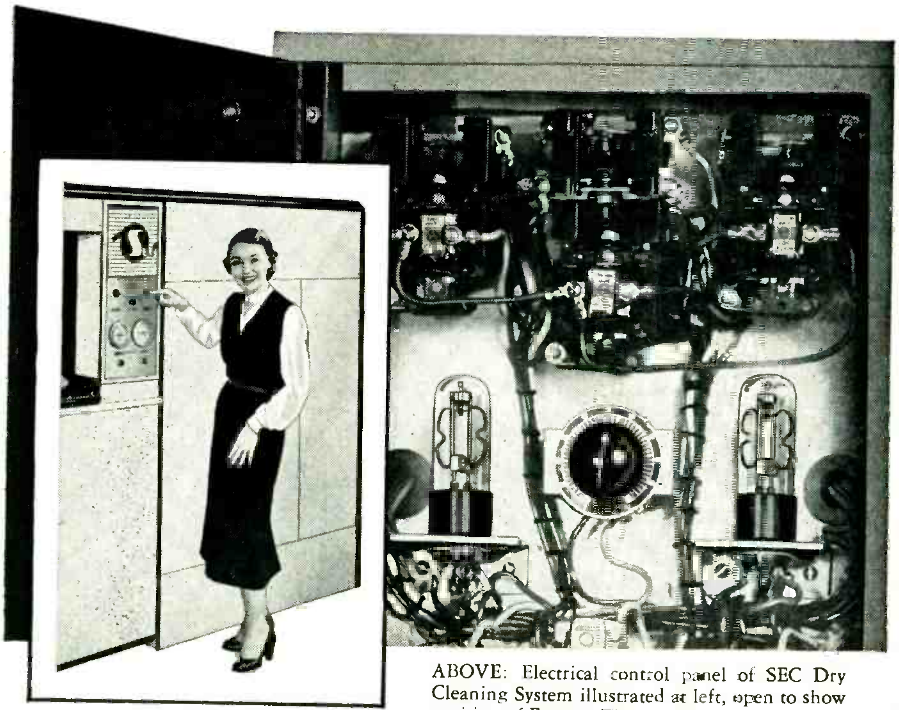

ABOVE: Electrical control panel of SEC Dry Cleaning System illustrated at left, open to show position of EDISON Thermal Relays.

THE SEC-O-MATIC CORP. chose the EDISON Model 501 Time Delay Relay to provide an automatic delay period in the washer and extractor cycles of their SEC automatic dry cleaning system.

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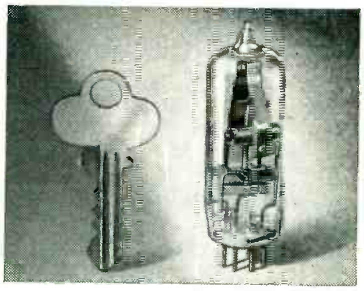

ASK FOR Bulletin E4-3027 on the new EDISON *Miniature* Thermal Relay.

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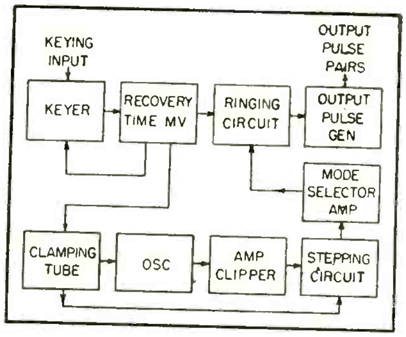


FIG. 2—Block diagram of the double-pulse generator

waveforms while Fig. 2 illustrates its principle of operation in block-diagram form. Single keyer pulses activate the driver stage which triggers a monostable multivibrator. The trailing edge of the multivibrator waveform is differentiated and used to cut off the keyer. Recovery time equals the multivibrator period plus the length of the differentiated pulse

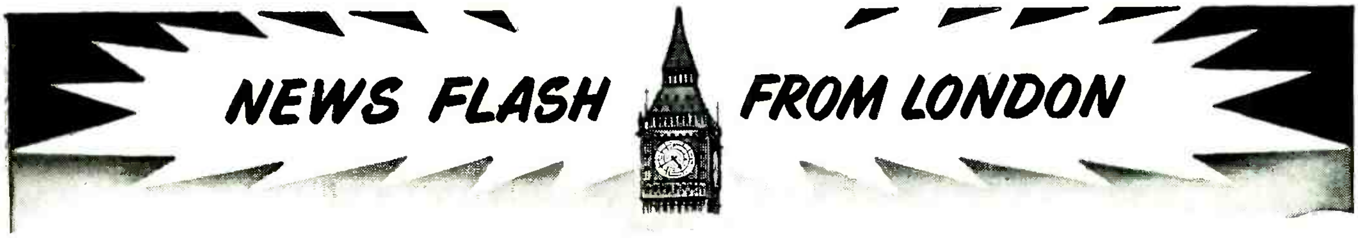
The leading edge of the multivibrator waveform drives a ringing circuit producing a short, half-sine-wave pulse shown in Fig. 1H. This pulse keys the output multivibrator to produce the first pulse of the output pair.

The recovery-time multivibrator also operates a clamping tube which permits an r-f oscillator to function during the m-v period. Its wave form is clipped as shown in Fig. 1E and applied to a stepping circuit which determines the twelve multiple modes. The step waveform drives a mode selector amplifier; the setting of the mode switch determines which of the steps will drive the amplifier into conduction thereby driving the ringing circuit to produce the second pulse of the output pair.

This information was abstracted from a Naval Research Laboratory report entitled "A Double-Pulse Generator for Transponder Simulation" by C. C. Watterson.

Direct-Acting Automatic Circuit Controller

A COMPACT automatic circuit controller of the direct-acting finger type known as the Regohm, is manufactured by the Electric Regulator Company of Norwalk, Conn. The controlled circuit components



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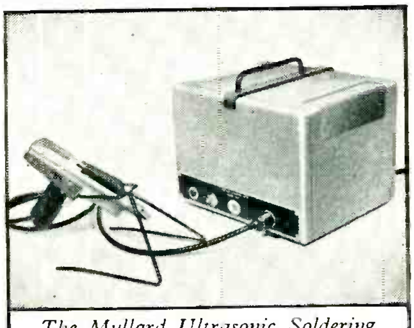

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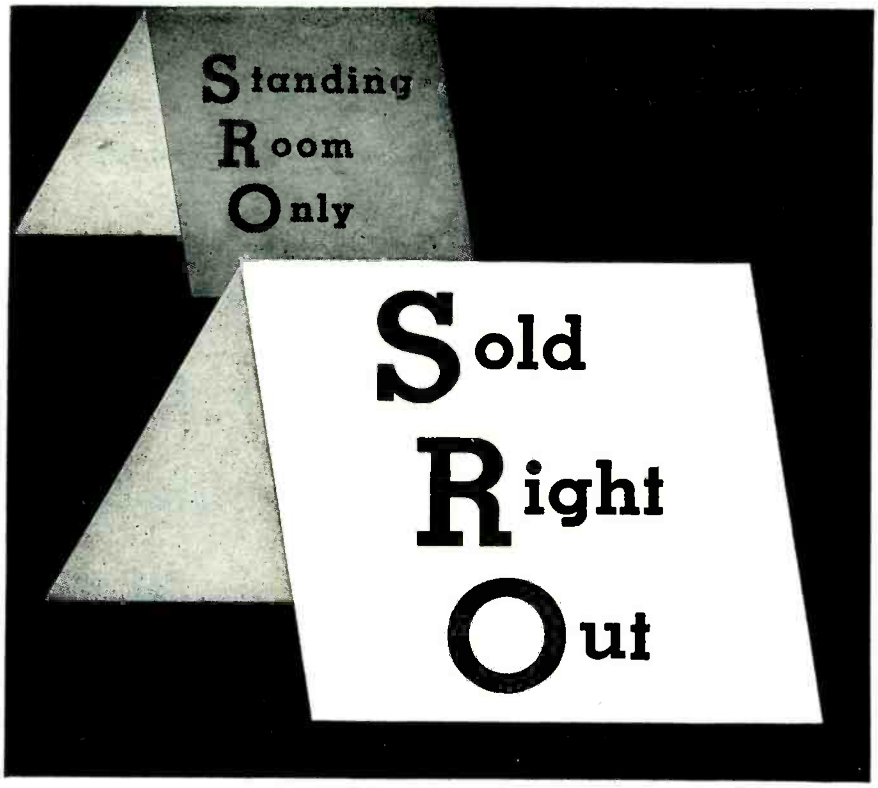

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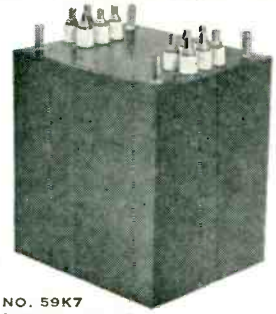

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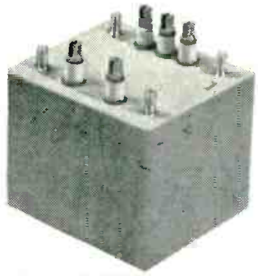

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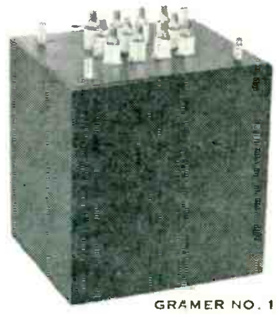

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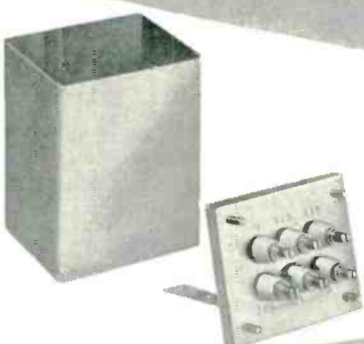

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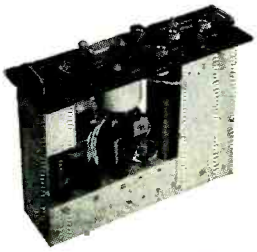

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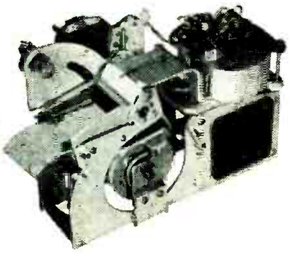

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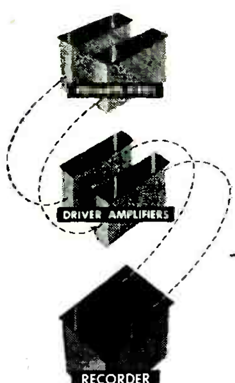
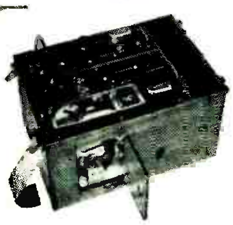


Any of the recording channels in the three systems at the right may include *either* a Strain Gage or General Purpose Amplifier, or the latter in combination (in 2-, and 4-channel systems) with either AC or DC Preamplifiers. For, any of the Amplifiers or Preamplifiers provided for in a system may be quickly *removed* from its place in the system and as quickly *replaced* with an alternate type.



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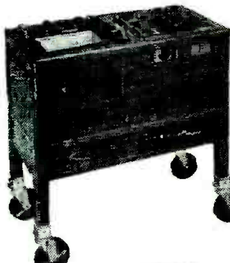

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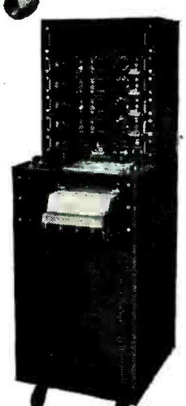

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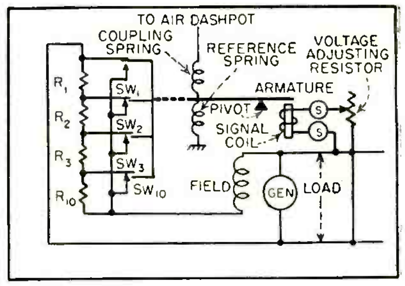

FIG. 1—Schematic-mechanical drawing showing operating principle of the controller

which are resistors in most cases are located outside the unit. The device has applications on many electric circuits.

Figure 1 is a combination schematic-mechanical drawing showing how the controller operates. The signal coil is connected in the signal circuit by means of terminals S. When energized, the signal coil attracts the armature and causes it to pivot against the action of a reference spring. The armature, in this manner, transduces variations in signal-coil energy into position variations. The armature is mechanically connected to a series of pairs of contact SW_1 through SW_{10}.

Each pair consists of a fixed finger with a resilient finger normally contacting the fixed finger. When the armature pivots in response to increased energy in the signal coil, the reference spring is extended. This action causes the resilient fingers of each pair to lift in sequence from their fixed fingers opening first SW_1, then SW_2, and so to SW_{10}.

An impedance unit is shunt-connected with the finger pairs. All of the finger pairs are closed when the energy fed into the signal coil is less than a predetermined value. At that time, all of the resistors are shorted out of the controlled circuit.

The armature pivots when the signal coil energy increases above pickup value. This action extends the reference spring and opens the first finger pair SW_1. Resistor R_1 is then placed in the controlled circuit. If the signal coil energy remains high, the armature pivots further and opens finger pair SW_2. Resistor R_2 is then inserted in the controlled circuit. The action continues in a similar manner for the

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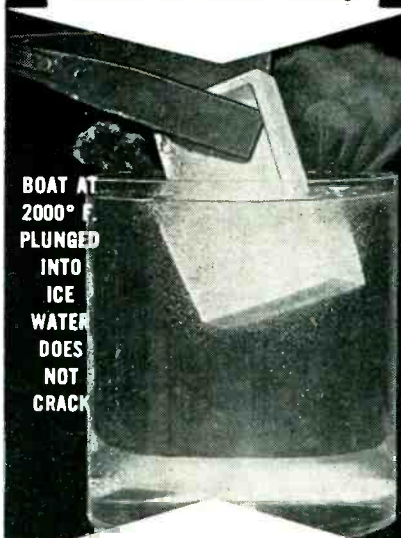

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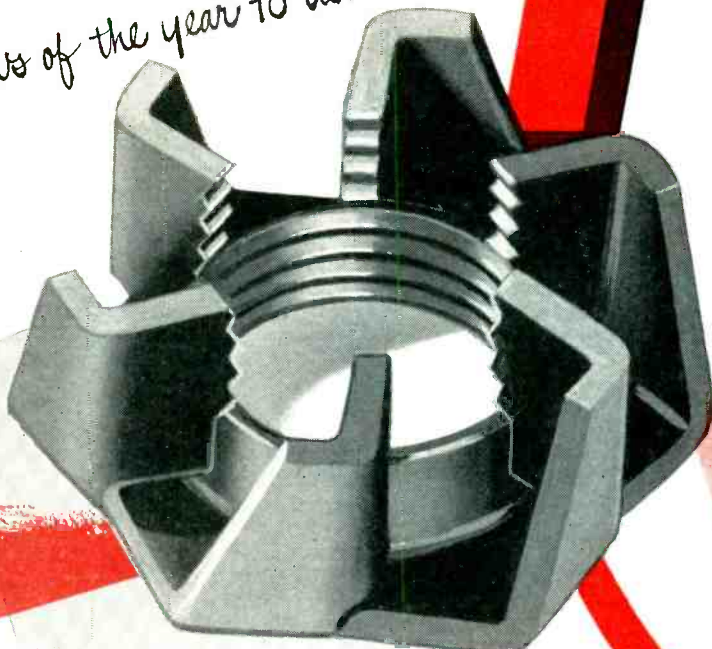

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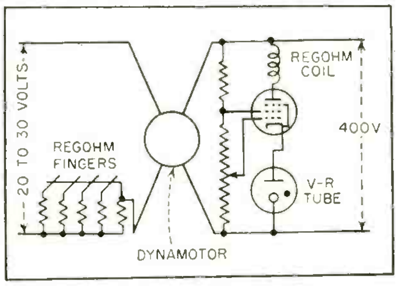

FIG. 2—Power amplifying and impedance watching abilities of stepped-resistance controller in a Motorola design

other finger pairs.

When SW_{10} opens, all of the resistors are in the controlled circuit. When the signal coil energy decreases, the armature pivots in the opposite direction. The reference spring contracts and SW_{10} to SW_1 close. Resistors R_{10} through R_1 are removed from the controlled circuit one by one.

A typical circuit application is shown in Fig. 2.

Ozone Generator

By Irving Gottlieb
Electrical Engineer
Mountain View, Calif.

The Electronic ozone generator depicted in Fig. 1 is very efficient, relatively immune to dust and involves no hazardous potentials. The efficiency is high because effective heat removal is possible with a small fan or blower to the extent that ozone is evolved from surfaces at near ambient temperature.

One "plate" consists of two rings of small gage wire, the other is the ionized gas within the VR tube. The dimensions and thermal characteristics of the plates and the accessibility of the glass dielectric to moving air allow for sufficient cooling. A second reason for efficient ozone generation is that the high frequency employed 200 kc, imparts more energy to the oxygen molecules than 60-cycle power of the same voltage.

The 200-kc autotransformer is of the type previously used in tv receivers for the high-voltage supply to the picture tube and is rated at 9 kv peak. The 807 oscillates vigorously in the simple regenera-

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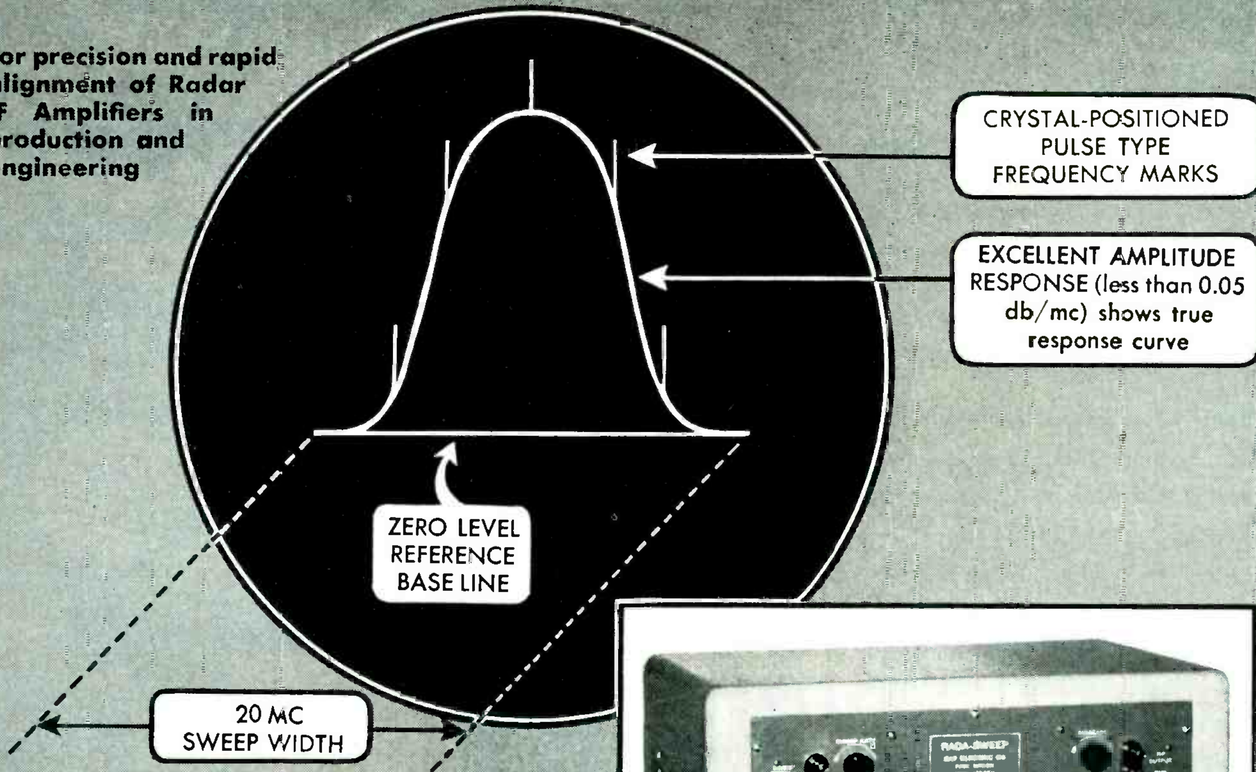

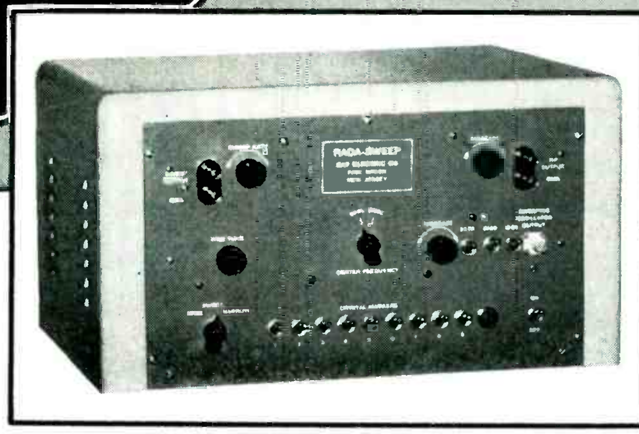

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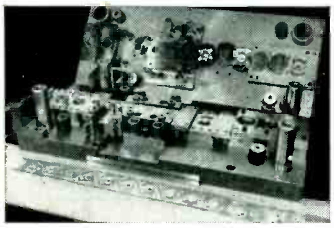

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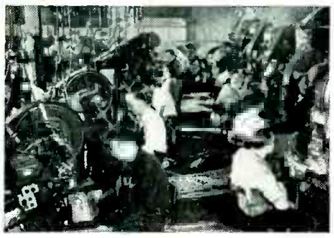

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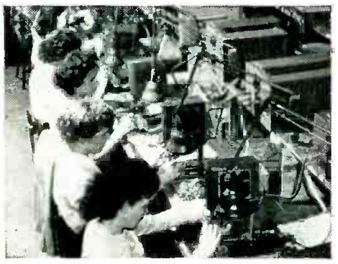

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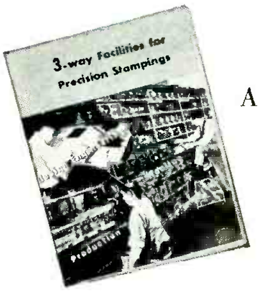

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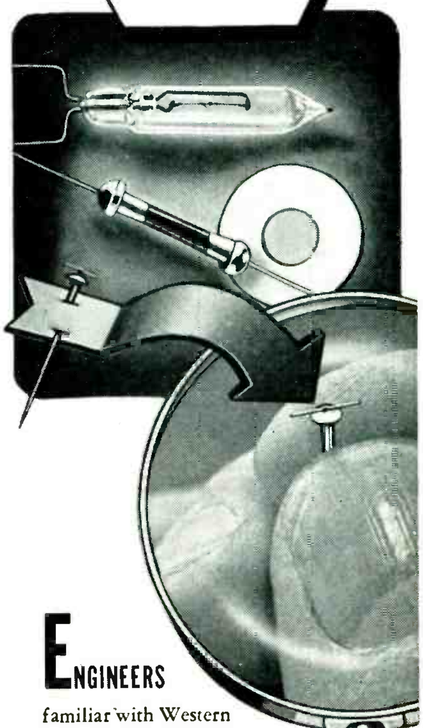

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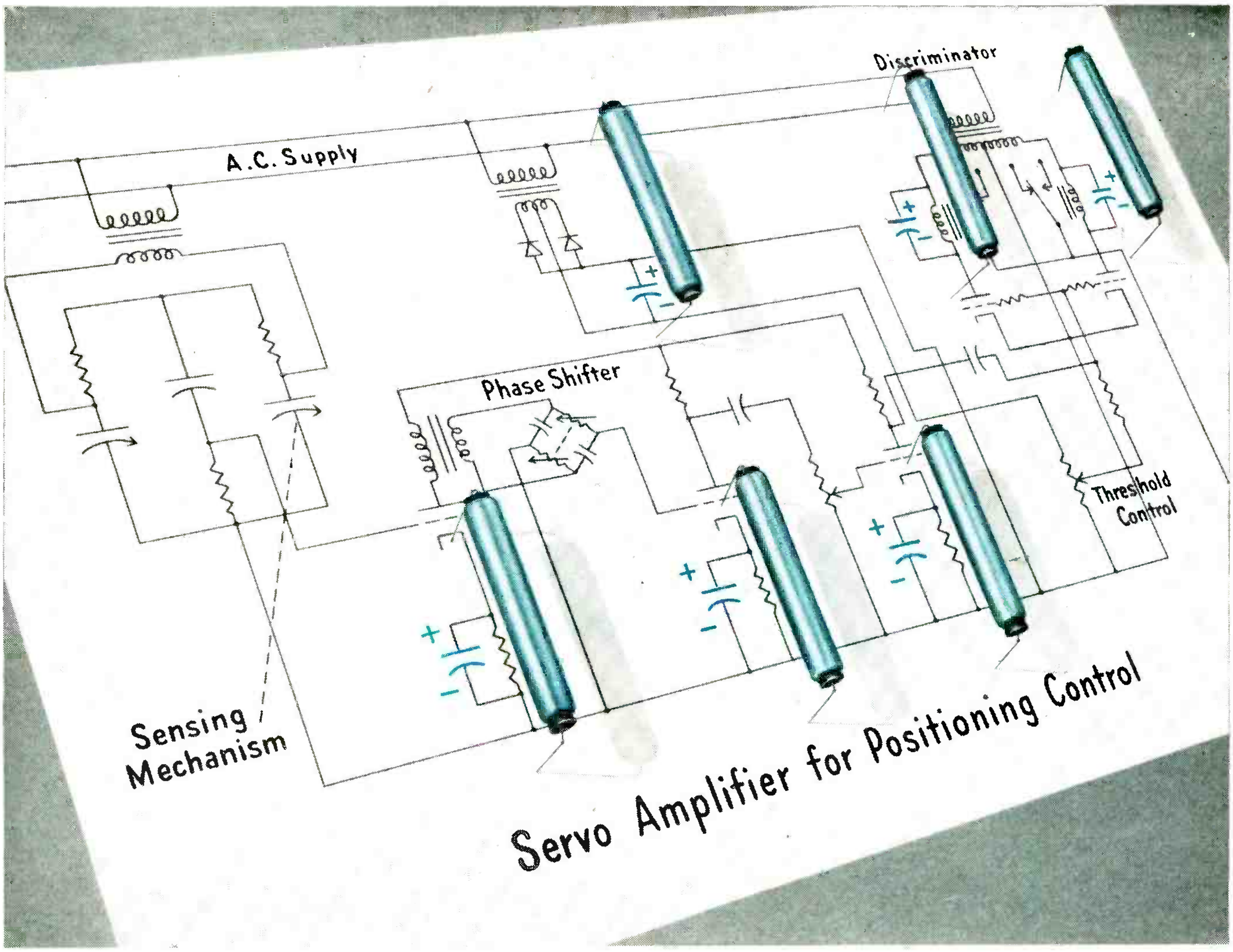

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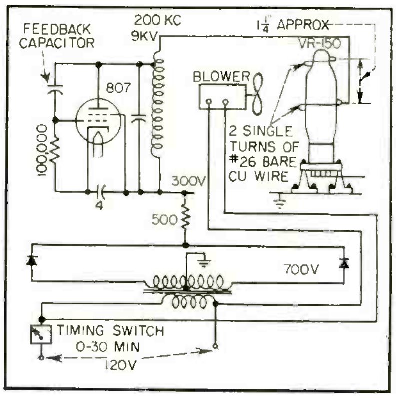

FIG. 1—Schematic and mechanical set-up for the ozone generator

loudest audible hiss emanating from the tube, this coinciding with maximum ozone generation. This capacitance completes the R-F circuit through the tube.

It should be appreciated that, without a fan or blower, the dielectric heating beneath the wire rings is sufficient to puncture the glass of the VR tube. However, the area of glass subjected to intense dielectric heating is small so that almost complete cooling results from the presence of a small fan or blower. The author has also experimented with gaseous quartz tubes which results in a further increase in ozone production from the action of a usable amount of ultraviolet light transmitted through the quartz envelope.

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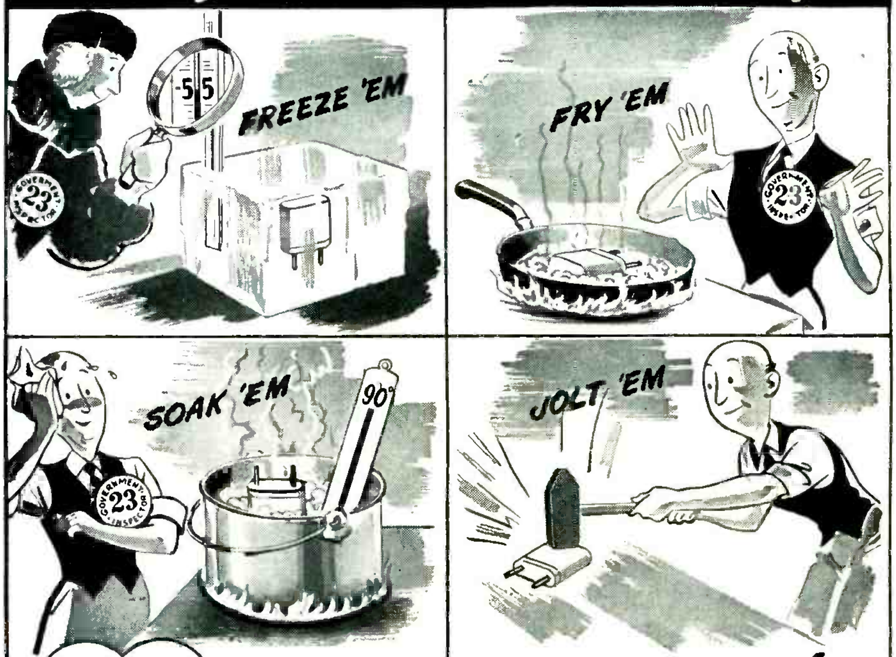

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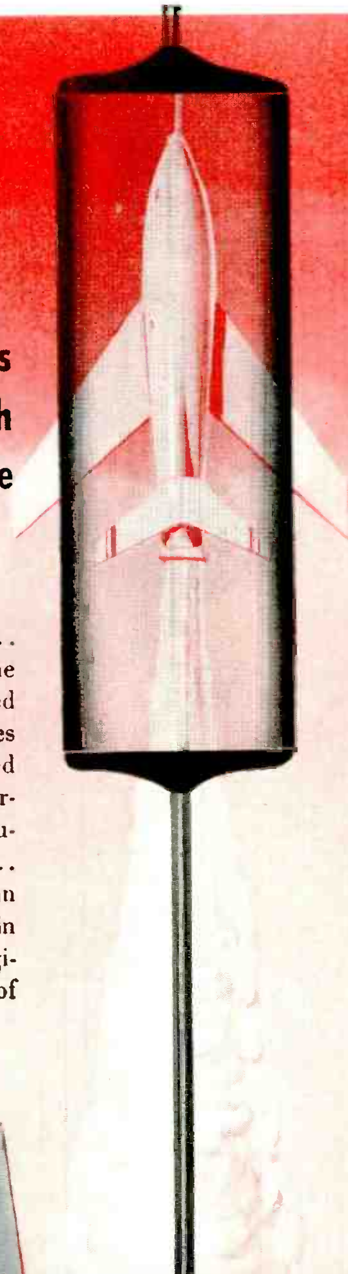

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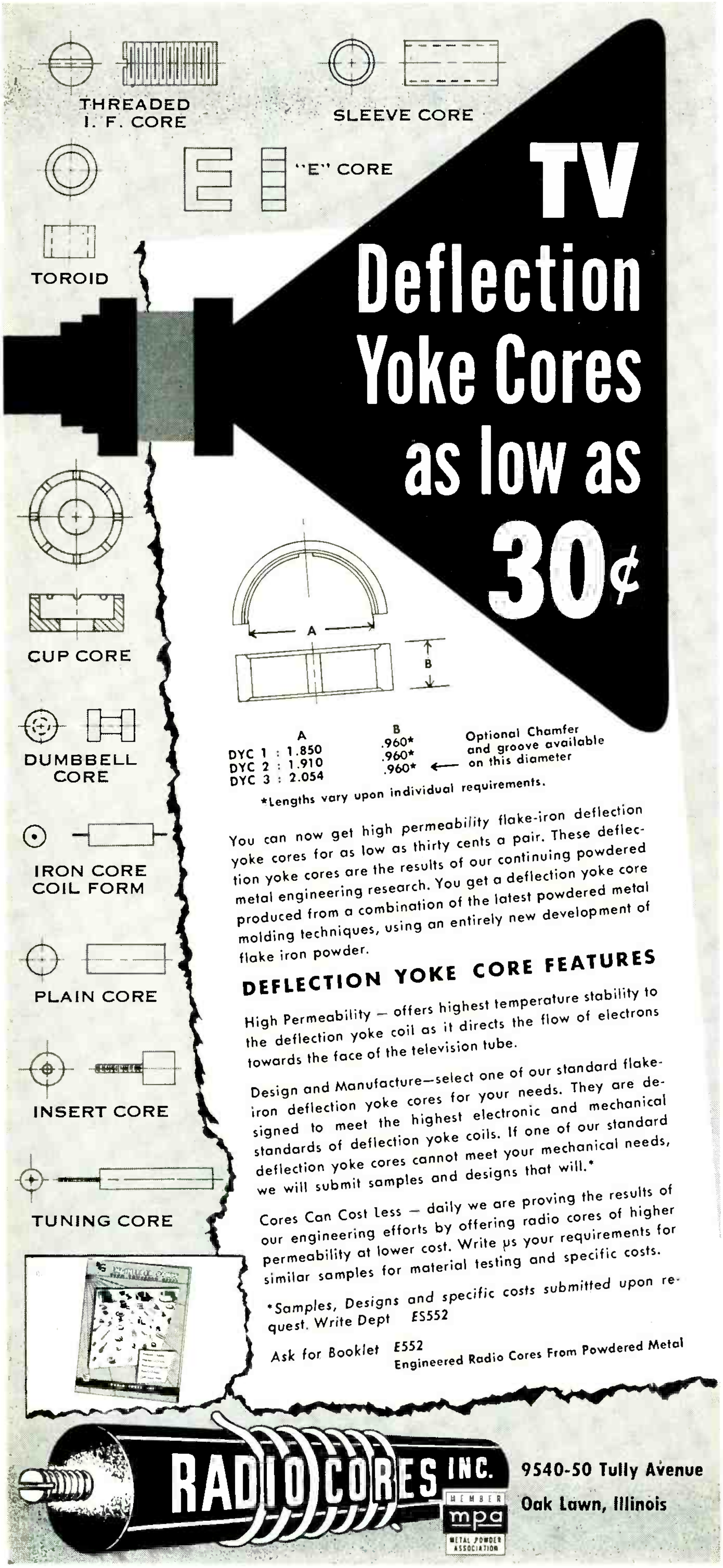

of its chemical energy, ozone diffuses readily into the air of a room. In twenty minutes, a room having an area of up to 400 square feet can be de-odorized. An additional ten minutes should be allowed to enable the surplus ozone to decompose into oxygen.

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To provide the desired condition of substantially equal mark and space potentials with opposite polarity referred to ground at the output of the converter discriminator, the receiver must be tuned to the mean or center frequency of the transmitter, often termed the phantom carrier.

In frequency-shift reception, the signal is either at the mark or space frequency usually without reaching a statistical average at the center frequency on a short-term basis. It therefore fails to produce the zero-average discriminator current required for tuning converters using the conventional zero-center, d-c voltmeter, tuning indicator. An instantaneous-type indicator is therefore required such as a cathode-ray tube.

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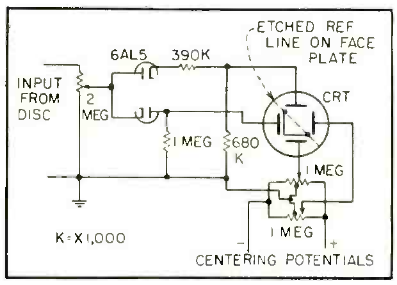

FIG. 1—Basic circuit of L-pattern tuning indicator

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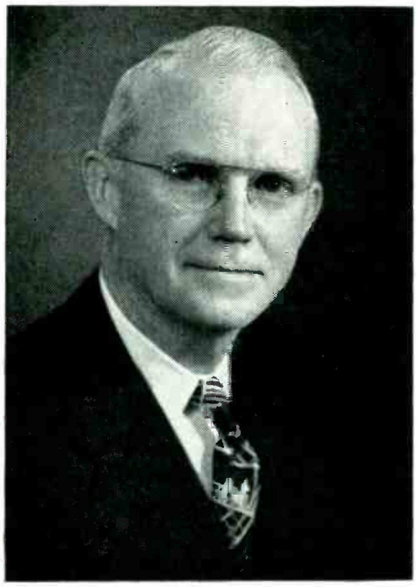

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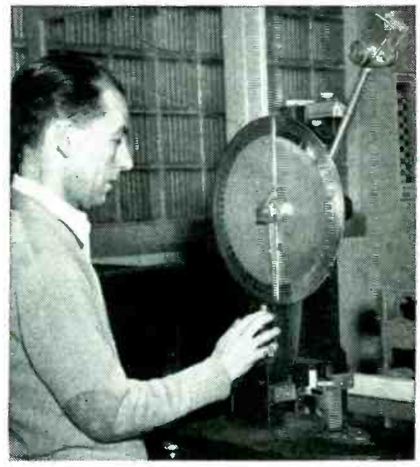

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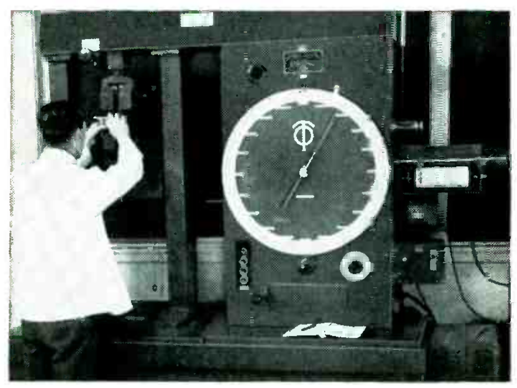

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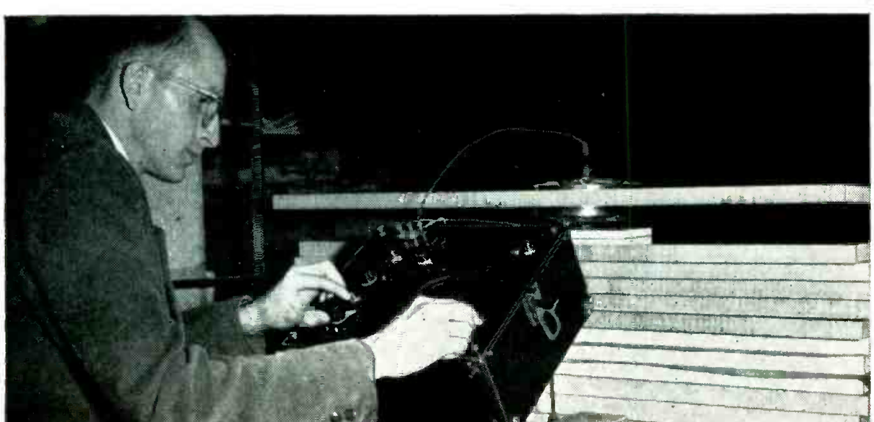

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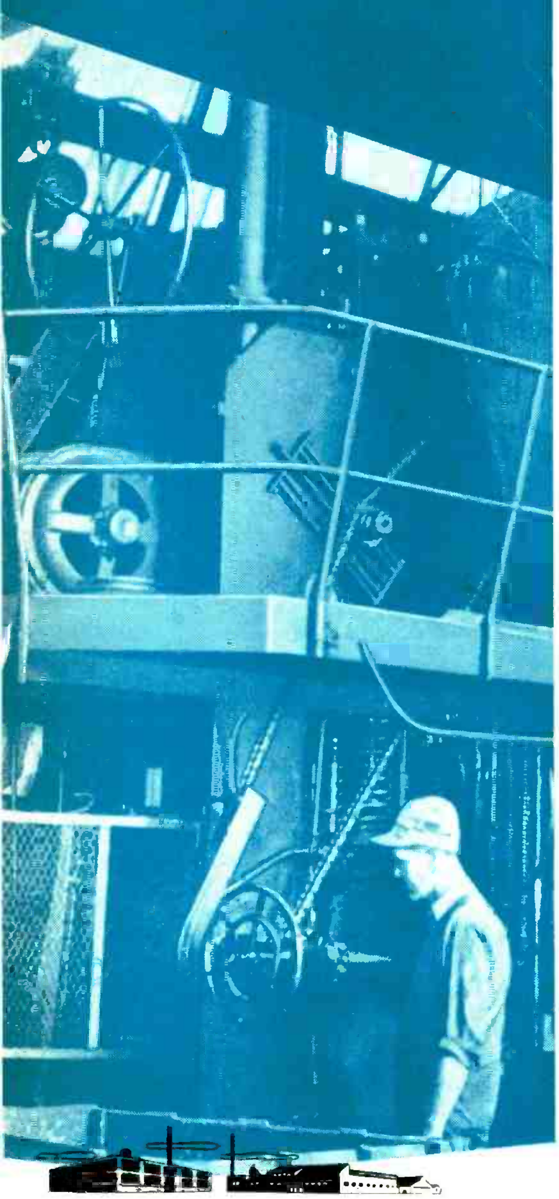

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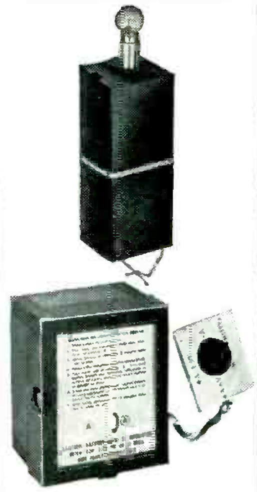

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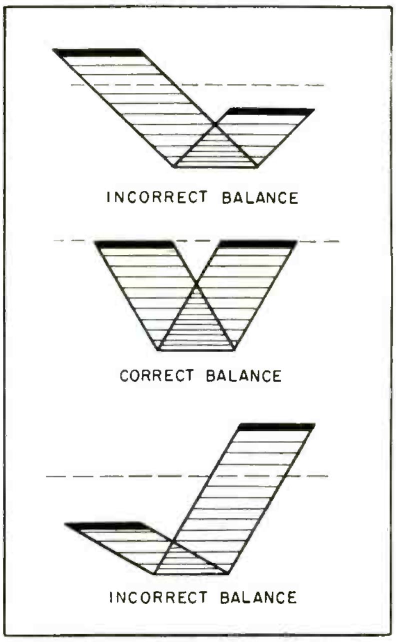

FIG. 2—Calibration patterns for correct and incorrect balance-control adjustments

simple two-line tuning pattern has also been found reliable as well as inexpensive.

When the receiving discriminator's mark signals are applied to one pair of deflection plates of the indicating crt and the space signals to the other pair, a figure L will be displayed on the screen. To obtain the L-shaped pattern, a polarity-gating device consisting of two thermionic diodes is connected between the source of alternating current and the scope plates as shown in Fig. 1. The crt is then oriented with respect to a reference line etched on its face to obtain the desired V-shaped pattern.

Figure 2 illustrates the tuning pattern. The sweep shown is provided by coupling the output of a 6,000-cps R-C oscillator to a horizontal deflection plate. A pentode d-c amplifier stage completes the unit.

The simple two-line tuning indicator presents the patterns shown in Fig. 3. Output from the discriminator is connected across the vertical deflection plates. The second dimension of the pattern is obtained by application of a sine-wave source to the horizontal plates as in the case of the collinear V indicator. Here, however, the frequency need be only three times the input frequency. Since a keying

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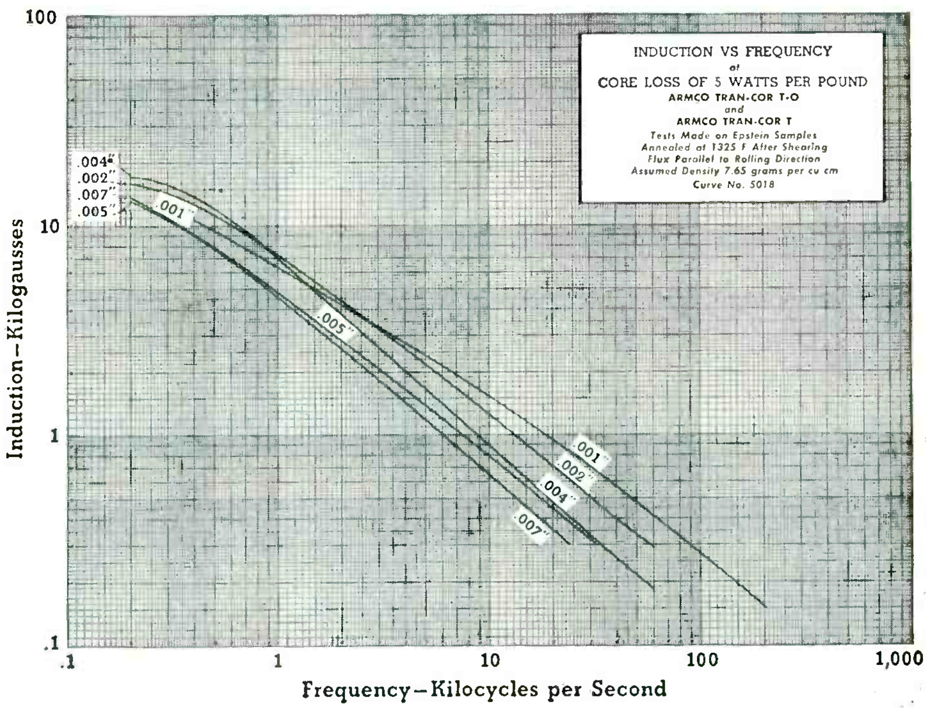

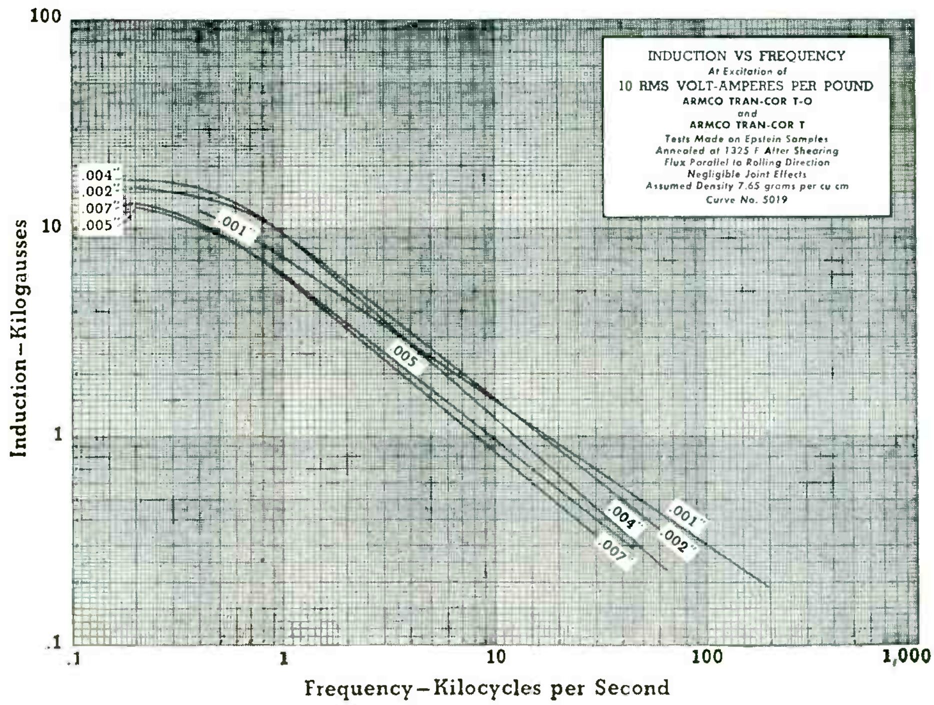

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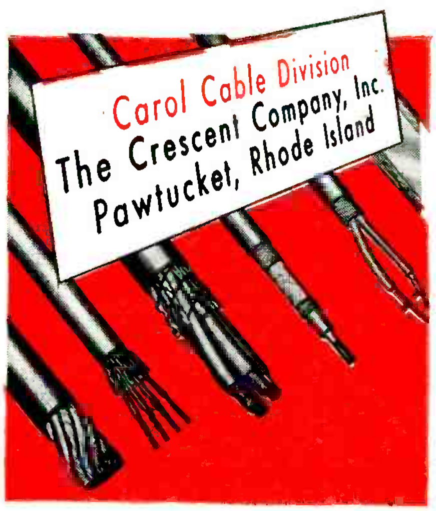

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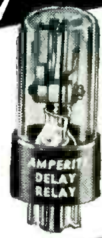

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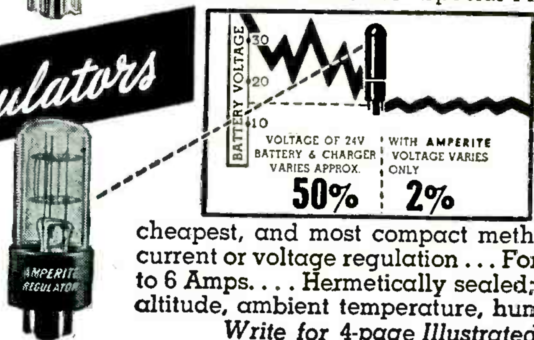

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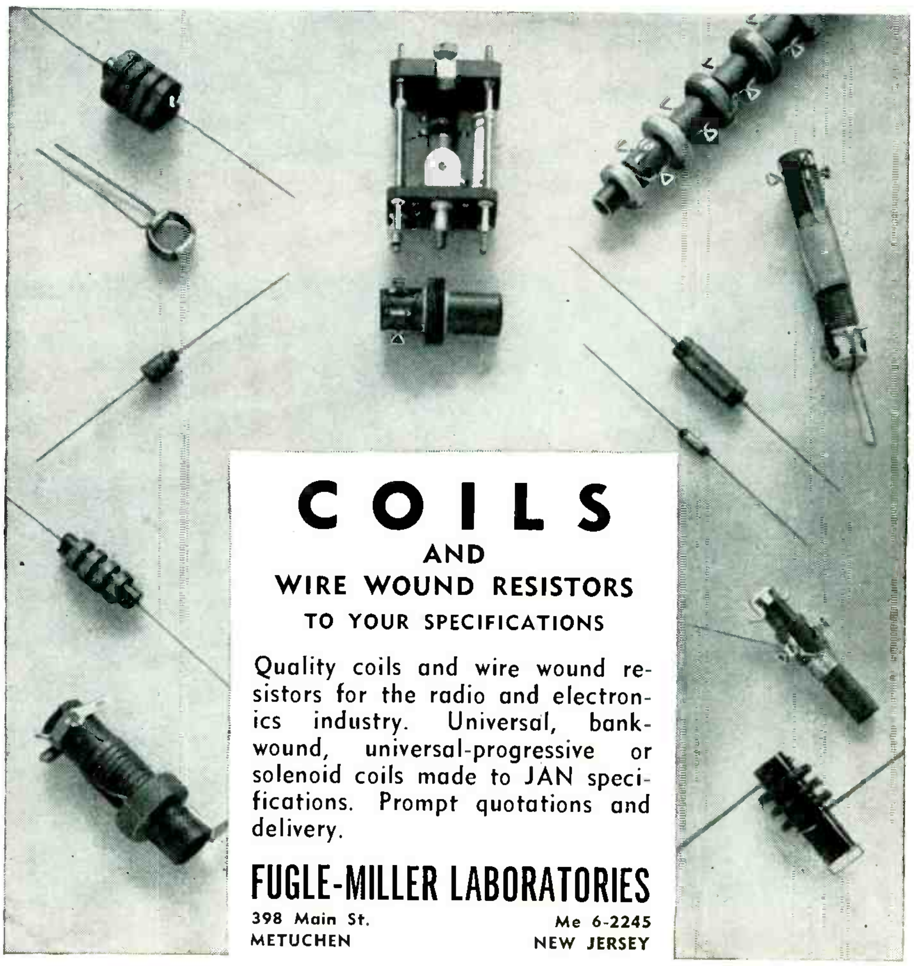

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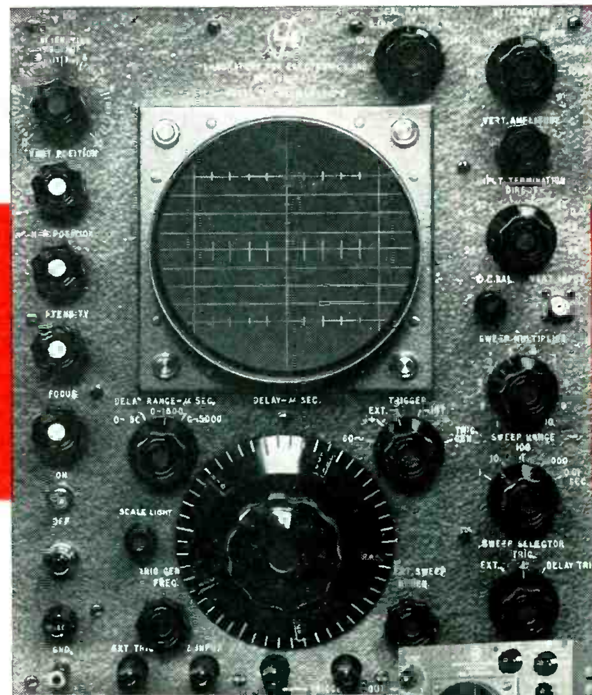

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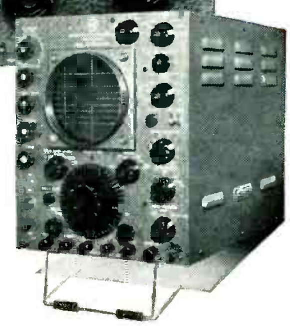

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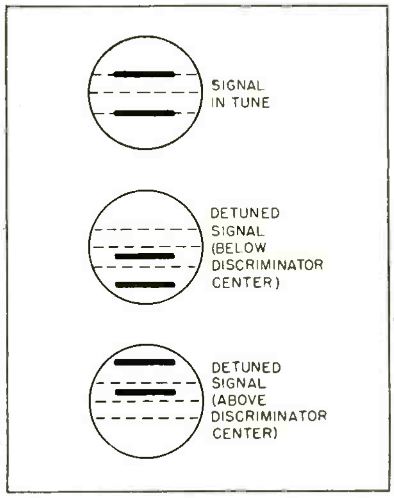


FIG. 3—Patterns obtained with two-line tuning indicator

speed of 60 wpm is equivalent to a 22-cps square wave, any 60-cps source will be adequate, obviating the need of a built-in sweep oscillator.

To insure adequate deflection voltage, a preamplifier is added ahead of the tuning indicator. Here linearity and stability requirements are stringent and a cathode-coupled d-c amplifier has been adapted to this application.

As illustrated in Fig. 4, the cathode-coupled d-c amplifier is most easily explained by considering a voltage increment Δe_s between the grid of V_a and B^-. If this causes the grid of V_a to become more positive with respect to ground, V_a plate current increases producing an increased voltage drop across R_3 and part of R_4 and R_k.

The cathode of V_b likewise becomes more positive since the cathodes of both tubes are tied together. However, since the V_b grid is grounded this has the effect of making the grid more negative. Consequently, the V_b plate current

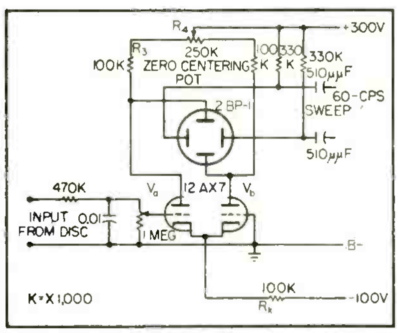
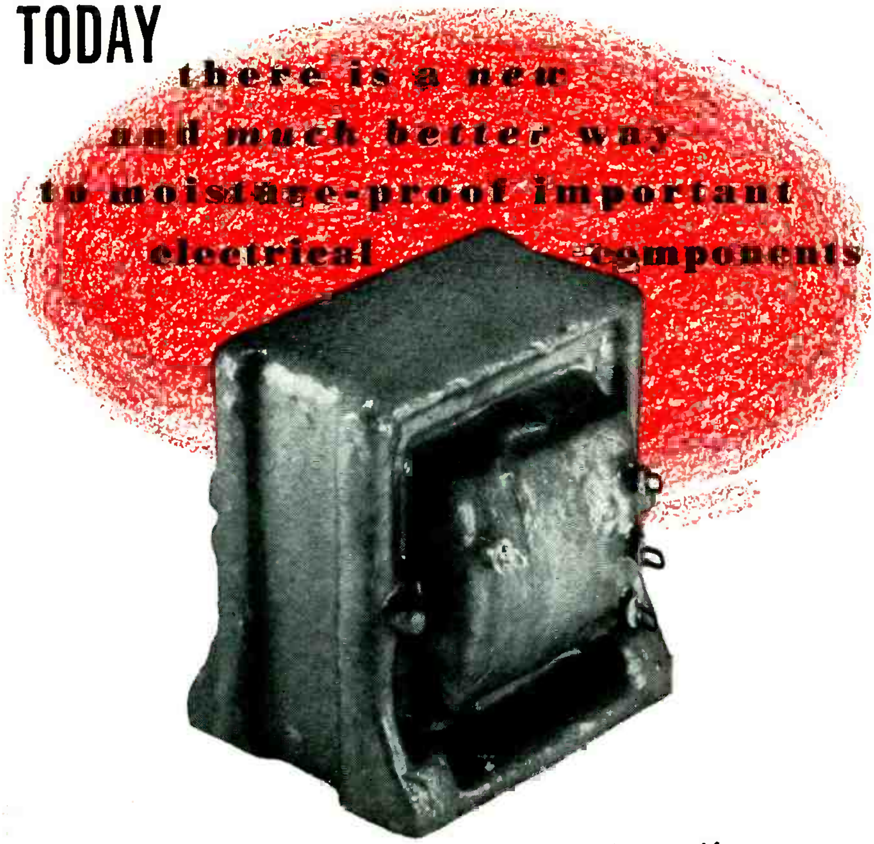


FIG. 4—Basic indicator circuit utilizing modified cathode-coupled amplifier

TODAY



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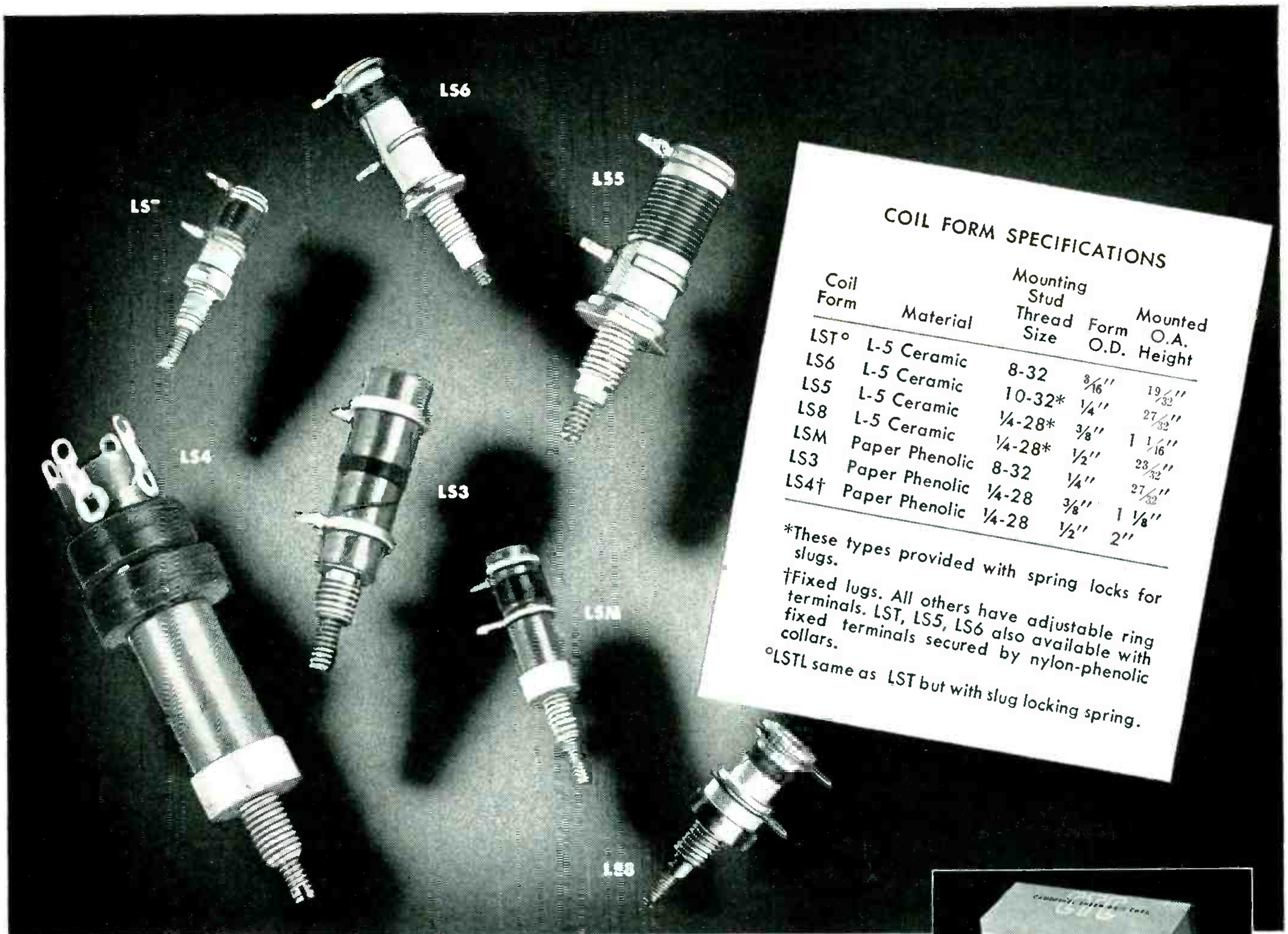

Coil Form	Material	Mounting Stud Thread Size	Form O.D.	Mounted O.A. Height
LST°	L-5 Ceramic	8-32	3/16"	19/32"
LS6	L-5 Ceramic	10-32*	1/4"	27/32"
LS5	L-5 Ceramic	1/4-28*	3/8"	1 1/16"
LS8	L-5 Ceramic	1/4-28*	1/2"	23/32"
LSM	Paper Phenolic	8-32	1/4"	27/32"
LS3	Paper Phenolic	1/4-28	3/8"	1 1/8"
LS4†	Paper Phenolic	1/4-28	1/2"	2"

*These types provided with spring locks for slugs.

†Fixed lugs. All others have adjustable ring terminals. LST, LS5, LS6 also available with fixed terminals secured by nylon-phenolic collars.

°LSTL same as LST but with slug locking spring.

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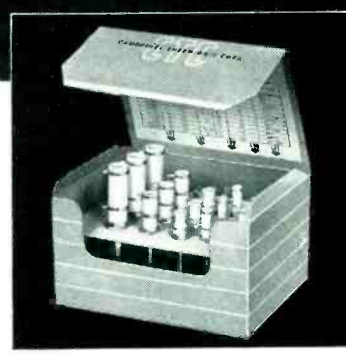

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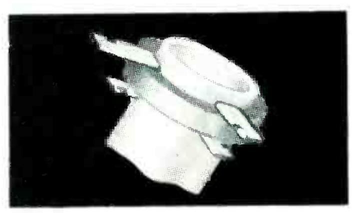

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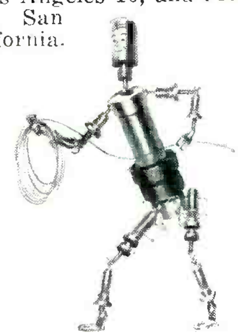

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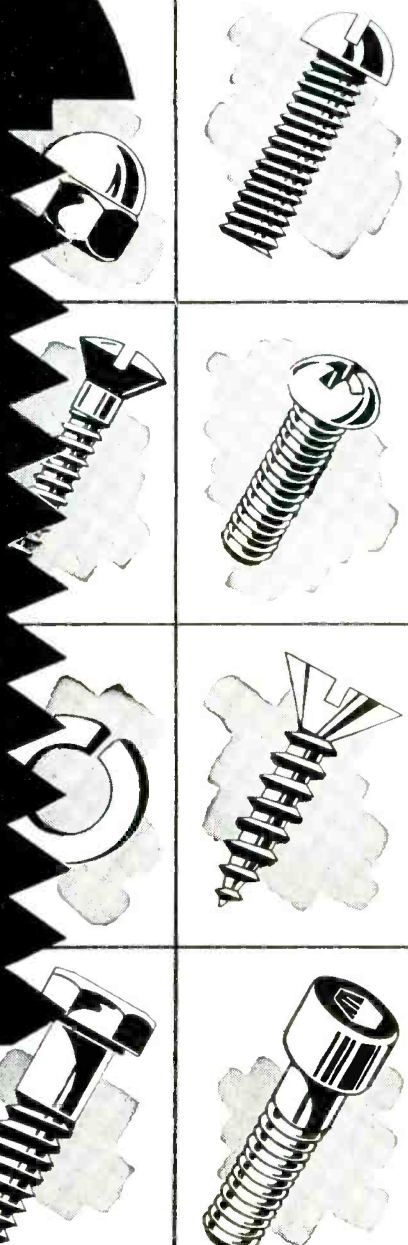

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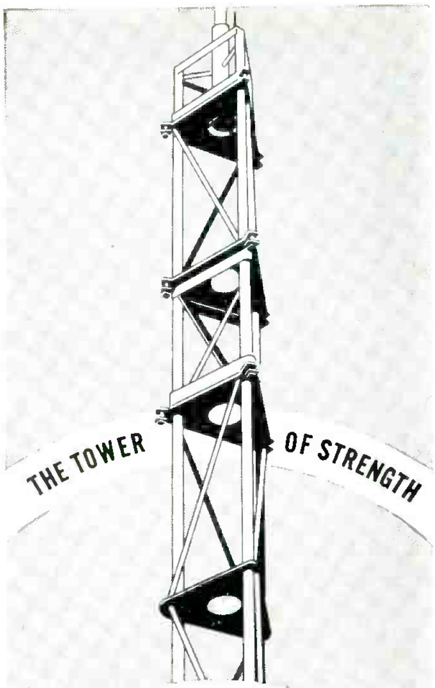

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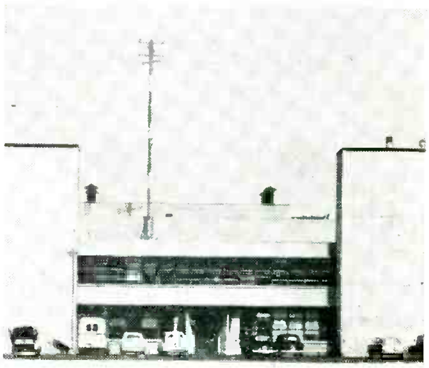

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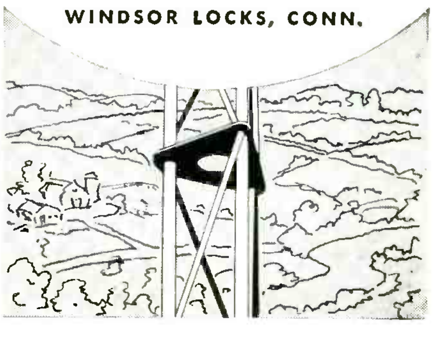

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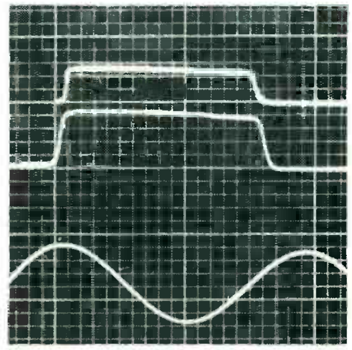

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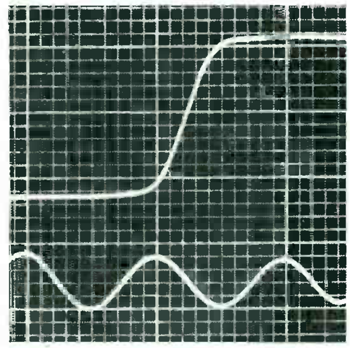

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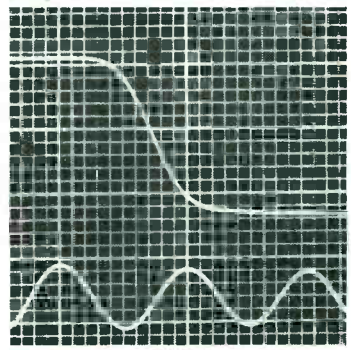

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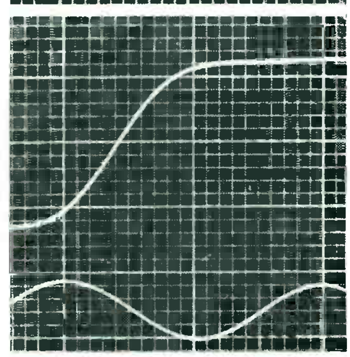

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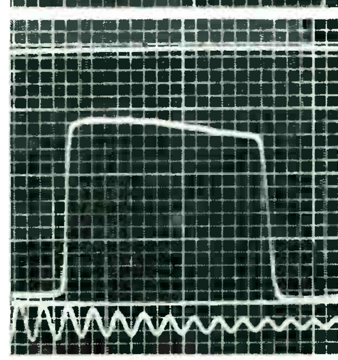

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decreases, its plate potential becomes more positive and a second output is provided which is in phase with Δe_s but opposed to the output of V_a.

This material was abstracted from a Naval Research Laboratory report entitled "Monitor Tuning Indicators for FSK Reception" by C. E. Young.

Underwater Sound Scattering

MODEL TECHNIQUES are being applied to the study of underwater sound scattering phenomena at Harvard University's Acoustics Research Laboratory. The equipment used is shown in block diagram form in Fig. 1.

Carrier frequency for the transmitter is one mc, so chosen to simulate, on a much reduced scale, scattering effects resulting from deep-water equipment operating just above the audio range.

The pulse-repetition rate, which may be varied from 50 to 500 kc is derived from an f-m pulse-rate generator whose output likewise is employed to trigger the horizontal sweep of the indicating oscilloscope. Pulses are applied to a boot-strap keying circuit. One-mc X-cut quartz crystals are used in both the transmitting and receiving transducers. The pulse width may be varied from 16 to 64 microseconds.

Receiver output is applied to the vertical plates of the indicator through a variable attenuator. The frequency modulation feature of the pulse-rate generator makes it possible to distinguish between multiple reflections and reverberations from successive pulses.

Sound scattering objects are scaled to represent actual obstructions under study. The scalar tech-

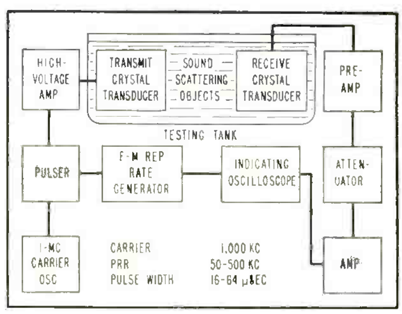
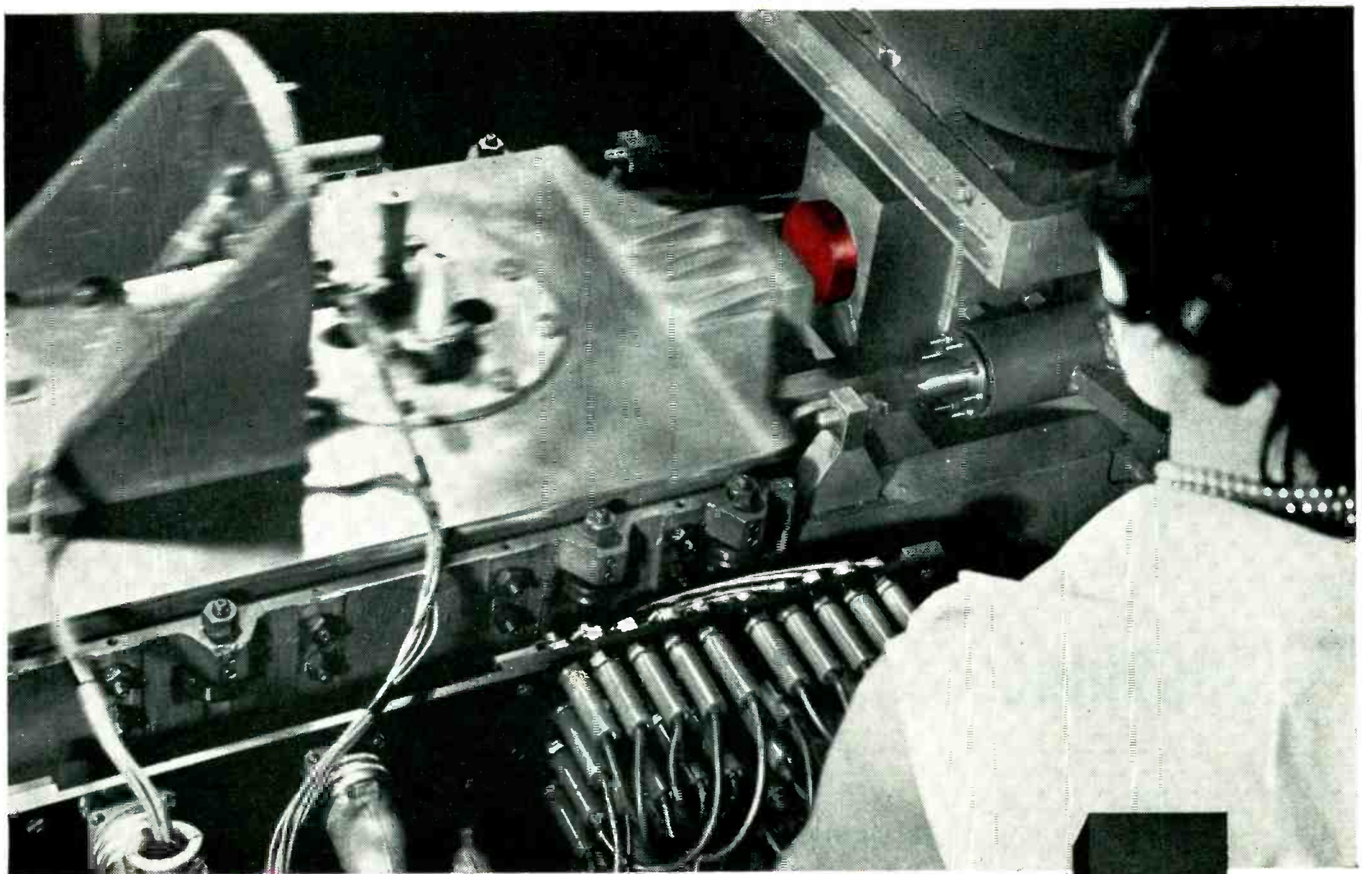
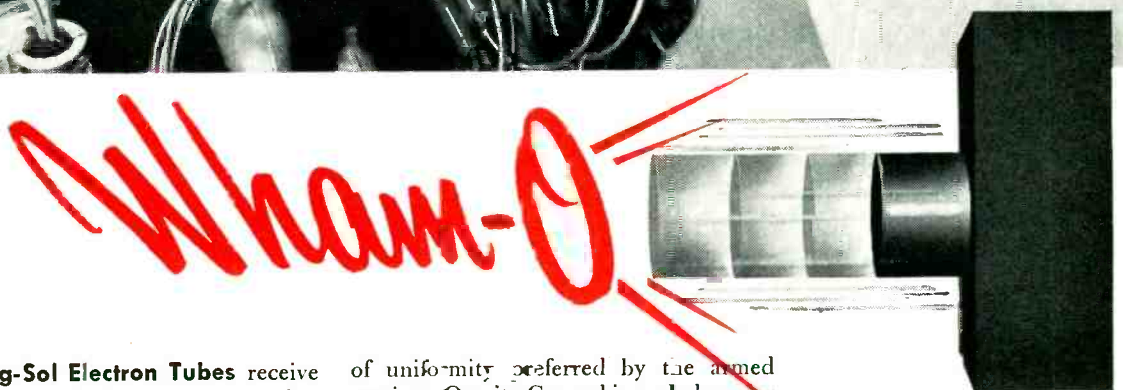


FIG. 1—Block diagram of sound-scattering investigation equipment





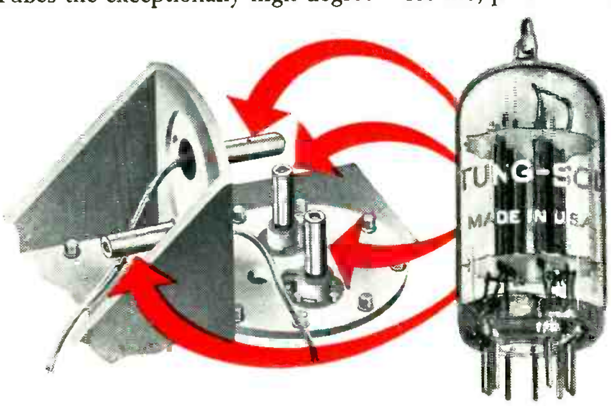
Four Tung-Sol Electron Tubes receive a terrific jolt as the heavy steel battering ram smashes against the movable table on which they are mounted. With an acceleration up to one thousand times the pull of gravity, this testing machine can give tubes a wicked beating.

Like other manufacturers, Tung-Sol is producing its share of defense requirements and it is vigorous Quality Control procedures such as this which give Tung-Sol Tubes the exceptionally high degree of uniformity preferred by the armed services. Quality Control is a whole series of exacting tests and inspections which point the way to better, more dependable tubes—sturdier both mechanically and electrically. Ruggedized Tubes we call them.

The ruggedized feature embodied in Tung-Sol Tubes for radio, TV and special industrial applications means top performance, longer and more efficient service life, plus lowest maintenance. So, for whatever purpose you use electron tubes, you'll find greater satisfaction with Tung-Sol Tubes and Tung-Sol Service.

Write for sales or engineering information, or for the name of the Tung-Sol distributor nearest you.

TUNG-SOL ELECTRIC INC., Newark 4, N. J.
Sales Offices: Atlanta · Chicago · Culver City
Dallas · Denver · Detroit · Newark



The four tubes are mounted in different positions to determine stability in all directions. Each tube is wired to a control panel where any electrical damage is recorded by indicator lights.

TUNG-SOL ELECTRON TUBES

RUGGEDIZED for Rugged Service

Tung-Sol makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes.

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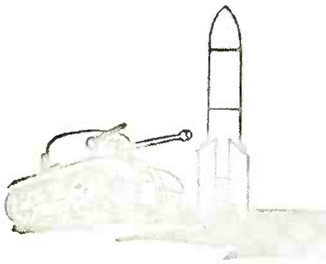
Pacing Relay Progress

"UPSTAIRS" *as well as* **down**



Recent additions to the broad array of Struthers-Dunn relay types play vital defense roles in a wide variety of applications ranging from 70,000 feet in the air to below the ocean surface. Important S-D design and engineering advances materially improve relay performance under shock, vibration, ambients to 200°C., high humidity and other adverse conditions encountered in military operations.

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"RELAY ENGINEERING," the famous 640-page handbook brings you full benefit of Struthers-Dunn's experience in producing thousands of relay types. The ideal guide to modern relay selection, use, maintenance and circuitry. Price $3.00.

nique is also applied to the study of sound scattering phenomona in other mediums, notable air, making use of density ratios.

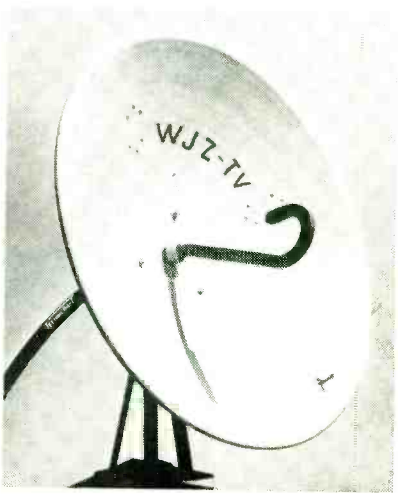
For further details see "Apparatus for Measurement of Scattering of Sound", J. J. Faran, Acoustics Research Laboratory, Harvard University.

Beam-Bending Microwave Reflector

PARABOLOID REFLECTORS manufactured by Technicraft Laboratories, Inc. and known as Beam-Benders can be used in place of an intermediate powered relay at a substantial saving in cost.

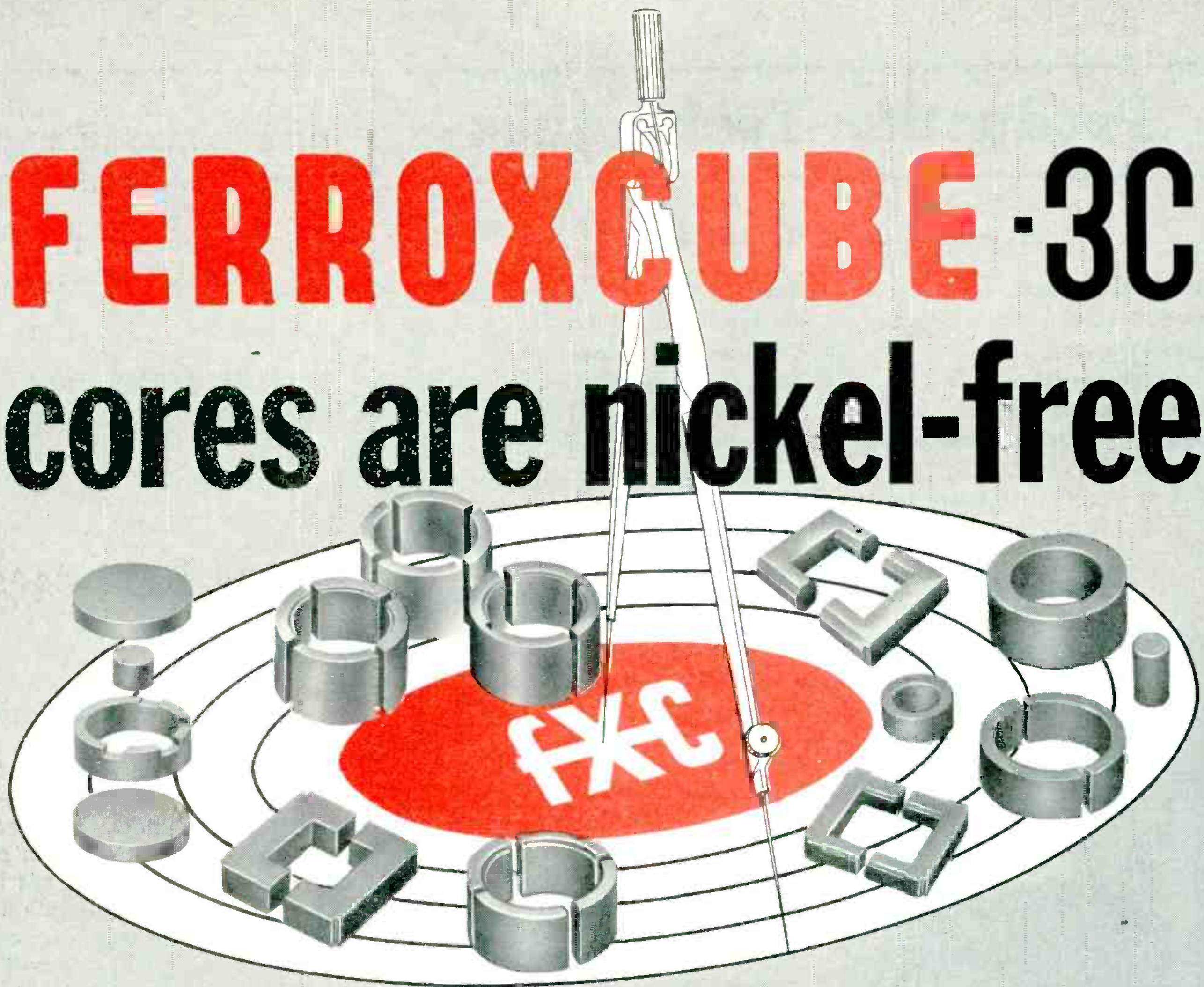
The reflectors are designed to operate in the frequency range from 5,850 to 8,200 mc and can be mounted up to 17-ft apart. A simple detachable gun-sight type sighting device is mounted on the reflector for easy alignment.

Field tests made on the prototype of the Beam-Bender by Station WJZ-TV in New York proved very successful. A signal was sent from a microwave transmitter located on the roof of the ABC Television Center at West 66th Street, New York City, to a Beam-Bender located on an apartment-house roof about 150 yards away and 10 stories above the transmitter. The reflector changed the course by about 75 deg and directed the signal to a microwave receiving location on the 67th floor of 30 Rockefeller Plaza, about 1½ miles away.



One of the paraboloid reflectors

FERROXCUBE 3C cores are nickel-free



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When your drawings call for Ferroxcube 3C cores for your TV deflection yokes and horizontal output transformers, you can forget about procurement problems. These ferrite cores are nickel-free . . . . and delivery will be made exactly as scheduled by you!

Improved temperature stability, high saturation flux density, and high permeability are among the other advantages of Ferroxcube 3C.

Complete technical data is yours for the asking in Engineering Bulletin FC-5101A, available on letterhead requests. ★ ★ ★ ★ ★ ★ ★ ★ ★

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Production Techniques

Edited by JOHN MARKUS

OTHER DEPARTMENTS featured in this issue:

Shielded Test Benches Replace Costly Screened-In Test Booths

Close-up of new test bench, showing how alignment adjustments can be made through screen of shielded compartment

A SCREENED box mounted in the surface of each test bench is used to hold radio transmitter and receiver units during alignment operations in Motorola's new Communications and Electronics Division plant in Chicago. The unit to be tested is placed in the box, and then a tip-back screen lid is pulled from the back of the bench and over the unit to form the working surface of the bench. Adjustments for alignment are made by inserting tools through the screen. During alignment, controls can be manipulated from the outside by means of isolated shafts that are a part of the bench.

Power supplies and test instrumentation circuits are housed in another screened-in section within the metal walls of the bench, giving double shielding. Each test bench has selenium-rectifier power supplies furnishing 6 v d-c, 12 v d-c and 117 v a-c, individually isolated by transformers and specially designed filtering units. Measurements show 110 db attenuation of radiated signals for each bench, which is more than adequate to permit locating benches as close together as factory layout permits.

Alongside each row of benches is a moving-belt conveyor that takes the sets directly to the packing department after they have been aligned and checked out. On the opposite side of each bench is a filing-cabinet unit having two roll-out drawers and a cabinet section

Modern steel desk-type benches replace shielded cages, giving engineering-office atmosphere to test and alignment section of Motorola's production floor. Unit under test fits into recess in surface of bench

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in solder, flux cores, too...

the right size is important!

AND ONLY

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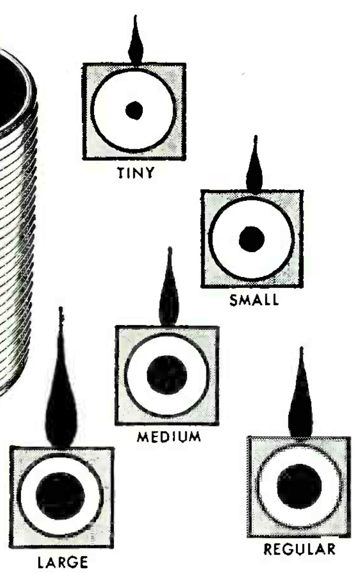
GIVES YOU

5

ENGINEERED CORE SIZES!

Just as in selecting the right hat size, it's important to select the correct core size in Flux-Core Solder to give you the proper predetermined amount of Flux needed to do the job right. Core size, which controls the ratio of flux to solder regardless of strand size, is always uniform with Kester.



Kester Solder meets all applicable Government and Military specifications

With five different core sizes, available only in Kester Solder, you're sure of the desired solder-spread and absolute control of flux residue. This is a "job-insurance" feature, only to be had with Kester, that will see you through satisfactorily in your production on those exacting government contracts, and all other soldering.

KESTER SOLDER COMPANY

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Newark 5, New Jersey • Brantford, Canada

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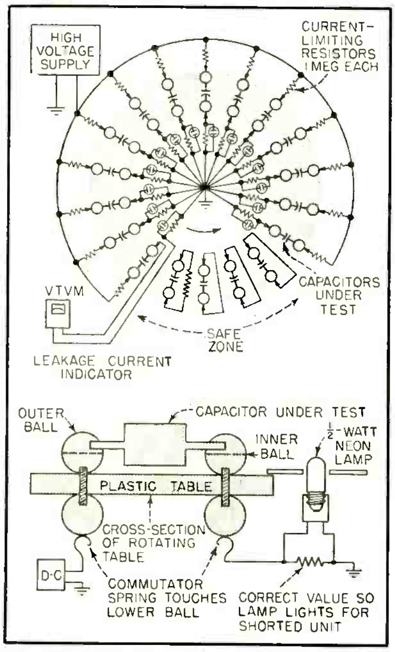
for storage of tools, instruments and spare parts. The tops of these units are made flush with the test bench surface by means of a wood base. A telephone on each bench further carries out the theme of an engineer's desk and saves time otherwise lost in going to the floor supervisor's desk to take a phone call.

Rotary Test Table for High-Voltage Capacitors

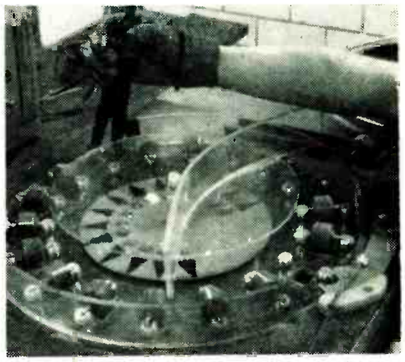


Details of capacitor tester

HIGH-VOLTAGE ceramic capacitors are automatically checked for voltage breakdown and leakage current in one trip around an automatically stepped 18-position turntable in the DuBois, Pa. plant of Jeffers Electronics, Inc. The operator puts in and removes capacitors in one of the four positions that are not energized, and watches readings of a vacuum-tube voltmeter that is connected to read leakage current at the final energized position.

Fourteen ½-watt neon lamps, one for each energized position, indicate breakdown of a capacitor. When this occurs, the operator uses plastic fuse-removing tongs to remove the defective unit immediately.

Notched brass balls are used as supports for the capacitor terminals, to minimize corona at test voltages that can be as high as 30,000 volts. Similar balls under the turntable serve as commutator contacts for wiping arms that go to the d-c high-voltage supply and to the discharge paths in the safety zone.



Removing shorted capacitor with fuse tongs. Transparent Lucite fences and circular cover minimize chances of shock while permitting quick removal of shorted units. Neon lamp lights to indicate which unit is shorted

The capacitors are connected to the high-voltage supply only during the short interval when the turntable is stopped at each position, but hold their charge while the wheel is in motion. The time for one complete revolution is one minute. Black triangles on the stationary central circle of the test table indicate live units.

The power supply is a standard 0-30,000-volt commercial unit made by Beta Electronics Co., with Variac control of the high voltage and meters for indicating output voltage and current.

In the four-station discharge zone, the first station discharges the capacitor through a high resistance to limit the discharge current to a safe value, and the other three stations short the capacitor directly for safety in unloading and loading.

Setup for production testing of high-voltage ceramic capacitors. Turntable is driven by standard rotary actuator. Spring-loaded cam in foreground insures precise positioning over contacts underneath after each movement of table

Chassis Storage Conveyor

By C. F. SCHULTZ

Process Section Manager
Allen B. DuMont Labs., Inc.
East Paterson, N. J.

UP to 1,900 television chassis of as many as 12 different models can be stored in a unique six-tier elevator-fed gravity roller conveyor installed in Du Mont's television receiver factory. Loading and unloading are done automatically by the self-level-

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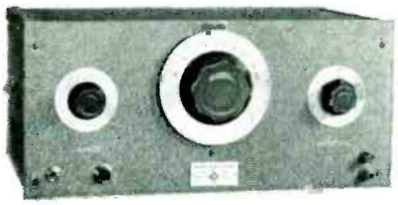
Accurate ac test voltages ½ to 10,000,000 cps

Complete Coverage

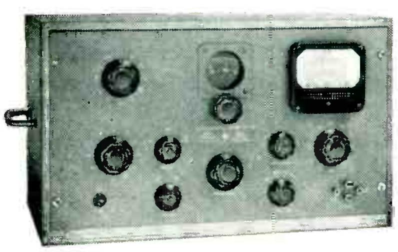


-hp- 200 Series Audio Oscillators

Six standard models, –hp– 200A and 200B have transformer-coupled output delivering 1 watt into matched load. –hp– 200C and 200D have resistance-coupled output and supply constant voltage over wide frequency range. –hp– 202D is similar to 200D, with lower frequency range. –hp– 200I is a spread-scale oscillator for interpolation or where frequency must be known accurately.

-hp- 650A Resistance-Tuned Oscillator

Highly stable, wide band (10 cps to 10 mc), operates independently of line or tube changes, requires no zero setting. Output flat within 1 db. Voltage range 0.00003 to 3 volts. Output impedance 600 ohms or 6 ohms with voltage divider.



-hp- 206A Audio Signal Generator

Provides a source of continuously variable audio frequency voltage with less than 0.1% distortion. Very high stability, accuracy 0.2 db at any level. Specially designed for testing high quality audio circuits, checking FM transmitter response and distortion, broadcast studio performance or as a low distortion source for bridge measurements, etc.

INSTRUMENT	PRIMARY USES	FREQUENCY RANGE	OUTPUT	PRICE
-hp- 200A	Audio tests	35 cps to 35 kc	1 watt/22.5v	$120.00
-hp- 200B	Audio tests	20 cps to 20 kc	1 watt/22.5v	$120.00
-hp- 200C	Audio and supersonic tests	20 cps to 200 kc	100 mw/10v	$150.00
-hp- 200D	Audio and supersonic tests	7 cps to 70 kc	100 mw/10v	$175.00
-hp- 200H	Carrier current, telephone tests	60 cps to 600 kc	10 mw/1v	$350.00
-hp- 200I	Interpolation and frequency measurement	6 cps to 6 kc	100 mw/10v	$225.00
-hp- 201B	High quality audio tests	20 cps to 20 kc	3 w/42.5v	$250.00
-hp- 202B	Low frequency measurements	½ cps to 50 kc	100 mw/10v	$350.00
-hp- 202D	Low frequency measurements	2 cps to 70 kc	100 mw/10v	$275.00
-hp- 204A	Portable, battery operated	2 cps to 20 kc	2.5 mw/5v	$175.00
-hp- 205A	High power audio tests	20 cps to 20 kc	5 watts	$390.00
-hp- 205AG	High power tests, gain measurements	20 cps to 20 kc	5 watts	$425.00
-hp- 205AH	High power supersonic tests	1 kc to 100 kc	5 watts	$550.00
-hp- 206A	High quality high accuracy audio tests	20 cps to 20 kc	+ 15 dbm	$550.00
-hp- 650A	Wide range video tests	10 cps to 10 mc	15 mw/3v	$475.00

Data subject to change without notice. Prices f. o. b. factory.

Whatever ac test voltage you need—whatever frequency or magnitude you require—there is an *-hp-* oscillator or generator to provide the exact signal desired.

-hp- oscillators offer complete coverage, ½ cps to 10,000,000 cps. They are dependable, fast in operation, easy to use. They bring you the traditional *-hp-* characteristics of high stability, constant output, wide frequency range, low distortion, no zero set during operation.

-hp- oscillators and audio signal generators are used by manufacturers, broadcasters, sound recorders, research laboratories and scientific facilities throughout the world. For complete details on any *-hp-* instrument, see your *-hp-* sales representative or write direct.

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MFG. CO., INC.

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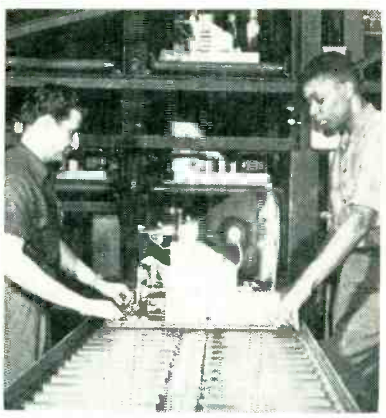
MASSACHUSETTS

Elevator end of chassis storage conveyor, with all three elevators at the loading and unloading level. Pushing a button brings chassis down automatically from any desired tier

ing elevators; any desired chassis model can be obtained merely by pressing a button.

The storage system occupies a floor space 12 feet wide and 154 feet long, and rises approximately 15 feet. Since it is four conveyors wide and six conveyors high, there are 24 conveyors in all in floor space normally taken by four of them.

In normal operation, sets are fed into the two center tiers and taken off from the two outer tiers. Sets travel by gravity the entire length of the conveyor to the far end and are transferred manually there, on a cross conveyor, from an inner tier to the same level of outer tier.



Moving a chassis pan from the portable roller conveyor onto the double-width loading elevator serving the two center tiers of the storage system

Outer tiers slope downward toward the loading or elevator end, so that the sets come back the entire distance by gravity again. Each chassis rides on a shallow steel pan. The pitch of each conveyor is designed to maintain a slow, even travel throughout the entire length of the system.

A double-width elevator serves both center tiers for loading. When sets are to be placed in storage they are brought up on conventional overhead conveyors, unloaded onto a portable section of transfer conveyor, and moved on the transfer conveyor to the loading elevator of the storage conveyor. Being on wheels, the transfer conveyor can be rolled back and forth transversely between the two sections of the loading elevator, for loading two sets at a time.

When the elevator is loaded, the button for the desired level is pressed. Upon reaching this level, the elevator stops and engages a switch that cuts in a motor, driving rollers that feed the pans onto the gravity conveyor for its ride. When the pans clear the end of the feed elevator it returns automatically to the starting level for loading two more pans.

Pans are transferred manually at the far end at present, hence ladders are needed there to reach the different levels. Plans for making

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COPPER ALLOY BULLETIN

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared Each Month by BRIDGEPORT BRASS COMPANY "Bridgeport" BRASS CO. *Headquarters for* BRASS, BRONZE *and* COPPER

Tubular and bifurcated rivets from 1/16" to 2¼" long are assembled by special automatic machines —Courtesy The Milford Rivet & Machine Co., Milford, Conn.

"Sewing" Metals with Rivets

Many Ductile Copper-Base Alloys Available

The development of tubular rivets and rivet-setting machines for high speed assembly has made riveting an important basic, modern assembly tool for quickly and permanently fastening metals, plastics, and soft goods.

The tubular rivet contains a hollow shank, usually extruded when shallow, and drilled when deep. When the rivet setting machine is tripped, the rivets drop into a guide from a revolving hopper, and are automatically set one or more at a time into the prepared holes of the parts to be riveted. The pin of the setting tool recedes, leading the rivet through the work. At the bottom of its travel, the pin, in conjunction with the anvil form, clinches the rivet, making a strong, permanent joint.

Since many applications present a special problem, rivets are "engineered" as to design, shape of head, dimensions, kind of metal, etc. Many have special heads for ornamental purposes or with stamped identification marks.

Rivets also function as electrical contacts, and for joining mechanically the components of electrical systems instead of soldering. Applications are almost endless ranging from novelties through die-cast assemblies, refrigerators, pen and pencil clips, eye glass frames, electrical contacts; for fastening brake linings, attaching handles to pots and pans; hinges to boxes, assembling components of television and radio instruments, etc.

The bifurcated rivet is widely used for attaching soft goods such as leather, fabrics, plastics and wood. The shank is split by sawing or punching a slot at the base. Special automatic machines are used as in the tubular applications. However, in most instances the bifurcated rivets pierce the material and the prongs are then clinched, making a strong joint.

Rivet Wire Has Special Properties

Rivet wire must be accurate in gauge, free from scratches, folds, blisters and other imperfections, and malleable to fill out the die.

Bridgeport has developed a number of alloys with special physical and chemical properties suitable for cold heading:

Yellow Brass 16 (approx. 65% copper, 35% zinc). Most popular of the heading wire alloys. Very malleable. High electrical conductivity used for electrical contacts and circuits.

Light Leaded Brass 43 (approx. 65% copper, 0.3% lead, balance zinc). Recommended for light machining and drilling.

70-30 Brass 37 (approx. 70% copper, 30% zinc). Slightly more ductile than yellow brass. Recommended for exceptionally large heads.

Low Brass 5 (approx. 80% copper, 20% zinc). Light golden color. Very ductile. Used for jewelry.

Rich Low Brass 85 (approx. 85% copper, 15% zinc). Fine golden color—for lipstick holders and vanities, and ornamental jewelry, pen and pencil clips.

Commercial Bronze 25 (approx. 90% copper, 10% zinc). Bronze color, resists season cracking.

Silicon Bronze 609 (approx. 98% copper, 2% silicon). Recommended for strength, ductility and for outdoor use. Resists season cracking.

Phono-Electric 840 (approx. 98.6% copper, 1.4% tin). Electrical conductivity about 40% that of copper, very malleable, stronger than copper.

Phono-Electric 985 (approx. 99.25% copper, and 0.75% cadmium). Electrical conductivity about 85% that of copper — stronger and tougher than copper.

Temper of Wire

The temper of drawn wire is indicated either in percent reduction or B&S hardness numbers.

Temper	Nominal Reduction B&S Gauge Nos.	Percent Reduction in Cross-Sectional Area
Eighth hard	½	10.9%
Quarter hard	1	20.7%
Half hard	2	37.1%
Three-quarter hard	3	50.0%
Hard	4	60.5%
Extra Hard	6	75.0%
Spring	8	84.4%

Rivet temper is generally supplied between 8% to 20% reduction in cross-sectional area; machine screw temper between 10% and 20%; wood screw temper between 15% and 37%

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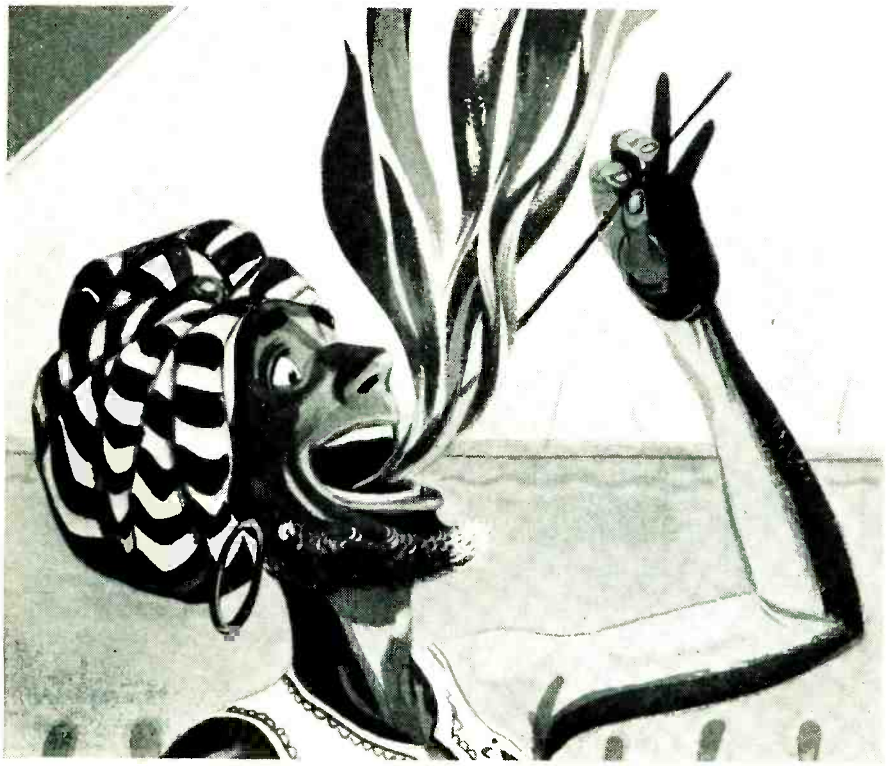

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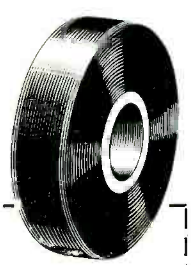

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☐ Please have a representative call to explain in detail the heat stability characteristics of PERMACEL Electrical Tapes.

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Makers of ® TEXCEL Cellophane Tape, and a complete line of pressure-sensitive tapes for industry.

the transfer automatically are under consideration.

The outer tiers have individual one-pan unloading elevators. A button is pressed to designate the level a chassis is to be removed from. When the elevator reaches this designated level it stops. Simultaneously, a brake-and-stop release is actuated electrically to allow one pan to roll onto the elevator. When this pan is on, it contacts a switch that makes the stops go up again, preventing any more pans from going beyond the end of the main conveyor.

When half the capacity of the system or less is needed, only the outer two tiers are used. Here the entire accumulation of pans must be pushed up the conveyor against gravity by the power-driven elevator rollers each time a new pan is put in storage. Unloading is the same as before.

Cutouts in Silk Screens

Objects with projecting parts and irregular shapes are being silk-screened with terminal and part-identifying numbers and legends through the use of cutouts in the screens in the military radio section of Federal Telephone and Radio Corporation's Clifton, N. J. plant. Large cutouts are framed with brass to maintain tautness of the screen; the screen cloth is pulled

Forcing ink through stencil onto flat chassis like that in foreground; wood lever arrangement lifts screen straight up when job is done, to prevent smearing of letters

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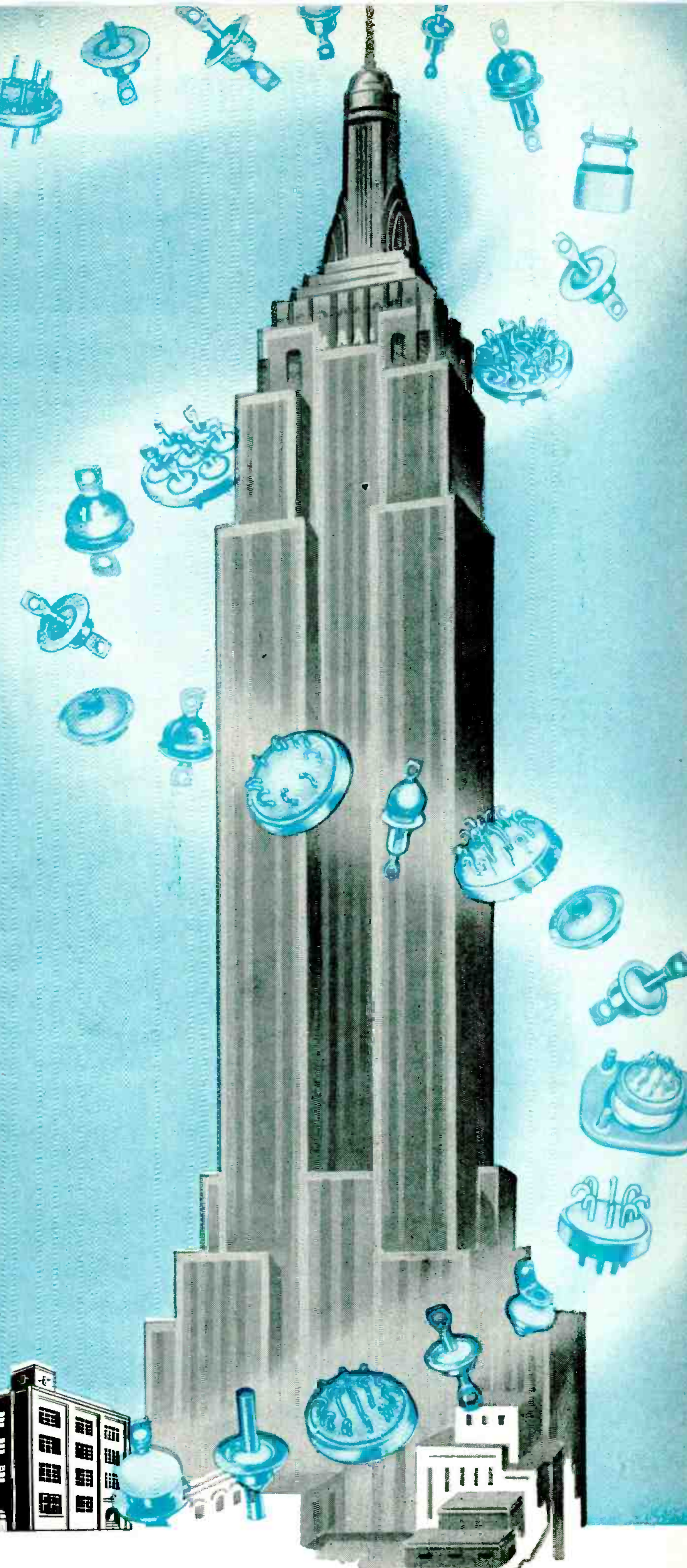
E-I production now reaching to 5½ TIMES the height of the Empire State Bldg. DAILY!

—the result of engineering ability devoted exclusively to producing

SEALED LEADS AND MULTIPLE HEADERS



Stacked singly, the hermetically sealed terminals produced every day by E-I would make a pile almost six times the height of the world's tallest building. This colossal volume illustrates the acceptance enjoyed by the E-I trademark wherever specifications call for hermetic sealing. If you have a sealed terminal problem, why not ask E-I engineers for a quick solution. Chances are you'll save time and trouble, not to mention the important advantage of custom quality at mass production prices.

WRITE FOR LATEST CATALOGS describing the many standard sealed terminals available for the economical solution of all but the most unusual circuit requirements. Also complete facilities for design and production of special types to specifications.

E-I INC

ELECTRICAL INDUSTRIES • INC

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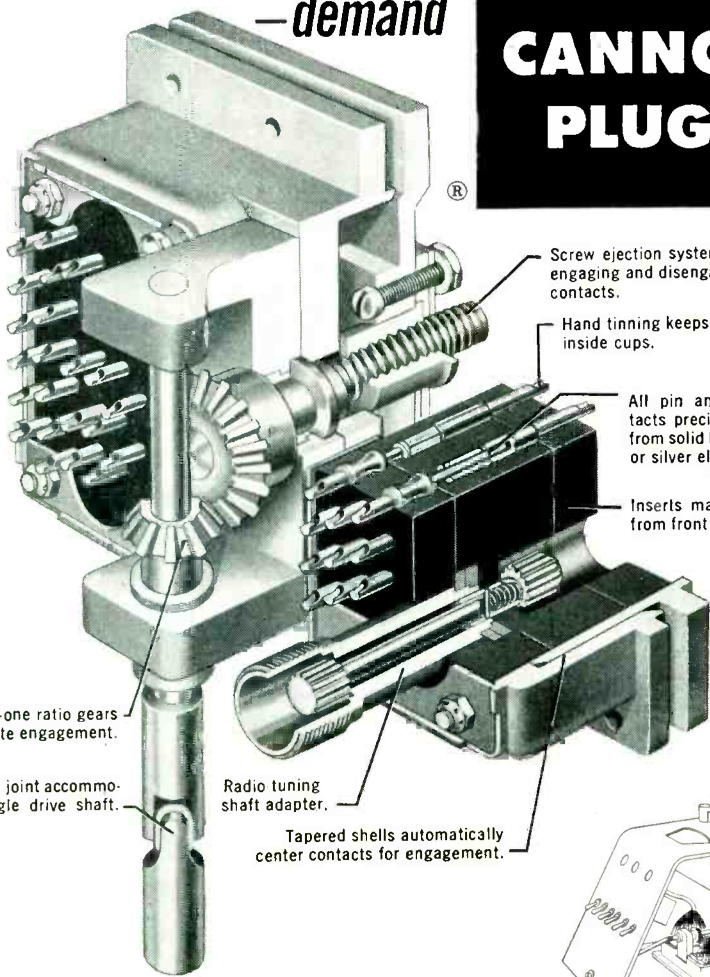
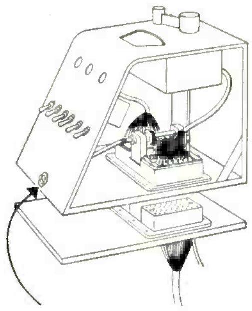
Here's why those in the know —demand CANNON PLUGS®



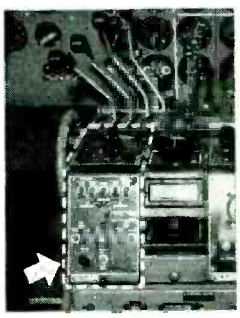
This highly specialized DPD2 Cannon Plug, a member of the DP Series, has its principal use in aircraft instrument panels and remote radio control equipment. But, like many other Cannon Plugs, it has found its way into other fields where the highest quality is needed and where the value of long, trouble-free performance is recognized.

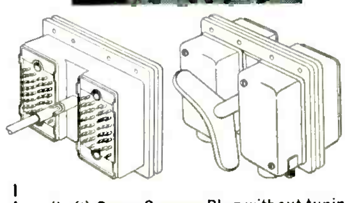
Originally this 2-gang connector was designed to assist in the standardization of radio and instrument assemblies so that such equipment might be interchanged between similar aircraft. It allows for compact design in close quarters with access from the front only. This type of application and variations of the fittings are shown at right. Any Cannon DPD insert may be placed within the shell, with or without tuning shaft, coax, twinax, large or small contacts, provided the separation forces of both halves are similar.

This plug typifies the close attention to important detail that distinguishes every Cannon Plug—the world's most extensive line. If you are looking for real value, regardless of the field you work in, your best bet is Cannon.



Connector is separated by turning slotted shaft here. Complete unit may then be removed from pedestal, shown below.





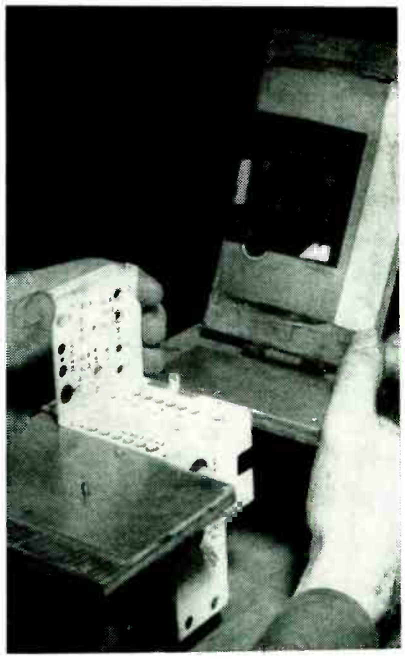
(Left) Same Cannon Plug without tuning shaft. Straight drive instead of 90° gear. (Right) Similar DPD2 with Dzus wing nut extraction method and junction shells. There are several other variations. Write for details.

CANNON ELECTRIC

Since 1915

CANNON ELECTRIC COMPANY
LOS ANGELES 31, CALIFORNIA

Factories in Los Angeles, Toronto, New Haven. Representatives in principal cities. Address inquiries to Cannon Electric Company, Dept. E-120, P.O. Box 75, Lincoln Heights Station, Los Angeles 31, California.



Hinged silk-screen stencil with round cutout fits over irregular chassis having bent-up lug, for applying identifying nomenclature required on military electronic equipment

over the brass and fastened with glyptol. For smaller holes, thin rubber grommets are similarly cemented in place to frame the hole. For small irregular hole shapes, cardboard frames are used.

When stamping the three faces of a subchassis having a double right-angle bend, a separate chassis-holding fixture is used for each face, with the appropriate silk-screen stencil hinged to the fixture. The operator need only insert the chassis, lower the screen over it, then make one wipe with a rubber squeegee to force ink through the screen pattern.

Capacitor and Resistor Lead-Cutting Machines

MACHINES that automatically cut the leads of small components to desired equal or unequal shorter lengths have long been sought as a means of reducing the amount of labor needed to prepare parts for use on high-speed assembly lines.

Complete mechanization of this job is still a long way off, partly because paper capacitors in particular come in consistently with bent and folded-back leads, but a

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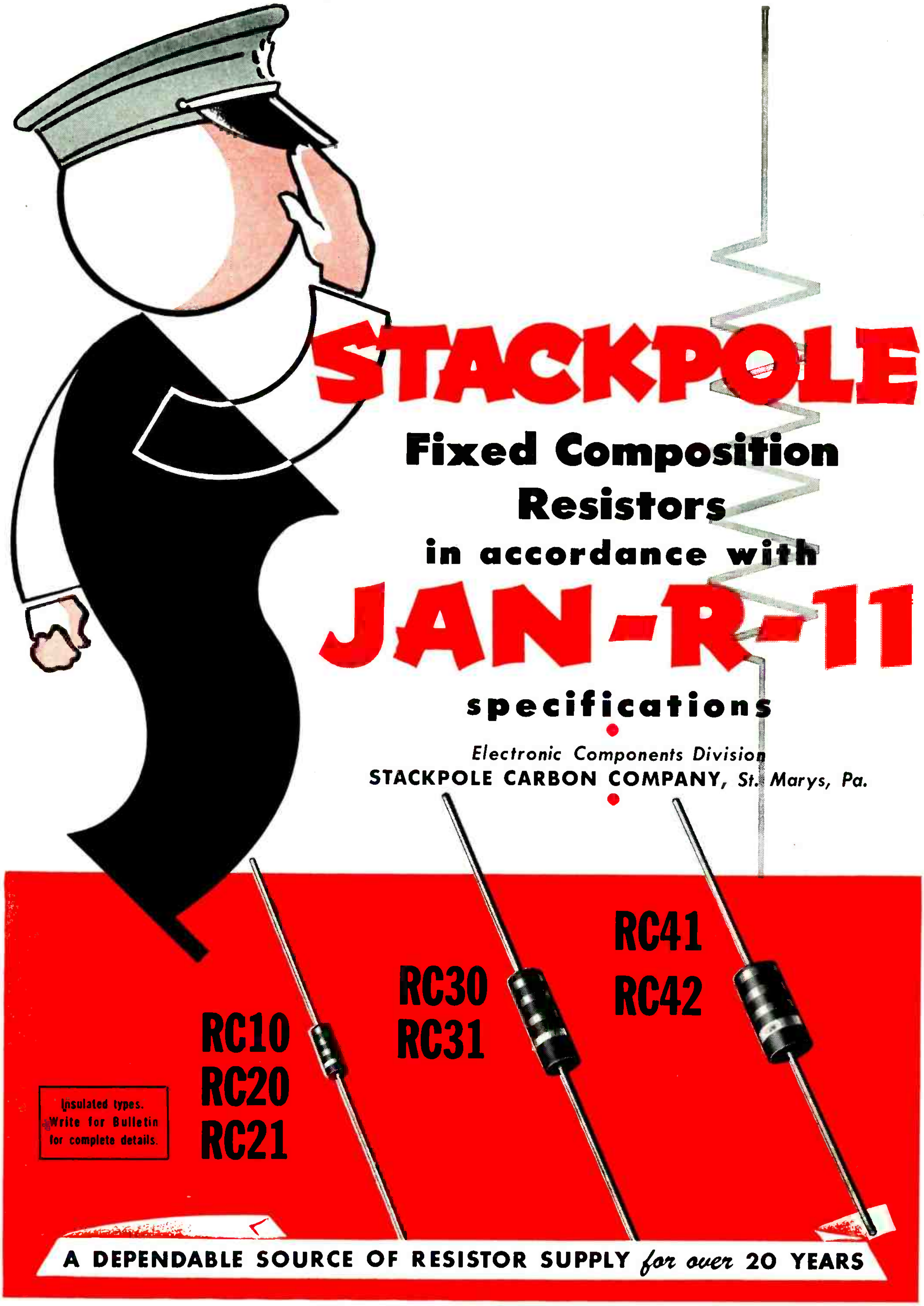

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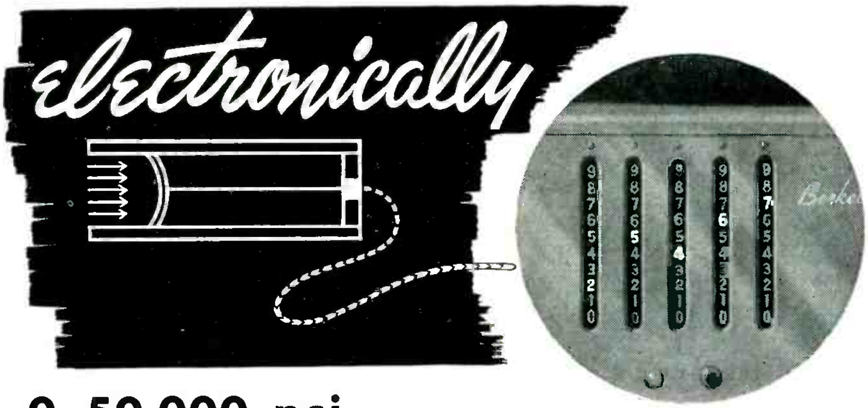
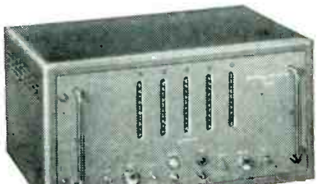
Pressure Measurement-



0-50,000 psi
WITH ACCURACIES TO .01%

METHOD: Direct reading digital indication of pressure variation is obtained by using the Berkeley EPUT (Events-Per-Unit-Time) Meter in conjunction with a pressure sensitive frequency generator. The sensing element emits a frequency which varies with pressure. This frequency is transmitted to the EPUT Meter and read directly on an illuminated front panel. The EPUT will count for a precise 1 second period and then read out for 1 second, thus providing independent samplings during alternate 1 second intervals.

ADVANTAGES: Minute variations of fluid pressures may thus be detected with accuracies to .01%. Remote indication can be obtained by telemetering over any desired range, or by cable transmission up to distances of 15,000 feet.



The sensing element is small in size (approx. 1" x 1" x 3") and extremely rugged in construction to permit mounting under practically any field or laboratory condition. This system then provides extreme utility, maximum safety factors, speed, accuracy, and simplicity of operation.

EQUIPMENT: A number of pressure sensing elements are available to accommodate various ranges of pressure from 0 to 50,000 psi. Several different models of the EPUT Meter may be used, depending upon the desired pressure range and the degree of accuracy required. Modifications of this equipment are available to provide extended time base for even greater accuracy and extended range, special mounting, explosion-proof housing, and other special facilities.

SPECIFICATIONS

	MODEL 554	MODEL 556
RANGE	20-100,000 cps	20-100,000 cps.
ACCURACY	± 1 cycle	Line voltage stability (approx. 0.1%)
TIME BASE	1 second	1 second
SHORT TERM STABILITY	Standard crystal—1 part in 10^5 Oven crystal—1 part in 10^6	Line voltage stability
POWER REQUIREMENTS	105v.-130v., 60c., 175w.	105v.-130v., 60c., 125w.
INPUT (any wave form)	0.2-50 volts rms (pos.)	0.2-50 volts, rms (pos.)
DISPLAY	Direct reading digital—variable 1-5 seconds	
DIMENSIONS	20¾" x 10½" x 15"	16⅝" x 10¼" x 12⅞"
PANEL	Standard rack 19" x 8¾"	15⅜" x 8¾"
PRICE	$775	$560

This is one of many broad applications wherein Berkeley instruments can provide direct reading digital presentation of information at extremely high orders of accuracy.

For literature and data, please write for Bulletin 554-E

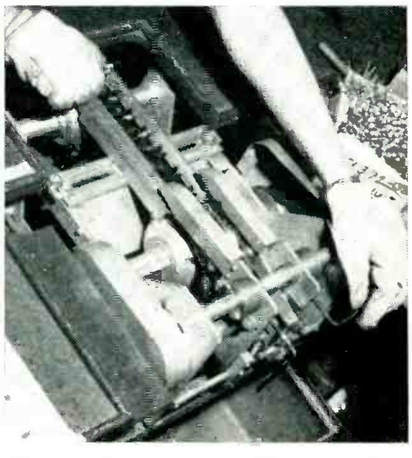
Berkeley Scientific Corporation

2200 WRIGHT AVENUE • RICHMOND, CALIFORNIA

Scrap from lead-cutting machine is saved for salvage at DuMont television plant. The DuMont-developed machine in background is being used for trimming leads of mica capacitors

variety of different lead-cutting machines have been developed that do the job nicely after leads have been straightened.

In the machine developed by Allen B. DuMont Labs. Inc. and used extensively in its East Paterson, N. J. plant as well as in Emerson's Jersey City, N. J. plant, parts are loaded into notched teeth of two parallel motor-driven sprocket chains. The spacing between the two chains is adjusted to the body length of the part being cut, so that the body centers itself between the chains and the leads pro-



Method of changing position of cutter wheel with Allen wrench on lead-cutting machine at Emerson plant. Sample parts are taped to cardboard alongside machine, with correct chain and cutter settings for each marked alongside

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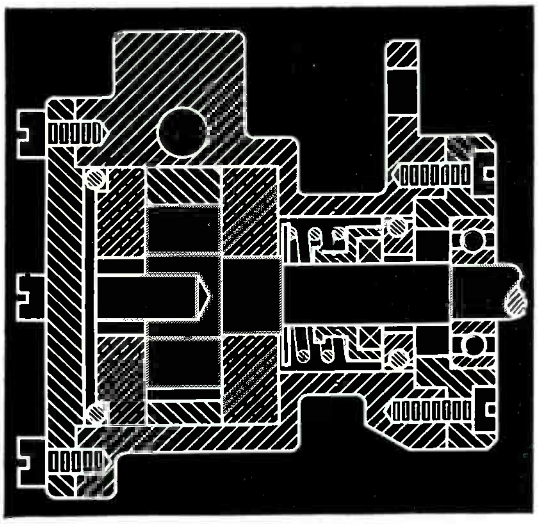
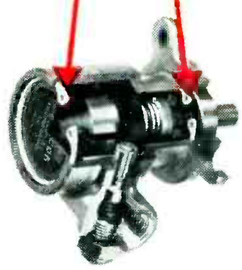
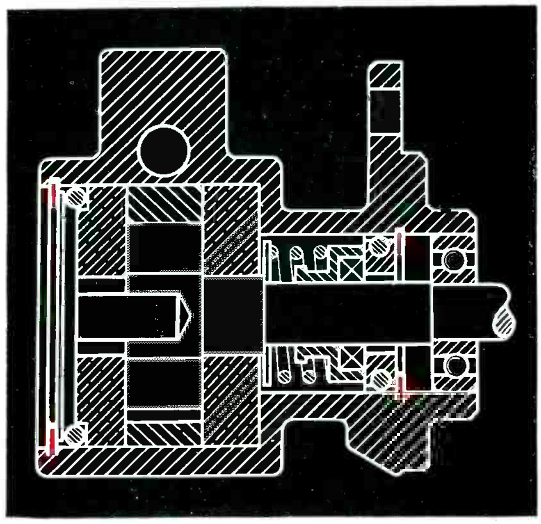
TWO TRUARC RINGS IN NEW PRESSURE PUMP SAVE $1.48 PER UNIT

OLD WAY Requires 4 skilled-labor threading operations...4 heavy screws on a cover plate and an internal tapped thread, plus plug at rear. Assembly is slow and difficult...maintenance necessary.

NEW WAY Just 2 Truarc Rings, set into accurately predetermined grooves, bring new simplicity of design... speedy assembly. No skilled-labor required! No maintenance! Rings lock parts accurately for life of unit.







Using 2 Waldes Truarc Retaining Rings in their new Pump, saved the Procon Pump & Engineering Co., Detroit, $1.48 per unit! With Truarc Rings, assembly is speedy, simple. Skilled-labor threading operations ...stripped threads...maintenance are eliminated. Parts are firmly held together for life of unit!

Redesign with Truarc Rings and you, too, will cut costs. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better job of holding parts together.

Truarc Rings are precision-engineered...quick and easy to assemble and disassemble. Always circular to give a never-failing grip. They can be used over and over again.

Find out what Truarc Rings can do for you. Send your blueprints to Waldes Truarc engineers for individual attention, without obligation. Waldes Truarc Retaining Rings are available for immediate delivery from stock, from leading ball bearing distributors throughout the country.

USE OF 2 WALDES TRUARC RINGS PERMITTED THESE BIG SAVINGS:

Eliminated 2 castings	$ .39
Eliminated 8 screws	.04
Eliminated machining of 2 castings	.56
Eliminated drilling and tapping housing	.40
Reduced assembly time by elimination of screws	.09
TOTAL SAVINGS	**$1.48**
Weight saved	14 ounces

For precision internal grooving and undercutting... Waldes Grooving Tool.

SEND FOR NEW BULLETINS ➡

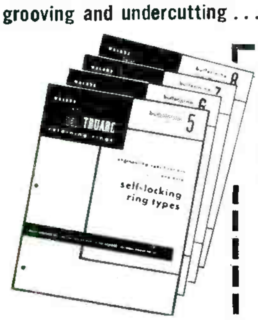
WALDES TRUARC

REG. U. S. PAT. OFF.

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.
Please send engineering specifications and data on Waldes Truarc Retaining Ring types checked below. E-054

- ☐ Bulletin #5 Self-locking ring types
- ☐ Bulletin #6 Ring types for taking up end-play
- ☐ Bulletin #7 Ring types for radial assembly
- ☐ Bulletin #8 Basic type rings
- ☐ Send me information about the Waldes Grooving Tool.

Name ____________

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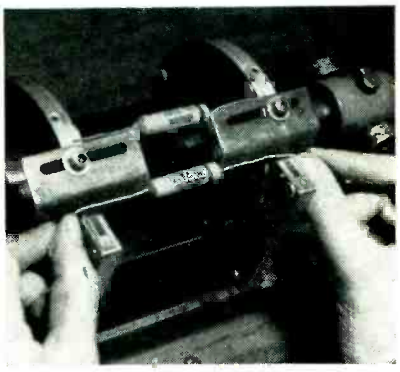
ject on either side of the chains. The chains bring the leads up to two motor-driven chopping blades that cut with a shearing rather than sawing action. The blades can be slid along their keyed drive shaft by loosening a locking set-screw with an Allen wrench, to give any desired lead length on each side. Finished parts drop into a large removable pan under the machine, while cut-off scraps of leads slide down chutes into a smaller pan for salvage. Value as scrap is around 22 cents a pound.

No automatic feed belts or chains are used in the lead cutter developed at the CBS-Columbia plant in Brooklyn, N. Y. Instead, each part is hand-held by the ends of its leads and moved down through the shearing blades. Adjustable stops above the cutters are set to the body width



Sample capacitor is placed on adjustable guides of CBS-Columbia machine to show operator correct position of outer-foil end when leads are cut to unequal lengths

of the part and positioned laterally to give equal or unequal lead lengths as desired. In addition, one cutter can be moved along its keyed shaft to change the distance between cuts. Though simpler in construction, this machine is somewhat slower in operation because only one part can be picked up at a time and both hands must be used for the cutting operation.

Leads are cut off one end of a part at a time by the machine used in RCA Victor's Camden plant. Two parts can be cut at a time, one being held in each hand. Stepped disc wheels on top of the machine control the distance from the body of the

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- CAVITIES
- WAVEGUIDES
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Inquiries invited regarding manufacture, development and calibration of any microwave units.

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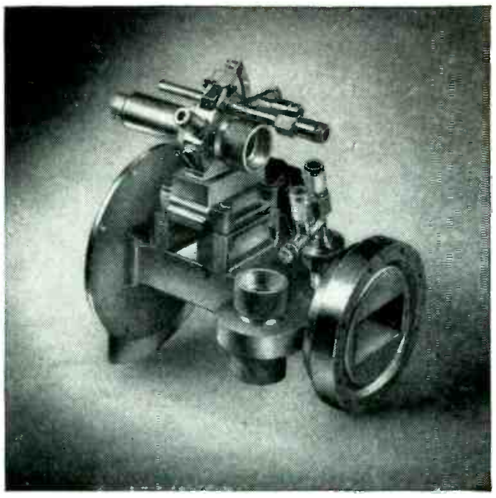
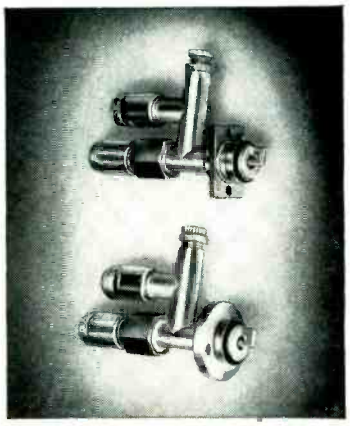
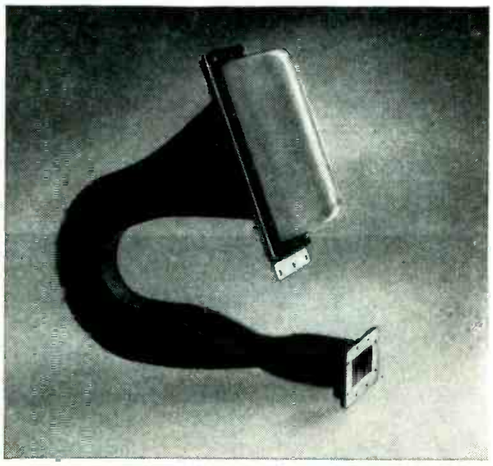


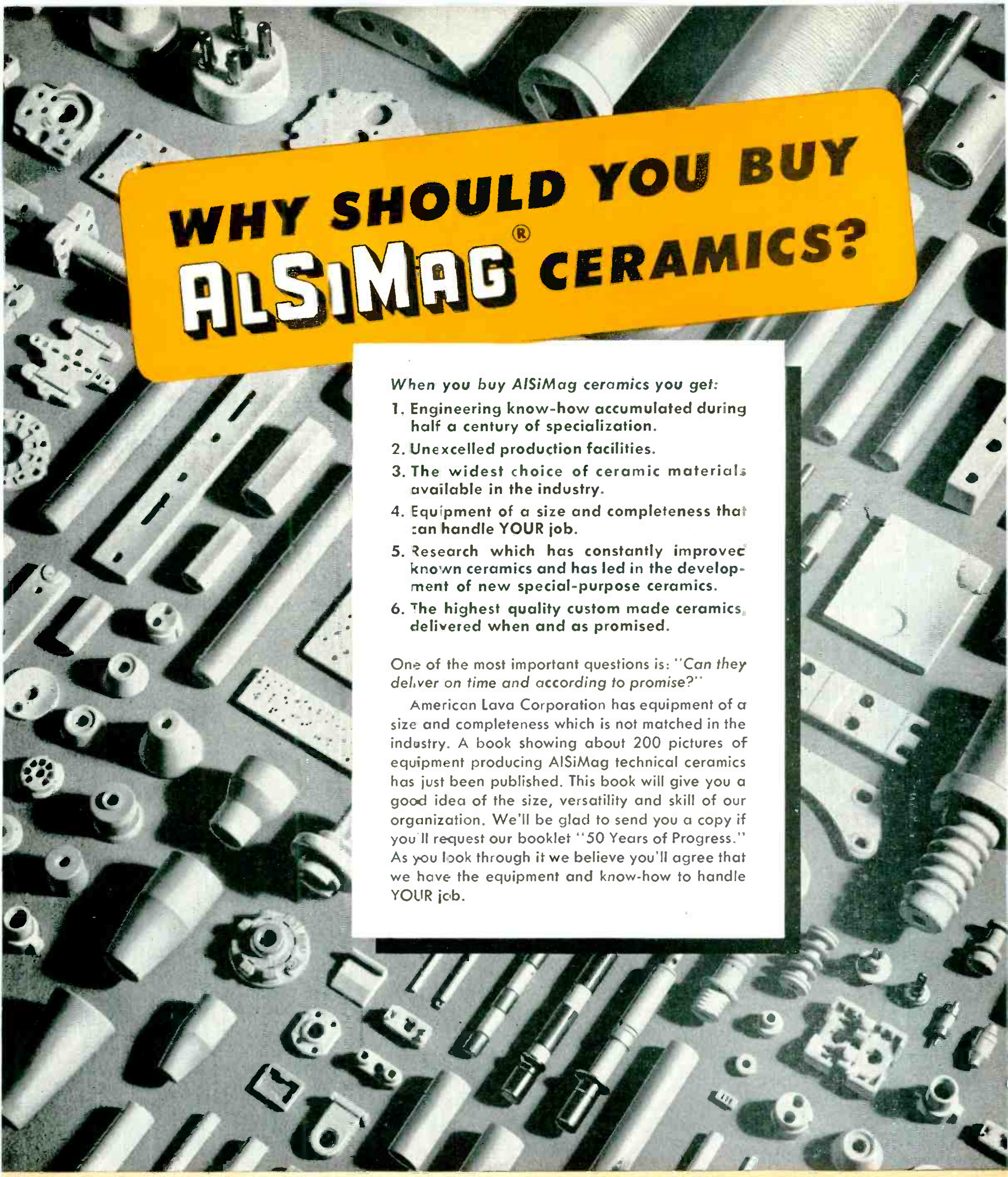


Top Photo
10 cm. Duplexer

Center Photo
Crystal Mixers

Bottom Photo
Antenna Feedhorn





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1. Engineering know-how accumulated during half a century of specialization.
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American Lava Corporation has equipment of a size and completeness which is not matched in the industry. A book showing about 200 pictures of equipment producing AlSiMag technical ceramics has just been published. This book will give you a good idea of the size, versatility and skill of our organization. We'll be glad to send you a copy if you'll request our booklet "50 Years of Progress." As you look through it we believe you'll agree that we have the equipment and know-how to handle YOUR job.

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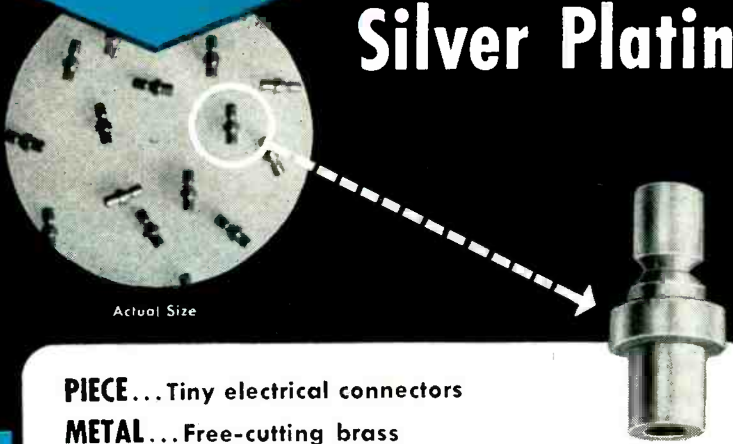
THIS is *Precision* Silver Plating



PIECE...Tiny electrical connectors

METAL...Free-cutting brass

SPECS...Navy; thickness and uniformity of silver deposit to rigid specifications; severe pull-out adhesion test, using fine wire soldered into hole

This sure was a job for 'precision plating!' Commercial plating could not possibly have met the rigid specifications.

Consider the size of each piece—no larger than an ant—yet the silver deposit had to be uniform and within close tolerances. Consider the fact there's a tiny hole in one of the two ends—yet the silver had to be so firmly bonded that it could pass the severe "pull-out" test without stripping. Consider that not only pieces had to be uniform in each batch but successive batches also had to be uniform.

This is the kind of work we are doing for well-known manufacturers of electronic and electrical parts. In one sense, it's contract work; in another, a broader sense, it's a technical service because we fully appreciate the importance of the finished plated piece and why the plating has to be as perfect as it is possible to make it. And in some cases, we have helped several companies make minor revisions in design in order to make the pieces more "platable."

If this is the kind of plating service you need for your assembly parts, we'll be happy to take care of your requirements.

Plating-Wise... YOUR Design is Protected by Our Work.

Donham Craft, Inc.

SPECIALISTS IN GOLD AND OTHER METAL FINISHES

THOMASTON, CONN.

Easily adjustable semiautomatic machine used at RCA Victor for cutting one lead at a time. For unequal lead lengths, one wheel can be set for each length and the parts interchanged when turned over for cutting other lead

part to the motor-driven cutter blade inside. Lead lengths are adjustable from $\frac{3}{16}$ inch to $1\frac{7}{8}$ inch in $\frac{1}{16}$-inch steps.

Automatic Switch for Infrared Baking Lamps

A MICRO SWITCH used in conjunction with a hinged wood platform turns on a 250-watt GE infrared baking lamp automatically when a chassis is placed on the platform. The technique is used by Utility Electronics in East Newark, N. J. for baking the 13-tube transmitter-receiver chassis of the AN/PRC6

Switch arrangement for turning baking lamps on and off automatically

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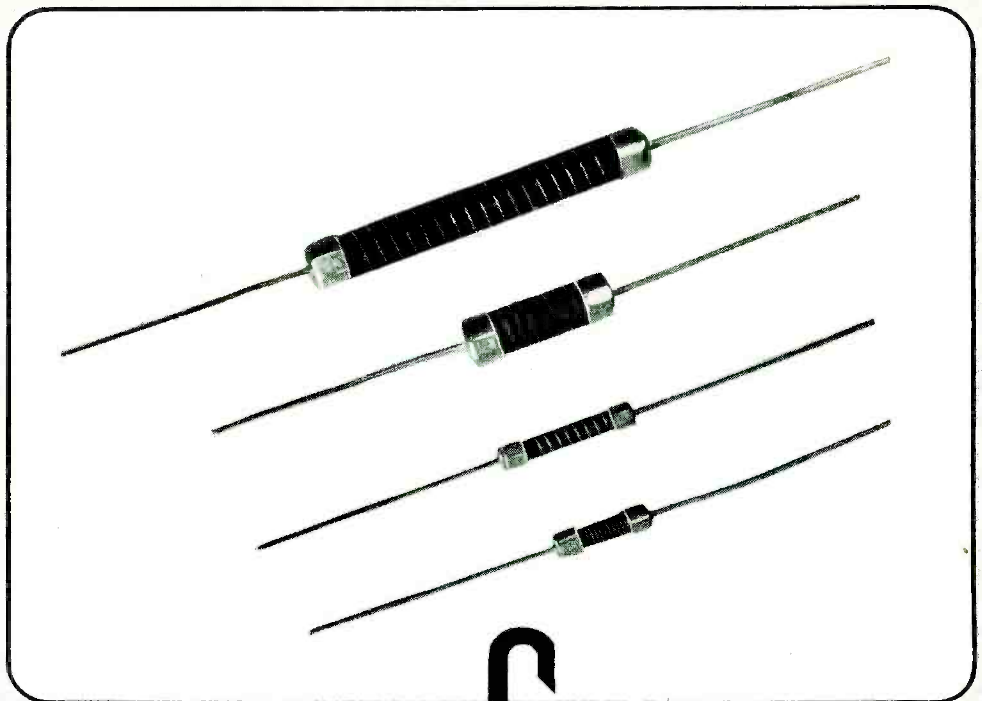
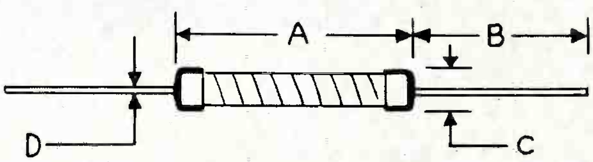
1% Precision Microcrystaline CARBON FILM RESISTORS





Stablohms

STABLOHMS are 1% precision resistors made by coating a specially treated ceramic core with a film of micro-crystalline carbon. The great stability of the resistor so formed makes it ideally suited for many applications in which precision and stability under widely varying ambient conditions are important requirements.

DIMENSIONS:	A	B	C	D	Resistance Ranges Minimum	Maximum
¼ watt	9/16	1½	.160	.032	100 ohms	1 megohm
½ watt	13/16	1½	.160	.032	100 ohms	5 megohms
1 watt	15/16	1½	.295	.032	100 ohms	10 megohms
2 watt	2 1/16	1½	.295	.032	200 ohms	20 megohms

Tolerance: ±1% ±2% ±5%

Temperature Coefficient: 180 to 590 ppm, depending upon resistance.

Voltage Coefficient: 0.002% per volt maximum.

Humidity Sensitivity: After 5 cycles from −55°C to +120°C the change in resistance averages 0.05%.

Overload Sensitivity: May be overloaded 100% for short times without permanent resistance change.

Load Life: After 100 hours at 125°C ambient (½ watt resistor dissipating 0.1 watt)average change in resistance is less than 0.1%.

Peak Voltage Rating: Maximum instantaneous peak voltage is 6000 volts.

CHASE RESISTOR COMPANY

9 RIVER STREET MORRISTOWN, N. J.

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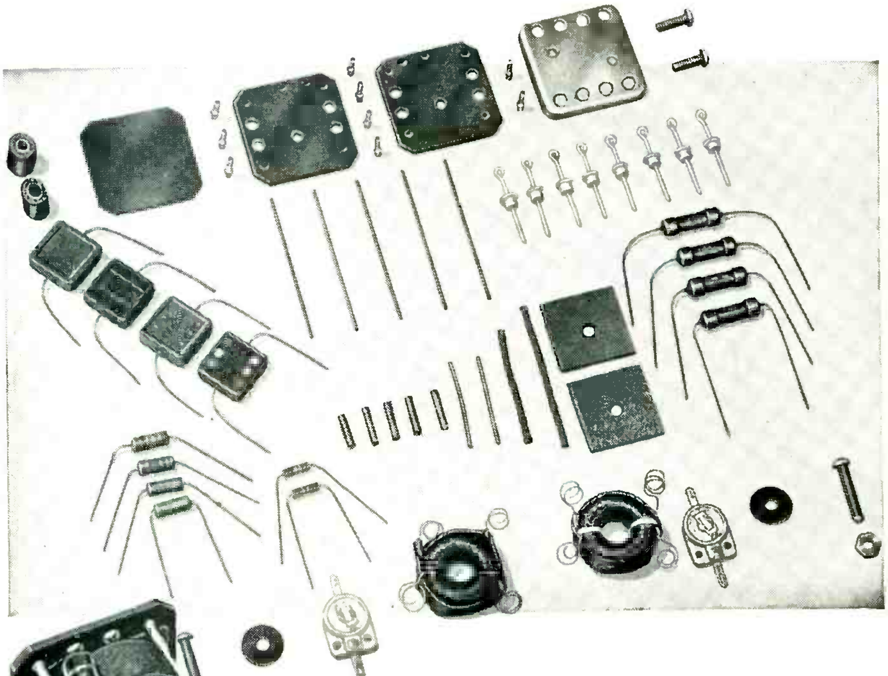
There's More to a Good Filter Than Meets the Eye!




All of these 66 parts are from a single B&W Toroidal-coil type discriminator only 1¾″ square by 3½″ long exclusive of terminals!

Throughout, the job is one calling for precision components plus a wealth of engineering "know how" in producing and assembling them for maximum performance and effectiveness.

Like all other B & W Special Components, the one illustrated here was designed and produced for a specific application—in this instance a critical military use.

FILTERS

In addition to "tailor-made" discriminators, B & W offers a complete line of performance-proved filters including high-pass, low-pass, band-pass and band suppression types.

TOROIDS

B & W Toroidal Coils of various styles and sizes are available in a wide range of inductance values in open, shielded, potted and hermetically sealed types.

B&W Barker & Williamson, Inc.

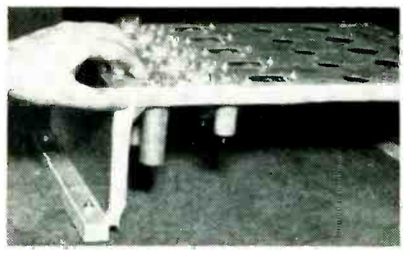
237 Fairfield Ave., Upper Darby, Pa.

unit before and after spraying for tropicalizing and fungiproofing.

Each switch is fastened to the end of its platform in what might be considered an upside-down position, so that the operating pin of the switch hits a striking plate on the bench whenever a chassis is placed on the platform. The weight of the platform by itself is not enough to operate the switch.

Protecting Chassis Finish

To PREVENT scratching or chipping of the baked enamel finish on portions of a television camera-amplifier chassis that are exposed in the final rack or cabinet mounting, RCA Victor uses masking tape and wood strips on these surfaces during assembly and test operations. The wood strips are bolted temporarily to the surfaces on which the chassis rests or slides during assembly at Camden, N. J.



Use of temporary wood strips and masking tape to protect baked enamel finish of chassis during assembly

This protective technique eliminates costly retouching operations. Retouching of scratches is rarely satisfactory anyway, because of the difficulty of baking the retouched areas adequately once parts have been installed.

Doghouse Crate for Tube

LARGE hydrogen thyratrons are shipped safely in individual wood and screen crates constructed much like a dog house. A gable roof prevents piling of other crates on top, and a hinged door with hasp and staple permits padlocking the crate during shipment. Screen is used in the door and on the other three sides so that anyone approaching the crate from any direction can see

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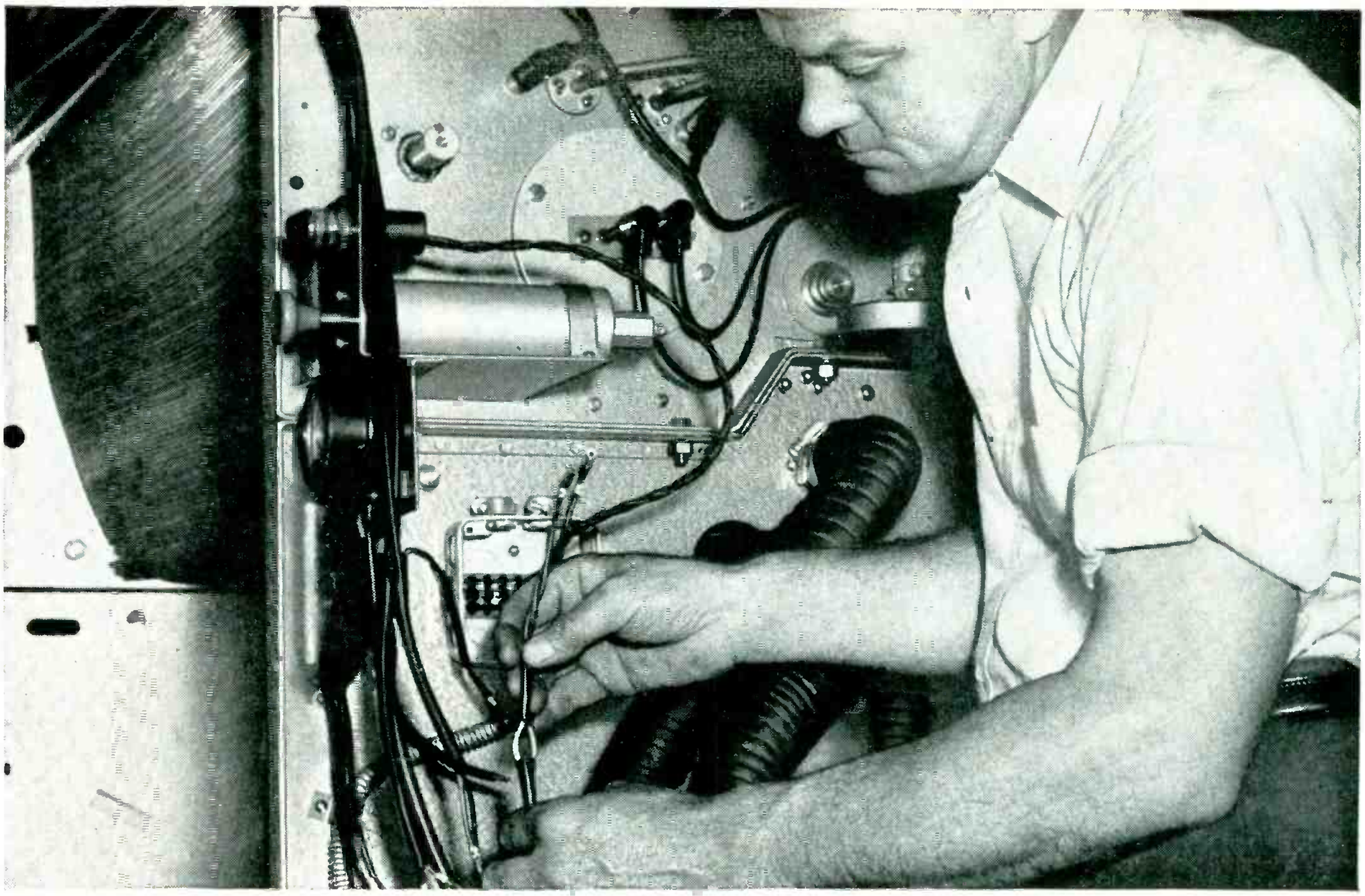

Ozalid saves time and money in Printmaster wiring

. . . with smooth, flexible Irvington FIBRON® Tubing

The job of wiring Printmasters and other duplicating and copying machines is simplified by the smooth interior surface and unusual flexibility of Irvington Fibron Extruded Plastic Tubing, according to the Engineering Department of Ozalid Division of General Aniline & Film Corporation. The tubing slips over the wires easily and quickly—thus saving time and money in assembly.

Ozalid's choice among the many available types of Fibron Tubing is IRV-O-LITE XTE-30—an unusually effective insulation for normal operating conditions. For more severe service—particularly where high ambient temperatures are encountered—many leading manufacturers of electrical equipment turn to Temflex 105. This Irvington Fibron Tubing is UL approved for 90° C. operation in oil—as well as for continuous service at 105° C.

Specifically formulated for *high-temperature* operation, Temflex 105 has the added advantage of retaining its flexibility at temperatures as low as −40° C!

There's a type of Fibron Tubing for just about every type of service requirement—why not look into the *entire* line? Just mail the coupon for the Fibron Catalog.

Look to
IRVINGTON
for Insulation leadership
INSULATING VARNISHES
VARNISHED CAMBRIC
VARNISHED PAPER
VARNISHED FIBERGLAS
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Please send me your catalog on IRV-O-LITE XTE-30, Temflex 105 and other types of Fibron Extruded Plastic Tubing.
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For Further Information, Consult pages 92-93 in the 1951-1952 Electronics Buyers' Guide

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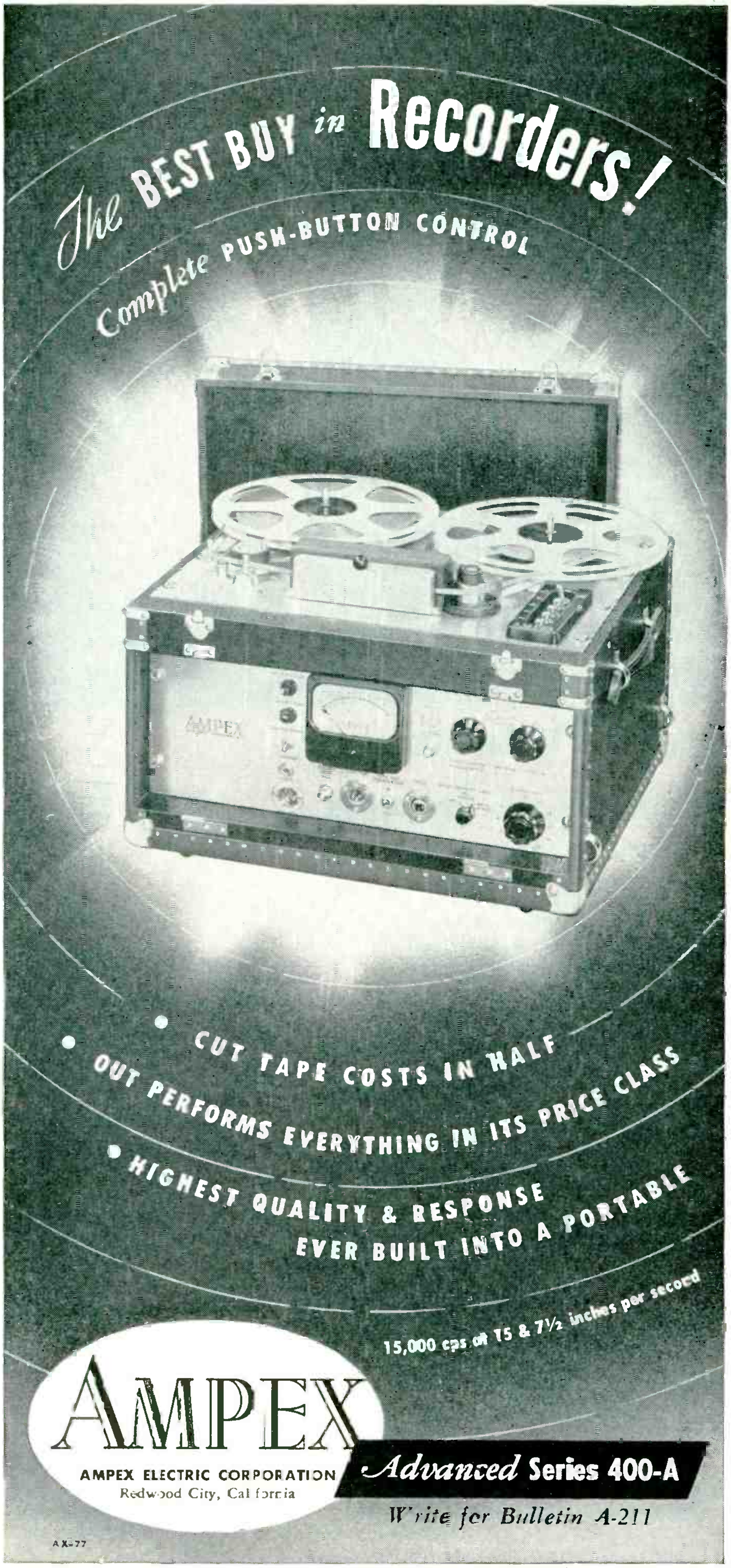

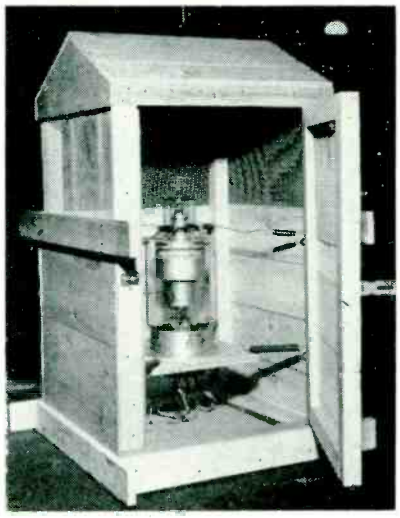

Crate for high-power tube

the fragile nature of its contents. Projecting boards on opposite sides provide convenient grips for a two-man carry.

The tube itself is spring-suspended inside. The cathode flange around the base is placed between two quarter-inch pieces of plywood held together by eyebolts that also serve as anchors for the four stiff steel supporting springs. A rubber-covered spring encircles the top part of the tube and provides anchors for four additional springs that go to the four corners of the crate.

Cost per crate is about $50, but crates are returned empty for re-use to cut down the packing cost per tube. This crating technique, as used by Chatham Electronics Corp. in Newark, N. J., meets with the approval of shipping companies.

Cable-Unwinding Tool

Two pieces of tubing welded together permit unwinding cable from heavy spools without first loading the spools on racks. One piece is straight and has one end flared. To this is welded a second piece bent in the form of a modified semi-spiral. The open end of the curved tube is also flared.

In use, the spool of cable is placed on end, and the unflared end of the straight tube is inserted in the top of the spool. The cable is then threaded through the curved tube and out through the top of the straight tube. A pull on the cable

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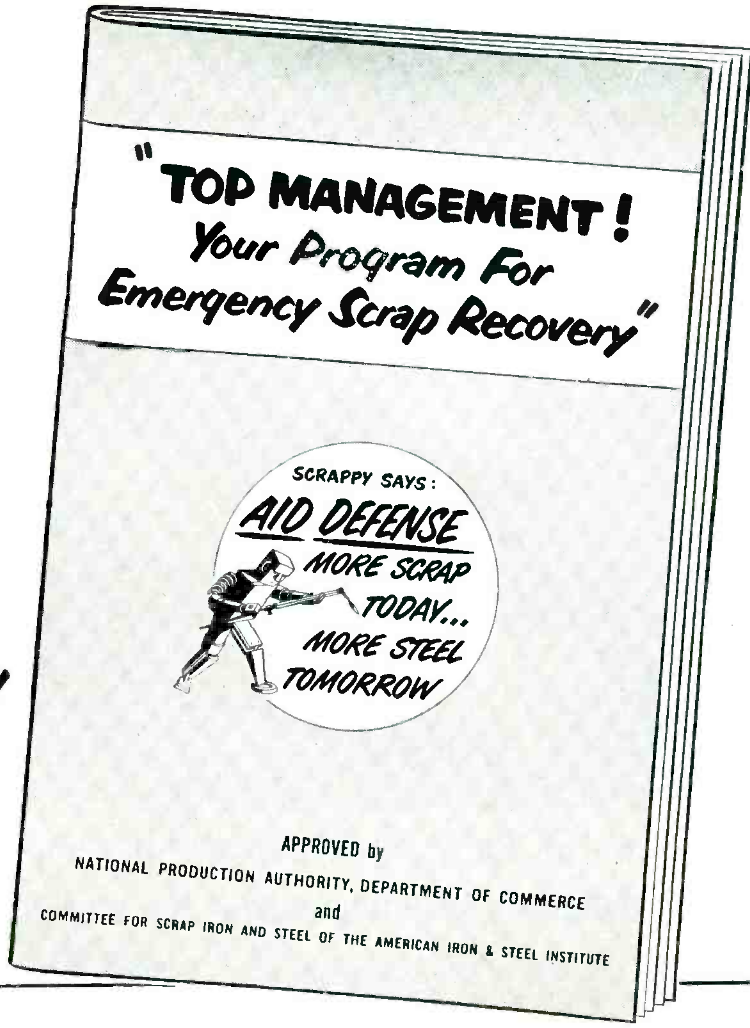
What YOU can do... Must do

to ease the critical iron and steel scrap problem



It's a problem calling for the assistance of every thoughtful business man—now.

Unless the steel mills get more scrap . . . furnaces may have to be shut down.

Shut down—at a time when our armed forces need more and more equipment . . . when civilian demands for steel are greater than ever . . . when our economy is fighting desperately against inflation!

You Can Help. Yes . . . regardless of the business you're in . . . you're in the scrap business, too.

If you're in the steel-fabricating business, you have extra *dormant* scrap to be added to your *production* scrap.

If you're in any other business, you surely have idle metal that will do you—and America—more good being fed into furnaces than cluttering up your premises.

Write for Suggestions. The booklet shown here tells how to set up a Scrap Salvage Program with least amount of effort and minimum interference with your regular operation. It tells where to look for scrap, what to do with it when you get it.

You are urged to send for the booklet now. Use the coupon.

FACTS ABOUT SCRAP SALVAGE

Steel production	1950	97,800,000 net tons
Estimated capacity	1952	119,500,000 net tons
Purchased scrap used*	1950	29,500,000 gross tons
Estimated purchased scrap requirement*	1952	36,200,000 gross tons

*All consumers

Where will the extra tonnage come from? Mostly from your *dormant* metal—obsolete machines and structures, tools, jigs, fixtures, gears, wheels, chains, track.

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A PUBLIC SERVICE PROJECT · THE ADVERTISING COUNCIL

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Please send me a copy of the free booklet: "Top Management: Your Program for Emergency Scrap Recovery"

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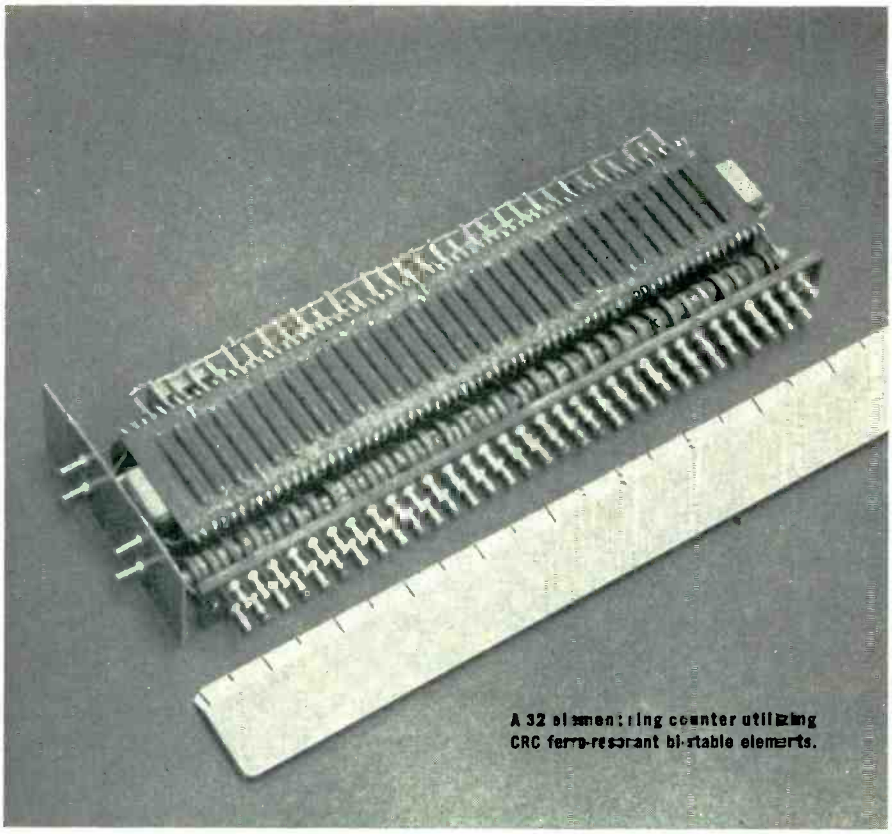

A 32 element ring counter utilizing CRC ferro-resonant bi-stable elements.

The new 100 kc Ferro-Resonant Flip Flop gives you 6 important advantages over the vacuum tube

The new CRC 100 kc Ferro-Resonant Flip Flop is a highly efficient vacuum tube replacement in certain counting, amplifying, and control applications, and can do many of the jobs of the magnetic amplifier.

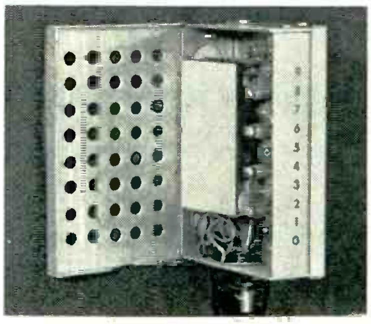
It has the long life, efficient use of power, and low heat dissipation of the saturable reactor, yet can be packaged to occupy less than 1/10 cubic inch of space.

Copper and core loss are the only causes of power consumption, permitting more than 90% of the input energy to be delivered as usable output under certain conditions. The Flip Flop is immune to high acceleration and shock, and virtually eliminates the problem of heat dissipation by using non-dissipating reactive elements.

Since there is nothing to wear out or burn out, the Flip Flop can be built permanently into the circuit. However, present models are available in octal plug-in bases for convenience.

Any specific question you may have regarding application of the Flip Flop to your product will be promptly answered by CRC engineers. Write today to the Applications Division for full information.

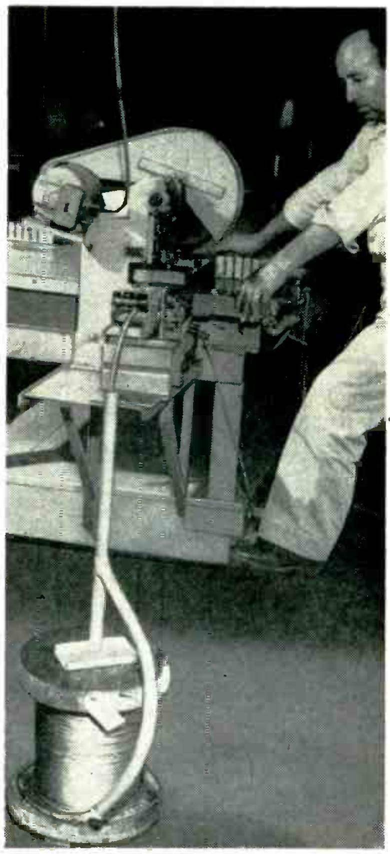
Model MC Flip Flop—actual size



A 10 stage ring counter using 20 kc Ferro-Resonant Flip Flops

CRC Computer Research CORPORATION

3348 W. EL SEGUNDO BLVD. HAWTHORNE, CALIFORNIA . . . OSBORNE 5-1171


Spiral pipe whips around to unreel cable faster than from conventional rack, with no need to lift spool

causes the tube assembly to revolve around the spool, unreeling the cable. The tool was developed by K. W. Goggans, employee in the Tubing and Cables Department of Texas Engineering and Mfg. Co., Inc., Dallas, Texas.

Socket-Life Extender

USE of an expendable adapter minimizes socket wear when a costly tube tester is used for daily incoming inspection of critical tubes in the Television Receiver Division of DuMont's East Paterson, N. J. plant.

Adapters are made up by putting together a base and socket for the type of tube being tested, with bare leads going straight up from base pins to corresponding socket terminals. Two bolts go through adapter socket holes into threaded holes in the panel, to hold the adapter rigidly in the corresponding tube tester socket.

A socket lasts two to three months in this type of service. A worn adapter can be replaced in a

These Fully Magnetic Circuit Breakers Will Help Your Testing Procedure in Two Big Ways . . .

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Murray Circuit Breakers are fully magnetic. When a short circuit occurs, as happens so often during testing, Murray Fully Magnetic Circuit Breakers trip instantly. Expensive, hard-to-replace, electronic parts are *protected* all along the line.

Murray Fully Magnetic Circuit Breakers can be calibrated to meet your specific needs.

2 THEY WILL SAVE YOU TIME AND MONEY

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While tripping instantly on short circuits, Murray Fully Magnetic Breakers will not disrupt your testing line with nuisance tripping. Hermetically sealed hydraulic time delay element allows Murray Breakers to carry harmless overloads without tripping. If the overload persists and reaches the danger point, the breaker will trip.

b. They Save You *Time* — No Waiting To Reset

Murray Fully Magnetic Circuit Breakers trip at fixed current values, regardless of temperature. Therefore, they can be reset immediately after the source of trouble has been removed because there is no "cooling off" period.

c. They Save You *Money* — Nothing Is Destroyed

The use of Murray Fully Magnetic Circuit Breakers will mean a further saving of time and money. When the breaker trips nothing is destroyed—there is nothing to replace. Simply remove the cause of the trouble and flip the switch back to the "on" position.

By using Murray Fully Magnetic Circuit Breakers your testing procedure flows smoothly with minimum interruptions. Your electronic equipment gets maximum protection at a reasonable cost.

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Range: 1 cps to 120,000 cps
Calibration: within 1½% plus 1/10 cycle
Output circuits: 20 volts or 20 milliamps and 1 volt at 300 ohms constant impedance
Amplitude stability: Plus or minus ½ db

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Power Supply Noise: Less than 1/100% of output signal
Power Line Surge: Less than 1/10% of output signal
Harmonic Distortion: Less than 2/10% from 20 cps to 15,000 cps. Less than 1% at all other frequencies
Microphonic Noise: Less than 1/100% of output signal

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minute, whereas formerly the tube tester was out of service for an hour or more while a worn panel socket was being replaced and rewired in the instrument repair department.

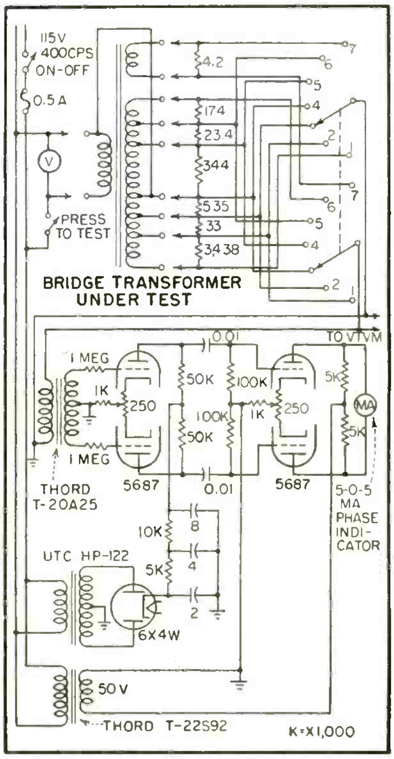
Bridge Transformer Tester

By Curtis R. Schafer
The Liquidometer Corp.
Long Island City, N. Y.

Incoming bridge transformers for capacitance-type aircraft fuel gages are quickly checked for voltage and phase relationships with the production-type test setup shown. The test fixture has an arrangement of leaf springs that contact the terminals on the header of the hermetically sealed transformer and conduct the currents from these terminals into the test unit proper.

In the test unit are the correct resistance loads for the various sections of the secondary windings. A seven-position selector switch on the front panel is rotated by the operator to select each section in turn, and the voltage of each section is then read with an electronic voltmeter.

A zero-center milliammeter is



Complete circuit of bridge transformer tester. First tube is push-pull voltage amplifier, feeding second tube which serves as phase detector

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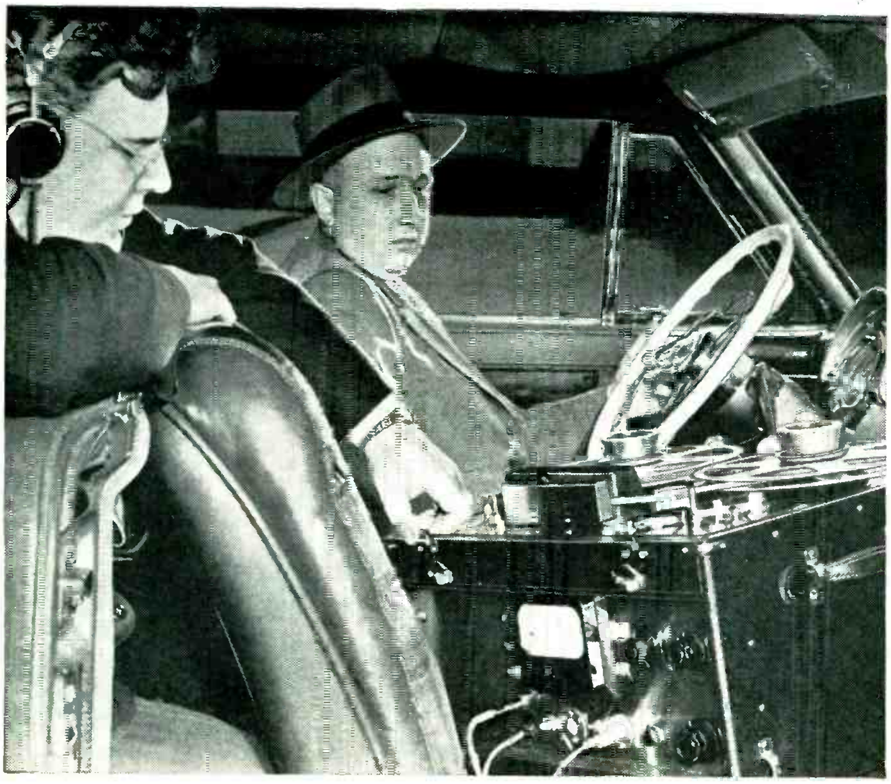

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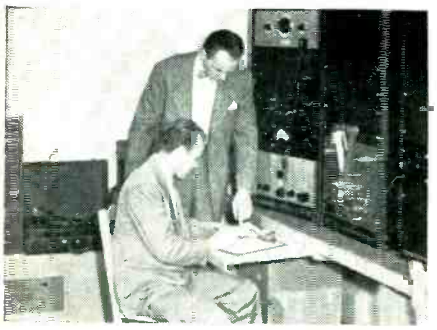
Designing of these devices was formerly a costly trial-and-error proposition, but tape recording has simplified the job. Engineers of the Industrial Wire Cloth Products Corporation at Wayne, Mich., now make recordings on "Scotch" Sound Recording Tape of actual road tests of design models. These noise signals are then analyzed for frequency and relative amplitude, giving engineers valuable data on which to base design modifications.



80 3M ENGINEERS in the field backed by 20 laboratory experts are ready to help you with recording problems. These men of the 3M Service Organization have had wide experience with radio, electronic and industrial sound engineers. They can suggest new recording methods, show you shortcuts, assist in selection of equipment. Call your local 3M Service Representative today . . . or write us direct: Dept. E-52, Minnesota Mining & Mfg. Co., St. Paul 6, Minn.

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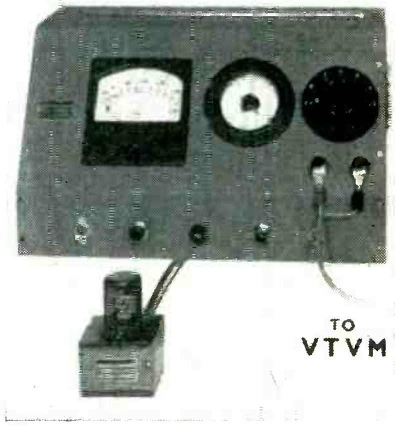


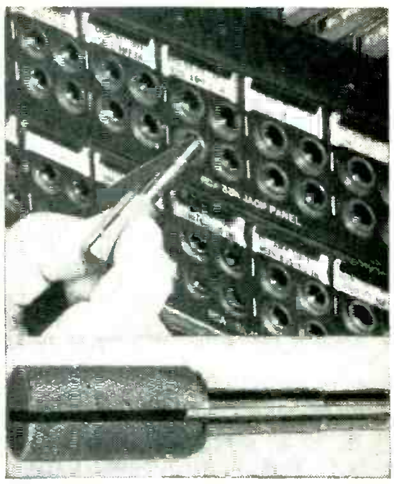
Test setup used at The Liquidometer Corp. for high-speed checking of all electrical characteristics of a bridge transformer that is plugged into box in foreground

used to indicate the phase relationship of each secondary section to the primary since the phase of the voltage is as important as the magnitude in self-balancing bridge applications. The 0–150 v a-c voltmeter serves to monitor the 400-cps line voltage applied to the primary of the transformer under test. All construction work was done by Arthur Hull.

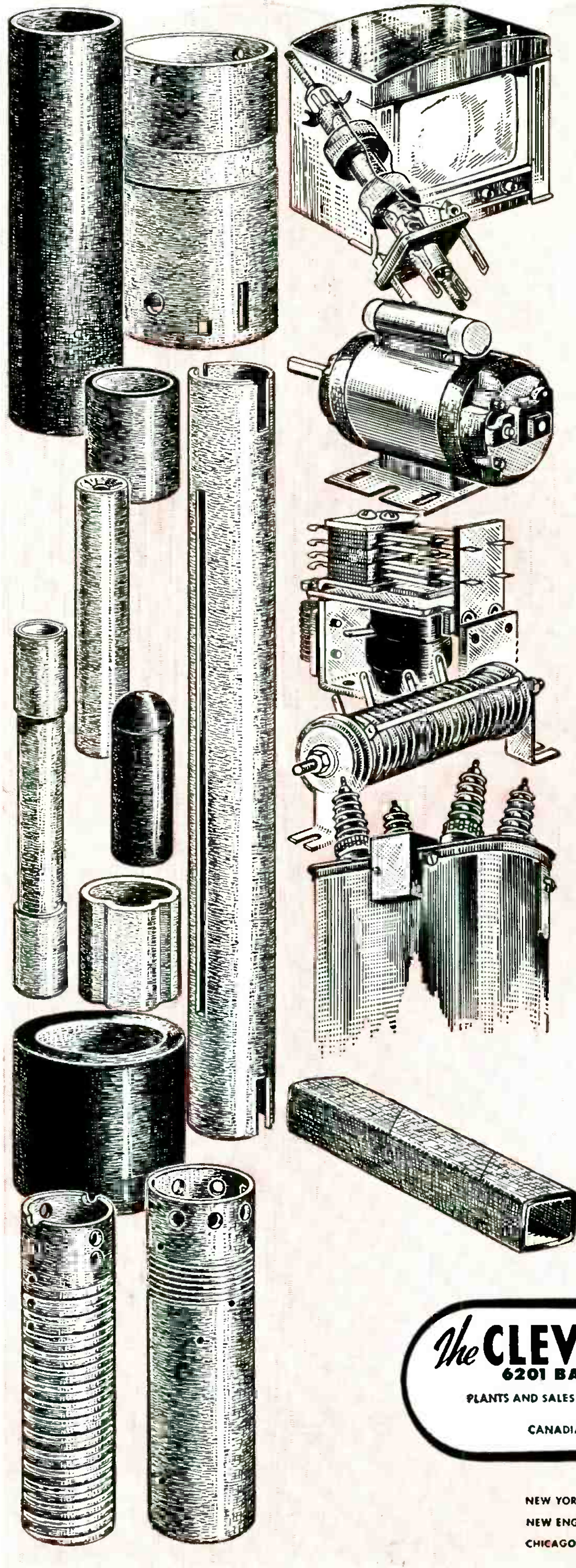
Jack-Cleaning Tool

A DUMMY brass plug with a machined slot speeds insertion of a burnishing tool in Western Electric type 218 and similar jacks for cleaning of contacts.

The dummy plug is inserted in the jack to spread the contacts, the



Removing dummy plug from jack after using it to speed insertion of the flat burnishing strip between the jack contacts



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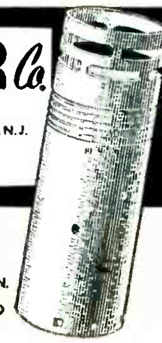

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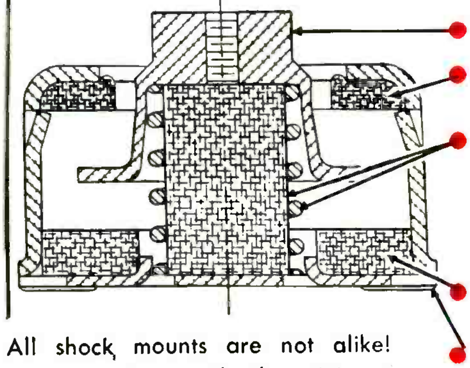

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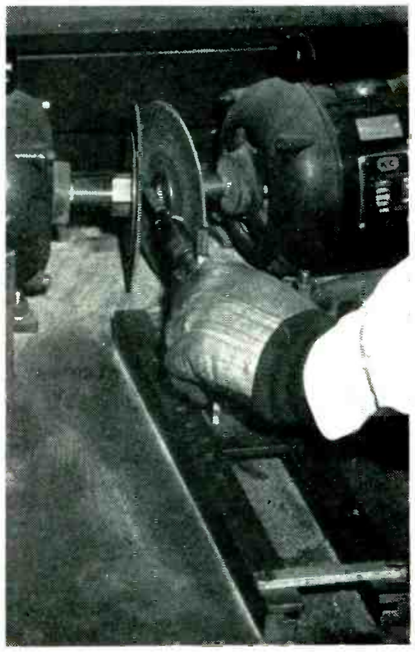
burnishing tool is pushed into the slot in the plug, and the plug is removed. This leaves the tool between the contacts, ready for burnishing. The idea can be applied to all types of contact-making or contact-breaking jacks, in initial production to improve seating of contacts and to routine maintenance. The plug was developed by Commercial Radio-Sound Corp., 231 E. 47th St., New York 17, and can be obtained from them.

Grinding Setup for Soldering Iron Tips

DEVELOPMENT of a highly efficient production setup for regrinding the copper tips of soldering irons has reduced the cost of reprocessing tips to 4 cents in the Television Transmitter Division of Allen B. DuMont Labs., Inc., Clifton, N. J. An additional saving is obtained by grinding new tips to shape from 5¼-inch lengths of ⅜-inch raw copper rod costing 11 cents per length.

Regrinding is the first step. The tip is inserted in a fixture mounted on a slide that moves in and out between two ¼ x 6-inch Norton Alundum wheels that are each set 7½ deg off the axis of the slide to give the



Pushing fixture in for rough grinding of soldering-iron tip. Metal protective cover, normally over grinding wheels, has been removed to show operation more clearly

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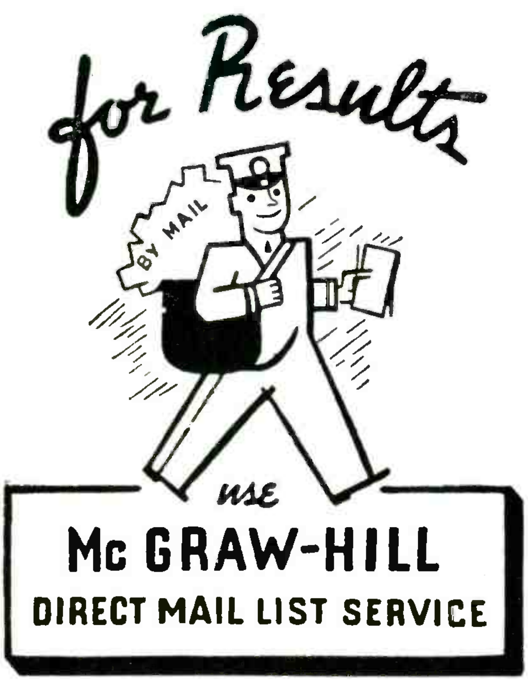

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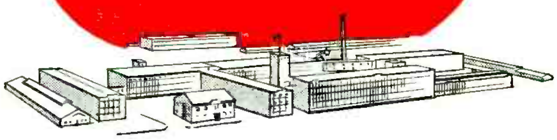
Investigate the advantages of Sessions Timers for your new clock radios—regular or lower price models. Write for technical details. The Sessions Clock Co., Timer Division, Dept. 45, Forestville, Connecticut.

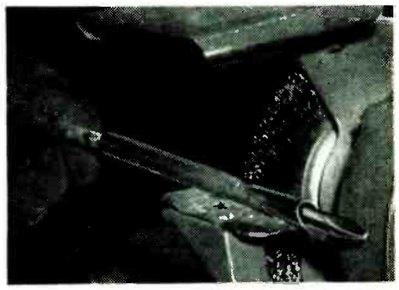
Sessions
SWITCH TIMERS



desired tip angle of 15 deg. The holding chuck is tapered to go between the grinding wheels without touching. An Allen screw on the chuck is tightened to lock the tip in place after it has been positioned by eye so the working face is vertical.

With the tip in position, the slide is moved in to regrind both faces simultaneously. This is done in several passes, inspecting each time to see if pits and holes are gone. Now a knurled locking pin at the top of the fixture is pulled up long enough to rotate the chuck and tip 90 degrees, and the pin is released to drop into another locking hole. The fixture is now pushed into the wheels again to trim the sides of the tip.

For these first grinding operations, the tip moves in past the exact center of the grinding wheels, so that grinding marks run across the faces of the tip. These marks are eliminated in the next step, which involves holding each face of the tip manually near the bottom of another grinding wheel of identical grade, with the shank of the tip horizontal. This smooths the surface, leaving only faint longitudinal grinding marks. Finally, the tip is held end-on to the wheel to square it off and give the desired $\frac{1}{16}$-inch point width. The wheel for finish-grinding is backed by an old $\frac{1}{2}$-inch wheel for rigidity. A batch of tips is rough-ground at a time, which allows the first ones ample time to cool so they can be picked up for the finish-grinding operation.



Scale is removed from shanks of tips in a few seconds as they are pushed through copper tube in this setup. Other end of this motor shaft has Alundum wheel for finish-grinding of tips

All three wheels are driven by $\frac{1}{3}$-hp 3,450-rpm capacitor-start a-c motors. These will slow down somewhat when a tip is pushed in for fast cutting, and provide less than

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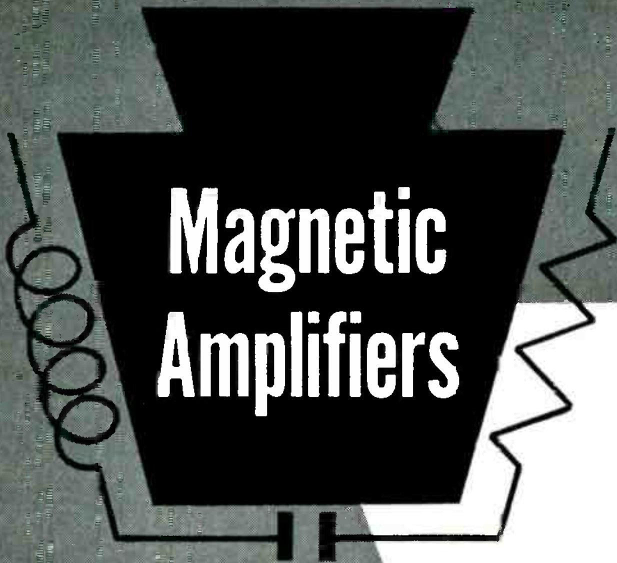

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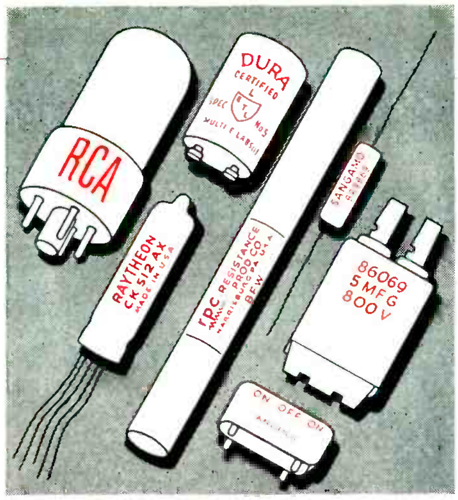

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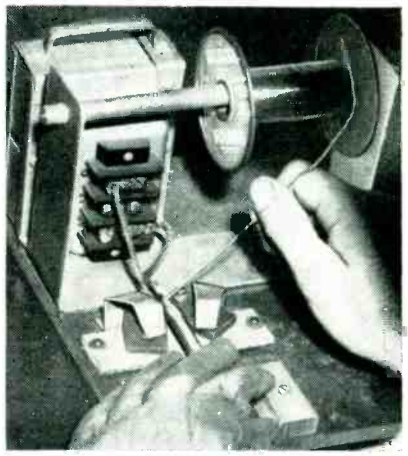

Setup for fast tinning of working face of soldering iron tip after grinding

half the 7,000-rpm optimum speed for the Alundum wheels. As a result of this initial experience, special $\frac{1}{2}$-hp 7,000-rpm motors have been ordered for use in a similar setup at DuMont's East Paterson plant.

After grinding, the tips are pushed through a copper tube mounted in front of a motor-driven wire brush. The copper tube has a cutout on the side facing the brush, through which the brush can spin the shank of the tip and simultaneously remove all scale, leaving a bright burnished surface for optimum heat transfer from the heating element of the soldering iron.

The final step is tinning one working face of the tip. The tip is pushed between angle-mounted carbon brushes connected to a 5-volt resistance-soldering transformer, so that it heats to soldering temperature almost instantly. Rosin-core solder from a conveniently mounted spool is wiped over the face to complete the job. The other face is left untinned, to minimize chances of having it unsolder an adjacent joint when working in close quarters and to aid in concentrating the heat on the working face.

Soldering iron tips are replaced each morning in the Television Transmitter Division, where irons are on all day long but are not being used constantly. With this use, tips are shortened $\frac{1}{8}$-inch on the average for each redressing. In receiver assembly-line work, tips are replaced as often as every two hours.

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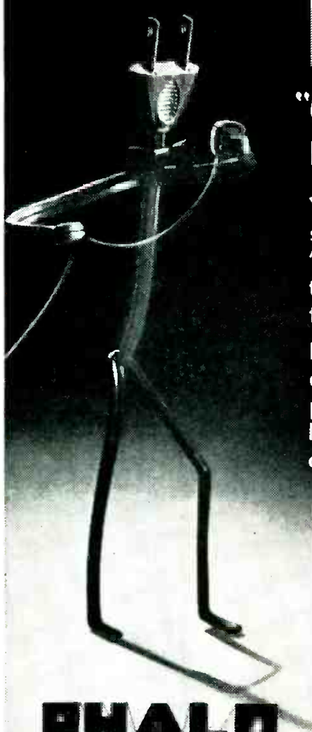
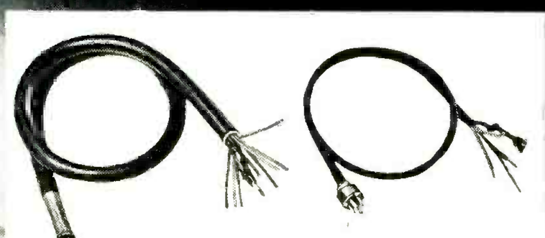
Phalo builds shielded cables that are as versatile as the systems they connect . . . whatever the purpose, you couldn't find a better quality answer. Next time specifications call for shielded communication cable, call for PHALO and be certain!





Shielded, jacketed mobile communication cable

Braided Assembly

PHALO Plastics Corporation

Manufacturers of Thermoplastic Insulated Wire, Cables, Cord Sets and Tubing to Government Specifications

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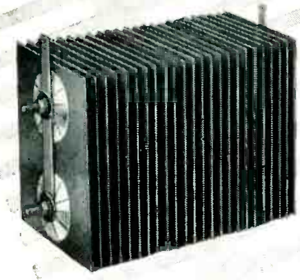
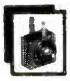
SYNTRON

SELENIUM RECTIFIERS





Made by a new process to a uniform, high quality for continuous, heavy-duty service.

1" sq. to 12"x16" cells—in stacks, or single cells for customer assembly.

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SERVOSCOPE®

Test analyzer for use in development and PRODUCTION of SERVOMECHANISMS and PROCESS CONTROLS. Measures FREQUENCY RESPONSE, PHASE SHIFT 0.1 to 20 CYCLES SINE WAVE, SQUARE WAVE, MODULATED CARRIER, 50 to 800 CYCLES.

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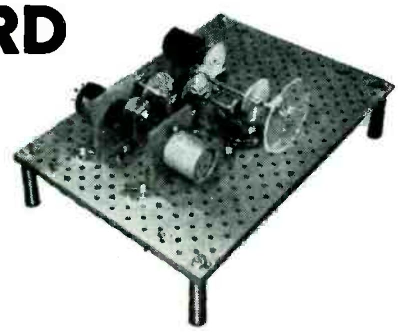
A FLEXIBLE SET of PRECISION mechanical parts for quickly coupling motors, synchros, potentiometers to form assemblies of Servo systems, regulators, computors.



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SERVO CORPORATION OF AMERICA

DEPT. E-5 NEW HYDE PARK, N.Y.

ELECTRONICALLY REGULATED

LABORATORY POWER SUPPLIES

BENCH MODEL 25

STABLE • DEPENDABLE • MODERATELY PRICED

- **INPUT:** 105 to 125 VAC. 50-60 cy
- **OUTPUT #1:** 200 to 325 Volts DC at 100 ma regulated
- **OUTPUT #2:** 6.3 Volts AC CT at 3A unregulated
- **RIPPLE OUTPUT:** Less than 10 millivolts rms

WIDTH 14"
DEPTH 6"
HEIGHT 8"
WT: 17 LBS.

For complete information write for Bulletin E

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Electron Tubes for Industry

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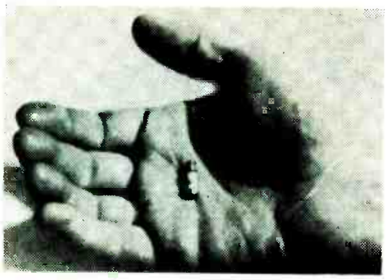
NEW PRODUCTS

Edited by WILLIAM P. O'BRIEN

Varied Instruments, Tubes, Parts and Allied Equipment Are Covered . . . Military Considerations Strongly Influence Component Design . . . Bumper Crop of Trade Catalogs Offered **(see p 314)**

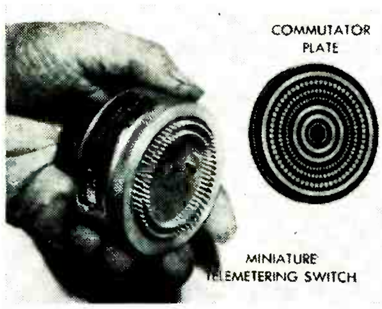


Miniature Terminal

HELDOR BUSHING & TERMINAL CO., INC., 255 Belleville Ave., Bloomfield, N. J., has announced the No. 187, smallest compression-type hermetically-sealed terminal for transformers and other hermetically-sealed components. Available in three styles—turret head, milled and drilled or eyelet—this terminal is only approximately 21/32 in. overall length with a maximum diameter of $\frac{3}{16}$ in. Recommended voltage rating is 2,000 v rms; recommended maximum current rating, 6 amperes and insulation resistance greater than 500,000 megohms.

Air-Cooled UHF TV Tube

GENERAL ELECTRIC CO., Schenectady 5, N. Y., has introduced the type GL-6183 air-cooled transmitting tube for use in uhf tv. It is designed to operate at up to 900 mc with a peak output of 1 kw. Use of ceramic in the envelope will increase the tube's resistance to high temperatures and shock, and will also minimize the problem of h-f losses. Maximum ratings at sync level for class-B tv service include: d-c plate voltage, 4,000 v; d-c screen voltage, 600 v; d-c plate current, 0.7 ampere; plate input, 2.5 kw; plate dissipation, 1.5 kw.



Telemetering Switch & Commutator Plate

MYCALEX CORP OF AMERICA, 30 Rockefeller Plaza, New York 20, N. Y. The type 410 telemetering commutator plate illustrated (right, above) has established an outstanding record on aeronautical research projects. Made of injection-molded glass-bonded mica, it has 180 contacts and 3 slip rings of coin silver integrally molded. The plate, providing 30 synchronizing pulses, samples 60 channels of information such as air speed, altitude, angle-of-attack, temperature, pressure, voltage and other variables. The miniature telemetering switch illustrated at the left has 120 contacts and 2 slip rings of coin silver. It is supplied currently for either 28-v d-c power or 8-v 400-cycle a-c power. For a-c use a selenium rectifier is employed in the circuit.

OTHER DEPARTMENTS featured in this issue:

Power Supply

KEPCO LABORATORIES, INC., 149-14 41st Ave., Flushing 55, N. Y., has just released the model 3100 standard-voltage regulated power supply. The d-c output voltage is continuously variable from 0 to 3 v and delivers from 0 to 100 ma. In the 0 to 3-v range the output voltage variation is less than 5 mv for both line fluctuations from 105 to 125 v and load variation from 0 to 100 ma. Ripple is less than 1 mv. The unit, designed for relay-rack mounting or bench use, is 19 in. wide, 7 in. high and 11 in. deep.

Remote Pickup Microphone

RADIO CORPORATION OF AMERICA, Camden, N. J. Type BK-1A semi-directional pressure microphone for general remote pickup use by a-m, f-m and tv stations has been announced. Sound pressure actuates a thin but rugged diaphragm to which an annular coil is attached. The coil is located in the air gap of a magnetic structure and connected to an impedance matching trans-

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RAYTHEON "Single Crystal"* GERMANIUM DIODES *Lead the Parade*

	CK705 General Purpose	CK706 Video Detector	CK707 50 V. dc Restorer	CK708 100 V. dc Restorer	CK709 Bridge Rectifier	CK710 UHF Mixer	CK711 Bridge Rectifier	CK712 200 V. dc Restorer	CK713 Computer Diode	CK715 Frequency Multiplier	1N67 High Back Resistance
MAXIMUM RATINGS (at 25°C.)											
DC Inverse Voltage (volts)	60	40	80	100	Four matched type CK705 diodes	5	Four matched type CK707 diodes	200	75	Low impedance frequency multiplier for UHF television	80
Average Rectified Current (ma.)	50	35	35	35		50		22.5	50		35
Peak Rectified Current (ma.)	150	125	100	100		150		70	150		100
Surge Current (for 1 sec.) (ma.)	500	300	500	500		500		250	500		500
Ambient Temperature for all types	−50°C to +100°C for all types										
CHARACTERISTICS (at 25°C.)											
Max. Inverse Current at −0.6 volts (ma.)						0.2					
Max. Inverse Current at −5 volts (ma.)			0.008								0.005
Max. Inverse Current at −10 volts (ma.)	0.05										
Max. Inverse Current at −40 volts (ma.)									0.25‡		
Max. Inverse Current at −50 volts (ma.)	0.8		0.10								0.05
Max. Inverse Current at −100 volts (ma.)				0.625							
Max. Inverse Current at −200 volts (ma.)								0.8			
Min. Forward Current at +0.5 volts (ma.)						3.0					
Min. Forward Current at +1 volt (ma.)	5.0		3.5	3.0				2.0			4.0
Min. Forward Current at +2 volts (ma.)									21.0‡		
Min. DC Reverse Voltage for Zero Dynamic Resistance (volts)	70.0	50	100.0	120.0		10.0		225.0	75.0‡		100.0
Shunt Capacitance (uuf), average	1.0		1.0	1.0		1.7		1.0	1.0		1.0
Rectification Efficiency at 54 mc (approx.%)		60									
Oscillator injection current (ma.)						0.75*					

*Conversion loss at 500 mc. and noise factor comparable with 1N21B. ‡at 50°C.

*For several years, Raytheon Germanium Diodes have been made from "Single Crystal" germanium.

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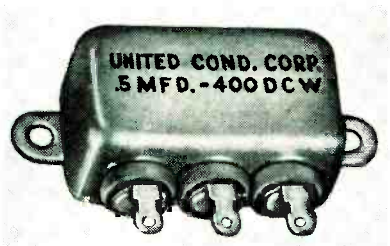
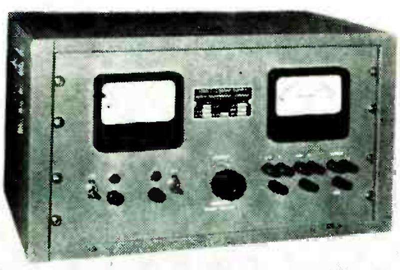
former which provides output impedances of 30,150 and 250 ohms. It has a frequency response of 60 to 10,000 cycles, and an effective output level of —53 dbm referred to one milliwatt and a sound pressure of 10 dynes per sq cm. For frequencies below 2,000 cycles, the microphone is nondirectional. The microphone has a removable base and an adjustable ball and socket swivel, which allows the announcer to tilt it noiselessly in any direction for the best speaking angle. It is 8 in. high and weighs 1 lb and 3 oz.



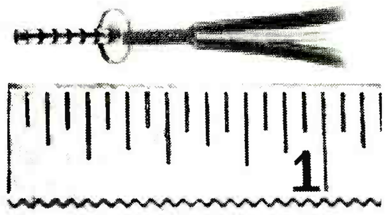
Lightweight Capacitor

UNITED CONDENSER CORP., 337 E. 139th St., New York 54, N. Y., has available a new, small, lightweight capacitor with 125C performance characteristics. With its small case size of ¾ in. × 1 in. × 1¾ in., and weighing but 1¼ oz, a typical Unicon type D film capacitor is conservatively rated at 0.5 μf and 400 v d-c working with no derating up to 125C. Insulation resistance is 6,000 megohms at 125 C. These Unicon capacitors are now in production in various housings and are available for prompt delivery.



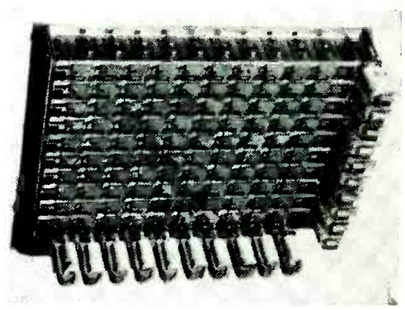
Electronic Power Supplies

PERKIN ENGINEERING CORP., 318 Kansas St., El Segundo, Calif., has developed a new line of standard electronic power supplies varying in rating from 100 ma up to 500 ma and from 200 v up to 1,000 v. There are eight standard models in this range and some have bias voltage ratings either at 0 to 150 v or 0 to 300 v at 5 ma. Each model also has a filament output voltage at 6.3 v at either 3.6 or 10 amperes. Percentage regulation goes as low as 0.5 percent, and ripple voltage, as low as 5 mv.



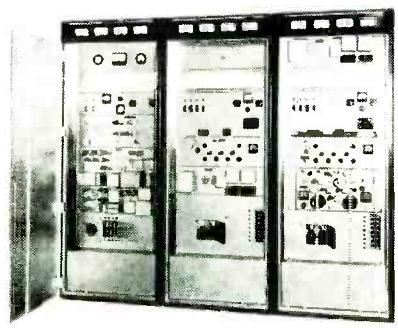
Slip Ring Assembly

ELECTRO TEC CORP., South Hackensack, N. J. Designed for incorporation in miniaturized equipment, this slip ring assembly is extremely small and of high dimensional accuracy. Units of from two to six rings are available with a separate lead feeding each ring. Ring diameters are 0.045 in. The assembly withstands a required 1,000-v hi-pot test, from ring to ring and between leads. The rings are hard (Brinell 60 to 70) fine silver with palladium and rhodium, or gold surface deposits. Weight of a six-ring unit is 5.5 grains (1/80th ounce). All leads are color coded.



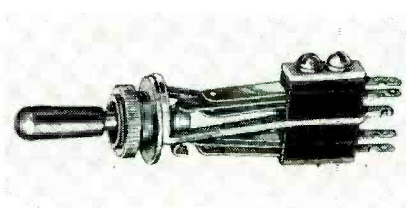
Crossbar Switch

A. W. VINCENT CO., 39 State St., Rochester 14, N. Y. The crossbar switch illustrated allows each circuit of a group of circuits to be connected to a circuit or circuits of another group of circuits in any combination and at frequencies from zero to 10 mc. It has application in telephony, intercommunication systems, telegraphy, computers, broadcast station studio, master control and monitoring switching of audio and video circuits. Capacitance between a single-wire horizontal and vertical connection to ground is 15 μμf in a 10 × 10 switch. Bridging capacitance between adjacent conductors in a horizontal and vertical connection is the same. The device is valuable for much microwave and other high-frequency work.



UHF Transmitter

ALLEN B. DUMONT LABORATORIES, INC., 1500 Main Ave., Clifton N. J., has announced a new uhf tv transmitter with a power output of 5 kw and providing an effective radiated power of 100 kw or greater. It is operable over the complete uhf range from 470 to 890 mc. The transmitter is composed of only three basic units: an Eimac long-life klystron amplifier; a low power modulator amplifier or driver; and a combined visual and aural frequency control or exciter. It will be available for shipment in early 1953 and will sell for approximately $70,000.



Lever Switch

GENERAL CONTROL CO., Boston 34, Mass., has developed a new, miniature, telephone-type lever switch for use in instruments, radio

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They bring true listening enjoyment to millions — through the finest in modern sound recording methods and equipment

RCA Victor's modern Vinylite phonograph records are infinitely superior to the old shellac pressings of a few years ago. Better in tone quality, distortion, surface noise and frequency range. This improvement in quality requires more precision than ever before in every step of record manufacture and processing. That's particularly true of the original sound recording and the master discs from which the stampers are made. And RCA Victor has found that Audiotape and Audiodiscs are an ideal combination to meet the exacting demands for today's high fidelity phonograph records — Audiotape for clearest recording of the original sound and Audiodiscs for fast, easy processing without loss of sound quality. In fact this record-making combination is now being used with outstanding success by America's *leading producers* of fine phonograph records and broadcast transcriptions.

Whatever *your* recording work may be, Audiotape and Audiodiscs offer you this same sound perfection — the result of more than 12 years of specialized experience by the only company in America devoted solely to the manufacture of fine sound recording media, both discs and tape.

... including
audiotape*
for the original sound

... and **audiodiscs***
for the master recording

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AUDIO DEVICES, Inc.

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Export Dept.: 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

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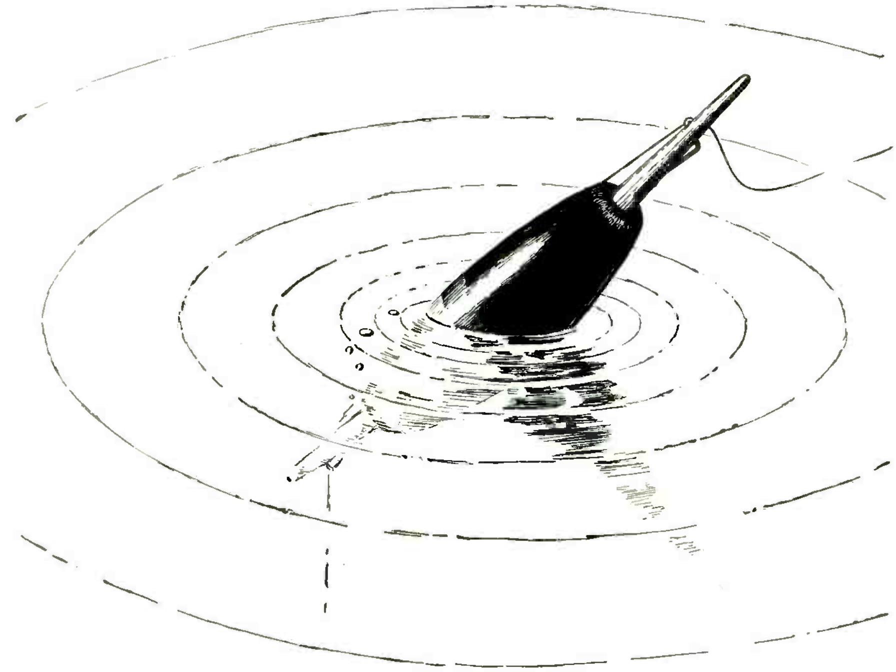


Amplification

AND SIGMA SENSITIVE RELAYS

Within certain limitations of frequency-response, the use of Sigma Sensitive Relays as amplifiers or power modulators gives tremendous gain, and performance otherwise achievable only with much more expensive and high powered electronic components.

For example, a well known 2 KVA Automatic Voltage Regulator employs a Sigma relay to "pick up" the low power signals of the electronic monitor and operate the motor control of a variable auto transformer. Systems of like nature but different purpose and design employ Sigma Relays for amplification at frequencies as high as 30-50 cps. Such amplifiers can even have linear response characteristics within their frequency limits.

Sigma Relays usually combine with sensitivity to extremely low input one or more of the following characteristics:

- POWER GAIN
- MEASUREMENT
- ULTRA HIGH SPEED
- COMPUTING CHARACTERISTICS
- SMALL SIZE AND WEIGHT

If your problem includes any of these factors, by all means get in touch with us.

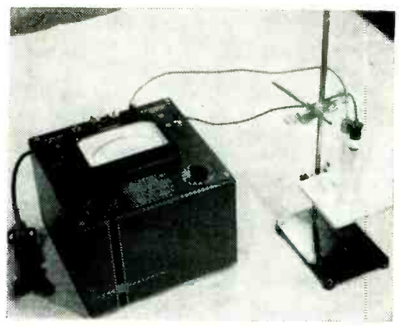
SIGMA

SIGMA INSTRUMENTS, INC.
62 PEARL ST., SO. BRAINTREE, BOSTON 85, MASS.

equipment and communication systems. The single-hole mounting reduces assembly time and simplifies panel design as this switch may be mounted in any position. Little space is required, for back-of-panel depth is only 2 1/16 in. while contact build-ups are 5/16 in. in width. Weight averages less than 1 oz. Contacts are pure, fine silver. They are rated at 1 ampere, 110 v a-c, 60-cycle noninductive load. Each switch is tested to withstand 1,500 v a-c, 60 cycle, between the contacts and the frame.

Electrical Tubing

IRVINGTON VARNISH AND INSULATOR Co., 6 Argyle Terrace, Irvington 11, N. J., has announced a new tubing known as Silicone rubber-coated Fiberglas tubing, which is a Class H product and will withstand exposure of 200 hours at 200 C without embrittlement. A preliminary data sheet showing the minimum average voltage breakdowns at varying temperatures, lengths and sizes available, as well as other pertinent information may be had for the writing.



pH Indicator and VTVM

LEEDS & NORTHRUP Co., 4934 Stenton Ave., Philadelphia 44, Pa., has developed a new line-operated pH indicator and vtvm that is un-

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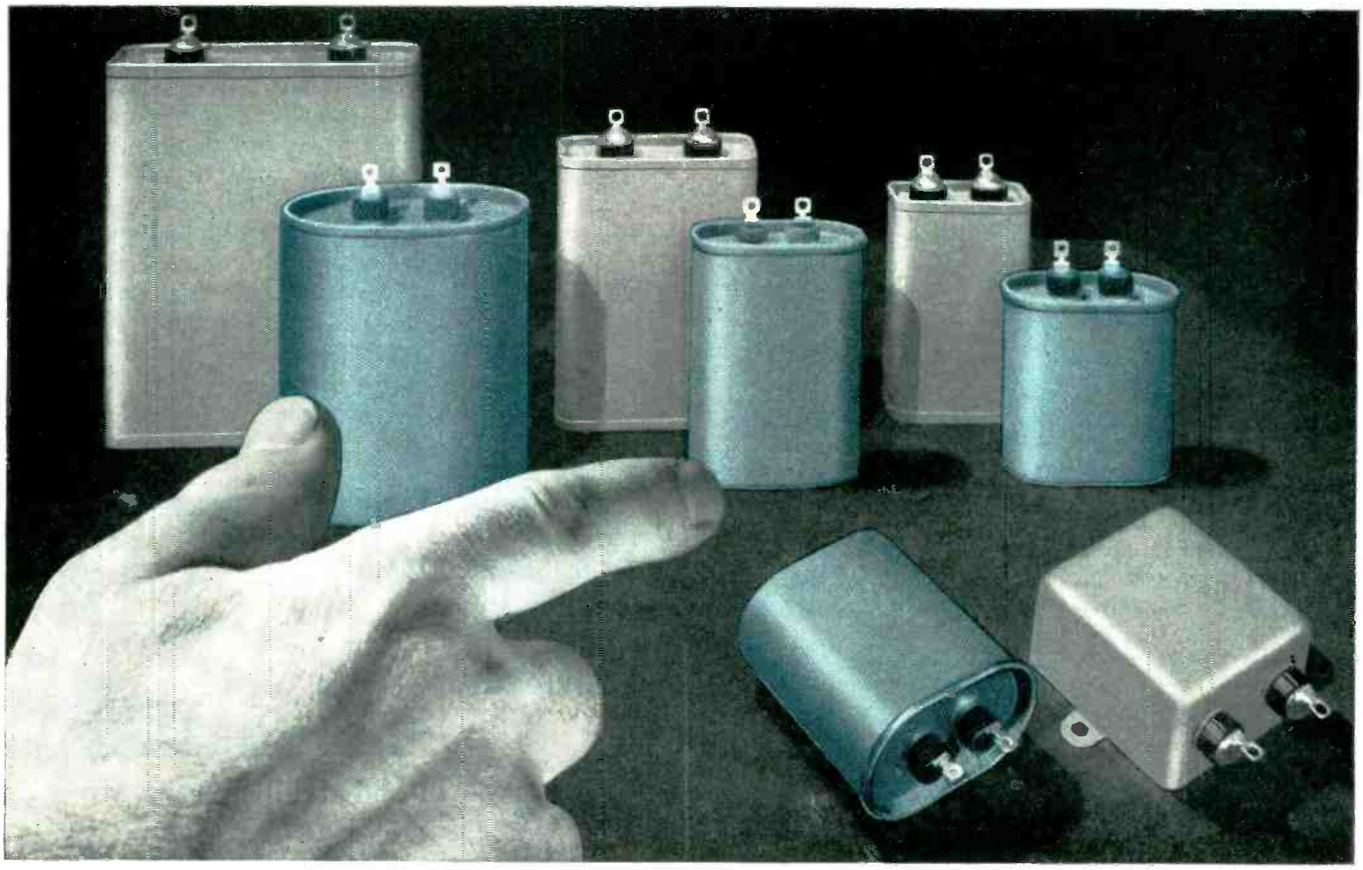

Photographic comparison of the new G-E Drawn-oval capacitors (in color) and the conventional units they replace, showing savings in size.

New General Electric Capacitor is Smaller, 10 to 20% Lower in Price

These fixed paper-dielectric hermetically-sealed capacitors offer:

- **Reduced costs — 10 to 20%**
- **Savings in size and weight**
- **Double-rolled seams**
- **Drawn-steel cases**
- **Savings in critical materials**

If you're using fixed paper-dielectric capacitors with case styles CP53 and CP70 in ratings from 1 to 10 muf, 600 to 1500 volts d-c or 330 to 660 volts a-c—these Drawn-oval units offer you improved reliability in addition to an opportunity for reducing the size, weight and *cost* of the electrical equipment you manufacture.

In the new Drawn-oval capacitors, we get minimum seam length by using drawn-steel cases, attaching the capacitor covers with a double-rolled seam of proven reliability. This construction results in a lighter, yet stronger capacitor. Actual savings in size and weight vary with case style and rating but they can amount to as much as 30%.

This new construction has enabled us to increase output while eliminating some critical materials. The resulting savings are passed on to you in the form of shorter shipments and lower prices. Prices average 10 to 20% lower than standard capacitors, again depending upon case style and, of course, quantity ordered.

For more information on the new G-E Drawn-oval capacitors, their ratings, dimensions and prices, see your local G-E apparatus sales representative or write for Bulletin GEA-5777. Address Section 407-311, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

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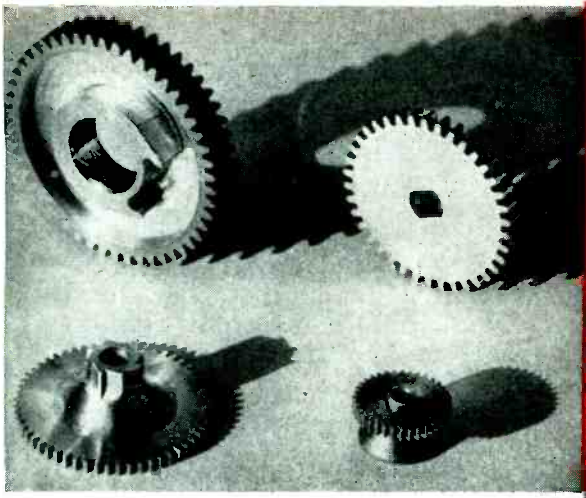

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1021 PARMELE STREET, ROCKFORD, ILLINOIS

STANDARD SIGNAL GENERATOR

MODEL 84—300-1000 Megacycles

OUTPUT VOLTAGE: Continuously variable from 0.1 to 100,000 microvolts. Output impedance, 50 ohms.

MODULATION: Sine Wave: 0-30%, 400, 1000 or 2500 cycles. Pulse: Frequency, 60 to 100,000 cycles. Width, 1 to 50 microseconds. Delay, 0 to 50 microseconds. Sync. output, up to 50 volts, either polarity.

POWER SUPPLY: 117 volts, 60 cycles. (Also available for 117 volts, 50 cycles; 220 volts, 60 cycles; 220 volts, 50 cycles.)

DIMENSIONS: 12" high x 26" wide x 10" deep, overall.

WEIGHT: Approximately 135 pounds, including external line voltage regulator.

Laboratory Standards

MANUFACTURERS OF
Standard Signal Generators
Pulse Generators
FM Signal Generators
Square Wave Generators
Vacuum Tube Voltmeters
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TV & FM Test Equipment

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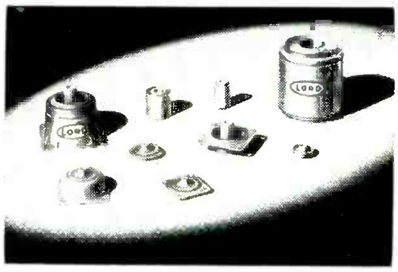
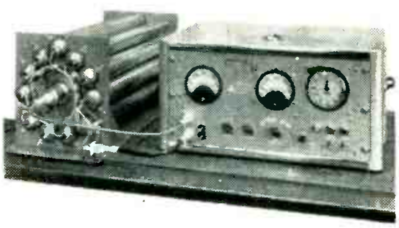
affected by normal fluctuations in line voltage or by zero drift of the amplifier. A converter-type instrument, its circuit employs d-c to a-c conversion, a-c amplification, and conversion back to d-c for voltage feedback. Conversion stabilizes zero; feedback stabilizes gain. Continuous pH 0 to 14 scale eliminates range changing. As a vtvm it can be used with any high or low impedance electrode system that develops potentials within range of the instrument.



Bonded Silicones

LORD MFG. CO., Erie, Pa., is now producing bonded-silicone vibration-control mountings and bonded-silicone parts. Silicone rubber maintains resiliency and provides maximum isolation of shock and vibration at such extreme temperatures as −100 F and +500 F. Molded into useful forms it opens up a wide field of value to the designer of industrial products. Especially is this true in the vitally important field of modern aviation, both military and commercial. The bonded silicones illustrated are now in service on aircraft nacelle mounted equipment and airborne electronic equipment as vibration isolation mountings.



Age Determination Machine

RADIATION COUNTER LABORATORIES, INC., 5122 W. Grove St., Skokie, Ill. The Libby Carbon 14 age determi-

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MEET YOUR H-F REQUIREMENTS

with *Federal's* complete line of

RG TYPE CABLES

FEDERAL RG TYPE COAXIAL CABLES

REGULAR JACKET

RG-5/U	RG-14/U	RG-23/U	RG-59/U
RG-6/U	RG-15/U	RG-24/U	RG-62/U
RG-7/U	RG-17/U	RG-29/U	RG-63/U
RG-8/U	RG-18/U	RG-34/U	RG-65/U
RG-9/U	RG-19/U	RG-35/U	RG-71/U
RG-9A/U	RG-20/U	RG-54A/U	RG-74/U
RG-10/U	RG-21/U	RG-55/U	RG-79/U
RG-11/U	RG-22/U	RG-57/U	RG-108/U
RG-12/U	RG-22A/U	RG-58/U	RG-111/U
RG-13/U	RG-22B/U	RG-58A/U	

LOW TEMPERATURE NON-CONTAMINATING JACKET
Types approved to date—

RG-5B/U	RG-11A/U	RG-22B/U	RG-62A/U
RG-6A/U	RG-12A/U	RG-58B/U	RG-63B/U
RG-8A/U	RG-13A/U	RG-58C/U	RG-65A/U
RG-9B/U	RG-21A/U	RG-59A/U	RG-79B/U
RG-10A/U			

The following types—over ½-inch diameter—are available, subject to military approval:

RG-14A/U	RG-18A/U	RG-20A/U	RG-34A/U
RG-17A/U	RG-19A/U	RG-23A/U	RG-74A/U

Federal Telephone and Radio Corporation
Selenium-Intelin Division—Clifton, N. J.

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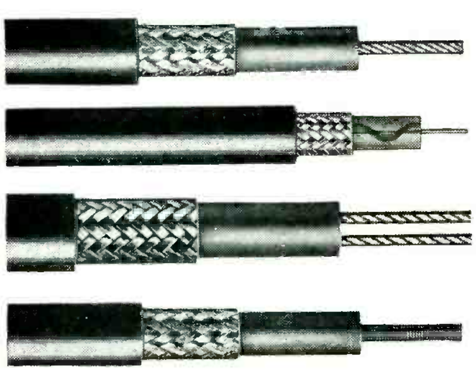
Including the Federal-developed
LOW TEMPERATURE NON-CONTAMINATING THERMOPLASTIC JACKET

Approved Army-Navy and Special Types for:

H-F Communications • Television • Industrial Electronics • Radio and TV Lead-Ins
Aviation • Test Equipment • Radar, Pulse and Experimental Equipment



Typical Federal RG Types

WHATEVER your requirements for high frequency coaxial cables—*look to Federal*—America's *top* source of *regular* RG types and *pioneer* source of *low temperature* RG types. Federal was *first* to develop the latter . . . *first* to produce it in tremendous quantities.

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COMPLETE COAXIAL CABLE ASSEMBLIES also are available from Federal . . . to meet your requirements. This new service offers the same "*Precision Production*" that made "*Federal*" the outstanding name in H-F cables. Write today to Dept. D-813.

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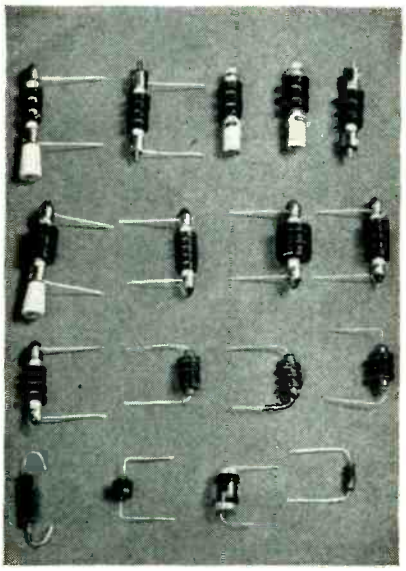

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National makes a complete line of quality R.F. chokes to meet every electronic need. In addition, National's engineering staff and production facilities are capable of winding chokes to any set of specifications for commercial or military applications. Close tolerances guaranteed. Write for complete information or send specifications.

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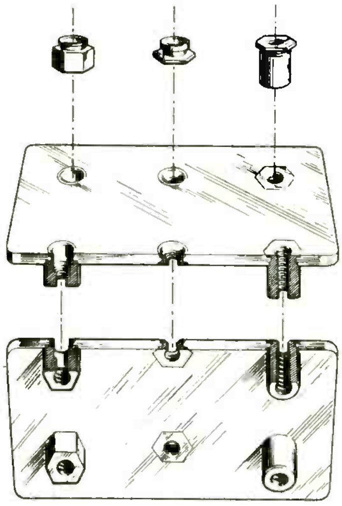
National Captive Nuts of stainless steel may be pressed into aluminum and certain types of brass sheet metal to provide integral flush-mounted tapped holes in a wide variety of sizes. Four basic types have been designed for metal thicknesses of 1/16", 3/32", 1/8", 3/16" and 1/4".



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nation machine was developed as a radioisotope method of determining the age of buried wood such as found in King Tut's tomb. With this apparatus the age of any historical artifact, between 1,000 and 25,000 years old, composed of organic material, may be determined. The machine consists of a ring of 11 matched anticoincidence counters, the latest design Libby screen wall counter, an electronic circuit containing separate voltage supplies for each set of counters, a scale-of-two circuit and a Veeder-Root recorder, together with an anticoincidence circuit. Detailed specifications are available from the company.

UHf Permanent-Wave Apparatus

BLAUPUNKTWERKE, Darmstadt, Germany (U. S. zone), has developed type KS5101 apparatus whereby the heat produced through uhf is used for drying and setting the hair. The double-phase transmitter of 27.2 mc conveys the uhf to the hair coilers whose inner and outer electrodes are connected to the transmitter over a movable arm. The hair coilers, soaked with a chemical liquid, are dried within 30 seconds. Resistance of the coilers at drying is increased from about 5 ohms when moist to about 30 ohms when dry. The uhf at the surface of the coilers is increased from about 30 v to 50 v when dry. The passing of the current is indicated by a glow lamp whose light gradually diminishes as the hair dries. A control voltmeter is provided to

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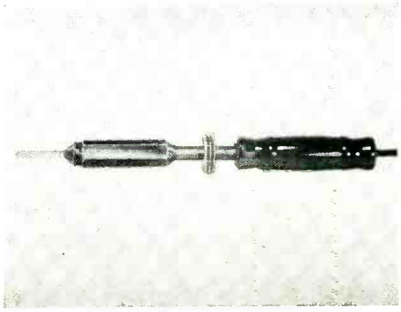
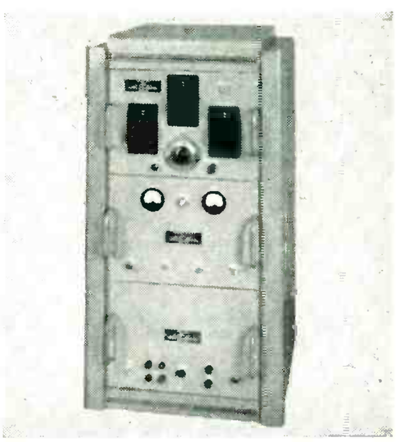
regulate the variations of the feeder current.



Super-Speed Soldering Iron

HEXACON ELECTRIC CO., 130 W. Clay Ave., Roselle Park, N. J., has announced a new electric soldering iron for use on fast production lines where greater speed is required from an iron with a small tip diameter. The iron is the plug-tip type, rated at 150 watts, with a ¼-in. diameter tip which reaches a soldering temperature considerably beyond that of the conventional soldering iron. Special provisions have been made in the element construction to withstand the unusually high temperature developed. Designated as model P-154, list price is $8.50.



Frequency Marker

POLARAD ELECTRONICS CORP., 100 Metropolitan Ave., Brooklyn 11, N. Y. Model FM-L precision frequency marker produces calibration signals at precisely determined intervals of 1 mc within the frequency range of 950 to 2,040 mc. Means are provided for selecting particular frequency markers and rejecting all others. Frequencies

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$142.00* Incl. all coils
Power supply, $22.43*

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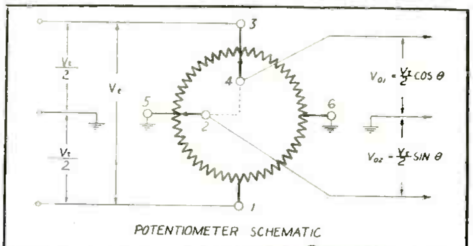
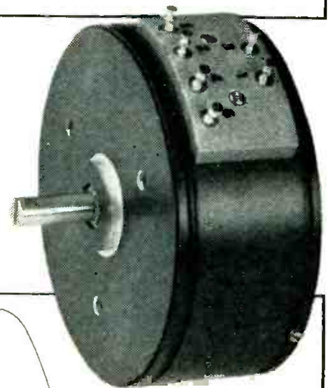
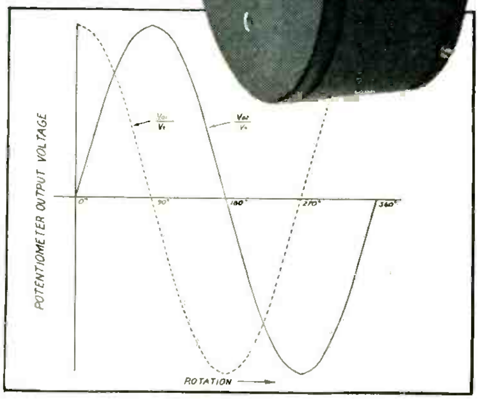
Something new in Precision Potentiometers . . .

. . . the standardization of a Non-Linear Precision Potentiometer, the *type* **RVP3-S59** Sine-Cosine potentiometer, one of the many types standard with the Technology Instrument Corporation, performs two operations in a single potentiometer assembly . . . two wipers spaced 90 degrees apart yield both sine and cosine outputs.



1. Total resistance: 20,000 ohms plus or minus 5 per cent between terminals 1 and 3.
2. Accuracy: Plus or minus .5 per cent of the peak to peak amplitude.
3. Maximum voltage: Conservatively rated as 80 volts between terminal 1 and 3.
4. Life: Guaranteed for at least 500,000 complete cycles in either direction at 30 rpm.
5. Potentiometer base: Precision machined aluminum (originated by TIC) finished with corrosion resistant black Alumilite.
6. All fixed connections are soldered.
7. Wipers: Paliney spring wiper with double contact, for positive electrical connection, long wear and light torque.
8. Resistance Element: Karma wire with temperature coefficient of .00002 parts per degree centigrade.
9. Slip Rings: Inlaid coin silver slip rings. Paliney contacts on dual brushes for positive connection and low contact resistance.
10. Full humidity protection with type 76-S fungus resistant varnish.
11. Units may be ganged, using TIC's patented "Constrict-O-Grip" clamp rings which permit precise phasing with amazing ease.





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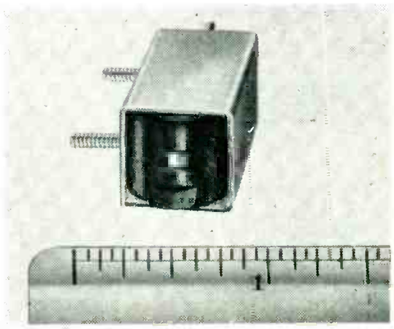
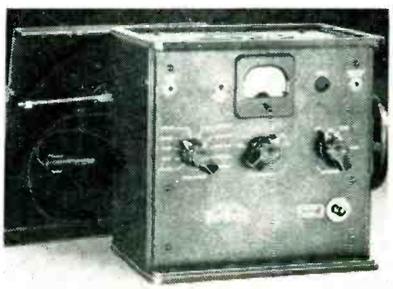


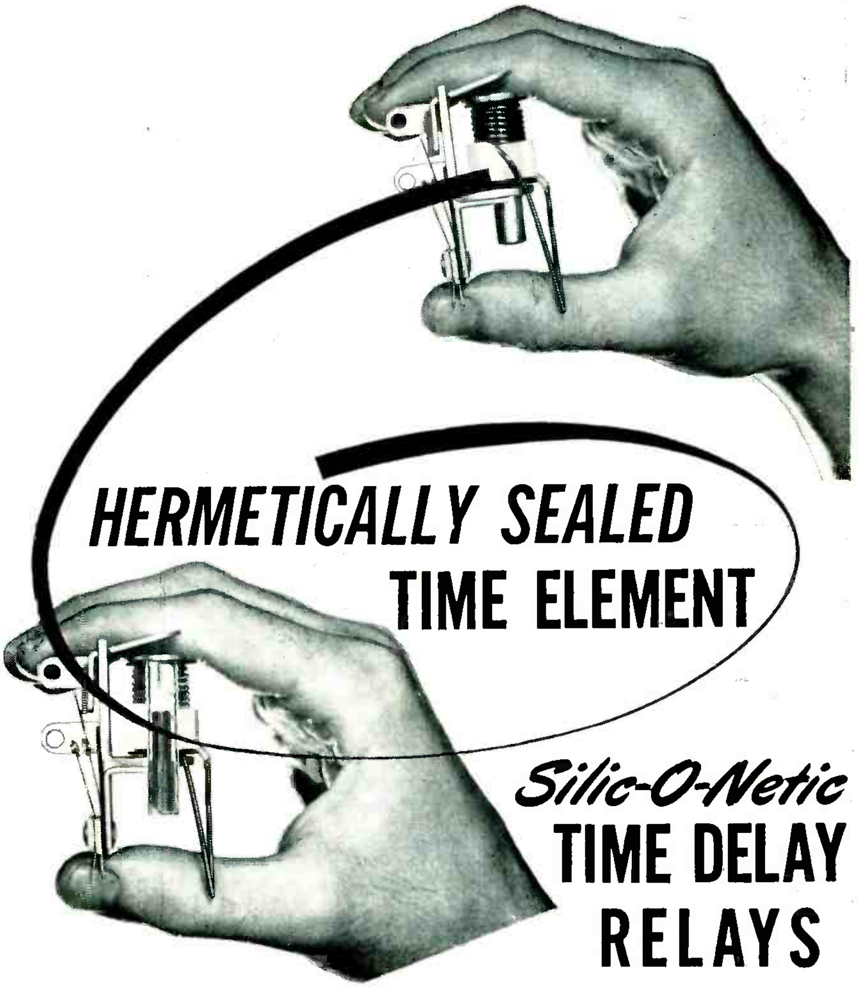
Magnetic Tape Recording Head

SHURE BROTHERS, INC., 225 W. Huron, Chicago 10, Ill. Model TR-16 low-cost magnetic tape recording head features excellent frequency response; compactness (0.765 in. wide × 0.845 in. long × 0.609 in. thick); precision-controlled track width (may be furnished with a track of from 0.025 to 0.1 in.); flexibility of mounting, using standard 2–56 mounting screws, and may be adapted to specific mounting bracket or used with the company mounting bracket that provides vertical and angularity adjustments. It has effective mu-metal shielding for optimum hum reduction and simplification of placement of hum-producing components.



Octave-Band Noise Analyzer

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1550-A octave-band noise analyzer is particularly useful in



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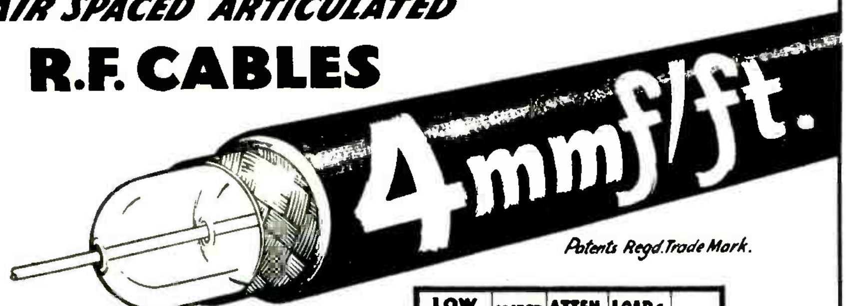

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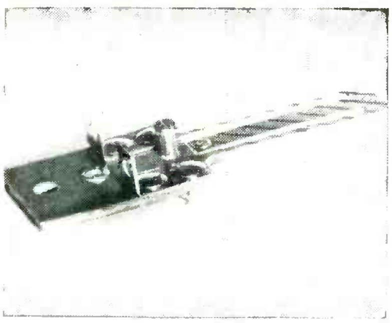
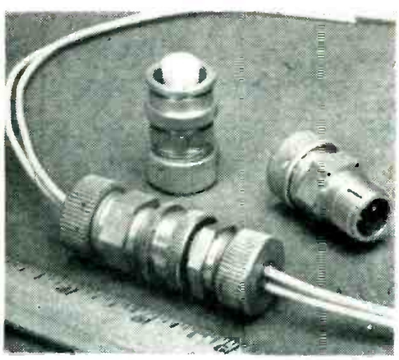


Thermo Relay

B.-T. MFG. CORP., 38 N. Second Ave., Mt. Vernon, N. Y. Model TR-2 thermo relay will control any equipment drawing up to 0.5 ampere at 117 v and now available for a wide range of actuating currents. Variation of time delay is adjustable from 0.1 to 4 seconds. Construction is rugged and simple and uses contacts of fine silver. Overall length is $2\frac{3}{8}$ in.



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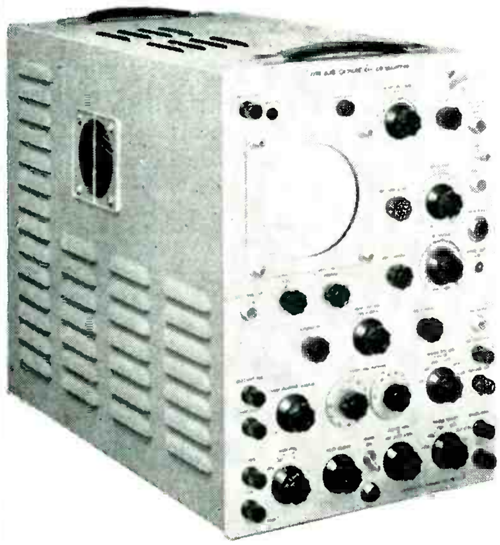

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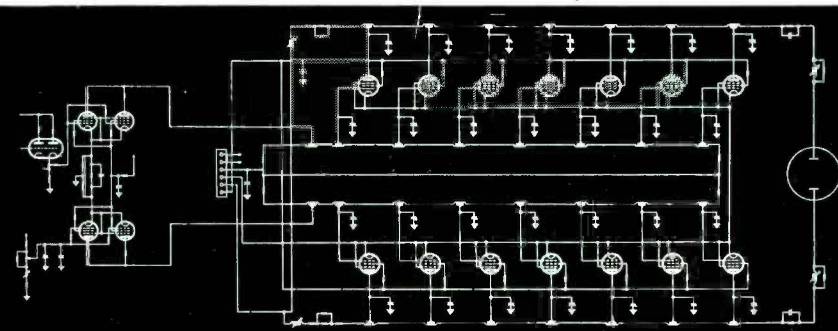

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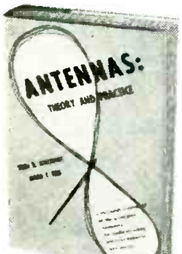

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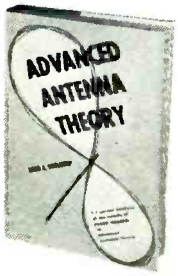

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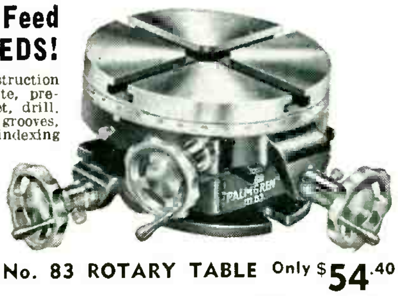

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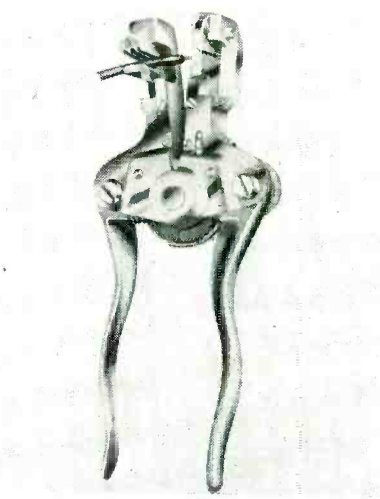

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WOOD SPECIALTY MFG. CO., 915 Taylor Ave., Rockford, Ill. The Speedex Automatic 766-I heavy duty wire stripper features a delayed action release. This prevents the wires from being crushed or bent. Squeezing the handles causes the stripper to grip the wire, cut the insulation and strip it free in one operation. It strips solid as well as stranded wire from 8 to 22 gage and by changing blades it can be used to strip parallel wire, 300 ohms tv and f-m twin transmission wire.

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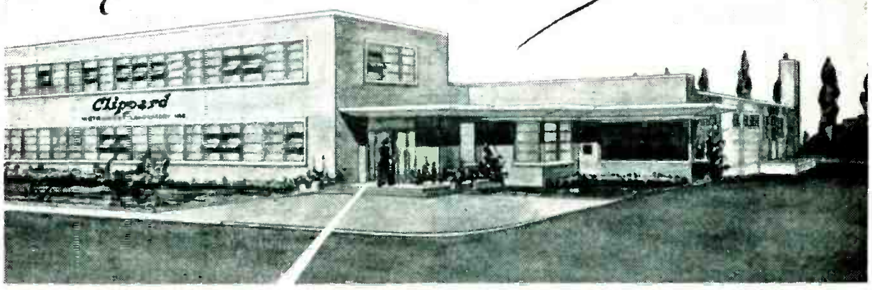

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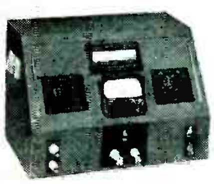

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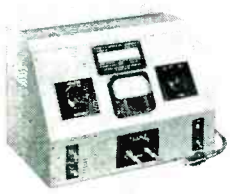

PC-4 CAPACITANCE COMPARATOR checks, grades, sorts all types of condensers at production speeds with unskilled labor.

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Clippard design, production and control engineers specialize in production runs of 1,000 to 10,000,000 units of laboratory accuracy. Clippard experience can also save you size, weight, critical materials, money, assembly problems and production delays.

Make the new Clippard plant a time and money-saving addition to your facilities. Free your production lines for more profitable work. Get precision coils and sub-assemblies or specialized instruments quickly and economically. Send us your problem, a sample, specifications or other details for a prompt solution or quotation, NOW!

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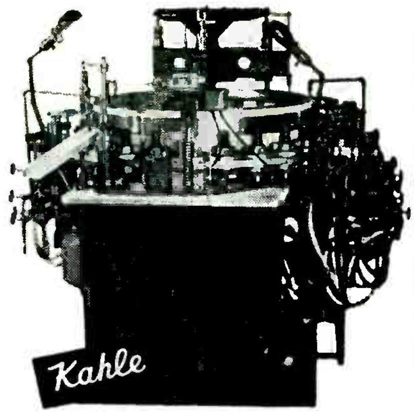

#1197 24-HEAD BUTTON STEM MACHINE For miniature and sub-miniature tubes. Two upper molds for making tubulated and non-tubulated stems. Dual motor drive. Capacity 1000 per hour. All automatic feeds.

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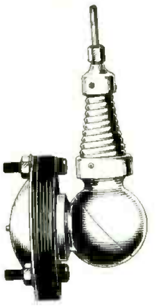

Premax can supply a complete line of vertical and mobile antennas for marine and amateur use or for CD. Send for new Bulletin.

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DIVISION CHISHOLM-RYDER CO., INC.

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Socket contacts phosphor bronze cadmium plated. Plug contacts hard brass cadmium plated. Insulation molded bakelite. Plugs and sockets polarized. 2, 4, 6, 8, 10, 12 contacts. Steel caps with baked black crackle enamel.

Catalog No. 18 gives full information on complete line of Jones Electrical Connecting Devices — Plugs, Sockets and Terminal Strips. Write

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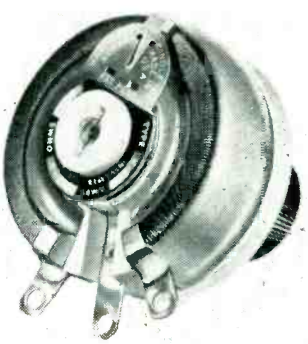
it has an 18 × 24-in. integral screen upon which patterns are projected from the rear. For wall screen projection the integral screen slides back and images 8 × 10 ft or larger are available. The oscilloscope amplifier and sweep circuits are equal in performance to a precision laboratory instrument, the vertical amplifier having a response within 3 db from 2 cycles to 825 kc at a sensitivity of 1 mv rms per in. on the integral screen and the sweeps being either triggered or recurrent from one cycle to 50 kc.

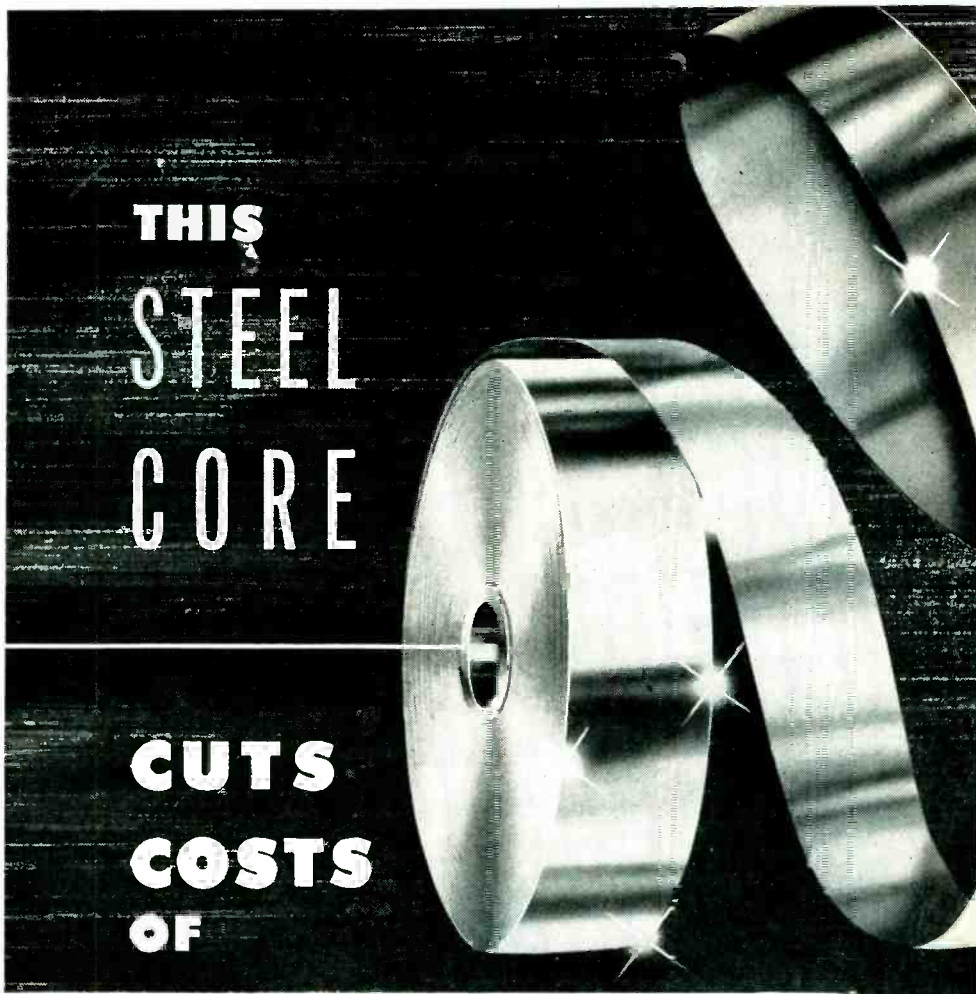


Rheostat

HARDWICK, HINDLE, INC., Newark 5, N. J., recently introduced a new 50-watt rheostat designed to comply with current standards of JAN-R-22, RTMA and NEMA. The toroidal ceramic form wound with resistance wire is coated and bonded to a refractory base with a new high-temperature vitreous enamel. A "buss bar" contact brush construction affords a minimum of resistance from resistive element to collector ring. Mechanical drawings and specifications may be found in bulletin 152 now available.

Audio Oscillator

KROHN-HITE INSTRUMENT CO., 580 Massachusetts Ave., Cambridge 39, Mass. Model 430-A audio oscillator



REPUBLIC

Aluminum Foil

Republic's development of steel cores for spooling capacitor foil can save you money. No more time-wasting cleaning of cores, no more sorting and guessing as to which supplier owns them, no more bother or fuss. Simply discard Republic's steel cores and sell them for scrap. This is just one of the many little things that make it economical to buy Republic Aluminum Foil.

Some of the really big things are that Republic capacitor foil has clean, straight edges, consistently accurate gage, and that coils are individually boxed for protection. These are the things that make for economy through maximum production.

Republic capacitor foil is available in widths of 1/4" and wider, and in gages from .00017" to .005".

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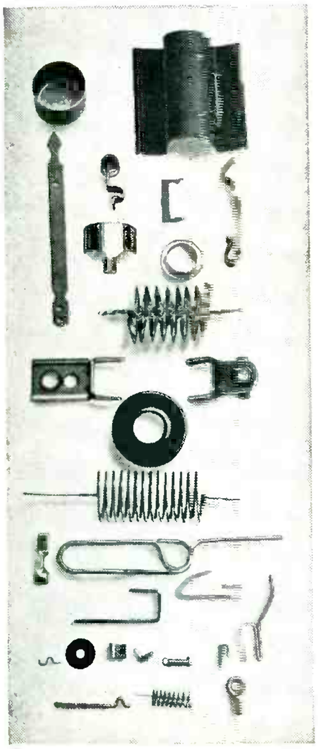

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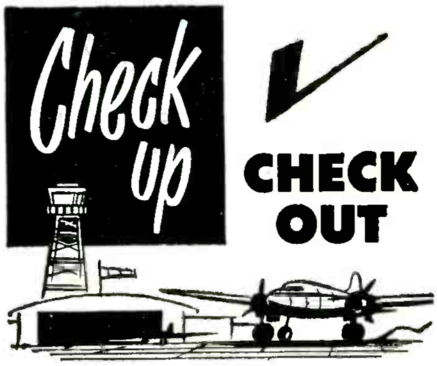
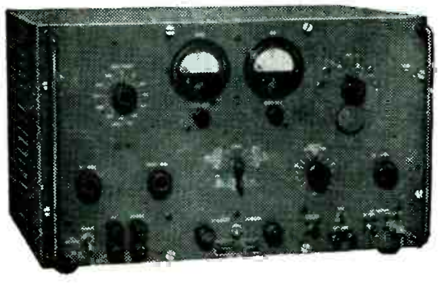


Check up ✓ CHECK OUT

WITH SIGNAL GENERATORS

by

AIRCRAFT RADIO Corporation



TYPE H-14 108-132 MEGACYCLES

Standard signal source for complete testing of VHF airborne omnirange and localizer receivers in aircraft or on the bench is ARC's Type H-14 Signal Generator. It checks up to 24 omni courses, omni course sensitivity, to-from and flag-alarm operation, left-center-right on 90/150 cycle and phase-localizers, and all necessary quantitative bench tests. Permits quick, accurate, check-out of aircraft just before take-off. For ramp checks RF output 1 volt into 52 ohm line; for bench checks, 0-10,000 microvolts. AF output available for bench maintenance and trouble shooting.

Price $885.00 net, f.o.b. Boonton, N.J.

Type H-12 VHF Signal Generator 900 — 2100 mc — source of cw or pulse amplitude-modulated RF. Power level 0 to −120 dbm. Internal pulse circuits with controls for width, delay, and rate, and provision for external pulsing. Frequency calibration better than 1%. Built to Navy specs for research, production testing. Equal to Military TS-419/U.

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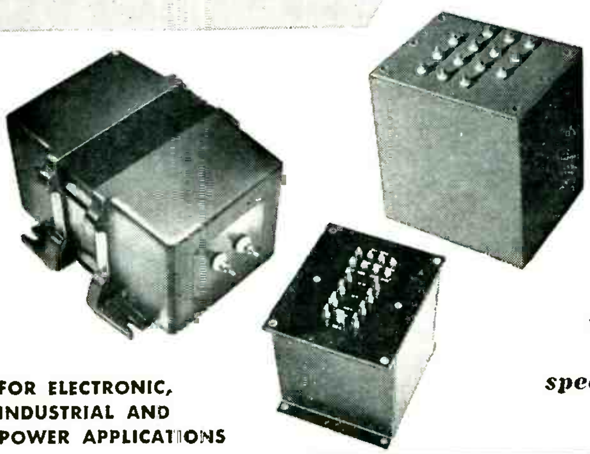

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covers the frequency range from 4.5 to 520,000 cps in five overlapping bands. A single scale logarithmic dial is used. Calibration is held within ±2-percent accuracy. Two output terminals are provided. The voltage on one of them is controlled by a calibrated output level control. The other provides a fixed sine wave signal for scope synchronization. Other features include low distortion and hum at any setting of the output level control and excellent amplitude constancy over the entire frequency range. The unit weighs 15 pounds and is priced at $145.

Desk Calculator

Benson-Lehner Corp., 2340 Sawtelle Blvd., Los Angeles 64, Calif. The Computyper introduces high speed recording of numerical information into the desk calculator field. Combining functions of a Friden model STW-10-JF calculator with those of an IBM type 111 electric typewriter, the unit is an integrated system capable of a wide range of arithmetic operations. It reduces both the time required for a given operation and eliminates the possibility of errors inherent in the manual process of transcribing numbers. Incorporated are appropriate electrical control circuits that are paced by the typewriter itself to achieve a recording rate of approximately 10 digits per second.

Megohmmeter

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. Rapid measurement of insulation resistance as well as general resistance testing is possible with the compact and portable type 1862-A megohmmeter. Range is from 0.5

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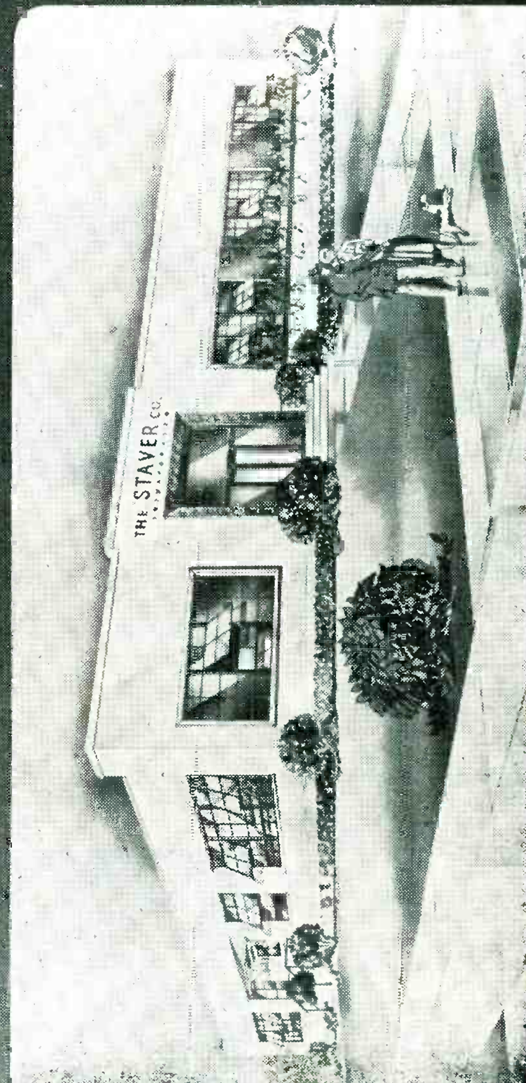

STAVER'S NEW HOME
This modern structure houses a large manufacturing area, tool room, experimental laboratory, office space, and shipping and receiving department.

With a threefold expansion in manufacturing facilities, the Staver Company is now in a better position than ever to design, produce and deliver our standard line of tube shields, tube holders and precision electronic stampings—plus a new line of electro-mechanical switching devices for the aircraft, communications and electronic industries.

Our engineering department is available now, to discuss your requirements. Complete information on our facilities and capacity is yours for the asking. Phone Bay Shore 3620 or write . . .

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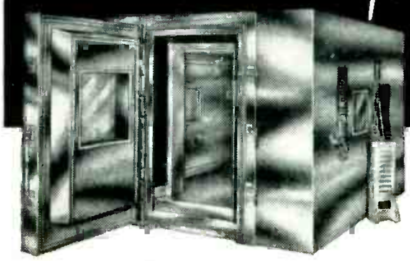
Another BOWSER *First!!*



Flight Simulation WALK-IN ROOMS *with* VIBRATION and ACCELERATION TEST FACILITIES

Bowser Environmental Simulation Test equipment has always been foremost in the field. Now, to comply with latest government specifications, Bowser introduces walk-in rooms with a temperature range from —100° F. to +200° F., relative humidity simulation from 20% to 95% and unlimited altitude simulation. In addition, these rooms are specially designed to be equipped with vibration machines to permit simultaneous testing under conditions of vibration, acceleration, low temperature and altitude.

Bowser Walk-In Rooms are engineered for completely automatic operation. Doors, available up to the full size of any wall, can be mechanically controlled to conform with limitations of size, space and weight. Performance characteristics, such as rate of climb, pull down, etc., are available to meet any government or research specifications.

✓ CHECK AND MAIL TODAY

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Send information on test equipment checked:

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- ☐ Low Temperature
- ☐ Temperature Shock
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- ☐ Altitude
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- ☐ Fungus Resistance
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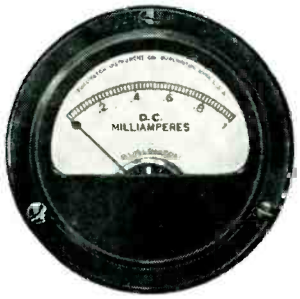

The Burlington "Hermetically Sealed" Instrument was designed and is manufactured to conform to JAN specifications for sealed instruments.

Burlington

HERMETICALLY SEALED INSTRUMENT

- Steel case with heavy copper-cadmium plate and black finish.
- Excellent shielding due to case material and construction.
- Double strength clear glass.
- Black satin onodized aluminum bezel.
- Glass to metal seal under controlled humidity and temperature conditions.
- D'Arsonval permanent magnet type movement for DC applications.
- Designed to enhance panel appearance.
- Available in 1½" square, 2½" and 3½" round case types.
- Guaranteed for one year against workmanship and materials.

BURLINGTON INSTRUMENT COMPANY

Dept. F-52, Burlington, Iowa

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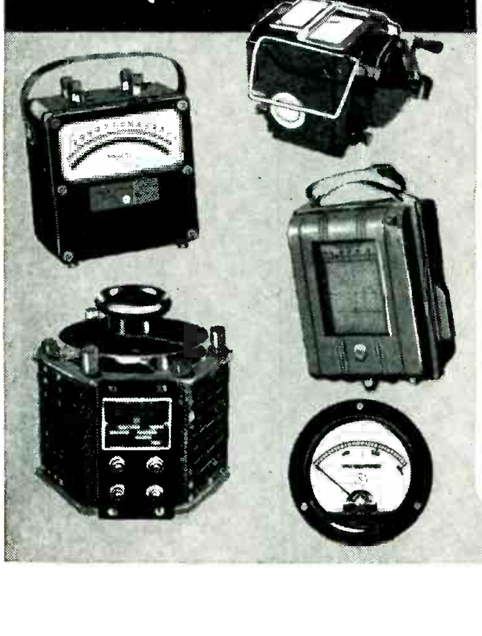
can save months on your schedule



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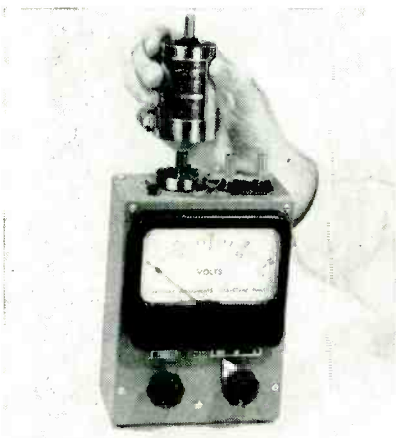
megohm to 2,000,000 megohms. Six decade ranges are used and each decade covers about 90 percent of the meter scale. The relatively low resistance of the megohmmeter circuit makes the rapid measurement of capacitor leakage resistance a major application. A constant test voltage of 500 v is applied to the resistance under test. The discharge position of the multiplier switch removes all voltage from the terminals. Separate guard and ground binding posts are also provided for making three-terminal resistance measurements.

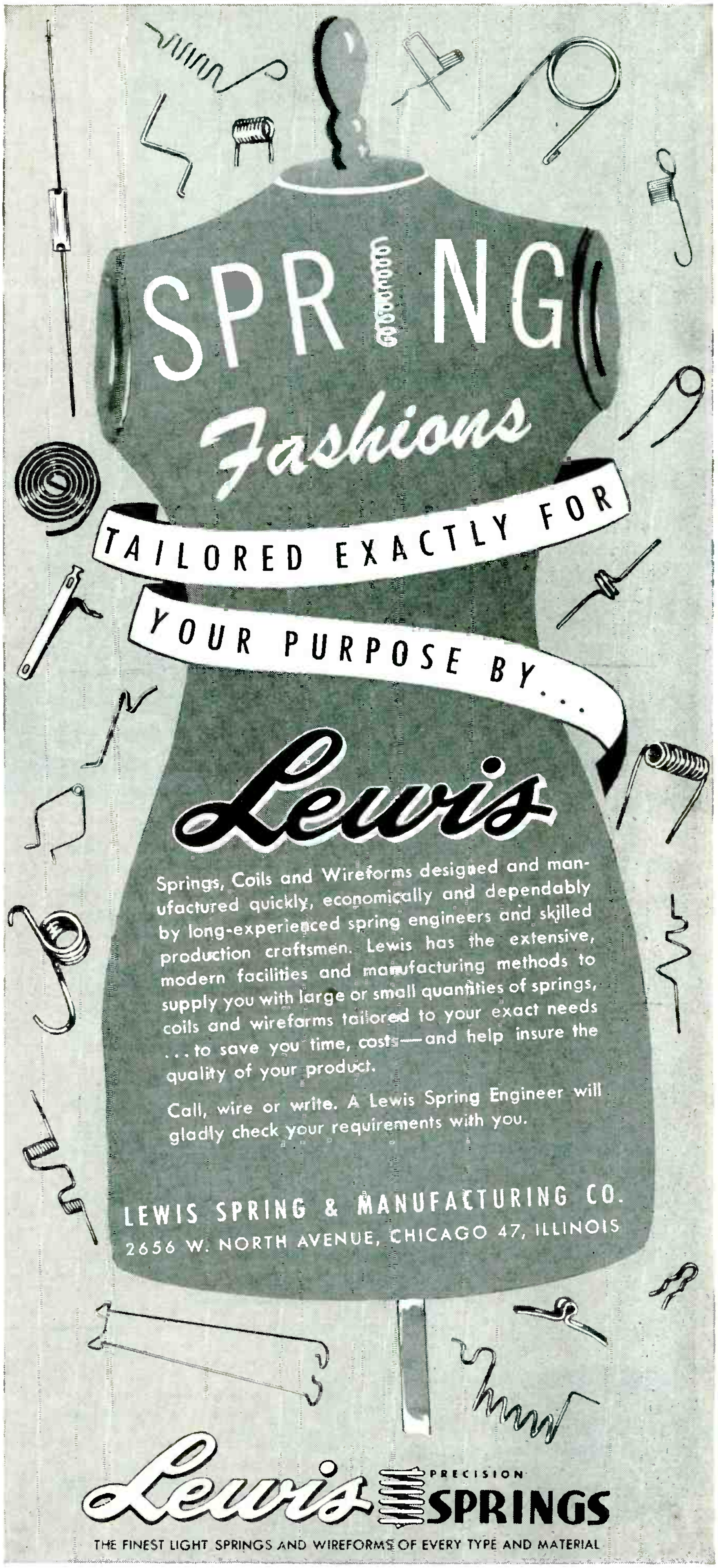


Electrometer Shunt

KEITHLEY INSTRUMENTS, 3868 Carnegie Ave., Cleveland 15, Ohio. Model 2001 electrometer shunt permits quick conversion of the model 200 v-t electrometer to a micromicroammeter. Available in any of seven standard resistance values, the shunt provides d-c readings from 10^{-6} to 10^{-13} ampere. It clips easily over the guard ring of the electrometer, with no other connections necessary. Many exacting measurements of current—such as insulation leakage, and in ion chambers and photoelectric cells—are now quickly made by the electrometer and shunt.

Aircraft Switches

KULKA ELECTRIC MFG. CO. INC., 633 S. Fulton Ave., Mt. Vernon, N. Y., has available single and double-pole toggle handle-type switches designed especially to meet JAN-S-23 specifications for aircraft use, but available also for many types of in-



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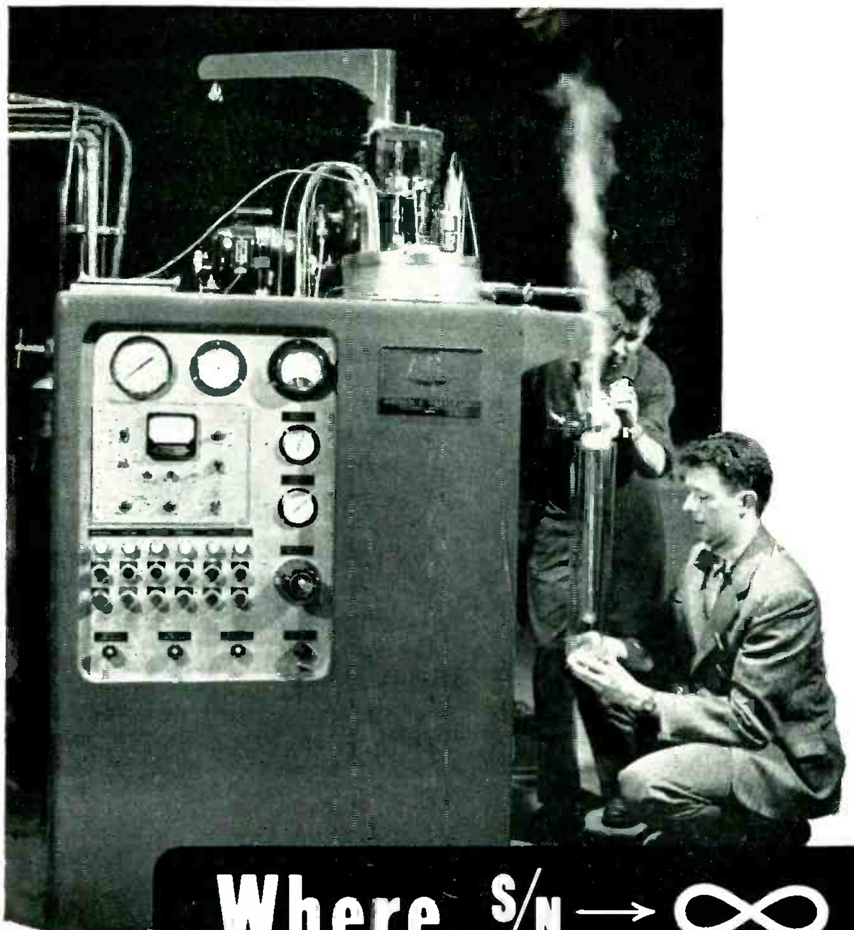

Where S/N → ∞

... We had stopped to watch the test run of a new Collins Helium Cryostat. As liquid helium poured into the dewar our guests, both electronic research workers, talked about Absolute Zero and Thermal Noise. As they talked we became interested ... perhaps you will too.

... apparently they've based a recent research project on the theory that thermal motion ceases at absolute zero which might mean that a Signal-to-Noise Ratio at 0°K. would approach infinity. Using one of our Collins Helium Cryostats to get within 4° of absolute zero, they actually minimized thermal noise in circuit components.

... their guess was that perfection of this technique might conceivably lead to new control devices operating from minute energy changes ... scintillation counters and voice modulation were mentioned as possibilities.

Perhaps your industry, equipped for low-temperature research, could profitably perfect a technique just like this.

Write for Bulletin E-2
on the Collins Helium Cryostat
and Low-Temperature Research in Electronics

ADL Mechanical Division

ARTHUR D. LITTLE, Inc.
Mechanical Division

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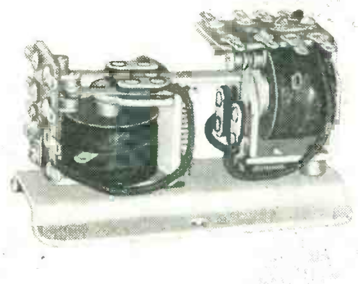
dustrial electronic and communications equipment comes encased in a Bakelite housing. It is made for use in d-c or a-c circuits of frequencies up to 1,600 cycles. Two styles are available—one of single-pole type designated ST-40, or AN-3021 series, with screw terminals, and the other, ST-42 series, with solder lugs. Switching characteristics provide for changes in electric circuits by the use of spst, spdt, dpst or dpdt.

Tiny Hermetically-Sealed Transformers

CREST LABORATORIES, INC., Whitehall Building, Far Rockaway, N. Y., announces availability of hermetically-sealed miniature and subminiature audio transformers designed specifically for severe climatic conditions and miniaturization applications. They are manufactured to meet MIL-T-27 specifications. Stypol impregnation prior to potting assures quiet operation and long life under all adverse conditions. Mumetal core assures a lightweight, compact unit with full efficiency and wide frequency response.



Latching Relays

POTTER & BRUMFIELD, Princeton, Ind., is producing the new LK series

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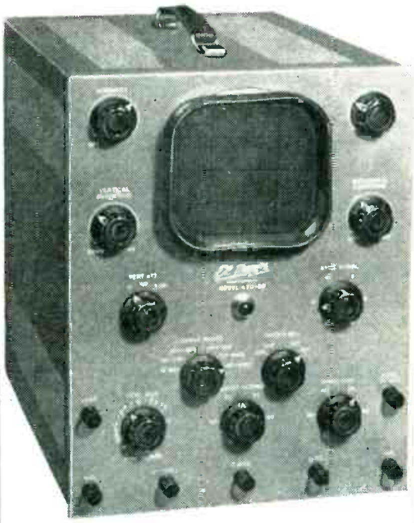
a different OSCILLOSCOPE



AT A NEW LOW PRICE

MODEL WBO-50

You can accomplish work faster and easier with this new El-tronics laboratory scope. This superior instrument combines flexibility and accuracy in a new design. This scope has vertical amplifier of 5MC bandwidth and a high frequency sweep oscillator variable to 150 KC There is a full 4" vertical deflection without overload. Frequency response drops off GRADUALLY beyond range.

Special slotted design of light shield permits easy removal of graduated scale, while a green light filter reduces external light interference. Stability is especially insured by a MU-METAL shield around the cathode ray tube to protect against external magnetic fields. Qualities that never before were available at such a low price

These are only a few of the characteristics that make this fine Oscilloscope DIFFERENT and superior. Write for Bulletin for complete information.

SPECIFICATIONS

VERTICAL AMPLIFIER

SENSITIVITY: 20 millivolts RMS per inch of deflection.

FREQUENCY RESPONSE: (Sine Wave) 20 cycles to 5 megacycles. Down 3DB at 5mc.

SQUARE WAVE RESPONSE: Excellent duplication of all square waves between 50 cycles and 1 megacycle. Maximum tilt of 50 cycle square wave 5%.

MAXIMUM INPUT POTENTIAL: 1000 volts peak to peak.

INPUT ATTENUATOR: X1—X10—X100 positions. Input attenuator is frequency compensated.

HORIZONTAL AMPLIFIER

SENSITIVITY: 0.3 volts RMS per inch of deflection.

FREQUENCY RESPONSE: (Sine Wave) flat to 300 KC.

RECURRENT SWEEP OSCILLATOR

FREQUENCY RANGE: 10 cycle to 150 kilocycles in 6 steps.

LINEARITY: Excellent linearity over entire range.

$249.50* FOB Factory

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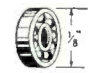
For ultra precision design



specify Micro, America's only fully ground miniature ball bearings

In just three years, sales of Micro bearings have soared 850% as more and more top-flight designers and engineers choose Micro for exacting designs. Only *grinding* can give you the ultra precision and trueness of dimension Micro offers — yet Micro bearings actually cost less than unground miniatures. 85 sizes and types in dimensions as small as 1/8" o.d. and in tolerance ranges of ABEC-5 and above.

Write for Technical Bulletin No. 50

New Hampshire **MICRO** Ball Bearings, Inc.

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TV SPOTS • Designed for Television Studios and Stages

Drawing upon their sixteen years of experience in the production of studio lights used by the motion picture industry, Bardwell & McAlister, Inc. now offers a complete new line of lights especially designed and engineered for TV stage and studio lighting.

Paint with Light

Painting with light is the ability to control the light source, in order to emphasize the necessary highlights and the all-important shadows. Only through controlled light can the scene or subject be given the desired brilliance, beauty and third dimensional effects.

Our Specialists . . . are always ready to assist and advise your engineering staff, so that your studios and stages will be fully equipped to properly "Paint with Light."

Write for complete specifications and prices of these TV SPOTS. Address Dept. 68.

BARDWELL & McALISTER 2950 ONTARIO STREET BURBANK, CALIFORNIA

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PULSE CAPACITORS

32 to 90 KV
50 megawatts

Designed for extremely low temperature rise when used in pulse-forming networks above 25,000 volts. Can pass 2500 amperes at 0.0005 duty cycle.

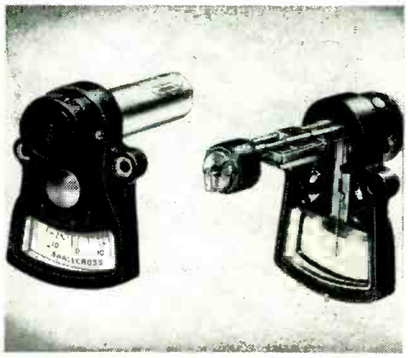
Catalog No.	Mfd.	Peak KV	Body Dimensions (in.)
XN-370	.0006	90	5 x 8 x 9
XN-285	.025	40	6 x 7 x 24-5/8
XN-284	.022	40	6 x 7 x 24-5/8
XN-381	.0167	40	5 x 6 x 21-1/2
XN-347	2x.00625	40	6 x 7 x 17
XN-369	.0075	35	5 x 7 x 8-3/8
XN-350	.0125	32	5 x 6 x 9-3/4

Write for data sheet listing pulse capacitors and standard pulse-forming networks.

TOBE

TOBE DEUTSCHMANN
CORPORATION
NORWOOD, MASSACHUSETTS

of latching relays, featuring smaller size, higher contact capacity and extremely high vibration resistance. Any specified contact combination up to 4-pdt (4 form C) can be obtained. A minimum of 35 grams contact pressure assures positive make or break under vibration forces of 10 g or higher. Relay contacts are 1/8 in. fine silver rated at 5 amperes or can be supplied on special order with 3/16 in. silver cadmium oxide, rated at 10 amperes. The open type relay measures 2 15/16 in. long, 1 13/16 in. wide and 1 3/4 in. high. The hermetically sealed type is 3 1/16 in. long, 1 3/16 in. wide and 2 3/16 in. high, and is fitted with an all-glass solder terminal header.



Galvanometer System

SHALLCROSS MFG. Co., Collingdale, Pa. Type 1951 d-c galvanometer system features simplified construction, lighter weight and consequent lower cost. Galvanometers are available in 4 types having sensitivities per mm division of 4, 2, 1 and 0.5 μa respectively. The high sensitivity, sturdy construction and compact size of the units make them particularly adaptable to bridge and potentiometer circuits or wherever indication of precise circuit balance is required. Each unit employs the rugged taut-suspension moving-coil principle with a pointer reading on a scale calibrated in 15 divisions of 1 mm either side of center.

Woofer

C. S. MFG. Co., 4089 Lincoln Blvd., Venice, Calif., has announced a new low-cost 18-in. woofer. Specifications include a heavy cast aluminum frame; 2 1/2-lb Alnico V magnet; 27

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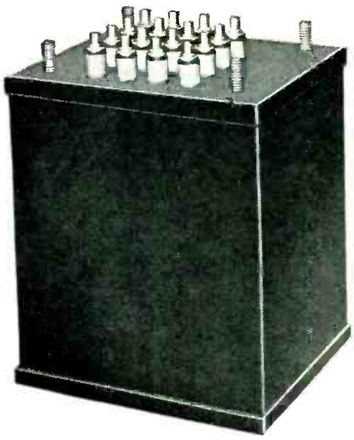
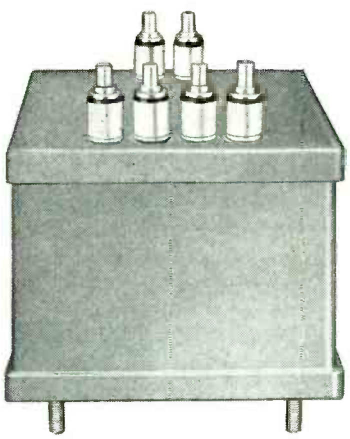
WE HAVE THE CONNECTIONS



TO MAKE BETTER TRANSFORMERS

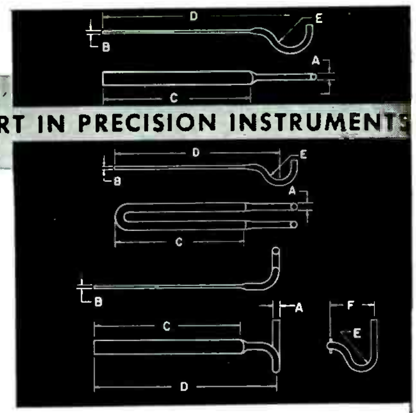
The transformer illustrated above has 16 terminal connections. For the electronic application under which this transformer is used, each series of connections must provide exact electrical characteristics.



Our experience in making precision transformers is of long standing. We welcome your inquiry. When transformer applications call for rugged, out-of-the-ordinary service, a design such as this may be the answer to your problem.

ACME ELECTRIC CORP.
315 Water St. Cuba, N. Y., U. S. A.

Acme Electric TRANSFORMERS



SMALL PARTS PLAY A **BIG** PART IN PRECISION INSTRUMENTS

HERE, for example, are typical sliding contacts now being supplied by us to manufacturers of precision potentiometers. PALINEY* #7, Ney-developed precious metal alloy from which they are made, has just about ideal physical and electrical properties for this service. It has very high tarnish resistance and is unaffected by most industrial atmospheres. Its hardness, controlled by simple heat-treatment, is especially suited to use with the nickel-chrome type of resistance wire, as well as our own high strength NEY-ORO G precious metal resistance wire. Potentiometers so equipped, have demonstrated service life of up to 20 million cycles with excellent sustained linearity and low noise level.

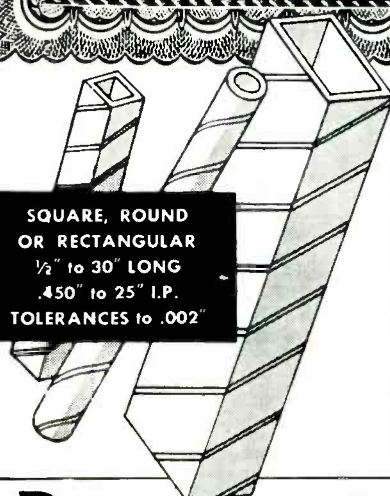
This is just one of many new and important precious metal alloy developments of interest to instrument and electronic engineers detailed in our new Technical Bulletin #R-12. Write for your copy.

*Reg. T. M. J. M. Ney Co.

THE J. M. NEY COMPANY, 179 Elm Street, Hartford 1, Connecticut
Specialists in Precious Metal Metallurgy Since 1812.

Coil Insurance

FOR FAMOUS PRODUCTS



SQUARE, ROUND OR RECTANGULAR
½" to 30" LONG
.450" to 25" I.P.
TOLERANCES to .002"

PARAMOUNT Spiral Wound PAPER TUBES
Protect Coil Accuracy and Stability in Countless Applications

Years of specialized "know-how" easily enable PARAMOUNT to provide exactly the shape and size tubes you need for coil forms and other uses. *Hi-Dielectric. Hi-Strength.* Kraft, Fish Paper, Red Rope or any combination wound on automatic machines. Wide range of stock arbors. Special tubes made to your specifications or engineered for you.

NEW! Moisture-Resistant *Shellac-Boun* Kraft Paper Tubing. Heated shellac forms a bond which prevents delaminating under moisture conditions.

Paramount PAPER TUBE CORP.
616 LAFAYETTE ST., FORT WAYNE, IND.
Mfrs. of Paper Tubing for the Electrical Industry Since 1931

WRITE ON COMPANY LETTERHEAD FOR STOCK ARBOR LIST OF OVER 1000 SIZES

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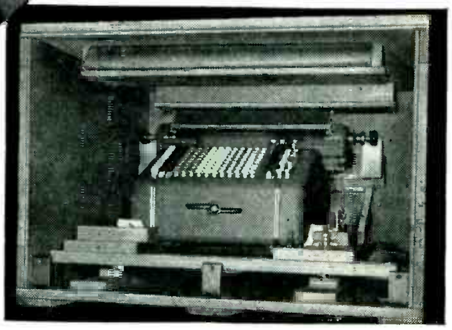
A Smooth, Safe Ride for SENSITIVE EQUIPMENT.



LORD SHIPPING MOUNTS,
of course!

Say goodbye to the costly servicing of sensitive equipment at destination — For one user Lord Shipping Mounts cut service and inspection time on overseas shipments from as many as 30 hours to only 4 hours.

Lord Shipping Mounts in your cases protect sensitive mechanisms in transit by cushioning the shocks of rough handling. This protection prevents maladjustment, greatly reducing costly servicing at destination.

If you are paying sizable service and inspection charges on newly shipped machines, stop it now. Lord Engineers will help you. Lord Shipping Mounts provide shock protection far superior to any other packing method . . . and they can be used indefinitely. To cut your shipping costs call or write to—

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1613 Tower Petroleum Building
PRospect 7996

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7310 Woodward Ave.
TRinity 5-8239

NEW YORK 16, NEW YORK
280 Madison Avenue
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PHILADELPHIA 7, PENNSYLVANIA
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LOcust 4-0147

ERIE, PENNSYLVANIA
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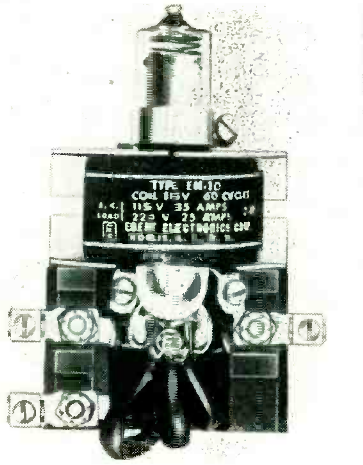
LORD BONDED RUBBER

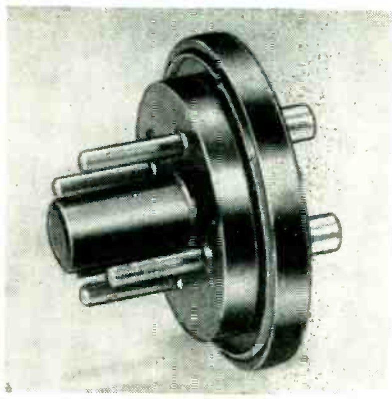
HEADQUARTERS FOR VIBRATION CONTROL MOUNTINGS . . . BONDED RUBBER PARTS

to 31-cps resonance frequency cone; 12-ohm impedance; 2-in. voice coil; 18¼-in. overall diameter and 16½-in. baffle opening.



Three-Wire Relay

EBERT ELECTRONICS CO., 185-09 Jamaica Ave., Hollis, Long Island, N.Y., announces the newly designed model EM-10 mercury plunger relay for three-wire operation. It has wide applications for lockup relay service and off-on pushbutton control. When contact is made the input line connects to the two isolated circuits. The tungsten contacts are hermetically sealed in vacuum or hydrogen-filled glass tubes. Loads up to 35 amperes at 115 v a-c or 25 amperes at 220 v d-c can be handled. The unit measures 3⅜ in. wide, 4⅜ in. high and 2¼ in. deep.



Nylon Plug Base

INDUSTRIAL DEVICES INC., 22 State Rd., Edgewater, N. J. Model 1800 Nylon plug base is manufactured for capacitors of the type CE50

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smaller than a suitcase

AMERICAN ELECTRIC

400 Cycle

MOTOR ALTERNATOR

WEIGHT: Approx 125 lbs.
SIZE: 22" x 12" x 12"

Designed for production and laboratory high frequency power supply requirements. STRONG—SIMPLE—INDESTRUCTIBLE CONSTRUCTION—No delicate moving parts, brushes or springs to wear out or maintain.

Replaces single large, hard-to-get H-F power supply serving multiple purposes . . . *A bank of these compact, flexible units costs far less, provides individual portable power sources for each project, avoids downtime hazards of single unit!*

Meets power supply requirements for AN-E-19 equipment.

OUTPUT: Up to 1000 Watts single phase 115V or up to 1800 Watts three phase 115/200V. Input: 60 cycle AC.

Total harmonic content under 5%; ± 1% voltage regulation.

WRITE FOR DETAILS!

Larger capacities available.

AMERICAN ELECTRIC MOTORS
TRADE MARK

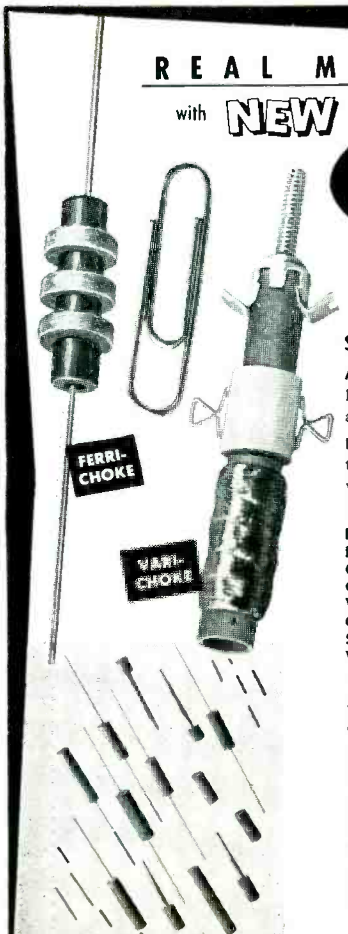
4811 Telegraph Rd.
Los Angeles 22,
California

REAL MINIATURIZATION

with NEW

GRAYBURNE

Grayburne means Quality Electronic Components



RF CHOKES!

SMALLEST, MOST EFFICIENT CHOKES EVER PRODUCED!

All Grayburne Chokes have higher "Q", lower DC resistance, lower distributed capacity . . . save copper, are the smallest and lightest . . . and employ the new Ferricore Ferrite cores.

ELECTRICAL COMPARISON between Grayburne and Conventional RF Chokes proves Grayburne superiority (both chokes valued at 2.5 mh, 125 ma).

	GRAYBURNE FERRI-CHOKE	CONVENTIONAL RF CHOKE
L	2.5 mh	2.5 mh
R	10.5 ohms	40.0 ohms
Cd	1.7 uuf	2.8 uuf
Q	110	45
Wire length	30.0 ft.*	96.0 ft.
Core	Ferrite	Isolantite
Size	1" long x ⅜" diam.	2½" long x ½" diam.
Wt.	4.5 grams	13.5 grams

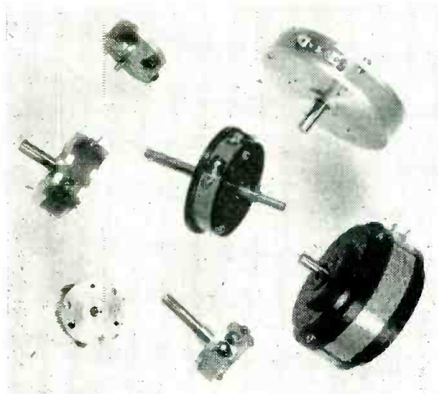
***NOTE:** *COPPER SAVINGS OVER 200%*

Grayburne Vari-Chokes: variable over a wide range of inductance, in many cases as high as 10-1 ratio.

Grayburne Ferri-Chokes and Vari-Chokes can be supplied in the inductance, mounting and type of winding you specify.

Grayburne Ferrite Core Kits of 27 various-sized cores, fixed and variable, are available for your development and research purposes. Net. $2.25.

GRAYBURNE CORP.
103 LAFAYETTE STREET, NEW YORK 13, N. Y.



PRECISION POTENTIOMETERS

Type RL-270:

Wedding ring type . . . five sizes charted below. Gamewell Potentiometers are precision instruments in every respect. They feature close limits in electrical characteristics and mechanical construction, low electrical noise, low torque, and long life. All types operate at —55°C. to +55°C., 95% relative humidity at altitudes up to 50,000 ft. Non-linear windings are available.

CONDENSED SPECIFICATIONS	RL-272	RL-270	RL-271	RL-275	RL-277
Diameter (in.)	5	3	2	1⅝	1¼
Rating (watts)	12	6	3	2	1.5
Torque, max. (oz. in.)	1	1	1	½	½
Weight (oz.)	15	6	3	2	1
Mounting: 3 holes ⅛" deep	#8-32	#8-32	#8-32	#6-32	#4-40
Mounting circle diam. (in.)	3.250	1.750	1.250	1.000	1.000
Max. resistance (ohms) ± 10%	500,000	275,000	160,000	105,000	64,000
Min. resistance (ohms) ± 10%	460	250	150	105	80
Max. useful angle (deg.)	358±½	356±½	354±½	352±½	350±½
Max. resolution (%)	0.05	0.08	0.15	0.2	0.25
Min. resolution (%)	0.01	0.015	0.025	0.04	0.05
Linearity (%)	±0.10	±0.10	±0.15	±0.25	±0.30

Standard Shaft: single end, ¾" extension, specify if otherwise.
Double ended shaft special; specify diameter and length.
Multiple sections can be ganged, add ⅜" to the overall length for each additional section.
Terminals will be positioned on the circumference as required for taps and winding angle.
Expected life of all types over 1,000,000 cycles.

FOR COMPLETE DETAILS SEND FOR BULLETIN F-68-A

TRADE MARK GAMEWELL REG. U.S. PAT. OFF.

THE GAMEWELL COMPANY
NEWTON UPPER FALLS 64, MASSACHUSETTS

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The primary function of a motor or dynamotor is to produce a specified type of mechanical or electrical energy. In the human body such energy, or muscular activity, is controlled by the nervous system which directs this force into useful work. Similarly, our units are built to be activated and controlled by a set of field coils, wound in each instance to obtain a certain performance.

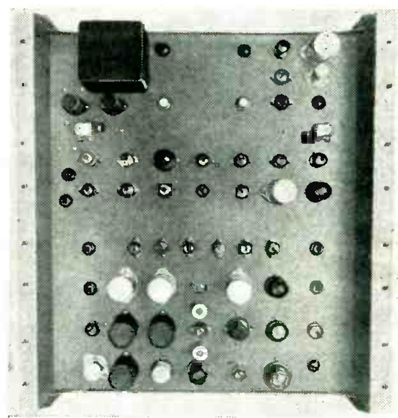
Field windings in Eicor products may be series, shunt, or compound wound, depending on the desired output characteristics. Such factors as the size of wire, number of turns, and type of insulation, are then carefully calculated so as to produce field strength of optimum efficiency for each design. These coils are unit or gang wound on forms, taped, impregnated and baked, and then protectively sealed to withstand extremes of humidity. These operations produce windings sufficiently flexible for shaping and mounting without strain, assuring trouble-free excitation for the life of the unit.

Properly designed and fabricated field windings represent only one of many important factors in building "specification" motors and dynamotors. *Every* detail of *every* operation is done with the same painstaking care. That's one more reason why Eicor products are so frequently specified.

AVIONIC EICOR PRODUCTS

Eicor, Inc. 1501 W. Congress St., Chicago 7, Illinois
DYNAMOTORS · INVERTERS · ELECTRONIC CONTROLS · ALTERNATORS · MOTORS

series, fitting a standard medium octal socket. It is suitable for use in capacitors made under JAN-C-62 specifications. Most important advantage of the use of Nylon is the toughness of the unit that reduces breakage to a minimum while being assembled to metal cans or other related parts. Nylon used has a melting point in excess of 425 F and excellent electrical properties as well. Slight resiliency of the material eliminates danger of base cutting cathode tabs and also results in a better seal to the metal can.



Special Effects Amplifier

RADIO CORP. OF AMERICA, Camden, N.J. Dramatic picture combinations, insertions, fades and wipes for tv programming are created by the TA-15A special effects amplifier. Such effects make it possible to display a commercial on a portion of the screen without interrupting the show. The system consists of a single rack-mounted unit which accepts the two video signals to be mixed, together with a masking signal, and delivers the desired composite signal. When the masking source scans black one picture signal is transmitted, and when it scans white the other signal is transmitted.

Induction Motor

HOWARD INDUSTRIES, INC., Racine, Wisconsin, are currently in production on the model 3700 Cyclohm induction motor. It is rated 1/25 to ¼ horsepower and features a new resilient mounting base, light weight and extremely quiet operation. Presently available in the

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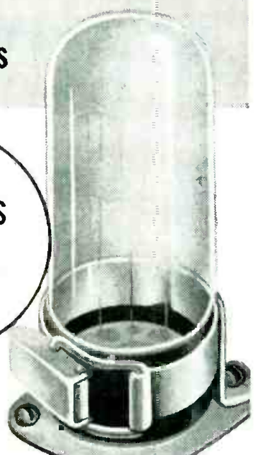
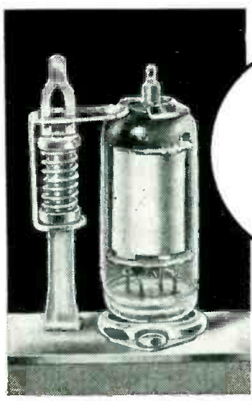
BIRTCHER

TUBE CLAMPS

Hold Tubes in Sockets under all Vibration, Impact and Climatic Conditions



83 VARIATIONS FOR STANDARD TUBES



NEW CLAMP FOR MINIATURE TUBES

You can't shake, pull or rotate a tube out of place when it's secured by a Birtcher Tube Clamp. The tube is there to stay. Made of Stainless Steel, the Birtcher Tube Clamp is impervious to wear and weather.

BIRTCHER TUBE CLAMPS can be used in the most confined spaces of any compact electronic device. Added stray capacity is kept at a minimum. Weight of tube clamp is negligible.

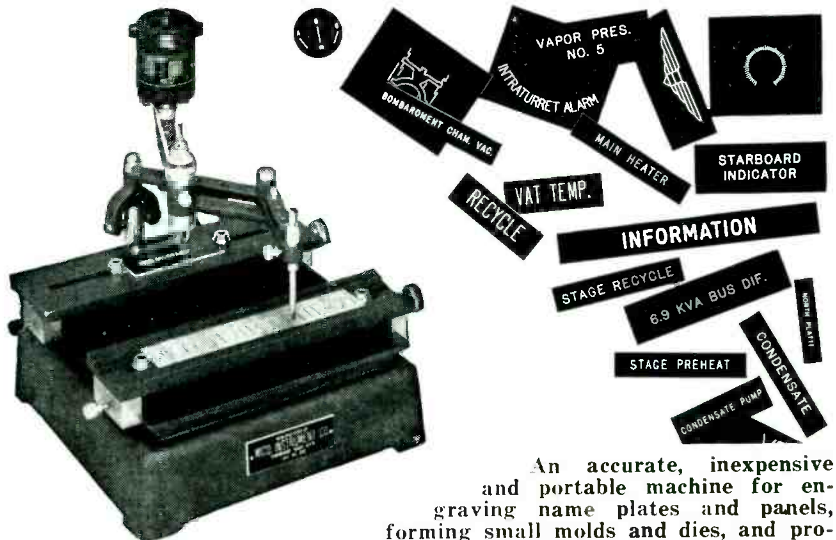
Millions of Birtcher Tube Clamps are in use in all parts of the world. They're recommended for all types of tubes: glass or metal—chassis or sub-chassis mounted.

THERE'S A BIRTCHER TUBE CLAMP FOR EVERY STANDARD AND MINIATURE TUBE!

Write for samples, catalogue and price lists.

THE BIRTCHER CORPORATION
4371 Valley Blvd.
Los Angeles 32, Calif.

MICO ENGRAVERS



An accurate, inexpensive and portable machine for engraving name plates and panels, forming small molds and dies, and profiling small parts. Geometrically correct for true three dimensional work. Accurately duplicates master copy in metals, plastics or wood. Rugged, sturdy construction.

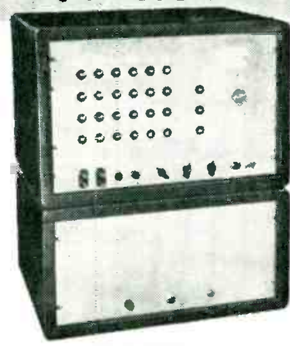
COMPARE THESE SUPERIOR FEATURES.

- Engraves in 2 or in 3 dimensions.
- Pantograph permits 4 reduction ratios.
- Micrometer depth control graduated in thousands of an inch.
- High speed, ball bearing spindle.
- Chuck 1/8" to take variety of small tools, burrs, mounted points as well as standard cutters.

Send for Illustrated Catalog

MICO INSTRUMENT COMPANY
76E. Trowbridge St. Cambridge, Mass.

NEW! FREQUENCY AND TIME MEASUREMENTS ACCURATELY . . . CONVENIENTLY!



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ANY FACTOR MAY BE MEASURED FOR FIXED VALUE OF THE OTHER

Universal 6-in-One MEGACYCLE FREQUENCY-TIME COUNTER

Model 801 by Potter

FREQUENCY MEASUREMENTS	0 to 1 mc range by counting cycles per pre-selected time or by measuring time per pre-selected count. Accuracy 0.001% minimum.
TIME INTERVAL MEASUREMENTS	0 to 10 seconds ± 10 microseconds.
FREQUENCY RATIO MEASUREMENTS	Ratio of two external frequencies can be measured.
SECONDARY FREQUENCY	100 kc crystal oscillator with divided frequencies available at 10, 1 kc and 100, 10, 1 cps.
TOTALIZING COUNTER	Six decades, pulses 0 to 1 mc, sine wave 10 cps to 1 mc.
DIRECT RPM READING TACHOMETER	Through the use of an external 60 count per revolution photoelectric disc generator an accuracy of ± 1 rpm is obtained.

Now, the Potter Instrument Company offers all in one equipment, the features heretofore available only in separate counting systems. Two complete counting channels, a 100 kc crystal oscillator time base and unique gating circuits are combined to provide the new FREQUENCY-TIME COUNTER.

Please address inquiries to Dept. 6M

POTTER INSTRUMENT COMPANY
INCORPORATED
115 CUTTER MILL RD., GREAT NECK, NEW YORK

25 YEARS OF LEADERSHIP IN FASTENINGS OF STAINLESS STEEL

To YOU, the 25th Anniversary of Anti-Corrosive is an assurance that when your requirements call for fastenings of stainless steel, you can *depend* on Anti-Corrosive to serve you best! Anti-Corrosive is the oldest, largest and best-known firm dealing exclusively in stainless steel fastenings . . . an enviable position in a fast-growing industry . . . your guarantee of product excellence!

Still Plenty of Fastenings IN STOCK

If you need quick delivery of stainless steel fastenings, check Anti-Corrosive first! Although most of our production requires D. O. Ratings, there is still a wide variety of stock items in our bins which may fit your needs . . . or, a suitable alternate ready for *immediate delivery* may be suggested!

FREE-A-N SELECTOR!

Write TODAY for handy Slide Chart No. 52E . . . instantly identifies A-N Nos. pertaining to stainless steel fastenings, gives sizes and other data. Free catalog also available.

Anti-Corrosive Metal Products Co., Inc. **1927–1952**

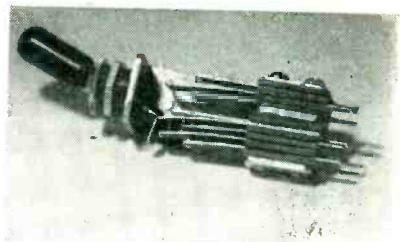
Manufacturers of STAINLESS STEEL FASTENINGS

CASTLETON-ON-HUDSON, NEW YORK

series are several models: the hysteresis synchronous and normal induction types in 2-pole versions, both single phase and polyphase. Model 3700 will be available in the near future in 2, 4, 6 and 8 pole models including reluctance synchronous and torque motor types.

Network Recorder

BERLANT ASSOCIATES, 4917 W. Jefferson Blvd., Los Angeles 16, Calif. Expressly designed for broadcast and recording studio and industrial installations, the Concertone network recorder NWR-1 operates completely from remote pushbutton control stations. Elimination of drive belts, clutches or idlers and a new self-adjusting disk braking system eliminates maintenance problems. Provision for installation of up to five magnetic heads permits a new range of application. Specifications meet present and proposed NARTB standards. Information including specifications, prices and descriptive literature will be sent upon request.



Toggle Key Switch

CIRCUIT CONTROLS Co., 3201 Peoria St., Steger, Ill. Model 4 toggle key switch was developed to provide

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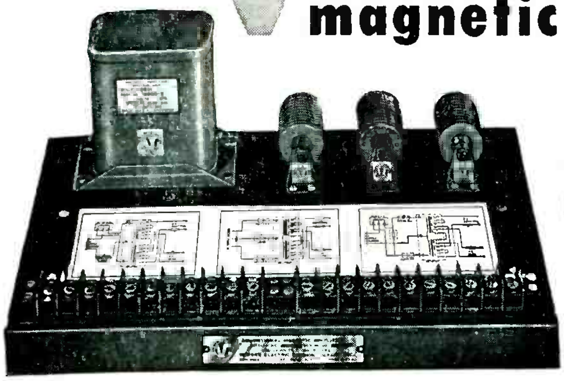
VICKERS educational magnetic amplifier



Permits study of all three basic single phase self-saturating circuits

- For Industrial Laboratories — Schools.
- Can actually be used in operating controls circuits.
- Gives d-c or a-c output . . . uses d-c or a-c control power.

Designed by Vickers Electric Division to help industrial personnel and students obtain a wider knowledge of the characteristics and applications of high-performance self-saturating magnetic amplifiers.

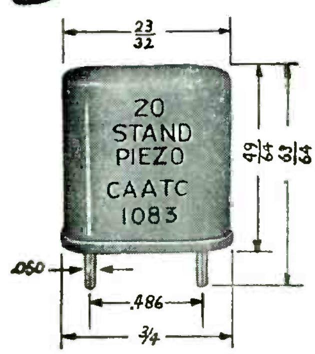
Complete with Magnetic Amplifier Laboratory Manuals and Magnetic Amplifier Design Handbooks.

Write for literature and price.

VICKERS ELECTRIC DIVISION

1801 LOCUST STREET • ST. LOUIS 3, MISSOURI

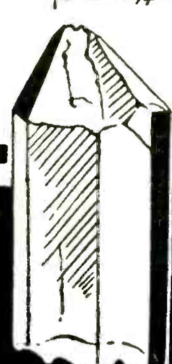
Eliminate CRYSTAL TEMPERATURE CONTROL COSTS . . .



Now you can forget temperature control. Just specify Standard's Type 20 Crystal Unit for your products.

In addition to lowering power requirements and weight, it increases compactness, durability and dependability. Type 20 meets all Government specifications, too.

Discover how the Standard Type 20 can cut costs and increase sales for you. A letter will bring Engineering data and complete details by return mail.



Standard Piezo
COMPANY
CARLISLE, PENNSYLVANIA

ATR

Makes it easy *to* **DEMONSTRATE AND TEST D.C. APPARATUS FROM A.C. LINES**

"A" BATTERY ELIMINATORS

For DEMONSTRATING AND TESTING AUTO RADIOS

New Models . . . Designed for testing D.C. Electrical Apparatus on Regular A.C. Lines. Equipped with Full-Wave Dry Disc Type Rectifier, Assuring Noise-less, Interference-Free Operation and Extreme Long Life and Reliability.

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a large number of switching combinations and is simply mounted in a single hole on the control panel. It is an unusually small lever-action switch and some of the typical applications include electronics, communications, relay or remote-control circuit switching. As many as ten circuits may be handled in some combinations by the contact springs. Insulation between springs and frame is tested to withstand 1,000 v a-c. Contacts rated at 3 amperes and of fine silver are mounted on nickel-silver springs in order to provide long life and easy operating action.

Literature

Rectifier Catalog. Bradley Laboratories, Inc., New Haven, Conn., has issued a catalog illustrating and describing its line of selenium rectifiers, copper oxide rectifiers and photoelectric cells. Complete technical information is included. A specification sheet is also available.

House Organ. Lenkurt Electric Co., San Carlos, Calif., is now publishing the Demodulator, a new house organ. Each issue will contain articles on such subjects as special problems of carrier operation, interesting or unusual applications of carrier equipment, and methods of using carrier equipment to obtain better and more economical communication channels. Requests for the publication should include name, company, position and address.

Dual-Beam Oscillograph. Allen B. Du Mont Laboratories, Inc., 1500 Main Ave., Clifton, N. J. A single-sheet bulletin discusses the new type 322 dual-beam oscillograph designed for general development work but rugged enough for production testing and industrial applications as well. Chief features and specifications are given. Price of the unit described is $835.

Plastics For Electronics. Emerson & Cuming Co., 126 Massachusetts Ave., Boston 15, Mass., is currently distributing a folder describing a number of its plastic materials, products, and techniques, as well

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INFORMATION on positions at NORTHROP

Northrop Aircraft, Inc. is engaged in the most absorbing work of a long career devoted to scientific and engineering development, as well as aircraft production. This includes new, long-range projects of the utmost importance and interest. Exceptional opportunities await qualified individuals.

The most responsible positions will go to top-caliber engineers and scientists. However, a number of excellent positions exist for capable, but less experienced, engineers. Some examples of the types of positions now open are:

ELECTRONIC PROJECT ENGINEERS... ELECTRONIC INSTRUMENTATION ENGINEERS...RADAR ENGINEERS... FLIGHT-TEST ENGINEERS... STRESS ENGINEERS... AERO- AND THERMODYNAMICISTS... SERVO-MECHANISTS...POWER-PLANT INSTALLATION DESIGNERS... STRUCTURAL DESIGNERS... ELECTRO-MECHANICAL DESIGNERS... ELECTRICAL INSTALLATION DESIGNERS.

Qualified engineers and scientists who wish to locate permanently in Southern California are invited to write for further information regarding these interesting, long-range positions. Please include an outline of your experience and training.

Allowance for travel expenses.

Address correspondence to Director of Engineering,

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HAWTHORNE, CALIFORNIA

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Foote
MINERAL COMPANY
A Step Ahead in Industrial Ores and Chemicals

PURE DUCTILE ZIRCONIUM

- Iodide processed Zirconium of highest purity for commercial use.
- 20% lighter than steel.
- outstanding resistance to corrosive attack by *both* acids and alkalies.
- remarkable gas absorption properties.

Zirconium is ductile and malleable. Its use in atomic reactors . . . as a "getter" in electronic tubes . . . as an additive in metal alloying . . . as an igniter in flash bulbs and as a non-corrosive metal in surgical specialties are a few of Zirconium's applications. Investigate Zirconium, the metal with a future.

Price reductions averaging 50% have been made on Foote Zirconium rods, sheets and wire.

Write now for the new Foote Zirconium price schedule and data. Experimental samples are available upon request.

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424 Eighteen W. Chelten Building
Philadelphia 44, Pennsylvania

NEW SIGNAL GENERATORS (Decade Switched)

NO
- CHARTS
- DIALS
- VERNIERS
- ZERO ADJUSTMENTS
- WARM-UP

THE DECALATOR

★ **DIRECT READING — 9,000 separate frequency steps**
★ **ALL FREQUENCIES are quartz crystal controlled in a heterodyne system**

DECALATOR Model	No. 10-100	No. 100-1
Frequency Range	10kc—100kc	100kc—1mc
Frequency Steps	10 cycles	100 cycles
Frequency Accuracy	0.05% at max. freq.	0.025% at max. freq.
Short Term Stability	2 cycles	5 cycles
Price f.o.b. Caldwell	$795.00	$795.00

Housed in handsome wood cabinets with self-contained regulated power supplies. All are equipped with precision attenuators and output meters.

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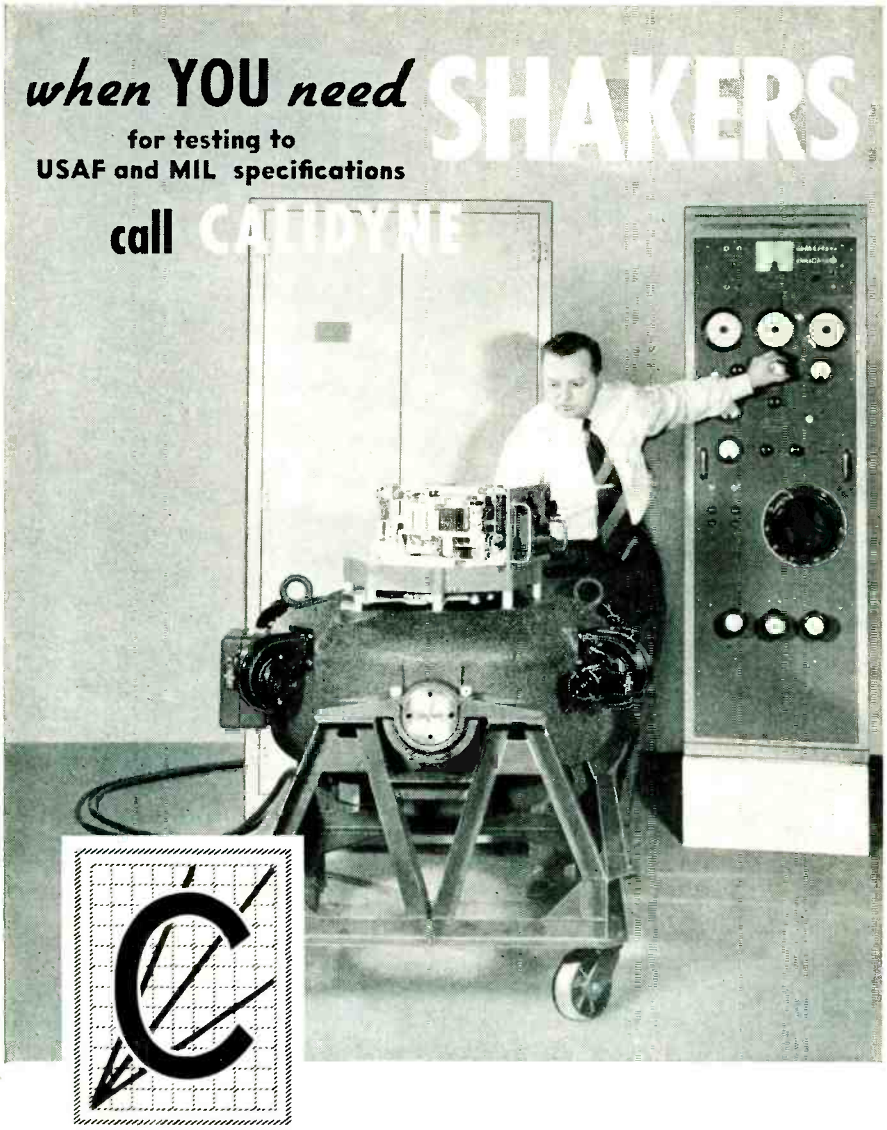

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as its facilities for research and development. The publication should be of interest to design, engineering and purchasing personnel. Fillers for the folder will be sent out from time to time as other developments occur.

Boundary Displacement Recording. Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn., has issued a 4-page report on boundary-displacement magnetic recording, a technique characterized by a high degree of amplitude linearity without either the dependence upon the magnetization curve of the medium or the critical adjustments required for optimum performance of conventional intensity recording systems. Chief features and an illustrated technical description of the method are given.

C-R Equipment. Waterman Products Co., 2445-63 Emerald St., Philadelphia 25, Pa., has introduced the Pocketscoop, a periodical publication dedicated to the enhancement of electronic engineering, with particular emphasis upon the principles, operation and applications of c-r oscilloscopes, c-r tubes and associated equipment. Volume 1 No. 1 considers the oscilloscope and its sections in general terms. Later issues will take up the details of these sections, further explaining the development, design and application of the modern oscilloscope.

Tiny Contact. Instrument Specialties Co. Inc., Little Falls, N. J., has published a one-page bulletin on its Flea contacts that are designed for use with subminiature vacuum tubes having coplanar leads with a spacing of 0.050 in. or more. The contacts described, made of micro-processed beryllium copper and furnished silver-plated, permit quick replacement of tubes. Mechanical and dimensional drawings are included.

Vacuum Gage. National Research Corp., Boston 15, Mass. A 4-page loose-leaf perforated folder describes and illustrates the type 510 Alphatron all-metal ionization-type vacuum gage with an effective

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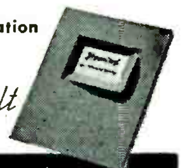

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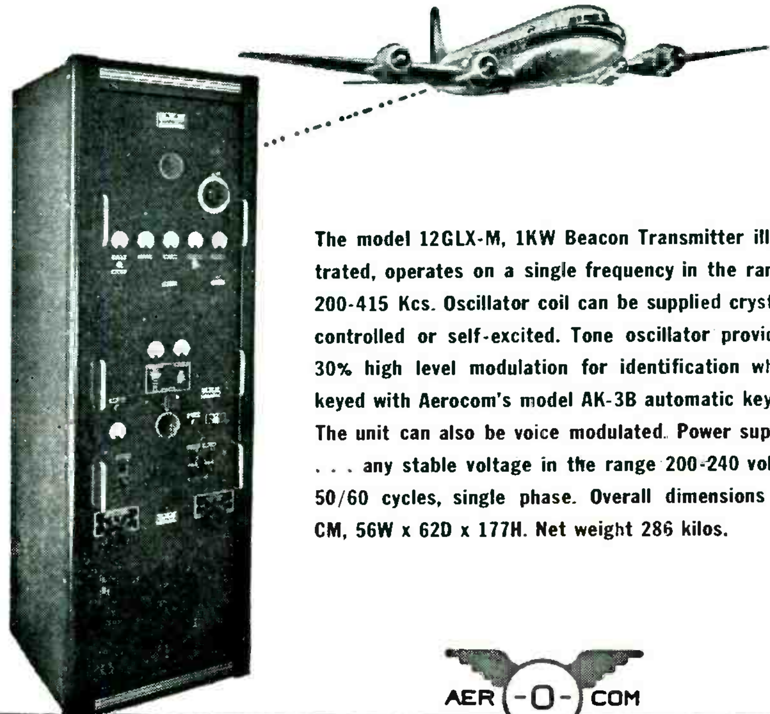

The model 12GLX-M, 1KW Beacon Transmitter illustrated, operates on a single frequency in the range 200-415 Kcs. Oscillator coil can be supplied crystal-controlled or self-excited. Tone oscillator provides 30% high level modulation for identification when keyed with Aerocom's model AK-3B automatic keyer. The unit can also be voice modulated. Power supply . . . any stable voltage in the range 200-240 volts, 50/60 cycles, single phase. Overall dimensions in CM, 56W x 62D x 177H. Net weight 286 kilos.

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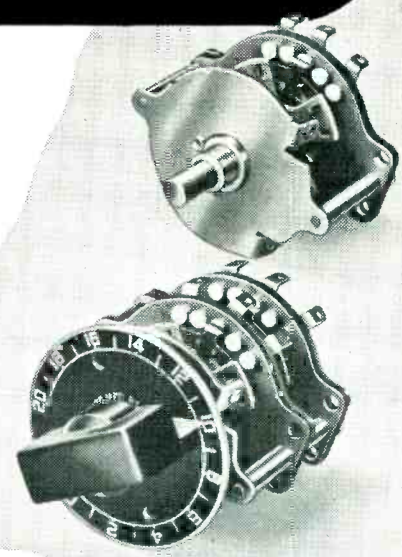

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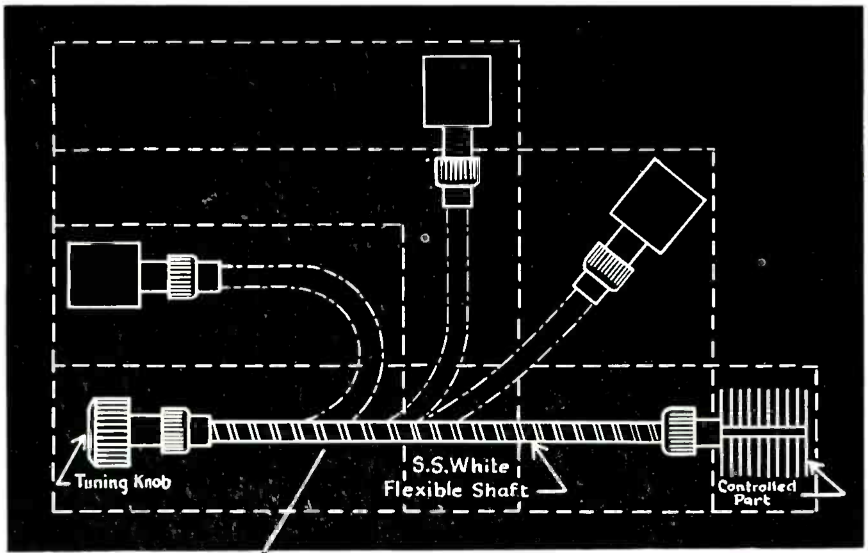

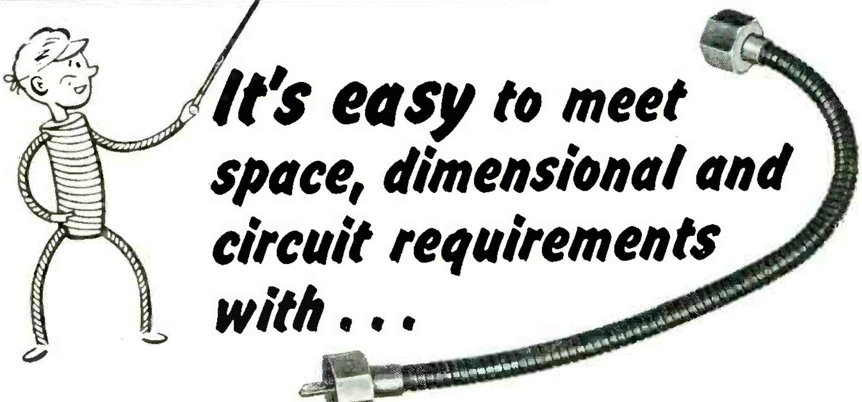

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range of 1 micron to 10 millimeters of mercury in three stages: 0 to 0.1 mm, 0 to 1.0 mm, and 0 to 10 mm. Chief features, specifications and operating principle are given.

Electrical Insulating Papers. Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill. Rag, part rag, wood pulp and rope papers, pressboards and electrical fiber for electrical insulation are described in a 12-page catalog complete with technical data. Information on the advantages, properties and applications of each paper grade is supplied.

Connectors. Cannon Electric Co., P.O. Box 75, Lincoln Heights Station, Los Angeles 31, Calif. Bulletins LS5-1951 and GB4-1951 cover types LS laboratory and switchboard and GB battery connectors respectively. The LS5-1951, ten pages in length, catalogs two new fittings recently added to the line —the CS tandem-type connector and the combination jack and binding post. The GB4-1951, 22 pages, covers the battery connector series used primarily for connecting and disconnecting starting equipment and widely adapted by the military services and general industrial fields.

Recorder Reproducer. Press Wireless Mfg. Co., Inc., Rockville, Conn. A recent brochure deals with the RRP-24 single-channel magnetic recorder-reproducer that will continuously record or transcribe voice frequency intelligence for an entire 24-hour period, or, by use of voice actuated relay circuits, will record intermittently for a number of days. The well-illustrated pamphlet tells how the unit operates and lists its chief applications and technical specifications.

Quartz Crystal Units. Standard Piezo Co., Carisle, Pa., recently issued a brochure on its line of quartz crystals that meet government specifications. Included is a table intended as a guide in selection of the proper crystal unit for a particular need. It also gives the company number that should be ordered where the Gov-

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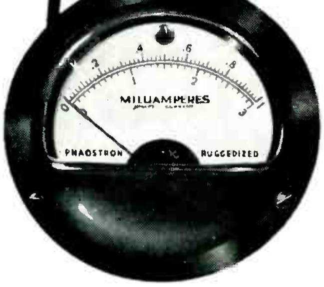

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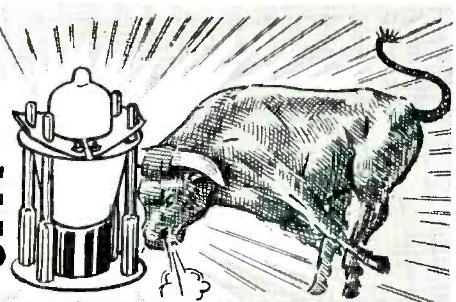

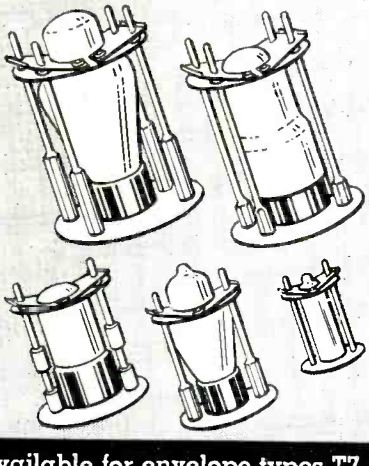

These retainers are used to secure Vacuum Tubes and to resist side motion of Vacuum Tubes used in radio equipment which is subject to shock and vibrations. These retainers meet the requirement of all JAN specifications. The insulated portion is made of a melamine base Fibre Glass Phenol which provides 300 volts insulation to ground and withstands a temperature of 350 F. The insulated plate can readily be fastened or released by hand.

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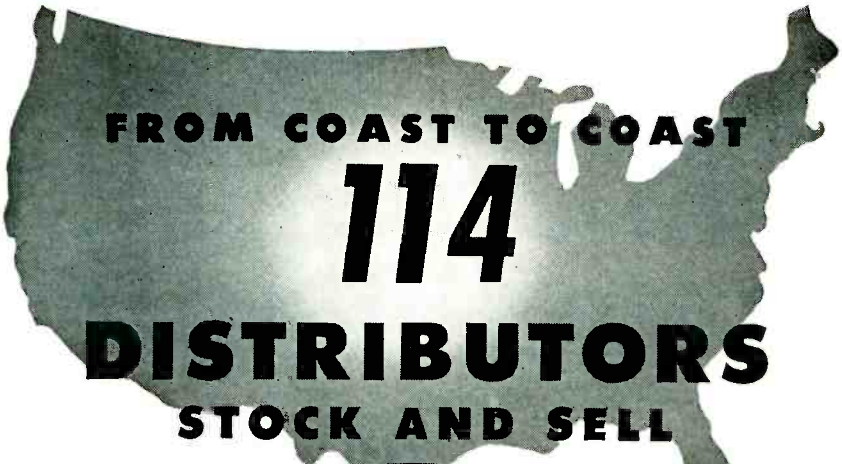

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*Reg. U.S. Pat. Off.

ernment specifies a definite crystal. Engineers drawings of six different types are shown.

Power Conversion Equipment. Bogue Railway Equipment Division, 52 Iowa Ave., Paterson 3, N. J. A new bulletin describes rotary converters and motor generators for converting d-c to 60-cycle and 400-cycle a-c on locomotives, cabooses and railway passenger cars. The power conversion equipment discussed is available in power output ratings ranging from 300 w to 10 kw and for operation from 12, 32, 64 or 114-v batteries.

Line Voltage Regulator. Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn. A single-page bulletin covers the model 1001 line voltage regulator that attains an accuracy of +0.01 percent a-c regulation. General specifications and extra features are outlined.

Subminiature Ceramic Capacitors. Mucon Corp., 9 St. Francis St., Newark 5, N. J., has available bulletins on a variety of subminiature ceramic capacitors. Sizes and characteristics of bypass, coupling and filter capacitors of the High-K series are shown in bulletin HK-1. Low capacitance units for tuned-circuit use or temperature compensating applications are discussed in bulletin CTC-1. Bulletin UHF-1 covers subminiature designs for ultra-high-frequency applications.

Industrial Mobile Radio. Radio Corp. of America, Camden, N. J. Form MC-1752 is a four-page illustrated leaflet outlining the use of two-way mobile radio equipment for materials handling, plant maintenance, plant protection and other industrial applications. It provides management with important information under such headings as: What 2-Way Radio Is, What It Does, Who Can Use 2-Way Radio, and Radio Helps Cut Costs and Improve Efficiency.

Electronic Tube Insulators. M. Kirchberger & Co., Inc., 1425 37th St., Brooklyn, N. Y. A four-page brochure gives an illustrated description of Lava (precision-ma-

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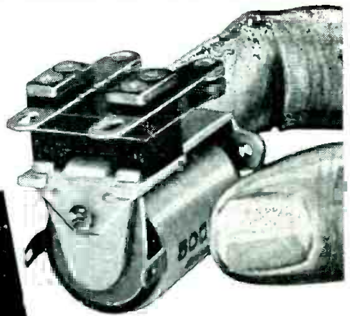

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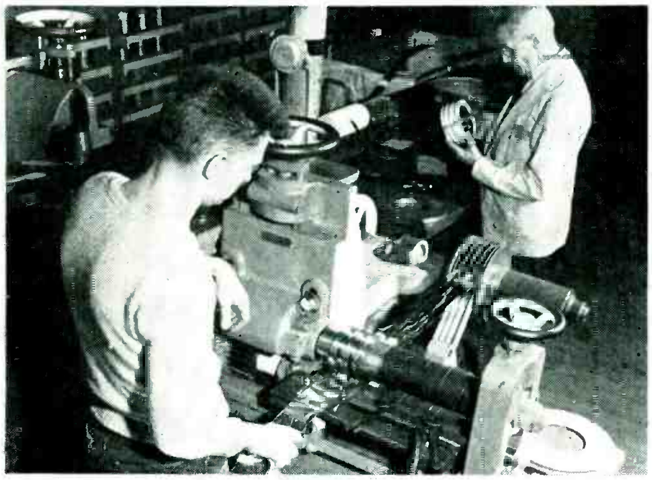

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chined steatite) insulators for electronic tubes. The insulators described feature precision, resistance to high temperature and heat shock, easy degassing and good dielectric properties. A table of technical data is included.

Audio Attenuators. Cinema Engineering Co., 1510 West Verdugo Ave., Burbank, Calif. Catalog 18-A contains a 16-page illustrated technical description of a wide line of attenuation controls. Internal resistors and mechanical construction are discussed. Ordering information and prices are given.

Rotary Stepping Switches. Automatic Electric Corp., 1033 W. Van Buren St., Chicago 7, Ill. A six-page folder deals with the types 44 and 45 rotary stepping switches that feature fast stepping, positive stopping and smooth running. Photographs, dimensional diagrams, performance charts and technical specifications are shown.

High-Speed Potentiometer Recorder. The Ralph M. Parsons Co., 689 South Fair Oaks Ave., Pasadena 2, Calif., has published a reprint in booklet form giving an illustrated description of the high-speed potentiometer recorder. The potentiometer discussed records in digitalized numbers of the binary system at a rate of 20 readings per second (10-channel input with each channel being read twice per second); has an inherent accuracy of 0.3 percent or 50μv; and is designed to provide d-c scales of 10, 50 and 100 mv. The input sensitivity and impedance of the unit described make it satisfactory for use with thermocouples and the strain and pressure pickups so frequently used in rocket test facilities.

Miniature Speed Changers. Metron Instrument Co., 432 Lincoln St., Denver 9, Colorado. Technical data sheet No. 7 describes the series antibacklash miniature speed changers, designed for applications where the backlash between high and low-speed shafts must be zero or a very low value. Included are mechanical drawings, principle of operation, friction and roughness

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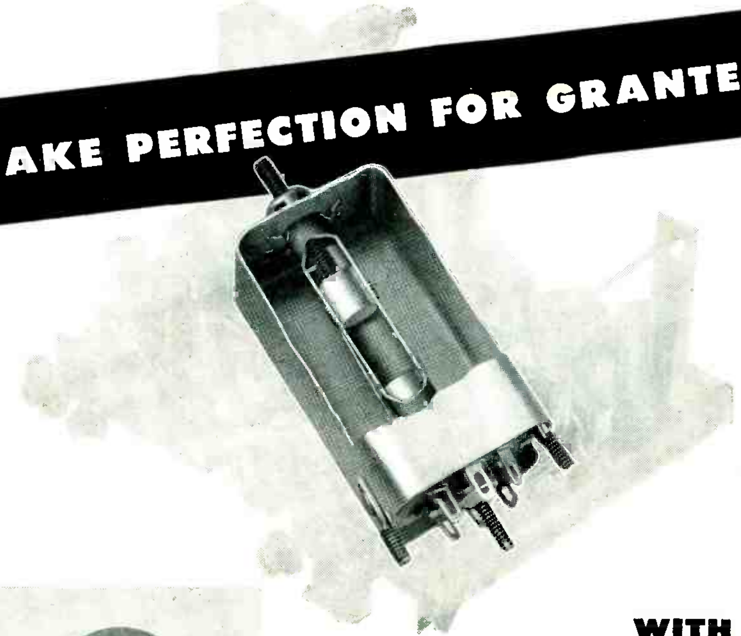

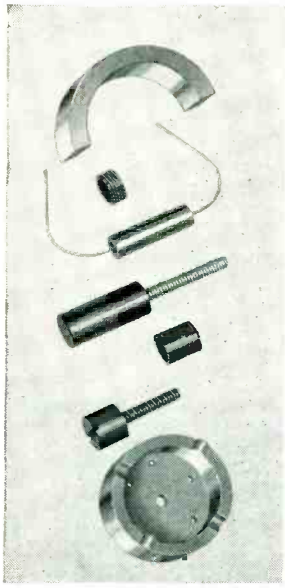

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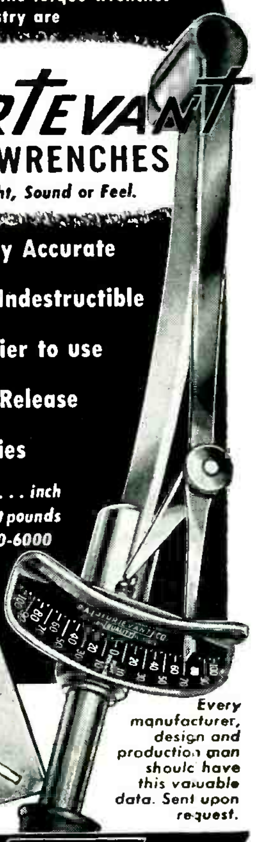

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information, effects of high ratio and required output and spring wind-up.

Tube Data. Hytron Radio & Electronics Co., a Division of Columbia Broadcasting System, Inc., Salem, Mass. Four engineering data sheets cover the 17QP4 rectangular, all-glass magnetically focused and deflected picture tube that incorporates a cylindrically shaped face plate designed to eliminate annoying specular reflection. Included are electrical and mechanical characteristics, maximum ratings, typical operating conditions, maximum circuit values and dimensional drawings.

Coaxial Connector. Barker & Williamson, Inc., 237 Fairfield Ave., Upper Darby, Pa. A single-sheet bulletin illustrates and describes the CC-50 coaxial cable connector that provides both commercial and amateur users with a means of making efficient, watertight coax cable connections for antennas. The connector discussed is made of aluminum with steatite insulation, and weighs only 12 oz assembled. Complete assembly instructions are given.

Carrier Telephone System. Lenkurt Electric Co. Inc., 1105 County Road, San Carlos, Calif. Description of a broad-band single-sideband suppressed-carrier radio channelizing system designed to provide 24 voice and signal circuits over one wide-band radio channel is contained in folder Form 33C-P. The publication illustrates a typical equipment rack, and provides block diagrams and a frequency allocation chart which show in detail how a simple and economical group modulation scheme is utilized to position three eight-channel groups into the spectrum between 10 and 135 kc.

Nucleonic Instruments. El-Tronics Inc., 2647 N. Howard St., Philadelphia 33, Pa. Bulletin 152-A is a condensed catalog of nucleonic instruments, accessories and supplies for the radioisotope laboratory. Complete information and price for each instrument are given. Information on the com-

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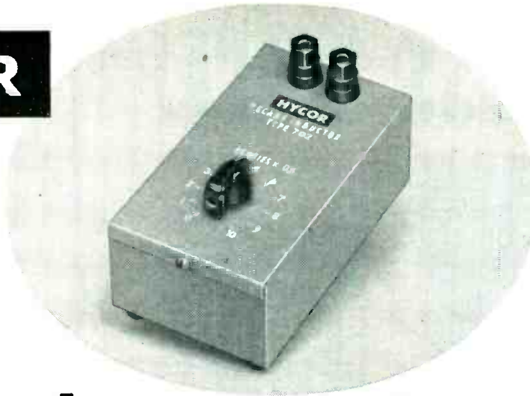

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- The units are available in four ranges up to 10 henries. Units may be used individually or all four may be connected in series to obtain 11.11 henries in 1 millihenry steps.
- Toroid coils are used to obtain high "Q", stability and low pickup from external fields. Inductance accuracy is 2%.

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Manufacturers of Toroid Inductors, Decade Inductor Instruments, Wave Filters, Resistive Networks, and Precision Resistors

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FORMVAR • FORMEX • ENAMEL
STRIPPED CLEAN IN SECONDS
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IN

1. DIP WIRE in X-VAR for 3 seconds.

OUT

2. WITHDRAW and watch coating disintegrate.

WIPE

3. WIPE CLEAN. Operation completed in seconds.

X-VAR is non-corrosive, non-creeping — leaves wire ready for soldering. Now in use by leading manufacturers of electrical products. *Write for FREE SAMPLE for testing.*

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HERMETICALLY SEALED RELAYS

Meet AN Standards or Armed Services Applications

Compact, multiple contact... vibration and shock proof. Built to meet rigid specifications and severe operating conditions.

Unique pile up arrangement reduces over-all space compared with conventional relays.

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MIDGET TELEPHONE TYPE RELAYS

NEW CONTAINER SAVES SPACE

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Gentlemen:
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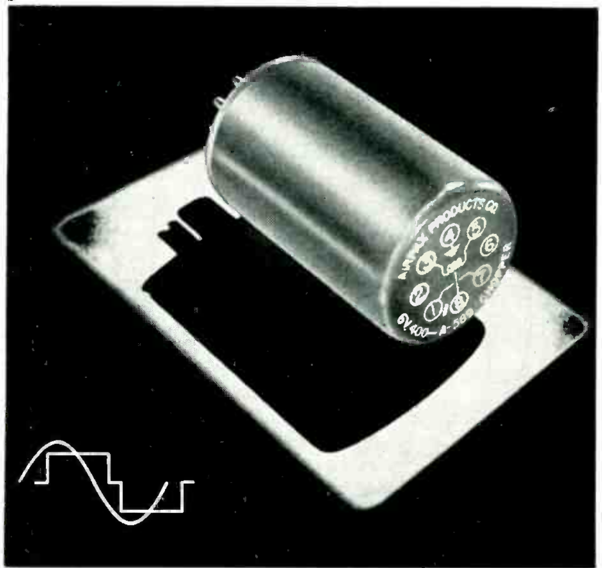

Model A589, a rugged 400 cycle chopper, 6 volt. Will withstand 10G vibration operating, 50G non-operating and can be used reliable over temperatures of —70C to 100C. This chopper has a phase lag of 65° between the drive voltage and the square wave output. Adjusted for 380 to 420 cycles, can be operated over much wider ranges. The residual noise is less than 1.5 mv peak at one megohm circuit impedance. Hermetically sealed, built in accordance with exacting military specifications and adjusted precisely to very close tolerances. Constructed per AN-E-19, employs silicone shock mounting, silicone glass insulation for maximum stability.

For more than five years, AIRPAX has blazed a trail in the chopper and miniature power supply field which is now clearly marked by acceptance in the nation's most prominent electronic concerns. Phone, wire or write, we can offer field proven experience, reliable units, quick sample delivery and volume production to meet your schedules.

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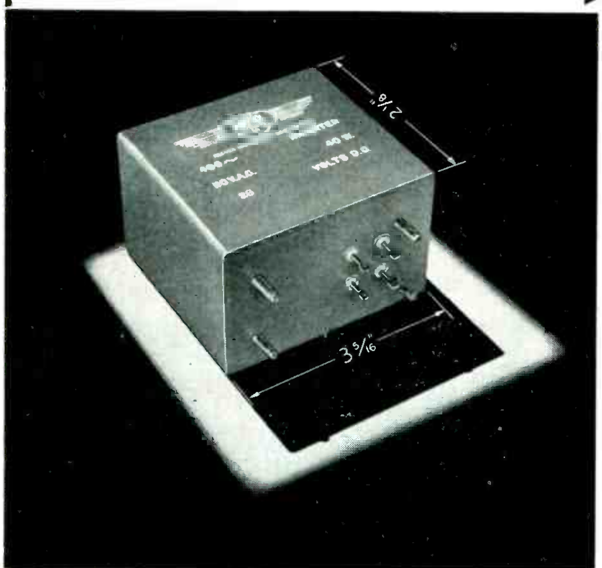
CHOPPERS
AND
INVERTERS
YOU CAN DEPEND ON!



Model A702 heavy duty miniature 400 cycle vibrator inverter, specifically designed to operate 400 cycle gyro motors. The nominal rating is 110 volts, 30 watts, but it will deliver 45 watts for short duty. Most motors require power factor correction as vibrator loads, this model has power factor correction built in to operate 4 small motors. Discuss your application with our engineering department, they may find it wise to make changes to accommodate your load. Will operate at temperatures down to —70C, up to 85C, can be subjected to violent vibration, acceleration and shock. Completely hermetically sealed. Weight 1 lb., 6 oz.

DESIGNERS AIRPAX PRODUCTS COMPANY ENGINEERS

MIDDLE RIVER BALTIMORE 20, MD.

pany's G-M counter tubes and tube holders is included.

Laminated Plastics. The Richardson Co., 2765 Lake St., Melrose Park, Ill., has published a 20-page catalog on laminated plastics and their applications in industry. The catalog discusses and compares the various grades of laminated plastics. It describes the general advantages and uses of each grade, and lists complete data on the mechanical and electrical properties of each. Laminates in two classifications are covered: Insurok materials conforming to NEMA specifications and Insurok materials in special grades with exceptional characteristics. Also listed are NEMA tolerance data on laminated sheets, rods and tubes, and information on sizes and thicknesses available.

Decade-Switched Oscillators. Decade Instrument Co., Box 153, Caldwell, N. J., has issued a single-sheet mailing piece illustrating and describing the Decalator model 10-100 signal generator that features no charts, dials, verniers, zero adjustments or warm-up period. The unit discussed has direct reading in 9,000 separate 10-cycle steps from 10 kc to 100 kc and is priced at $795.

Rectifier Tubes. Electronics, Inc., 127 Sussex Ave., Newark 4, N. J., has available a new publication dealing with gaseous discharge rectifier and control-rectifier tubes. The first half of the booklet is an engineering manual concerned mostly with design information. The second half is comprised of a group of catalog sheets illustrating and giving complete technical data for a variety of types. Price lists are included.

Resistor Catalog. Tru-Ohm Products, Division of Model Engineering & Mfg. Inc., 2800 U. Milwaukee Ave., Chicago 18, Ill., has released a multicolored catalog that includes illustrations of the company's various products: power rheostats, fixed and adjustable resistors and Econohm resistors. Complete technical and engineering data are given. The catalog

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For 110 or 220 volt circuits

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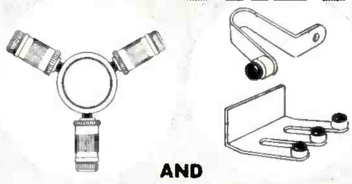

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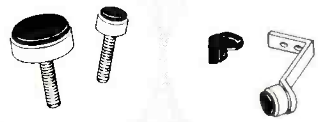

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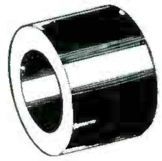

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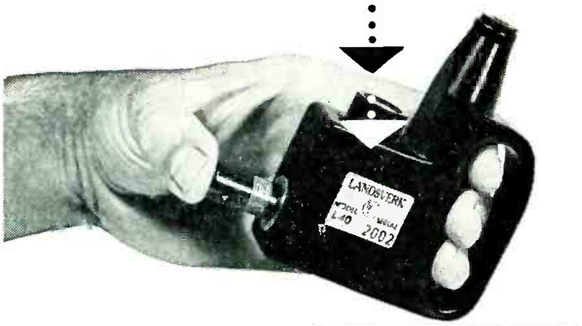

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Wherever there's an *unanswered question*—a *guess* instead of a *know*, or a *hesitation* on identification or procedure—Label it with Avery Kum-Kleen Labels and save time, labor and costly mistakes!

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For Example . . . One electronic manufacturer uses Kum-Kleen Labeling to identify component parts and to give vital information to the users of a radio-active meter. Chances are there's some way these labels can be of help to *you* in *your* business.
WRITE now for samples and further information.

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illustrates facilities, graphs, resistor mounting diagrams, terminal types and other information.

High-Mu Power Triode. Lewis and Kaufman, Inc., Los Gatos, Calif. A new technical data sheet describes the type 250TH Los Gatos brand high-mu power triode. The tube is illustrated and described with dimensions, operating curves and electrical characteristics. Figures for typical operation and maximum ratings are given for the tube in service as a class-B a-f power amplifier and modulator and a class-C r-f power amplifier and oscillator.

TV Transformers and Replacements. Standard Transformer Corp., 3581 Elston Ave., Chicago, Ill. The new edition of the tv transformer catalog and replacement guide lists 2,416 tv models and chassis made by 82 manufacturers, and lists 107 transformers in the catalog section. Set up for easy reference, it lists manufacturers alphabetically. All models and chassis are listed in convenient numerical order and each replacement transformer is listed with the original manufacturer's part number for instant identification.

Carbon Resistors. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. Catalog bulletins B-6 and B-7 deal with types. BOC Boron carbon and DCC deposited carbon resistors respectively. Both units covered are conservatively rated at 0.5 watt, with a 9/16-in. body length and a 5/32-in. outside cap diameter. Applications described are precise military electronic equipment, radar, gun directors, instruments and meter multipliers. Specifications and characteristics charts are given.

Kit-Form Test Equipment. Heath Co., Benton Harbor, Mich., has prepared a new catalog covering its line of Heathkit test equipment and amplifiers. Included in the detailed catalog are schematics, inside photographs, uses, specifications, circuit descriptions and prices of the instruments. Copies

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Annual

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It's another XCELITE "first"! Unidriver has a large, genuine XCELITE hollow handle which holds the following screwdriver bits:

- Phillips No. 1 Point
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- Clutch type 3/16" blade

The chuck permits quick blade changes. Here's a complete screwdriver kit that puts an end to delays in finding the right screwdriver.

Tool and blades, $3.50 List

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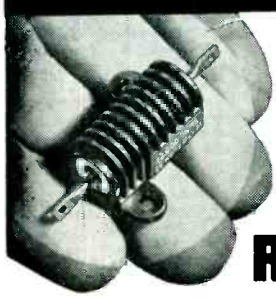
For Originality LOOK TO XCELITE

FOR THOSE *TIGHT* SPECIFICATIONS

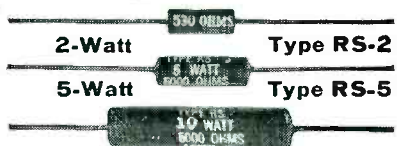


Miniature POWER RESISTORS

25-Watt Type RH-25

50-Watt Type RH-50

EVERY DESIRABLE CHARACTERISTIC



2-Watt Type RS-2

5-Watt Type RS-5

10-Watt Type RS-10

- Smallest in size.
- Sealed in Silicone.
- 100% impervious to moisture and salt spray.
- Complete welded construction from terminal to terminal.
- Temperature coefficient 0.00002% per degree C.
- Ranges from .05 Ohms to 55,000 Ohms, depending on type.
- Tolerance .1%, .5%, 1%, 3%, and 5%.
- RH Types—Silicone sealed in a die-cast, black anodized radiator finned housing and mounts on sub-panel for maximum heat dissipation.
- Prompt Delivery.
- Let us quote on your immediate needs.

Phone, wire or write George Risk
Telephone 2139—2500 13th Street
For Price & delivery
(We also manufacture deposited carbon resistors)

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MINIATURE PRECISION RESISTORS

MANUFACTURED IN ACCORDANCE TO JAN-R-26A Specifications Characteristic G'

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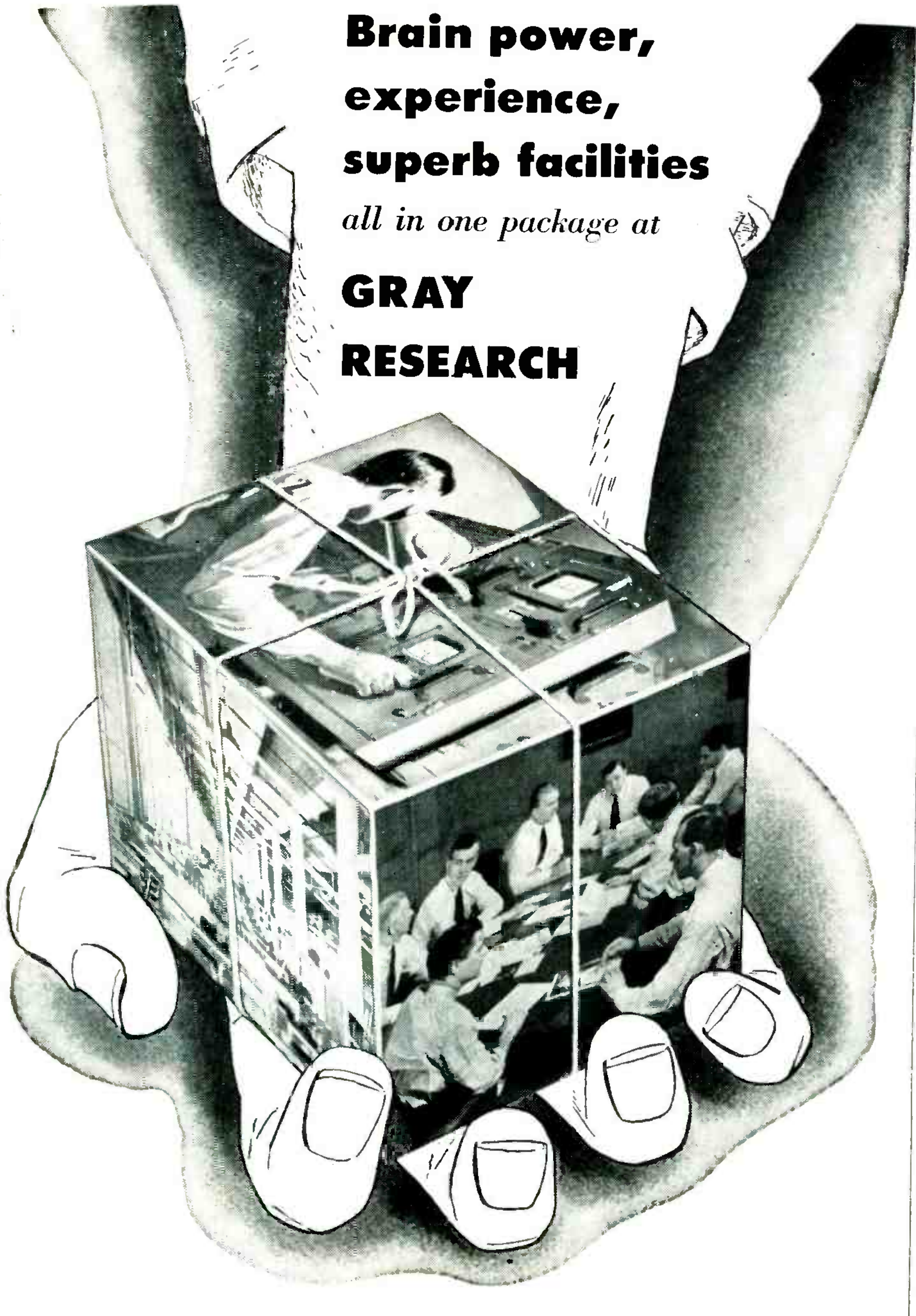

- Television
- Video and display systems
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- Teleprinter techniques
- Precise electro-mechanisms
- Aeronautic control devices
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- Facsimile

In each of the defense-important fields listed here, the Gray organization has recently solved important problems. These facilities are available to prime contractors and to the military services as our contribution to the national effort in furtherance of communications, engineering or electro-mechanical designing. A booklet telling more of the Gray story will be sent for the asking.

• Please write for Bulletin RB-10 describing the above equipment

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AUDOGRAPH

Walter E. Ditmars
President

may be obtained free of charge by writing directly to the company.

Electronic Equipment Catalog. Grayburne Corp., 103 Lafayette St., New York 13, N. Y., has announced its 1952 equipment catalog containing four two-color pages comprehensively describing the complete line. An outstanding feature is the detailed analysis of the specific market potential for each product—from the service dealer's viewpoint—combined with specific recommendations for the exploitation of these markets. Products described include such basic accessories as Ferri-Loopsticks and Vari-Loopsticks, tvi filters, tube carriers and tv/i-f signal boosters.

Hermetic Sealing Service. Hermetic Sealing Corp., 99 E. Hawthorne Ave., Valley Stream, L. I., N. Y. A recent data sheet describes the company's facilities for high vacuum and hermetic sealing service to the electronic and allied industries. Among the facilities described are mechanical and diffusion pumps capable of producing vacuums up to 2×10^{-7} mm Hg; two 20-port all-metal high-vacuum pumping stations that provide adequate capacity for evacuating production quantities of all types of equipment; and a Chromalox trolley, thermostatically-controlled high temperature oven that outgasses the equipment being processed to insure true hermetically-sealed conditions.

Resistance Soldering. Contact, Inc., 238 Main St., Cambridge 42, Mass. A single-page bulletin illustrates and describes the Hotip Tweezer method of resistance soldering small parts. The model H-101 discussed operates on 110-120 v a-c, 50-60 cycles, with an output of 4 v at 15 amperes. Important features and prices are listed for this unit that is designed for use on all circuit work, especially miniature assemblies.

Voltage and Current Regulators. Electric Regulator Corp., 50 Day St., South Norwalk, Conn. Functions and applications of Regohm direct-acting finger-type voltage and current regulators are ana-

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Subminiature

VOLTAGE REGULATOR TUBES

Victoreen's low-power subminiature voltage regulator tubes are being widely acclaimed for their superior characteristics, reliability and performance. These tubes have been developed specifically for such applications as: power supplies for counter-tubes and photomultiplier tubes, stabilizing the second anode potential of cathode ray tubes, nuclear and cosmic ray research, high voltage clippers, and relaxation oscillators. They have found wide application in radio frequency and vibrator power supplies. They have excellent regulation, exceedingly long life, and their small size gives them a high degree of space efficiency.

In sufficient quantities, these regulators can be supplied for any voltage between 450 and 16,000 volts.

VOLTAGE REGULATOR TUBES

VXR-130 130 VOLT GLOW REGULATOR . . . used for regulating low power plate supplies, screen potentials, and coupling in D. C. amplifiers.

5950 700 VOLT CORONA REGULATOR . . . for high voltage, low current applications such as stabilizing the power supply for 700 volt geiger tubes.

5841 900 VOLT CORONA REGULATOR . . . used with R. F. or vibrator power supplies for counter tubes in nuclear and cosmic ray research.

VXR-1000 1000 VOLT, LOW CURRENT CORONA REGULATOR

6143 1200 VOLT, LOW CURRENT CORONA REGULATOR

VXR-1500 1500 VOLT, LOW CURRENT CORONA REGULATOR

6119 2100 VOLT, LOW CURRENT CORONA REGULATOR

Victoreen has a wide selection of subminiature types to fit your application. Write our Components Division for further information.

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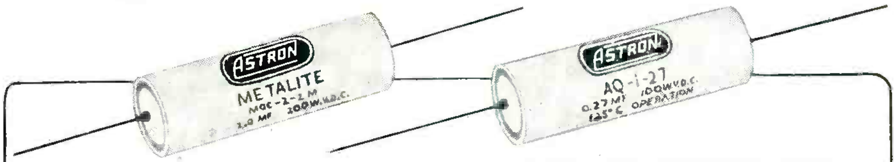

Astron ultra-compact, self-healing METALITE metallized paper capacitors offer the ultimate in capacitor miniaturization and dependability. Ideal for military applications, they are available in a variety of standard and special designs.

Astron type AQ subminiature paper capacitors, specifically designed for high temperature operation through 125°C. without derating, offer exceptional capacitance stability over the entire temperature range. Ideally suited for military applications.

For complete information, write for Catalog AC-3

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- Internally generated single pulses and recurrent pulses 20 cycles to 20 KC
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- Direct reading Recurrence Rate Meter, 20 cycles to 20 KC
- Pulse duration continuously variable and calibrated from 0.1 to 50 μ seconds
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- Position continuously variable and calibrated from 50 μ seconds advanced to 50 μ seconds delayed with respect to synch output trigger
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- Amplitude control isolated from un-terminated DC coupled output for maximum flexibility
- Maximum average load current 0.1 amperes automatically limited

TELETRONICS LABORATORY INC.
WESTBURY, L. I., N. Y.

MANUFACTURERS OF ELECTRONIC INSTRUMENTS AND PRODUCTION TEST EQUIPMENT

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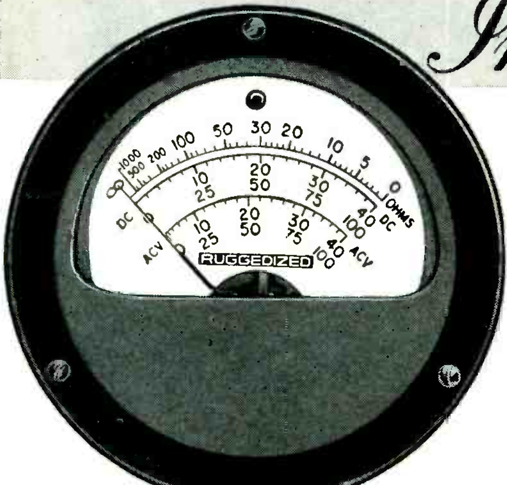
Presenting THE *NEW* DeJUR RUGGEDIZED *Instruments*



DeJUR Amsco Corporation announces the addition of the new Series R-210 and R-310 Ruggedized Instruments. In meeting government specification MIL-M-10304, DeJUR has incorporated features heretofore unobtainable in ruggedized instruments. They have been designed to meet and even surpass the exhaustive tests required by the armed services. They perform perfectly under the severest service conditions that would destroy conventional instruments.

2½" AND 3½"

RUGGEDIZED D. C. INSTRUMENTS

MODEL R-210 MODEL R-310

MEETS MIL-M-10304

- Mechanism suspended by internal live rubber ring mounts for maximum shock displacement and protection.
- External live rubber grommet for shock mounting with interlocking part of front bezel eliminates glass breakage and bezel distortion.
- Water-tight seal to panel provided by rubber grommet.
- Glass to metal seal for perfect hermetic sealing.
- Drawn steel case with heavy cadmium plate provides high degree of magnetic shielding.
- High-grade fusion seals for terminals and window glass withstand thermal shock of extreme temperature changes.
- Rugged glass-to-metal seal terminals withstand a 3000 volt breakdown test under extreme humidity conditions.
- Entire mechanism has complete ruggedized construction for high shock and vibration resistance.

Ranges from 250 microamperes to 8 milliamperes D.C. available for immediate delivery in 2½" size. Other ranges in 2½" and 3½" being submitted for government approval.

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lyzed in Engineering Bulletin 505.00 recently announced. The two-color, 12-page book tells how Regohm provides close control of voltage, frequency and current, and how it can be used in servo systems. Typical circuits are included.

Electromagnetic and Magnetic Devices. Heppner Mfg. Co., Round Lake, Ill., has issued a catalog illustrating and describing its line of snap-on, slip-on and screw type ion traps, centering devices for electrostatic tv tubes of all sizes, Alnico p-m speakers, adjustable focus magnet with picture positioning control and flyback transformers. Described also are facilities for military orders, including engineering, tooling, punch press, screw machine, welding, milling, machining and silver plating.

Laboratory Counter Sets. El-Tronics Inc., 2647-67 N. Howard St., Philadelphia 33, Pa., has published the four-page bulletin 492 describing its LS64 series binary scaler type G-M laboratory counter sets. Included are a list of tubes used and circuit components involved, as well as information on input sensitivity, resolving time, controls provided, counting speed, power source, size, weight and price list.

Stroboscopes. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. A recent eight-page folder describes and illustrates how the electronic stroboscope works. It also gives specific applications of the different instruments, detailed specifications and prices.

Measuring Magnetic Properties. General Electric Co., Schenectady 5, N. Y. Bulletin GEC-777 describes the application and operation of equipment used for measuring magnetic properties. The publication covers the company's gauss meter, indicating fluxmeter, recording fluxmeter and fluxmeter calibrating unit. The instruments discussed provide proper measurements of magnetic properties such as flux density, flux direction and total flux, all of which

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- HIGH INSULATION RESISTANCE
- HIGH OPERATING TEMPERATURE
- HIGH CAPACITANCE STABILITY
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Unicon Capacitors wound with POLYSTYRENE, POLYETHYLENE, TEFLON, or other plastic dielectrics, give an optimum combination of the above characteristics for your capacitor problems. Unicon Capacitors are priced competitively, and delivery is excellent. Write for our recommendations on the correct Unicon Capacitor for your requirements.

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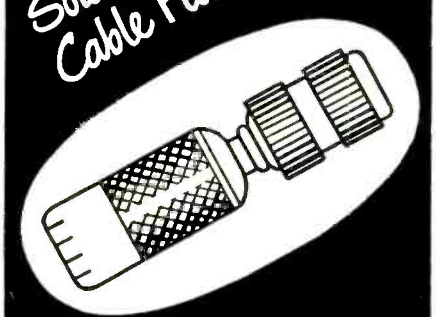
CANADA: 359 St. James St., Montreal

Solderless Cable Fittings



WORKSHOP provides a complete line of solderless cable fittings for RG-59/U, RG-11/U and RG-8/U coaxial cables—all in current production and available in large quantities. Pictured above is the W-50 male cable connector, silver plated and specially slotted to withstand strain. Write for catalog and complete specifications.

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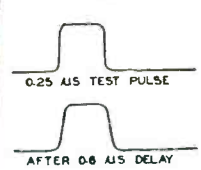
World's Largest Manufacturer of Portable Engraving Machines

Type 302 *Continuously Variable Delay Line*



This is the first commercially available distributed-parameter line capable of providing continuously variable time delay from zero to 0.6 microsecond. Its transmission characteristics are far superior to those of electron-tube delay circuits, ultra-sonic lines, or other delay systems. Pulse response of Type 302 variable delay line may be seen on the left oscillograms. Upper—Waveform of a test pulse having 0.25 microsecond duration. Lower—Waveform of the same pulse after being delayed 0.6 microsecond by Type 302 variable delay line.

SPECIFICATIONS

TIME DELAY:
Continuously variable from 0 to 0.6 microsecond.

RISE TIME:
0.00082 $\sqrt{t}$ microsecond, where t is the amount of delay in millimicrosecond.

CHARACTERISTIC IMPEDANCE:
960 ohms nominal.

ATTENUATION:
The attenuation in db per 100 millimicrosecond delay is: approximately zero below 1 mc, 0.3 at 5 mc, 0.95 at 10 mc, 1.3 at 20 mc, and 1.5 at 30 mc.

ADVANCE ELECTRONICS CO., P. O. Box 394, Passaic, New Jersey

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are essential to the continued industrial progress made possible by research.

Surge Comparison Tester. Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa., gives complete information on the industrial electronic surge comparison tester in the eight-page bulletin DB 85-960. The bulletin describes the tester which is used mainly to locate insulation faults and winding dissymmetries in various electrical apparatus. Principles and methods of operation are presented. Detailed specifications are shown and examples of various applications are illustrated.

Telemetering. Raymond Rosen Engineering Products, Inc., 32nd & Walnut Sts., Philadelphia 4, Pa. A recent 32-page brochure illustrates the company's facilities and activities and discusses the telemetering system. Line drawings are included showing the basic six-channel system, the 32-channel system with both manual and automatic data separation, and the 58-channel and subchannel system. Equipment incorporated, functional analyses and performance data are given.

Temperature Control. Minneapolis-Honeywell Regulator Co., Brown Instruments Division, Wayne and Windrim Aves., Philadelphia 44, Pa. Specification sheet 114 covers the Pyr-O-Vane controller that features snap action and is available with one, two or three-position electronic control. Both the measuring and control mechanisms described and illustrated are plug-in units for ease of removal or replacement. Included are tables showing a partial list of scale ranges and control forms.

Delay Lines. Technitrol Engineering Co., 2751 N. Fourth St., Philadelphia 33, Pa., has issued a data sheet on the type DS continuously wound delay lines. Complete specifications are included. For quotations on the units described kindly state delay, impedance and permissible attenuation and rise time.

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FOR HIGHEST TEMPERATURE APPLICATIONS

We invite inquiries where requirements call for:

small SPACE FACTOR
HIGHEST ABRASION RESISTANCE
FLEXIBILITY AND ADHERENCE
DIELECTRIC STRENGTH
RESISTANCE TO CHEMICALS

capable of withstanding temperatures of 250 centigrade.

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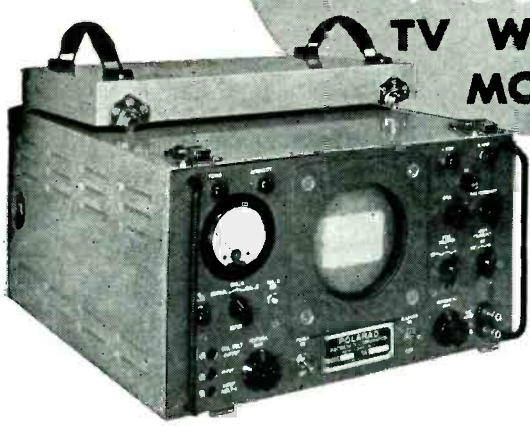
Polarad
Portable
TV WAVE FORM MONITOR



Features

- Sweep expansion of 20 tube diameters.
- Voltage calibration accuracy to 2%.
- Input signal level 0.1 to 500 volts peak to peak.
- Rack mounting and portable.
- Excellent synchronizing capabilities.

Specifically designed for precision waveform analysis and amplitude measurement of video signals in television circuits. Also ideally suited as a general purpose instrument in many applications due to its wide frequency response, high sensitivity, and excellent synchronizing capabilities.

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Brooklyn 11, N. Y.

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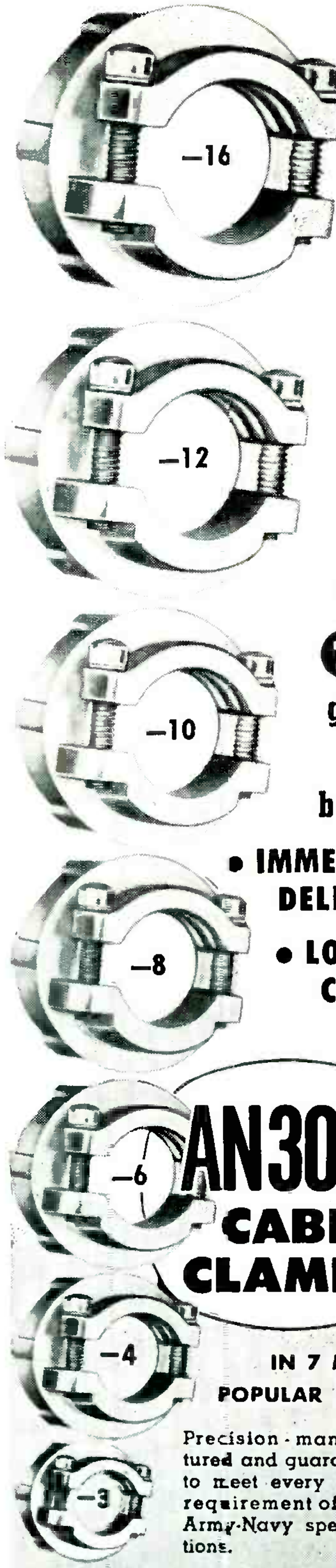

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News From The Field

Edited by WILLIAM P. O'BRIEN

Additions to WCEMA Announced

SIX new corporate members were recently elected to membership in the Los Angeles Council of the West Coast Electronic Manufacturers' Association. This brings the Council roster to 69 members, and a grand total of 91 in the state. New members include Electro-Cap, Inc., 1269 Riverside Drive, Los Angeles; Rytel Electronics Mfg. Co., Inglewood; Dielectric Laboratories, Inc., 1275 Riverside Dr., Los Angeles; Perkin Engineering Corp., 318 Kansas St., El Segundo; Pacific Electricord Co., 3217 Exposition Place, Los Angeles; and Hopkins Engineering Co., 2028 Lincoln Ave., Altadena.

The Council's monthly dinner meetings are now being held at 6 p.m. on the first Thursday of each month at the Wilshire Country Club.

OTHER DEPARTMENTS
featured in this issue:

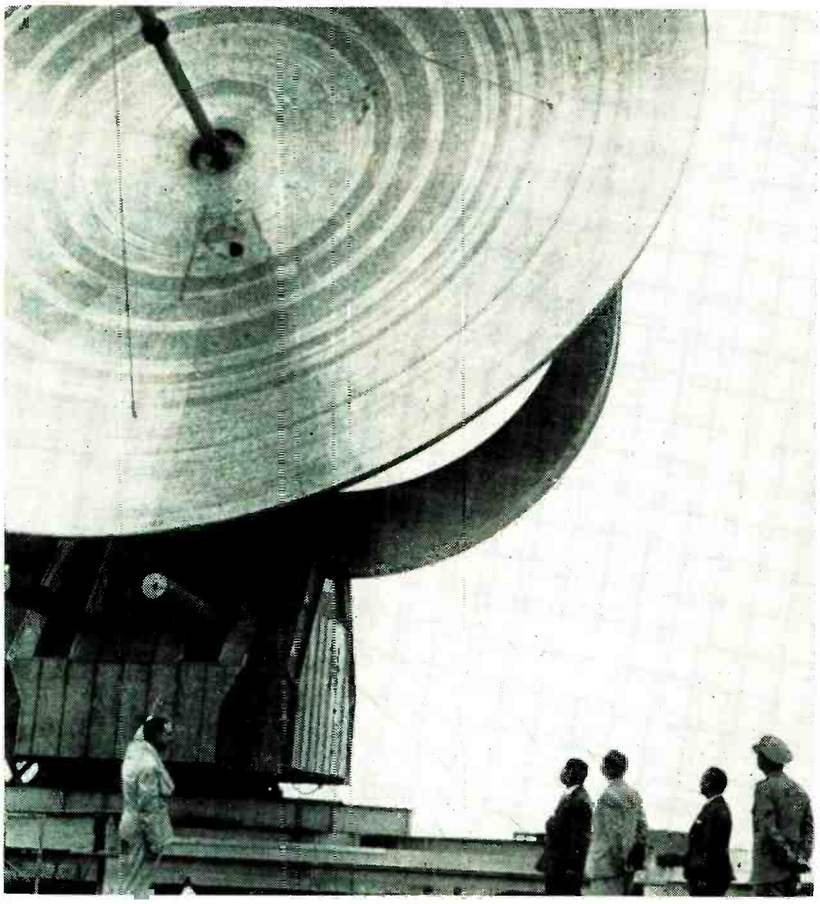
Maritime Radiotelephone

GREAT LAKES and connecting waterways communications will be aided if the new FCC proposal encounters no strong opposition from government, Public Safety Service or railroad interests.

In June 1951, two pairs of ship-shore public-correspondence channels were provided in the 152-162 mc band for various port areas. Chicago, however, failed to receive a second channel (161.90 mc) because 161.91 mc had been assigned to railroad radio service in that area since 1945. Since the railroads haven't used the channel, it is proposed that it be given to public coast stations, provided no interference is caused the railroad channel 161.85 mc. Under this arrangement, two ship-shore channels—162 mc coast paired with 157.3 mc ship and 161.9 mc coast paired with 157.4 mc ship—would be common to all areas.

The full proposal will require some additional rearrangement of government and Public Safety services.

JAPANESE GROUP VISITS NRL RADIO TELESCOPE



This unusual photograph of the Naval Research Laboratory 600-inch radio telescope was taken on the occasion of a visit by a Japanese legislative, scientific and technical mission. The giant antenna is expected to provide means for studying sun spots and their effect on earth radio and communications

Industry Advisory Subcommittees

SERVING the Munitions Board, Dept. of Defense, are eleven Industry Advisory Subcommittees in the field of electronics. They assist the Board by advising and making recommendations on military aspects of industrial mobilization planning, procurement planning and the stockpiling of critical materials.

Herewith is a revised listing of the electronic equipment industry advisory subcommittees:

Capacitor Subcommittee: T. M. Natt of the Office of Electronics Programs, Munitions Board, Washington, D. C.; P. McK. Deeley of Cornell-Dubilier Electric Corp., South Plainfield, N. J.; G. R. Fryling of Erie Resistor Corp., Erie, Pa.; J. F. Gudeman of Gudeman Co., Chicago, Ill.; L. Kopinski of John E. Fast & Co., Chi-

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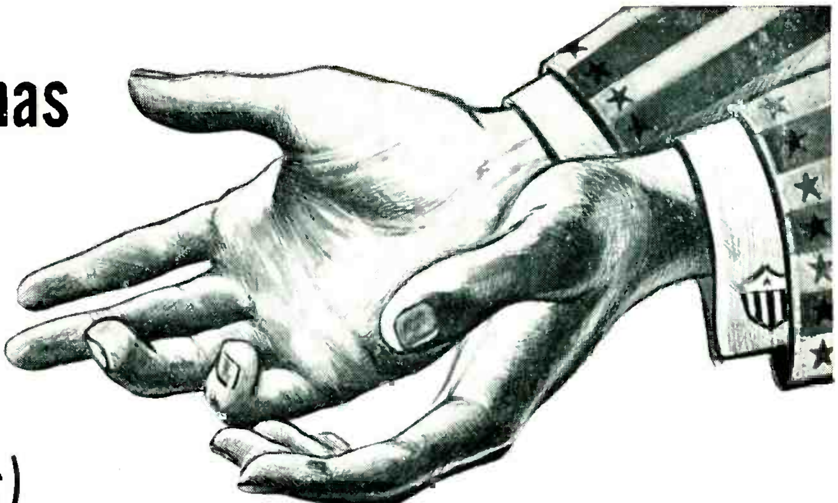
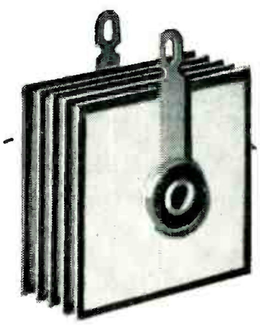
If the government has tossed a problem in your lap . . . *(having to do with rectification, that is)*



. . . we'd like to assist you!

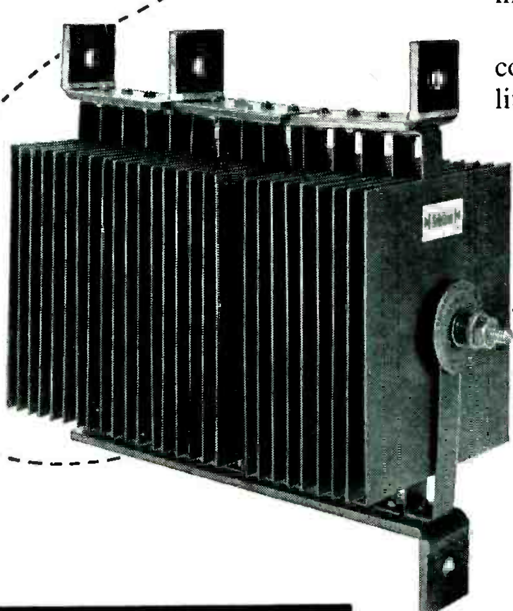


We've made *millions* of SELETRON selenium rectifiers in all sizes and shapes – tiny ones and whoppers – standard commercial ones, and those designed especially to meet government's rigid specifications. That includes hermetically sealed jobs as well as stacks built to withstand salt spray and high humidity tests.

We've sold a whale of a lot of 'em to the various branches of government including the armed services and their contractors, and thus have learned a great deal about rectifier idiosyncrasies and their application.

All this accumulated rectifier wisdom we'll share with engineers and technical men who have U.S. Government induced problems . . . and no strings attached!

State that problem, please. You'll receive a detailed, constructive answer promptly. Or if you wish our general literature on the subject, ask us for bulletin No. 104-D-4.



Do you have your copy of this instructive 24 page booklet? If not, send for Booklet No. 117-D-4.

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cago, Ill.; L. Kunz of Sangamo Electric Co., Springfield, Ill.; W. M. Owen of Aerovox Corp., New Bedford, Mass.; W. S. Parsons of Centralab Div., Globe Union, Inc., Milwaukee, Wisc.; G. Peck of P. R. Mallory & Co., Inc., Indianapolis, Ind.; J. K. Sprague of Sprague Electric Co., North Adams, Mass.; F. G. Stebbins of General Electric Co., Pittsfield, Mass. and E. Tyler of Micamold Radio Corp., Brooklyn, N. Y.

Dynamotor Subcommittee: T. M. Natt of the Office of Electronics Programs, M. B., Washington, D. C.; C. T. Button of Holtzer-Cabot Co., Boston, Mass.; R. W. Carter of Carter Motor Co., Chicago, Ill.; W. A. Gothard Mfg. Co., Springfield, Ill.; R. C. Hanna of General Electric Co., Fort Wayne, Ind.; R. L. Irvin of Westinghouse Electric Co., Lima, Ohio; H. K. Mann of Bendix Aviation Corp., Red Bank, N. J.; M. L. Robinson of Jannette Mfg. Co., Chicago, Ill.; E. I. Winquist, Continental Electric Co., Inc., Newark, N. J.; J. Bentia of Alliance Mfg. Co., Alliance, Ohio; and A. Wylie of Redmond Co., Inc., Ohio.

Electron Tubes (Receiving Tubes) Subcommittee: T. M. Natt of the Office of Electronics Programs, M. B., Washington, D. C.; J. Q. Adams of Hytron Radio & Electronics Corp., Salem, Mass.; R. E. Carlson of Tung-Sol Lamp Works, Newark, N. J.; R. W. Cotton of Philco Radio Corp., Philadelphia, Pa.; N. B. Krim of Raytheon Mfg. Co., Newton, Mass.; J. M. Lang of General Electric Co., Schenectady, N. Y.; F. Mansfield of Sylvania Electric Products, New York, N. Y.; and C. F. Miller of Westinghouse Electric Corp., Bloomfield, N. J.

Indicating Instruments (Meters) Task Group: T. M. Natt of the Office of Electronics Programs, M. B., Washington, D. C.; R. A. Ammon of Marion Electric Instrument Co., Manchester, N. H.; H. A. Bernreuter of Simpson Electric Co., Chicago, Ill.; E. J. Boland of General Electric Co., West Lynn, Mass.; G. T. Deaney of Weston Instrument Co., Newark, N. J.; J. M. Heggy of Westinghouse Electric Co., Newark, N. J.; and N. A. Triplett of Triplett Electrical Instrument Co., Bluffton, Ohio.

Quartz Crystals Subcommittee: T. A. Perrott of the Office of Electronics Programs, M. B., Washington, D. C.; K. Jahn of James Knights Co., Sandwich, Ill.; L. McCoy of Standard Piezo Co., Carlisle, Pa.; A. E. Miller of Miller Laboratories, North Bergen, N. J.; S. Ryesby of Hunt Corp., Carlisle, Pa.; J. H. Sweeney of General Electric Co., Syracuse, N. Y.; R. A. Sykes of Bell Telephone Laboratories, Inc., Murray Hill, N. J.; and G. E. Wright of Bliley Electric Co., Erie, Pa.

Relay Subcommittee: T. M. Natt of the Office of Electronics Programs, M. B., Washington, D. C.; G. A. Berting of North Electric Mfg. Co., Galion, Ohio; R. T. Brengle of Potter & Brumfield Co., Princeton, Ind.; C. Clare of C. P. Clare & Co., Chicago, Ill.; F. H. Clark of Westinghouse Electric Corp., Beaver, Pa.; J. F. Clark of Leach Relay Co., Los Angeles, Calif.; G. T. Deaney of Weston Electrical Instrument Corp., Newark, N. J.; R. Fischer of Sigma Instruments, Inc., Boston, Mass.; E. Gilletee of Allied Control Co., New York, N. Y.; A. C. Keller of Western Electric Co., Bell Telephone Laboratories, New York, N. Y.; E. Howe of Comar Electric Co., Chicago, Ill.; H. W. Pfeffer of Struthers-Dunn, Philadelphia, Pa.; J. Roughan of Price Electric Co., Frederick, Md.; and J. Rowell of Guardian Electric Co., Chicago, Ill.

Resistor Subcommittee: T. M. Natt of the Office of Electronics Programs, M. B., Washington, D. C.; G. F. Benkelman of Continental Carbon, Inc., Cleveland, Ohio; D. H. Shallcross of Shallcross Mfg. Co., Collingdale, Pa.; H. A. Ehle of International Resistance Co., Philadelphia, Pa.; A. Kaul of Speer Carbon Co., St. Marys, Pa.; D. W. W. Kelly of Allen Bradley Co., Milwaukee, Wis.; W. M. Kohring of Wilkor Products Co., Cleveland, Ohio; R. S. Laird of Ohmite Mfg. Co., Chicago, Ill.; L. Podolsky of Sprague Electric Co., North Adams, Mass.; J. H. Stackpole of Stackpole Carbon Co., St. Marys, Pa.; and B. S. Turner of Chicago Telephone Supply Co., Elkhart, Ind.

Steatite Subcommittee: T. A. Perrott of the Office of Electronics Programs, M. B., Washington, D. C.; E. H. Fritz of Stupakoff Ceramics Mfg. Co., Latrobe, Pa.; W. S. Parsons of Centralab Div., Globe Union, Inc., Milwaukee, Wis.; G. E. Richter of American Lava Corp., Chattanooga, Tenn.; J. Schemerhorn of National Ceramic & Steatite Co., Trenton, N. J.; and C. L. Snyder of General Ceramics & Steatite Corp., Keasbey, N. J.

Test Equipment Subcommittee: T. M. Natt of the Office of Electronics Programs, M. B., Washington, D. C.; H. A. Bernreuter of Simpson Electric Co., Chicago, Ill.; G. T. Deaney of Weston Instrument Co., Newark, N. J.; R. H. Denton of Radio Frequency Laboratories, Inc., Boonton, N. J.; G. A. Downsbrough of Boonton Radio Corp., Boonton, N. J.; L. A. Goodwin, Jr., of RCA, Camden, N. J.; R. D. Hickok of Hickok Electrical Instrument Co., Cleveland, Ohio; H. W. Houck of Measurements Corp., Boonton, N. J.; S. D. Lavoie, of Lavoie Laboratories, Inc., Morganville, N. J.; A. J. W. Novah of Brush Development Co., Cleveland, Ohio; D. Packard of Hewlett-Packard Co., Palo Alto, Calif.; J. P. Smith, Jr., of The Daven Co., Newark, N. J.; R. R. Stoddart of Stoddart Aircraft Radio Co. Hollywood, Calif.; A. E. Thiessen of General Radio Co., Cambridge, Mass.; R. L. Triplett of Triplett Electrical Instrument Co., Bluffton, Ohio; E. C. Williams of Allen B. DuMont Laboratories, Inc., Clifton, N. J.; and F. Zayac of Ballantine Lab., Inc., Boonton, N. J.

Transformer Subcommittee: T. M. Natt of the Office of Electronics Programs, M. B., Washington, D. C.; F. E. Baker of Westinghouse Electric Corp., Sharon, Pa.; M. Cohen of F. W. Sickles Co., Chicopee, Mass.; L. R. Duman of Advance Transformer Co., Chicago, Ill.; K. W. Gordon of Raytheon Mfg. Corp., Waltham, Mass.; J. J. Kahn of Standard Transformer Corp., Chicago, Ill.; L. A. King of Rola Co., Inc., Cleveland, Ohio; L. Muter of Muter Coil Co., Chicago, Ill; L. S. Racine of Chicago Transformer Div., Essex Wire Corp., Chicago, Ill.; J. B. Schaefer of New York Transformer Co., Inc., Alpha, N. J.; P. M. Staehle of General Electric Co., Fort Wayne, Ind.; W. E. Wilson of Acme Electric Corp., Cuba, N. Y.; L. Howard of Triad Transformer Mfg. Co., Los Angeles, Calif.

Transmitting Tube Subcommittee: T. M. Natt of the Office of Electronics Programs, M. B., Washington, D. C.; H. Argento of Raytheon Mfg. Co., Waltham, Mass.; C. E. Burnett of RCA, Harrison, N. J.; T. Clinton of Thomas Electronics, Inc., Passaic, N. J.; C. E. Cohn of Arcturus Electronics, Inc., Newark, N. J.; W. A. Hayes of Westinghouse Electric Co., Bloomfield, N. J.; G. W. Henyan of General Electric Co., Schenectady, N. Y.; H. J. Hoffman of Machlett Laboratories, Inc., Springdale, Conn.; L. C. Jarvis of Western Electric Co., Allentown, Pa.; H. Kuthe of Kuthe Laboratories, Newark, N. J.; J. A. McCullough of Eitel-McCullough, Inc., San Bruno, Calif.; A. L. Milk of Sylvania Electric Products, Inc., Washington, D. C.; and S. Norris of Amperex Electronic Corp., Brooklyn, N. Y.

All subcommittee correspondence and business will be conducted with the Office of Electronics Programs, Room 2D845, Pentagon Building, Washington 25, D. C.

ICAO-CAA Word Code

EFFECTIVE April 1, 1952, communicators using CAA radiotelephone transmitters will start using the new word code recommended by International Civil Aviation Organization. Chief advantage of this word code over the Able-Baker-Charlie code is that despite language habits of the speaker, there are no wide variations in pronunciation.

A—Alfa	G—Golf
B—Bravo	H—Hotel
C—Coca	I—India
D—Delta	J—Juliett
E—Echo	K—Kilo
F—Foxtrot	L—Lima
M—Metro	T—Tango
N—Nectar	U—Union
O—Oscar	V—Victor
P—Papa	W—Whiskey
Q—Quebec	X—Extra
R—Romeo	Y—Yankee
S—Sierra	Z—Zulu

Numbers will be transmitted using the following pronunciation for the individual numerals:

0—ZE-RO	6—SIX
1—WUN	7—SEV-en
2—TOO	8—AIT
3—TREE	9—NIN-er
4—FOW-er	1,000—THOU-SAND
5—FIFE	.—DE-CI-MAL

People in the News

FEATURED among the recent top level and staff appointments, transfers and promotions are twenty names.

Joshua Sieger, in the communications field for 28 years and during World War II the principal technical officer and engineering head of the British Telecommunications Research Establishment, has been elected president of the J. H. Bunnell & Co., Brooklyn, N. Y., manufacturers of communications equipment.

J. Sieger

J. H. DuBois

J. H. Du Bois, formerly sales manager of the Plax Corp., has been appointed vice-president in charge of engineering at Mycalex Corp. of America, and will make his headquarters at the plant and general offices in Clifton, N. J.

Warren C. Stoker, professor of electrical engineering at Rensselaer Polytechnic Institute and member of the department since 1933, has resigned to become director of the Institute's computer laboratory.

Harold H. Buttner, vice-president of International Telephone and Telegraph Corp., has been

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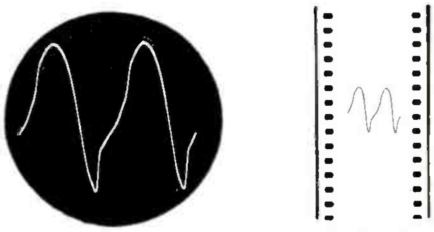
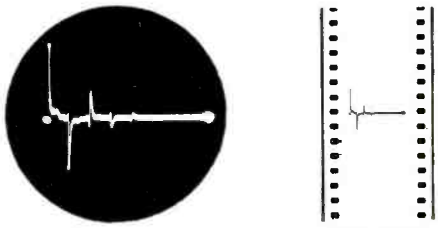
Want an oscilloscope camera NOW?



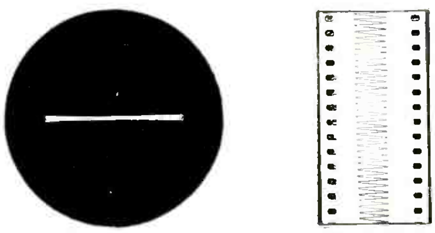
Scope Image — Film Recording

1. Single-frame photography of stationary patterns using a continuously running sweep.



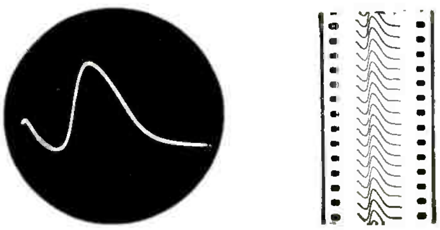
Scope Image — Film Recording

2. Single-frame photography of single transients using a single sweep.



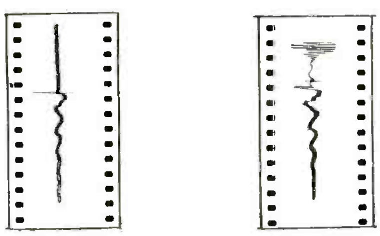
Scope Image — Film Recording

3. Continuous-motion photography employing film motion as a time base.



Scope Image — Film Recording

4. Continuous-motion photography employing oscilloscope sweep as a time base.



FILM MOTION TIME BASE — FILM MOTION AND SCOPE SWEEP

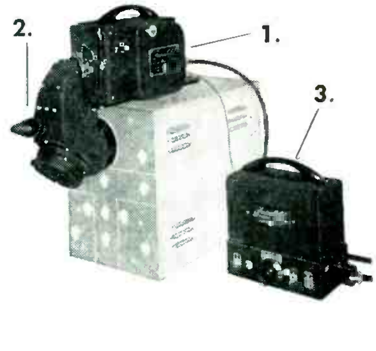
5. Continuous-motion photography employing combination of film motion and oscilloscope sweep as a time base.

Fairchild cameras for recording oscilloscope traces are available *from stock* for immediate shipment. With these units you obtain permanent photographic records of scope traces. This eliminates possible errors in making hand sketches from memory. Consider the time-saving convenience of either of the types described below.

FAIRCHILD OSCILLO-RECORD CAMERA IS UNUSUALLY VERSATILE

Users of the Fairchild Oscillo-Record Camera like its versatility. Designed for both still and continuous-motion photography on 35-mm film, it records non-recurring phenomena that are too rapid for visual study, others that are so slow that continuity is lost, and the occasions where very high-speed transients are combined with very slow-speed phenomena. For some idea of the types of jobs this instrument can do, study the examples at the left. Each solves a particular problem. Oscillo-Record camera users especially like its:

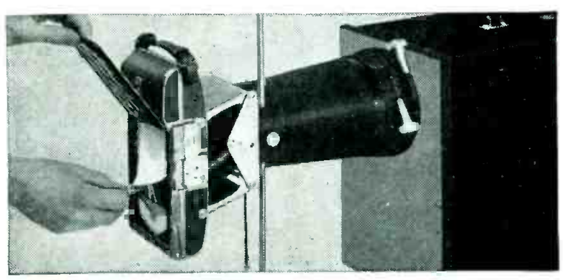
- **CONTINUOUSLY VARIABLE SPEED CONTROL** — 1 in/min. to 3600 in/min.
- **TOP OF SCOPE MOUNTING** that leaves controls easily accessible.
- **PROVISION FOR 3 FILM LENGTHS**—100, 400 or 1,000 feet.



1. Camera, 2. periscope, 3. electronic speed control. Accessories include 400- and 1,000-ft. film magazines, magazine adaptor and motor, universal mount for camera and periscope, binocular split-beam viewer.

FAIRCHILD-POLAROID® OSCILLOSCOPE CAMERA MAKES ACCURATE RECORDS FOR IMMEDIATE EVALUATION

Valuable but inexpensive oscillograms for immediate study; automatic one-minute processing without a darkroom; set-up time of two minutes or less—these are a few of the many advantages of using the Fairchild-Polaroid Oscilloscope Camera. If individual exposures meet your requirements—where you want permanent records of the traces you're now sketching or just remembering, this camera will give you new speed, convenience, and economy. Prints are 3¼ x 4¼ and each records two traces exactly one-half actual size.



One minute after you pull the tab, a finished print is ready for your evaluation.

Complete information about applications and operation of both the Fairchild Oscillo-Record Camera and the Fairchild-Polaroid Oscilloscope Camera is available. Write today to *Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Boulevard, Jamaica 1, New York, Department 120-18A.*

FAIRCHILD
OSCILLOSCOPE RECORDING CAMERAS

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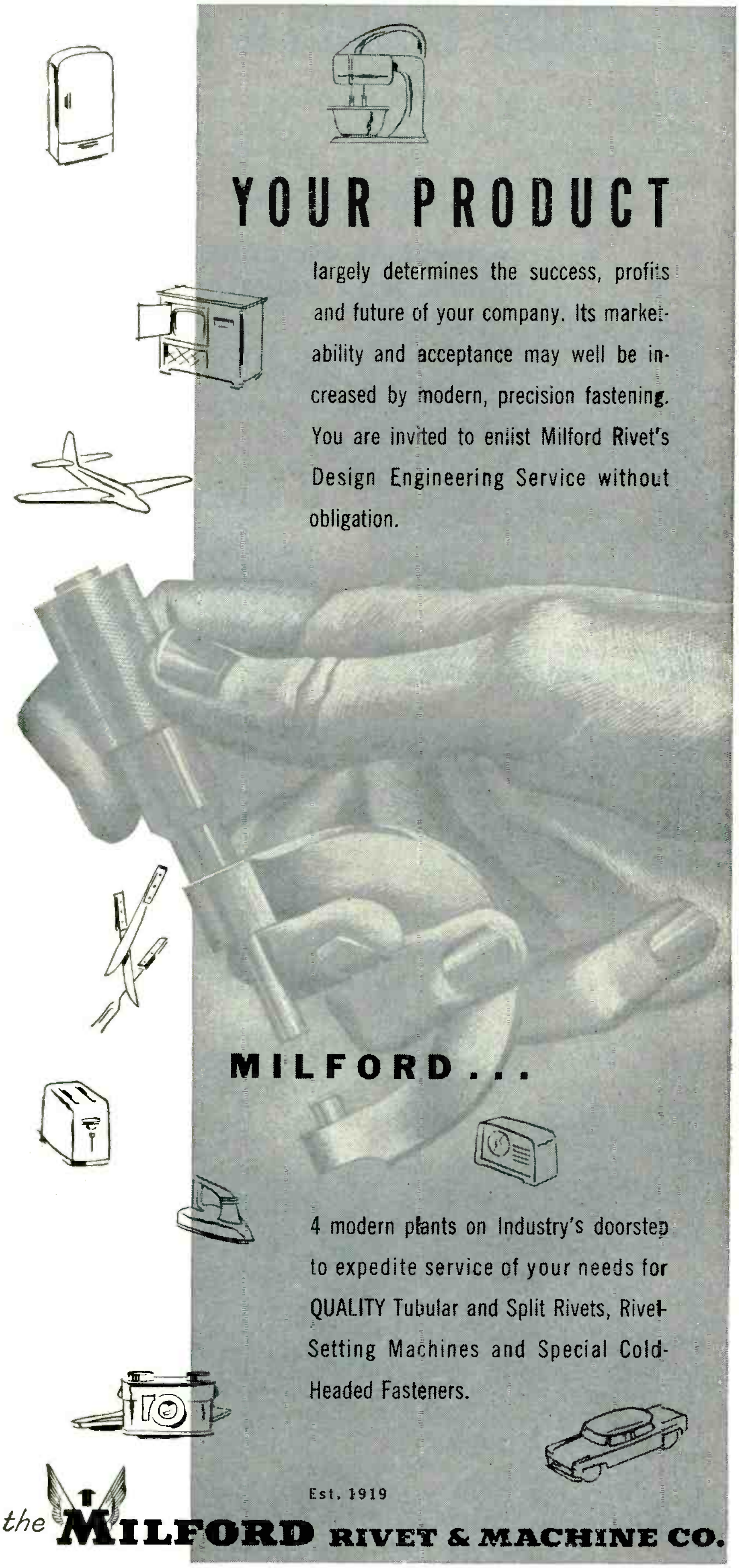

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806 Illinois Ave., AURORA, ILL.
26 Platt St., HATBORO, PA.

elected president of Federal Telecommunication Laboratories, Inc., research unit of IT&T in Nutley, N. J. He succeeds **Roger B. Colton** who has been appointed deputy technical director of IT&T.

Stanley I. Messing, until recently with Starrett Television Corp., has been named manager of the Government Contract Division of the Philharmonic Radio & Television Corp., New Brunswick, N. J.


S. I. Messing


J. F. Falk

John F. Falk, with Radio Frequency Laboratories, Inc., Boonton, N. J., for four years, and responsible for company relations with the Signal Corps and Air Force, was elected a vice-president.

Berlant Associates, Los Angeles, Calif., manufacturers of magnetic tape recorders, have made two additions to their staff: **Dick Hoskin,** formerly with Hughes Aircraft, has been appointed chief electronic engineer, heading up electronic design and development; **Vic Schramm,** formerly of Lear, Inc., has been named electronics production manager.

Herbert S. Bennett, former chief of the engineering branch at the Electronic Warfare Center, Ft. Monmouth, N. J., was recently appointed director of research and engineering of the Engineering & Production Division of Dynamic Electronics—New York, Inc., Forest Hills, N. Y.

Taylor Tubes, Inc., Chicago, Ill., manufacturer of high-vacuum power tubes, gaseous rectifiers and special-purpose tubes, has appointed **I. L. Brandt** chief engineer. He was formerly project engineer at Continental Electric Co., Geneva, Ill.

Robert L. Batts, past president of the Associated Police Communications Officers and former deputy director of civil defense communi-

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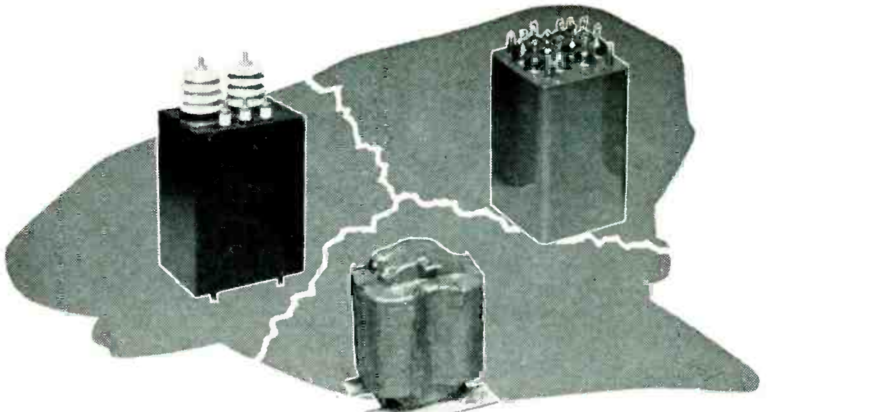

★FOR MILITARY SERVICE

Today most Peerless transformers are assigned for military service. They are being used in Radar, Sonar, guided missiles, radio communications and many other applications. Peerless is building transformers today to meet all JAN-T-27 and MIL-T-27 specifications. If you have transformer requirements for government apparatus you will find it profitable to contact Peerless for engineering and manufacturing. Below are a few general facts on some transformers now in production in the Peerless plant.

TYPES:	High voltage filament and plate supply, charging chokes, saturable reactors, pulse transformers, etc.
POWER RANGE:	From microvolts to 30,000 volts. From 1 milliwatt to 25 K. V. A.
CONSTRUCTION:	Hermatically sealed, oil filled, heliarc case construction. Hermatically sealed, potted type, solder sealed metal cases. Fosterite treated with thermosetting resin.

PEERLESS Electrical Products
A Division of ALTEC LANSING CORPORATION ®
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SHIELDING PROBLEMS

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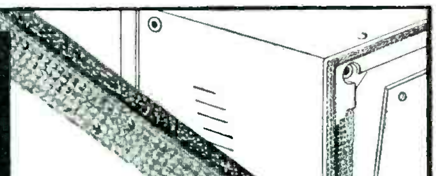
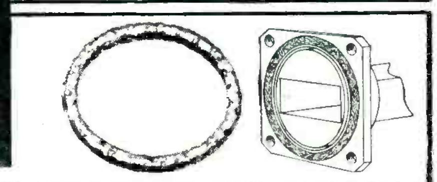
METEX

electronic "Weather Strips"





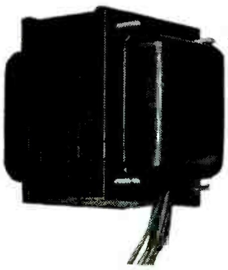
Resilient...Conductive...Compressible...Cohesive

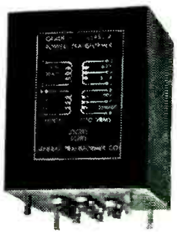
From closures for cabinets to gaskets for waveguide couplings, Metex Electronic Shielding assures *lasting* metal-to-metal contact to prevent leakage, without the need for costly machining to secure precise surface-to-surface contacts. Metal wire — *knitted*, not woven or braided — gives Metex Electronic Strips and Gaskets that combination of conductivity and resiliency which makes them so effective and economical for shielding.

For a more detailed picture of the scope of utility of Metex Electronic Products, write for free copy of "Metex Electronic Weather Strips." Or outline your specific shielding problem—it will receive immediate attention.

METAL TEXTILE CORPORATION
KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY
METEX
641 East First Avenue Roselle, N. J.

We offer our proved ability to produce hermetically-sealed transformers to JAN-T-27 or MIL-T-27 government specifications. Prompt delivery, efficient engineering techniques and modern production facilities which include conveyorized assembly lines make "GTC" worthy of your consideration.





Our new plant is self-contained with complete metal-working and tool-making facilities. We invite inquiries from prime and sub-contractors.

There is a "GTC" representative in your territory

GTC

GENERAL TRANSFORMER COMPANY

serving industry since 1928

18240 Harwood Avenue, Homewood, Illinois

(Suburb of Chicago)

cations in Indianapolis, Ind., has joined the Communications and Electronics Division of Motorola, Inc., Chicago, Ill., as an engineer and field representative.

Malcolm S. McIlroy has been advanced from professor to assistant dean of the College of Engineering at Cornell University, Ithaca, N. Y.

Sylvania Electric Products Inc. announces the appointment of **George L. Loomis** as manager of the radio tube plant at Burlington, Iowa. He succeeds **Walter A. Weiss**, Sylvania's first plant manager at Burlington, who has been appointed general manufacturing manager of the Radio Tube Division, with headquarters at Emporium, Pa. Loomis was formerly engineering manager of the Division's Product Development Section.

Robert D. Piper, previously associated with the Automatic Electric Co. and the Thomas A. Edison Co. in engineering capacities, has been named assistant sales manager of Nuclear Instrument & Chemical Corp., Chicago, Ill.

Martin V. Kiebert, Jr., affiliated with Raymond Rosen Engineering Products, Inc., before joining Bendix, has been appointed director of a large government project under the jurisdiction of Raymond P. Lansing, vice-president and group executive of Bendix Aviation Corp.

Caywood C. Cooley, formerly chief field engineer for Jerrold Electronics Corp., was recently named sales manager of the company. At the same time **Carl W. Schmelzle**, formerly with Philco Corp. as a radar and tv field engineer, was appointed assistant sales manager at Jerrold.

Theodore Saltzberg, junior development engineer for Motorola, Inc., has been appointed an assistant engineer in the electrical engineering department at Armour Research Foundation of Illinois Institute of Technology.

Plant News

FORMATION of three new companies and expansion of fourteen others

www.americanradiohistory.com

The new S.S.WHITE 80X HIGH VOLTAGE RESISTOR

(½ Actual Size)

4 watts · 100 to 100,000 megohms

Developed for use as potential dividers in high voltage electrostatic generators, S.S.White 80X Resistors have many characteristics—particularly negative temperature and voltage coefficients—which make them suitable for other high voltage applications.

They are constructed of a mixture of conducting material and binder made by a process which assures adequate mechanical strength and durability. This material is non-hygroscopic and, therefore, moisture - resistant. The resistors are also coated with General Electric Dri-film which further protects them against humidity and also stabilizes the resistors.

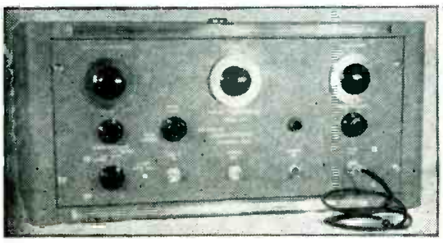
WRITE FOR BULLETIN 4906

It gives complete information on S.S.White resistors. A free copy and price list will be sent on request. Send for a copy.

THE S.S.White DENTAL MFG. CO. INDUSTRIAL DIVISION

Dept. R, 10 East 40th St.
NEW YORK 16, N. Y.

WESTERN DISTRICT OFFICE: Times Building, Long Beach, Calif.



NEW PULSE GENERATOR

FEATURES

Pulse Height: 0-50 v. continuously variable, positive or negative polarity.
Pulse Width: 0.07 to 7 μs. continuously variable.
Repetition Frequency: 50-5000 cycles, controlled from an internal or external oscillator.
Output Impedance: 75 ohms or less.
Pulse Shape: 0.02 μs. rise and fall times. Top flat within 2%.
Synch Out: 50 v. into 200 ohms, 1 μs. wide, 0.1 μs. rise time.
Pulse Phasing: Output pulse can be delayed 100 μs. or advanced 10 μs. with respect to the synch output.

Other laboratory pulse generators also available.
For full details write for Bulletin PG-50

76 STAGE STREET — **MANSON LABORATORIES** — STAMFORD CONN.

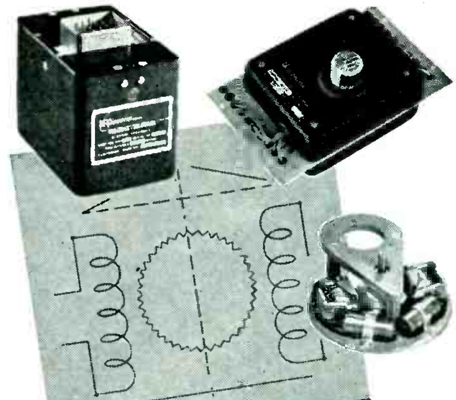
SPECIFICATION

AN-P-89

PANELS - DIALS - ETC.

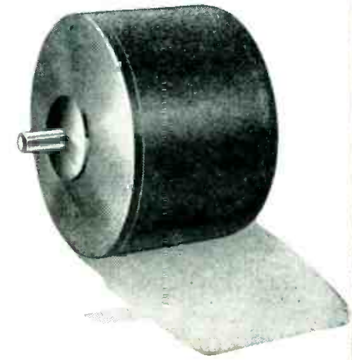
BODNAR INDUSTRIES, INC.

19 RAILROAD AVE., NEW ROCHELLE, N.Y.



NEW UNIVERSAL

Stepping Positioners



The Roto Steppers

provide 360° clockwise and counter-clockwise rotation in 2° increments as standard. Shaft output has sufficient torque to drive many low torque mechanisms, indicators, potentiometers, selsyns, synchros, switching devices and others. Features 24 volt system, long life solenoids and combinations.

AS LISTED BY PRODUCT NO. DIA. 3.13 IN.

Product No.	Case Lgth.	Shaft Output	Potentiometer Output	Homing Segments	Internal Auto Cycle
8915-1	2.25	√			
8915-2	3.25	√*	√		
8915-3	4.00	√*	√	√	
8915-4	4.00	√*	√	√	√

*AVAILABLE WITHOUT SHAFT OUTPUT

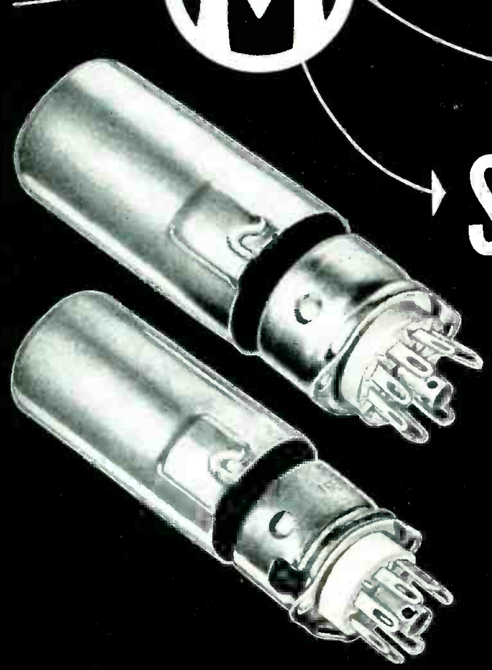
Write for Engineering Data

G. M. GIANNINI & CO., INC.
Pasadena 1, Calif.

Giannini

www.americanradiohistory.com

Military Tube Sockets



In addition to meeting applicable JAN specifications, METHODE sockets and accessories for military applications are manufactured with all the EXTRA quality, precision and care which can go into a compact heavy duty wiring device.

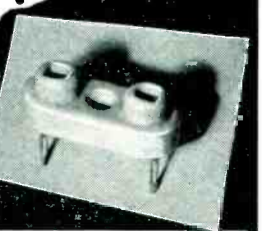
With test failures and component rejections so costly now, the many extras, standard with METHODE, and the uniformity assured by perfected quality control techniques worked out in conjunction with the services are saving users many headaches.

Following are standard JAN specifications to which METHODE is currently producing:

DESCRIPTION	JAN S-28A AMEND. 1 (2-19-51)	JAN S-28A (2-28-49)	JAN S-28 (8-31-44)	KEY DIMENSIONS
Miniature 7 Pin Plastic Socket	TS102P01	TSE7T101	S010M S011M	Mtg. Centers 7/8"; Mtg. Holes 1/8"; Chassis Hole 5/8".
Miniature 7 Pin Ceramic Socket	TS102C01	TSE7T102	S010C S011C	Mtg. Centers 7/8"; Mtg. Holes 1/8"; Chassis Hole 5/8".
Noval 9 Pin Plastic Socket	TS103P01	TSE9T101		Mtg. Centers 1 1/8"; Mtg. Holes 1/8"; Chassis Hole 3/4".
Naval 9 Pin Ceramic Socket	TS103C01	TSE9T102		Mtg. Centers 1 1/8"; Mtg. Holes 1/8"; Chassis Hole 3/4".
Miniature 7 Pin Tube Shield	TS102U01	TSF0T101	SOS 3	Height 1 3/8"
Miniature 7 Pin Tube Shield	TS102U02	TSF0T102	SOS 6	Height 1 3/4"
Miniature 7 Pin Tube Shield	TS102U03	TSF0T103		Height 2 1/4"
Miniature 9 Pin Tube Shield	TS103U01	TSF0T104		Height 1 1/2"
Miniature 9 Pin Tube Shield	TS103U02	TSF0T105		Height 1-15/16"
Miniature 9 Pin Tube Shield	TS103U03	TSF0T106		Height 2 3/8"

Plastic insulators in above sockets are Type MFE, phenolic, per MIL P-14A. Ceramic insulators are steatite, Grade L-4B or better per JAN 1-10. Contacts are silver plated copper base alloy (phosphor bronze and beryllium where specified) with terminals hot tin dipped. Shields and bases on JAN S-28 units are steel cadmium plated; S-28A and Amendment 1 parts use brass, nickel plated.

Crystal Socket



A number of METHODE products not as yet covered by JAN specifications are finding application in military equipments, such as the two prong crystal socket for holders with .050" pins on .486" centers shown. Consult METHODE for standard type sockets with special materials and performance incorporated for military applications.

Inquiries are invited

METHODE Manufacturing Corp.

2021 West Churchill Street • Chicago 47, Illinois

Geared to produce Plastic and Metal Electronic Components

highlight this month's review of plant activities.

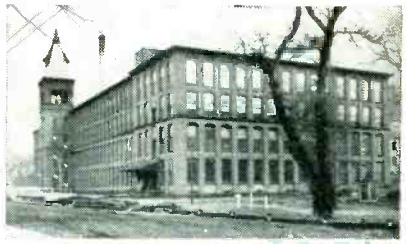
The new companies recently announced are *Hermetic Sealing Corp.* of Valley Stream, N. Y., for mass production of a hermetic sealing system; *Magnex Corp.* of Jamaica, N. Y., manufacturer of nuclear instruments; and *Chase Resistors Co.* of Morristown, N. J., producer of carbon film resistors.

Facilities expansions reported are as follows:

Bond Electronics Corp., formerly of Summit, N. J., now occupies its new larger building at 60 Springfield Ave., Springfield, N. J.

Unimax Switch Division of the W. L. Maxson Corp. has moved to a large new factory at 527 W. 34th St., New York City, due to increased demand for JAN, AN and commercial types of precision snap-acting switches.

The LaPointe Plascomold Corp., Windsor Locks, Conn., has pur-



New Location of Press Wireless

chased the Springville Mill in Rockville, Conn., which it will use to house Press Wireless Mfg. Co. Inc., also recently acquired.

Standard Coil Products Co. Inc. has acquired the Sherold Crystal Division of Espey Mfg. Co., for the manufacture of quartz crystals for the Armed Services and the electronics industry in general.

Westinghouse Electric Corp. recently leased two plants at Greenville, Pa. and Lima, Ohio, for the production of transformer cores. This production will release about 30,000 sq ft of space for the manufacture of distribution transformers in the Westinghouse transformer division's main plant at Sharon, Pa.

Norden Instruments, Inc. of Milford, Conn., manufacturers of precision instruments and aircraft bomb director systems, have announced a new facility now under construction which will provide

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Exclusives in the coming (Mid-June) electronics

BUYERS' GUIDE

include:

- a cumulative editorial index to ELECTRONICS, 1940-1949 inclusive
- extensive trade name listings
- geographical listings of distributors
- simple telephone book type product listings

"Just tell them they CAN'T AFFORD TO USE ANYTHING ELSE . . ."

That's Joe Gibbons speaking. We were talking about how to make people realize what a terrific thing this new

JELLIFF ALLOY 1000 RESISTANCE WIRE

really is, and that's the way he summed it up. And even when you make allowances for a salesman's natural enthusiasm, he's pretty near right. Just look at some of the important data:

DIPPING BASKETS • LEKTROMESH • RESISTANCE WIRE • FILTERS • STRAINERS • WIRE CLOTH • WIRE MESH PARTS

THE C. O. JELLIFF MANUFACTURING CORPORATION SOUTHPORT, CONN.

WIRE PRODUCTS Jelliff SINCE-1880

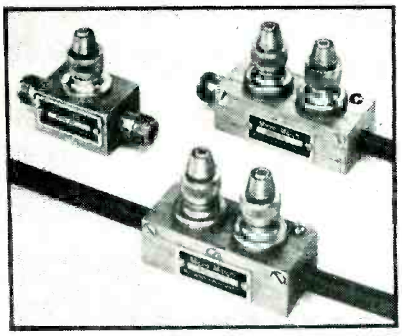
★

Resistivity 1000 ohms/cmf
Tensile strength 165,000 psi—
TC of Resistance 20 ppm—
Coefficient of Expansion 13.9 ppm—
Corrosion Resistance equal to the best nickel-chromiums—
Winds fast and solders easily—
Lots more ohms in lots less space.

See what we mean? For the whole story, write for Bulletin 17.

MONITOR RF POWER & VSWR

SMALL, LIGHTWEIGHT COUPLER CAN BE BUILT DIRECTLY INTO TRANSMITTERS



MicroMatch

MM 570 SERIES

4—1200 Watts 20—2000 MCS

This light, compact coupler unit, built into an RF transmission line, continually monitors RF power output, VSWR, and side tone. Monitoring these most important characteristics enables detection of trouble before it can become serious. Converts RF power into DC voltage which is read on indicator circuit meter.

SPECIFICATIONS

FREQUENCY RANGE—20 to 2000 MCS.
IMPEDANCE—51 ohms.
CONNECTORS—Supplied with RG-9A/U cable. N, HN, C, or UHF Type connectors either or both ends. Also available for RG-17/U cable.
POWER RANGES—May be set to provide full scale reading on the indicator for any power level from 4 watts to 1200 watts.
VSWR RANGES—Meter scale reads 0 to infinity. A VSWR of 3.0 corresponds to approximately half scale deflection.
INDICATOR CIRCUIT—Circuit diagram furnished.
METER CALIBRATION—All meter calibration data for both power and VSWR are supplied. Meter scales or meters will be supplied if desired.
ACCURACY—Plus or minus 5% of full scale for RF power. Plus or minus 10% for VSWR.
SIZE—Single coupler 1¾" l. x 1¼" w. x 2⅝" h. Double coupler 2-15/16" l. x 1¼" w. x 2⅝" h.
WEIGHT—Single coupler unit 6 ounces. Double coupler unit 8 ounces.
SIDE TONE MONITOR OUTPUT—AF output available for monitoring when used with an AM type transmitter.

MC Jones

M. C. JONES ELECTRONICS COMPANY
BRISTOL, CONNECTICUT

Distributed outside of Continental U.S.A. by RCA International Div., N.Y., N.Y., U.S.A.

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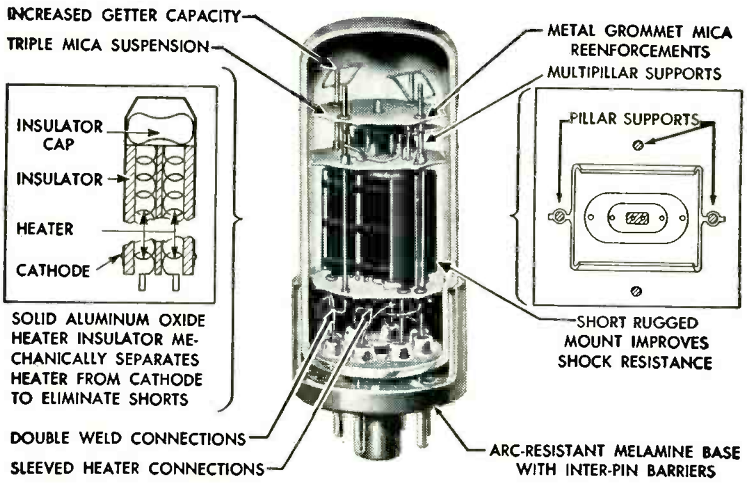
BEAM POWER AMPLIFIER

ANOTHER RELIABLE ELECTRON TUBE RUGGEDIZED BY

ECLIPSE-PIONEER



● We are not in the standard vacuum tube business, but we are in the business of developing and manufacturing a reliable line of special purpose electron tubes—tubes that will serve and meet the stiff and varied operational requirements of aviation, ordnance, marine and other fields of modern industry. Typical of these are receiving type tubes such as Full-Wave Rectifiers, R-F Pentodes, Twin Triodes, and the Beam Power Amplifiers illustrated above and described below. All of these tubes are exhausted on a special automatic exhausting machine capable of extra high evacuation, and are aged under full operating and vibration conditions for a period of 50 hours. In addition to the tubes described above, Eclipse-Pioneer also manufactures special purpose tubes in the following categories: gas-filled control tubes, Klystron tubes, spark gaps, temperature tubes and voltage regulator tubes.

LOOK FOR THE PIONEER MARK OF QUALITY
REG. U. S. PAT. OFF.

RATINGS

Heater voltage—(A-C or D-C)	6.3 volts
Heater current	0.6 amps
Plate voltage—(max.)	300 volts
Screen voltage—(max.)	275 volts
Plate dissipation—(max.)	10 watts
Screen dissipation—(max.)	2 watts
Max. heater-cathode voltage	300 volts
Max. grid resistance	0.1 megohms
Warm-up time	45 sec.

(Plate and heater voltage may be applied simultaneously)

TYPICAL OPERATION

Single-Tube, Class A_1 Amplifier

Plate voltage	250 volts
Screen voltage	250 volts
Grid voltage	−12.5 volts
Peak A-F grid voltage	12.5 volts
Zero signal plate current	45 ma
Max. signal plate current	47 ma
Zero signal screen current	4.5 ma
Max. signal screen current	7.0 ma
Plate resistance	45,000 ohms
Transconductance	4,000 μmhos
Load resistance	5,000 ohms
Total harmonic distortion	8%
Max. signal power output	4.0 watts

PHYSICAL CHARACTERISTICS

Base	Intermediate shell octal 8-pin
Bulb	T-9
Max. overall length	3¼ in.
Max. seated height	2⅝ in.

Other E-P precision components for servo mechanism and computing equipment:

Synchros • Servo motors and systems • rate generators • gyros • stabilization equipment • turbine power supplies and remote indicating-transmitting systems.

For detailed information, write to Dept. O

ECLIPSE-PIONEER DIVISION of Bendix

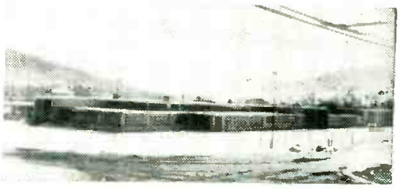
TETERBORO, NEW JERSEY AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

40,000 sq ft of additional manufacturing space.

The James Knights Co., Sandwich, Ill., announces acquisition of the Frequency Modulation Division of Doolittle Radio, Inc. The addition is to be known as the Electronics Products Division of the James Knights Co.

A new plant for the manufacture of fixed carbon composition resistors has been completed in Bradford, Pa., by the *Speer Resistor Corp.*, a subsidiary of Speer Carbon Co., St. Marys, Pa.



New Speer Resistor Plant

To supply the increasing needs of industrial, medical and educational users of radioisotope measuring instruments and biosynthesized radiochemicals, the *Nuclear Instrument & Chemical Corp.*, Chicago, Ill., recently enlarged its plant area 20 percent by acquiring additional space in their present building.

Two latest steps in the expansion program of *Victoreen Instrument Co.*, Cleveland, Ohio, are: (1) Taking over Pioneer Electronics Corp., Salem, Mass., as a wholly owned subsidiary; and (2) the acquisition of 23,000 sq ft of manufacturing space and 16 acres of property at New London, Ohio.

Consolidated Engineering Corp., Pasadena, Calif., has purchased the Monrovia Airport, a 35-acre tract in the nearby city of Monrovia, for future expansion of facilities.

Patterson, Moos & Co., Inc., research and development firm, has moved from Long Island City to larger quarters in Jamaica, N. Y., expanding its physical facilities by 100 percent.

The Birtcher Corp., Los Angeles, manufacturer of electromedical apparatus, recently opened a new 37,500-sq ft office-factory building.

Ultrasonic Corp. of Cambridge, Mass., recently announced acquisition of The Monitor Controller Co. of Braintree, Mass., manufacturer and distributor of motor control and switch gear equipment for industrial use.

development and production

METALLURGISTS

BASE, RARE AND PRECIOUS METALS AND ALLOYS

SMALL UNITS

SMALL SIZES

CLOSE TOLERANCES

Nickel alloy, filament wire and ribbon: flat, grooved, crowned.

Grid wire electroplated.

Alloys for special requirements, bare or enamelled.

•

Further details upon request.

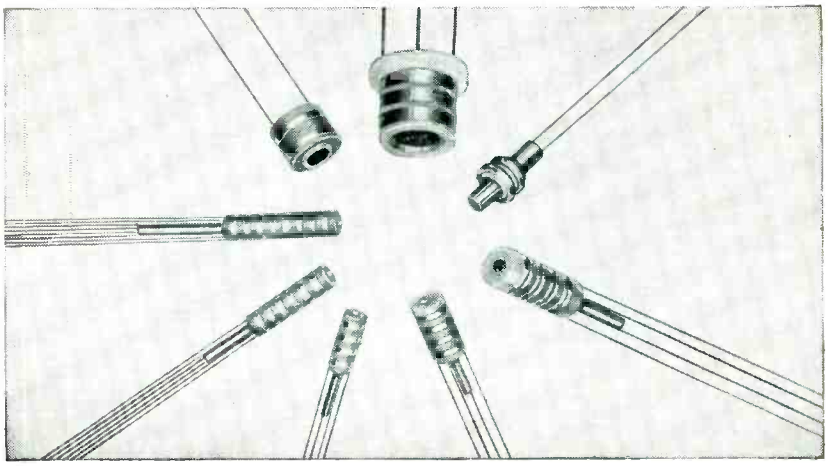
SECON

METALS CORPORATION
228 East 45th Street, New York 17, N. Y.
MUrray Hill 7-1594

MINIATURE SLIP RING ASSEMBLIES

AND COMMUTATORS

PRECISION MADE TO YOUR OWN SPECIFICATIONS



Our Swiss methods and techniques are geared to meet exacting requirements. We invite your inquiries.

COLLECTRON CORPORATION
216 EAST 45th STREET • NEW YORK 17, N. Y.
MUrray Hill 2-8473

PICKERING *solenoids*

for DC Circuits

Pickering engineering service is available for special applications where Pickering standard Solenoids do not apply.

PICKERING & CO., Inc.

Manufacturers of world-famous electro-magnetic phonograph cartridges and audio equipment.
Oceanside, L. I., New York

For details and literature address Department N

Its control is anybody's job. But when it involves an intricate problem, the concern that may be depended upon to correctly solve it is the **A. W. Haydon Company**

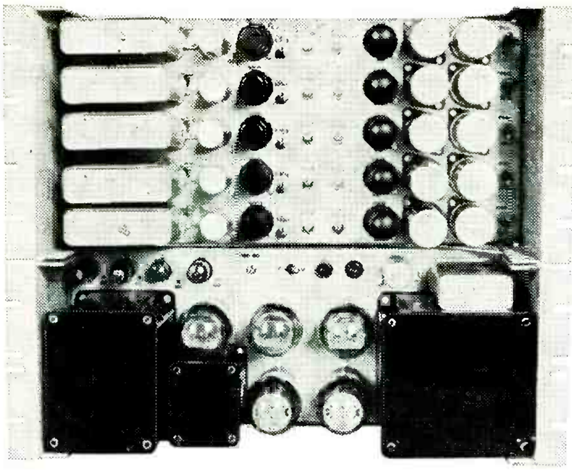
Thoroughly experienced timing engineers assure prompt, accurate solutions to the most difficult of proposed applications.

WRITE FOR CATALOG

The **A. W. HAYDON COMPANY**
235 NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electrical Timing Devices

VIDEO DISTRIBUTION AMPLIFIER

TYPE 1311



TYPE 1311 Video Distribution Amplifier is specifically designed to distribute video or synchronizing signals to several outlets. Thus, five separate equipments can be fed from a single synchronizing signal generator and monoscope combination.

The high degree of isolation between each output and each input circuit prevents interaction, even in the event of a short circuit at any one of the output lines.

Type 1311 is also commonly used to distribute picture signals from TV studios to a number of different locations.

SPECIFICATIONS

INPUT IMPEDANCE:	High impedance, for bridging 75 ohm coaxial lines.
OUTPUT IMPEDANCE:	To match 75 ohm lines.
INPUT VOLTAGE:	2 Volts peak to peak.
VOLTAGE GAIN EACH CHANNEL:	Adjustable from 0.9 to 1.1.
OUTPUT POLARITY:	Same as, or opposite of, input polarity, selectable by toggle switch.
NUMBER OF CHANNELS:	5 separate channels.
FREQUENCY RESPONSE:	Pass 60 cycle square wave undistorted. No overshoot on 100 KC square wave Down 3 DB @ 11 MC. Down 6 DB @ 13 MC.
CONNECTORS:	Both the input and output circuits use PL-259 coaxial line connectors which are not supplied.
POWER SUPPLY:	105-125 Volts, 60 cycle, single phase, 250 watts.
FINISH:	Natural sandblasted aluminum.
WEIGHT:	Amplifier: 17 lbs. net. Power Supply: 35 lbs. net.
PRICE:	$550.00 F.O.B. Plant (including power supply as illustrated).

Complete specifications available on request.

ELECTRONIC DEVELOPMENT, ENGINEERING and PRODUCTION:

Our reputation for producing top quality precision electronic equipment qualifies us as a reliable and capable subcontractor for manufacturers currently holding primary defense orders. Inquiries will be given our immediate attention.

Manufacturers of a complete line of TV and Radar Test Equipment

TIC Tel-Instrument Co. Inc.

50 PATERSON AVENUE • EAST RUTHERFORD, N. J.

NEW BOOKS

Television Engineering

BY DONALD G. FINK, *Editor, Electronics. McGraw-Hill Book Co., New York, N. Y., 1952, 721 pages, $8.50.*

THIS book fills the need for an up-to-date comprehensive treatment of television broadcasting in the United States.

It is only twelve years since the first edition of this book was published and yet in this short span of time television broadcasting has grown from an experimental venture to an important public service reaching into millions of homes. It is not surprising, therefore, that this book is really not a second edition, but rather a new volume completely rewritten and greatly enlarged to cover the many advances which have taken place in the last decade, in theory as well as in equipment and system design.

The presentation of the material starts with a discussion of the fundamental principles involved in the electrical transmission of visual information and in the analysis and synthesis of images. The following chapters deal with cameras and picture tubes, synchronizing and scanning methods and equipment, video amplification, and video and carrier transmission of the signal. The final two chapters describe in detail typical circuits and operations of modern television broadcasting equipment and television receiving equipment. A working knowledge of radio and communications engineering principles is assumed, but the book is written in a clear style, easy to read, and avoids any complicated mathematical treatment. Each chapter is followed by a series of exercises and answers. A very valuable addition is the inclusion of extensive bibliographical references to current periodical publications at the end of each chapter. A total of 425 such references is included.

The new material in the book includes two chapters on color principles and color television systems. The status of color television today is about that of monochrome television at the time of the first edition, namely, almost ready for commercial broadcasting. It is

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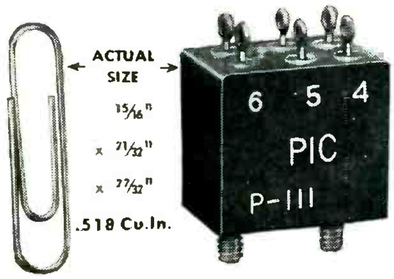
New!

PIC* Ferrite Pulse Transformer



Fits in Half the Space!

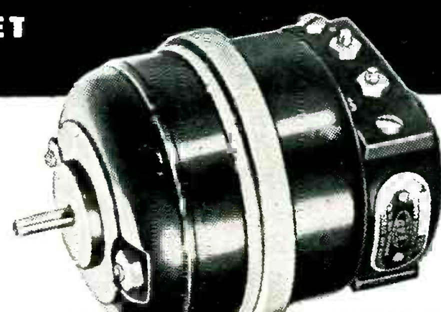
Features: Shorter Rise Time
MIL-T-27 or Commercial
Wider Frequency Response
Complete Interchangeability
with Conventional Transformers

Other Ferrite transformers designed to your circuits or specifications

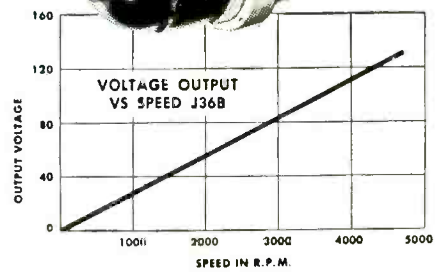
***POLYPHASE**
INSTRUMENT COMPANY
765 Lancaster Ave.
BRYN MAWR, PA.

DC VOLTAGE GENERATOR

PERMANENT MAGNET
AIR STABILIZED



- Output voltage linear with speed to within +1%—Extremely low ripple.
- Continuous duty.
- Moisture and fungus proof to meet military specifications.
- Designed for horizontal or vertical mounting.
- Vacuum impregnated windings.
- Ball bearing.



PERFORMANCE CHARACTERISTICS

DC volts per RPM	0.02V or 0.025V
Internal resistance	260 ohms +10%
Req. driving torque	0.8 oz./in. max.
Useful speed range	0—5,000 R.P.M.
Weight	20 ounces
Overall dim. J36B (as shown)	2-1/2" x 3-3/4"
J36	2-1/2" x 3-5/8"

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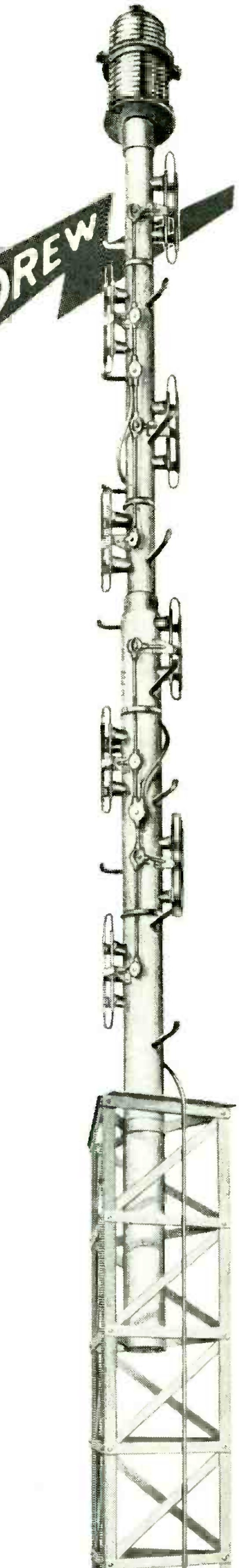

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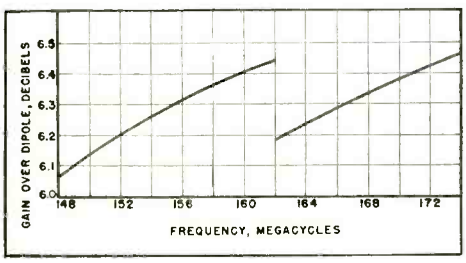

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therefore a field of rapid development and constant improvement.

The author gives a comprehensive description of the several systems proposed before the FFC at the recent hearing, including, of course, the CBS field sequential system adopted by the Commission for commercial broadcasting. He also gives an up-to-date description of the work presently under way in the National Television Systems Committee toward the formulation of standards for a future compatible type of color television system.

One small criticism might be leveled at this otherwise very excellent book. The quality of the half-tone reproductions of cathode-ray tube images is not always good enough to illustrate the points referred to. Such phenomena as ghosts, ringing or sound carrier interference are practically lost in the complicated process of transferring the original image to a half-tone cut. It would have been preferable if another method of reproduction had been used in such cases.

The previous edition of this book has been used extensively as a textbook in colleges and trade schools. There is no doubt that the present volume is even more suitable for this purpose. It will also serve as a very valuable reference book for the steadily growing number of engineers engaged in the field of television engineering.—A. G. JENSEN, *Bell Telephone Laboratories, Inc., Murray Hill, New Jersey.*

Risks and Rights

BY SAMUEL SPRING. *W. W. Norton & Co., Inc., New York, 1952, 385 pages, $7.50.*

THIS is an extraordinarily interesting book for anyone engaged in publishing, television, radio, motion pictures, advertising or the theater. The jacket says it is "the only complete book on privacy, slander, libel, copyright, and unfair competition for book, magazine, newspaper, and music publishers; television, radio, motion picture, and stage producers; literary, talent, and advertising agents; writers, composers, actors, and models."

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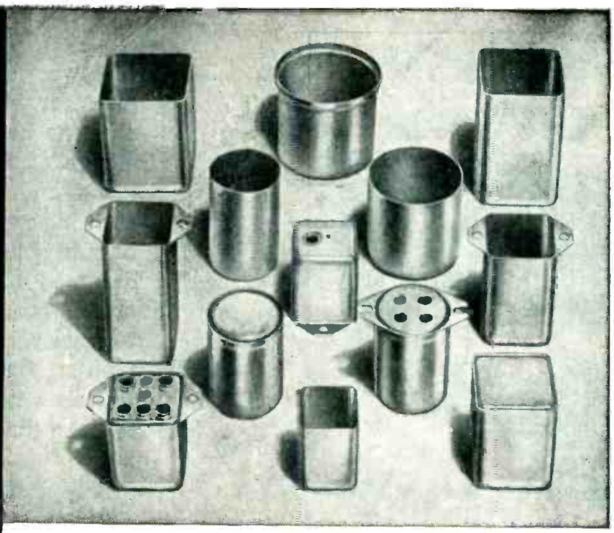

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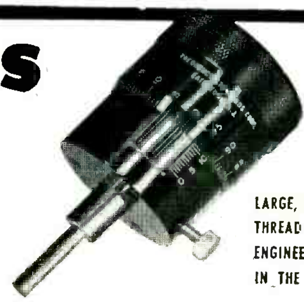

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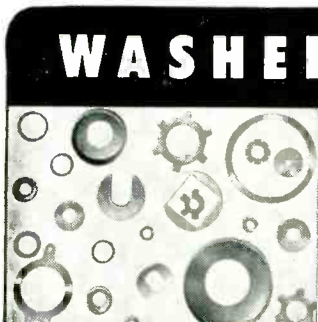

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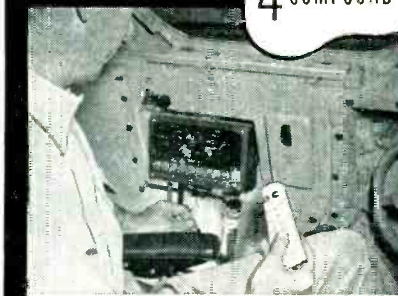
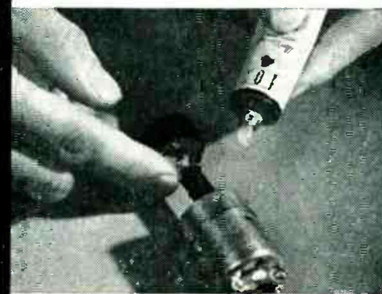
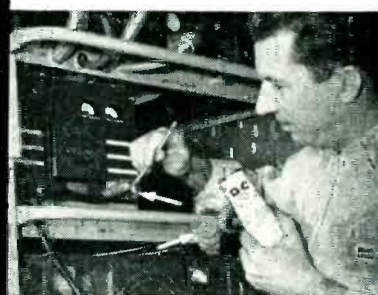


Dow Corning 4 applied by brushing to AN connector receptacle of pilot's "jack box" prevents interference caused by moisture at this critical junction in aircraft communications system.



Dow Corning 4 applied by brushing to AN connector on V. H. F. Transmitter/Receiver excludes moisture without appreciable change in resistance across properly mated pin and socket connections.



Arrows show where Dow Corning 4 is used on variable inductance rollers in a Collins-Western Electric V. H. F. Transmitter/Receiver to lubricate, minimize resistance and reduce leakage losses.

Photos courtesy Braniff International Airways.

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reviewer is astonished that, in all his years in the publishing business, he has neither been sued for all he is worth, nor, conversely, has found opportunity to get rich at the expense of someone who has invaded his privacy, or has defamed him by libel or slander, or has engaged in unfair competition with him or violated his copyrights. For the risks and rights for all who engage in any aspect of the publishing business are many.

The first part deals with privacy (the right to be let alone) as a fairly recent legal right. This is followed by two chapters on the subject of defamation, many chapters dealing with the problems and legalities of copyright, then a section on the expanding protection against unfair competition; finally some chapters on such important matters as the protection of commercial ideas, obscenity and censorship, protection of manuscripts and rights of authors, and the new problems brought up by television.

The book is distinctly readable by the layman for there are few technical terms and the situations cited are backed up by actual cases so that the reader can learn by example. It should be useful to lawyers, legislators, authors, entertainers—all who live by the written or pictured word, by musical composition or reproduction, by list compilation, advertising—or by any artistic endeavor. It is highly recommended.—K.H.

Communication Networks and Lines

By Walter J. Creamer. *Harper and Brothers, New York, 1951, 353 pages, $6.00.*

Designed as a basic text for engineering students in the communications option on an upper level, this book gives a thorough treatment of networks and lines. The first eleven chapters deal entirely with networks and the remaining eight chapters deal with cables and open-wire lines.

The author assumes the reader to have a general knowledge of elementary hyperbolic function theory as well as telephone apparatus and systems. Numerous sample prob-

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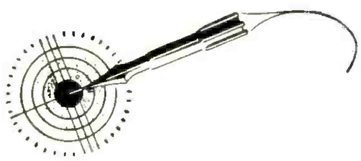

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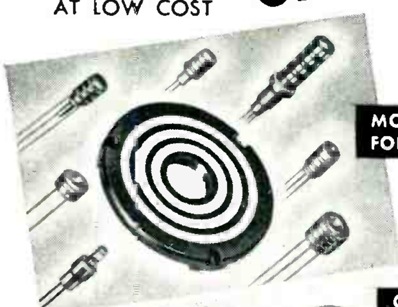

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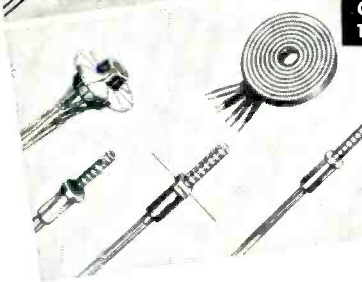

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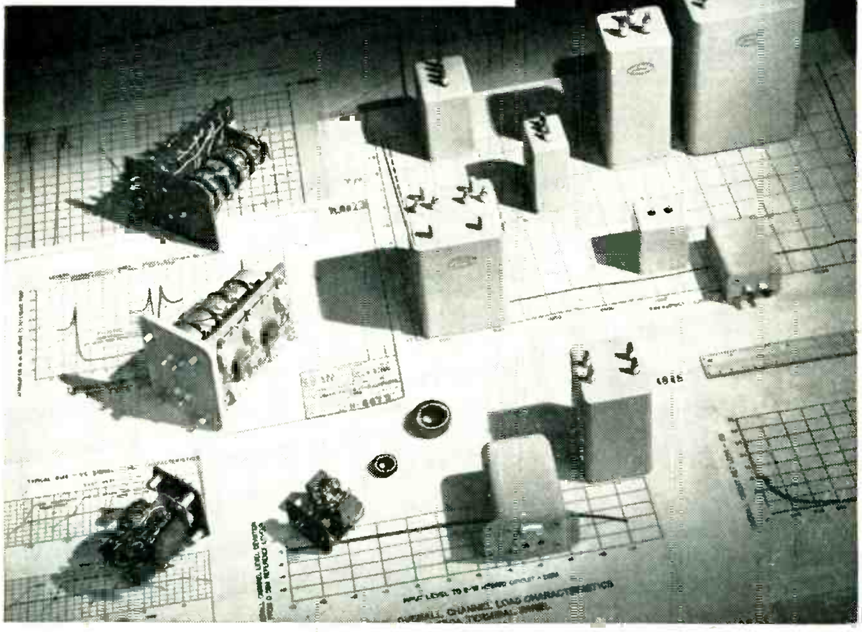

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lems are incorporated in the text and worked out completely. Problems to be worked by the student are included at the end of each chapter but no answers are included, thus making it difficult for the student who must study without the aid of an instructor.

Subject content of the book includes network analysis; problems in the design of filters, attenuators and equalizers; network synthesis; cables; open-wire circuits at audio and carrier frequencies and the high-frequency lossless line.

The book should prove valuable as a reference book for engineers in the field, as it brings together in one volume material of the type found scattered throughout various texts on the subject.

All the necessary supplementary materials, including tables of hyperbolic functions, characteristics of transmission lines, formulas and charts are found in the eight appendices to the text.—R.K.J.

High Frequency Transmission Lines

BY WILLIS JACKSON. *Methuen's Monographs on Physical Subjects, John Wiley and Sons, Inc., New York,* 1951, 152 *pages,* 75¢.

THIS BOOK is the third unrevised printing of the original volume first published in 1945, containing several concise but lucid chapters on basic transmission line theory, and a brief discussion of some common applications of transmission lines. It incorporates little material that cannot be found in other texts, and in scope falls somewhere between a theoretical treatise, and a handbook.

After a cursory description of several common applications of transmission lines at high frequencies, the author continues with a clear formulation of the basic transmission line equations for TEM mode propagation, and discusses the limitations to which this approximate theory is subject at high frequencies. The propagation characteristics of lines are then discussed, and equations for computing the various parameters of coaxial and two-wire lines are given. The significance of the phase and attenuation constants is discussed, and

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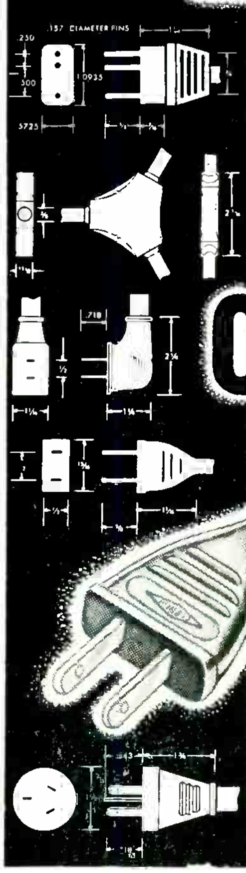

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equations for calculating them are included, as well as a discussion of optimum coaxial line dimensions for minimum attenuation and maximum transmissible power. The temperature rise in solid dielectric lines due to power transmission is examined briefly.

The behavior of terminated lines is treated, with a discussion of the concepts of reflection coefficient and VSWR. Resonant lines are discussed, along with equations for calculating input impedance and Q values. The use of resonant lines to form filters and to measure the characteristic impedance of a line is described. The book concludes with a chapter on impedance transformations, with a development of the necessary equations required to produce a Smith chart. The determination of propagation constants of a line by the use of such a chart is discussed, as well as the positioning of stub lines for matching purposes.—J. C. GREENE, *Engineer, Radar Section, Airborne Instruments Laboratory.*

THUMBNAIL REVIEWS

EXERCISES de RADIOELECTRICITE. By S. Albagli. Gauthier-Villars, 55 Quai des Grands-Augustins, Paris 6, France. 72 pages, $1.80, 1952. A collection (in French) of problems and solutions relating to lines, antennas and hyperfrequencies. The problems are practical and range from the use of a line to measure impedance to a problem in metallic-lens antennas.

REFERENCE TABLES FOR THERMOCOUPLES. By Shenker, Lauritzen, Jr., and Corruccini, National Bureau of Standards. Circular No. 508, May 7, 1951, 71 pages, 35¢, Superintendent of Documents, U. S. Government Printing Office. Millivolts versus temperature for common commercial thermocouples; the tables incorporating recent changes in electrical units and temperature.

TRANSMITTING VALVES. By J. P. Heyboer and P. Zijlstra. Philips, Holland. Elsevier Press Inc., Houston 6, Texas. 284 pages $6.25, 1951. Book VII in Philips' Technical Library dealing entirely with transmitting pentodes, tetrodes and triodes as amplifiers, oscillators, and frequency changers.

HOW TO PASS LICENSE EXAMINATIONS, 3rd edition. By Charles E. Drew. John Wiley & Sons, Inc., New York. 366 pages, paperbound, $4.50, 1952. Elements 1 through 6; questions and answers to enable the reader to determine if he has sufficient knowledge to pass the commercial operator examinations. Elements 7 and 8 dealing with aircraft radiotelegraph, and repair and maintenance of radar apparatus are not included.

FUNDAMENTALS OF ELECTRONICS AND CONTROL. By Milton G. Young and Harry S. Bueche, University of Delaware. Harper & Brothers, New York, 525 pages, $6.00. 1952. A basic text designed for electrical and non-electrical engineering students, and of practical value to practicing engineers.

PRACTICAL INDUSTRIAL ELECTRONICS. By F. A. Annett, Associate editor, *Power*. McGraw-Hill, 381 pages, $5.50, 1952. How industrial electronics devices work; a compilation of a series of articles from *Power*, in the plainest sort of language for the non-electronic man.

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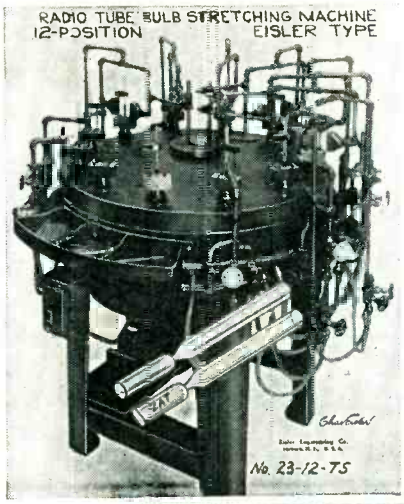

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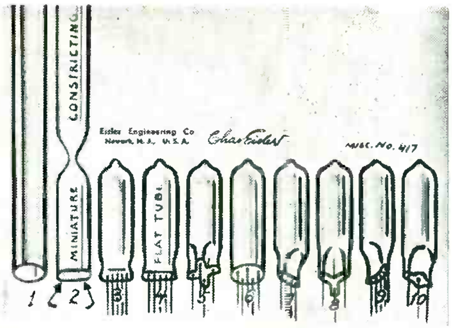

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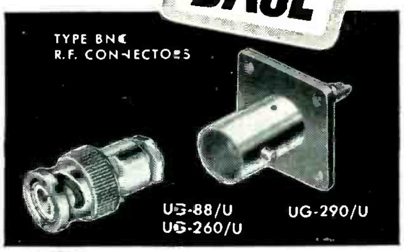

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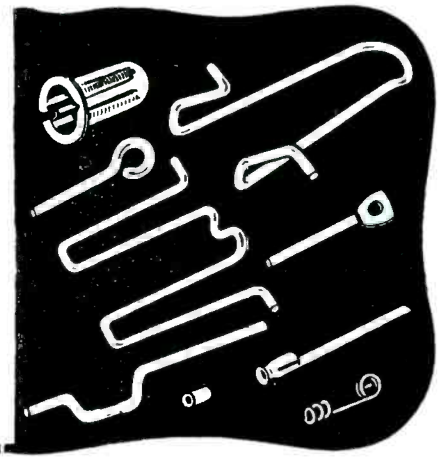

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BACKTALK

Faith

DEAR SIRS:

IN YOUR *Crosstalk* column of the January issue of ELECTRONICS you certainly hit the nail on the head with your story on Faith.

In many cases of industrial applications of electronics the prospective, and somewhat skeptical, user not only expects that the electronic device shall be accurate, sensitive, fully automatic and preferably of superhuman intelligence, but he also expects that the same said electronic device shall be able to undergo unlimited abuse without damage. The same man who would exercise great care in the handling of a 200-dollar mechanical equipment will many times not give proper care to a $10,000 electronic installation. The chances are he will sometimes encourage the boys to swing a hammer at it to find out whether the suspicious device is able to take it.

Basically, we are all more attached to things which are familiar to us. Maybe the time will come when electronic devices in industry will be familiar enough to operators to induce them toward a more sympathetic attitude. At that time they will be surprised what electronics can really do for them.

EUGENE MITTELMANN
Consulting Engineer
Chicago, Illinois

Zero Impedance

DEAR SIRS:

REFERENCE is made to the article "Zero Impedance Power Supply Termination", ELECTRONICS, p 240, Aug. 1951, by Professor Jordan J. Baruch. The article incorrectly claims that a conventional power supply circuit (Fig. 1 of original article, reproduced below) has the

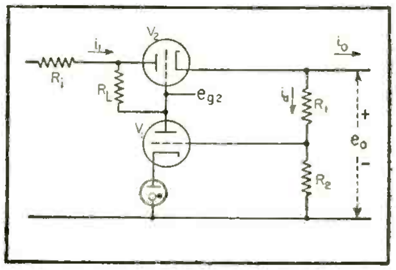

FIG. 1—Original circuit shown by Baruch in Aug. 1951 Article

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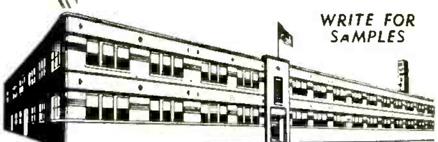

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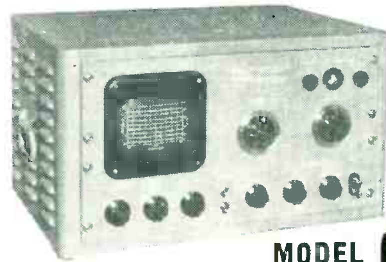

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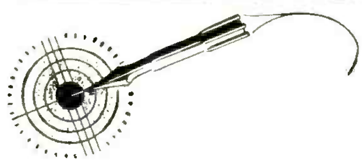

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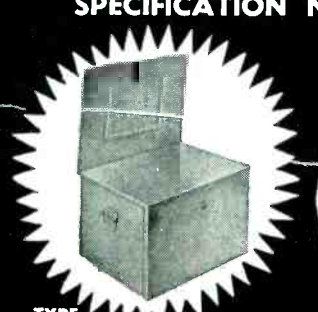

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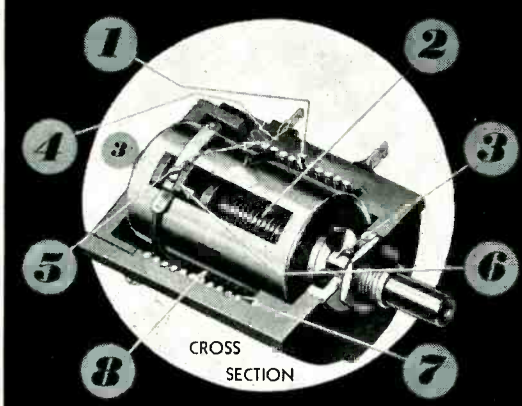

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remarkable feature of negative inner resistance! This letter will disprove the mathematical analysis given, and associated claims such as: (A) "... for the zero-impedance condition, the amplifier tube V_1 should be operated in the region of negative resistance."; (B) that magically, for this reason, the entire power supply appears with negative resistance; (C) "... the negative resistance characteristic required of V_1 can often be obtained through the suitable use of a pentode such as the 6SJ7" (Fig. 2 of the original article).

A rigid analysis, in which the network theory is based on clearly formulated definitions and a simple and correct sign concept, both noticeably missing in the original paper, proves that: (a) there is no such thing as a region of negative plate resistance for V_1—the plate resistance being positive and a constant; (b) the conclusion in A above is erroneous, thus the conclusion in B is erroneous, the loose handling of signs and circuit theory finally leading the author to the wrong sign on the inner impedance; (c) one basic principle in electronics has been mistaken for another, for the mathematical analysis of the circuit in Fig. 1 does not apply to the pentode in Fig. 2 or vice versa.[1]

On one hand Dr. Baruch's derivation equates transconductance and dynamic transconductance, although the Barkhausen formula in the latter case[2] is $\mu = (r_p + R_i)g_{md}$, not $\mu = r_p g_m$. On the other hand, rigorous treatment of details leads Dr. Baruch to the false conclusion that extension of the analysis to the potential divider $R_L r_{p1}$ suddenly introduces a 180-degree phase shift.

To clarify this point we will use the simplifying notation $n = r_{p1}/(r_{p1} + R_L)$, $k = R_2/(R_1 + R_2)$, and $A = -\mu_1 R_L/(r_{p1} + R_L)$, where n and k represent voltage divisions, and A represents the voltage gain in V_1 when its output voltage is counted positive upwards. If $+e_o$ sends a current $+i_o$ into the power supply, the approximate output impedance should become

$$Z_o = \frac{R_i(\mu_2 n + 1) + r_{p2}}{\mu_2(kA + 1) + 1} \longrightarrow 0; \quad (1)$$

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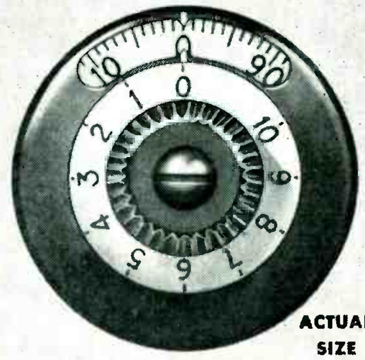

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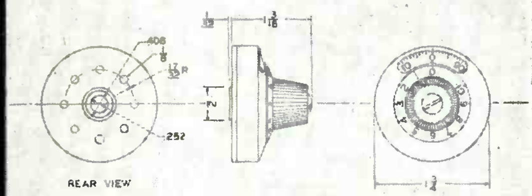

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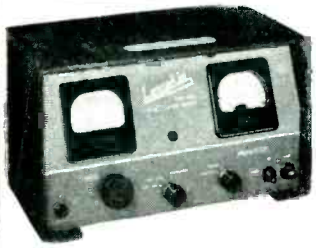

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neglecting the influence of $R_i i_o$ on the grid of V_2 ($n = 0$), and temporarily allowing $\mu_2 >> 1$, we obtain

$$Z_o \doteq \frac{R_i + r_{p2}}{\mu_2 (kA + 1)} \longrightarrow 0 \qquad (2)$$

The arrows above indicate that we are interested in conditions under which Z_o goes to zero. One such condition is from Eq. 2 where $r_{p2} = -R_i$. This does not mean that the circuit is able to produce zero inner impedance this way. It only means that if some other circuit existed, which Eq. 2 described, and $r_{p2} = -R_i$. This does not mean that circuit could be made negative, the desired condition of $Z_o = 0$ would obtain. Thus this solution is purely academic. The same reasoning applies to the more complete Eq. 1, including the potential divider $R_L r_{p1}$. In setting the numerator of Eq. 1 equal to zero, Dr. Baruch's derivation fails, however, to draw the above stated logical conclusion, and for some reason proceeds to solve for r_{p1} instead of r_{p2}, obtaining

$$r_{p1} = -R_L/(1 + R_i g_{m2}) \qquad (3)$$

and stating, erroneously, that the minus sign means that the plate resistance r_{p1} is negative and, mysteriously, that the entire power supply from now on has negative resistance.

Since the circuit in Fig. 1 has no means for making either r_{p1} or r_{p2} negative, no conclusion whatsoever that the power supply has negative resistance can be correctly drawn from Eq. 3, which in the original paper is Eq. 6.

To avoid the dead-end Dr. Baruch's analysis leads us to, let us re-examine Eq. 1 and Eq. 2, and instead of letting the numerator go to zero, have the denominator go to infinity. The desired limit is now simply expressed as $kA = \infty$, and there are no confusing negative resistances involved anywhere. For a given k the condition for $Z_o = 0$ is $A = \infty$, which is impossible. Therefore, Z_o can never become zero; nor can the inner resisance ever become negative.

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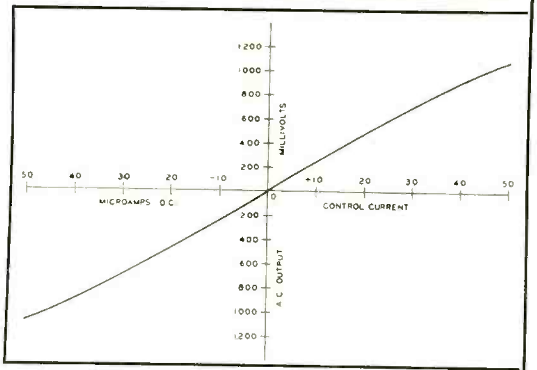

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approximately equal to $1/kAg_{m2}$, which may be a fraction of an ohm but, as seen, always positive. Baruch's equally erroneous second derivation of Eq. 1 brings up the fact that V_2 may be interpreted as a negative resistance in series with R_i. The correct value is, however, $r_- = R_i - Z_o$ with the net resistance $(R_i - r_-)$ always positive.

The circuit actually may produce negative power supply resistance, not in accordance with the believed theory, but in accordance with the entirely different theory of double-control-grid injection, to the writer's knowledge first published by Hickman and Hunt, Harvard University, in 1939.[1] Thus the screen-grid circuit contributed by Baruch is 12 years old. The feedback circuit phase shift caused by the particular screen-grid feed, tube V_2, is the true and logical reason, as explained in 1939, for the actual appearance of power supply negative resistance, not some sort of "Negative plate resistance" in the voltage control tube V_1.

DR. HARRY STOCKMAN
Waltham, Mass.

REFERENCES

(1) R. W. Hickman and F. V. Hunt, On Electronic Voltage Stabilizers, *Rev. Sci. Instr.*, **10**, Jan. 1939.
(2) H. Stockman, Signs of Voltages and Currents in Vacuum Tube Circuits, *Communications*, Feb. 1944.

Re-rebuttal

DEAR SIRS:

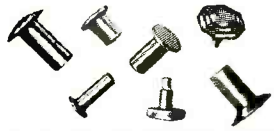
THIS might be titled "Re-rebuttal" for the "Cathode Follower Loudspeaker Coupling" discussion.[1,2,3]

May I call your attention to some remarks by Irving Langmuir in the current GE advertisement "What GE people are saying" and also to an article by H. B. Phillipps in the *Technology Review* for June 1948, as familiarity with at least one of these is germane to what follows.

It is very comforting to know that one lives in a society which, at least electronically speaking, permits such wild excursions as that of the subject article, for this is clearly what pays off. What both Messrs. Langmuir and Phillipps failed to point out, presumable because it is so self evident, is that individual freedom is only a good idea if or when there is available

CONTACTS
FOR THE FIELD OF ELECTRONICS

GRC



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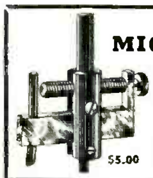

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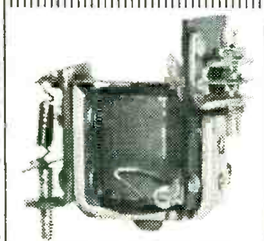

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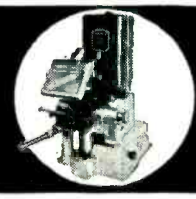

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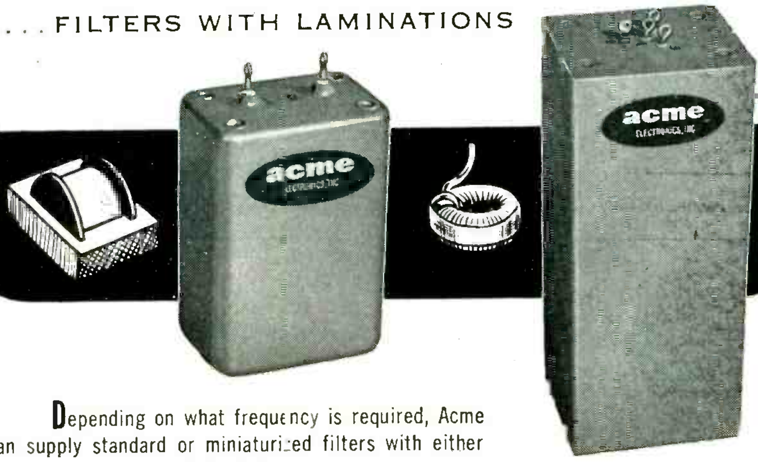

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means for determining which wild excursion was wise and which turned out to be a waste of time and money.

Can't we somehow keep this subject warm long enough to forget about trying to prove that a $782 cathode follower is better than a $15 transformer and try to steer some of this energy into loudspeaker design. Something truly revolutionary might easily alter the whole course of radio, f-m, tv and electronics. For the better, I might add.

BENJAMIN B. DRISKO
Hingham, Massachusetts

P. S. If the authors of the subject article will pick up the sound emitted by their plaything when it is held "at a half inch displacement with a suitable d-c signal"[1] with a microphone whose frequency response is flat from 0 to 20,000 cps and examine its output they may get some clues as to why the subjectively heard sounds depart noticeably from those of the instrument being reproduced.

REFERENCES

(1) E. W. Fletcher and S. F. Cooke, Cathode-Follower Loudspeaker Coupling, ELECTRONICS, p 118, Nov. 1951.
(2) William L. Hatton and Robert A. Rapuano, How High The Fidelity, ELECTRONICS, *Backtalk*, p 18, Mar. 1952
(3) Ewan W. Fletcher and Stuart P. Cooke, Authors' Rebuttal, ELECTRONICS, *Backtalk*, p 420, Mar. 1952.

(Editor's Note: We gratefully accept Mr. Drisko's suggestion for titling his letter. We have received a number of letters regarding the cathode-follower loudspeaker coupling article and the discussion printed in Backtalk pertaining to it. Judging by this voluntary display of interest, we feel safe in assuring Mr. Drisko that the subject will be kept warm—if not, sizzling—by the readers of ELECTRONICS. At present, the audio boys seem to have the lead with their endorsements of Fletcher and Cooke's work.)

Hah!

DEAR SIRS:

THE VOLTMETER circuit described by M. G. Scroggie (ELECTRONICS, Dec. 1951, p 142) is an exceedingly good one. In view of the following facts: (1) I published a description of a similar circuit in ELECTRONICS in April 1951 (p 181), (2) Mr. Scroggie failed to reference that article, and (3) *Wireless World* has printed more than one adverse criticism of U. S. writers for failing to reference British publications, I wish to make the following remark: Hah!

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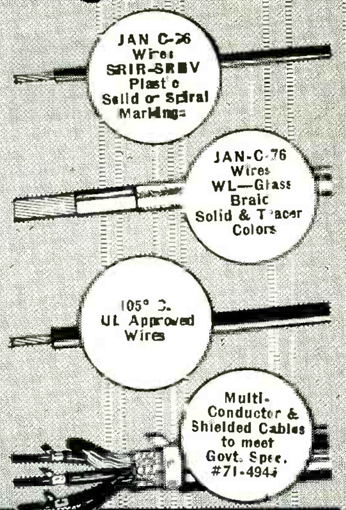

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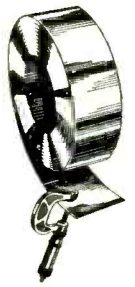

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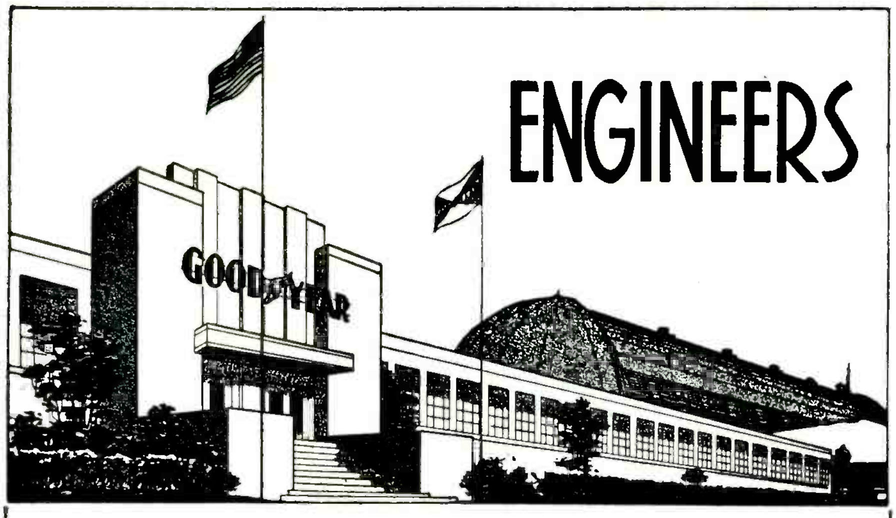

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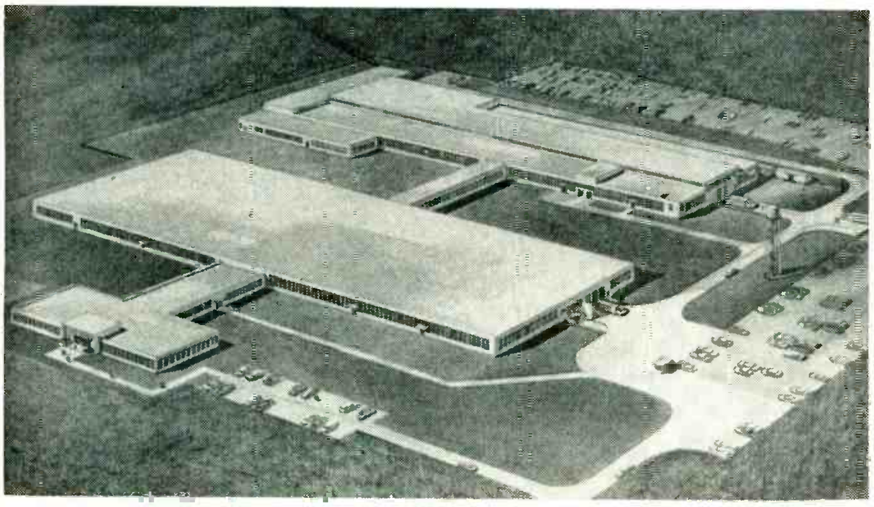

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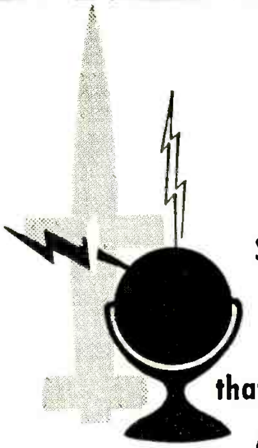

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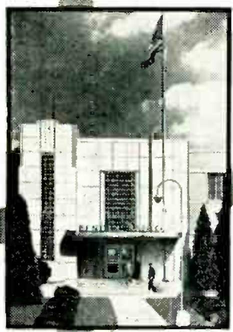

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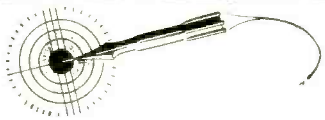

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1	600	.55	1	3000	3.40
2	600	.69	2	3000	4.50
2	600R'd	.69	.03	4000	1.25
2-2	600R'd	1.65	3 x .2	4000	2.95
3	600	.95	2	4000	6.95
4	600	1.65	.1	5000	1.60
4	600R'd	1.65	.2	5000	2.50
5	600	1.75	1	5000	4.88
6	600	1.85	2	5000	18.50
8	600R'd	1.85	.01-.03	6000	1.65
8-8	600	1.95	.1	7000R'd	1.79
4-4-4	600	2.50	.1	7500	2.85
4 x 3	600	2.50	.1-.1	7500	5.95
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1	1200	.85	.045	16KV	4.70
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.5	1500	1.25	.25	20KV	19.95
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UG-21B/U	1.35	UG-88/U	1.35	UG-206/U	1.80
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RG-10/U	240.00	RG-35/U	900.00
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1N22	1.09	1N34	.79	1N42	18.75
1N23	1.95	1N34A	.95	1N45	.94
1N23A	3.25	1N38	1.70	1N52	1.05
				1N55	3.15

TYPE "J" POTENTIOMETERS

Resis.	Shaft	Resis.	Shaft	Resis.	Shaft
60	SS	5K	1/4"	50K	3/8"
60	9/16"	5K	3/8"	50K	1/2"
100	SS	5K	1/2"	100K	SS
200	SS	10K	SS	150K	1/2"
250	1/8"	10K	3/8"	200K	3/8"
500	SS	10K	1/2"	250K	SS
500	5/16"	15K	SS	250K	3/4"
500	1/2"	15K	1/2"	250K	3/8"
500	5/8"	20K	SS	500K	SS
650	1/2"	25K	SS	500K	1/4"
1K1	SS	25K	1/4"	500K	7/16"
2K	3/8"	30K	1 1/8"	1 Meg	SS
2500	SS	40K	SS	2.5 Meg	SS
4K	SS	50K	SS	5 Meg	SS
5K	SS	50K	1/4"		

DUAL "JJ" POTENTIOMETERS

50	SS	500	SS	1 Meg	SS
100	SS	1K	SS	2.5 Meg	SS
250	SS	2500	SS	5 Meg	SS
330	SS	10K	SS	1K/25K	3/8"

TRIPLE JJJ POTENTIOMETERS

100K/100K/100K—3/8"   20K/150K/15K—3/8"

SOUND POWERED TELEPHONES

U. S. NAVY TYPE M HEAD AND CHEST SETS
U.S.I. A-260   W.E. D-173013
A.E. GL832BAO
ANY TYPE—$14.88 EACH
TS-10 Type Handsets ....$8.92 ea.

GENERATORS AND INVERTERS

Eclipse-Pioneer type 716-3A (Navy Model NEA-3A) Output-AC 115V 10.4A 800 to 1400cy. 1φ; DC 30 Volts 60 Amps. Brand new $38.50
Eclipse-Pioneer type 1235-1A. Output-30 Volts DC 15 Amps. Brand New-Original Packing.....$15.50
PE-218 Inverters-28 VDC to 115 VAC 400 cy 1500 VA. (New) $49.50
G. E. 5D21NJ3A Inverter-24 VDC to 115 VAC 400 cy 485 VA (New) $32.50
Pioneer Type 800-1B Inverter-28VDC to 120V 800 cy 7 amp AC (used) $22.65
G. E. Inverter-28 VDC to 120 VAC 800 cy 750 VA 1φ $39.50
ATR Inverter 6VDC to 110 VAC 60 cy 75W....$22.95
PU-7/AP Inverter-28 VDC to 115 VAC 400 cy 2500 VA (used) $75.00
Eclipse-Pioneer type 12121A Inverter—Voltage and frequency regulated—24VDC 18 Amp Input—AC output 115V 3φ 400 cy 250VA 0.7 PF — (New) $225.00

TEST EQUIPMENT

- Gen. Radio 475B Frequency Monitor *$200.00
- Gen. Radio 681A Freq. Deviation Meter....*$87.50
- I-222A Signal Generator *$79.50
- I-72K Signal Generator $48.50
- C-D Quietone Filter Type IF-16 110/220V AC/DC 20 Amps. *$9.00
- TS-143/CPN Oscilloscope *95.00
- Dumont 175A Oscilloscope *$225.00
- Gen. Radio 757-P1 Power Supply..........*$27.00
- I-130A Signal Generator *$85.00
- A.W. Barber Labs. VM-25 VTVM..........*$86.00
- TS-10A/APN Delay Line Test Set..........$45.00
- TS-19/APQ-5 Calibrator $75.00
- CW1-60AAG Range Calibrator for ASB, ASE, ASV and ASVC Radars $39.95
- CRV-14AAS Phantom Antenna for Transmitters up to 400 MC..........$11.75
- 3 CM Pickup Horn Antenna AT-48/UP.....$9.95
- I-138A Signal Generator—10 cm..........*$185.00
- BC-221 Frequency meter *$95.00
- BC-221 Freq. Meter (late models)..........*$125.00
- Weston Model 1 D.C. Milliameter 150/1500 MA with leather case..........$75.00

All items New Except Where noted * (Exc. Used Condition.

MISCELLANEOUS EQUIPMENT

I-82F Selsyn Indicator $6.95
SCR-515 compl. w/dynamotor, control box.... 69.50
Amperex 1B98 Gamma Counter.......... 9.87
Powerstat 1226—115/230V Input—0-270V out @ 9 amp. 37.00
EIMAC 35T Ionization Gauge.......... 5.95
R-7/APS-2 Receiver 49.50
R-78/APS-15 Receiver 49.50
FL-8 1020 cycle filter.......... 2.95
RM-29 remote control unit.......... 8.95
RM-14 remote control unit.......... 8.95
RTA-1B 12/24 V dynamotor.......... 40.00
BC-1206-CM2 Receiver 12.95
ASB-4 Radar equip. Complete.......... 69.75
RCA AVR-15 Beacon Recvr.......... 18.50
Navy SD-3 Radar complete..........1200.00
Navy DP-14 Direction Finder complete...... 385.00

PULSE TRANSFORMERS

UTAH 9262 9278 9280   UTAH 9318 9340 9350

G.E. 68G-627	Westinghouse 232-AW2
G.E. 68G828	Westinghouse 232-BW-2
G.E. 68G929G1	AN/APN-4 Block Osc.
G.E. 80G13	Philco 352-7149
G.E. K-2469A	Philco 352-7150
G.E. K-2744B	Philco 352-7071
AN/APN-9 (901756-501)	Philco 352-7178
AN/APN-9 (901756-502)	Raytheon UX-7350
AN/APN-9 (352-7250)	W.E. D-161310
AN/APN-9 (352-7251)	W.E. D-163247
Westinghouse 132-AW	W.E. D-163325
Westinghouse 139DW2F	W.E. D-164661
Westinghouse 187AW2F	W.E. KS-9563

AN/APA-23 RECORDER

Sweeps any receiver through its tuning range and permanently records frequency and time of received signals on paper chart. Power input—(motor) 27V DC 1.5A, and (recorder) 80/115V AC 60-2600 cy 135W.

Originally designed to record pulse or sine-wave modulated signals received by AN-APR-1, AN/APR-2, AN-APR-4, AN/APR-5, BC-348, S-27, SX-28. BRAND NEW $147.50

SPRAGUE PULSE NETWORKS

7.5 E3-1-200-67P, 7.5 KV, "E" Circuit 1 Microsec. 200 PPS 67 ohms imped, 3 sections..........$4.30
7.5 E3-3-200-67P, 7.5 KV, "E" Circuit 3 Microsec. 200 PPS. 67 ohms imped, 3 sections..........$6.75
7.5 E4-16-60-67P, 7.5 KV, "E" Circuit 4 sections. 16 microsec. 60 PPS, 67 ohms Imped..........$8.25
15 E4-.91-400-50P. 15 KV. "E" Circuit .91 microsec. 400 PPS. 50 ohms imped. 4 sections..........$16.50
15-A-1-400-50P, 15 KV. "A" Circuit, 1 microsec. 400 PPS, 50 ohms imped..........$37.50

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST.   PHILA. 6, PA.

Telephones - MARKET 7-6771-2-3

www.americanradiohistory.com

GUARANTEED BRAND NEW

LECTRONIC RESEARCH

TUBE SPECIALS

STANDARD BRANDS ONLY

Receiving Tubes

OOA	$1.50
O1A	.67
OZ4	.74
OZ4A	.90
1A3	.71
1A5GT	.72
1A6	.72
1A7GT	.91
1AF5	.89
1B3GT	.99
1B4P	1.17
1C5GT	.85
1C6	.69
1C7G	.69
1D5GP	.69
1D7G	.69
1D8GT	.71
1F5GP	.71
1F4	.69
1F5G	.69
1F6	.71
1G4GT	.69
1G5G	.69
1G6GT	.69
1H4G	.89
1H5GT	.74
1H6G	.99
1H6GT	1.01
1J5G	.74
1J6G	.95
1L4	.69
1LA4	.87
1LA6	1.10
1LB4	1.01
1LC5	.81
1LC6	.93
1LD5	.93
1LF3	.93
1LH4	.82
1LN5	.91
1N5GT	.85
1N6G	.97
1P5GT	.69
1Q5GT	.99
1R4	.69
1R5	.89
1S4	.71
1S5	.81
1T4	.81
1T5GT	.71
1U4	.86
1U5	.81
1V	.69
1X2	1.09
2A3	1.28
2A5	.79
2A7	.89
2B7	.79
2F5	.94
2X2	.89
2X2A	1.85
3A4	.65
3A5	1.89
3A8GT	2.25
3B7	.57
3C6	1.15
3D6	.57
3LF4	.91
3Q4	.77
3Q5GT	.83
3S4	.77
3V4	.87
5AZ4	.69
5R4GY	1.59
5T4	1.91
5U4G	.69
5V4G	1.07
5W4	.82
5X4G	.87
5Y3GT	.59
5Y4G	.71
5Z3	.87
5Z4	1.11
6A4	1.35
6A6	1.17
6A7	1.05
6A8	1.08
6AB4	.99
6AB7	1.05
6AC5GT	1.19
6AC7	1.11
6AC7W	3.25
6AD6G	.98
6AD7G	1.31
6AE6G	.89
6AF6G	.89
6AG5	.87

6AG7	1.59
6AH6	1.39
6AJ5	2.50
6AK5	1.35
WE-6AK5	2.85
6AK5W	3.05
6AK6	.99
6AL5	.69
6AL5W	2.90
6AQ5	.89
6AQ6	.79
6AR5	.79
6AS5	.99
6AS6	3.30
6AS7G	4.53
6AT6	.63
6AU5GT	1.21
6AU6	.69
6AV6	.63
6B4G	1.60
6B5	1.20
6B7	.97
6B8	.99
6B8G	.85
6BA6	.72
6BA7	1.20
6BC5	.88
6BC7	1.10
6BD5GT	1.60
6BD6	.99
6BE6	.72
6BF5	1.10
6BF6	.83
6BG6G	1.92
6BH6	.99
6BJ6	.99
6BK7	1.60
6BL7GT	1.45
6BN6	1.59
6BQ6GT	1.26
6C4	.65
6C5	.75
6CB6	.89
6C6	.88
6C8G	.96
6CD6G	2.40
6D6	.88
6D8G	.83
6E5	1.10
6F5GT	.83
6F6	.99
6F6G	.99
6F7	.85
6F8G	.91
6G6G	1.06
6H6	.83
6H6GT	.83
6J5	.75
6J5G	.64
6J5GT	.64
6J6	1.09
6J7	.99
6J7GT	.79
6J8G	1.28
6K5GT	.99
6K6GT	.69
6K7	.83
6K7G	.88
6K8	1.22
6K8GT	.96
6L5G	1.06
6L6	1.87
6L6G	1.79
6L6GA	1.59
6L7	1.08
6L7G	.95
6N7	1.19
6N7GT	1.10
6P5GT	.96
6Q7	.99
6Q7G	.89
6R7	.99
6S4	.72
6S7	1.06
6S7G	.99
6SA7	.84
6SA7GT	.74
6SB7Y	1.05
6SC7	1.20
6SC7GT	1.05
6SD7GT	.94
6SF5	.83
6SF5GT	.80
6SF7	.69
6SG7	.91
6SH7	.89
6SH7GT	.89
6SJ7	.89
6SJ7GT	.89

6SK7	.89
6SK7GT	.89
6SL7GT	.96
6SN7GT	.89
6SN7WGT	2.30
6SQ7	.75
6SQ7GT	.75
6SR7	.81
6SS7	.99
6ST7	1.25
6T7G	1.09
6T8	1.11
6U5	1.19
6U7G	.88
6V6	1.60
6V6G	.89
6V6GT	.79
6W4GT	.72
6W6GT	.99
6X4	.59
6X5GT	.59
6Y6G	.89
6ZY5G	.89
7A4	.79
7A5	.88
7A6	.83
7A7	.83
7A8	.83
7AD7	1.44
7AH7	1.08
7B4	.83
7B5	.83
7B6	.83
7B7	.83
7B8	.89
7C4	.69
7C5	.83
7C7	.83
7E5	1.20
7F6	.58
7E7	.83
7F7	.99
7F8	1.59
7G7	1.32
7H7	.83
7J7	1.32
7K7	1.32
7L7	.97
7N7	.97
7Q7	.83
7R7	.94
7S7	1.11
7V7	1.11
7W7	1.11
7Y4	.73
7Z4	.89
10	.45
12A	.65
12A6	.71
12A6GT	.69
12A7	1.16
12A8GT	.77
12AH7GT	1.32
12AL5	.89
12AT6	.59
12AT7	1.15
12AU6	.79
12AU7	.95
12AV6	.63
12AW6	1.20
12AX7	1.08
12BA6	.72
12BA7	.95
12BD6	.99
12BE6	.70
12C8	.77
12F5GT	.79
12H6	.69
12J5GT	.69
12K8	.83
12Q7GT	.67
12SA7	.89
12SA7GT	.89
12SF5	.79
12SF5GT	.79
12SF7	.79
12SG7	.99
12SH7	.73
12SJ7	.79
12SJ7GT	.89
12SK7	.81
12SL7GT	1.03
12SN7GT	.99
12SQ7GT	.79
12SR7	.89
12SR7GT	.89
12X3	1.19
12Z3	.89
14A4	.97

14A7	.97
14B6	.93
14B8	1.09
14C5	1.29
14C7	1.15
14E6	1.09
14E7	1.29
14F7	.93
14H7	.93
14J7	.93
14N7	.93
14R7	.93
14W7	.93
14X7	.93
19	.89
19T8	1.16
22	1.16
24A	.79
25A6	1.16
25L6GT	.89
25Z5	.99
26	.79
27	.69
28D7	1.75
30	.72
30 Spec	.48
31	.62
32	.99
32L7GT	.87
33	.99
34	.99
35/51	.79
35A5	.89
35B5	.87
35L6GT	.81
35W4	.55
35Y4	.81
35Z4GT	.69
35Z5GT	.59
36	.69
37	.69
38	.69
39/44	.59
41	.71
42	.89
43	.89
45	.89
45Z5GT	.79
46	.81
47	.99
48	1.60
49	1.19
50	1.41
50A5	.91
50B5	.88
50C5	.88
50L6GT	.79
50Y6GT	.92
53	.95
55	.99
BK55B	.40
L55B	.32
56	.69
57	.89
58	.89
59	1.24
70L7GT	.91
71A	.79
75	.89
76	.69
77	.69
78	.79
79	.89
80	.65
81	1.41
82	1.19
83	1.11
83V	1.45
84/6Z4	.79
85	.79
89Y	.55
117L7GT	1.89
117P7GT	1.89
117Z3	.74
117Z6GT	.97
FM-1000	1.59

Cathode Ray Tubes

2AP1	$9.75
2AP5	9.75
3AP1	10.25
3AP4	10.25
3BP1	7.95
3CP1	2.25
3DP1	4.85
3DP1A	6.75
3EP1	4.95
3FP7	4.95
3FP7A	6.95
3GP1	4.95
3HP7	4.91
4AP10	4.75
5AP1	5.95
5AP4	4.75
5BP1	5.75
5BP4	5.75
5CP1	4.95
5CP7	9.50
5FP7	4.95
5HP1	5.75
5HP4	5.75
5JP1	26.50
5JP2	26.50
5JP4	26.50
5LP1	19.75
5LP5	19.75
5MP1	10.65
7BP1	8.75
7BP7	7.95
7BP12	14.95
7BP14	14.95
7CP1	14.95
9GP7	12.85
9LP7	9.95
10BP4	18.50
10FP4	24.50
12DP7	16.50
12GP7	16.50
12HP7	16.50
902P1	9.95
905	4.45

Photo Cells

1P23	$4.10
1P24	1.27
918	1.65
919	1.95
923	1.35
927	1.85
931A	6.95
1645	1.95

Thyratrons & Ignitrons

OA4G	$1.32
EL-C1A	4.75
2A4G	1.25
2B4	2.10
2C33	4.95
2D21	1.55
3C23	9.95
3C31/EL-C1B	3.95
3C45	17.50
4C35	28.75
EL-C5B	9.95
5C22	53.45
C6A	6.75
C6J	9.95
FG-17/5557	5.25
FG-33	17.50
FG-41	122.50
FG-67	14.80
FG-81A	4.95
91	7.85
FG-95/5560	25.00
FG-104/5561	24.60
FG-105	19.50
FG-166	95.00
FG-172	39.50
FG-178	14.50
RX-233A	4.95
FG-235A/5552	94.50
FG-271/5551	62.50
393A	8.60
394A	4.77
GL-415/5550	39.50
KU-610	12.50
KU-623	39.50
KU-628	22.25
KU-634	39.50
WL-652/5551	62.50
WL-654/659	82.00
WL-672	22.00
WL-677	39.50
WL-681/5550	39.50
722A	3.75
884	1.85
885	1.90
1665	1.80
1904	14.80
2050	1.80
2051	1.15
5545	32.50

Transmitting & Special Purpose Tubes

OA2	$1.30
OA3	1.51
OB2	1.50
OB3	1.29
OC3	1.20
OD3	1.15
1B21A	2.85
1B22	3.25
1B23	9.95
1B24 (West)	12.95
1B24 (Sylv)	18.95
1B26	3.73
1B27	19.50
1B29	2.90
1B32	3.95
1B35	12.50
1B36	12.50
1B38	32.50
1B41	47.50
1B42	9.80
1B54	32.50
1H20	.88
1S21	9.50
1Z2	3.75
2B22	2.20
2C21	.75
2C22	.75
2C26	.49
2C26A	.49
2C34	.49
2C39	22.00
2C40	16.25
2C42	26.50
2C43	22.50
2C44	1.50
2C46	29.50
2C51	5.75
2E22	1.85
2E24	4.10
2J21A	9.95
2J22	9.95
2J26	26.50
2J27	24.50
2J31	39.50
2J32	42.50
2J33	39.50
2J34	39.50
2J36	85.00
2J37	13.70
2J38	17.50
2J39	49.50
2J40	39.50
2J41	175.00
2J48	27.50
2J49	65.00
2J50	39.50
2JB51	2.50
2J55	87.50
2J56	150.00
2J61	45.20
2K23	37.50
2K25	33.50
2K26	107.15
2K28	34.50
2K29	26.00
2K33	295.00
2K45	145.00
2K54	135.00
2K55	135.00
2X2A	1.85
3B22/EL-1C	2.95
3B23	4.75
3B24	5.25
3B24W	7.95
3B25	4.50
3B26	3.75
3B27	3.95
3C24	1.85
3C27	6.95
3D21	1.98
3D21A	2.25
3E29	14.50
3J31	95.00
4-125A	29.50
4A1	1.18
4B22/EL-5B	8.95

4B24	5.75
4B25/EL-6CF	8.95
4E27	17.25
4J36	150.00
4J38	120.00
4J50	375.00
4J52	400.00
5D21	26.50
5J23	24.50
5J29	18.50
6-8B	.85
6AN5	5.95
6AR6	3.35
6C21	29.50
6C24	52.50
6J4	7.95
7-7-11	1.19
10T1	.88
10Y	.45
13-4	.80
15E	2.35
15R	.95
REL-21	2.25
24G	1.85
HK-24	3.95
RK-25	3.82
FG-32/5558	6.75
RK-34	.49
35T	4.95
35T Ion gauge	5.95
35TG	4.95
REL-36	.78
RK-47	4.92
EF-50	.79
VT-52	.65
53A	5.60
RK-59	2.44
RK-60	1.95
VT-62(Br)	1.15
RK-63	22.50
VT-67	.48
RK-69	2.25
72	1.32
73	1.32
RK-75	3.50
VR-75/OA3	1.51
75T	5.80
VR-78	.64
VR-90/OB3	1.29
VT-98 (Br)	65.00
C100E	2.30
100R	2.90
100TH	10.25
WE-101D	1.65
WE-101F	3.62
WE-102F	2.85
VR-105/OC3	1.20
WE-113A	1.32
HY-114	.75
WE-117A	.95
F-123A	8.95
WE-124A	3.80
F-127A	22.50
VT-127A	3.60
AB-150	12.50
VR-150/OD3	1.15
FG-190	12.15
HF-200	16.50
203A	7.40
203B	6.33
204A	49.50
CE-206	3.15
211	.95
WE-211D	12.50
WE-211E	12.50
212E	42.50
WE-215A	.24
217C	8.95
221A	1.95
227A/5C27	4.60
WE-231D	2.25
232CH	240.00
WE-244A	5.20
WE-245A	2.35
WE-249B	3.50
WE-249C	3.50
250TH	22.50
250TL	22.50
WE-252A	5.65
WE-254A	5.90

WE-257A	3.77
WE-274A	5.50
274B	2.85
WE-275A	6.95
WE-283A	4.25
WE-285A	5.57
WE-286A	7.90
WE-294A	5.75
304TH	9.75
304TL	9.75
307A	5.50
WE-309A	6.45
WE-310A	7.50
WE-313C	4.15
316A	.89
327A	4.25
WE-331A	9.75
WE-343A	185.00
WE-346A	2.75
WE-350A	6.95
350B	4.95
WE-356B	5.45
361A	4.75
368A	6.95
371A	.95
371B	.95
388A	2.95
WE-399A	4.70
417A	16.95
434A	17.50
446	1.95
446A	1.95
446B	2.25
450TH	42.50
450TL	42.50
451	1.39
471A/1B21A	2.75
SS-501	12.50
503AX	1.65
506AX	1.47
507AX	1.47
527	12.25
530	17.20
531	8.25
532A	3.95
WL-533	65.00
559	2.20
561	3.50
HY615	.49
WL670A	8.70
700A	24.50
700B	24.50
700C	24.50
700D	24.50
702A	2.95
702B	4.25
703A	6.95
704A	.95
705A	2.75
706AY	45.00
706BY	45.00
706CY	45.00
706FY	45.00
706GY	45.00
707A	9.95
707B	22.50
708A	4.85
709A	4.87
710A	1.70
713A	1.45
714AY	6.95
715A	6.75
715B	12.75
715C	26.50
717A	1.47
718AY	45.00
718BY	45.00
WE-719A	26.50
720CY	75.00
720DY	75.00
721A	4.90
723A	9.95
723A/B	18.50
724A	3.22
724B	3.22
725A	8.95
726A	8.50
726B	45.00
730A	25.00
731A	2.45
WL-787	9.80
788Y	1.40
800	1.88
801A	.48
803	4.95
804	8.95
805	4.50
806	24.50

807	1.70
808	2.65
809	2.40
810	10.95
811	3.60
813	9.50
814	3.95
815	2.75
816	1.45
826	1.45
828	13.48
829	9.95
829A	14.50
829B	14.50
830B	3.95
832	7.95
832A	9.95
836	3.50
837	1.85
838	3.25
841	.49
843	.59
845	5.75
845W	6.75
849	29.50
851	67.00
852	22.60
860	4.95
861	24.50
864	.39
865	1.28
866A	1.48
869B	45.00
872A	3.95
874	1.45
876	1.60
878	1.85
886	3.50
954	.39
955	.70
956	.49
957	.49
958A	.69
959	1.50
991	.45
1003	.90
CK-1005	.79
E-1148	.35
1201	1.20
1203	.69
1291	.69
1294	.69
1299	.69
1602	2.25
1613	1.20
1614	2.00
1616	1.07
1619	.39
1620	6.25
1622	2.30
1624	1.95
1625	.45
1626	.39
1629	.39
1630	.95
1631	1.38
1632	.75
1636	3.10
1638	.70
1641	1.95
1642	.75
1644	1.17
1655	1.90
1960	.70
5611	135.00
5651	3.05
5654	5.85
5691	7.75
5692	7.75
5693	6.40
UX-6653	.65
7193	.75
8005	5.95
8011	.87
8012	2.60
8013	2.75
8013A	4.90
8016	1.05
8020	1.39
8025	6.95
9001	1.75
9002	1.50
9003	1.75
9004	.55
9005	1.95
9006	.35
189048	3.79
189049	3.79
199698	2.69

SYNCHROS

ARMY ORDNANCE, NAVY ORDNANCE AND COMMERCIAL SIZE 1, 3, 5, 6, 7 and 8 GENERATORS, MOTORS, CONTROL TRANSFORMERS, DIFFERENTIAL GENERATORS AND DIFFERENTIAL MOTORS IN STOCK

AY-101D	1G	5F	7DG	N	C-44968-6	C-69406-1	C-78411
AY-120D	5B	5G	7G	X	C-56701	C-77610	C-78415
AY-130D	5CT	5N	A	2J1F1	C-56776-1	C-78248	C-79331
1CT	5D	6DG	B	2J1G1	C-69405-2	C-78249	C-78254
1F	5DG	6G	M	2J1H1	C-69406	C-78410	C-78670

SEND FOR COMPLETE LISTING   SYNCHRO CAPACITORS IN STOCK

Terms 20% cash with order, balance C. O. D. unless rated. All prices net F.O.B. our warehouse, Phila., Penna., subject to change without notice.

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715-19 ARCH ST.   PHILA. 6, PA.
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Reliance Specials

TIMING MOTOR
8 RPM 115V 60 cyc
E. Ingraham Co.

$1.79

GEAR ASSORTMENT
100 small assorted gears. Most are stainless steel or brass. Experimenter's dream! ....Only $6.50

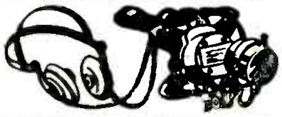
VERNIER DIAL or DRUM (From BC-221)
DIAL—2⅝" dia. 0-100 in 360°. Black with silver marks. Has thumblock. DRUM—0-50 in 180°. Black with silver marks ....either 85¢

SOUND POWER HANDSET
BRAND NEW

Includes 6 ft. cord.—No batteries or external power source used. $17.60 pr

AC LINE CORDS—4 ft. long with molded rubber plug 10¢

Sound Powered Chest Set RCA—With 24 Ft. Cord
Per Pair
USED $17.60
NEW $26.40



400 CYCLE INVERTERS
Leeland Electric Co.
#10890 in: 20-28 V.D.C., 92 A. 8000 R.P.M. Out: 115V. 400 Cyc. 1 phase. 1500 V.A. 90 PF........$24.95

3 AG FUSES

Am.	Per 100	Amp	Per 100	Amp	Per 100
1/16	$4.00	3/4	$4.00	8	$3.00
1/8	4.00	1	3.00	10	3.00
3/8	4.00	4	3.00	15	3.00
1/2	4.00	6	3.00		

3 AG FUSE HOLDERS (Finger) 25¢

DELAY NETWORK—ALL 1400Ω
T 114—Approx. 2.2 micro sec. delay........ } 95¢
T 115 Similar to T 114 with tap brought out........ } each

BEARINGS

Mfg. No.	ID	OD	Thickness	Price
MRC5028-1	5 1/2	6 1/2"	1"	$3.50
MRC7026-1	5 5/64	6 15/64	9/16	3.50
Timken 37625	4 5/16	6 1/4	29/32	4.25
MRC-7021-200	4 1/8	5 9/32	23/64	2.95
MRC 106 M2	1 17/64	2 7/16	25/64	1.75
MRC 106 M1	1 13/64	2 7/16	25/64	1.60
Federal LS 11	1 1/8	2 1/2	5/8	1.75
Norma S 11 R	1 1/8	2 1/8	3/8	1.25
Fafnir B 541	1 1/16	1 1/2	9/32	.55
Hoover 7203	5/8	1 9/16	7/16	.90
Norma 203S	5/8	1 9/16	7/16	.90
SCHATZ	3/4	1 3/4	9/16	1.00
N5 5202-C13M	1/2	1 3/8	1 3/8	1.00
ND 3200	25/64	1 5/32	11/32	.55
Norma S 3R	3/8	7/8	7/32	.45
MRC 39 R1	11/32	1 1/32	5/16	.45
MRC 38 R3	5/16	55/64	9/32	.45

NEEDLE BEARINGS
TORRINGTON B108 ½" wide ⅝" 13'16" 30¢

Brand New Meters—Guaranteed
0-10 ma. D.C. 3½"...3.95 0-80 Amp. D.C. 2½"..$2.25
0-1 ma. D.C. 3½" DeJur...Scale Reads 0-4 KV....$5.75

SELENIUM RECTIFIERS
Full Wave 200 MA 115V........$1.79
Half Wave 100 MA 115V........ .91

SPAGHETTI SLEEVING—assortment—99 feet.....$1.00

TYPE "J" POTENTIOMETERS

100 S.S.*	2,000 1/4	15K 1/4	200K 5/8
150 S.S.	2,500 S.S.	15K S.S.*	200K S.S.*
300 S.S.	3,000 3/8	25K S.S.	250K 5/8
400 S.S.	4,000 3/8	70K S.S.	250K S.S.*
500 S.S.	5,000 3/4*	80K S.S.	500K S.S.*
1,000 3/8	10K 5/8	100K 7/16	1Meg S.S.
1,000 9/16		100K S.S.*	
1,500 1/4S.S.			

*Split Locking Bushing $1.50 EACH

TYPE "JJ" POTENTIOMETERS

Ohms	Shaft	Ohms	Shaft	Ohms	Shaft
1000	SD	30K-10K	3/8"#	1 Meg.	1/2"
10K	5/16"	3K-90K	1/4"	1 Meg.	SD
15K	SD			1 Meg.	SD*

SD—Screw Driver *—Split Locking Bushing— #—With Switch
PRICE—$2.00 EACH

JONES BARRIER STRIPS

2—140Y	.15	3—141W	.27	9—141W	.71
3—140¾W	.21	4—141	.26	9—141Y	.71
6—140	.28	5—141	.30	3—142	.24
10—140W	.59	5—141¾W	.41	2—150	.43
10—140¾W	.59	7—141¾W	.57	3—150	.60
3—141¾W	.27	8—141¾W	.64		

TIME DELAY RELAY

Eagle Signal Corp., Moline, Illinois
1 Min. Delay. 115 V., 60 Cycle
2½ second recycling time spring return • Micro-switch contact, 10A • Holds ON as long as power is applied • Fully Cased •
ONLY $6.50

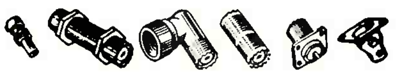
AN CONNECTORS
IMMEDIATE SERVICE
PHONE! WIRE! WRITE! YOUR NEEDS

NEW COAXIAL CABLES

	Price per 1000 Ft.		Price per 1,000 Ft
RG 5/U*	$140.00	RG 22A/U	$285.00
RG 6	180.00	RG 24	675.00
RG 7*	85.00	RG 26	475.00
RG 8*	120.00	RG 29*	50.00
RG 9*	250.00	RG 34	300.00
RG 9A/U	275.00	RG 35	900.00
RG 10	240.00	RG 41*	295.00
RG 11*	120.00	RG 54A/U	97.00
RG 12	240.00	RG 55*	110.00
RG 13*	216.00	RG 57*	325.00
RG 17	650.00	RG 58*	60.00
RG 18	900.00	RG 58A/U*	65.00
RG 19	1250.00	RG 59*	60.00
RG 20	1450.00	RG 62*	75.00
RG 21	220.00	RG 77*	100.00
RG 22/U*	150.00		

Add 25% for orders less than 500 feet.
*No minimum order—others 250' minimum.

COAXIAL CABLE CONNECTORS



15¢ UG 175/U	$1.30 83-1F	30¢ 83-1AP	80¢ 83-1J	40¢ SO-329	12¢ HOOD

83—1AC	$0.42	UG 13/U	$1.75	UG 87/U	$1.60
83—1AP	.30	21/U	1.20	88/U	1.35
83—1F	1.30	21B/U	1.35	102/U	.90
83—1H	.12	22/U	1.30	103/U	.68
83—1HP	.25	22A/U	1.65	104/U	1.10
83—1J	.80	23B/U	1.70	167/U	4.85
83—1R	.40	24/U	1.30	175/U	.15
83—1SP	.60	25/U	1.30	176/U	.15
83—1SPN	.60	27/U	1.30	224/U	1.40
83—1T	1.30	30/U	2.50	225/U	2.45
83—2AP	1.95	57/U	2.30	260/U	1.35
83—2J	2.10	58/U	.80	290/U	1.35
83—22AP	1.10	59A/U	2.25	306/U	2.95
83—22SP	1.15	60/U	2.40	499/U	1.25
83—22R	.68	85/U	1.75		

DIFFERENTIAL
115 V., 60 Cyc.
#C78249
$3.95 ea.

3⅝" dia. x 5⅝" long
Used between two C78248's as a dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted)........$4.50
Mounting Brackets — Bakelite for selsyns, and differentials shown above ....35¢ pair

2J1G1 SELSYNS
400 CYCLE BRAND NEW

POSTAGE STAMP MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd
7	25	56	110	250	500	800	.001625	.0044
7.5	26	60	120	270	510	820	.002	.0056
8.2	30	62	125	300	560	.001	.0027	.006
10	33	68	150	330	580	.0011	.003	.0062
15	39	70	160	350	600	.0012	.0033	.0065
18	40	75	175	370	620	.0013	.0035	.0068
20	43	80	180	390	650	.00136	.0036	.0082
22	47	82	200	400	680	.0015	.004	.01
23	50	90	220	470	750	.0016		
24	51	100	240					

Price Schedule
8.2 mmf to 910 mmf........5¢
.001 mmf to .001625........8¢
.002 mfd to .0082 mfd........15¢
.01 mfd........28¢

SILVER MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
8	40	82	155	325	470	800	.0024	.0039
10	50	100	170	350	500	.0011	.0025	.005
18	51	110	180	360	510	.0013	.0026	.0051
22	56	115	208	370	525	.0015	.0027	.0056
23	60	120	225	390	560	.0016	.00282	.006
24	62	125	240	400	570	.001625	.002826	.0068
27	66	130	250	410	680	.0018	.003	.0082
30	68	135	260	430	700	.0022	.0033	.01
39	75	150	270	466		.0023		

Price Schedule
10 mmf to 875 mfd........10¢
.0011 mfd to .0025 mfd........20¢
.0026 mfd to .0082 mfd........50¢
.01 mfd........$1.00

PULSE TRANSFORMERS
UTAH—9262 9278 9280 9340
WESTERN ELECTRIC—D166173 D161310
KS8696, KS9365, KS9565, KS9800, KS9862, KS13161
GENERAL ELECTRIC—K2731 80-G-5
JEFFERSON ELECTRIC—C-12A-1318
DINION COIL—TR1048 TR1049
also 352-7250-2A; 352-7251-2A; T-1229621-60

PRECISION RESISTORS—¼ WATT—30¢

2	10.48	12.32	14.98	62.54	147.5	705
2.5	10.84	13.02	15.8	79.81	220.4	2,193
3.5	11.25	13.52	16.37	105.8	301.8	3,500
5	11.74	13.89		123.8	366.6	
6.68				125	414.3	59,148

PRECISION RESISTORS—½ WATT—35¢

.25	11.1	87	400	6,500	16,000	36,000
.334	13.15	97.8	723.1	7,000	16,700	37,000
.444	13.3	125	855	7,300	17,000	45,000
.502	15	178	970	7,500	19,860	47,000
.557	25	179.5	1,500	8,000	20,150	50,000
.627	45	180	2,500	8,500	21,300	56,000
.76	46	200	2,850	8,800	25,000	59,000
1.00	52	210	3,995	10,000	26,667	59,905
1.01	55.1	235	4,000	12,000	30,000	58,000
1.53	60	240	4,285	14,825	32,700	70,000
2.04	61	260	4,300	15,000	32,888	79,012
3.25	65	270	4,451	15,750	33,000	92,000
5.26	66.6	290	5,714	15,755	33,300	100,000
5.89	69	298.3	5,900	15,810	35,888	180,000
10.58	75					

PRECISION RESISTORS—1 WATT—45¢

.1	2.58	15	60	425	7,000	55,000
.11	2.6	18	80	1,530	8,250	56,000
.2	2.66	28	125	2,215	9,000	65,000
.31	3.1	30	250	2,250	10,000	68,000
.861	3.39	38	270	3,300	12,000	70,000
1.01	4.29	45.5	312	5,000	12,420	84,000
1.166	5.21	51.25	420	5,221	50,000	95,000
2.55						

PRECISION RESISTORS—1 WATT—60¢

100,000	166,100	320,000	399,000	590,000
105,000	240,000		413,000	600,000
120,000	260,000	348,000	520,000	645,000
128,000	270,000		522,000	650,000
130,000	296,000	376,000		700,000
132,000	310,000			800,000
149,500				
150,000				

MEGOHM 1 WATT 1%—$1.50—2 5%—60¢

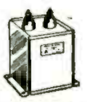
PRECISION RESISTORS—2 WATT—75¢
4,385 5,000 6,000 10,000 19,917 23,000

UNIVERSAL JOINTS ALUMINUM

3/16" hole x ⅜ O.D. 1-⅛" long—50¢
¼" hole x ½ O.D. 1-⅛" long—75¢

OIL FILLED CONDENSERS

MFD	V.D.C.	Price	MFD	V.D.C.	Price
.25	20,000	19.95	8	1,000	$2.95
2 x .075	8,000	1.95	4	1,000	2.25
.15-.15	8,000	2.95	3	1,000	1.75
2 x .02	7,000	1.60	2	1,000	.95
.1	7,500	2.25	1	1,000	.75
.03	7,500	1.95	1	800	.60
.1-.1	7,000	2.25	10	600	2.95
.1	7,000	1.95	8-8	600	1.79
.02-.03	7,000	1.65	8	600	2.05
.1	6,000	1.75	4	600	1.63
2	4,000	6.95	4 x 3	600	1.95
3 x .2	4,000	2.50	2	600	.79
.06	4,000	1.40	2 x 2	600	1.35
.25	3,500	2.25	8	500	1.50
8	2,000	7.95	4	500	.98
3	2,000	3.75			
.5-.1	2,000	1.95			
.5	2,000	1.95			
.3	2,000	1.75			
.1-.1	2,000	1.65			
.02	2,000	.89			
4	1,500	2.50			
1	1,500	1.50			



8 MFD. 2000 V.D.C. **$7.95**

OIL FILLED A.C. CONDENSERS

MFD	V.A.C.	Price	MFD	V.A.C.	Price
2	750	$0.69	4.4	375	$2.15
8	660	7.50	30	330	8.50
6	660	5.95	25	330	7.50
5	660	5.45	20	330	6.75
4	660	4.95	10	330	4.95
3	660	4.45	6	330	3.25
2.9	660	4.35	4	330	2.25
2	660	3.95	3	330	1.45
1	660	2.95	1.75	330	.85
15	440	6.25	20	220	4.95
6	440	3.95	10	220	2.95
5-3	440	3.95	7.5	220	2.00

1N34 Crystal Diode........79¢

300 Twin Lead........02½ per ft. $18.95 per M.

Dynamotor DM 33A........$3.75 ea.

Chokes: 30 Hy. 80MA @....$1.29; 6HY, 80MA @..79¢

Power Tap Switch—OHMITE (#312-5 Taps) non-shorting 25A 150 V. A.C........$3.95

Timer—Industrial Timer Corp. 15 min. on 15 min. off continuous 115 V. A. C. Fully cased Plugs into octal socket........$6.50

Just received—Quantity of used BC 221 parts. Send us your requirements.

Mike Connector Amphenol 80-81 Interchangeable with Amphenol 80-M cad plated........25¢

Send Us Your Name For FREE Mailings

Hardware Assortment
Screws, Nuts, Washers, Lugs, Etc. Mostly Brass 3 Lbs. $1

Minimum Orders $3........All orders f.o.b. PHILA, PA.

RELIANCE MERCHANDIZING CO.

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MOTOR GENERATORS

2.5 KVA Diehl Elec. Co. 120DC to 120AC, 60 cy., 1 Ph., Complete with Magnetic Controller, 2 Field Rheos and full set spare parts including spare armatures for generator and motor. New condition $295.00
2 KVA O'Keefe and Merritt. 115DC to 120AC, 50 cy., 1 Ph. Export Crated. New....$195.00
1.25 KVA Allis-Chalmers. 115DC to 120AC., 60 cy., 1 Ph. New with box of spares....$175.00
Same machine 230DC to 120AC....$175.00

INVERTERS

Onan M.G.-215H. Navy type PU/13. Input 115/230, 60 cy., 1 Ph. Output: 115, 480 cy., 1 Ph., 1200W and 26V DC at 4 amps. New....$295.00
G.E. 5D21NJ3A. Input: 24DC. Output: 115, 400 cy., 485VA. New....$29.50
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. 5ASJ315511A, Model 218J. Input: 28DC. Output: 115, 400 cy., 1 Ph., 1.5KVA. Regulated. New....$59.50
Holtzer-Cabot M.G. 164. Input: 440, 3Ph., 60 cy., Output: 70V, 146 cy, 3 Ph., 0.140KVA. New $67.50
Eicor. 32DG to 110AC. 60 cy., 1 Ph. at 2.4 Amps. New....$32.50

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....$19.50
Carter. 6VDC to 400VDC at 375MA. New...$39.50

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....$22.50
G.E. 5AM45DB20. Input: 115, 60 cy., 1 Ph., 3450-RPM. Output: 250VDC at 0.5 Amps. New..$165.00

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. 27.5VDC, 1/20HP, 3600RPM. Shunt Wound. New....$9.50
Dumore Co. type ELBG. 24VDC. 40-1 gear ratio. For type B-4 Intervalometer. New....$8.50

400 CYCLE BLOWER

Westinghouse. Type FL. 115V, 400 cy., 6,700 RPM. Airflow 17C.F.M. New....$9.50

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
Electrolux. Torque Motor. Power Drives MK10 Bu. of Ord. Dr. No. 499500. New....$6.50

PARABOLOIDS

Spun Magnesium dishes 17½" dia. 4" deep. Mounting brackets for elevation and azimuth control on rear. 1½ x 1⅝" opening in center for dipole. **Brand new, per pair**....$8.75

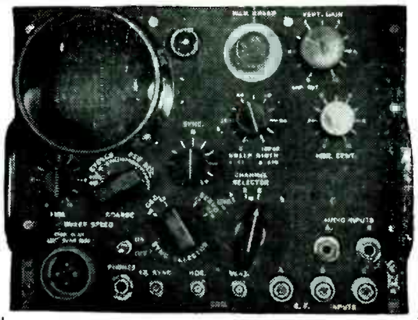
SOUND POWERED PHONES

Western Electric No. D173312, Type O. Combination headset and chest microphone. Brand new including 20 ft. of rubber covered cable....$17.50
Automatic Electric Co. No. GL-843AO. Similar to above but including Throat microphone in addition to chest microphone. Brand new with 20 ft. rubber covered cable....$10.00
U. S. Instrument Co. No. A-260. Complete with 20' cable and plug. Brand new....$17.50
W.E. Type 316B Laboratory Headsets. Price per set....$8.50

RELAYS

Struthers-Dunn 1BXX129, 110 A.C....$2.60
Advance type 455C, SPDT, 115 A.C....$1.95
Leach type 1154A, SPDT, 115 A.C....$2.35
Leach type 1054, BSN 20-28V D.C....$2.35
Clare Plug-in base No. 30FMX 115 A.C....$3.50
G.E. Plug-in base Sensitive K27J853....$4.50
Allied Control type BJ 452-1128....$1.95
Western Electric D-163781 Plug-in....$10.00
Guardian Time Delay type B-9-SPDT....$2.95
Haydon Time Delay 17717 110V/60....$4.75

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

TEST EQUIPMENT

TS-127/U Lavoie Freq. Meter—375 to 725 MC.
TS-47APR Test Osc. 40-500MC.
TS-487/U Peak to Peak VTVM.
AN/APR-1 Receiving sets.
R111A/APR-5A Receiver—1000 to 6000 MC.
AN/APR-4 Tuning Units TN-17 (76-300 MC).
AN/APR-4 Tuning Units TN-18 (300-1000 MC).
AN/APR-4 Tuning Units TN-19 (950-2200 MC).
TU-58 Range "A" Tuning Units (110-370 MC).
BC1203 APN-4 Tests Sets.
AN/APA-10 Panoramic Adaptors 115V/60 cycles.

Repair Parts for BC-348 (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., front panels, dial assemblies, vol. conts., etc. Write for complete list and free diagram.

HIGH QUALITY CRYSTAL UNITS

Western Electric—type CR-1A/AR in holders. ½" pin spacing. Ideal for net frequency operation. Available in quantities. 5910-6350-6370-6470-6510-6610-6870-6690-6940-7270-7350-7380-7390-7480-7580-9720. All fundamentals in KC. Good multipliers to higher frequencies....**$1.25 each**

RADAR

Antenna-Trans-Rec Unit ASG-1.
Radar Set SQ complete with spares.
Modulator type SO-11.
Pulse Timers CUZ-50AGD (SD-5 Radar).
Radar Crystal Units 98.35kc, Raytheon.
1N21B Sylvania Diodes.
Repeater Adapters CBM-50 AFO.
SO Series Accessory Control Panels.
SO Series Transmitter-Receiver unit.
CARD 23AEK Bearing Control Units for SO Series.
Auxiliary Rectifier.

RADAR ANTENNAS

Type SO-1 (10CM) Complete assembly with reflector, waveguide nozzle, drive motor and synchros. etc. New in original cases....$279.50
Type SO-3 (3 CM.) Surface Search type complete with reflector, drive motor, synchro, etc., but less plumbing. New in original cases....$189.50
Type SO-13 (10CM.) Complete assembly with 24" dish with feedback dipole. Complete with synchros, drive motor, gearing, etc. New in original cases....$149.50
Also in stock — spare reflectors, nozzles, probes, right angle bends for SO-1 antennas.

RECTIFIERS

G.E. No. 6 RC89F16 for 54 cells 10 amps.
G.E. No. 6 RC133F2—In: 110/220/60/1. Out: 15/30V-75-150A
Mallory APS-20—In: 115/230/60/3. Out: 12/24V-65-130A
Turret Trainer Supply. In: 220/60/3. Out: 28V-130A
Complete specs on request

TERMS: Rated Concerns Net 30, FOB Bronxville, New York. All Merchandise Guaranteed. Prices Subject to Change

400 CYCLE TRANSFORMERS

AUTO. 400 cy. G.E. Cat. No. 80G184. **KVA** .945S-.520P Volts 460/345/200/115. New....$6.95
FILAMENT. 400/2600 cy. Input: 0/75/80/85/105/115/125V. Output: 5V3A/.5V3A/5V3A/5V3A/5V6A/5V6A/6.3V6A/6.35A. New....$3.95
PLATE & FIL. Raytheon UX7238. Pri: 115. Sec #1: 830VCT/0.085A. Sec #2: 5V/3A. Sec #3: 640VCT/0.10A. Sec #4: 5V/3A. T.V. 1780 RMS....$4.75
PLATE WECO KS9560. 400/800 cy. Pri: 115V, Sec: 1350-0-1350 at .057A (2700 V Total). Elecstat shlded. Wt. 2.3 lbs. New....$2.95
Plate. Thordarson #T46889. 1650 VA. Pri: 105-120V. 500 cy. 1 PH. Sec: 5600V. Center tapped. 1.5KV insulation. Brand new....$49.50
PLATE & FIL. WECO KS9555. 400 cy. Pri: 115V. Sec #1: 930-0-930. Sec #2: Three 6.3V windings....$4.95
FILAMENT. 400/2400 cps. WECO KS9553. Pri: 115V. Sec: 8.2V1.25A/6.35V1.5A Elecstat shlded. Wt. 0.5 lbs. New....$2.95
PLATE & FIL. 400/2600 cy. Pri: 0/80/115V. Sec: #1=1200VDC at 1.5MA. Sec. #2=400 VDC at 130MA. Fil. Secs: 6.4V4.3A/6.35VO.8A (ins. 1500V)/5V2A/5V2A....$4.95
RETARD. 400 cy. WECO KS9598. 4 Henry 100MA....$2.75

HIGH POT TRANSFORMERS

High Voltage Trans. Westinghouse Pri: 115, 60 cy. Sec: 15,000 C.T., 60 MA. Good for IH Pot test set up. C. T. ungrounded....$39.50

PULSE TRANSFORMERS

PULSE. WECO KS-9563. Supplies voltage peaks of 3500 from 807 tube. Tested at 2000 Pulses/sec and 5000V peak. Wdg. 1-2=18 ohms. Wdg. 1-3=72 ohms. L of Wedg. 1.3=.082H at 100 cps....$7.50
PULSE. WECO KS-161310, 50 KC to 4MC, 1¾" Dia. x 1⅞" high, 120 to 2350 ohms. New....$6.75
High Reactance Trans. G.E. type Y-3502A.—60 cy., Voltage 11200-135. Inductance H.V. Winding 135 Henries. Output: Peak Voltage 22.8KV. Cat. 8318065G1. New....$89.50

400 CY. SERVO TRANSFORMERS

G.E. #68G665X Pri: 57.5V. Sec: #1=28.75V. Sec: #2=28.75V....$3.75
G.E. #68G666X Pri: 57.5V. Sec: 115V C.T...$3.75
G.E. #68G667 Pri: 220V C.T. Sec: 220V C.T.$3.75
G.E. #68G668X Pri: 115V. Sec: 275V/275V/275V/275V/230V/230V/6.3V CT/6.3V CT....$6.50

RAYTHEON VOLTAGE REGULATORS

Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V. 60 Watts, ½ of 1% Reg. Wt. 20 lbs. 6⅛" H x 8¼" L x 4⅝" W. Overload protected. Sturdily constructed. Tropicalized. Special....$16.75

AMPLIFIERS

GE Servo type 2CV1C1 400 cycle
Constant Output Line RC-730C
Synchro Amplifiers for Radar
Intercommunication type BC-605

ANTENNAS

Coast Guard MR-162 Whips 23½ ft.
Microwave types, AT-38, AS-125
APT-2 Dipole Antennas
TDY Radar Jammer Horns
Paraboloids, Magnesium Dishes 17½" dia.
SCR-634-A (Part of RC-153-B Antenna).

POTENTIOMETERS

W.E. KS-15138 Linear Sawtooth
W.E. KS-8732 for SCR547 Radar
W.E. KS-8801 Motor Driven

MISCELLANEOUS

Cathode Ray Shields for 3" tube....$3.75
Variac type Motor Controls 600 watt....$13.50
10 CM Waveguide 90° elbow....$20.00
Adel Clamps assorted types—write for samples
Shock Mounts Lord #20....$.40
Shock Mounts U. S. Rubber #5150C....$.30
Commando Pole Jacks (Cook Elec. Co)....$1.00
Fuestron (Bus FRN 50 Ampere 250V)....$.25
Switchboard Lamp Receptacles & Jewels....$.40
SCR522 Transmitter Receivers Brand New
TCR Transmitters 125 watt Ship to Shore
BC966A Transponders
RT7-AN/APN-1 Receivers
BC-423B Modulators
BC-1366M Jack Boxes—Large quantity
Sweep Generator Capacitors 5/10 mfd.

SWEEP GENERATOR CAPACITORS

High speed ball bearings. Split stator silver plated coaxial type 5/10 mmfd. Brand new.... **$2.50**

HI-VOLT CAPACITORS

.25 Mfd., 20KV....$26.50
.25 Mfd., 15KV....$22.50
1 Mfd., 15KV....$44.50
1 Mfd., 7.5KV....$12.50
2 Mfd., 6.0KVA....$14.50

ELECTRONICRAFT
INC.
27 MILBURN ST. BRONXVILLE 8, N. Y.
PHONE: BRONXVILLE 2-0044

INDICATORS

ID-24/ARN-9....$12.50
ID-14/APN-1....$7.95
ID-60/APA-10 Panoramic Adapter converted for 60 cycle operation—complete with tubes and 80 page Tech. Manual....$245.00

SEE OUR PREVIOUS ELECTRONICS ADS FOR LISTINGS OR WRITE FOR CIRCULARS

OVER 300,000 RELAYS IN OUR VAST STOCK

OVER 1000 DIFFERENT TYPES

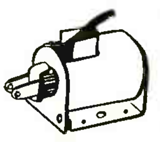
WE ALSO HAVE PRODUCTION QUANTITIES IN STOCK OF:

APC AIR TRIMMERS
BINDING POSTS
CABLE
CAPACITORS
CERAMICONS
CERAMICS
ADEL & TINNERMAN CLAMPS
CHOKES
COILS
CONTROLS
CRYSTALS
FILTERS
FUSES
KOVAR GLASS SEALS
RUBBER GROMMETS
HARDWARE
IRON CORE SLUGS
KNOBS
SINE-COSINE POTENTIOMETERS
PULSE TRANSFORMERS
RELAYS
RESISTORS
SERVO TRANSFORMERS
SHOCKMOUNTS
SOCKETS
SPAGHETTI
MICRO SWITCHES
TOGGLE SWITCHES
TRANSFORMERS
TUBES
AND OTHER RADIO & ELECTRONIC PARTS

A. C. RELAYS
RELAY BANK FOR CIGARETTE MACHINES

Guardian No. 53317—Consists of 9 Guardian 24 VAC, 10 ohm relay activators on metal strip. When each relay is energized the actuator pulls down and is held in place by a mechanical latching arm. It also operates 2 make 1 break contacts. Unit is prewired. #R 803 **$7.95 each**

SOLENOIDS

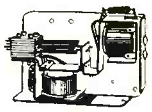


GUARDIAN No. 1: 24 VAC, 6 ohms ⅛ to ½" stroke, 6 oz.-in. #R 804 **$1.95 each $150/C**

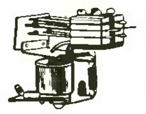
GUARDIAN No. 4: 115 VAC, 133 ohms ⅛ to 1⅛" stroke, 14 oz.-in. #R 805 **$3.95 each $350/C**

GUARDIAN No. 4: 115 VAC, Intermittent Duty, 49 ohms ⅛" to 1⅛" Stroke, 2 lb.-in. **$3.95 each $350/C**

RELAYS



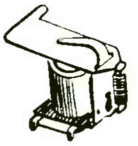
GUARDIAN: 24 VAC, 25 ohms, Interlocking Relay Breaks 3 Makes 2—Electrical reset #R 806 **$2.49 ea. $200/C**



GUARDIAN: 24 VAC, 48 ohm relay, Makes 4 Breaks 1 #R 807. **$1.49 ea. $125/C**

GUARDIAN: 24 VAC, 48 ohm relay, Makes 2 Breaks 2 #R 808. **$1.49 ea. $125/C**

ACTUATORS



GUARDIAN 24 VAC 10 ohms #R 809 **69¢ ea. $50/C**

GUARDIAN 24 VAC 15 ohms #R 810 **69¢ ea. $50/C**

GUARDIAN 24 VAC 25 ohms #R 811 **69¢ ea. $50/C**

Clare B19553†	24VAC	2C, 1A	R582	$3.49
Leach 1154	50VAC	2A‡	R431	2.49
Guardian 200	24VAC	1A‡	R274A	.98
Guardian 200	24VAC	1A, 1C‡	R273A	1.10
	12VAC	2A	R275	.98
Clare Type C†	110VAC	2A, 1B	R161	3.25
Automatic F Type RA	110VAC	4PDT	R159	4.49
Automatic F Type RA	110VAC	DPDT	R160	3.49
Amperite 24 No 2† (Delay)	24VAC	1A	R316	.98
Potter Brumfield KR11A	12–24VAC‡ or 6VDC	DPDT	R812	1.95

Time Delay 2 sec., can be used on 110V with 1250 ohms.
* A=Normally Open; B=Normally Closed; C=Double Throw.
† Octal Type Plug Base.
‡ Heavy Duty 10 Amp Contacts.

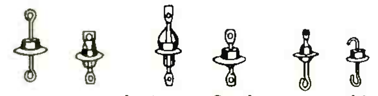
110V 60 Cyc TIMING MOTORS

INGRAHAM 8 RPM Fully Enclosed....$1.95
TELECHRON 3.6 RPM.............. 2.50
GILBERT With Gear Train for 6 RPDay 1.95
GILBERT 60 RPM (1 RPS)........... 1.75

CERAMIC & FEEDTHRU CAPACITORS

Type	No.	MMF Tol.	Ea.	per C
Button	FA	175±10%	.18	15.00
Button	FA	240±10%	.18	15.00
Button	FA	345±10%	.18	15.00
Button	FA	470±10%	.18	15.00
Disc		2000±10%	.40	30.00
Standoff	324	1000±10%	.12	10.00
Feedthru		55±10%	.10	9.00

KOVAR GLASS TO METAL SEALS HIGH-VOLTAGE FEED THRU



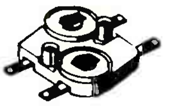
Many types and sizes. Send us your blueprint or sample for our quote. Our prices are a fraction of original factory cost.

Sample Kit; 12 each of 8 Types
96 Seals $5.00 postpaid in U.S.

TS2A VARIABLE CERAMICONS

1.5 to 7; 1.5 to 7.5; 3.5 to 30; 5 to 40; 5 to 50; 7 to 45; 30 to 65 mmf (Types N-500) **35 ea; 32.50/C; 300.00/M**
Also 12-62; 20-125 mmf.. **.40 ea.; 35.00/C**

TD2A DUAL CERAMICONS



2X4-30; 2X7-45 mmf..... **.60 pr; 54.00/C**

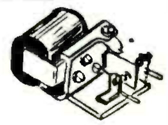
DIFFERENTIAL

Dual 8000 ohm coils, Armature pivoted between poles, all contacts normally open. High-speed. Suitable for P.P. bridge or balanced circuits where differential action is required.

COOK 11710/613 DPDT, 6 ma., #R605 .$5.95
Allied 803476 SPDT, 2.5 ma.. #R418.. **4.95**

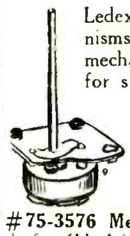
TERMS: All Prices F.O.B. Our Plant. Rated Firms Net 10 Days; All Others Remittance with Order.
Orders Under $10 Remittance With Order, Plus Approximate Shipping Charges (overage will be returned).

D.C. SENSITIVE RELAYS



SIGMA 4F; 1 ma.; SPDT; 10,000 ohm; #R801 .... **3.95**
RBM 23024; 6 ma.; 4PST n.o., (4As); 6,500 ohm; #R802.............. **2.95**
RBM 23025 6 ma., SPDT, 8000 ohm, #R428 .... **1.50**
W.E. (Whelock) KS9665 9 ma., 1A, 1B, 1C, 2000 ohm, #R426............ **4.95**
Kurman Midget 12 ma., SPDT, 1500 ohm, #R427 .... **.98**
Clare Type J (K102) 6 ma., SPDT, 3500 ohm, #R30 .... **3.50**
Dumont 5 ma., 1A, 5000 ohm #R230.. **.98**
Automatic 5035A7 8 ma., 1A, 1300 ohm, #103 .... **1.25**
Cooke Type C 4 ma., 1A, 6500 ohm, #R596 .... **3.50**
Claire B11613 (K101) 2 ma., SPDT, 6500 ohm, #R588 .... **4.95**
Clare A8053 8 ma., 3A, 6500 ohm, #R408 .... **3.95**
Potter-Brumfield; 9 ma; 2500 ohm, SPDT; 5 Amp Contacts; #R364... **1.25**
Potter-Brumfield; 5 ma; 5000 ohm; SPDT; 5 Amp Contacts; #684.... **1.50**
RBM 452-1041; 4 ma.; 12,000 ohm; DPDT; Telephone Type; #R685... **4.95**

ROTARY RATCHET RELAYS



Ledex D.C. Impulse operated mechanisms rotate in 30° steps. Ratchet mechanism has ¼" shaft with flats for standard switch wafers.

#33 Mechanism only, 24V, 200 ohm, #R597...... **1.50**
#76-2945 Mechanism & Ratchet & 3" long shaft, 6V ½ ohm, #R598 .... **3.50**
#75-3576 Mechanism & Ratchet & 4" long shaft, 6V, ½ ohm, #R599.......... **3.75**
#25 Mechanism Only, 12V, 4.5 ohm, #R824 .... **1.50**
#26 Mechanism Only, 6V, 2 ohm, #R825 .... **1.50**
Miniature Mechanism Only, 12V, 35 ohm, #R826 .... **1.50**
Miniature Mechanism Only, 6V, 10 ohm, #R827 .... **1.50**

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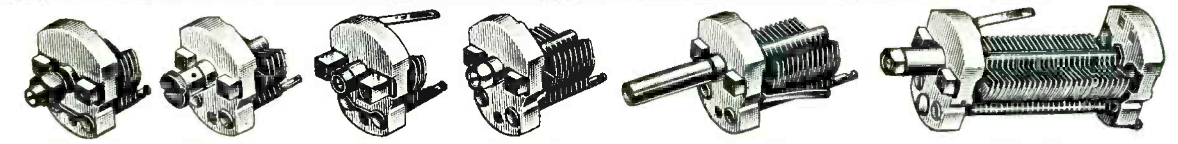


Fig. A Fig. B Fig. C Fig. D Fig. E Fig. F

STOCK NO.	CAPACITY Min. Max.	MANUFACTURER'S NUMBER	FIGURE	SHAFT LENGTH	POST LENGTH	GROUND LUG	PRICE EACH
2937	2.5 – 7	Hamm 250034	D	5/16	3/32	Right	18¢
5716*	3 – 8	ASP 17A224	A	9/16	3/32	Top	25¢
5717	3 – 10	ASP 22G192	A	9/16	3/32	To Post	18¢
4090	2 – 15	ASP 482212	E	1"x1/4" D	3/32	Left	25¢
2939	3 – 15	ASP 217-2	C	5/16	1/4	Top	20¢
5718	3 – 15	Telrad 682070-30	D	5/16	3/32	Right	20¢
5719	3 – 15	Hamm 682070-30	D	5/16	3/32	Right	20¢
231	3 – 25	CAIM 481881	A	9/16	3/32	Left	25¢
5720	3 – 27	Hamm 11725-1	D	5/16	3/32	Right	25¢
5721	2.5 – 28	Comar M420864-6	D	5/16	3/32	Top	25¢
2940	2 – 30	ASF A8H-501	D	5/16	5/16	To Post	30¢
5724	4.5 – 30	OB7751E-25	D	5/16	5/16	Right	30¢
5086	5 – 30	Hamm SBL-72265-3	B	1/2	3/32	Bottom	30¢
2941	4.5 – 35	Hamm ESA682070-37	D	5/16	3/32	Left	30¢
232	5 – 54	Hamm ESA682070-35	D	5/16	3/32	Left	40¢
5087	5 – 54	Hamm BL 72265-4	B	1/2	3/32	Right	40¢
5725	4.5 – 55	Sickles M7466880-2	D	5/16	3/16	Right	40¢
5088	6 – 100	Hamm SBL72265-6	B	1/2	3/32	Bottom	50¢
236**	8 – 140	ASP 19A34504	D	5/16	3/32	To Post	55¢
5675	6 – 150	Hamm APCIE150	E	1 1/16"x1/4" D	3/32	Right	75¢
5726	9 – 204	OAK-114M510	F	9/16	3/32	Top	95¢

* Double spaced plates.
** Adjusts both ends, some available w/dust cover.
Fig. A Round Shaft Screwdriver adj. w/locknut.
Fig. B Bakelite Knobs Ins. Screwdriver adj.
Fig. C Round Shaft Screwdriver adj.
Fig. D Hexnut Screwdriver adj.
Fig. E ¼ Round Shaft.
Fig. F Double End Plate.

TRANSMITTING MICAS

Stock No.	Cap.	Test Volts	Type No.	Price Each
5493A*	.01	1000	1445	.35¢
5494A	.02	1000	144T	.40¢
5495A	.006	1200	A 2	.40¢
5496A	.001	1500	BE 15	.20¢
5498A	.004	2500	4	.30¢
5499A	.001	5000	F	.60¢
5600A	.0036	5000	A2	$1.00
5601A	.15	1000V	XS	1.90
5602A	.00007	2500V	3	.90¢
5603A	.00005	3000V	15L	1.00
5604A	.0001	5000V	F2L	1.00
5605A	.0008	5000V	F2L	1.00
5606A	.000025	10,000	PL-341	1.95
5687A**	.00015	10,000	PL-315	7.95

* Supplied with Meter Bracket
** D.C. Working Voltage

OTHER TYPES AND SIZES AVAILABLE

AUDIO PASS FILTERS

Band pass 800 to 1200 cycles input 10000 ohms—Output 25000 ohms Level 10DB

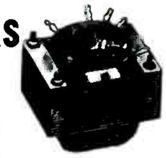
Stock No. T48500 Price to: $5.50 ea.

Oil Filled Condenser 10 Mfd. 220 V.A.C. Round Can, 2-½" Diameter x 3-⅞" High. Stock No. 5658A. $.95 each

AMPHENOL & CANNON CONNECTORS & FITTINGS

WRITE YOUR REQUIREMENTS

6.3 VOLT FILAMENT TRANSFORMERS



Primary 115 Volt 60 Cycle 1600 Insulation Three 6.3 Volt Secondaries

6.3 Volts @ 4.9 Amps.
6.3 Volts @ 4.5 Amps.
6.3 Volts @ 1.1 Amps.

Stock No. 5254A

Horizontal Half Shell Mounting. 2¼" x 2 13/16" Mounting Centers. 2 13/16" x 2⅜" Core Size 2½" above Chassis. Solder Lug Terminals — All Terminals Marked.

Price EACH $2.65

ART/13 COMPONENTS

G.E. pressure switch
Collins No. 260457000

Stock No. 5730A $6.50 ea.

Autotune Motor. 1/20th HP. 28 Volt; 4.2 Amp.; 3600 RPM. Collins No. NY818CB.

Stock No. 5731A $7.50 ea.

OIL FILLED CONDENSERS

.045 MFD 16,000 Volt Vitamin "Q". One Ceramic Insulated Screw Terminal 1¾" x 3½" x 4¾" High Can. Stock No. 5399A. $4.95

Standard Brand, Mfr. Name on Request

AN/APQ-13 MODULATOR UNIT

Signal Corps # 2CK2537-13 W.E. No. D-151-754. Oil filled modulator containing a pulse amplifier and associated rectifier.

$125.00 ea.

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ELECTRO-VOICE—602 DIFFERENTIAL DYNAMIC MICROPHONE

A close talking, noise-cancelling Speech Microphone. 150 Ohm Impedance Dynamic Unit comes complete with press-to-talk switch and 5 Ft. Shielded Four Conductor Cable. Brand New. Individually boxed.

Stock No. 5282A Price Each $15.00

BUTTERFLY CONDENSERS

FIG. 1

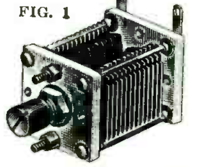
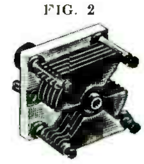


FIG. 2



9-62 mmfd per section. 6-34 mmfd sections in series. Double ceramic end plates and bearings. ¼" diam. shaft, 5/16" long. 065 Plate spacing end plates 1-⅜" square.

Stock No. 5076-A FIG. 1 Price Each 90¢

4-22 mmfd per section. 3-12 mmfd sections in series. Single ceramic end plate 1-⅜" square. ¼" diam. x ¼" long shaft.

Stock No. 5077-A FIG. 2 Price Each 60¢

Terms: Open Account to rated or acceptable referenced accounts. Others Pre-payment or 25% deposit with order, balance C.O.D. Price F.O.B. Chicago and subject to change without notice. Merchandise subject prior sale.

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ARMA LATITUDE MOTOR

Dwg. 8413-30
DC step motor.
Stock #SA-272
Special at $3.75 each.

SERVO MOTOR (DC)

Sperry 8001058
6 terminal-Armature and duel field control motor. 2" diam.-3¼" lg. Front flange mounting. Shaft ext. ¼", 5/32" diam. **Stock #SA-289**
Price $9.75 each.

AIRCRAFT MOTOR

G. E. Type 5BA25AJ32A

24 volts at 2.9 amps. 75 in/lb. torque. 3 lead shunt with brake. 1 minute rating. Double worm gear reduction. 4 rpm reversible.
Stock #SA-298 **Price $39.50 each.**

27.5 VOLT DC MOTOR

John Oster Type E-7-5 4 lead shunt. 1/20th hp. Internal fan cooled 4¾" lg. 3¼" diam. ⅞" shaft extension. 5/16" diam. 3650 rpm. **Stock #SA-310 Price $9.50 each**

G. E. 1/10 HP DC Motor

G.E. Type 5BN58LA5

125 volts DC at 1.2 amps. 4000 rpm. Int. duty. Internal fan cooled. 3½" sq. front mounting flange.
Stock #SA-312
Price $19.50 each.

MOTOR SPECIAL BODINE NSHG-12 MOTOR

Constant Speed

27 v. D-C Governor controlled 3600 rpm. 1/30th hp. Stock #SA-39.
Price $17.50 each.

DELCO CONSTANT SPEED MOTOR A-7155

1/30 hp. 27.5 v d-c 3600 rpm. Cont. duty. 2½" diam. x 5½" lg. ⅞" shaft extension, 5/32" diam. 4 hole base mounting. Stock #SA-94. **Price $19.50 each**

OSTER PM MOTOR

Alinco Field

27.5 v. d-c. Can also be used as rate generator. #SA-281. **$8.75 each**

DC GENERATOR

Ford Instrument Co. Compound Wound. Bu. of Ordnance Dwg. 223128. 115 v. d-c @ 0.75 amperes Cont. duty. Ideal for laboratory use. **Special low price $4.95 ea.** Stock #SA-258.

INSTRUMENT INVERTER

Pioneer Type 12128-1B
Post War Model. Input 27.5 volts DC at 1 amp. Output 26 volts 400 cy. Single phase. P.F. 0.4. 6.0 VA. Stock #SA-295
Price $39.50 each.

Other Inverters (400 Cycle)

WINCHARGER PU-7/AP: PU-16.
GENERAL ELECTRIC 5AS131NJ3 (PE-118); 5D21NJ3A: PE-218.
LELAND 10339; 10285; PE-218.
PIONEER, 12130-4B; 12108-2B; 12121-2; 12116-2.
HOLTZER CABOT MG-149F; MG-149H; MG-153; MG-153F.

SYNCHROS AND SELSYNS

Navy Types
A; M; 1SF; 5G; 5F; 5SDG; 5SG; 5SF; 5HSF; 6DG; 7G, etc.

Army Types
II; IV; V; VII; IX; XXI; XV, etc.

G.E. Types
2J6F2; 2JD5J2; 2J5A2; 2J5HA1; 2J1H1; 2J1F1; 2J1G1; 2J1F3; 2JD5HB1; 2J5LA1; 2JD5C2, etc.

RECTIFIER POWER SUPPLY

Hammet Electric Mfg. Co. Model SPS-100B. Input 220 volts 3 phase 60 cycles at 13 amps. Output 15-30 volts at 130-65 amps. 8 point tap selection. DC meter. New. **Stock #SA-510 Special $325.00 ea.**

HOLTZER CABOT MG SETS

Type MG-221. Input 32 volts DC at 8.5 amps. 3430 rpm. Output 110 volts at 1.0 amps. 400 cy. Single phase. 100 watts. **Stock #SA-506. Price $99.50 ea.**

Type MG-218. Input 115 volts DC at 2.3 Amps. Output 110 volts 400 cy. Single phase. 100 watts. **Stock #SA-507 Price $119.50 ea.**

2 HP ACTUATORS

AIRESEARCH—Linear Actuator—Dwg. 29178. Frame 26-39. 200 volt 3 phase 400 cycle motor with thermal protection. 2 hp. 8 amps. 11,000 rpm. Duty 1-20. Stat. 3100; Tens. 1600; Comp. 1600. **Stock #SA-508.**

Torque Actuator
Dwg. 29180. Driven by same motor as above. Stock #SA-509.
PRICES ON REQUEST

60 CYCLE AMPLIDYNES

G.E. Types 5AM45DB15 and 5AM73AB95. Type 45DB15 input 115 v. 60 cy. at 5 amps. Output 250 volts DC at 0.6 amps. Stock #SA-147.

Type 73AB95 input 115 volts 60 cy. at 9 amps. Output 250 volts DC at 1.5 amps. Stock #SA-257.
PRICES ON REQUEST

AC MOTOR SPECIAL

Leland Type D-43744. 0.6 hp. 130/115 v. 50/60 cycles. 3 phase. 945/1145 rpm. EXPLOSION PROOF. Stock #SA-254. Small quantity left at ONLY **$24.50 each.**

DRAG CUP GENERATOR

Kollsman Type 977-01600 115 volt 60 cycle input. 60 cycle output voltage proportional to shaft speed rotation. **Stock #SA-307 Price $29.50 each.**

AUTOSYN MOTOR

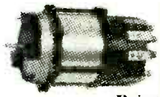
Bendix-Marine 851

32 v. 60 cycle excitation. Use as either generator or repeater. Stock #SA-158
Price $24.50 each.

PIONEER AUTOSYNS

Pioneer Bendix Types AY-1; AY-54; AY-14D; AY-14G and others.
Prices on request.

KOLLSMAN TELETORQUE



Kollsman Type 403 self synchronous units. (Synchro) 115 volt 60 cycle excitation. Use as either generator or repeater. Stock #SA-79
Prices on request.

115 Volt D-C Motor

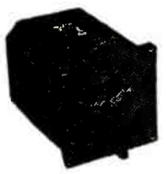
G.E. Type SD. 1/20 hp. 4 lead shunt. Reversible. Double shaft extension. Speed 1725 rpm. **Large Quantity.**

Prices on request.

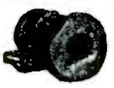
REVERE CAMERA MOTOR

27 v. D-C Split-field series. Approx. 2½" sq. x 2½" lg. Stock #SA-315.
Price $6.75 each.

Indicator Attitude Gyro



Sperry No. 659644. Gov't. No. R-86-1-1310 Three phase 115 v. 400 cycle. Navy overhauled May 1950. **Prices on request.**



John Oster A-21E-12R — Split field series reversible motor. W.E. KS-5996-LO-4. 28 v. d-c at 0.4 amps. 2 watts output. 1½" diam. x 2¼" lg. Ideal for relay or thyratron servos. Stock #SA-282.
Price $9.75 each

PERMANENT MAGNET GEARHEAD MOTORS

Delco type 5069600—27.5 v. D.C. 250 rpm output shaft speed. 12 in/oz.
Delco type 5071895—27.5 VDC. 250 rpm.
Delco type 5069230—27.5 VDC. 145 rpm.

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General Electric 2J1F3

115 v. 400 cycle Selsyn Generator. Large quantity.
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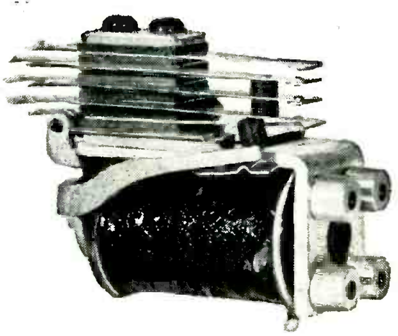

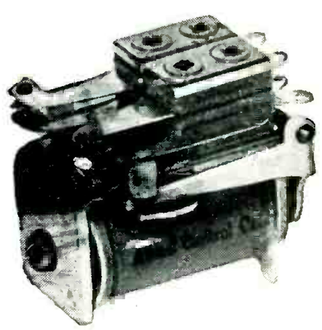

Midget Relays

STK. NO.	VOLTAGE	OHMAGE	CONTACTS	MFG. & NO.	UNIT PRICE
R-416	4 VDC.	9	1C @ 1.5 AMP.	ADVANCE 1603S	$1.65
R-378	6 VDC.	100	1A @ 1.5 AMP.	ADVANCE 1601S	1.50
R-850	12 VDC.	450	1A @ 1.5 AMP.	ADVANCE 1601	1.50
R-379	19/27 VDC.	250	2A @ 1.5 AMP.	ADVANCE 1605	1.65
R-694	24 VDC.	300	1A @ 5 AMP.	ADVANCE 1601A	1.50
R-935	28 VDC.	1000	1C @ 1.5 AMP.	ADVANCE 1603S	1.65
R-572	24 VDC.	256	1C	AIRCRAFT RADIO CORP.	1.25
R-857	24 VDC.	260	1 MAKE BEFORE MAKE	AIRCRAFT RADIO CORP. 9453	1.75
R-912	4/5 VDC.	20	3A-1C CERAMIC	ALLIED TKX50	1.45
R-291	6 VDC.	5	1A	ALLIED .73A71	1.25
R-921	6.7 VDC.	18	1A Dbl. Brk. @ 10 amp.	ALLIED CRX-11	1.45
R-738	12 VDC.	60	3A	ALLIED TX3A	1.20
R-922	12 VDC.	75	1A Dbl. Brk. @ 10 amp.	ALLIED CRX-13	1.45
R-144	12 VDC.	228	1A	ALLIED D-283486	1.45
R-696	24 VDC.	230	1A @ 8 AMP.	ALLIED 55837	2.00
R-145	18/24 VDC.	250	2A CERAMIC	ALLIED 7252	1.45
R-723	24 VDC.	280	1C	ALLIED 7251	1.50
R-298	21 VDC.	300	1A	ALLIED CB-5	1.25
R-296	21 VDC.	300	1A	ALLIED CA-5	1.25
R-586	21 VDC.	300	1A & 1C	ALLIED 73A-69	1.25
R-142	24 VDC.	400	2C	ALLIED 73A50	1.50
R-785	24 VDC.	200	2C @ 10 AMPS.	AUTO. ELECT. ZH-37169-1	2.00
R-375	24 VDC.	200	2A heavy duty	AUTO. ELECT. H-87063-1	1.75
R-373	12/20 VDC.	225	1A split	AUTO. ELECT. SQA	2.50
R-370	12 VDC.	75	1C	AUTO. ELECT. MANKATO R-25	2.30
R-607	24 VAC.	INT.	1A	AUTO. ELECT. MANKATO R-45-D	1.20
R-606	24 VAC.	INT.	1A & 1B	AUTO. ELECT. MANKATO R-45-F	1.20
R-605	24 VAC.	INT.	3A	AUTO. ELECT. MANKATO R-45-G	1.20
R-374	24 VDC.	300	2A heavy duty	BETTS & BETTS RAC-15AS	1.75
R-728	6 VDC.	30	1A	CLARE........A-26690	1.25
R-149	6/8 VDC.	45	1B	CLARE........A-20545	1.50
R-732	12 VDC.	120	1A	CLARE........A-25454	1.45
R-281	12 VDC.	126	2A	CLARE........A-13415	1.25
R-347	18/24 VDC.	300	1A	CLARE........A-19469	1.10
R-376	24 VDC.	300	1A	CLARE........K	1.25
R-818	18/24 VDC.	300	1B	CLARE........A-8058	1.30
R-133	24 VDC.	300	NONE	CLARE........A-20388	.75
R-348	18/24 VDC.	300	2A	CLARE........A-16734	1.15
R-138	24 VDC.	300	4A	CLARE........A-16280	1.45
R-349	18/24 VDC.	300	1C	CLARE........B-16947	1.25
R-377	24 VDC.	300	1C	CLARE........B-22441	1.45
R-132	24 VDC.	300	2C	CLARE........	1.50
R-731	24 VDC.	300	2C	CLARE........A-16265	1.55
R-492	24 VDC.	300	4C 1A	CLARE........	1.95
R-626	24 VDC.	400	1A @ 5 AMPS.	CLARE........A-22717	1.55
R-786	60 VDC.	1300	2C	CLARE........A-12408	2.00
R-415	60/85 VDC.	1800	2A	CLARE........K	1.95
R-371	2 VDC.	30	1C Ceramic	COOK........418	1.75
R-755	24 VDC.	300	1A	COOK........55340	1.45
R-150	6 VDC.	30	1A	E-Z ELECTRIC	1.50
R-893	14 VDC.	150	1A, 1C	G. E.........55526	2.50
R-895	14 VDC.	150	2A, 1B, 1C	G. E.........55531	2.50
R-896	24 VDC.	260	2A	G. E.........55589	2.50
R-959	24 VDC.	747	2C	GUARDIAN....36761	1.50
R-693	2/6 VDC.	125	1C @ 3 AMP.	LEACH........P-501424	1.20
R-947	12/24 VDC.	320	1C @ 3 AMP.	LEACH........P-3	1.25
R-692	6/24 VDC.	1280	1C @ 3 AMP.	LEACH........P-3	1.35
R-856	18/24 VDC.	300	1B	PAUL HENRY 1010	1.45
R-913	6 VDC.	20	3A, 1C CERAMIC	PRICE BROS.	1.45
R-915	12 VDC.	70	1A Dbl. Brk. @ 10 amp.	PRICE BROS.	2.00
R-148	12 VDC.	100	2C & 1B	PRICE BROS.	1.85
R-222	12 VDC.	100	2A	POTT. & BRUM.	1.00
R-834	6 VDC.	20	3A, 1C	RBM	1.45

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OB2	2.00	2J27	29.95	5BP4	6.95	307A	4.95	724A	4.95	869B	57.50
OC3	1.75	2J31	29.95	5CP1	6.95	310A	7.95	724B	6.95	869BX	35.00
OD3	1.50	2J32	69.95	5D21	22.50	311A	7.95	725A	9.95	872A	3.95
C1A	4.95	2J36	105.00	5FD7	2.75	323A	25.00	726A	6.95	878	1.95
C1B	6.95	2J38	17.95	5JP1	27.50	327A	3.95	726B	56.00	884	1.95
1B21A	2.75	2J39	17.95	5JP2	19.50	328A	9.95	726C	69.00	885	1.75
1B22	3.95	2J42	150.00	5JP4	27.50	350A	7.95	727A	3.95	914	75.00
1B23	9.95	2J49	109.00	WE6AK5	2.50	350B	5.95	728AY	27.00	931A	6.95
1B24	17.95	2J50	69.50	6C21	29.50	357A	22.50	801A	1.00	954	.35
1B26	2.95	2J61	75.00	C6A	3.95	368AS	6.95	802	4.25	955	.55
1B27	19.50	2J62	75.00	C6J	10.95	371B	2.95	803	7.95	956	.69
1B32	4.10	2K25	29.50	7BP7	7.95	385A	4.95	804	13.50	957	.29
1B38	33.00	2K28	35.00	7DP4	10.00	388A	2.95	805	5.95	958A	.69
1B42	19.95	2K29	37.50	12AP4	55.00	393A	8.95	806	25.00	959	1.69
1B51	9.95	2K45	109.50	15E	2.95	394A	7.95	807	1.69	991	.65
1B56	49.95	2V3G	2.10	15R	.95	MX408U	.75	808	3.50	E1148	.35
1B60	69.95	3B24	5.50	NE16	.68	417A	17.95	810	11.00	1280	1.95
1N21	1.35	3B24W	7.50	FG17	6.95	434A	19.95	811A	3.15	1611	1.95
1N21A	1.75	EL3C	5.95	RX21	3.95	446A	3.95	813	8.95	1613	1.38
1N21B	4.25	3C24	1.95	FG33	12.95	450TH	45.00	814	3.95	1616	2.95
1N22	1.75	3C31	5.95	35T	4.95	450TL	45.00	815	3.50	1619	.89
1N23	2.00	3DP1A	10.95	45 Special	.35	464A	9.95	816	1.45	1622	2.75
1N23A	3.75	3E29	15.50	RK39	2.95	471A	2.75	829	12.95	1624	2.00
1N23B	6.00	SN4	5.50	VT52	.25	527	15.00	829A	13.95	1625	.45
1N26	8.00	4A1	1.75	RK72	1.95	WL531	22.50	829B	15.95	1851	1.85
1N27	5.00	4B26	10.95	RK73	1.95	700A/D	25.00	830B	11.50	2050	1.85
1N43	2.50	4C27	25.00	100TH	9.00	701A	7.50	832	7.95	2051	1.80
1N48	1.00	4C28	35.00	FG105	19.00	703A	6.95	832A	9.95	8012	4.25
1S21	6.95	4E27	17.50	F123A	8.95	705A	2.95	833A	49.95	8013	2.95
2B22	4.95	4J25	199.00	203A	8.95	707A	17.95	834	10.95	8013A	5.95
2B26	3.75	4J26	199.00	211	.95	707B	27.00	836	4.95	8020	3.50
2C34	.35	4J27	199.00	217C	18.00	714AY	17.95	837	2.95	8025	6.95
2C40	20.00	4J31	199.00	242C	10.00	715A	7.95	838	6.95	9001	1.75
2C43	27.00	4J32	199.00	244A	12.95	715B	18.00	845	8.75	9002	1.50
2C44	.90	4J33	199.00	249C	4.95	715C	25.00	849	52.50	9003	1.75
2D21	1.75	4J37	199.00	250TL	19.95	717A	1.95	851	80.50	9004	1.75
2E22	3.75	4J38	89.00	274B	3.00	718AY/EY	48.50	857B	99.00	9005	1.90
2E30	2.75	4J39	199.00	AR300	27.50	719A	29.50	860	4.95	9006	.35
2J21A	17.95	4J41	199.00	HF300	27.50	721A	3.95				

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TS15
APA28
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TS34
TS34A
TS35
TS36
TS69
CY94
TS100
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TS127
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TS155
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& Parts, APS 3,
APS 4.

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SHIP SUPPLIERS,

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R·H·S

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Set of 83-1SP Coax-Connectors for Above	1.35
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1B22	2.35
1B23	9.75
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1B26	2.49
1B27	18.95
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1B32	3.75
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1B38	28.75
1B42	4.75
1N21 xtal	.85
1N21A "	1.59
1N21B "	3.79
1N22 "	1.19
1N23 "	1.45
1N23A "	2.95
1N23B "	4.95
1N26 "	6.95
1N27 "	1.59
1N34A "	.97
1P21	45.00
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2C40	8.49
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2C44	1.19
2C46	7.95
2C51	6.95
2D21	1.35
2E22	1.19
2E24	4.69
2E26	3.42
2E30	2.15
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2J26	24.50
2J27	24.50
2J30	87.50
2J31	27.50
2J32	27.50
2J33	27.50
2J34	27.50
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2J37	11.95
2J38	11.95
2J39	44.50
2J40	39.50
2J46	39.50
2J48	24.50
2J49	34.50
2J50	21.50
2J54B	32.50
2J55	97.50
2J61	69.50
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3AP1	11.95
3B22/ELIC	2.59
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3B24	5.25
3B24W	7.95
3B25	4.39
3B26	3.59
3B27	3.75
B28	8.39
P1	5.95

3C22	$124.50
3C23	10.95
3C24/24G	1.75
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3CP1	1.95
3CP1S1	1.95
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3FP7	1.75
3GP1	4.39
3HP7	3.45
4-65A	19.95
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4 AP10	4.45
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5AP1	3.45
5AP4	3.45
5BP1	4.45
5BP4	4.45
5CP1	4.59
5CP7	12.95
5C22	65.00
5D21	24.25
5FP7	2.85
5GP1	4.85
5JP1	24.45
5JP2	22.50
5JP4	24.45
5J23	12.25
5J29	12.25
5J30	49.50
5J32	99.50
51P1	18.95
5NP1	5.50
6AN5	5.85
6AS6	2.75
6AS7	4.75
6C21	22.25
6F4	6.25
6J4	7.55
7BP7	6.55
7DP4	14.50
9GP7	13.75
9JP1	13.75
9LP1	14.95
9LP7	9.95
10BP4	17.45
10Y	.45
12DP7	14.75
12GP7	14.75
12HP7	14.75
12LP4	20.95
15E	1.10
15R	.69
19T8	.99
23D4	.45
28D7	2.25
30 special	.45
35TG	3.25
45 special	.32
53A	5.95
75TL	6.25
100R	.89
100TH	7.95
121A	2.39
203A	8.45
204A	69.50
211	.69
212E	49.50

215A	$8.15
217C	8.49
227A/5C27	4.59
249C	3.69
250R	9.45
250TH	21.95
250TL	18.95
274A	5.50
274B	1.75
276A	9.75
293A	2.69
294A	3.95
300B	9.95
304TH	9.35
304TL	9.95
305A	34.95
307A/RK75	4.45
310A	7.49
316A	.65
323A/B	23.95
327/5C37	4.75
328A	8.95
331A	11.95
350A	7.95
350B	3.95
368AS	7.50
371A	.95
371B	.69
388A	1.45
393A	7.95
394A	3.95
417A	12.95
434A	27.50
446A	1.15
446B	3.75
450TH	38.75
450TL	43.95
471A/1B21	2.45
527	12.45
559	1.35
562	97.50
575A	13.45
701A	5.75
702A	3.25
703A	5.25
704A	.95
705A	2.49
706BY	35.00
706CY	35.00
706FY	39.50
706GY	39.50
707B	13.95
708A	4.45
709A	3.45
710A/8011	.89
713	.95
714AY	4.95
715A	6.39
715B	9.55
715C	28.95
717A	.98
721A	2.45
722A	2.35
723A	9.50
723A/B	19.95
724B	3.25
725A	6.95
726A	6.50
726B	49.50
730A	29.50
750TL	89.50
800	1.75
801A	.25
802	3.95
803	3.75
804	11.75
805	3.75
806	24.95
807	1.59
808	2.69
809	1.69
810	9.95

811	$2.85
812	2.75
813	7.95
814	2.69
815	2.69
816	1.05
826	.69
828	9.95
829	10.95
829B	12.95
830B	2.75
832	8.95
832A	9.45
833A	42.50
836A	3.49
837	1.45
838	2.25
841	.45
843	.27
845	4.25
849	27.50
851	47.50
852	27.50
860	3.95
861	22.50
864	.27
865	.98
866A	1.35
866JR	1.29
869B	35.00
872A	2.95
874	1.19
876	.27
878	1.59
884	1.75
885	1.39
902A	9.95
905	3.25
908	9.95
918	1.45
919	2.79
922	1.25
923	.95
927	1.10
930	1.20
931A	4.50
954	.25
955	.39
956	.35
957	.39
958	.39
959	3.95
991/NE16	.35
1603	4.95
1613	.89
1614	2.49
1616	.89
1619	.28
1622	2.45
1624	1.45
1625	.38
1626	.38
1629	.33
1630	.75
1631	.97
1632	.72
1633	.69
1634	.69
1636	2.75
1638	.45
1641/RK60	2.25
1644	.89
1654	2.89
1655	1.50
1665	1.25
1851	1.55
1960	.65
1961	4.95
2050	1.75
2051	1.18
5670	6.95
8005	5.95

8008	$5.95
8011	1.59
8012	2.65
8013	2.59
8014	28.75
8020	.98
8025	5.45
9001	1.65
9002	.98
9003	1.65
9004	.55
9005	1.85
9006	.27
C1JA	9.95
C5B	8.95
C6A	7.45
C6J	6.39
C100D	1.49
CK502AX	2.49
CK503AX	2.95
CK505AX	1.98
CK506AX	2.25
CK507AX	2.25
CK512AX	1.98
CK517AX	7.45
CK1005	.48
CK1006	3.25
E1148	.35
EF50	.69
F123A	7.95
F127A	27.50
F128A	89.50
F606	37.50
F660	47.50
FG17	4.89
FG27A	4.95
FG32	8. ?
FG57	14. ?
FG81A	3.49
FG105	17.95
FG172	33.50
FG146	8.95
FG451	4.95
GL434A	29.95
FG562	97.50
GL502A	1.79
HF100	8.95
HF300	22.45
HY114B	.79
HY115	.69
HY615	.19
KC4	37.50
KU610	6.75
ML101	47.50
REL21	1.95
RK48A	4.59
RK59	1.25
RK60/1641	2.25
RK65	26.50
RK72	.48
RK73	.48
RX21A	2.49
RX120	12.95
TZ40	3.75
V70D	6.95
VR78	.48
VR91	.95
VR92	.45
VT127A	2.45
VT158	13.95
VU29	2.49
VU111	1.19
VX33	3.95
VX41	6.95
WL468	19.95
WL530	12.75
WL531	5.95
WL532	2.45
WL578	1.29
WL616	34.50
WL619	18.95
WL697	27.50
"B3200	145.00

OA2	$1.25
OA4G	1.15
OB2	1.48
OZ4	.59
O1A	.65
1A3	.70
1A4P	.75
1A5GT	.58
1A6	.65
1A7GT	.85
1AB5	.69
1B3/8016	1.19
1B4P	.79
1B5/25S	.82
1B7GT	1.19
1C5GT	.75
1C8	.69
1C7G	.69
1D5GP	.65
1D7G	.65
1D8GT	.65
1E5GT	.69
1E7G	.95
1F4	.65
1F5G	.65
1G4	.65
1G6GT	.65
1H4G	.62
1H5GT	.72
1H6GT	.75
1J6	.75
1L4	.67
1LA4	.85
1LA6	.95
1LB4	.98
1LC5	.75
1LC6	.91
1LD5	.90
1LE3	.79
1LG5	.79
1LH4	.87
1LN5	.75
1N5GT	.75
1P5GT	.69
1Q5GT	.68
1R4	.69
1R5	.65
1S4	.69
1S5	.65
1T4	.65
1T5GT	.68
1U4	.67
1V	.65
1X2	.96
2A3	1.10
2A4G	.85
2A5	.45
2A6	.45
2A7	.45
2B7	.40
2V3G	1.05
2X2	.59
2X2A	1.55
3A4	.65
3A5	.85
3B7/1291	.42
3D6/1299	.43
3LF4	.89
3Q4	.63
3Q5GT	.79
3S4	.74
3V4	.74
5R4GY	1.95
5T4	1.32
5U4G	.69
5V4G	.98
5W4	.79
5X4G	.85
5Y3GT	.45
5Y4G	.67

5Z3	$0.85
5Z4	.65
6A3	.95
6A4/LA	.95
6A6	.82
6A7	.89
6A8GT	.95
6AB7	.98
6AC5GT	1.05
6AC7	.95
6AD7GT	1.29
6AE6G	.79
6AF6G	.85
6AG5	.82
6AG7	1.45
6AH6	1.29
6AJ5	1.95
6AK5	1.30
6AK6	1.09
6AL5	.59
6AQ5	.65
6AQ6	.85
6AR5	.25
6AT6	.65
6AU5	1.19
6AU6	.65
6AV6	.55
6B4G	1.25
6B7	.95
6B8G	.75
6BA6	.65
6BC5	.75
6BE6	.65
6BF6	.72
6BG6G	1.59
6BH6	.95
6BJ6	.95
6BQ6	1.25
6C4	.55
6C5	.60
6C6	.59
6C8G	.85
6CB6	.72
6D6	.72
6D8	.85
6E5	.75
6F6	.85
6F7	.85
6F8G	.87
6G6G	.95
6H6	.65
6H6GT	.65
6J5	.75
6J5GT	.55
6J6	.95
6J7	.65
6J7G	.60
6K6GT	.65
6K7	.79
6K8	.85
6L5G	.75
6L6	2.25
6L6G	1.50
6L6GA	1.50
6L7	.85
6L7G	.85
6N7GT	.85
6Q7GT	.85
6R7	.79
6S7G	.85
6S8GT	.92
6SA7GT	.65
6SC7	.95
6SD7GT	.85
6SF5	.77
6SF5GT	.77
6SF7	.75
6SG7	.75
6SH7	.65
6SJ7	.75

6SK7GT	$0.7-
6SL7GT	.75
6SN7GT	.75
6SQ7	.65
6SR7GT	.68
6SS7	.80
6ST7	.98
6SU7GTY	2.75
6SV7	.98
6T7G	.85
6T8	1.05
6U5G	.89
6U6GT	.85
6U7G	.55
6V6	1.39
6V6GT	.65
6W4	.65
6W7G	.65
6X4	.65
6X5GT	.95
6Y6G	.95
6Y7G	.75
6ZY5G	.65
7A4/XX1	.75
7A5	.75
7A6	.75
7A7	.75
7A8	.75
7AG7	1.00
7B4	.75
7B5	.75
7B6	.75
7B7	.75
7C4	.75
7C5	.75
7C6	.80
7C7	.65
7E5	.65
7E6	.55
7E7	.75
7F7	.75
7H7	.75
7K7	1.10
7L7	.85
7N7	.85
7Q7	.75
7R7	.85
7S7	.95
7V7	.89
7W7	.95
7X7	.99
7Y4	.59
7Z4	.65
12A	.59
12A6	.65
12A7	.95
12A8GT	.69
12AH7GT	1.19
12AL5	.85
12AT6	.55
12AT7	1.10
12AU6	.75
12AU7	.88
12AV6	.65
12BA6	.69
12BE6	.69
12C8	.85
12E5GT	.65
12H6	.69
12J5GT	.50
12J7GT	.75
12K7GT	.65
12K8	.72
12Q7	.65
12SA7GT	.75
12SC7	.85
12SF5	.75
12SF7	.52
12SG7	.85
12SH7GT	.68

12SJ7GT	$0.65
12SK7GT	.80
12SL7GT	.75
12SN7GT	.85
12SQ7GT	.72
12SR7	.72
12Z3	.75
14A4	.89
14A7	.85
14B6	.75
14F7	.82
14F8	.85
14H7	.85
14J7	.85
14N7	.89
14Q7	.75
14R7	.82
19BG6G	1.85
25L6GT	.65
25Z5	.65
25Z6GT	.68
26	.47
27	.30
30	.25
31	.55
32	.47
32L7GT	.78
33	.57
34	.65
35/51	.60
35A5	.68
35B5	.78
35C5	.67
35L6GT	.65
35W4	.53
35Y4	.65
35Z3	.68
35Z4	.60
35Z5	.52
36	.64
37	.59
38	.52
39/44	.25
41	.69
42	.65
43	.65
45	.75
45Z3	.54
45Z5	.69
46	.76
47	.79
48	1.25
49	.75
50A5	.85
50B5	.75
50C5	.67
50L6GT	.65
50Y6	.72
53	.68
56	.55
57	.62
58	.65
59	.85
70L7GT	1.35
71A	.55
75	.82
76	.55
77	.55
78	.75
80	.65
82	.85
83	1.10
83V	.92
84/6Z4	.75
85	.69
89	.25
117L7/M7	1.29
117N7	1.29
117P7	1.29
117Z3	.65
117Z6	.89

RADAR—COMMUNICATIONS—TEST EQUIPMENT

AN/APA10 Panoramic Adapter	$75.00
AN/APA11 Pulse Analyzer.	
AN/APN-4B	39.95
AN/APR4 Radar Search Receiver.	
AN/APR5 Radar Search Rec. 1000-3,100mcs	375.00
AN/APS3 Airborne X-Band Search Radar	875.00
AN/APS15 X-Band R.F. Head	99.50
AN/APT5 300-1500 mcs Xmitter	149.50
AN/CPT3 Dual Freq Victory Girl	129.50
Complete YJ Beacon Installations	19.95
AN/PPN-1 Portable Radar Beacon.	
BC221AK Freq. Mtr. with Modulation	149.50
BC-433G Compass Receiver	39.95
BC-639 Receiver	285.00
BC-640B 100-156 mcs ground xmitter	1300.00
BC-733D Receiver	29.95
BC-1016 Tape Code Recorder	459.50
BC-1206 Beacon Receiver	4.95
MN26V Compass Receiver	24.95
PE-75 2½KW Gasoline Generators	450.00
RA-34 Power Supply	250.00
SCR269G Automatic Radio Compass	129.95
SCR504 Portable D.F. 100 KC-65MC.	
SCR522 Airborne VHF Transceiver.	
SCR536 Handi-Talkie.	
SCR694 Lightweight Field Radio.	
SK-1M Radar Receiver Indicator	89.50
SQ Portable Radar 10 CM	850.00
T-50 Portable Radiotelegraph Xmitter	275.00
TCS Marine 2 Way Radio.	
TRC-1 Complete Antenna System.	
RA-62 Power Supply for SCR-522	
MD-5/APS-3 Modulators with Tubes	65.00
ARA 500-1500KC Receiver, good	24.95

AN/ARR-2X RECEIVER

Secret Transmission Receiver for reception of double modulated carrier. Will receive 235-258 mcs signals that have been modulated by a 600-750 KC signal. When carrier is heard on a standard receiver no modulation is heard on the carrier when actually speech is being transmitted. 12V DC input. Excellent condition.

R28/ARC- Receiver	$29.95
BC455B 6-9 mcs. Receiver	19.95
BC433 200-175KC Compass Rec	29.95
ARR-2 234-258 mcs. Receiver	19.95
BC-454 3-6 mcs. Rec. w/tubes, New	16.95
T23/ARC-5 Xmitter	49.95
BC696-A 3-4 mcs Xmitter	29.95
TYPE O 5.3-7 mcs Xmitter	9.95
AVT-23 300-13,000KC Complete, New	79.50
BC-950A 100-156 mcs. Xmitter, New	59.95
BC-456 Modulator, good	2.25
BC-450 Control Box (3 Rec.) used	1.25
BC-451 Control Box (Xmitter) used	.98
BC-442 Relay Unit (Ant) Used	1.95

FLEXIBLE SHAFTING AVAILABLE.

HRU-28 28V 2000W Gasoline Generator	
RG-8U Coaxial Cable. Per Thousand Feet	$85.00
SCR-518 Altimeter. Complete installation	29.95
SCR-522 Trans/Rec. Complete installation 28V Input. 12V input avail	129.50
RCA Sound Powered Chest & Headsets. Pair	29.95

LARGE QUANTITY PE-104 VIBRAPACK FOR SCR-284 NEW EXPORT PACKED.

HS-30 Headsets	3.95
FT-154 (BC-348 Shock Mount)	2.98
HS-33 Headsets	4.95
BC-608 Automatic Keyer for SCR522	5.95
BC1284 Lighthouse Tube Preamplifier	69.95
APA-17 D.F. Antenna. 300-1000 MC	59.00
BC-996 Interphone Amplifier	9.95
ART-13 Loading Condenser	4.95
CU-25 Loading Box for Art-13	49.95
AS-27/ARN5 Antenna	4.95
SA-1/ARN-1	2.95
1D-80/APA-17 Indicator	129.95
RM-29 Remote Control	18.95
RA-300 FM Exciter	32.50
A-55 Dummy Antenna	2.25
BC-1365 Control Box	3.95
FL-8 Filter	3.95
FL-5 Filter less Cables	2.65
3C-16D GSAP Gun Camera Computer, complete	19.95
AT-2/APN-2 Antenna	4.95
CG-(172/173)CPN-8 10CM Patch Cable	4.95

TS3/AP S-Band Freq & Power Meter.	
TS10/APN Altimeter Test Set, Ex	$35.00
TS11/AP.	
TS12/AP V.S.W.R. Test Set for X-Band.	
TS13/AP XA Band Sig Gen Pwr & Freq Mtr.	
TS14/AP SA Band Sig Gen.	
TS15/AP Flux Meter.	
TS16AP/ Altimeter Test Set	$29.95
TS19/APQ5 Range Calibrator.	
TS23/APN Test Set for SCR718 Altimeter.	
TS32/TRC-1 70-100 mcs Sig Gen used to check ANTRAC Equipment.	
TS33/AP X-Band Freq. Meter.	
TS34/AP Synchroscope.	
TS35/AP X-Band Sig Gen Pwr Mtr Freq Mtr	
TS36/AP X-Band Power Meter.	
TS45/AP X-Band Sig Gen.	
TS47/APR Sig Gen 40-500 Mcs.	
TS59/APN Altimeter Test Set.	
TS61/AP S-Band Echo Box	$140.00
TS62/AP X-Band Echo Box.	
TS67/AP I.L.S. Test Set.	
TS69/AP Freq. Mtr. 300-1000 mcs.	$72.50
TS89/AP Voltage Divider.	
TS102/AP Range Calibrator.	
TS110/AP Echo Box.	
TS111/AP S-Band Freq. Meter.	
TS125/AP S-Band Power Meter.	
TS126/AP Synchroscope.	
TS155/UP S-Band Sig Gen Pwr Mtr Freq. Mtr.	
TS164/AR A.C. Version of BC221.	
TS170/ARN I.L.S. Test Set.	
TS174/AP Freq. Mtr. 40-400 Mcs.	$385.00
TS175/AP Freq. Mtr. 300-1000 mcs.	
TS184/AP	
TS139/AP	
TS226/AP 300-1000 mcs Pwr Mtr	
TS268 Xtal Diode Test Se .	
TS278/AP AN/APS13 Test Set.	
BC-221 Frequency Meter.	
1E-19 Test Set for SCR522.	
1E-36 Test Set for SCR522.	

SO-13 S-BAND MARINE RADAR

Compact Sea Search Radar for small vessels. P.P.I. indication is provided. Complete in original cases with complete sets of spares. Excellent condition.

AN/ARC-1 TRANS/REC.

Provides Radio-Telephone Communication between Aircraft or Aircraft & Ground. Complete with Shock Mount & Control Box. Input: 28V DC. Excellent condition. Available in either 10 or 20 Crystal Controlled Channels 100-156 MCS. checked out.

TELETYPEWRITER SERVICE NY1-771

WE NOW OFFER THIS CONVENIENCE TO OUR CUSTOMERS. SEND YOUR REQUESTS AND ORDERS FOR TUBES, EQUIPMENT, TEST SETS, PARTS, ETC. TO NY1-771.

RADIO HAM SHACK Inc.
189 GREENWICH STREET . NEW YORK, N. Y.

PHONE DIGBY 9-0347

Cable Address: Hamshack New York

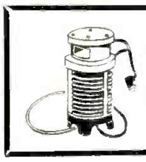
Prices subject to change without notice. F.O.B. NYC, minimum order $10.00. 20% deposit required. All merchandise guaranteed.

COMMUNICATIONS

ELECTROLYTIC CAPACITORS

METAL CAN—TWIST PRONG

Cap. Mfd	WVDC	Price
8-8-10	450/25	.26
10-10/10	150/25	.23
10-10/20	450/25	.26
10-15/20	350/25	.18
15-15/10	450/350	.23
16-16/25	450/50	.23
80-40/150	400/50	.45
120-60/20	150/25	.45
30-30-15/30	300/50	.39
40-40-20/20	350/15	.28
60-40-20/50	300/25	.28
60-40-20/200	150/10	.39
80-40-30/20	150/25	.36
80-40-30/100	150/25	.36
8/8/8	475/100/100	.23
10/50/100	350/100/50	.23
10/50/100	450/100/50	.27
20/20/10/20	350/300/300/25	.35



VOLTAGE REGULATORS

LELAND ELECTRIC TYPE B. Carbon Pile 21-30VDC reg. output 18V at 5 Amps.
WEBSTER ELECTRIC—35x025.
LELAND ELECTRIC TYPE C Spec VR9000-2C. Input volts 22-30. Output volts 19V at 5.7 Amps.

F. W. BRIDGE SELENIUM RECTIFIERS

UP TO 18 VAC IN—UP TO 14 VDC OUT

2A	$2.50
4A	4.00
6A	6.00
10A	7.50
12A	9.00
24A	18.00

UP TO 36 VAC IN—UP TO 28 VDC OUT

1A	$3.00
2A	4.00
4A	8.00
10A	14.50
12A	18.00
24A	36.00

UP TO 54 VAC IN—UP TO 42 VDC OUT

2A	$6.50
4A	8.50

UP TO 120 VAC IN—UP TO 100 VDC OUT

2A	$11.00
10A	48.00
12A	60.00

Special Rectifiers On Request

Hi-Current Chokes

1 HY—12 Amp—46 Ohms ... $14.95
.01 HY—2.5 Amp—Cased ... $2.25

LO-VOLT. XFMRS
Primaries 115v, 60 Cycle

8v-1.5A	.98
16v-5A	3.75
12v-5A	3.75

HI CAP. FILTER CONDENSERS

Cap	WVDC	Price
800	15	$1.35
2000	6	1.85
500	200	2.00
250	150	1.45

1 PER CENT PRECISION RESISTORS

OHMS	OHMS	OHMS
5	150	7,500
5.05	250	10,000
10	430	12,000
18	468	17,000
82	800	20,000
120	920	30,000
125	1100	35,000
128	4300	84,000

30c EACH ...... 10 FOR $2.50
100K 120K 150K 220K
40c EACH ...... 10 FOR $3.50
1 MEGOHM ...... EACH 75c

MAGNETRONS

Tube	
2J27	2J62
2J31	3J31
2J21'A	5J30
2J22	718DY
2J26	720BY
2J32	725-A
2J38 Pkg.	730-A
2J39 Pkg.	QK 62
2J49	QK 59
2J61	QK 61
	QK 60

700 A, B, C, D
706 AY, BY, DY, EY, FY, GY

UNIVERSAL POWER TRANSFORMER

Pri: Vibrator Input @ 6/12/24/110 VDC, AC Input: 110/220-V. @ 60 CY.
Sec: 230-0-230 V — 40 MA 6.3V — 1.8A. Ea. **$1.49**

RELAYS

Relay	Coil Res (ohms)	Coil Volts (D.C.)	Contacts	Price
RY 107	20	4-12	1A-20 Amp	$1.65
RY 1F3	100	12	2C	1.45
RY 12S	13,500	48	1A-1B	1.49
RY X42	120	18-24	2-B	.97
RY X27	120	18-24	2-B	.97
RY 80-2	100	20-24	2-A	.89
RY 834	30	3 (Can)	1-B	1.75
RY 6J3 c	150	24	3-C	1.29

ABOVE ARE LISTED ONLY A FEW OF OUR LARGE STOCK OF D.C. RELAYS. SEND FOR COMPLETE LISTING.

THERMISTORS

D-166283 .... $1.50
D-167332 (tube) $1.50
D-170396 (bead) $1.50
D-167613 (button) .. $1.50
D-164699 for MTG "X" band Guide. $2.50

VARISTORS

D-167176 .... $ .95
D-172155 .... $2.25
D-172307 .... $1.70
D-168687 .... $ .95
D-171812 .... $ .95
D-171528 .... $ .95
D-162356 (308A) ... $1.50

POWER TRANSFORMERS

Comb. Transformers—115V50-60 cps input

CT-07	760VCT	.300A	5V/3A, 6.3VCT/7A	$5.95
CT-15A	550VCT	.085A	6.3V/.6A, 6.3V/1.8A	2.35
CT-164	4200V/.002A/12KV Test, 5VCT/3A/12KV Test, 6.3V/0.6A/5400V Test			12.95
CT-341	1050V 10 MA, —625V @5 MA, 26V @ 4.5A 2x2.5V/3A, 6.3V @ 3A			22.50
CR-825	360VCT	.340	6.3VCT/3.6, 6.3VCT/3A	3.95
CT-626	1500V	.160	2.5/12, 30/.100	9.95
CT-15A	350VCT	.070	6.3/.6, 6.3/1.8, 3 lbs	2.95
CT-071	110V	.200	33/.200, 5V/10, 2.5/10	4.95
CT-378	2300V	4 Ma	2.5/2	6.95
CT-367	580VCT	.050	5VCT/3A	2.25
CT-721	550VCT	.100	6.3/1, 2.5VCT/2	2.95
CT-99A	2x110VCT	.010	6.3/1A, 2.5VCT/7A.	3.25
CT-403	350VCT	.026 MA	5V/3A	2.75
CT-931	585VCT	.036	5V/3A, 6.3V/6A	4.25
CT-610	1250	.002 MA	2.5V/2.1A, 2.5V/1.75A	4.95
CT-137	350VCT	.026 MA	5V/3A	2.75
CT-866	330V	.065	6.3V/1.2, 6.3V/600 MA	1.75
CT-456	390VCT	30 MA	6.3V/1.3A, 5V/3A	3.45
CT-160	800 VCT	100 MA	6.3V/1.2A, 5V/3A	4.95
CT-931	585VCT	86 MA	5V/3A, 6.3V/6A	4.95
CT-442	525VCT	75 MA	5V/2A, 10VCT/2A, 50V/200 MA	3.85

Filament Transformers—115V/50-60 cps input.

Item	Rating	Each
FT-674	8.1V/1.5A	$1.10
FT-157	4V/16A, 2.5V/1.75A	2.95
FT-101	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	17.95
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	12.95
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-986	16V @4.5A or 12V@4.5A	3.75
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A, TAP 2.5V/2.5A, 16KV TEST	18.95
FT-340	2x2.5V/3A, 7V/7A—23KV TEST	24.95
FT-038	6.3V/500A WELD	29.45
FT-608	6.3V/3A/750V Test	1.79
FT-873	4.5V/.5A, 7V/7A	2.19

FILTER CHOKES

Stock	Description	Price
CH-250	SWING, 2.5-24H/.4-.05A, 10KV Test	$7.95
CH-8-19	SWING, .006H/5A-.035H/.5A, .032 ohs DCR, 1KV TEST	2.95
CH-776	1.28 H/130 MA/75 ohms	2.25
CH-344	1.5 H/145MA/1200V Test	2.35
CH-43A	10 HY/15MA—850 ohms DCR	1.75
CH-917	10H, 450MA, 10KV TEST	12.95
CH-366	20H/300MA	6.95
CH-999	15 HY/15MA—400 ohms DCR	1.95
CH-511	6 H/80MA—310 ohms DCR	2.45
CH3-501	2x5H/400MA	2.79
CH-188M	5 HY 200MA	1.79
CH-488	10 HY .030A	1.19
CH-791	Dual 1.75-.125 HY 100 MA.	1.27
CH-981	15 HY .110A	1.59
CH-22-1	1 HY .100A	1.17
CH-779	.6 HY .490A	1.25
CH-25A	SW .09/.018 HY 3/.3A	8.95
CH-922	10000 HY O MA	2.75
CH-043	2.2 HY 80 MA	.98

400 CYCLE TRANSFORMERS

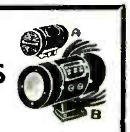
(All Primaries 115V, 400 Cycles)

Stock #	Ratings	Price
352-7039	640VCT @250MA, 6.3V/.9A, 6.3V/.6A, 5V/6A	$5.49
702724	9800/8600V @ 32MA	8.95
12033	4540V/250MA	17.50
KS9584	5000V/290MA, 5V/10A	22.50
52J652	13,500V/3.5MA	14.65
KS9607	731VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V/0.9A, 6.3V/2.5A, 6.3V/.06A, 5V/6A	6.95
352-7070	2X2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/1000/750V @ .005A	7.45
352-7196	1140V/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	900V/75MA, 100V/.04A	4.29
UX8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/80MA, 5V/3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300 VCT, 135MA	5.95
KS 9336	1100V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/21A	4.25
KS 8984	27V/4.3A, 6.3V/2.9A, 1.25V/.02A	4.95
52C080	526VCT/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
80G198	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	6.4V/7.5A, 6.4V/3.8A, 6.4V/2.5A ALL CT	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95
95-G-45	2000V/.002A, 465V/.6A, 14V/10A, 6.3V/23.5A, 6.3V/1.8A, 5V/9A, 2X2.5V/1.75A	17.95
TRANSTAT	IN: 115V, 400 CY. OUT: 75-120V, 6.0 Amps	12.95

AUDIO TRANSFORMERS

AT501 Hi-Fi Special: PRI: 3000 ohms P-P/Sec: 4/16/12/50/200 ohms 60-10,000 CY—1 db 50W. $3.49
AT152 Hi-Fi Driver Pri: 10,000 ohms Sec: 40,000 ohms PP Grids 50-15 KC/1 db. $1.49
AT063 Output to H.S. or line PRI: 14,200 ohms SEC: 8000/600 ohms $1.10
AT449 Hi-Fi Driver (5000 ohms) to P.P. output grids (4,000 ohms) 100-10,000 CY. 10 W. 6V6 to PP 805's $2.39
AT666 Intercon Input: Spkr (-4-8 ohms) to grid (250-000 ohms) $0.69
AT415 Plate (18,000 ohms C.T.) to line (125 ohms) 175 w.—500-600 CY. $1.95
AT858 Plate (10,000 ohms C.T.) to line V.C. (500/125130 ohms) HI-FI—50 W $6.95
AT070 Mike-or-Line (250 ohms) to grid (250,000 ohms C.T.) $1.20
AT765 Mike-or-Line (600 ohms) to grid (50,000 ohms ..C.T.) $0.89
AT871 Universal Output—10W Hi-Fi
PRI: 20,000 Ohms P-P/16,000 Ohms P-P also 5000/4000 ohms. Single End.
SEC. 500/15/7.5/3.75/1.25 ohms. Response Flat P.M. 1 d.b. 30-20,000 Cycles $4.75
AT-694 Hi-Fi Output: 3 Watts. 8500 Ohms P-P to V.C. (15 Ohms) 15-15KC PM 1 db. $1.49
AT4-A1: Mike (35 ohm Carbon) to Line 600 ohm/200 ohm $1.19
AT 649: Line (500 ohms) to Grid (75K ohms) .... .89c
AT-448: Line (600 ohms) to V.C. (6 ohms) 17 d.b. Level $1.19
AT 631: Mike-or-Line (200 ohms) To Single or P-P Grids (50K Ohms) .... .59c
AT 718 Line (300 ohms) to Line (600/30 Ohm) Response 50-20KC P.M. 1 db. .... .49c

DYNAMOTORS



Type	Input Volts	Input Amps	Output Volts	Output Amps	Radio Set
PE86	28	1.25	250	.060	RC 36
DM416	14	6.2	330	.170	RU 19
DM33A	28	7	540	.250	BC 456
PE101C	13/26	12.6	400	.135	SCR 515
		6.3	800	.020	
BD AR 93	28	3.25	375	.150	
23350	27	1.75	285	.075	APN-1
ZA0515	12/24	4/2	500	.050	
B-19 pack	12	9.4	275	.110	MARK II
			500	.050	
D-104	12		225	.100	
			440	.200	
DA-3A	28	10	300	.060	SCR 522
			150	.010	
			14.5	.5	
5053	28	1.4	250	.060	APN-1
PE73CM	28	19	1000	.350	BC 375
CW21AAX	13	12.6	400	.135	
	26	6.3	800	.020	
			9	1.12	
PE94	28	10	300	.200	SCR 522
			150	.101	
			14.5	.5	

INVERTERS

PE-218-E: Input: 25-28 vdc, 92 amp. Output: 115 v. 350-500 cy 1500 volt-amperes. Dim. 17"x6½"x10". New $34.50
PE-218-H: Same as above except size: 16½"x6"x10". New $34.50
PE-206: Input: 28 vdc, 38 amps. Output: 80 v. 800-cy. 500 volt-amps. Dim: 13"x5½"x10½". New $22.50
MG 149F. Input: 24 vdc. 36A. Output: 26 v @ 250 va. 400 cy. and 115 v @ 400 cy—500 va 1 phase $75.00

SPECIALS

SUPERSONIC CRYSTALS, Rochelle salt ..... $.50 Ea.
SYNCH. Motor, 1Rpm, 110 v, 60 cy $2.35
MOTOR, 24 vdc. 3 HP, 3800 rpm. New $75.00
TV LEAD IN WIRE, 300 ohms, HI-Q, Lo-Loss .... $1750/M FT Roll
GIBSON GIRL, Emerg. Xmtr, 500 kc $12.95
BC 306 ANTENNA TUNING UNIT, NEW $6.95
R9/APN-4, New, With Tubes $75.00
ID6/APN-4, New, With Tubes and Crystal $75.00
A-62 Phantom Antennae $8.50
2 Meter Choke, 1000 MA, 20-144 .... 8/$1.00
Supersonic Crystal Head, M-1, 22-27KC HI-2 .. $27.45
Underwater Microphone, Model JR, Z=50ω $24.50
Dynamic Mike & Headset Combo, B-19, New $3.75
HS-30 Inserts, M-300 .... $3.50 per M
Motors, 3 RPM—115V, 60 Cy $1.85
AN/ARC-4 VHF Trans-Rcvr $75.00
IE 36 Test Set, New $37.50
SCR 274 Test Set, I-104 .... $12.25
Carbon Pile Reg., 18V-5V #35X025 ....
ART-13 Driver Trans, 6V6 to P-P 811's $1.29
DM 34 Dynamotor, 14V In. 220V, 80 MA out ....
Sens. Relay: 3.5MA, 13K ohms, 2PST, 2A $1.29
Klixon Breaker: Thermal, 35A .... .69
T-30 Carbon Mikes. New .... .89

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ALL SHIPMENTS IN EXCESS OF 20 LBS. WILL BE SENT RAIL. EX. OR CHEAPEST TRUCK.

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EQUIPMENT CO.

RADAR— TEST GEAR

AN/APS-2	Airborne S Band Radar
AN/APS-3	Airborne 3CM Radar
AN/APS-4	3CM Airborne Radar
RU/GF	Complete Airborne Xmtr-Rcvr $99.50
TS60/AP	Freq. Meter, 341-1000MC.. $72.50
TS36	Power Meter, 3CM
TS 127/UP	Wavemeter, 300 700MC $72.50
TS268/AP	Xtl. Test Set $50
TS65/AP	Slotted Line, 500MC
TS15/AP	Flux Meter
TS47/APR	Test Osc. 50-3000MC.. $325.00
TS102	Range Callibrator
TS10/APN	Altmeter Test Set
SQ	10CM Portable Radar, 115V, 60Cy.
SO-1	10CM SEA Radar, 115VDC
SN	10CM Portable Radar, 115V, 60Cy.
PP-4/APQ-2	DC Power Supply from 400 Cy $65.00
MK10	10CM Gun Laying Radar
MKIV	800MC Gun Laying Radar
SO-8	10CM Radar, 115VDC
CPN-8	10CM NAV. Beacon, Ground Station
SG	10CM Heavy Duty Ship Radar
SO-7	10CM Radar, Truck Portable 115VAC
AN APN 4	Loran Set, Airborne
AN APN 3	Shoran, Xmtr. only
SE	10 cm Surface Search Radar
RA 38	H.V.P. Power Supply

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: 1-715B, 4-829-B, 3-'72's, 1-'73. New..$110.00

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

APS-1C MODULATOR DECK. Complete, less tubes.................. $75.00

PULSE NETWORKS

15A—1-400-50: 15 KV. "A" CKT. 1 microsec 400 PPS, 50 ohms imp..... $37.50

G.E. #6E3-5-2000-50P2T. 6KV "E" circuit, 3 sections .5 microsecond, 2000 PPS. 50 ohms impedance $6.50

G.E. #3E (3-84-810) (8-2.24-405) 50P4T; 3KV "E" CKT Dual Unit: Unit 1, 3 sections, 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

7.5E3-3-200-6FT. 7.5 KV. "E" Circuit, 3 microsec, 200 PPS, 67 ohms imp. 3 sections $12.50

PULSE TRANSFORMERS

G.E.K.-2745 .... $39.50

G.E.K.-2744-A. 11.5 KV High Voltage, 3.2 KV Low Voltage @ 200 KW oper. (270 KW max.) 1 microsec, or 1/microsec, @ 600 PPS................ $39.50

W.E.-KS 9800 Input transformer. Winding ratio between terminals 3-5 and 1-2 is 1.1:1, and between terminals 6-7 and 1-2 is 2:1. Frequency range: 380-520 c.p.s., Permalloy core $6.00

W.E. #D169271 Hi Volt input pulse Transformer.................... $27.50

G.E. K2450A. Will receive 13KV. 4 micro-second pulse on pri. secondary delivers 14KV. Peak power out 100KW G. E.................... $34.50

G.E. K2748A. Pulse Input line to magnetron.................... $36.00

Ray UX 7896—Pulse Output Pri. 5v, sec. 41v.................... $7.50

Ray UX 8442—Pulse inversion—40v + 40v.................... $7.50

Ray UX 7361 5 msec. 60-400 cy.................... $5.00

PHILCO #352-7250, 352-7251, 352-7287 **UTAH** #9262, 9332, 9278, 9341.

RAYTHEON: UX8693, UX7428, UX7350.

WEST. ELECT: D-161310, D-166638, D-166173, D-169114, D-161929, KS9948.

MICROWAVE TEST EQUIPMENT

X BAND POWER METER

Consists of thermistor mount and bridge, microammeter, rough attenuator. X-Band Waveguide thruout. For power measurements anywhere in the 9000 MC band $225.00

BROADBAND TEST OSCILLATOR

Freq. coverage 50-3000 MC. By direct calibration and interpolation anti-backlash gear drive: compact, portable. Operates from any 115V source or battery source. New, with all tubes.................... $325.00

MICROWAVE ANTENNA EQUIPMENT

AS-31 APN-7: 10 cm. Polyrod in Lucite Ball. Type N Fitting, Coax Feed $27.50

Relay System Parabolic reflectors approx. range 2000 to 6000 Mc. Dimensions 4½' x 3'. New........ $75.00

Dipole for above.................... $12.00

TDY "JAM" Radar rotating antenna, 10 cm. 30 deg. beam, 115 V AC drive. New.................... $150.00

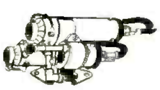
10 CM Horn, Rectangular-to square-to circular RF assembly ending in horn, radiating circularly polarized beam. Waveguide input. Complete with flange $50.00

Parabolic Peel. Radiation pattern approx. 25 deg. in horizontal, 33 deg. in vertical planes $35.00

Cone Antenna. AS 125 APR, 1000-3200 mc. Stub supported, with type 'N" connector $4.50

140-600 mc Directional Antenna

140-310 mc cone and 300-600 mc cone, each consisting of 2 end fed half wave conical sections with enclosed matching stub for reactance changes with changing frequency. New: complete with mast, guys, cables, carrying chest $49.50



10 CM RESEARCH EQUIPMENT

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

REACTION WAVEMETER 3000-3700 MC. Mfg. Head. Comp. with Cal. Chart $125.00

BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice..........each $47.50

MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plate $45.00

SIGNAL GENERATOR, using 417A klystron, 2700-3300 mc. Output approx. 50 mw. 115 vac power supply. With tubes, new.................... $425.00

REGULATED POWER SUPPLY for GL 446 type lighthouse tubes (2C40, etc.) 115 vac, 60 cycles. Panel Mounting. Less tubes.................... $32.50

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. Three types available. $4.00

TS 268 CRYSTAL CHECKER.................... $35.00

F 29/SPR-2 FILTERS. type "N" input and output.................... $12.50

WAVEGUIDE TO ⅞" RIGID COAX "DOORKNOB" ADAPTER CHOKE FLANGE, SILVER PLATED BROAD BAND.................... $32.50

AN/APR5A 10 cm antenna equipment consisting of two 10 cm waveguide sections, each polarized, 45 degrees....................per set. $75.00

AS14A/AP-10 CM Pick up Dipole with "N" Cables.................... $4.50

S BAND SIGNAL GENERATOR, complete with calibrated attenuator, W. E. coax. wavemeter, McNally Klystron Cavity. Regulated power supply operates from 115 V.A.C., 50-1200 Cycles. Manufactured by W. E.................... $650.00

OAJ ECHO BOX, 10 CM. TUNABLE.................... $22.50

⅞" RIGID COAX—⅜" I. C.

RIGHT ANGLE BEND. with flexible coax output pickup loop.................... $8.00

SHORT RIGHT ANGLE BEND. with pressurizing nipple.................... $3.00

RIGID COAX to flex coax connector.................... $3.50

STUB-SUPPORTED RIGID COAX. gold plated 5' lengths. Per length... $5.00

RT. ANGLES for above.................... $2.50

RT. ANGLE BEND 15" L. OA.................... $3.50

FLEXIBLE SECTION. 15" L. Male to female.................... $4.25

FLEX COAX SECT. Approx. 30 ft.................... $16.50

⅞" RIGID COAX. PULKHEAD FEED-THRU.................... $14.00

1.25 CM RESEARCH EQUIPMENT

APS-34 Rotating Joint.................... $49.50

Right Angle Bend E or H Plane, specify combination of couplings desired..$12.00

45° Bend E or H Plane, choke to cover.................... $12.00

Mitered Elbow. cover to cover.................... $4.00

TR-ATR-Section, Choke to cover.................... $4.00

Flexible Section 1" choke to choke.................... $5.00

"S" Curve Choke to cover.................... $4.50

Adapter. round to square cover.................... $5.00

Feedback to Parabola Horn with pressurized window.................... $27.50

90° Twist.................... $10.00

3 CM Research Equipment

1" x ½" Waveguide

1" x ½" waveguide in 5' lengths, UG 39 flange to UG40 cover....per length, $7.50

Rotating Joints supplied either with or without deck mounting. With UG40 flanges ....each, $17.50

2J42 Magnetron Pulse Modulator. 14kw max. rating 7kw min. Plate voltage pulsed 5.5kv 6.5 Amp. .001 duty cycles. 2.5 usec pulse length max. filament 6.3V .5 Amp. Includes magnetron mtg. and blower. Requires 3C45 and 2-3B24. New $75.00

TS 268 Crystal Checker.................... $50.00

Bulkhead Feed-Thru Assembly.................... $15.00

Pressure Gauge Section 15 lb. gauge and press nipple.................... $10.00

Pressure Gauge, 15 lbs.................... $2.50

Dual Oscillator-Beacon Mount. P/O APS 10 Radar for mounting two 723A/B klystron with crystal mts. matching slugs, shields.................... $42.50

Dual Oscillator. Mount. (Back to back) with crystal mount, tunable termination attenuating slugs $18.50

Directional Coupler. UG-40/U Take off 20 db.................... $17.50

2K25/723 AB Receiver local oscillator Klystron Mount, complete with crystal mount. Iris coupling and choke coupling to TR.................... $22.50

TR-ATR Duplexer section for above.................... $8.50

CU 105/APS 31 Direction Coupler 25 db.................... $25.00

723AB Mixer—Beacon dual Osc. Mnt. w/xtal holder.................... $12.00

Waveguide Section 12" long choke to cover 45 deg. twist & 2½" radius, 90 deg. bend $4.50

Twist 90 deg. 5" choke to cover w/ press nipple.................... $6.50

Waveguide Sections 2½ ft. long silver plated with choke flange.................... $5.75

Rotary Joint choke to choke with deck mounting.................... $17.50

3 cm. mitred elbow "E" plane.................... $12.00

90 degree elbows, "E" or "H" plane 2½" radius.................... $12.50

90 degree twist 6" long.................... $8.00

45 degree twist.................... $8.00

40KW X BAND Radar, complete as described and illustrated in July 1951 PROC IRE

APS-4 Under Belly Assembly Used, less tubes.................... $375.00

1¼" x ⅝" Waveguide

Mitred Elbow H Plane UG51-UG52.................... $12.00

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., 75¢

Slug Tuner Attenuator W.E. guide. Gold 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" Adaptor, Broadband.................... $22.50

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NEW GE 1 KW, 3 KW, and 10 KW-RF AMPLIFIERS!!

G.E. Transmitting Equipment of recent design, NOT WAR SURPLUS, all NEW and export cased—at tremendous reduction from original price! Available, *in quantity:* Type BF-1-A, 1 KW Power Amplifier and Power Supply; BF-2-A, 3 KW Power Amplifier with separate matching Rectifier-Power Supply; BF-3-A, 10 KW Power Amplifier with separate matching Rectifier-Power Supply. This equipment is designed for 88-108 MC FM Broadcasting application, beautifully engineered and constructed. (250 Watt FM Exciter or Driver NOT AVAILABLE). Conversion to lower frequencies (2 to 24 mc, or other frequencies) can be accomplished at very low cost. Our factory will be glad to quote on conversion to specified frequencies. All units designed for 208/230 volts, 50/60 cycles operation; 3 KW and 10 KW units require 3-phase. All incorporate internal blower systems for forced air-cooling, and use latest G.E. hi-efficiency tubes. Quantities sufficient to interest manufacturers—to convert for other applications. Ideal for FM Broadcasters, communication companies, Schools, Labs! Available as separate units, or complete. Write for more complete specifications and prices.

WILCOX, 96-200-A, 2 KW TRANSMITTER, with **Wilcox 36A RECTIFIER.** 125 to 525 KC. complete RF cabinet (96-200A) and Rectifier cabinet which is designed for modulation also (modulator not in stock). New Condition. **PRICE, both units, less tubes. $1,750.00**

TBK-10, 500 watt, 2-18.1 MC. CW Telegraph Transmitter designed for ship installation. Almost NEW condition, complete with tubes, less MG set and accessories.
PRICE $300.00

LINK FM TRANSMITTER-RECEIVER, 70-100 mc. 500 watts output. Model 1498 DC. Wall style cabinet containing transmitter, receiver and 14 V.D.C. power supply, hand-set. Dim.: 34" x 21" x 11". NEW Condition. Complete with tubes, crystals, special telescopic antenna, instruction book.
PRICE $500.00

MODEL ATD AIRCRAFT RADIO TRANSMITTER EQUIPMENT. This is a Navy Model. 4-channel (motor driven band switching), covering the range of 540 KC to 9050 KC. Output 50 watts phone, but operate A-1, A-2 as well as A-3. Operates from 24-28 Volt DC Dynamotor. Each set includes: Dynamotor, Remote Control, Channel Selector Control, Plug Connectors, Operating Tubes, Spare Chest with Spare Tubes and Parts, and Instruction Books. All BRAND NEW, in Original Cases: each with 4 Tuning Units to cover the aforementioned range of frequency.
PRICE, EACH $160.00

RCA ET-4332-B and MI-8167 TRANSMITTERS. 250 watt output phone. 350 watts CW. Range 2.0 to 20.0 mc. Crystal or M.O. control. Operation 230/1/50/60 cycles AC. With separate speech amplifier, tubes. LIKE NEW condition.
PRICE, EACH $675.00

TDQ TRANSMITTERS. VHF. 45 watts output AM. 110 to 156 mc; 115/230 V. AC. 60 cycles. with tubes, cables, EXCELLENT condition.
PRICE, EACH $650.00

BC-797-A TRANSMITTERS, 110-126 mc, 50 watts output phone, AM, for 110 V. 60 cycle operation.
PRICE, EACH $600.00

SCR-522 VHF AIRBORNE TRANSMITTER RECEIVERS, With Tubes, LIKE NEW condition.
PRICE, EACH, less accessories $75.00

RMCA MODEL 8010 I.F. SHIP MAIN RADIO TRANSMITTER. 325 to 500 KC. GOOD Condition. Less MG.
PRICE, EACH $550.00

TDE-2 TRANSMITTER, 230 V. DC Operation. EXCELLENT condition. With mg. set.
PRICE, EACH $675.00

RMCA. 8021 RADIO TELEPHONE SHIP RADIO. 25 watts phone, 6 channel transmitter and receiver, 32 and 110 V. DC Operation. LIKE NEW condition.
PRICE, EACH $275.00

RMCA. 8003 EMERGENCY TRANSMITTER. 500 KC. 50 watts output with 12/115 V. DC motor generator set, and battery charging unit. EXCELLENT condition. Complete with tubes.
PRICE, EACH $275.00

MACKAY TRANSMITTER #136-A, Freq. 5.5 to 22 mc.; 40 watts, 115 DC with Motor Generator.
PRICE, EACH $100.00

SUPREME SHIP-TO-SHORE TRANSMITTER-RECEIVER, 110 watt output, 10 channel, 2-3 mcs., crystal controlled, for 110 V. AC. 60 cycles. Condition LIKE NEW. Complete with tubes and microphone.
PRICE $500.00

TRANS-RECEIVERS

TCS COLLINS SHIP TRANSMITTER-RECEIVERS. Each with cables, remote control box and loading coil, radio-telephone and radio-telegraph at 20 and 40 Watts, 1.5 to 12.0 mc. Following power supplies available: 12 V. DC. 24 V. DC. 230 V. DC. 110 V. AC.
Complete with all accessories EXCELLENT, like NEW condition. **WRITE FOR PRICE.**

SCR-284 EQUIPMENT, consisting of BC-654 Transmitter-Receiver, PE-103 Generator Power Supply, GN-45 Hand Generator with cranks and legs, and PE-104 Receiver-Vibrator Power Supply, plus other minor accessories. All equipment in EXCELLENT Condition, with complete tubes. **WRITE FOR PRICE.**

SCR-511 POGO STICK WALKIE-TALKIE. This is a low Powered portable AM Radio Telephone Transmitter-Receiver, covering a frequency range of from 3 to 6 mc. Pre-Tuned Plug-in Tuning Units (BC-746) which contain appropriate Transmitter and Receiver. Crystals and matching coils are employed to provide quick changeover to any frequency in the 3 to 6 mc. band. The Transmitter-Receiver (BC-745) is mounted on a 30" metal stake, which can be driven into the ground to support the unit. A telescopic antenna is provided at the top, along with a convenient "press to transmit" switch. Each set consists of: BC-745 Transmitter-Receiver, complete with Tubes; 13 Plug-in Tuning Units BC-746, with crystals and coils to provide coverage over the 3 to 6 mc. range; PE-157 Vibrator Power Supply, which incorporates the dynamic Loudspeaker (for reception), Vibrator, Dry Disc Rectifier, and space for a 2 volt non-spillable acid type storage battery (not supplied). Equipment is NEW and UNUSED. A T-17 Microphone and 2-Volt Storage Battery (Plastic case type readily available) are all that are required for each set to put into operation. **PRICE EACH $125.00**

TEST EQPT.

BC-221, I-222-A Signal Generator, 100-156 MC, with crystal calibrator, for 115 V. 60 cycles AC.

TU-56, TU-57, BC-1236-A, and 78E Sig. Generators, TS-143, I-148, TS-143/CPM—1 Synchroscope. Others.

AUDIO SOUND

BEACHMASTER AMPLIFIERS, 250 Watt Portable Sound System. Operates from 110 volt, 1-phase, 60 cycles AC. Tripod, Bracket. Complete Tubes and Cables included. All Equipment in NEW and EXCELLENT condition.
PRICE, EACH $485.00

WESTERN ELECTRIC MODEL HLAS, 500 Watt SOUND AMPLIFIER SYSTEM, consisting of: 40 Watt Pre-Amplifier, 500 Watt Power Amplifier with built-in Power Supply, Expandor-Compressor Circuit. 12-Speaker Horn Racks, and Motor Generator which operates from a 48 Volt DC source to supply 1.5 KVA, 115 Volts, 60 Cycles, 3-phase AC. Included are all Tubes and Cables. Most of this Equipment is NEW to Like-New Condition.
PER SET WITH MG $985.00
PRICE, LESS MG $895.00

HLAS 6-UNIT SPEAKER HORN RACKS. Each Speaker Unit will handle 50-60 Watts of Audio Sound Power. Extremely large Alnico Slugs (approximately 6 pounds) used in Speaker. Two of these Speakers make up a 12-Speaker Rack for above 500 Watt HLAS System. NEW, UNUSED Condition.
PRICE PER 6 UNIT HORN $135.00

W.E SPEAKER UNITS, D-173246, (25-30 W) Dynamic PM, cone type, Beachmaster replacement.
PRICE, EACH $14.95

W.E. SPEAKER UNITS, D-173232A (50 to 60 W) Dynamic PM, Cone Type, Western Elec. 500 W. HLAS replacement.
PRICE, EACH $20.95

RCA 12 V. DC PUBLIC ADDRESS SYSTEM, 25 watts peak power output, SPEAKER not included. NEW equipment.
PRICE, EACH, complete with sound-powered mike $54.75
PRICE, EACH, less microphone $44.75
PRICE, EACH, Modified for 110 V. AC, less mike $49.50

RADAR

SCR-545-A, Complete in Trailer Trucks, with or without 25KVA Gas-Engine Generator Unit and Motor Cab.
Hundreds of radar components, plumbing, magnets, tubes, transformers, etc.

RECEIVERS

RBM, RBS, BC-1068 VHF, SCR-206 Direction Finders with Loops. Others.
CRV-46136, 100 to 1500 KC, part of DP-13 Radio Eqpt.
RT-3/ARN-1 Radio Receivers, New. **Model ZB-3, Aircraft Homing Adapters,** with plugs and accessories. New Eqpt.

MISCELLANEOUS

GENERAL ELECTRIC VOLTAGE REGULATOR (POWER SUPPLY), Model 3GVD-14B-3, delivers up to 750 volts at 100 MA. with voltage divider network to provide lower voltages all regulated. Incorporates switch for "regulating", "non-regulating", and "stand-by". Uses following tubes (not supplied): 1—807, 1—6SJ7, 2—6H6, 1—VR-105, 1—VR-150, 1—6AG7, and 1—5R4GY. Chassis dimensions 11" x 16" x 3" with chassis cover 9" high. Ideal for laboratories, Frequency Shift Equipment, Stable Oscillator construction, etc. All NEW Condition Units.
PRICE, EACH $24.50

DECK ENTRANCE INSULATORS. Manufactured by Ohio Brass Co. for Army and Navy use. Has heavy galvanized metal flange 8⅞" diameter, porcelain bowl set in rubber gaskets, top bell is 6¼" in diameter. Brass feed-thru rod 11½" long. Insulation distance between top bell and flange is 4½". All NEW Condition.
PRICE, 10 FOR $20.00

KATO 32 VOLT DC to 110 VOLT AC ROTARY CONVERTERS. Model 5KA43, Type 608A. Rated at .225 KVA. 1-phase, 60 cycles, 110 volts AC, but will deliver up to 300 watts at intermittent service. Completely filtered input and output circuits and rubber shock-mounted to minimize noise and vibration. These are NEW, UNUSED units, packed two to a case. Ideal for boats, cabins, farm use, etc.
PRICE, EACH $39.50

G.E. D. & W. OIL FUSE CUTOUTS. Model 9F292, rated 50 amps/5,000 V. or 100 amps/2,500 V. grd. Y. NEW Units.
PRICE, EACH $60.00

DYNAMOTOR DM-28, for BC-348, Receiver. NEW.
PRICE, EACH $6.95

MP-22A MAST BASE. W/insulator, spring loaded for swiveling and quick return. NEW Units.
PRICE, EACH $3.95

RADIOSONDE AN/AMQ-1. Meteorological Balloon transmitter with self-contained instruments. New Units, with slide-rule temperature evaluators and spare (sealed) humidity elements. Large quantity available. Receiving and Recording supplementary eqpt. also available. Type AN/FMQ-1. **WRITE FOR PRICE.**

"SNOOPERSCOPE" TUBES, British Infra-Red Image Converter Tubes, with matching Bausch & Lomb front-end Lens.
TUBE .... $5.00 ea. LENS .... $10.00.

T-9/APQ-2 Radio Transmitters. Noise modulated Jamming Transmitter, using Electron-Multiplier Photocell. For Jamming certain types radar eqpt. New unused transmitters only, with Electron-Multiplier tube, less other tubes. **EACH $32.50**

SB-23/GTA-2 & SB-14/GY Switchboards & Power Supply, for operation from 110V, 60 Cycles AC (with storage batteries). Each in individual metal cabinet. NEW.
Price, Each Set $300.00

ECLIPSE PIONEER TYPE C-14 MAGNESYN UNIT

Per W.E. Spec., KS-5899-L01 excitation 26 volts 400 C.P.S. current drawn 200 to 500 MA. Shaft locking arrangement overall dim. 2¼" dia. 2¼" long. .812" x 2.562" Mtg. centers NEW Units.
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INDUSTRIAL CAPACITORS
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Syncro—Capacitor

30-50-50 mfd., Standard Brand Delta connected. 90 V. AC, 60 cps. oil-filled. All NEW, packaged capacitors. For power-factor correction on 115 V. 3 phase AC. etc. Large quantity available.
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TELECHRON SYNCHRONOUS MOTOR Type BC, 110 V., 60 Cy., 6 W., 60 RPM. PRICE $4.00 EA.

HAYDON TIMING MOTORS 110 V., 60 CY.

Type 1600, 2.2 W., 4/5 RPM. PRICE $3.00 EA.
TYPE 1600, 2.2 W., 1/240 RPM. PRICE $3.00 EA.

TYPE 1600, 2.3 W., 1 RPM. PRICE $3.00 EA.
TYPE 1600, 2.2 W., 1-1/5 RPM. PRICE $3.00 EA.

TYPE 1600, 2.2 W., 1/60 RPM. PRICE $3.00 EA.

SERVO MOTORS

CK1, PIONEER, 2 φ 400 Cy. PRICE $10.00 EA.

CK2, PIONEER, 2 φ, 400 Cy. PRICE $14.00 EA.

CK2, PIONEER, 2 φ, 400 Cy., with 40:1 reduction gear. PRICE $15.50 EA.

10047-2-A, PIONEER, 2 φ, 400 Cy., with 40:1 reduction gear. PRICE $10.00 EA.

MINNEAPOLIS HONEYWELL Amplier Type G403, 115 V., 400 Cy., Used with above motor. PRICE $10.00 EA. WITH TUBES

REMOTE INDICATING COMPASSES 26 V., 400 CY.

PIONEER TYPE AN5730-2 Indicator and AN5730-3 Trasmitter. PRICE $40.00 PER SET

KOLLSMAN TYPE 680K-03 Indicator and 679-01 Transmitter. PRICE $15.00 PER SET

D C MOTORS

BODINE NFHG-12 MOTOR 27 V. DC Governor Controlled, 1/30 HP, Constant Speed. PRICE $16.50

DELCO MOTOR, TYPE 5068750, 27 V., D.C., 160 R.P.M., with Brake. Price $22.50 EA.

JAEGER WATCH CO. TYPE 44K-2 Contactor Motor, 3 to 4.5 V. Makes one contact per second. PRICE $3.50 EA.

BARBER-COLMAN CONTROL MOTOR, Type AYLC 5091, 27 V., 0.7 Amps., 1 RPM. Contains 2 ad. limit switches. 500 in. lbs. torque. PRICE $9.50 EA.

WHITE ROGERS ELECTRIC CO., Type 6905 No. 3, 12 V., 1.3 Amps., 1½ RPM, torque 75 in. lbs. PRICE $10.50 EA.

ENGINE HOUR METER

John W. Hobbs Model MI-277. Records running time up 1000 hours. 20 to 30 volts D.C. PRICE $15.50 EA.

INVERTERS

WINCHARGER CORP. PU 16/AP, MG570. Input 24 V. D.C., 60 Amps. Output 115 V., 400 Cy., 1 φ, 6.5 Amps. PRICE $100.00 EA.

HOLTZER CABOT TYPE 149F, Input 24 V. D.C. at 36 Amps., Output 26 V. at 250 V.A., 400 Cy., and 115 V., 400 Cy., at 500 V.A., 1 φ, PRICE $75.00 EA.

PIONEER TYPE 12117. Input 12 V. D.C., Output 26 V., 400 Cy. at 6 V.A. PRICE $30.00 EA.

PIONEER TYPE 12117. Input 24 V. D.C., Output 26 V., 400 Cy. at 6 V.A. PRICE $30.00 EA.

PIONEER TYPE 12116-2-A. Input 24 V. D.C., at 5 Amps, Output 115 V., 400 Cy., 1 φ at 45 watts. PRICE $100.00 EA.

GENERAL ELECTRIC TYPE 5D21NJ3A. Input 24 V. D.C. at 35 Amps. Output 115V., 400 Cy., 485 V.A., 1 φ. PRICE $35.00 EA.

LELAND PE 218. Input 24 V. D.C. at 90 Amps. Output 115 V., 400 Cy., 1 φ at 1.5 K.V.A. PRICE $47.50 EA.

PIONEER AUTOSYNS

TYPE AY1, 26 V., 400 Cy. PRICE $8.50 EA.
TYPE AY5, 26 V., 400 Cy. PRICE $8.50 EA.
TYPE AY14G, 26 V., 400 Cy. PRICE $15.00 EA.
TYPE AY14D, 26 V., 400 Cy. PRICE $15.00 EA.
TYPE AY54D, 26 V., 400 Cy. PRICE $10.00 EA.
TYPE AY131D Precision Autosyn. PRICE $35.00 EA.

PIONEER AUTOSYN POSITION INDICATORS & TRANSMITTERS

TYPE 5907-17. Dial graduated 0 to 360°, 26 V., 400 Cy. PRICE $30.00 EA.

TYPE 6007-39. Dual Dial graduated 0 to 360°, 26 V., 400 Cy. PRICE $50.00 EA.

TYPE 4550-2-A Transmitter, 26 V., 400 Cy., 2:1 gear ratio. PRICE $20.00 EA.

VOLTAGE REGULATORS

LELAND ELECTRIC CO. TYPE B, Carbon Pile type. Input 21 to 30 V. D.C. Regulated

WESTERN ELECTRIC TRANSTAT VOLTAGE output 18.25 at 5 Amps. PRICE $6.50 EA.
REGULATOR Spec. No. V-122855, Load K.V.A. 0.5 Input 115 V., 400 Cy. Output adjustable from 92 to 115 V. PRICE $10.50 EA.

RATE OR TACHOMETER GENERATORS

GENERAL ELECTRIC TACHOMETER GENERATOR TYPE AN5531-1. Variable frequency, 3 φ output. PRICE $30.00 EA.

GENERAL ELECTRIC TACHOMETER GENERATOR TYPE AN5531-2. Variable frequency, 3 φ output. PRICE $30.00 EA.

ALL PRICES F. O. B. GREAT NECK N. Y.

SYNCHROS

IF SPECIAL REPEATER, 115 V., 400 Cy. PRICE $20.00 EA.
2J1F3 GENERATOR, 115 V., 400 Cy. PRICE $10.00 EA.
2J1G1 CONTROL TRANSFORMER, 57.5/57.5 V., 400 Cy. PRICE $10.00 EA.
2J1F1 GENERATOR, 115 V., 400 Cy. PRICE $10.00 EA.
2J1H1 DIFFERENTIAL GENERATOR 57.5/57.5 V., 400 Cy. PRICE $10.00 EA.
5SDG DIFFERENTIAL GENERATOR, 90/90 V., 400 Cy. PRICE $20.00 EA.
5G GENERATOR, 115 V., 60 Cy. PRICE $50.00 EA.
W. E. KS-5950-L2 Size 5G, 115V, 400 Cy. PRICE $10.00 EA.

D C ALNICO FIELD MOTORS

DIEHL TYPE S.S. FD6-23, 27 V., 10,000 RPM. PRICE $10.00 EA.
DELCO TYPE 5069370, 27 V., 10,000 RPM. PRICE $15.00 EA.
DELCO TYPE 5072400, 27 V., 10,000 RPM. PRICE $15.00 EA.

BLOWER ASSEMBLIES

JOHN OSTER TYPE MX215/APG, 28 V. D.C., 7,000 RPM, 1/100 H.P. PRICE $10.00

WESTINGHOSE TYPE FL, 115 V., 400 Cy., 6,700 RPM, Airflow 17 C.F.M. PRICE $10.00 EA.

DELCO TYPE 5608571 Motor and Blower Assembly, P.M. Motor, 27 V., 10,000 RPM. PRICE $15.00 EA.

GENERAL ELECTRIC D C SELSYNS

8TJ9-PAB, TRANSMITTER, 24 V. PRICE $4.50 EA.
8DJ11-PCY, INDICATOR, 24 V. Dial marked —10° to +65°. PRICE $6.00 EA.
8DJ11-PCY, INDICATOR, 24 V. Dial marked 0 to 360°. PRICE $7.50 EA.

RECTIFIER POWER SUPPLY

Hammett Electric Mfg. Co., Model SPS-130, Input Voltage AC 208 or 230, 60 cycle, 3 phase, 21 amps. Output 28 Volts, 130 amps, continuous duty. 37" high, 22½" wide, 21" deep. Contains DC Volt meter, DC amp meter and 8 point tap switch for variable output voltage. Brand new. Price $350.00.

MISCELLANEOUS

PIONEER MAGNETIC AMPLIFIER ASSEMBLY Saturable reactor type output transformer. Designed to supply 1 phase to a 400 cycle motor such as the Pioneer CK-5 or CK-2 from the plate of a 6SN7 tube. PRICE $15.00 EA.

SPERRY A5 CONTROL NIT, Part No. 644836. PRICE $7.50 EA.

SPERRY A5 AZIMTH FOLLOW-UP AMPLIFIER, Part No. 656030, with tubes. PRICE $5.50 EA.

SPERRY A5 DIRECTIONAL GYRO, Part No. 656029, 115 V., 400 Cy., 3 φ. PRICE $25.00 EA.

PIONEER TYPE 12800-1 GYRO SERVO UNIT. 115 V., 400 Cy., 3 φ. PRICE $20.00 EA.

ALLEN CALCULATOR TYPE C1 TURN & BANK INDICATOR, Part No. 21500, 28 V. D.C. PRICE $15.00 EA.

TYPE C1 AUTO-PILOT FORMATION STICK, Part No. G1080A3. PRICE $15.00 EA.

PIONEER GYRO FLUX GATE AMPLIFIER Type 12076-1-A, 115 V., 400 Cy. PRICE $40.00 EA.

INSTRUMENT ASSOCIATES

363 GREAT NECK ROAD, GREAT NECK, N. Y.
Telephone GReat Neck 4-1147

Write for Catalog NE100

U. S. Export License-2140

Western Union address: WUX Great Neck, N. Y.

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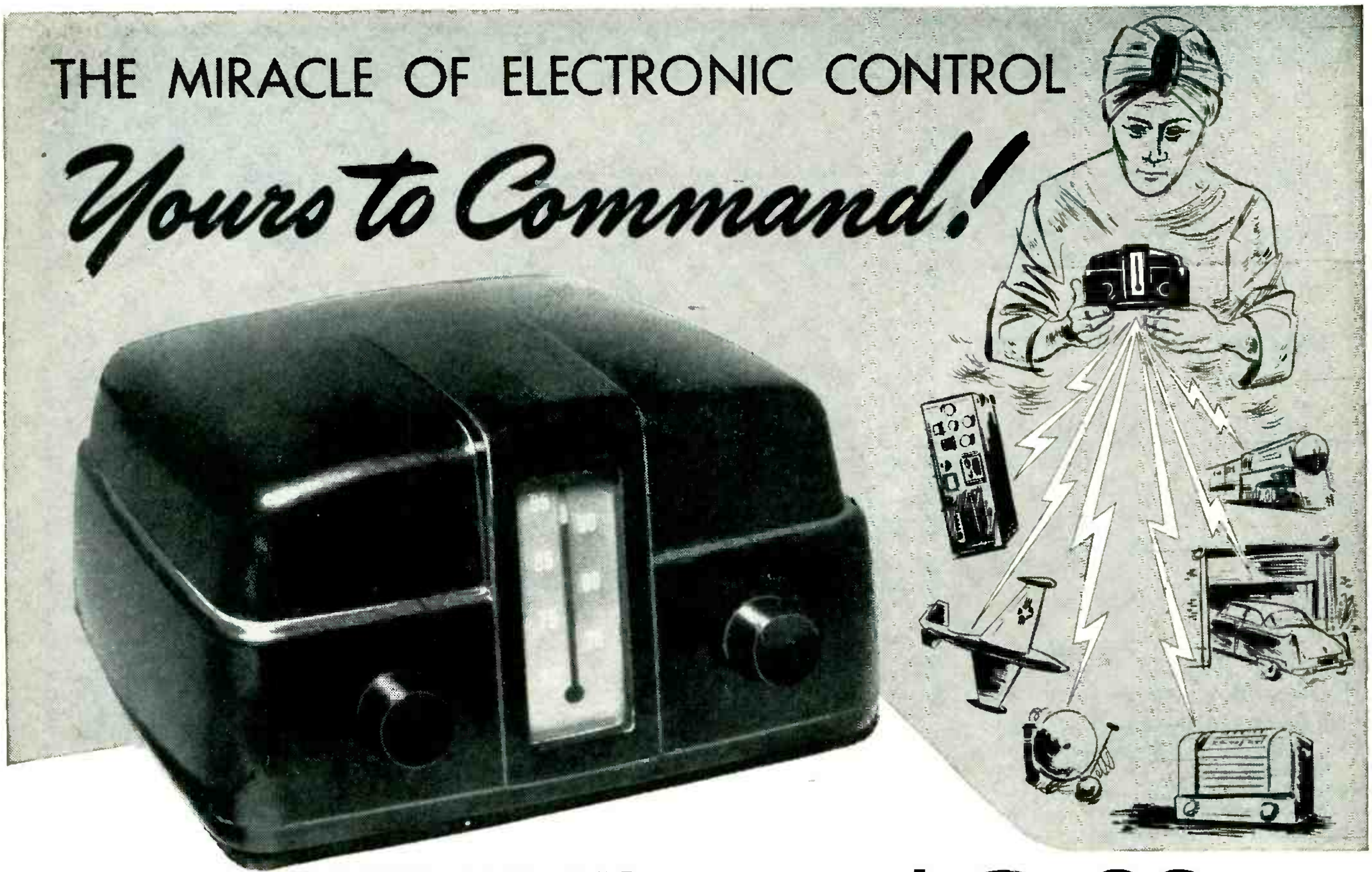


ADVANCED THYRATRON CIRCUIT REMOTE CONTROL

FOR 110 VOLTS 60 CYCLES AC

only **$2.88** (Less Cabinet & Tube Kit)
No. C.O.D. Postpaid in U.S.A. Only

Complete With Cabinet and Thyratron Tube Kit........ **$7.50**
No. C.O.D. Postpaid in U.S.A. Only

Engineers—Hams—Students Servicemen—Hobbyists

Here's the chance of a lifetime to own a genuine Thyratron Electronic Remote Control of your own at a fraction of its regular price! This mighty handful (only 5¾x5x3¼") of miracle control can be made to perform hundreds of practical, fascinating feats of remote control.

PRECISION THYRATRON CIRCUITRY

These amazing Thyratron precision thermostatic controls can easily and quickly be modified by you for electronic remote control of: Transmitters; Turn Radio and TV on and off; Open and Close Garage Doors from your car; Remote Control of Appliances, Machinery, Power Tools; Remote Controls for Model Railroads, Planes, Boats, Trucks; Burglar, Fire, Temperature and Rain Alarm Systems; Poultry Brooder Controls, etc., etc.

Your own ingenuity and inventiveness can devise many more interesting and practical uses which this remarkable unit can control for you. A complete schematic is furnished with each control.

PARTS ALONE WORTH TWICE THE COST

Each control unit contains a highly sensitive plate circuit trigger relay, a 110 volt 60 cycle AC filament transformer, many condensors and resistors (including 1% precisions) and a host of other voluable parts worth twice or more our low, low bargain price. No matter how you use it it's a great buy!

Kit of 3 Tubes for Remote Control Unit, consisting of 6SN7GT, 6SL7GT and a GE Thyratron GL-5662 (net $3.30 by itself).
All 3 *plus* Bakelite Cabinet—only $4.95
No. C.O.D. Postpaid in U.S.A. Only
(10 Days Net to Rated Firms)
Send Check or Money Order to ***Dept. E.***

ATTENTION: Electronic Alarm Manufacturers! These Thyratron controls are ideal for adaptation by you for FIRE, BURGLAR and other alarm systems you make. Increase your profits, make a better product by using this control or its components in your products. Let your engineers check a few and see for yourself. Terms: Net 10 days to rated firms.

POPULAR REMOTE CONTROL USES

- **ON-OFF for Transmitters, Radio or Television Sets**
- **Open and Close Garage Doors From Inside Your Car**
- **Model Railroads, Boats, Planes, Cars, Trucks**
- **ON-OFF for Appliances, Machinery, Power Tools**
- **Burglar, Fire, Temperature or Rain Alarm Systems**
- **Poultry Brooder Temperature Controls**
- **Remote Thermostatic Control**

MANUEL KLEIN COMPANY 94-E Chambers Street, New York 7, N. Y.
REctor 2-6460

www.americanradiohistory.com

CONDENSERS

CONDENSER SPECIALS

10 mfd—600 V . . . . **$.89**

Three term. bot. mntg. channel type. Dim. 3¾" x 3½" x 2". Two 5 mfd sections rated 400V. at 72 degs. "C". 1800V. test. Meets commercial specs. for 600V. operation up to 40 degs. "C". Repeat sales prove this rugged high quality condenser to be of outstanding value. Carton of 24 wt. 42 lbs. . . . . **$.79**

6 mfd—150 V . . . . **$.29**

Three term. dual 3 mfd. oil cond. with brackets. Dims. 4¼" x 1¾" x 1". Ideal for audio crossover networks.

Mfd	Volts	Price
.005–		
.005–.01	10KV	3.75
.012	25KV	19.90
.02	20KV	15.90
.075–		
.075	7.5KV	3.95
.08	12.5KV	15.95
.1	1500V	.59
.1	2000V	.49
.1	2500V	1.20
.1	3000V	1.75
.1	7500V	1.95
.1	7500V	4.25
.1–.1	7500V	6.25
.1	10KV	8.95
.1	15KV	15.95
.1	25KV	25.95
.15–.15	8000V	1.95
.2	10KV	10.95
.25	2000V	1.25
.25	3000V	2.15
.25	6000V	1.75
.25	18KV	15.95
.25	20KV	19.95
.4	10KV	12.95
.5	1500V	1.02
.5	2000V	1.39
.5	3000V	2.69
.5	25KV	Quote
.5–.1	2000V	.89
.5–.5	600V	.69
1	400V	.45
1	500V	.59
1	1000V	.69

Mfd	Volts	Price
1	1500V	1.35
1	2000V	1.95
1	2500V	2.25
1	3000V	3.50
1	5000V	4.99
1	15KV	Quote
1	16KV	Quote
1	20KV	Quote
1	25KV	Quote
1–1	7500V	19.50
2	600V	.59–.79
2TLAD	600V	.80
2	1000V	.85
2 TLA	1000V	1.29
2	1500V	1.65
2	2000V	2.80
2	2500V	3.39
2	3000V	4.69
2	4000V	5.69
2	5000V	10.95
2	13.5KV	39.50
2–2	600V	1.25
3	600V	.59
3	4000V	6.95
3–3	150V	.29
3–3–3	400V	.75
3.75	1000V	1.59
4	400V	.85
4	600V	1.25
4 TLAD	600V	1.35
4	1000V	1.95
4	1500V	2.79
4	2000V	4.25

Mfd	Volts	Price
4	3000V	7.95
4	4000V	10.95
4–4	1000V	1.85
5	330 VAC	1.75
5	600	1.35
5	660V	2.49
5–5	400V	.89
6	600V	1.45
6	330 VAC	2.49
6	1000V	2.49
6	1500V	3.25
6	2000V	3.95
7	600V	1.45
7	800V	1.90
7	1000V	2.49
8	500V	1.35
8	600V	1.75–2.15
8	660 VAC	4.25
8	1000V	3.25
8	2000V	4.95
8–8	600V	1.75
10	600V	2.50
10	1000V	4.55
10	6000V	Quote
12	1000V	4.95
14	1000V	5.25
15	1000V	5.25
17	25V	.69
24	1500V	8.50

BATHTUB CONDENSERS

Mfd	Volts	Price
.01–.01	600	.25
.02–.02	600	.25
.04–.04	600	.25
.05	600	.15
.05	1400	.49
.05–.05	600	.25
.08–.08	600	.25
.1	600	.39
.1	1000	.42
.1	1200	.45
.1–.1	400	.29
.1–.1	600	.39
.1–.1	1000	.51
3x.1	600	.40
.2	1000	.21
.25	300	.19

Mfd	Volts	Price
.25	400	.30
.25	600	.41
.25	1000	.45
2x.25	600	.48
.3	400	.15
.5	400	.37
.5	600	.47
.5	1000	.52
2x.5	600	.59
1	200	.25
1	300	.30
1	400	.48
1	600	.58
2	400	.60
2	600	.91
4	100	.35

Sp. Bathtub Kit 15 @ 1.00

Channel Condensers

Mfd	Volts	Price
.05–		
.05	600	.30
.1	500	.28
.1	600	.32
.1	2500	1.20
2x.1	400	.34
2x.1	600	.40
3x.1	400	.40
.25	600V	.43
2x.25	600V	.48

Mfd	Volts	Price
.4	600V	.30
5	400V	.19
.5	500V	.43
.5	600V	.49
1	400V	.45
1	500V	.58
1	600V	.65

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, 680, 700, 750, 800, 820, 900, 1000, 1200, 1250, 1400, 1500, 2000, 2200, 2400, 2500, 3000, 3300, 3700, 3900, 4000, 4700, 5000, 5100, 6000, 6200, 6500, 6800, 7900, 7950 & 9100 mmfd.

5 to 900 mmfd	$.05
1000 to 1500 mmfd	.07
2000 to 5000 mmfd	.11
5100 to 9100 mmfd	.13

Special Mica Kit—100 @ $3.50

SILVER MICA CONDS

7, 10, 15, 20, 24, 25, 33, 35, 50, 60, 75, 95, 100, 120, 130, 135, 150, 170, 200, 270, 300, 400, 500, 700, 750, 800, 1000, 1400, 1450, 1700, 2200.

7 to 95 mmfd	$.08
100 to 800 mmfd	$.09
1000 to 1700 mmfd	$.14
2200 to 2500 mmfd	$.16

Special S. Mica Kit—100 @ $6.50

METAL TUBULAR OIL CONDS.

Mfd	Volts	Price
.01	100	.14
.02	100	.14
.25	100	.14
.5	100	.14
.05	200	.14
.1	200	.15
.03	300	.15
.02	400	.16

Mfd	Volts	Price
.027	400	.16
.03	400	.16
.05	400	.16
.1	400	.17
.02	600	.19
.05	600	.19
.1	600	.20
.001	1000	.20
.1	1000	.22

COAX CONNECTORS

83—1R	.49	83—1T	1.65
83—1AP	.25	83—1SP	.55
83—1J	.65	83—1SPN	.51

Other Types Available

"J" POTS—$1.35

Ohms	Shaft
50	1/8 S & 1/2
60	1/8 LS
150	1/4 S
300	3/8 S
500	3/8 S & 1/8 S
1000	1/8 S
1500	1/4 S
2000	1/8 LS & 3/8 S
2500	1/8 S
3000	1/8 LS
5000	1/8 LS
10000	3/8 S
15000	1/8 S
20000	1/8 LS & 1 1/4

Ohms	Shaft
25000	3/8 & 1/8 S
30000	5/16
40000	1/8 LS
50000	1/8 S & 1/8 LS
50000	1/4
100000	1/2
150000	2 1/8
200000	1/8 LS & 1/8 S
250000	1/8 LS & 1/8 S
300000	1/8 S
1 Meg	1/8 S & 1/2
1 Meg	1/8 LS

"JJ" POTS—$2.75

Ohms	Shaft
1500	5/16
1-5 meg	1/2
20K	7/16

Ohms	Shaft
1 meg	1/2
2 meg	1/8 S

Other Types Available

DIESEL GENERATOR

25 KW 230 V, 3 ph., 60 cy. generator. Direct coupled to Hill Diesel Model 6R rated 44 HP at 1,200 RPM. This standard gen. unit, complete with panel board is practically new and will be sold under guarantee. Can be inspected under operation.

TOGGLE SWS.

SPST	3A. 250V. 1/8" S D shaft	.08
SPDT	C-H #8800 K 4 bat hand	.62
SPST	C-H #8803 K 4 bat hand	.62
DPST	A H & H 3/8" bush., bat hand	.55
DPDT	A H & H 1" bush., bat hand	.59
DPDT	C-H #8800 K 4 bat hand	.70

Other Types Available

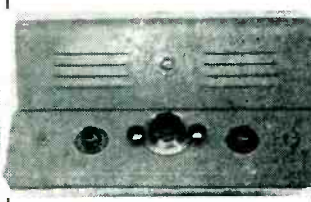
TRANS. MICA CONDS.

Mfd	Wvdc	Price
.00015	5000	1.75
.00025	1200	.35
.00025	5000	1.95
.001	2500	.48
.001	8000	3.65
.002	6000	3.50
.0024	5000	1.95
.003	6000	5.95
.01	600	.40
.01	1200	.55

Mfd	Wvdc	Price
.01	15KV	Quote
.0125	6000	7.50
.02	600	.27
.03	600	.49

Other types available.

$59.50 ELECTRONIC RADIO ALARM



Guaranteed new, functionally perfect and designed by a leading manufacturer. Uses balanced bridge principle. Intrusion operates any external alarm system. (Bell, horn, light, etc.) Automatic reset. Protects any underground object, room or bldg. Safe, cabinet, window screen, screening under window or door. Protection against injury by high voltage, hazardous equip and locations. Added feature includes built in fire detector. Operates alarm at 160 deg. F. Complete with instructions.

New - TUBES - Boxed

3C24	.69	1B29	1.05
954	.20	838	2.95
1616	1.35	12C8	.88
9004	.45	2J39	Quote

25 WATT POWER RHEOSTATS

Ohms	Shaft	Price
1.3–1.3	1/8 S	1.00
15	1/2	.79
20	1/2	.79
25	1/2	.79
50	1/8 S	.79
50–50	1/2	1.50
75	1/0	.79
100	1/2	.79
125	1/2 S	.89
175	1/2	.89

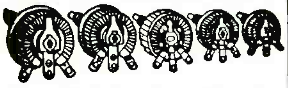
Ohms	Shaft	Price
225	1/4 S	.89
225	1/8 LS	.89
300	1/2	.89
500	1/4 S	.89
500	1/8 S	.89
1500	1/2 S	[illegible]
2000	3/8	.99
2500	1/2	1.25
5000	1/8 S	1.15
5000	1/2	1.15

100 ohm type Lots of 100 . . . 54¢

MONMOUTH RADIO LABORATORIES

BOX 159 **Long Branch 6-5192** **OAKHURST, N. J.**

POWER RHEOSTATS



Ohms	Watt	Ea.	Ohms	Watt	Ea.
.5	25	1.98	250	25	2.23
.5	50	2.81	250	50	2.53
.5	150	5.93	300	50	2.53
1	50	2.81	300	75	3.90
2	50	2.81	300	100	4.40
2	100	4.68	300	150	5.04
2	300	8.42	350	25	2.25
3	100	4.67	350	100	4.40
3	225	6.58	370	25	2.23
4	225	6.60	378	150	6.59
5	25	1.97	400	25	2.23
5	50	2.53	400	75	3.90
5	100	4.68	500	25	2.23
6	25	2.23	500	50	2.53
6	50	2.53	500	75	3.95
6	75	3.90	500	100	4.50
7	25	1.98	500	150	5.15
7.5	75	3.95	500	300	9.49
8	50	2.53	585	150	6.59
10	25	2.23	750	25	2.23
10	50	2.53	750	150	5.46
10	100	4.37	1000	25	2.53
12	25	2.23	1000	50	2.66
12	50	2.53	1200	225	7.20
15	25	1.98	1200	300	8.40
15	75	3.90	1250	50	2.66
15	100	4.38	1250	150	6.10
20	50	2.53	1500	25	2.53
22	50	2.53	1500	50	2.66
25	25	2.23	1600	50	2.66
50	25	1.98	1800	150	6.19
50	50	2.53	2000	25	2.53
75	25	1.98	2000	50	2.66
75	75	3.90	2250	150	6.24
80	50	2.53	2500	50	2.66
90	500	12.46	2500	100	4.68
100	25	1.98	2500	150	6.24
100	50	2.53	3000	25	2.66
100	100	4.39	3000	100	4.95
125	25	2.23	5000	25	2.66
150	50	2.53	5000	50	2.90
175	25	2.23	7500	50	2.90
185	25	2.23	7500	100	5.32
200	25	2.23	10000	50	2.99
200	100	4.40	10000	100	5.51
200	150	5.04	15000	25	3.25
225	50	2.53	20000	150	8.75

OTHERS

Dual	1.3	25	4.95
Dual	10	25	4.49
Dual	13.2	300	15.95
Dual	100	25	4.49
Dual	200	50	4.95
Dual	300	50	4.95
Dual	378-585	150	12.75
Dual	500	25	4.49
Dual	1375	25	4.49
Triple	3	300	24.95

Specify Type Shaft Required "SS" or "Knob"

"AN" CONNECTORS

Large Variety Available At Great Savings

Send your specs and let us quote

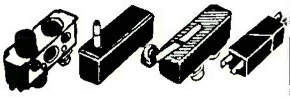
BIRTCHER TUBE CLAMPS

#926-A, #926-A1, #926-A14, #926-B, #926-B1, #926-B7, #926-B22, #926-C

FROM **35c**

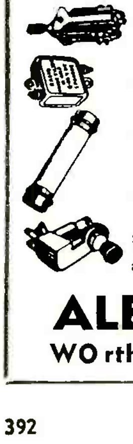
#926-C5, #926-C10, #926-C24, #929-1, #930-12, #930-18, #930-19, #930-21

MICRO SWITCHES



LARGE VARIETY

MISCELLANEOUS



A. MOSSMAN LEVER SWITCHES
B. NOISE FILTERS
C. GLASS FERRULE RESISTORS
D. MALLORY SERIES 2000 PUSH SWITCHES
E. WE-1%—PRECISION RESISTORS

See Dec. Issue for Complete Listings of above.

OIL CAPACITORS

RECTANGULAR

.00025–25kv	1000		
	1500		
.0025	2000		
1500	2500		
.004 10kv	4000		
.0075 7kv		3.	ac 240
10kv		4.	ac 220
.02	7500		600
.03	ac 500		700
.05	2500		1000
.1	3000		1500
.1	6000	5.	600
.1	20kv	6.	400
.25	2000		600
	3000		1500
	3500		2000
	4000	8.	600
	5000	10.	ac 440
.5	600		600
	1500		2500
	3000	15.	600
.5	25kv		1000
.75	1000	30.	ac 90
1.	ac 250	100.	ac230
	ac 330	2x.1	7000
	600	2x.4	1000
	1000	2x.5	9kv
	1500	2x1.	ac 230
	2000	2x3.	150
	5000	3x4.	500
	6000	3x8.	400
1.5	ac 400	3x8.	500
2.	ac 220		600
	ac 250		
	ac 330	3x10.	ac 90
	400	4x3.	600
	600	4x8.	600
	ac 660		

BATHTUBS

.02	600	50.	25
.033	600	100.	15
.05	200	200.	12
	400	300.	6
	600	2x.01	200
.1	200		400
	400		600
	600	2x.02	400
	1000		600
.15	600		1500
.2	600	2x.045	
.25	200		600
	400	2x.05	600
	600		1500
	1000	.05–.1	200
.35	400	2x.1	400
.5	200		600
	400	.1–.5	400
	600	2x.16	600
	1000	2x.2	600
.75	600	2x.25	400
1.	50		600
	100	.3–.5	500
	200	2x.5	100
	300		200
	400		400
	600		600
	1000	.1–.5	ac 30
2.	400	.05–1.	500
	600	.1–1.	300
4.	50	.5–1.	200
	100	2x1.	600
5.	50	2x10.	25
8.	500	2x200.	9
10.	50	3x.001	
	150		600
15.	200	3x.05	600
16.	450	3x.1	200
20.	25		400
25.	25		600
	50	3x.25	400
	75		600
40.	25	3x.5	100
	40		600
	100	3x1.	100

Specify 1st & 2nd choice Side-Top-Bottom Terminal
JAN types available

CHANNEL

.01	600		600
	1000	2.	200
.02	400		400
.025	600		600
.05	400	4.	600
	600	.01–.1	400
	1000	.02–.1	600
.1	400	.035–.2	600
	500	2x.05	400
	600		600
	1000	2x.1	400
.15	600		600
.25	400	2x.25	200
	600		400
	1000		600
.31	600		1000
.42	600	2x.5	300
.5	400		400
	500		600
	600	3x.02	400
	1000	3x.1	400
.7	600		600
1.	400		1000
	500	3x.25	600

Top-Bottom or Universal Mtg
JAN types available

HIGH POWER TR. MICA

G-1 TYPE

.0001	KV
.00015	5 KV
.0002	6 KV
.0008	6 KV
.051	1.5KV
.01	4KV
.032	2KV
.04	1KV
.08	1.5KV
.09	1.5KV

G-2 TYPE

.0001	10KV
.00015	10KV
.0002	10KV
.0003	10KV
.000375	10KV
.0004	5KV
.0005	10KV
.00065	10KV
.001	6KV

G-3 TYPE

.0001	20KV
.00015	20KV
.0004	20KV
.00045	15KV
.00047	20KV
.0005	20KV
.00095	5KV
.001	20KV
.0011	20KV
.00124	20KV
.004	12KV
.005	8KV
.015	3KV
.25	1.6KV

G-4 TYPE

.0002	30KV
.0025	25KV
.005	8KV
.01	15KV
.0006	35KV
.003	20KV
.0039	20KV
.0075	15KV
.03	8KV
.056	5KV

TYPE #56

.000155	30KV
.000533	30KV
.0004	30KV
.001	30KV

TRANSMITTING MICAS

.00001, .000025, .00003, .00004, .000047, .00005, .000051, .000056, .000068, .00007, .000075, .00008
.0001, .00011, .00015, .000152, .00016, .000175, .00018
.0002, .00022, .00024, .00025, .00027
.0003, .00033, .00039, .0004, .00047, .0005, .00051, .0006, .0007, .00075, .0008, .0009
.001, .0013
.0015, .00162, .00175, .0018
.002, .0022, .0024, .0025, .003, .0039, .004, .0043, .0047
.005, .0051, .006, .0062, .007, .008
.0082, .0009
.01, .012, .0135, .0142, .015, .016, .018, .02, .022, .024, .025, .027, .03, .033, .04, .043, .05

Available in 300/600/1200/2500 VDCW or 1000/1200/2500/5000 VDC test.

JAN types available, also F1L and F2L types.

TYPE "J" POTENTIOMETERS

"J" $1.50

65, 75, 300, 400, 500, 600, 750, 1000, 1400, 1500, 2000, 4000, 5000, 6500, 9000, 10k, 12k, 15k, 20k, 25k, 30k, 50k, 75k, 80k, 100k, 125k, 150k, 165k, 250k, 500k, 1.meg, 2.meg, 3.meg

"JJJ" $4.95

20k-200k-20k
45k-27k-2500
700k-700k-700k
750k-750k-750k
800k-800k-800k
1.meg-1.meg-1.meg

"JL" $1.75

2k-25k
25k-10k
5k-35k
2k-20k
7k-1.meg
300k-5k
25k-400k
40k-70k
30k-60k
50k-80k
20k-50k
100k-200k
1.meg-500k

"JJ" $2.95

500-500
600-600
1500-1500
2000-2000
5000-5000
10k-10k
25k-25k
50k-50k
100k-100k
130k-130k
150k-150k
250k-250k
300k-300k
1. meg-1. meg
2. meg-2. meg

Available in 1/8" SS or knob type shafts. Please specify which.

JONES Connectors — Jones BARRIER STRIPS

Jones Plugs
P-101-1/4, 101-3/8, 306-AB, 306-CCTL, 308-FHTL, 310-LAB, 310-FHT, 310-CCT, 310-AB, 312-LAB, 312-CCTL, 312-CCT, 312-AB, 315-FHT, 315-CCE, 315-CCT, 315-FHE, 315-EB, 318-CCE, 321-AB, 321-DB, 324-EB, 324-FHT, 324-CCT, 324-AB, 330-SB, 330-FHT, 330-CCT, 333-CCT

Sockets
S-101-D Mod, 201, 202-B, 302-CCT, 302-AB, 304-CCT, 306-LAB, 306-FHT, 306-FHTL, 306-CCT, 308-AB, 308-FHTL, 308-CCTL, 310-LAB, S-312-FP

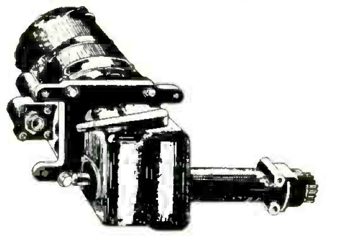
315-EB, 315-AB, 315-FHT, 315-CCT, 315-LAB, 318-AB, 321-CCE, 321-CCEL, 330-AB, 330-SB, 330-CCT, P-402-SB, 404-DB, 406-AB, 406-FHE, 406-CCE, 408-LAB, 408-DB, 410-CCE, 412-DB, 412-CCE, S-404-AB, 404-DB, 406-CCT, 408-LAB, 408-CCT, 410-CCE, 410-AB, 412-DB, P-2410-CCE, 2410-SB, 2410-FHE, 2412-SB, 2412-CCE, S-2406-CCE, 2408-LAB, 2408-SB, 2410-LAB, 2412-LAB, 2412-FHE, 2412-CCE, P-502-DB, 504-DB, 504-CE, 506-CE, 506-DB, 508-CE

510-CE, 512-CE, S-502-DB, 504-DB, 504-CE, 506-DB, 506-CE

Barrier Strips
2-140-3, 2-140-Y, 3-140, 4-140, 6-140, 10-140-3/4W, 12-140-Y, 16-140-Y, 10-240, 11-240, 17-240, 18-240, 20-160R, 3-141, 4-141-W, 4-141-3/4W, 6-141, 7-141-Y, 8-141-Y, 10-141-Y Mel, 12-141-3/4W, 13-141, 20-141-3/4W Mel, 20-161-AR, 2-142-Y, 4-142-Y, 5-142, 12-142, 3-150, 4-150-Y, 4-152, 6-22, 8-6, 8-54, 2002, 2008, 2013

ALEXANDER MOGULL COMPANY

WOrth 4-0865 — 50 W. Broadway — N. Y. 7, N. Y.



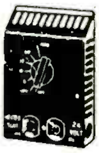
GEAR HEAD MOTOR—Emerson Electric. DC motor Model 5BA50LJ1, 0.4 H.P. 3000 RPM, Armature 60v-6.5a, field 27v, reversible. Gear Box has double-end power shaft turning 280 RPM. Shaft is 7/16 x ½" on left and on the right, at end of 5" arm extending from gear box, is 5/8 x 1" with 1-⅛" pinion gear. Throw-out type clutch is actuated by lever on front top. Ball-bearings. Size 5x12x10". Wt. 14 lbs. Price, NEW...$12.95

SEE APRIL AD ON PAGE 380 FOR OTHER GEAR HEAD MOTORS. OUR CUSTOMERS HAVE USED THESE TO MAKE COIL-WINDERS, MIXERS, HOISTS, WINCHES, DUMB WAITERS, GARAGE DOOR-OPENERS, RETRACTABLE STAIRS, BUFFERS, AND FOR MANY OTHER APPLICATIONS. LIMITED STOCK ON SOME TYPES.

GUN FIRE INTERRUPTER

Mfg. by Fox Industries for Emerson Electric. Mod. 150-CH-3. Disassembles into two independent gear boxes. Back half is worm type with a 30 to 1 ratio and has a 7/16" take-off shaft 4½" long. Front half is a pinion-rack gear combination. Rack has a 6" travel. Ball and sleeve bearings. Size 5x6x13". Wt. 6½ lbs. Acquisition cost $158.00. Our price NEW in original boxes ONLY $5.95

RHEOSTAT



Ideal for regulating voltage on motors, generators, soldering irons, etc. Rated 100 watts, double windings, and dual female 25 amp. 125 volt receptacles. Supplied in either 2.0 or 5.75 ohm models. (Specify). 7x5¼x1¾". Wt. 2½ lbs. Price NEW ONLY $1.95

SPECIALS

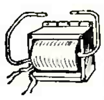
DC MOTOR—Emerson Electric. Type D44F0447-0417. 1 H.P. 5400 RPM. 12 volts. 100 amps. Double-end shaft ⅝" dia. by 1-3/16" length on each end. 4½x4½x9". Wt. 17 lbs. Price NEW $8.50

AMPLIDYNE MOTOR GENERATOR. Emerson Electric. #5AM31NJ18A. Input 27 VDC—44 amps. Output 60 VDC—8.8 amps. 530 watts. 8300 RPM. 6x8x12". Wt. 34 lbs. Price NEW....$7.95

WHITE-ROGER SERVO MOTORS—24 VDC. Torque 150 in., lbs. Reversible. Control box on top has limit switches, relays, and selenium rectifiers (to block AC out of motor). 5x5x4". Can be supplied in Models 6904—5 RPM. 6904—3½ RPM, or 6905—2½ RPM. Price each NEW..........$8.95

DM 42A DYNAMOTOR—G.E. Model 5DY81AB12. Input 14v—46a. Output: 515/1030/2/8 volts. Price NEW $9.95

OPEN TYPE TRANSFORMERS—60CY.



#0692. Input 115/230 V. Output 18 V at 100 amps. Secondary leads 18" long. 7¾x5x6". Wt. 40 lbs. Price NEW $16.50

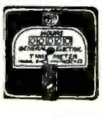
#4320 Input 115 V. Output 25 V at 9 amp. 3¼x4x4". Wt. 6¼ lbs. Price NEW........$3.75

#306. Input 115 V. Output 11 V at 5 amp. 2¾x3½x2¾". Wt. 3 lbs. Price NEW........$2.95

#1940. Input 115 V. Output 10.5 V at 5 amp. 3½x4x2¾". Wt. 3 lbs. NEW..........$2.95

#506. Input 220 V. Output 15 V at 10 amp. 3¾x4½x3". Wt. 6¼ lbs. Price NEW.......$3.50

ELAPSED TIME METER



General Electric Sym. M305. Indicates 1-99,999 hours. 115 VAC, 60 cycles. 3" round bakelite case. Square flush face. Price New.$11.50

PROMPT DELIVERY ON ALL ORDERS
ALL MERCHANDISE FULLY GUARANTEED

Terms: Prices FOB St. Louis. Cash or 25% with orders. Balance COD. Rated Concerns (D&B) Net 10 days cash. Prices subject to change without notice.

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2½ MILLION PRECISION RESISTORS IN STOCK

"TAB"—Specialists in Precision Resistors No Mfrs Choice—We ship Types in Stock

0.116	150	600	1830	3333	10500	36000	200000
0.42	160	612	1850	3384	10600	37000	201000
0.425	165	620	1865	3500	10900	38140	205000
0.607	170	625	1892	3509	10936	38500	210000
0.7	175	633	1894	3600	11000	39000	215000
1.03	179	640	1895	3700	11400	39500	220000
1.3	180	641	1896	3730	11500	40000	225000
1.75	182	645	1897	3760	11690	41400	229000
2.5	182.4	649	1898	3900	12000	42000	230000
3=	200	650	1899	4000	12500	43000	235500
3.83	209.4	657	1900	4030	12800	45000	238000
4	210	665	1901	4200		47000	240000
4.35	216	670	1902	4220	13100	47500	245000
5	220	673	1903	4280	13500	48000	250000
5.025	220.4	675	1904	4300	13550	48660	265000
6.25	225	680	1905	4314	13600	49000	268000
6.5	230	681	1906	4440	14000	50000	270000
7	235	684	1907	4444	14250	51000	275000
7.8	240	689	1908	4500	14400	52000	294000
7.9	245	697	1909		14500	55000	300000
8	245.4	699	1910	4720	14550	56000	307500
10.38	250	700	911	5750	14600	57065	311000
11.25	260	711	1912	4850	15000	58333	314000
	270	733	1913	4885	16000	60000	316000
13.52	271	740	1914	4900	16500	61430	325000
14.2	275	750	1915	5000	16800	62000	330000
	280	800	1916	5100	17000	64000	333500
14.5	286	806	1917	5210	17500	65000	350000
15	289	820	1918	5235	17977	66600	353500
16	299	850	1919	5270	18000	66650	375000
17	300	854	1922	5300	18300	67500	380000
19.5	310	899	1924	5500	18380	68000	390000
19.2	311.5	900	1926	5600	18500	70000	400000
20	320	910	1960	5730	18800	72000	402000
22	325	917	1980	5770	19000	73500	420000
23	330	946	2000	5910	19500	75000	422000
24	340	978	2045	6000	20000	80000	425000
25	350	1000	2080	6100	20441	82000	430000
27	360	1030	2095	6125	20500	84000	450000
28	366.6	1056	2141	6140	21000	85000	458000
30	370	1059	2142	6200	21500	85750	470000
31.5	375	1067	2145	6300	22000	88000	472000
37	380	1100	2150	6495	22500	90000	478000
48	389	1110	2160	6500	22990	91000	500000
	390	1150	2180	6800	23000	93000	510000
50	400	1155	2187	6840	23150	93300	520000
51.78	410	1162	2195	6990	23325	95000	521000
55	414.3	1200	2200	7000	23400	100000	525000
56.7	418.8	1225	2250	7320	23500	110000	543000
60	425	1250	2300	7500	24000	115000	550000
63	426.9	1260	2400	7700	24600	116667	560000
68	427		2450	7717	25000	120000	570000
74	430	1350	2463	7900	25200	130000	575000
75	440	1355	2485	7930	25400	135000	600000
80	450	1400	2490	7950	25833	140000	620000
81.4	452	1488	2500	8000	26000	141000	650000
88	460	1495	2525	8094	26500	145000	654000
	470	1500	2600	8200	26600	147000	660000
95	475	1510	2625	8250	27000	150000	680000
100	478	1518	2635	8500	27500	155000	690000
101	480	1600	2700	8700	28000	160000	700000
103.2	487	1640	2750	8770	28430	165000	750000
105	500	1646	2850	9000	28500	166750	761300
105.7	510	1650	2860	9100	29000	167000	800000
107	520	1670	2870	9445	29500	169200	813000
110	525	1680	2900	9500	29990	175000	820000
120	540	1710	3000	9710	30000	180000	850000
121.2	550	1712	3100	9800	31000	180600	860000
125	560	1740	3163	9900	31500	185000	900000
130	575	1770	3259	9902	32000	186600	910000
135	580	1800	3290	10000	33000	190000	930000
147.5	588	1818	3300	10430	35000	198000	950000

Any Size Above. Each 35c: Ten for $3.29

MEGOHMS

1.	1.4	1.9	2.75	3.75	5.1	7.5	9.5
1.1	1.5	2.	2.8	3.9	5.5	7.62	10.
1.2	1.57	2.11	2.855	4.	6.	7.74	11.55
1.25	1.579	2.2	3.	4.23	6.5	8.	12.
1.3	1.65	2.25	3.3	4.25	6.6	8.02	12.83
1.35	1.75	2.5	3.5	4.5	6.7	8.5	13.
1.39	1.8	2.7	3.673	5.	7.	9.05	13.85
							30.

Any Size Above. Each 70c: Ten for $6.49

POWER TRANSFORMERS

2500V for Crt 6.3V/.6A. 2.5V/1.75 csd Hvins 4/BC412 replmnt...57,98
1320V & 375vct/110ma. 5V/3A, 2.5V/3.25A: 6.3V/2.75A Hsld Hvins 9.98
1000vct/200ma. 18V/.55A. 6.3V/5A. 5V/6A 6,98
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
900V/35ma. 2x2.5V/2A, xcint 1800V dblr two 2x2 fil. wndgs hsld.. 3.49
840vct/110ma. 530vct/21ma. 2x5V/3A 6.3vct/1A, 6.3vct/.3A..... 4.98
770vct/85ma. 5V/2A. 6.3V/3.5A Throd.......... 3.98
750vct/200ma. 6.3V/5A. 5V/4amp 5.95
720vct/115ma. 2x6.3V/.6A. 5.05V/2A. 6.3V/3.8A.......... 3.95
700vct/120ma. 2x6.3V/3A, 6.3V/1A.......... 3.98
600vct/100ma. Tapped 350vct, 6.3V/3A, 2.5V/3A Isolation Wndg 115V/.45A.......... 3.25
550vct/150madc. 5V/3A, 6.3V/5A.......... 3.49
500vct/60ma. 6.3V/4A Hsld.......... 2.98
450vct/200ma 6.3V/3A. 5V/3A.......... 3.95

FILAMENT & RECTIFIER

6.3vct/4A (gud 6.5A) H'Sld HVins..........$2.69
6.3vct/1A..........$1.98; 6.3v/.6A..........$1.98
2.5v/2A....79c.......2 for 1.49; 7.5vct/12A 15Kvins.......10.98
24v/6a csd.......... 4.98; 24v/1.25 csd.......... 1.98
2.5vct/10Amp 5Kvins...... 3.59; 2x12V/2A or 24V/2A 2Kvins 3.89

STEP UP OR STEP DOWN

110V to 220V or 440V/185 Watt..........$ 4.98
110V to 220V/200 Watts $5.98..........2 for 10.98
Isolation 115V to 115V/185 Watt.......... 3.98
220V to 440/250 Watt $5.98..........2 for 10.98

CIRCUIT BREAKERS

Heinmann Magn Bkrs. Amps; 0.22, 2, 3, 5, 7, 9, 12, 15, 20, 30, 35, 40 80, 180. Each $1.69..........10 for $15.98
Sq. D & CH Toggle Sw Brkrs. Amp; 5, 10, 15, 20, 25 98c..10 for $8.98
Klixon Thermal Push Button Brkrs Amps; 5, 10, 15, 20, 30 89c 10 for 7.98

METER SPECIALS
DC MILLIAMMETERS

0-1Ma 3" sq. Weston..........$7.50
0-10Ma & 0-5KV (Basic 1Ma) 3½".......... 4.98
0-25Ma, Weston 3"sq.......... 6.98

DC AMMETERS

0-10A, 3 sq" Triplett.......... 3.98
0-30A, 2½" Shunt WECo. Wstghs.......... 2.98
0-240A, 2½" Round Less Shunt.......... 3.98
0-300A, 3" Rnd. Less Shunt Weco.......... 4.49

MISCELLANEOUS TYPES

0-50 Micro Ammeter 3" sq. Weston..........$16.98
—20 +3 VU, Weston Vol. Level Indict.......... 16.98
0-8V A.C. 3¼" Rnd. Weston.......... 3.49
0-150V A.C. 3" sq. Weston Rect. Type.......... 8.98
57-63 Cycles Freq. Mtr. 3" RND.......... 4.98
350-450 Cycles Freq. Mtr. "AN" 3½" RND.......... 6.98

BLOWERS

40 CFM 28 vacdc..........$5.98 250 CFM 28 vacdc..........$9.95
250 CFM with 28 to 115 vac Trans..........11.95
175 CFM 220 vac..........11.98 40 CFM 24 vdc BL1000.... 6.90
70 CFM 115V 400 Cycle.......... 6.95

UHF ANTENNA

UHF ANTENNA 12"/30CM AT5/ARR1 Citzn & Ham Band Mobile Mtg. 39c; 4 for $1.00......PL259 for above.......... .65
TV CONICAL ANTENNA Sturdy Prefab Const. Versatile 72, 150 or 300 ohm Match. Incl. 8 elements & 100 ft. Copper Twinex Cross Bar & Hd'ware..........$8.49
MICROWAVE ANT AS125/APR 1000 to 3400Mc w/UG58U Term, InBuilt HiPass Fltr. Flange Mtg Incl H'ware.......... 5.98
ANT AN130B, 33" Whip....$1.98 ANT AN131A, 11 ft. 8 sect. 3.98

Sectional Antennas

MS49-52, 12½ ft...$1.69; MS49-53..........$2.49
BASES: MP22 $3.98; MP48 $3.98; MP47.......... 3.75

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6 Church St.
New York 6, N. Y., U. S. A.
WOrth 2-7230

SURPLUS EQUIPMENT

G. E. ALTERNATOR

208 Volts, 400 Cycle, 3 Phase
Model 2CM97B1
55.5 Amps., PF .75, Speed 8000 KW 15,
Cont. Duty, Limited Quantity..$320.00

G. E. MOTOR AMPLIDYNE

Mod. 5AM45DB15. Input: 115 volts, single phase, 60 cycle, 4.5 amp. Output: 250 volts DC, .6 amps. 3450 RPMS........$79.00 ea.

PIONEER TORQUE UNITS

TYPE 12604-3-A: Contains 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 12606-1-A: Same as 12604-3-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.

BLOWER ASSEMBLY

115 Volt, 400 Cycle. Westinghouse Type FL, 17CFM, complete with capacitor. New ....$12.50 ea.

SINE-COSINE GENERATORS
(Resolvers)

Diehl Type FJE-43-9 (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......$25.00 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.

ALNICO FIELD MOTORS

(Approx. size overall . . . 3¾" x 1¼" diameter) Delco-Type 5069230: 27.5 volts; DC; 145RPM $19.95 ea.

PIONEER AUTOSYNS

AY-1......26 Volt—400 Cycle...... $6.95
AY-5......26 Volt—400 Cycle...... $7.95
AY27D $25.50
AY6—26 Volt—400 cyc..........$4.95 ea.
AY30D—26 Volt—400 cyc.......$25.00 ea.
AY14D $14.00
AY34 ....$20.00
AY20—26 Volt—400 cyc..........$12.50 ea.

SERVO MOTOR 10047-2-A: 2 Phase; 400 Cycle; with 40-1 Reduction Gear $10.00 ea.

400 CYCLE MOTORS

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.

PIONEER, CK-2, 400 cycle 2-phase. $20.00 ea.

INVERTERS

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.

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.

12116-2-A PIONEER

Output: 115 VAC; 400 cyc; single phase; 45 amp. Input: 24 VDC 5 amp...$90.00 ea.

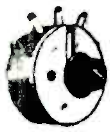
10563 LELAND ELECTRIC

Output: 115 VAC; 400 cycle; 3-Phase; 115 VA; 75 PF. Input: 28.5 VDC; 12 amp..........$80.00 ea.

16486 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.

POWER RHEOSTATS



Standard Brands: 5 Ohms; 100 Watt; 4.48 amps 100 Ohms; 100 Watt; 1.0 amp.

Boxed, Brand New with Knob $2.50 each—or—$25.00 per Doz.

420 CYCLE GENERATOR

General Electric #5AB324A7: 115 Volts, single phase, 7.5 KVA, 3480 rpm, equipped with triple V-belt pulley. Cycle and voltage may be varied by varying speed. New price......$525.00

SMALL DC MOTORS

(Approx. size...4" long x 1¼" dia.)
General Electric-Type 5BA10AJ37; 27 volts, DC; .5 amps, 8 oz inches torque; 250 RPM; shunt wound; 4 leads; reversible $12.50 ea.

G. E. Type 5BA10FJ215, 24 volts DC, .77 amp. 30 lbs. in. torque, 4 RPM..$15.00 ea.

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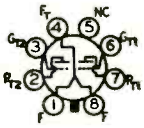
No Minimum

1B23	5.00	807	1.35
1B24	9.50	808	1.75
1B27	10.00	809	2.10
1B42	8.00	811	3.25
1N22	.65	813	8.00
2C25	.50	815	2.50
2C26A	.20	826	1.00
2C34	.25	829B	9.00
2C44	.50	832A	8.00
2J21A	9.00	836	4.00
2X2/879	.40	838	3.00
2X2A	.70	841	.45
3B24	3.75	843	1.00
3C24	1.00	850	2.00
3C27	3.25	851	40.00
3E29	9.00	860	3.75
3DP1-S2	2.75	861	23.00
4B24	4.75	864	.35
4J25	75.00	872A	3.50
5BP1	3.25	874	1.25
5D21	18.00	878	1.75
6C21	20.00	884	1.00
7H-12	2.50	902	3.00
15E	1.50	954	.20
23D4	1.00	955	.35
GL146	4.75	956	.30
GL159	5.50	957	.30
215A	2.25	CK1089	2.00
327	1.75	CK1090	2.00
327A	2.50	1616	1.00
371B	1.00	1619	.25
393A	6.50	1625	.40
446	1.00	1626	.15
446A	1.50	1630	.55
464A	2.50	1632	.65
471A	1.75	1633	.70
532A	.75	1644	.60
705A	1.50	1659	.50
715A	5.00	1661	.50
717A	1.20	1851	.75
718BY	20.00	2051	.80
719A	15.00	7193	.15
721A	2.00	8011	1.50
724B	2.00	8012	1.75
725A	4.75	8020	1.75
730A	12.00	9002	1.00
800	5.50	9004	.38
803	3.50	9006	.20
805	3.00		

20000 UHF TWIN TRIODE

3B7/1291

3B7/1291, a Twin Triode Lock-in type for Class A Amp. use with Fil. Voltage 2.8 at .11 amp. or 1.4 using center tap. Plate voltage, 90; Grid Bias, 0; Plate current (MA) 5.2; Plate resistance 11350 ohms; Transconductance Micromhos, 1850; Amp. factor 21; Capacitance μμfd. in, 1.4; out 2.6; Plate-Grid 2.6.



BULK ORIGINAL PACKAGE, 200 PER CARTON. NAME OF STANDARD MANUFACTURER DOES NOT APPEAR ON TUBE. GUARANTEED FIRST QUALITY, CLEAN AND BRIGHT. INQUIRIES SOLICITED.

• 47c

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5000 AVAILABLE IN ORIGINAL CARTONS OF 100 EACH

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- Amphenol Connectors
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- T & B "Sta-Kon" Terminals
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- Superior Powerstats
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- Tube Sockets
- Hardware
- Contactors
- Magnet Wire & Hook-up Wire
- Vacuum Condensers
- Gas-filled Condensers
- Oil-filled Capacitors
- High-voltage Mica Capacitors
- High-voltage Oil-filled Capacitors
- Mica & Silver Mica Capacitors
- Tubes
- Switchboard Meters
- Crystal Diodes
- Interlock Switches
- Key Switches
- Type FP Capacitors
- Type G Capacitors
- Fiberglass Yarn
- Contactors & Contactor Coils
- T & B "Wedge-On" Terminals, Glass-enclosed Relays
- Welding Rod; including Type 347
- Tube Crocks

We invite inquiries regarding items not listed above.

Replies will be made to your Inquiries within twenty-four hours after they are received by us.

Key Electronics Division

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Wilkens 6300

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WRITE FOR OUR WINTER 24 PAGE

SURPLUS SALES CATALOG

WE WILL BUY YOUR NEW OR CLEAN USED ELECTRONIC SURPLUS: ARC-1, ARC-3, BC-224, BC-348, BC-312, BC-342, ATC, ART-13, APS-13, BC-221, LM's, TS-12, TS-13, TS-23, TS-34, TS-35, IE-19A, I-222, SCR-522, TS-100, I-100, or any BC, I, IE, TS, APR.

WRITE FOR PRICES

APR4, TS-34/AP, TS13/AP, TS148/AP, ARG-1, ART13, APA11, TS148, TS251, etc.

Weston 769 Electronic Analyzer	LIKE NEW	$200.00
APN-1 Altimeter Indicator 0-1 ma. shunt, 250° dial	NEW	2.95
1E36A Test Sets for SCR-522	NEW	35.00
DuMont 241 Oscillograph	EXC.	300.00
DuMont 208 B Oscillograph	EXC.	225.00
G.E. CRO5Y Oscillograph	EXC.	225.00
LM & BC-221 Frequency Meters xtal, tubes, cal. book	EXC.	99.50
804 LX-1 UHF Sig. Gen. 8-330 mc. Complete		500.00
CRT-3 Two-channel Gibson Girl	NEW	75.00
Drafting Machine single scale 16" fulcrum less scale	EXC.	35.00
BC-463 Target xmtr 5 channel control 68-73 with tubes	EXCELLENT	100.00
TS-34/AP Portable Oscilloscope	LIKE NEW	600.00
	EXC. COND	500.00

NOTE: One of the largest and most complete electronic surplus stocks in the country. We have thousands of tubes, capacitors, plugs, accessories, transmitters-receivers, test equipment, etc. Send us your requirements.

TERMS: Prices F.O.B. Pasadena, California. 25% on all C.O.D. orders. Californians add 3% Sales Tax. Prices subject to change without notice.

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ATTENTION: PURCHASING AGENTS

If the type of tube you are looking for is listed, you have a buy!! All brand new, guaranteed tubes at the lowest prices in the industry. We have them in stock. Immediate delivery.

OA2	.99	2C44	.75	3Q4	.59	RK73	1.00	328A	7.95	706EY-GY	29.95	814	3.40	1608	3.95
OA3/VR75	1.25	2E22	1.95	4B28	3.95	RK75	3.95	329A	7.25	707A	7.95	829B	14.50	1616	.69
OB2	1.05	2J22	7.50	4J42/700A	17.50	REL5	75.00	331A	6.95	708A	3.75	830B	2.95	1619	.39
OB3/VR90	1.05	2J26	9.95	5AP1	3.49	FG81A	3.49	350B	3.95	710A/8011	.75	838	2.95	1625	.45
OC3/VR105	1.10	2J27	9.95	5C30/C5B	3.75	VT90	.75	353A	3.95	713A	.92	841	.39	1626	.45
OD3/VR150	.85	2J39	19.50	5FP7	3.95	VT98	75.00	357A	14.95	714AY	5.75	843	.33	1629	.30
1B22	2.19	2J40	29.50	C5B	3.75	100TH	7.50	371B	.89	715A	5.95	846	49.95	1636	2.95
1B26	2.49	2J61	39.50	C6A	5.75	HY114B	.75	388A	1.29	715B	8.50	851	39.50	1642	.59
1B27	14.50	2J62	29.95	6AK5	.95	VT127	1.75	394A	4.75	717A	1.19	860	6.50	1851	1.69
1B29	4.75	2K25	27.50	6C8G	.69	205B	1.49	417A	14.95	721A	1.75	861	23.25	2051	1.09
1B36	7.50	2V3G	.75	6K7G	.49	211	.75	450TH	37.50	722A	1.89	864	.75	7193	.35
1B56	24.50	2X2	.49	7BP5	14.95	211 GE	1.75	530	16.95	723AB	17.95	865	1.25	8011	.75
EL1C	2.49	3B7/1291	.35	7C4	.35	217C	6.95	531	6.75	724B	2.69	866A	1.45	8012	2.75
1D8G	.59	3B22	2.49	7E5	.39	249B	3.25	533	75.00	725A	6.25	872A GE	3.95	8013A	3.95
1L4	.59	3B24	4.25	10Y	.43	250TH	18.95	559	2.25	800A	1.75	874	.69	8021	1.95
1R4/1294	.89	3C24	1.49	12A6	.49	250TL	16.95	HY615	.22	801A	.44	876	.59	8025A	6.95
1T4	.59	3C28	4.95	24G	1.49	257B	9.95	700A	17.50	803	3.25	879	.95	9001	1.50
2C21/1642	.59	3CP1/S1	1.95	RK34	.49	285A	4.95	701A	4.95	805	3.69	931A	5.95	9002	1.25
2C22/7193	.30	3DP1	3.95	45 Special	.29	286A	6.95	702A	2.49	807	1.59	954	.35	9003	1.75
2C26	.19			FG17	4.50	304TH	8.75	703A	4.75	808	2.25				
2C26A	.39	3D6/1299	.39	CRP72	1.00	304TL	8.75	704A	.89	811	3.25	955	.45	9004	.49
2C34/RK34	.49	3D23	4.75	RK72	1.00	307A	3.95	705A	1.95	812	3.25	957	.45	9005	1.50
2C40	9.95	3FP7	1.75	CRP73	1.00	316A	.49	706AY-DY	39.50	813	7.95	E1148	.33	9006	.29

THIS MONTH'S SPECIAL:

Only 2000 at this price—RCA 9004 Acorn Type UHF Diode Rectifiers, in original Red and Black RCA cartons, JAN specifications—$.40 each.

MARITIME INTERNATIONAL COMPANY

11 State Street, New York 4, N. Y. Cable Address "Foxcroft" Phones: DIgby 4-3192-3

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CORDAGE
CO-122 3 conductor each #22 AWG neoprene jacket 550' lengths
CO-127 single #14 AWG braided and tinned copper braid shield

MULTI-CONDUCTOR
2 conductor AWG 12
7 conductor AWG 14
14 conductor AWG 16
11 conductor shielded AWG 20
2 conductor AWG 18
7 conductor AWG 16
19 conductor AWG 16
6 conductor AWG 20
10 conductor AWG 16
22 conductor AWG 16

ARMOUR
DRIA-23 FRIA-4

SINGLE CONDUCTOR AWG 10
shielded cable with terminal lug each end 100' and 150' lengths

WIRE
AWG 18 copperweld
AWG 29 tinned copper
Resistance wire AWG 32
AWG 22 with nylon core plastic insulation

HEADSET CORDS
Y shaped with one 7 foot leg and two 15½" legs comprising 2 tinsel conductors, arranged for 2 receivers in series, rubber insulation, $.95
ANB-H-1 300 ohm receivers W.E. New. $1.95

METERS
Portable 0-25 Amps AC Weston #433 Brand New $37.50
Switch Board Panel 0-100 Amps DC Weston #269 with 100 Amp Shunt Brand New $24.95

SPECIALS
80-86 Crystal in Holder $2.50
Balloon with Hydrogen Generator $2.50
300 Feet Aerial Wire $2.00
Box Kite 17" x 17" x 36" $2.25
24-750 MMF Tapered Rotor $1.95

MICROWAVE TEST EQUIPMENT
10 CM echo box CABV 14ABA-1 of OBU-3, frequency range 2890 MC—3170 MCS. Direct reading micrometer head. Ring prediction scale plus 9% to minus 9%. Type "N" input. Resonance indicator meter. With accessories, spares and 10 CM directional coupler. Brand New

TUBE LIST

2C34	$0.85	713A	$1.00	9006	$0.50
2X2/879	.65	801A	.45	C5B	9.75
3C24	1.95	803	4.45	CEQ72	1.30
7C4/1203A	.75	826	.95	CK70	1.25
10Y	.45	931A	5.95	CRP-72	1.30
15R	.85	864	.40	E-1148	.35
30 Special	.55	CK1005	.85	HY-615	.25
39/44	.40	CK1007	1.20	RKR-72	1.30
45 Special	.35	1626	.45	RK-73	.65
WE 203A	8.80	1629	.35	5BP4	4.95
211	.65	2051	1.15	5FP7	1.95
316A	.65	7193	.50	1J6G	.75
WL531	9.95	8011	1.70	12A6	.85

TWIN CHART GRAPH RECORDER
Esterline Angus Twin Chart Recorder Model AWT-N
Scale: 2.5-0-2.5 MA DC
Feed hourly: ¾"-1½"-3"-6"-12" Minute: ¾"-1½"-3"-6"
Synchronous clock on each unit and chronograph pens Complete Brand New

LINEAR WIRE WOUND POTENTIOMETERS

10 Ohm	25 Watt	$.90	15000 Ohm	25 Watt	$1.70
15	25	.95	20000	25	2.00
20	25	.95	6	50	1.60
25	25	.95	150 w/switch	50	2.15
50	25	.95	200 w/switch	50	2.15
100	25	.95	10000	50	2.95
200	25	1.20	15	75	2.95
350	25	1.20	.5 Meg 1" Shaft	AB "J"	1.45
500	25	1.20	200,000 1/8 SD	AB "J"	1.40
1000	25	1.30	200 1/8 SD	AB "J"	1.40

10 CM ROTATING ANTENNA
24" Parabola in turret 360° span at 12 RPM DC, motor control and reversing switch New

HI VOLTAGE FILTER CHOKES
.4 HY 4.5 Amp DC 3 ohms 1230 RMS to ground GE69G351 New
.25 HY 4 Amp .5 ohm 20,000 Test New
1 HY 3.2 Amp DC 3.5 ohm GE69G459 New
1.7-3 HY 2 Amp DC 34,000 VDC GE Y346A New

TIME DELAY SWITCHES
1 Minute 115 VAC 60 cycle Enc. in Waterproof Metal Case New $5.25
3 Micro Switches Contact at 40-41-42 Second Time Delay 110 VAC Motor New $4.50
Thermo Switch 50° to 300° F 115 VAC @ 6A 230 VAC @ 5A
Breaks Contact with Increase of Temperature New $1.35

CONTACTORS
DPST 115 VAC 60 cycle 15 Amp De-Ion Line Starter Westinghouse $6.95
DPST 115 VAC "AB" #700 $5.95

RELAYS
12 VDC DPST Allied Control Box 32 ..... $1.25
24 VDC DPDT Allied Control BJ6D36 ... $1.45
24 VDC 3PDT 8 Amp $1.50
110 VAC DPST 1 Amp Contacts Struthers Dunn CKA 1970 ..... $3.65
115 VAC DPST Struthers Dunn CXA 2997 $3.65
220 VDC DPDT Struthers Dunn CK 2122 .. $4.50
230 V 50 cycle DPDT G.E. 12HGA11A2 .. $4.00

HYDROMATIC PROPELLER CONTROL
Constant Speed Control Governor which automatically brings about the adjustments in propeller blade pitch necessary to maintain constant engine speed. Used on DC-3 Airplanes. Brand New.

EQUIPMENT
Walkie-Talkies 2.3-4.6 MC
MN-26Y Bendix Compass Receiver
BC-733 Glide Path Receiver
DAB-3—Direction Finder
RDF Receiver Equipment 200-550 KC Fixed Tuned

SWITCHES - BATHTUB - OIL FILLED - MICA CONDENSERS - POTENTIOMETERS. SEND FOR CATALOG

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TEST EQUIPMENT

DUMMY LOADS

X Band, 1¼" x ⅝" guide, choke or plain flange, dissipates 300 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 100 Watts average power continuously in still air, VSWR less than 1.15 between 8.2 x 12.4 KMC, weight 14 oz.

X Band, 1¼" x ⅝" guide, plain flange, dissipates 250 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 200 watts average power continuously in still air, weight 2 pounds 4 ounces.

S Band, 1½" x 3" guide dissipates 1000 watts average power in still air, VSWR less than 1.15 between 2.5 to 3.7 KMC, choke flange, weight 13 pounds.

TS-36, X Band Power Meter, measures 1 milliwatt to 1 watt of X Band average power for ⅝" x 1¼" wave guide,—$200.00.

TS-155 S Band Signal Generator and Power Meter.

X Band Power and Frequency Meter for 8,500 to 9,600 megacycles measures 1 to 1,000 milliwatts average power. The frequency meter is direct reading within 25 megacycles and within 4 megacycles with correction chart; commercial equivalent of TS-230 B/AP.

TS-110/AP S Band Echo Box,—$150.00.

TS-12/AP (Unit 2) X Band slotted line with adapters and probes,—$175.00.

TS-100 Synchroscope.

T-85/APT-5, 300-1,600 megacycles Noise Modulated Transmitter, 40 watts C. W.

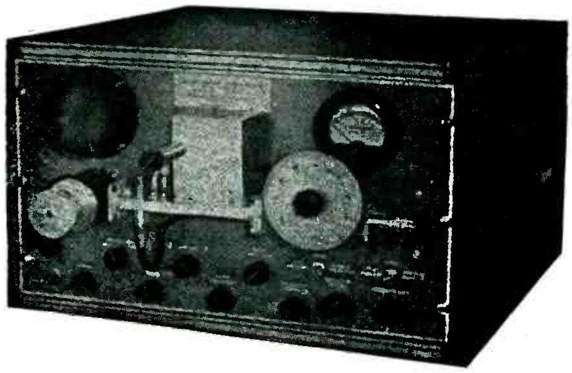
Waveguide Below Cut-Off Attenuator L 101-A, U. H. F. Connectors at each end calibration 30-100 db,—$25.00.

Amplifier Strip AM-SSA/SPR-2 contains I. F. amplifier, detector, video amplifier, pulse stretcher and audio amplifier and Rectifier Power Unit PP-155A/SPR-2 bandwidth 10 megacycles, center frequency 30 megacycles, sensitivity 50 microvolts for 10 milliwatts output. Power supply 80/115 V ac, 60-2, 600 cps 1.3 amps. Send for schematic,—$65.00 less tubes.

Tuning Units for APR-4 Receiver—TN 16 30-80 megacycles, TN 17 80-300 megacycles, TN 18 300-1,000 megacycles, TN 19 1,000-2,200 megacycles, TN 54 2,200-4,000 megacycles.

X Band Spectrum Analyzer 8500-9600 Mc., calibrated linear below cut-off attenuator, calibrated frequency meter, tuned mixer, 4 i.f. stages, 3 video stages over-all gain 125 db., reg. power supply.

S Band Spectrum Analyzer 2700-3900 Mc., similar to above.



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WE HAVE LARGE QUANTITIES OF RADIO TUBES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
OZ4A	$0.70	6BE6	$1.20	6SN7GT	$1.20
1G6GT	0.72	6C4	0.86	6SS7	0.95
1R5	0.90	6C5GT	0.51	12A6	0.48
1S4	0.86	6C6	0.75	12SH7	0.96
1T4	0.86	6H6	0.94	12SK7	0.98
5U4G	0.80	6J5	0.60	12SQ7GT	0.90
6AB7	0.90	6J5GT	0.51	12SR7	0.90
6AC7	1.20	6K6GT	0.91	35Z4GT	0.85
6AL5	1.00	6K7GT	0.70	35Z5GT	0.75
6AQ5	1.40	6SG7	0.90	42	0.60
6B8	0.93	6SK7	0.96	50L6GT	0.90
6B8G	0.93	6SK7GT	0.96	80	0.54

TYPE	PRICE
2E22	$2.50
6C21	30.00
307A	3.75
357A	22.50
805	2.90
808	1.70
830B	3.00
9005	1.30

This offer subject to change and prior sale.

SPECIAL SALE TYPE 805 OUR PRICE: $2.90
List Price: $13.50

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SEARCH RECEIVER – ARD-2

Frequency range 80 to 3000 Mcs.

Measures RF signals from 80 to 3000 Mcs and pulse rates from 50 to 8000 cycles.
The ARD-2 can be used as a Direction Finder to locate signals, or as a frequency meter, by VISUAL and AURAL indicators, provide Originally designed and used by USN aircraft. Ideally suited for military, laboratory and general purpose use.
Equipment consists of the following:
Antenna Detector-CMD-66AFH — Has variable length antennas, diode detector and silver plated tuning stub with calibrated scale.
AMPLIFIER CMD-50ADC—has three stage pulse amplifier, a trigger circuit, a pulse rate counter circuit and audio amplifier, visual signal indicator, rectifier power supply which is operative on 115 Volts AC 60 to 2400 cycles current, regulated.
Test OSCILLATOR-CD-60ABG—Has cavity frequency of 400 cycles with selection of four pulse repetition rates.
ALL CABLES AND FITTINGS, ACCESSORIES AND SHOCK MOUNTED RACK for immediate instalation, plus two Technical Manuals.
SPARE PARTS—Steel chest includes spares for components and two extra sets spare tubes.

Guaranteed NEW

All the above in original export packed cases.
Wt.: 113-lbs

Price each $225.00

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39 pieces
BC-957-A RADAR INDICATOR

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24 pieces
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32 pieces
BC-605-D INTERPHONE AMPLIFIER

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Large stock of AN connectors in most sizes . . . big assortment electronic components; plugs, resistors, condensers, potentiometers and other parts.

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NEW & USED — COMPLETE LINE OF
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QUARTZ CRYSTALS

Made from the finest Brazilian Quartz. Will provide a high degree of activity and frequency stability. All tested and marked by the manufacturer to a very close tolerance. In the frequencies outlined below the crystals itemized under the heading "From & To" are mostly in progressive frequencies between the limits shown (as for example: "From 3300 to 3377 are as follows: 3300KC, 3301KC, 3302KC—, 3377KC.) are of limited quantities in each frequency. Those listed singly are in quantities of 50 or more.

FT243

Prong centers ½", Prong dia. 3/32"

Price $1.15 ea. (25 for $25.00)

FROM (Frequencies in KC)	TO	FROM (Frequencies in KC)	TO	FROM (Frequencies in KC)	TO
2880		6250		7875	
3150	3152	6275		7805	7873
3251		6300	6375	7900	
3300	3377	6400		7925	
3400	3467	6406	6498	7950	
3500	3553	6500		7975	
3627		6506	6573	7906	7968
3654	3700	6525		8000	
3701	3800	6575		8025	
3801	3830	6600	6675	8050	
3900		6625		8075	
4001	4050	6700	6725	8040	
4100	4176	6800	6875	8100	
4244	4290	6815		8106	8175
4300	4366	6830		8200	8275
4400	4450	6900	6975	8300	8375
4680	4697	7025		8400	8475
4700	4780	7075		8500	8575
4800	4899	7100		8600	8650
4900	4941	7175		9254	9300
5081	5100	7220	7287	9342	9400
5124	5195	7312.5		9401	9499
5200	5280	7300	7375	9500	
5350	5397	7400	7473	9501	9590
5450		7500	7597	9608	9638
5550		7600		10075	
5633.3		7606	7673	12602	13000
5655.5		7625		13001	13100
5650	5677	7650		13101	13200
5677.7		7600		13201	13300
5700		7606	7673	13301	13400
5706	5800	7625		13401	13500
5722.2		7650		13501	13600
5744.4		7675		13601	13700
5801	5900	7700		13701	13800
5906	6000	7725		13801	13900
6006	6073	7750		13901	14000
6100	6173	7775		14001	14100
6150		7701	7794	14101	14200
6175		7800		14201	14300
6200		7825			
6225		7850			

CR 1A/AR or FT241

Prong spacing ½", Prong dia ⅛"

Price .79¢ ea. 12 for $3.00

FROM (Frequencies in KC)	TO	FROM (Frequencies in KC)	TO
2853		7700	
3988		7725	
4188		7738	
4285		7740	
4300	4374	7750	
4640		7760	
4788		7770	
5020	5090	7775	
5100		7778	
5120	5180	7780	
5200	5295	7790	
5250		7800	
5300	5396	7810	
5410		7825	
5470		7830	
5500		7850	
5648		7851	7880
5740	5780	7900	
5810		7910	
5891		7925	
5910		7930	
5923	5960	7940	
6011	6080	7950	
6130	6195	7970	
6203	6275	7975	
6270		7990	
6300	6375	8000	
6370		8001	
6400	6499	8002	
6490		8008	8010
6500	6590	8007	
6600	6685	8012	
6744		8010	8092
6815	6877	8205	8298
6905	6980	8308	
7270		8300	8370
7330		8407	
7440		8412	
7460		8405	8490
7500		8506	8561
7560		8645	
7600		8630	8650
7620		8985	
7625		11677	
7650			

XL5 Dual

3 prongs ½" X 1 19/32" prong dia.

Price $1.95 ea.

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2731 & 2891
2436 & 2276
3128 & 3153
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XL5 Single

3 prongs ½" X 1 19/32" prong dia

Price $1.35 ea.

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2300	2384
2410	2450
2561	
2600	2698
2704	2787
2802	2891
2916	
3117	3171
3154	
3325	3371
3435	
3857	

FT241A

SPECIAL TYPE WE.
Prong spacing 1" CTS.
Prong Size 3/32" dia.

These are in successive steps of .1 MC variation from 20.0 MC to 38MC.

Price $1.15 ea.

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7541		7950	8750
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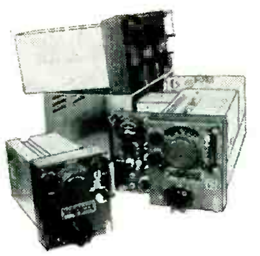

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957	.49
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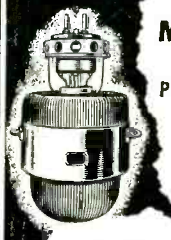

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TS-23/AP
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TS-34A/AP
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TS-100/AP
TS-101/AP
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TS-155A/AP
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TS-389/U
TS-421/U
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I-106/A
I-122
I-130A
I-145
I-177
I-178
I-208/A

I-212
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I-225
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BC-1203
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BC-1255/A
BC-1287/A
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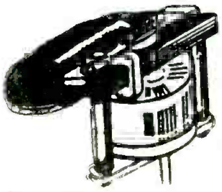

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ZENITH 1951 TV Remote Control Motor Units

Reversing control switch at end of 17 foot cable. Powerful 4 RPM clutch motor.

Will drive anything

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Nat. known Mfgrs. 50 watt 2 windings, 115 V. to 115 V. 60 cy. Ideal to prevent shocks from small radios and medical and electronic devices.

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C/H Off center. SPDT Toggle Switch......... .35

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Geared down 24v. universal motor with transformer $7.50

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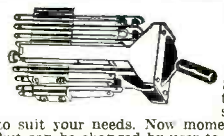

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10 Amp. Heavy Duty Silver Contacts. Contacts can easily be restocked and changed to suit your needs. Now momentary OFF CENTER but can be changed by user to stay either side. Removed from un-used Government Surplus Equipment.

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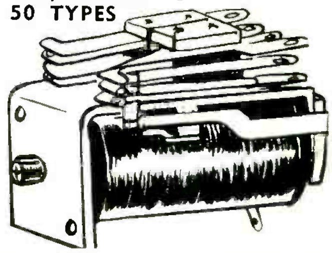

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Same Relay but with 12 V.D.C. 70 ohm coil..$2.45

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Quantity	Gauge	Strip Width	Build Up	Window Width	Window Height
11,365	.003	1⅛	½	7/16	3
3,741	.003	⅞	⅜	7/16	3

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ALLIED DO-7D 3 Pole 24 VDC ..... $2.25 ea.
HART #B-8 200 Amp 24VDC SPST $2.50 ea.
TELEPHONE TYPE: Clare 3300 ohm Coil 1 N.O. 1 SPDT .... $1.35 ea.
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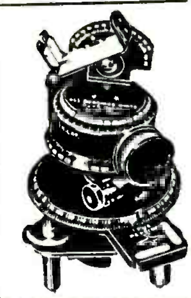
ASTRO COMPASS



The Astro Compass is a precision instrument measuring 8¼" high x 5¼". Furnished in Carrying Case. Designed to provide accurately (a) True heading of Aircraft or boat. (b) True bearing of a distant object. (c) The relative bearing of distant objects.
Of special interest to Astronomers & Experimenters.

$9.50

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Point-to-point communications

Freq. Range: 2000 to 20,000 Kcs.
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Input: 190 to 250 Volts AC 50/60 cps.
Size: 60" high, 17" wide, 27" deep.
Tubes: 807s, 813s, 805s, 866s.
Crystal Oscillator unit built-in, fully shielded and stable. All self contained including antenna network. Master Oscillator unit (available) fits in place of Xtal unit. Speech amplifier is only external unit and has 110/220 v. AC input, four stages, high gain. Total net weight, 625 lbs.

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  Multi-Channel Aircraft Radio Receiving & Transmitting Equipment.

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.02	400 DC	23F274	.39
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.05	1000 DC	23F328	.49
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.05-.05	600 DC	22F797	.69
.06	25 KVDC	26F585	17.50
.1	400 DC	481379	.45
.1	500 DC	K7876543	.49
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.2	1000 DC	23F316	.72
.2	10 KVDC	26F433	10.95
.2-.2-.2	4000 DC	10345	4.95
.25	250 AC	26F822	.69
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.25	400 DC	DA4025	.49
.25	460 AC	26F876	.79
.25	600 DC	22F611	.69
.25	1000 DC	62B1FG254K	.89
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.25	1000 DC	26F467	.85
.25	1000 AC	481129	1.45
.25	2000 DC	TJU200025	1.45
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.25	3500 DC	25F637	4.95
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.38-.38	800 AC	21F707	1.65
.4	500 AC	21F720	.79
.4-.4	800 AC	21F588	1.70
.4	1400 AC	25F934	1.70
.42	800 AC	21F331	.85
.44-.44	880 AC	21F484	1.70
.45	120 DC	Ldg. Mfg.	.65
.45-.45	800 AC	21F569	1.95
.46	1750 AC	21F573	1.95
.5	200 DC	Ldg. Mfg.	.62
.5	330 AC	25F572	.79
.5	400 DC	CS9589	.69
.5	400 DC	Ldg. Mfg.	.69
.5	600 DC	22F612	.79
.5	600 DC	Ldg. Mfg.	.79
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.5	1500 DC	22F386	.95
.5	2000 DC	26F698	1.95
.5	3000 DC	30003	3.95
.5	4000 DC	28F128	6.95
.5	5000 DC	50005	7.95
.5-.1	400 DC	481769	.70
.5-.5	300 DC	23F280	.32
.5-.5	400 DC	Top Term.	.39
.5-.5	600 DC	23F498	.92
.5-.5	600 DC	23F487	.92
.5-.5	3000 DC	25F526	4.95
.5-.5-.5	600 DC	22F437	1.25
.58	1000 AC	21F476	1.65
.6	200 AC	28F120	.95
.6-.6-.6	100 AC	22F7142	1.25
.635	1300 AC	21F386	1.65
.656	900 AC	25F891	1.65
.666	800 AC	21F333	1.35
.67	120 AC	26F663	.95
.7	1300 AC	21F485	1.50
.7-.7	800 AC	21F381	1.95
.7-.7	800 AC	21F718	1.95
.75	330 AC	9CE1A148	.55
.75	400 DC	28F168	.89
.8	120 AC	21F603	.89
.86	660 AC	21F336	.95
1.0	100 DC	54B1EB105K	1.25
1.0	500 DC	23F303	.95
1.0	500 DC	9CD6A4	.95
1.0	440 AC	9CE1A320	1.05
1.0	600 DC	62B1BF105K	1.15
1.0	600 DC	Bathtub	.89
1.0	600 DC	Ldg. Mfg.	1.05
1.0	1000 DC	Ldg. Mfg.	1.15
1.0	1150 AC	21F641	1.75
1.0	1500 DC	15010	1.85
1.0	2000 DC	23F70	2.95
1.0	4000 DC	40010	8.95
1.0-1.0	600 DC	Bathtub	1.25
1.0-1.0	600 DC	23F569	1.65
1-1-3-5	150 DC	Ldg. Mfg.	.95
1.05	800 AC	21F592	1.25
1.1	200 AC	25F450	1.25
1.1	440 AC	26F853	1.30
1.1	720 AC	21F477	1.65
1.25	125 AC	26F594	1.45
1.25	125 AC	28F192	1.45
1.25	660 AC	21F713	1.65
1.26	440 AC	21F338	1.45
1.26-.25	1000 AC	21F850	.95
1.26-3.0	1000 AC	21F714	.95
1.35	125 AC	28F238	1.49
1.45	750 AC	Ldg. Mfg.	1.55
1.45-2.8	850 AC	Ldg. Mfg.	1.55
1.5	330 AC	25F483	1.55
1.5	660 AC	21F651	1.75
1.58-0.3	800 AC	21F671	.95
1.66	850 AC	21F697	1.75
1.75	150 AC	28F159	1.55
1.75	330 AC	21F174	1.75
1.75	660 AC	21F631	1.95
2.0	120 AC	1A931	1.45
2.0	220 AC	21F169	1.65
2.0	330 AC	Ldg. Mfg.	1.70
2.0	400 DC	Bathtub	1.45
2.0	600 DC	Ldg. Mfg.	1.70
2.0	600 DC	22F999	1.70
2.0	250 AC	25F150	1.68
2.0	660 AC	25F993	1.85
2.0	800 AC	21F835	1.90
2.0	1000 DC	Ldg. Mfg.	2.95
2.0	1500 DC	Ldg. Mfg.	3.95
2.0	2000 DC	20020	5.50
2.0	2500 DC	Ldg. Mfg.	6.45
2.0	3000 DC	Ldg. Mfg.	7.95
2.0	4000 DC	22F985	14.95
2.0	5000 DC	23F50	15.95
2.0	6000 DC	60020	27.50
2.0-.5-.3	200 DC	355	.95
2.2	750 AC	21F563	1.75
2.25	330 AC	21F479	1.85
2.25	600 DC	Ldg. Mfg.	1.85
2.25	1600 AC	21F667	4.50
2.5	330 AC	Ldg. Mfg.	2.35
2.6	440 AC	21F744	2.35
2.6-0.4	440 AC	21F676	1.75
2.7	230 AC	Ldg. Mfg.	2.45
2.75	330 AC	25F983	2.50
2.75	385 AC	49F16	2.60
3.0	330 AC	Ldg. Mfg.	2.75
3.0	600 DC	F6030	2.25
3.0	1000 DC	Ldg. Mfg.	2.75
3.0-.05	600 DC	22F632	1.65
3.25	330 AC	21F378	3.15
3.26	230 AC	21F636	2.75
3.5	330 AC	21F587	3.45
3.5	660 AC	25F971	3.95
3.7	330 AC	49F9	3.45
3.7	230 AC	21F705	3.45
3.75	330 AC	Ldg. Mfg.	3.50
3.75	1000 DC	6037	3.75
3.9	230 DC	Ldg. Mfg.	3.50
4.0	100 DC	23F548	1.95
4.0	330 AC	Ldg. Mfg.	3.65
4.0	400 DC	Oil Filled	2.50
4.0	500 DC	Oil Filled	2.65
4.0	600 DC	26F106	2.75
4.0	600 DC	70B1FF405V	3.45
4.0	600 DC	481249	2.75
4.0	660 AC	21F665	3.95
4.0	1000 DC	Oil Filled	3.75
4.0	2000 DC	22F195	15.95
4.0	4000 DC	70E1EM405K	27.50
4.0-4.0	1000 DC	4223	4.50
4.5	230 AC	21F703	3.95
4.5	330 AC	21F691	4.25
4.65	230 AC	21F365	3.95
5.0	220 AC	21F134	4.35
5.0	330 AC	9CE1A306	4.35
5.5	230 AC	21F702	4.40
5.75	330 AC	26F100	4.50
5.0	440 AC	21F420	4.75
6.0	330 AC	3060	4.85
6.0	600 DC	5060	4.85
6.5	330 AC	Ldg. Mfg.	4.95
7.0	330 AC	21F300	4.95
7.5	330 AC	9CE1A309	4.95
8.0	660 AC	6080	5.25
8.0	1000 DC	Oil Filled	4.95
9.5	330 AC	26F727	2.95
10.0	50 AC	26F412	2.75
10.0	330 AC	Oil Filled	5.95
10.0	440 AC	25F501	5.95
10.0	600 DC	Ldg. Mfg.	5.95
10.0	1000 DC	10100G	7.95
10.0	1500 DC	23F152	8.95
10.0	1500 DC	70B1FH106K	8.95
12.0	750 AC	25F268	8.95
12.0	1000 AC	25F234	8.95
14.5	275 AC	26F500	9.50
15.0	330 AC	Ldg. Mfg.	9.50
20.0	220 AC	21F299	9.50
25.0	25 DC	Bathtub	.95
25.0	50 DC	Bathtub	1.45
30.0	90 AC	Ldg. Mfg.	2.65
30.0	400 DC	26F702	9.95
42.0	600 DC	25F673	17.50
46.2	330 AC	26F413	24.50
50.0	330 AC	KS8545	27.50
50-50-50	90 AC	MK4 MOD2	29.95
60.0	3000 DC	18F269	75.00

HIGH VOLTAGE CAPACITORS

MFD.	VOLTAGE	TYPE	PRICE
.06	25 KVDC	26F585	17.50
.02	10 KVDC	24714	9.50
.045	16 KVDC	D4495	9.95
.1	6000 DC	19F210	27.50
.1	10 KVDC	23F430	9.95
.1	12 KVDC	26F68	9.95
.2	10 KVDC	26F433	10.95
.25	15 KVDC	15020	19.50
.25	20 KVDC	20020	27.50
.25	20 KVDC	14F64	29.95
.25-.25	6000 DC	A7548	14.50
.275-.275	7500 DC	Inerteen	16.50
.5	20 KVDC	20005	45.00
.5	25 KVDC	14F103	57.50
.5	25 KVDC	25050	57.50
.5	25 KVDC	Inerteen	57.50
.5-.5	9000 DC	2C21B1	32.50
.65	12.5 KVDC	120065	19.95
.75	25 KVDC	14F88	72.50
1.0	7500 DC	7520	27.50
1.0	10 KVDC	Inerteen	37.50
1.0	15 KVDC	14F63	45.00
1.0	20 KVDC	14F22	69.50
1.0	25 KVDC	A6734	82.50
2.0	6000 DC	60020	27.50
4.5	7500 DC	14F338	69.50
7.0	4000 DC	40244	37.50

ELECTRONIC TUBES

TYPE	PRICE
OA2	1.20
OA3/VR75	1.23
OA4G	1.19
OB2	1.40
OB3/VR90	1.05
OC3/VR105	1.05
OD3/VR150	.90
OZ3/	.85
BG1A	9.50
1B21A	2.75
1B22	2.25
1B23	8.25
1B24/Syl	10.50
1B24/West	9.00
1B26/	2.95
1B27	18.75
1B29	2.45
1B32	2.50
1B35	12.50
1B36	15.75
1B38	28.50
1B40	8.50
1B42	16.00
1B44	Q
1B50	Q
1B51	Q
1B52	Q
1B53	Q
1B54	Q
1B55	Q
1B56	Q
1B57	Q
1B58	Q
1B60	Q
1B62	Q
1N21 xtal	1.25
1N21A xtal	1.75
1N21B xtal	3.75
1N23 xtal	1.45
1N23A xtal	2.95
1N23B xtal	4.75
1N34 xtal	.75
1N34A xtal	.80
1D21/SN4	3.25
1P42	3.95
2AP1	7.50
2B22	2.45
2C21/1642	.69
2C22/7193	.29
2C26A	.49
2C33/RX233A	Q
2C34	.75
2C39	24.50
2C40	14.95
2C43	14.95
2C44	1.15
2C50	Q
2C51	8.50
2C52	Q
2D21	1.35
2E22	1.95
2E24	4.65
2E26	3.75
2E27	3.50
2E30	4.00
2E31	Q
2E32	1.50
2E36	4.20
2E41	Q
2E42	2.75
2G21	2.45
2G22	2.45
2J21A	7.50
2J22	7.50
2J26	17.50
2J27	17.50
2J30	49.50
2J31	25.00
2J32	27.50
2J33	27.50
2J34	27.50
2J37A	12.75
2K25	25.00
2RA3/CE213	2.50
3AP1	9.95
3BP1	5.75
3BP4	8.39
3B24	4.75
3B24W	5.75
3B27	3.75
3B29	Q
3CP1	2.25
3C23	9.95
3C24	1.75
3C31/C1B	2.95
3C33	15.00
3C45	17.50
3DP1	5.00
3DP1A	9.00
3DP1S2	10.00
3D23	Q
3D21A	3.45
3D24	7.10
3E29	12.95
3FP7	1.95
3GP1	4.25
3HP7	3.50
4-65A	19.95
4-125A	29.50
4-250A	42.50
KC4-3	49.95
4B22/EL5B	10.95
4B24/EL3C	6.95
4B25/6CF	9.95
4B26/2000	7.95
4B28	5.95
4B32	11.00
4C35	32.50
4E27	17.50
4J32	95.00
4J33	95.00
4J37	Q
4J38	Q
4J39	Q
4J41	Q
4X500A	85.00
C5B	3.95
5BP1	6.95
5AP1	4.95
5AP4	4.95
5BP4	4.25
5CP1	3.95
5C22	55.00
5CP7	12.50
5D21	17.50
5FP7	1.95
5GP1	4.95
5J23	11.95
5J30	49.50
5R4GY	1.85
6AN5	4.95
4AR6	3.25
6AS6	2.75
6AS7G	4.35
C6J	7.95
6C21	22.50
6J4	6.95
6K4	Q
7BP7	6.50
9GP7	14.50
10Y	.49
12DP7	12.50
12GP7	12.50
12HP7	12.50
15E	1.25
15R	.79
FG17(GE)	4.95
RK20A	9.95
24G	1.75
FG27A	6.95
RK28A	Q
RK34/2C34	.75
RK48A	9.50
53A	5.95
FG57	14.95
QK59	65.00
QK62	65.00
FG67	49.95
CEQ72	.75
CRP72	.75
RKR72	.85
RKR73	.65
FG81A	3.45
FG97	Q
100TH	7.95
FG104/5561	22.95
FG105	17.95
VU111S	1.10
114B	.85
RX120A	8.95
VT127A	1.95
FG172	24.50
HF125	24.00
HF130	19.00
HF140	15.25
HF150	18.00
HF175	18.00
HF200	25.00
T200	23.00
HF201A	Q
203A	8.25
204A	59.50
211	.89
CE213/2RA3	2.50
217C	8.25
227A	4.25
FG235A/5552	79.50
237A	Q
241B	Q
242C	14.00
245A	19.90
249B	7.50
249C	3.75
HF250	28.00
250R	9.25
250TH	21.50
250TL	18.95
251A	Q
252A	20.95
255B	Q
258B	10.25
266B	Q
270A	99.50
FG271/5551	69.50
282A	Q
284D	16.50
286A	21.00
287A	13.85
293A	2.95
294A	3.95
HF300	32.00
304TH	13.95
304TL	11.95
307A/RK75	4.25
308A	55.00
309A	Q
313C	Q
316A	.65
323AB	14.95
327A	4.75
331	9.95
S340	2.50
349A	Q
350A	7.95
350B	4.95
355A	23.00
368AS	6.95
371A/B	.89
393A	8.95
394A	4.95
417A	11.95
434A	19.00
446A/2C40	4.95
446B	17.50
450TL	55.00
450TH	55.00
451	14.75
464A	8.95
468	26.00
471A	2.25
GL502A	1.85
527	12.95
530	16.95
531	9.50
532A	2.50
533	Q
559	1.25
562A	Q
575A	13.95
600	7.25
602	9.10
604	7.95
614	7.95
615	6.50
617	10.35
618	11.00
623	10.35
625	26.00
627	32.25
635	11.25
643	12.00
649	6.60
WL651/656	Q
F660	39.95
WL672	29.95
GL673	20.95
701A	5.75
702A	3.25
703A	5.25
704A	.95
705A	2.15
706DY	37.50
706FY	39.50
706GY	39.50
707A	17.95
707B	18.95
708A	4.25
709A	3.25
710A/8011	.95
713A	1.45
714AY	5.95
715A	6.25
715B	9.50
715C	24.50
717A	1.15
718BY	49.50
719A	24.50
721A	2.25
722A	2.95
723A/B	17.95
724A	2.95
724B	3.15
725A	6.75
726A	6.25
726B	29.50
SN729	Q
730A	28.95
801A	.49
802	4.25
803	3.75
803A	9.95
805	3.75
807	1.59
808	2.50
809	1.65
810	9.95
811	2.85
812	2.75
813	8.95
814	2.75
815	2.65
816	1.05
826	1.50
828	8.95
829	9.95
829A	10.95
829B	12.95
830B	2.75
832	7.95
832A	8.95
833A	39.95
836	4.45
837	1.35
838	2.25
841	.45
843	.39
849	24.50
851	39.95
852	25.00
860	3.25
861	21.95
864	.25
865	.98
866A	1.39
868	Q
869B	32.50
872A	3.95
874	1.15
876	.39
878	1.69
905	3.95
906P1	9.95
908	9.95
918	1.45
919	2.95
922	1.39
927	1.10
926	2.75
930	1.20
931A	4.50
954	.25
955	.35
956	.35
957	.35
958	.35
959	3.95
991	.39
CK1005	.89
CK1006	3.25
CK1089	.95
CK1090	.75
R1111	Q
R1131C	Q
E1148	Q
1206	Q
1603	5.25
1613	.95
1614	2.95
1616	.98
1619	.89
1622	2.45
1624	1.69
1625	.39
1626	.39
1629	.39
1630	.89
1631	1.39
1632	.79
1633	.79
1634	.79
1636	2.95
1638	.79
1641/RK60	2.49
1644	1.25
1642	.69
1851	1.55
1960	.65
1961	5.95
2050	1.75
2051	1.10
HF3000	Q
ZB3200	Q
4120/SS501	Q
R4210	Q
R4410	Q
R4330	Q
5511	82.00
5557	6.70
5559	18.95
X6089	Q
UX6653	Q
7193	.29
8005	6.95
8008	6.95
8011	1.69
8012	3.95
8013	2.95
8013A	5.95
8020	1.95
8025	5.45
9001	1.49
9002	.98
9003	1.65
9004	.75
9005	1.90
9006	.35

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189049	6A	2.50
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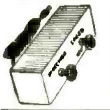

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10AMP	6.75	9.98	12.00	20.00	45.00
12AMP	8.50		16.00	25.50	52.50
20AMP	13.25	16.20	24.00	36.00	
24AMP	16.00		31.00	48.00	
30AMP	18.50	24.30	36.00		
36AMP	25.50		45.00		

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38KDD Fafnir	20/64	55/64	17/64	.98
SKF 13303	20/64	55/64	18/64	.98
R6-5 N.D.	24/64	56/64	14/64	.85
13304 SKF	23/64	1 1/64	20/64	.90
200 KDD Fafnir	25/64	1 11/64	22/64	1.00
S12/12R Norma	1 24/64	2 32/64	27/64	1.89

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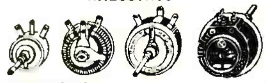
Sensational 10" Hi Fi Spkr Idea 10 Watt Home Size. 30 to 16000 cps Range English mfgr ... $18.98

RHEOSTATS

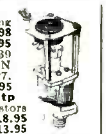


15 ohm 25W w/knob ... 1.98
60 ohm 50W w/knob ... 2.69
200 ohm 25W Model D ... 1.98
250 ohm 25W ... ea. 1.39; 4 for 5.00
300 ohm 200W Model P ... 5.49
350, 500, 5000 ohm Slotted shaft 25W ... 3 for 2.00
1000 ohm 25W Model J ... 2.19
10000 ohm 50W Model J ... 2.89

CONNECTORS AND CORDS
831R/SO239 Receptacle $0.50 ... 10 for $3.90
831SPN/PL259A Plug $0.65 ... 10 for 5.50
831SP/PL259 Plug $0.50 ... 10 for 4.75
83-1J/PL258 Junction ... .95
CORD CD307A W/JK26 & PL55 5 ft long ... 1.09
CORD same as above 8 ft $1.29; 12 ft long ... 1.49
CORD RG8U COAXIAL CABLE per ft ... .12
RG59U Cable Special per ft ... .08

POTENTIOMETERS Type J
1000 ohm Type J ¼" Flatted Shaft ... 1.45
3500 ohm Type J ½" Shaft ... 1.45
7K ohm Type J ⅜" Slotted Shaft ... 1.25
25K ohm Type J ⅜" Slotted Shaft ... 1.25
50K ohm Type J ⅜" Flatted Shaft ... 1.45
100K ohm Type J ⅜" Flatted Shaft ... 1.45
1 meg Type J ⅜" Slotted Shaft ... 1.25
1 meg Type JJJ (Triple) 1⅛" Shaft ... 3.69

MICROWAVE!!



Klystron Mtg Assy (723 AB) & Coupling to 2 Type "N" Co-Ax Fittings ... $9.98
1 Microsecond Delay Line. Millen $2.95
Microwave Lighthouse Assy P/O RT39 Ang & 15 use and Tr Cavities. Type N Coupling. Uses 2C32, 2C40, 1B27. Tuns 2400-2700 MC Less Tubes ... $29.95
3 cm T-Sect. Waveguide & Atten Outp Thermal Comp & Pwr Meas Thermistors & Xtal Diode Detector Mtg & Cplg. $18.95
Less Xtal Mtg & Thermistor ... $13.95

PULSE TRANSFORMERS
7.5 KV Pulse. Pri 4KV, 50-1000 ohm imped. Permalloy Core, WEco ... $14.98
Pulse Blocking Osc. 3 wndgs. Video Interstage 1:1 ratio. 32 mh wndgs. H'Sld. HiVins. GE ... $1.98
Pulse Blocking Osc. 3 wndgs. 1:1:1 ratio. 1 mh wndgs GE. H'Sld. HiVins ... $2.98
Pulse Blocking Osc. Video Interstage. 3 wndgs. 1:1:1 ratio. 4.5 mh wndgs. GE. H'Sld. HiVins. 1 Micro Second rise time ... $2.98
PULSE SHAPING Xfmr Raytheon UX12819. IMU Sec. 2000Cy ... $8.95

END EQUIPMENT BUYS
ART13 Speh Amp. New. Less Tubes ... $12.98
RM29 Control Unit. BRAND NEW ... 12.98
PE97 Plate Supply Unit. Less Tubes ... 9.98
I-108 Range Calibrator. Metal Case ... 29.98
I-198 Sig. Gen. Good Cond. Less Tubes ... 14.95
SCR595 IFF Less Tubes. As Is ... 3.98
BC906 Freq. Mtr. exc. cond ... 29.95
I-122A Sig Gen. 115V/60 Cy ... 149.50
BC221 Sig Gen. Exc. Cond ... 125.00
SCR522A Less/Xtals w/Tubes ... 69.95

OIL CAPACITORS

MFD	EACH	MFD	EACH	MFD	EACH
600wvdc		1000wvdc		2000wvdc	
.1	.64	.45	.79	.1	1.49
.25	.71	2	1.69	2x.1	1.75
.5	.75	3	2.98	.5	1.89
1	.85	4	4.98	1	2.98
2	.99	1400wvdc		2	3.69
3	1.08	.25	1.29	8	9.49
4	1.89	.5	1.39	2500wvdc	
5	2.29	1500wvdc		.25	2.29
6	2.69	.5	1.59	3000wvdc	
8	2.89	.75	1.69	.1	2.49
10	3.29	1	1.79	.5	2.98
2x.1	.79	2	2.29	1	4.49
2x.25	.85	3	3.49	2	6.98
2x.5	.98	4	3.98	4	7.98

PHOTOFLASH CAPACITORS
2x.36 mfd Total .72mfd per Unit 30 Units 2/.6mfd/1800vdc 38.8 W Sec ... 55.95
30 Units 21 (lmfd) 3000vdc/64.8 W.Sec ... 7.95
Save on Peel ... and Write for Details

TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W-Sec. Max.	Each
U10	Ge FT114	100	$9.98
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT 210	200	10.98
53GT	GE FT403	500	16.98
VA	SYLV.4330	200	11.98

Write for Complete "THRIFTLITE" Data Boosterpacks, Ext lites, Units for Focal plane shutters.

CARTER GENEMOTORS 6 VOLT IN
Output — Model
400/375Ma Int 4037AS New Each ... $29.95
590V/150Ma Int 5915AS New Each ... 29.95
590V/250Ma Int 5929AS New Each ... 34.95
All CARTER GENEMOTORS supplied with General-Electric Input Filter FREE!

DYNAMOTORS
DM37C in 28V/9.2A out 625V/225ma ... $9.98
Inpt 6V Outpt 200V/100Ma ... 3.75
DM32 28V/1.1A out 250V/60ma ... 3.69
DM4 12 & 24V. out 225V/100ma. 440V/200ma ... 11.98
DM53A 28V/1.45A out 220V/80ma ... 3.59
DA3A 28V/10.5A out 300VDC/260ma 150VDC/10ma. 14.5vdc/.5A ... 5.75
PE94 Plate Supp. Uses DA3A (SCR522) ... 8.98

SELSYNS
2J1H1 GE Selsyns ... 2 for $6.98
2J1F3 GE Brand New 115V/400 cy ea ... 9.75
C78248 Sync Trans. 115/60 cy 15.95 ... 2 for 29.95
C78249 Sync. Diff. 115V/60 cy 12.95 ... 2 for 25.00
Sync Trans. C-69405-2 Type 1-1 $27.70 ... 2 for 50.00

ATTENUATORS
7470 & 1063 ohm 12 step W.W. ... $3.98
DUAL 25000 ohm 20 step ... 3.98
DUAL 15000 ohm 20 step ... 3.98
100,000 ohm 20 step 3DB/Step ... 4.98
Barometric Pot 140K ohms ... 1.98

TUBE CARTONS

STYLE	SIZE	Per/100	Per/500	Per/1000
Min	1"SQx2¼	.85	4.10	7.75
Lge Min	1"SQx2¾	.95	4.50	8.25
Sml G	1¼SQx4½	1.35	6.50	12.45
"GT"	1¼SQx3¼	1.00	4.65	8.45
Ext Lge	2¼SQx6¾	2.95	13.50	24.95

TABOGRAM
WRITE FOR IT
WE STOCK LARGE VARIETY OF COMPONENTS. TELL US YOUR NEEDS.
SELL US YOUR TUBES & EQUIPMENT.

TUBES
"TAB" TESTED & GUARANTEED
PRICES SUBJECT TO CHANGE

OA2	.98
OA3/VR75	1.23
OA4G	1.45
OB2	1.37
OB3/VR90	1.09
OC3/VR105	1.19
OD3/VR150	.98
OY4	2.53
OZ4	.60
C1A	9.75
O1A	.69
VS-1	12.49
1A3	1.10
1A4P	.79
1A5GT	.79
1A6	1.49
1A7GT	1.32
1AE4	1.80
1B3/8016	.83
1B4P	.89
1B5/25S	.99
1B7GT	.99
1B21/471A	2.85
1B22	2.20
1B23	9.90
1B24	17.49
1B26	2.45
1B27	14.98
1B32/532A	3.90
1B35	10.98
1B37	16.98
1B38	29.95
1B40	4.95
1B41	49.95
1B42	18.00
1B46	1.98
1B53	49.95
1B56	38.50
1B58	350.00
1B60	69.75
1B63	50.00
1B63A	75.00
ELIC	2.70
1C5GT	.89
1C6	.79
1C7G	.89
1D5GP	.99
1D7G	.89
1D8GT	.89
1E5	.99
1E7G	.99
1F4	.69
1F5G	.79
1F6	.89
1F7G	.89
1G4GT	.89
1G5G	.89
1G6GT	.79
1H4G	.89
1H5GT	.89
1H6GT	.79
1J5G	1.20
1J6GT	.79
1L4	.69
1L6	.98
1LA4	1.19
1LA6	.99
1LB4	1.29
1LC5	.79
1LC6	1.39
1LD5	.99
1LE3	.99
1LH4	.89
1LN5	.79
1N5GT	.99
1P5GT	.79
1P42	4.75
1Q5GT	.89
1Q26	69.00
1R4/1294	1.29
1R5	.79
1S4	1.19
1S5	.79
1S21	6.90
1T4	.79
1T5GT	.99
1U4/5910	.73
1U5	.79
1V	.79
1V2	.70
1X2	.99
1Y2	6.98
1Z2	3.98
2A3	1.78
2A4G	1.19
2A5	.69
2A6	.69
2A7	.69
2AC15	4.98
2AS15	4.98
2B7	.89
2B22	3.90
2C21/1642	.67
2C22/7193	.33
2C26	.19
2C33/RX233A	3.49
2C34/RK34	.69
2C39	33.98
2C40	9.98
2C40 JAN	19.90
2C43	26.75
2C43/464A	9.49
2C44	1.20
2C50	3.69
2C51	7.98
2C52	5.98
2D21	1.49
2E5	1.19

2E22	1.95
2E24	4.69
2E25HY65	5.15
2E26	3.19
2E30	2.19
2J21	10.69
2J21A	9.25
2J22	7.90
2J31	29.75
2J31A	79.95
2J32	59.95
2J33	39.39
2J34	38.50
2J36	120.00
2J37	12.70
2J38	17.75
2J39	49.50
2J42	250.00
2J48	28.50
2J49	39.45
2J50	27.50
2J52	249.50
2J55	85.00
2J56	199.50
2J61	49.95
2J62	49.45
2K25	39.95
2K25/723AB	29.00
2K28	34.95
2K29	23.95
2K33	300.00
2K48	118.00
2X2	.69
3A4	.99
3A5	1.69
3A8GT	1.59
3B4	2.69
3B5	.98
3B7/1291	.69
3B23/RK22	4.95
3B24	5.40
3B25	4.50
3B26	3.70
3B28	8.80
3C6/XXB	1.49
3C22	125.00
3C23	12.45
3C31/C1B	3.45
3C33	14.98
3C34/HK24	5.49
3C45	25.00
3D6/1299	.69
3D21A	2.39
3D22	13.95
3D23	4.90
3E29	14.95
3LF4	1.29
3Q4	.79
3Q5GT	1.29
3S4	.85
3V4	.79
4-125A	29.95
4-250A	40.95
4-1000A	108.50
4B27	4.98
4C25/HK54	5.98
4C33	59.00
4C35	28.65
4C36	15.98
4E27/257	14.50
4J22	148.50
4J31	95.00
4J34	194.00
4J42/700	27.00
4J47	260.00
4J47CY	198.00
4J52	350.00
4T4/2	5.95
4X-150A	45.00
4X-500F	85.00
5AX4GT	.54
5A24	1.35
EL5BHD	16.98
5C22	53.35
5C30/C5B	3.95
5D21	27.45
5D23/RK65	24.95
5J29	12.40
5R4GY	1.80
5R4WGY	1.75
5T4	2.49
5U4G	.77
5V4G	1.10
5W4	.89
5X4G	.79
5Y3GT	.49
5Y4G	.79
5Z3	.99
5Z4	1.29
C6A	6.75
6A3	1.59
6A4	1.89
6A5G	2.39
6A6	.89
6A7	1.32
6A8GT	1.09
6AB4	.79
6AB5/6N5	1.33
6AB7/1853	1.39
6AC5GT	1.09
6AC6G	1.45
6AC7	.99
6AD6G	.98
6AD7G	1.49
6AF6G	1.33
6AG5	.89
6AG7	1.99
6AH5G	1.49

6AH6	1.99
6AJ5	1.40
6AK5	.90
6AK5W	2.98
6AK6	1.49
6AL5	.69
6AL7GT	1.29
6AN5	2.90
6AQ5	.59
6AQ5W	3.98
6AQ6	1.00
6AQ7GT	1.29
6AR5	.79
6AR6	2.98
6AS5	.79
6AS6	2.79
6AS7G	4.35
6AT6	.82
6AU5GT	1.49
6AU6	.69
6AV5GT	1.29
6AV6	.59
6AW6	1.89
6Ax4/6U4	.79
6AX5GT	.79
6B4G	1.59
6B5	1.19
6B6G	.89
6B7	1.19
6B8G	1.09
6BA6	.79
6BA7	1.19
6BC5	.69
6BC7	1.23
6BD5GT	1.65
6BD6	.89
6BE6	.79
6BF5	1.06
6BF6	1.49
6BF7	2.55
6BG6G	1.65
6BG7	1.98
6BH6	.89
6BJ6	.99
6BK7	2.15
6BL7GT	1.45
6BN6	1.49
6BN7	1.69
6BQ6GT	1.29
6BQ7	2.15
6C4	.60
6BY5G	1.45
6C5GT	.79
6C6	.79
6C7	1.26
6C8G	.89
6C21	29.45
6CB6	.89
6CD6G	2.49
6D4	2.85
6D6	.89
6D7G	.89
6D8G	.89
6E5	.89
6E7	1.39
6F4	6.35
6F5	.79
6F6	.99
6F6GT	.79
6F7	1.39
6F7G	1.29
6G6G	1.39
6H4GT	.98
6H6	.89
C6J	6.95
6J4	7.65
6J5GT	.59
6J6	.89
6J7	1.09
6J8G	1.19
6K4A	4.75
6K5GT	1.09
6K6GT	.79
6K7	.85
6K8	.99
6L5G	.79
6L6	2.25
6L6G	1.09
6L6GA	1.69
6L6GAY	2.29
6L7	1.19
6N4	2.39
6N6G	1.69
6N7GT	1.29
6P5GT	.89
6Q7	.89
6R7	.99
6R8	1.39
6S4	.98
6S7G	.89
6S8GT	.99
6SA7GT	.89
6SA7GTY	3.37
6SB7Y	1.19
6SC7	1.39
6SD7GT	.99
6SF5	.89
6SF7	.89
6SG7	1.39
6SH7	.99
6SJ7	.89
6SK7GT	.89
6SL7GT	.89
6SN7GT	.79
6SN7WGT	2.25
6SQ7GT	.79
6SR7	.69
6SS7	1.09

6ST7	1.33	12BH7	1.29	35C5	.69	117Z3	.59	702A	3.29
6SU7GTY	3.37	12BY7	1.35	35L6GT	.79	117Z4GT	1.39	702B	5.98
6SZ7	1.05	12BZ7	1.25	35T	6.95	117Z6GT	1.19	703A	5.98
6T7G	1.39	12C8	1.39	35TG	5.45	117Z7GT	1.49	704A	.98
6T8	1.09	12F5GT	.79	35W4	.59	CK118	0.00	705A/8021	1.98
6U6GT	1.09	12H6	.79	35Y4	.69	F123A	7.90	707A	7.90
6U7G	.69	12J5GT	.69	35Z3	.69	T125	12.49	707B	17.49
6V3	1.89	12J7GT	.79	35Z4GT	.69	F127A	19.98	710A/8011	.95
6V6	2.25	12K7GT	.79	35Z5GT	.59	VT127A	3.90	713A	.98
6V6GT	.69	12K8	.99	REL36/6J4	.49	CV148	4.98	NL714	5.95
6V8	1.89	12Q7GT	.79	36	.65	150T	14.50	714AY	5.90
6W4GT	.69	12SA7GT	.98	37	.59	VT158	14.49	715A	6.45
6W6GT	.59	12SC7	.98	38	.59	FG166	49.00	715B	8.90
6W7G	1.89	12SC7	1.39	RK39	2.89	FG172	42.50	715C	29.85
6X4	.69	12SF5GT	.79	39/44	.59	182B	1.20	717A	1.49
6X5GT	.75	12SF7GT	.59	CRC40	.59	FG190	12.80	718BY	48.45
6Y6G	1.27	12SG7	1.05	T40	.45	T200	22.98	718CY	48.45
6Y7G	.89	12SH7	1.10	TZ40	3.98	201A/CX301A	.98	719A	49.95
6Z7G	.89	12SJ7GT	.79	40	1.09	203A	5.98	721A	2.49
6ZY5G	.89	12SK7	.79	HY40Z	3.75	205B/VT2	1.69	722A/287	2.45
7A4/XXL	1.09	12SL7GT	.89	41	.79	CE206	3.15	723A	11.95
7A5	.99	12SN7GT	.89	42	.69	211/VT4C	.45	723A/B	25.00
7A6	.79	12SQ7GT	.79	43	.79	CE215	8.98	724A	3.95
7A7	.79	12SR7	.98	45	.65	RX215	9.95	724B	3.45
7A8	.89	12X3	.89	45S/VT52	.65	WE215A	.18	725A	6.90
7AD7	1.49	12Z3	.89	45Z3	.65	217C	8.75	726A	8.45
7AF7	.79	14A4	1.09	45Z5GT	.89	227A	5.75	726B	59.95
7AG7	1.99	14A7/12B7	.99	46	.89	231	1.20	726C	69.95
7AH7	1.19	14AF7/XXD	1.19	47	.99	242C	3.95	800	1.85
		14B6	.99	48	1.99	244A	4.15	801A	.45

Use Your Priority for SPEEDY DELIVERY—Extend Your DO & Contract Nos.

7B4	.79	14B8	.79	RK48A	6.85	247A	9.95	803	3.89
7B5	.79	14C5	1.09	RK49	7.50	249B	3.75	805	3.90
7B6	.79	14C7	1.09	49	.83	250R	9.90	807	1.65
7B7	.89	14E6	.99	50	1.19	250TH	22.25	808	2.98
7B8	.89	14E7	1.09	50A5	1.19	250TL	18.50	809	2.43
7C4/1203A	.79	14F7	1.09	50B5	.79	HK254	14.49	810	10.98
7C5	.79	14F8	1.29	50C5	.79	262B	3.98	811	2.90
7C6	.79	14H7	.99	50C6	1.49	274B	3.45	812	2.70
7C7	1.00	14J7	1.19	50L6GT	.69	276A	9.89	813	7.83
7C23	12.00	14N7	1.19	50X6	.79	T300	26.98	814	3.45
7C29	69.95	14Q7	1.19	50Y6GT	.98	304TH	8.90	815	2.45
7E5/1201	1.25	14R7	1.19	50Z7G	.89	304TL	8.90	816/866Jr.	1.07
7E6	.89	14S7	1.09	52	.99	307A/RK75	4.85	826	.95
7E7	.89	14W7	1.09	53	.69	310A	8.26	828	11.29
7F7	1.25	14X7	1.23	T55	8.79	311CH	10.90	829	11.49
7F8	2.19	15E	1.29	55	1.06	313C	2.98	829B	12.45
7G7/1232	1.29	15R	.89	56	.85	311CT	10.50	830B	3.49
7H7	.89	FG17	3.95	57	.79	311T	10.50	832	7.65
7J7	1.09	18	.58	58	.79	316A	.49	832A	9.65
7K7	1.29	19	.65	HK59	11.90	323A	24.25	833A	39.45
7L7	1.29	19BG6G	1.75	59	1.95	327A	4.95	834	5.95
7N7	1.19	19T8	1.69	T60	10.45	350A	6.50	836	4.75
7Q7	.79	19Y8	1.62	HY69	4.98	350B	5.90	837	1.45
7R7	.79	T20/1623	3.75	70A7	1.59	353A	4.65	838	3.98
7S7	1.09	1UF20	5.45	70L7GT	1.59	HK354	24.98	843	.39
7T7	1.35	T220	1.35	71A	.79	355A	14.15	845	5.55
7V7	1.35	20	1.17	75	.95	368AS	7.75	849	29.45
7W7	1.19	RK20A	8.95	CRP72	1.20	371B	.90	852	19.98
7X7/XXFM	1.15	RX21	3.75	CRP73	1.20	380A	1.49	860	4.90
7Y4	.65	22	.95	73	1.67	388A	1.49	861	23.95

Top Dollar Paid for Your Surplus Tubes—Send List and Prices

7Z4	.69	24	.85	NR74	.79	383A	8.90	864	.39
8DC-15	4.98	24A	1.10	HY75	4.59	394A	4.50	865	1.29
10Y	.43	24G/3C24	1.80	75	.59	FF400	15.98	866A	1.50
CV11	5.25	25A6	1.09	76	.59	417A	25.95	868/CE1C	3.49
UXCV11	5.25	25A7	2.58	77	.59	GL434A	29.95	869	36.95
12A	.89	25AC5GT	1.58	78	.59	446A	1.89	872A	3.29
12A5	1.39	25AV5GT	1.29	79	.99	446B	3.89	874	1.39
12A6	.85	25BQ6GT	1.19	80	.69	450TH	44.00	878	1.95
12A7	1.29	25C6	1.18	81	1.65	450TL	52.00	884/6Q5G	1.80
12A8GT	.79	25L6GT	.69	FC81A	3.90	460/HF200	15.95	885	1.45
12AC7	1.45	25W4GT	.89	82	1.19	WL468	13.95	893A	250.00
12AH7GT	1.45	25Y5	.79	82V	1.39	GL471A	2.69	922	1.85
12AH5	1.98	25Z5	.79	83	1.45	GL502A	3.79	923	1.00
12AK5W	2.88	25Z6GT	.79	83V	1.19	RH507	9.98	927/CE25	1.49
12AL5	1.11	26	.59	84/6Z4	.99	GL530	22.00	929	1.33
12AT6	.59	27	.68	85	.99	531	6.98	930	1.25
12AT7	1.19	FG27A	8.70	89	.75	WL532	3.89	931A	6.90
12AU6	.89	HY27	10.95	VR92	.25	550P1	19.95	954	.25
12AU7	.89	FM28A	4.95	FG95/5560	24.85	575A/975	13.95	955	.39
12AV6	.89	28D7	.35	FG98	19.95	WL579	10.49	956	.36
12AV7	1.79	30	.59	FCTH	2.58	WL579B	12.98	957	.45
12AX4GT	1.20	31	.59	102D	2.58	601B	.19	958A	.67
12AX7	1.19	HY31Z	2.75	102G	2.58	HY615	.25	967/FG17	3.95
12AY7	2.95	FG32/558	13.85	FG104	37.98	616	37.00	973	10.75
12AZ7	1.49	32L7GT	1.49	FG105	18.98	KU627	18.00	991	.39
12BA6	.79	33	.79	VU111	.75	WL652	65.00	FM1000	1.50
12BA7	.79	34	.69	HY114B	.75	WL670A	11.98	CK1005	.85
12BD6	1.75	35/51	.79	HY115/145	.75	WL676	39.95	CK1006	3.49
12BE6	.99	35A5	.79	117L/M7GT	1.59	WL677	34.00	R1100	5.00
12BF6	.85	35B5	.79	117N7GT	1.79	WL686	35.00	R1130	12.00
				117P7GT	1.39	701A	5.89	E1148	1.35

HY1231Z	5.39	3EP1/1806P1	4.98
1612	1.98	3FP7	1.65
1613	.89	3FP7A	14.98
1616	.74	3GP1	4.70
1619	.25	3HP7	3.88
1620	6.25	3HP14	14.90
1622	2.69	3JP7	12.55
1624	1.90	3JP12	19.95
1625	.39	3JP14	16.90
1626	.39	4AP10	4.68
1629	.29	5AP1	5.99
1630	.97	5BP1	4.45
1631	.74	5BP1A	19.95
1632	.77	5BP4	4.75
1633	.73	5CP1	4.75
1634	.73	5CP7	11.95
1636	3.19	5FP7	1.85
1644	.95	5HP1	9.75
2000T	149.50	5HP4	9.70
2050	1.47	5JP2	24.45
2051	1.19	5JP4	26.75
5516	5.98	5LP1	29.95
5517	3.39	5LP7	19.95
5608A	5.95	5MP1	9.75
5594	6.65	7BP1	4.95
5637	7.15	7BP7	6.78
5638	4.79	7EP4	17.99
5651	3.05	7JP4	18.39
5654	2.95	9GP7	14.89
5656	6.90	9LP7	5.95
5663	1.85	12DP7	16.89
5670	6.98	12DP7A	49.50
5684	14.98	12GP1	49.98
5686	3.90	12GP7	16.89
5687	5.75	12HP7	16.89
5692	7.69	12JP4	27.00
5693	7.69	12KP4	47.00
5694	3.65	17LP4	21.25
5718	10.15	905	3.49
5719	17.75	912	89.98
5726	4.39	913	11.98
5744/CK619CX	6.49	914A	45.00
5749	3.39		
5751	5.45		
5763	1.70		
5812	2.99		
5814	5.49		
5840	12.75		
5881	3.29		
X6030	4.49		
UX6653	.69		
8002R	99.50		
8005	7.25		
8008	6.49		
8012	2.89		
8013	2.75		
8013A	6.45		
8014A	28.95		
8020	1.25		
8025	5.79		
9001	1.65		
9002	1.29		
9003	1.69		
9004	.42		
9005	1.45		
9006	.39		

Vacuum Capacitors

MMF	KV	Each
25	7.5	3.49
12	20	9.98
50	20	9.98
55	20	9.98
150	20	14.98
12	32	12.98
25	32	14.98
50	7.5	1.49
50	32	16.98

Mazda Pilots
311/28V ... .15
313/28V ... .15
323/3V ... .25

Sub-Miniatures

1AD4	2.95
2E31	1.49
2E36	2.19
2E41	2.39
2E43	1.39
2G21	2.39
CK512AX	3.15
CK522AX	2.49
CK525AX	3.15
CK526AX	3.95
CK534AX	.89
CK536AX	.89
CK538DX	.89
CK571AX/5886	4.98
CK573AX/6029	4.45
CK1027	3.35
CK1028	9.98
CK1089	2.98
CK1090	2.98
CK5672	2.29
CK5676	2.29
CK5678	2.45
CK5697	5.98
CK5702	7.45
CK5703	.98
CK5704	4.39
CK5783	6.69
CK5784	7.40
CK5829	4.49
CK5851	4.98
CK5875	1.98

C'Ray Tubes

2AP1	11.90
3AP1	10.69
3AP1A	14.25
3BP1	7.19
3BP1A	14.98
3CP1	2.20
3DP1	4.85

Xtal Diodes
Many Late Dates Latest JAN Specs.

1N21	.79
1N21A	1.65
1N21B	3.45
1N21C	27.45
1N22	1.25
1N23	1.35
1N23A	2.45
1N23B	3.70
1N25	7.45
1N26	9.15
1N27	1.65
1N29	3.50
1N32	24.50
1N34	.64
1N34A	.98
1N35	1.95
1N38	1.65
1N39	6.15
1N40	9.98
1N43	1.69
1N44	1.21
1N45	1.39
1N46	.69
1N48	.59
1N47	9.50
1N51	.45
1N52	1.85
1N54	.89
1N55	2.99
1N56	.89
1N57	.89
1N58	1.19
1N60	.60
1N61	2.10
1N63/K63	2.49
1N64	.69
1N67	1.95
1N69	1.98
K34	1.39
CK705	.77
CK706	.54
CK707	1.80

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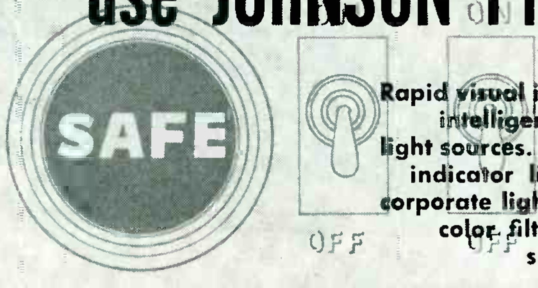
May - 1952

Where Visibility Counts Most!

use JOHNSON Pilot Lights



Rapid visual interpretation of coded intelligence requires controlled light sources. Each of the JOHNSON indicator lights listed below incorporate light control by means of color filtering, variable intensity or radiation angle.

147-430

Variable light intensity indicator assembly for miniature bayonet based bulbs. Camera type shutter, operated from front of panel, is an integral part of the ½" jewel assembly. Variation of light intensity by means of polarized discs may be affected by using the nearly identical assembly 147-420.

147-1600

Good visibility from extremely wide angles. S-6 lamp extends well into the internally ribbed glass bullseye jewel providing diffused light with excellent intensity. This Underwriters' Laboratories approved assembly equipped with phenolic base and screw terminals. Chrome plated brass bezel; finish and appearance suitable for the finest equipment.

147-1220

A lamp assembly designed for economical continuous operation utilizing neon bulbs. Double contact bayonet base contains series current limiting resistor. Protective Lucite cap, color red, amber or clear, transmits light with good efficiency. Similar models with sockets for other neon and low powered incandescent bulbs. All types Underwriters' Laboratories approved.

147-1034

Pilot light with internally frosted 1" snap-in jewel and colored plastic backing disc. Color does not appear until bulb is lighted, false indication due to external light eliminated. Lettering, numerals or insignia may be printed on disc and arranged to be visible either continuously or only after lamp is lighted. Phenolic body, screw terminals, Underwriters' Laboratories approved.

JOHNSON Pilot Lights are available as stock items in an extremely wide range of types for virtually all miniature lamps. As a rule, faceted or smooth jewels are available in six colors for any light assembly. Our catalog contains concise, quick reference listings of the JOHNSON Pilot Light Line.

Send for your copy of Catalog 972-A5 today!

E. F. JOHNSON CO.
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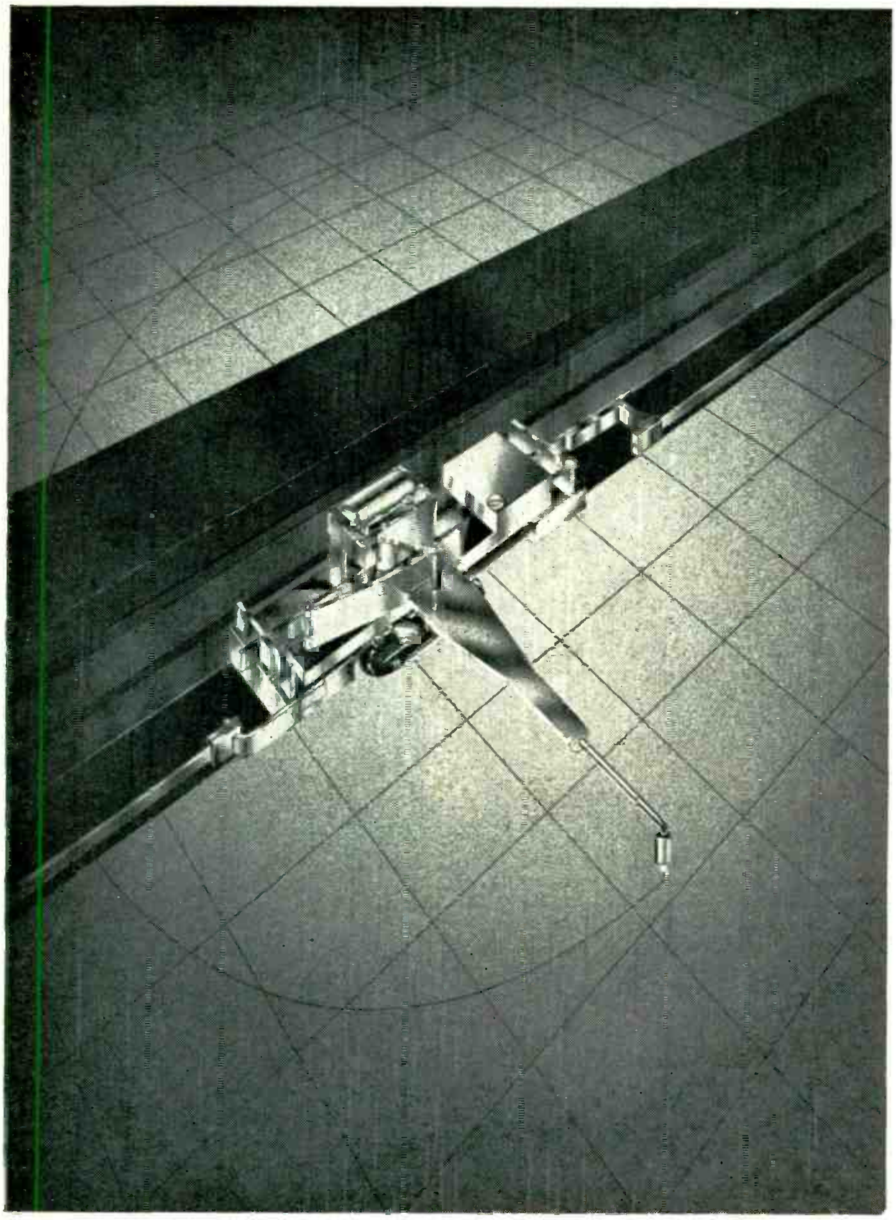


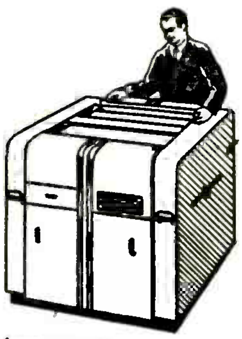
This is a pen of a Variplotter plotting board.

Function: Plots D.C. voltages x vs. y or x_1 vs. y_1 and x_2 vs. y_2.

Surface: Thirty inch square plotting surface.

Accuracy: .05% static. .1% dynamic.

Information: Contact Electronic Associates, Inc.
Long Branch, N. J.



ELECTRONIC ASSOCIATES Incorporated

Variplotter

MODEL 205 SERIES PLOTTING BOARDS

LONG BRANCH, NEW JERSEY

Measure and Record Strain with PRECISION

6-channel unit

The Hathaway TYPE RS-10 PRECISION STRAIN INDICATOR

6, 12, 25 or 50 Channels

FOR PRECISION MEASUREMENTS OF STATIC STRAIN

Static strain in 1 to 50 channels can be measured in rapid succession. Individually-calibrated 21-inch dial provides an accuracy of ¼ percent. Smooth and accurate balancing controls for each channel. Continuously-variable gage-factor adjustment.

FOR RECORDING DYNAMIC STRAIN

The RS-10 can be used with an oscillograph (such as the Hathaway type S14-C) for recording dynamic strain, providing *accurate balancing* and means for *precision calibration of the records.*

MULTI-CHANNEL PRECISION MEASUREMENTS OF STATIC STRAIN

DYNAMIC STRAIN RECORDING TO 300 CPS WITHOUT AMPLIFIERS

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- proper characteristics for plastics operations and parts . . .
- uniform softness, stiffness, flexibility, toughness . . . or other vital technical characteristics.

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Now, Chemelec Mixtures further broaden the scope of this wonder plastic. If you want Teflon that can be soldered or cemented, you may have it. If you want Teflon, "alloyed" with metal, glass, ceramics, carbon, mica, quartz, alnico, asbestos, silicate, calcium, or boron, etc., to meet a particular material requirement, you may have it, too.

Bring us your problem and our engineering department will work with yours to determine the material best suited to your needs.

*du Pont's trademark for its tetrafluoroethylene resin

-PRECISION-
SERIES ES-500A
High Sensitivity—Wide Range
5" OSCILLOSCOPE
with PUSH-PULL VERTICAL and HORIZONTAL AMPLIFIERS

20 MV. per inch "V" Sensitivity
150 MV. per inch "H" Sensitivity

IMPORTANT FEATURES

- ★ **High Sensitivity, Extended Range, Push-Pull, Voltage Regulated Vertical Amplifier** — 10 cycles to 1 MC response. Input 2 megs. 22 mmfd.
- ★ **Frequency Compensated "V" Input Step Attenuator.**
- ★ **Vertical Phase-Reversing Switch.**
- ★ **Extended Range, High Sensitivity, Push-Pull Horizontal Amplifier** — 10 cycles to 1 MC response at full gain. Input ½ meg. and 20 mmfd.
- ★ **Linear Multi-Vibrator Sweep Circuit** — 10 cycles to 30 KC plus line and external sweep.
- ★ **4-Way Synch. Selection** — Internal Positive, Internal Negative, External and Line.
- ★ **"Z" Axis Modulation terminal for blanking, etc.**
- ★ **Internal, Phasable, 60 cycle Beam Blanking.**
- ★ **Sweep Phasing Control.** Wide-angle bridge circuit.
- ★ **Direct H and V Plate Connections;** all 4 plates.
- ★ **Audio Monitoring Phone Jacks.**
- ★ **High Intensity CR Patterns** through use of adequate high voltage power supply with 2X2 rectifier.
- ★ **Tube Complement and Circuit** — 6C4 "V" cathode follower, 6CB6 "V" amplifier. 6C4 "V" phase inverter. Push-Pull 6AU6's "V" CR driver. 7N7 "H" amplifier and phase inverter. Push-Pull 6AU6's "H" CR driver. 7N7 sweep oscillator. 5Y3 and 2X2 rectifiers. VR-150 voltage regulator. 5CP1/A CR Tube.
- ★ **7 Four-Way Lab. Type Input Terminals** — Take banana plugs, phone tips, bare wire or spade lugs.
- ★ **Light Shield and Mask removable and rotatable.**
- ★ **Extra Heavy-Duty Construction and components** to assure "Precision" performance.
- ★ **Heavy Gauge, Anodized, No-Glare, Aluminum Panel.**
- ★ **Fully Licensed under W.E. Co. patents.**

★ In louvred, black ripple, heavy gauge steel case. Size 8¼" x 14½" x 18". Complete with light shield, calibrating mask and instruction manual.................. **NET PRICE $169.50**

See this *new "PRECISION" 5" Oscilloscope on display and available at leading radio equipment distributors.*

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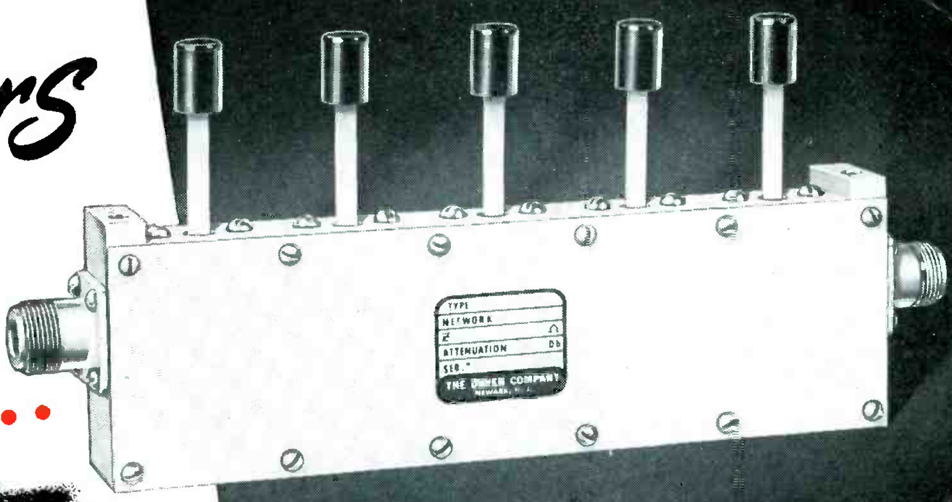
IN

Attenuators

WHY DOES ONE NAME.. DAVEN STAND OUT?



Series 550-RF Attenuator

In addition to Daven being the leader in audio attenuators, they have achieved equal prominence in the production of RF units. A partial listing of some types is given below.

DAVEN Radio Frequency Attenuators, by combining proper units in series, are available with losses up to 120 DB in two DB Steps or 100 DB in one DB Steps. They have a zero insertion loss and a frequency range from DC to 225 MC.

Standard impedances are 50 and 73 ohms, with special impedances available on request. Resistor accuracy is within ± 2% at DC. An unbalanced circuit is used which provides constant input and output impedance. The units are supplied with either UG-58/U* or UG-185/U** receptacles.

TYPE	LOSS	TOTAL DB	STANDARD IMPEDANCES
RFA* & RFB 540**	1, 2, 3, 4 DB	10	50/50Ω and 73/73Ω
RFA & RFB 541	10, 20, 20, 20 DB	70	50/50Ω and 73/73Ω
RFA & RFB 542	2, 4, 6, 8 DB	20	50/50Ω and 73/73Ω
RFA & RFB 543	20, 20, 20, 20 DB	80	50/50Ω and 73/73Ω
RFA & RFB 550	1, 2, 3, 4, 10 DB	20	50/50Ω and 73/73Ω
RFA & RFB 551	10, 10, 20, 20, 20 DB	80	50/50Ω and 73/73Ω
RFA & RFB 552	2, 4, 6, 8, 20 DB	40	50/50Ω and 73/73Ω

Because DAVEN makes the most complete, the most accurate line of ATTENUATORS in the world!

Series 640-RF Attenuation Network

These units are now being used in equipment manufactured for the Army, Navy and Air Force.

Write for "Catalog" Data.

THE DAVEN CO.
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

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RCA metal-shell kinescopes

give you 8 plus features at no extra cost

RCA-developed metal-shell kinescopes offer design engineers, manufacturers, and users of TV receivers, many important advantages over all-glass types . . .

1. **Reflection-free Faceplates:** Frosted surface of faceplate prevents reflections of light sources and bright room objects at any angle to the tube.

2. **Superior Faceplate Quality:** Metal-shell construction permits the use of high-quality sheet glass *made to RCA specifications.* Its use results in greater freedom from imperfections, such as blisters, chill marks, shear marks, mold marks, and ripples. Faceplates of uniform thickness transmit the picture with uniform brightness levels over the entire viewing area.

3. **Less Weight:** RCA 21" metal-shell kinescopes weigh only about 18 pounds, a value approximately 12 pounds less than comparable-size glass types. Hence, they are cheaper to ship, easier to handle during assembly and testing operations, and can be mounted with lighter supporting structures.

4. **Optically Superior:** Relatively thin and flat spherical faceplate of uniform thickness permits wide-angle viewing with minimum picture distortion.

5. **High Safety Factor:** Inherent mechanical strength of metal-shell construction provides greater factor of safety in handling operations.

6. **Utilize Time-Tested Components:** 21" metal-shell kinescopes permit the use of proven deflection circuits and available components to produce pictures having good corner focus and negligible pin cushion. No need to experiment with special components; volume production can be achieved with minimum delay.

7. **Volume Types:** More RCA 21" metal-shell kinescopes have been produced than the total of all 21" glass kinescopes. Because of this production experience, 21" metal-shell kinescopes offer a greater degree of dependability and uniformity.

8. **Availability:** Manufacturing facilities in two RCA plants insure continuous high-volume supply.

For technical data or design assistance on RCA kinescopes or other types of tubes, write RCA, Commercial Engineering, Section ER42, or contact your nearest RCA field office:—

FIELD OFFICES: (East) Humboldt 5-3900, 415 S. 5th St., Harrison, N. J. (Midwest) Whitehall 4-2900, 589 E. Illinois St., Chicago, Ill. (West) Madison 9-3671, 420 S. San Pedro St., Los Angeles, Calif.

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