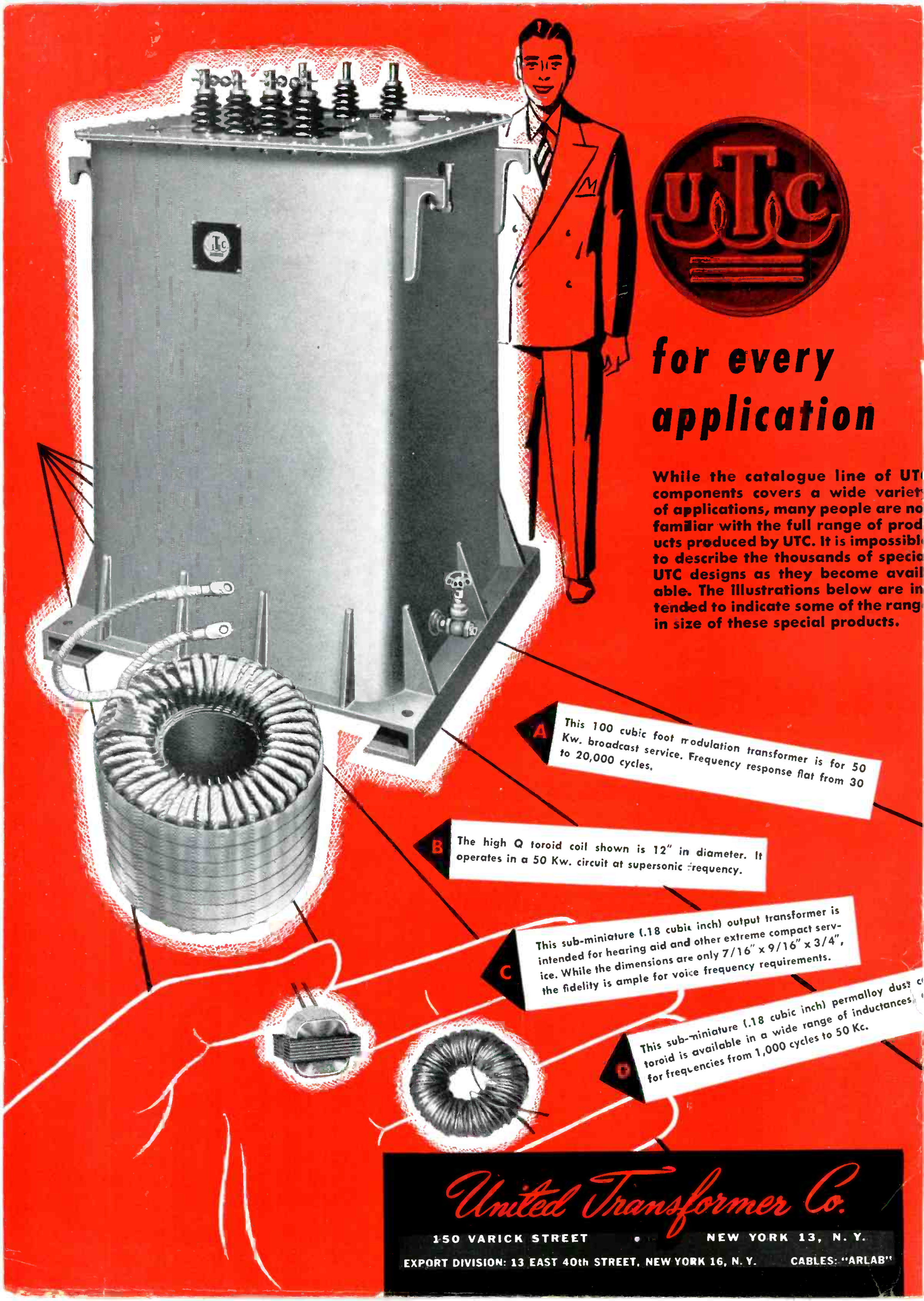
NOVEMBER · 1952

PRICE 75 CENTS

electronics

A McGRAW-HILL PUBLICATION


UTC
for every application
While the catalogue line of UT
components covers a wide variet
of applications, many people are no
familiar with the full range of prod
ucts produced by UTC. It is impossibl
to describe the thousands of specia
UTC designs as they become avail
able. The illustrations below are in
tended to indicate some of the rang
in size of these special products.
A
This 100 cubic foot modulation transformer is for 50 Kw. broadcast service. Frequency response flat from 30 to 20,000 cycles.
B
The high Q toroid coil shown is 12" in diameter. It operates in a 50 Kw. circuit at supersonic frequency.
C
This sub-miniature (.18 cubic inch) output transformer is intended for hearing aid and other extreme compact service. While the dimensions are only 7/16" x 9/16" x 3/4", the fidelity is ample for voice frequency requirements.
D
This sub-miniature (.18 cubic inch) permalloy dust
toroid is available in a wide range of inductances,
for frequencies from 1,000 cycles to 50 Kc.
United Transformer Co.
150 VARICK STREET • NEW YORK 13, N. Y.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"

electronics

NOVEMBER • 1952

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COVER—Servomechanically controlled milling machine can be made to cut a block of metal into any desired shape in response to number code punched in paper tape and fed through an electronic decoder developed at Servomechanisms Laboratory, MIT. (See page 172)

ABP November, 1952 ELECTRONICS Member ABC and ABP Vol. 25, No. 11 ABC

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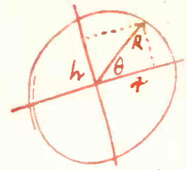
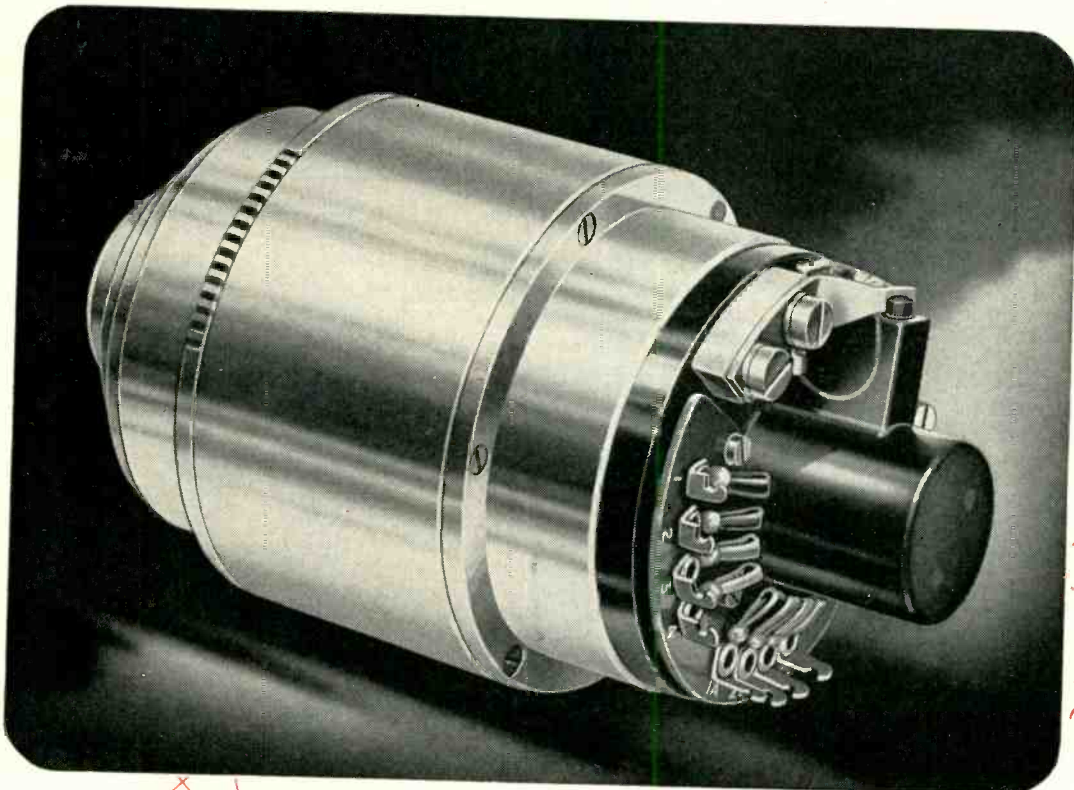
MARION
METER TESTER

MUIRHEAD

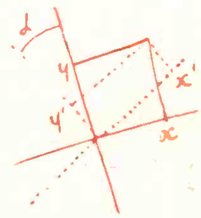


Given R & θ
find h & x
$h = R \sin \theta$
$x = R \cos \theta$

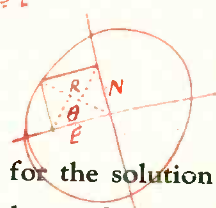
MAGSLIP RESOLVER No. 2

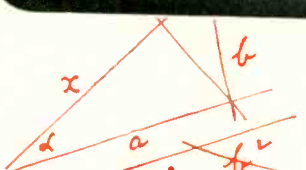


Change of axes
$x' = x \cos \alpha + y \sin \alpha$
$y' = y \cos \alpha - x \sin \alpha$



Given N, E
determine R & θ
$R = E \cos \theta + N \sin \theta$
Zero $= E \sin \theta + N \cos \theta$





$x = \sqrt{a^2 + b^2}$
$x = a \cos \alpha + b \sin \alpha$

THE RESOLVER No. 2 is a special type of Magslip used for the solution of trigonometrical problems, such as the conversion of polar to Cartesian co-ordinates.

Each stator phase is energized in accordance with an applied computing voltage. No power is taken from this source, energization being obtained by means of an amplifier and a second (feedback) stator winding. The rotor voltages are proportional to the exciting voltages and to the sine and cosine of the angle between the stator and rotor electrical axes. The error does not exceed 0.1%.

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Please mail Bulletin B-690 fully describing
MUIRHEAD MAGSLIP RESOLVERS.

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POSITION ....

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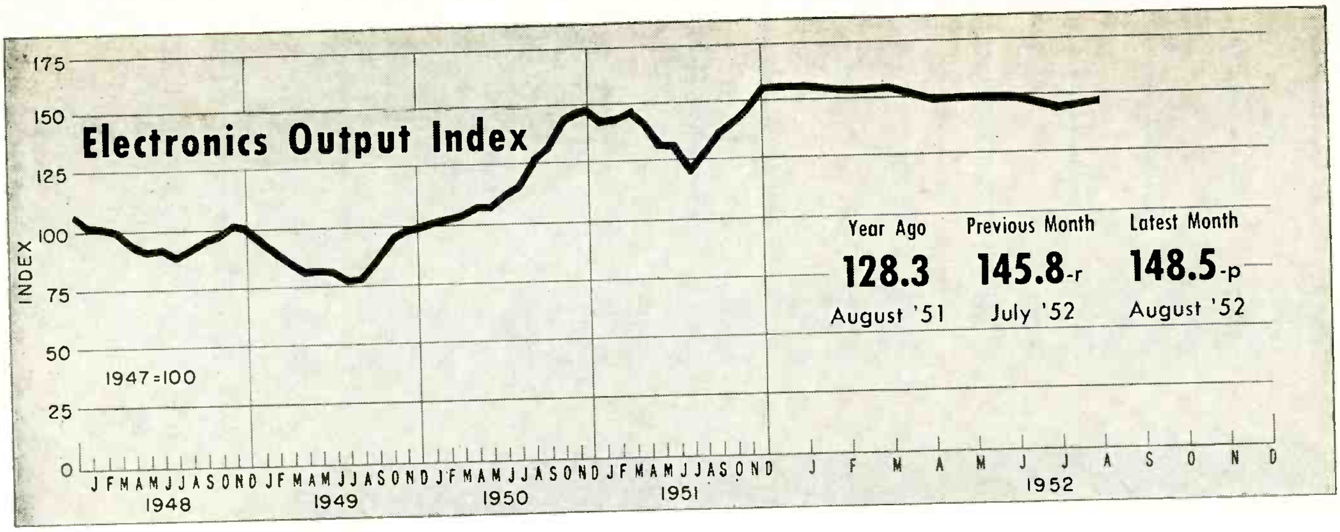


FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RTMA)	Year Ago Aug. '51	Previous Month July '52	Latest Month Aug. '52
Television sets	146,705	198,921	397,769-p
Home Radio sets	295,587	265,163	344,481-p
Portable sets	77,568	81,353	105,006-p
Auto sets	190,252	95,220	94,315-p

RECEIVER SALES

(Source: RTMA)			June, July & Aug. '52
	——	——	
Television sets, units			700,490
Radio sets (except auto)			1,139,467

RECEIVING TUBE SALES

(Source: RTMA)	Aug. '51	July '52	Aug. '52
Receiv. tubes, total units	23,761,253	20,944,831	30,141,536
Receiving tubes, new sets	12,917,526	11,504,503	19,583,879
Rec. tubes, replacement	7,230,419	6,795,252	7,463,893
Receiving tubes, gov't	845,514	1,956,905	1,706,868
Receiving tubes, export	2,767,794	688,171	1,386,896
Picture tubes, to mfrs.	210,043	239,625	394,605

BROADCAST STATIONS

(Source: FCC)	Sept. '51	Aug. '52	Sept. '52
TV Stations on Air	108	109	111
TV Stns CPs—not on air	0	34	51
TV Stns—Applications	444	855	855
AM Stations on Air	2,300	2,356	2,364
AM Stns CPs—not on air	101	112	119
AM Stns—Applications	280	291	276
FM Stations on Air	644	622	624
FM Stns CPs—not on air	9	21	18
FM Stns—Applications	8	12	10

NETWORK BILLINGS

(Source: Pub. Info. Bureau)	Aug. '51	July '52	Aug. '52
AM/FM—ABC	$2,210,352	$2,082,666	$2,281,852
AM/FM—CBS	$4,440,261	$3,238,256	$3,991,490
AM/FM—MBS	$1,329,375	$1,339,276	$1,325,059
AM/FM—NBC	$3,808,906	$2,878,196	$3,338,843
TV—ABC	$1,444,593	$943,387	$1,166,169
TV—CBS	$3,734,551	$4,163,245	$5,105,929
TV—DuMont	$763,071	$653,415	$845,780
TV—NBC	$3,359,856	$4,591,130	$5,618,643

TV AUDIENCE

(Source: NBC Research Dept.)	Year Ago Sept. '51	Previous Month Aug. '52	Latest Month Sept. '52
Sets in Use—total	13,556,000	18,354,300	18,711,800
Sets in Use—netw'k conn.	12,839,400	18,325,700	18,682,800
Sets in Use—New York	2,490,000	3,070,000	3,100,000
Sets in Use—Los Angeles	1,012,000	1,230,000	1,240,000
Sets in Use—Chicago	960,000	1,210,000	1,235,000

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	July '51	June '52	July '52
Aeronautical	33,007	32,603	33,462
Marine	30,174	35,500	36,068
Police, fire, etc.	9,310	11,143	11,274
Industrial	9,895	13,680	13,968
Land Transportation	4,324	5,027	5,120
Amateur	92,822	113,092	113,863
Citizens Radio	585	1,401	1,697
Disaster	9	71	80
Experimental	428	488	489
Common carrier	824	985	985

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	July '51	June '52	July '52
Prod. workers, electronic	229,500	266,300-r	263,400-p
Prod. wkrs., radio, etc.	138,400	165,300-r	162,700-p
Av. wkly. earnings, elect.	$60.34	$64.52-r	$62.52-p
Av. wkly. earnings, radio	$57.35	$61.58-r	$60.68-p
Av. weekly hours, elect.	41.4	40.3	39.1-p
Av. weekly hours, radio	39.2	40.5-r	39.3-p

STOCK PRICE AVERAGES

(Source: Standard and Poor's)	Sept. '51	Aug. '52	Sept. '52
Radio—TV & Electronics	259.5	291.1	304.3
Radio Broadcasters	244.8	279.6	288.3

Quarterly Figures

INDUSTRIAL EQUIPMENT ORDERS

(Source: NEMA)	Year Ago 2nd '51	Previous Quarter 1st '52	Latest Quarter 2nd '52
Dielectric Heating	$600,000	$150,000	$510,000
Induction Heating	$3,140,000	$2,400,000	$2,410,000

INDUSTRIAL TUBE SALES

(Source: NEMA)	2nd '51	1st '52	2nd '52
Vacuum (non-receiving)	$7,750,000	$11,320,000	$12,110,000
Gas or vapor	$2,700,000	$3,100,000	$3,150,000
Phototubes	$360,000	$500,000	$480,000
Magnetrons and velocity modulation tubes	$4,130,000	$8,460,000	$9,830,000

p—provisional; r—revised; e—estimated

electronics—NOVEMBER • 1952

Plants Push 'Rainy-Day' Planning

New-product ideas are being stockpiled against possible drop in military orders

THOUGH business is good today in the electronic industry, the spectre of possible military contract tapering off is once again dominating many engineering and executive planning conferences.

A surprisingly large number of post-cold-war projects have already reached the drafting board. These divide into four major categories.

▶ **Custom Engineering Jobs**—Here is maximum job security for engineering staffs, because special electronic control systems tailored to a particular machine come close to development contracts in engineer man-hour requirements.

In anticipation of custom engineering, engineering staffs are getting acquainted with general process requirements in the most promising fields. The textile, food, machine tool and chemical industries are getting major attention. These and other prospective fields can be parceled out among groups of engineers even today, to encourage the specialization needed for getting best results when the day for action arrives.

▶ **New Stock Products**—This is the obvious but tough answer to the problem. There'll always be some market for a newer and better test instrument, for improved communication equipment, or for new packaged electronic controls, but good new-product ideas here are hard to come by and generally require years to develop. Opportunities are good in the mass entertainment field, but existing large manufacturers with national distribution have a distinct edge on newcomers.

▶ **White Goods**—To counteract traditional summer slump in radio and television receiver business, larger manufacturers in this field have been adding or acquiring lines of refrigerators, air conditioners, dehumidifiers and other so-called white goods. This boosts business during the slack months.

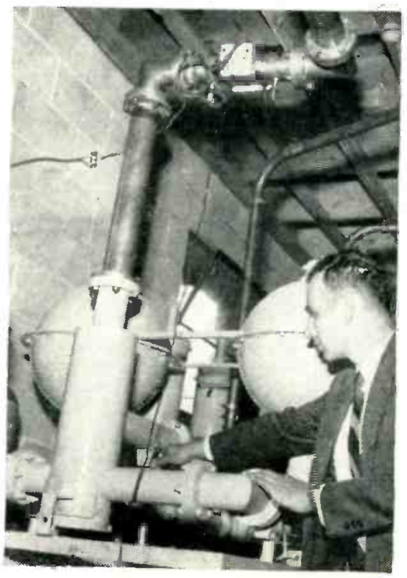
▶ **Nonelectronic Products**—Some small firms are looking ahead with a maximum of flexibility and open-mindedness. They'll make any product, electronic or otherwise, that will hold together their engineering and production staffs long enough for transition from military boom business to normal commercial activity.

UHF Egg Hatches In Portland, Oregon

Market becomes commercial guinea pig for companies in the television industry

EYES of the electronics industry are closely watching every development in the nation's first commercial uhf television market, Portland, Oregon. Literally thousands of representatives of all segments of the industry have visited the city since KPTV took to the air on Sept. 18. Resulting comments of various observers of the Portland picture vary from "confused" to "very encouraging."

▶ **Shortages**—Despite recent experience with the vhf Denver market, some tv distributors were caught without sets when commercial uhf television made its bow in Portland. However, shortages did not become as serious as in Denver, because sets were available in nearby Seattle and San Francisco.



UHF filterplexer, which coordinates tv sound and picture for KPTV in Portland, is examined by one of the engineers who made the historic installation

But other shortages have hampered sales to some extent. Most bothersome has been the shortage of channel-27 tuning strips. Converters have also been in short supply.

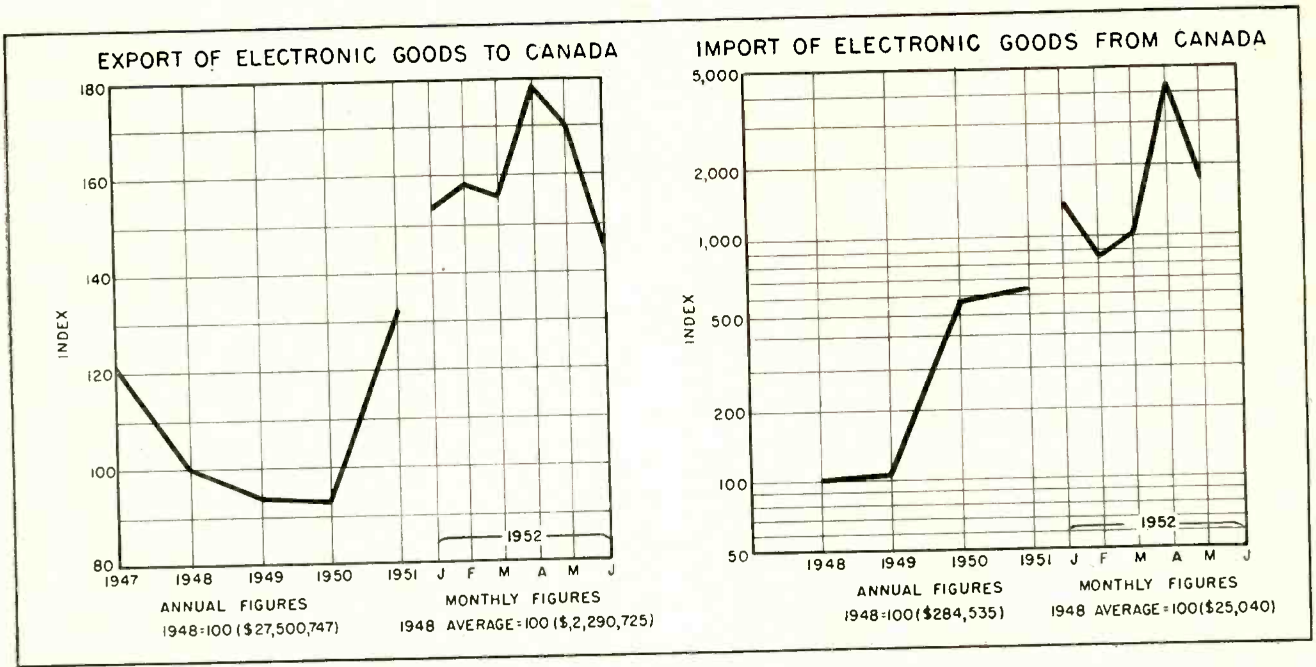
▶ **Interference**—Some manufacturers have run into picture interference problems in the Portland market. Taxicab radio, which operates around 150 megacycles, has been partially responsible. But most manufacturers have already licked this problem by using 'stubs' of leadin wire serving as wave-traps.

Some uhf converters have themselves created interference.

▶ **Coverage** — Most manufacturers seem pretty happy with the coverage pattern of KPTV. RCA surveyed the Portland area to chart reception as soon as the station began operating. They report that the station is radiating a good signal and actual coverage agrees surprisingly well with FCC predictions. There are, however, a few dead spots.

Grade A signals from Portland are reported in adjacent cities of Vancouver, Washington, and in St. Helens and Oregon City, Oregon. Even Salem, Oregon, 42 air miles from Portland, reports reception.

With coverage better than expected, most tv manufacturers are optimistic about uhf tv sales in the Portland area. It is reported that set sales during the first three weeks reached nearly 2,000. Some predict that by the end of the year they will reach at least 50,000.



TRADE with our northern neighbor reaches new heights in both directions across the border as . . .

Electronic Business Booms in Canada

Exports rise steadily; many U.S. concerns open branch plants in the Dominion

CANADA'S SURGE towards industrial prominence means good business for electronics manufacturers on both sides of the border. Exports to Canada of electronic equipment and components are at an all-time high, topping $36 million last year and increasing rapidly. Meanwhile, more than 100 Canadian plants are producing electronic parts and end products. About one-third of these plants are branch plants or subsidiary companies of U.S. concerns.

A rough gage of Canada's growing electronics production is the fact that U.S. imports from Canada promise to top $4.5 million for 1952, representing a 20-fold increase over 1948 figures.

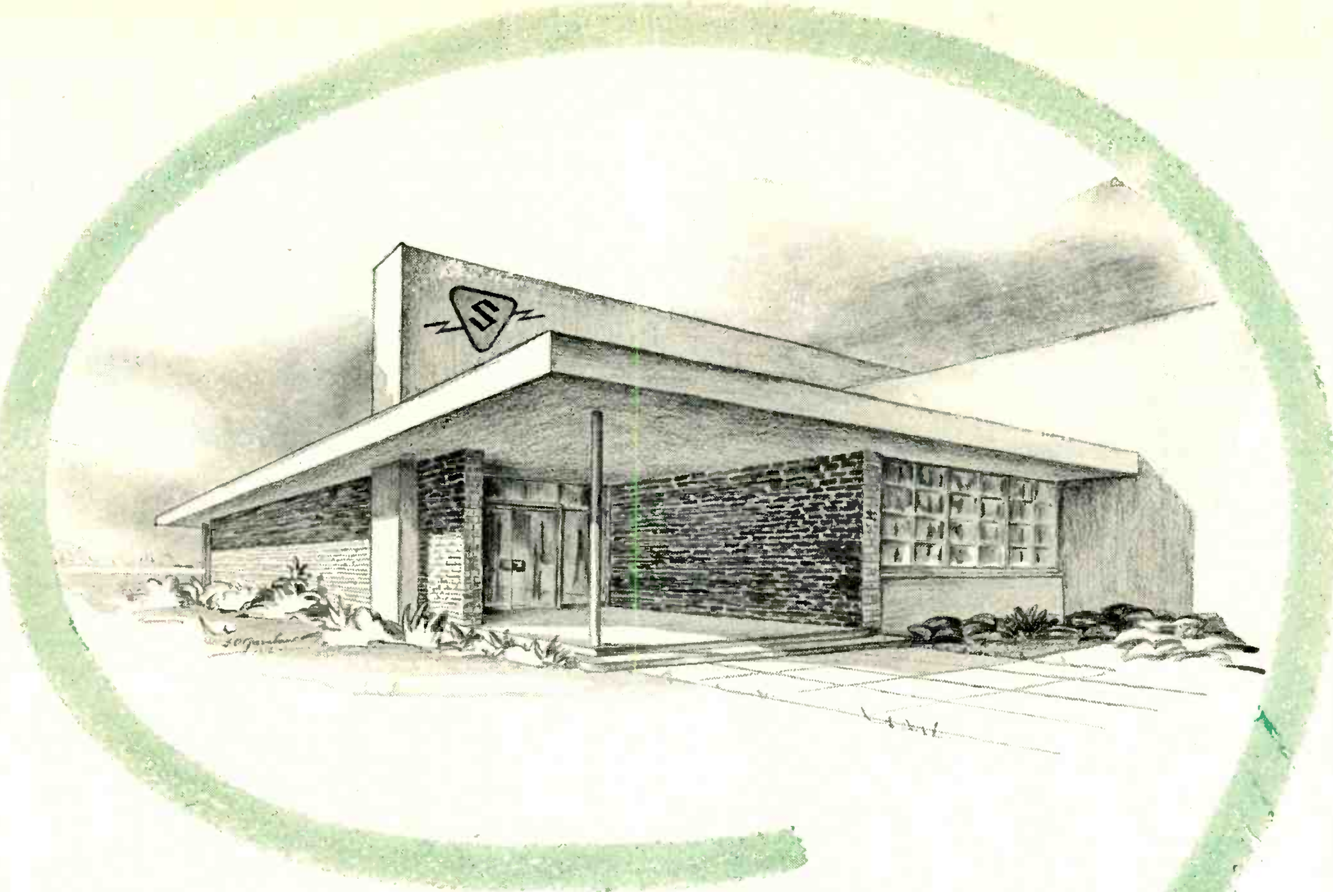
The graphs illustrate the astonishing growth of electronics business across America's northern border. Both graphs are plotted in index figures obtained by dividing yearly totals by 1948 totals and 1952 monthly totals by the average figure for the corresponding period of 1948. The totals were obtained by summing Bureau of Census foreign trade figures for ELECTRONICS' list of electronic commodities.

▶ **Economic Growth**—Sparked by development of Canada's rich natural resources, her economic growth has snowballed during the last 12 years through reinvestment of national income in manufacturing industries. Canada's prosperity, reflected in every facet of her economic life, means improved living standards for her people, additional investment in new plants and equipment and relentless pressure against her natural frontiers.

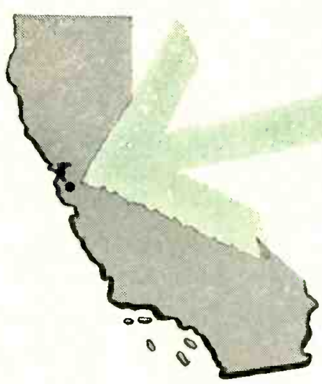
Canada's economic growth pattern is faithfully reflected by U.S. electronic exports to her. Basic electronic components such as resistors, capacitors and tubes to feed Canadian production lines comprise 36.2 percent of U.S. exports northward. Also high on the list of electronic exports are communications equipments needed to span the miles between Canada's new mines and factories and industrial electronic equipment and instruments needed to equip new plants and laboratories. Export of r-f heating equipment for industry shows the greatest percentage increase over 1950 figures of all electronic equipment.

▶ **Consumer Market**—The home instrument market in Canada directly

(Continued on page 8)



Sylvania to Serve West Coast Electronics Market from California Location



Sylvania has announced that construction is under way on a modern, completely equipped Electronics Division plant and laboratory in Mountain View, California.

This up-to-date facility of 35,000 square feet is being made available to West Coast manufacturers as a source of electronic components including semiconductor devices, microwave components, and special purpose tubes.

A research and development laboratory will be included to handle design and applications problems on these and other related products.

The addition of this California location to Sylvania's existing electronics facilities marks another step in the company's long-term plan to provide the finest quality products and fastest service to all markets.

For complete information on Sylvania Electronic Products, write Dept. E-2611, Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

SYLVANIA

ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; RADIO TUBES; TELEVISION PICTURE TUBES; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS accounts for barely three percent of U. S. electronic exports. Although much of this market is served by Canadian set manufacturers and branch plants of U. S. concerns, the outlook for increased export sales is encouraging. Television sets, auto radios and juke boxes closely follow r-f heating equipment among exports showing the greatest percentagewise increase.

▶ **Electronic Developments**—Upturn in Canada's electronics industry keys into several specific developments outside her overall economic growth. Always a good customer for electronic equipment, the aircraft industry is going great guns in Canada. Jetmakers at AVRO-Canada's Malton plant near Toronto are making headline news with both military and commercial models.

Handmaiden to nuclear energy, the electronics industry derives additional impetus as Canada forges ahead in this field. The Canadian AEC operates establishments at Chalk River and Petawawa, near Pembroke, Ont. Canadian rearmament opens still another field for electronics. Much electronic equipment, particularly radar and microwave communications equipment, is going to Canada's armed forces.

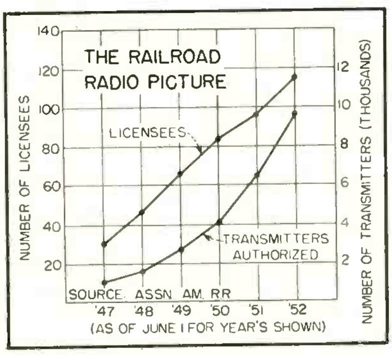
Other significant developments on the Canadian electronics scene include Bell of Canada's Buffalo-Toronto and Toronto-Montreal microwave radio-relay systems, extensive use of broad-band vhf radiotelephone circuits in Western Canada and the recent inauguration of the Canadian Broadcasting Company's first television network that now has stations in Toronto and Montreal.

▶ **Pattern of Growth**—Canadian electronics manufacturers tend to cluster about her two largest cities, Toronto and Montreal. More than half the electronic business is concentrated in Toronto and its sprawling suburbs. Montreal, with its surplus of women workers, has 19 plants engaged in electronics manufacturing. Nearly all the remaining plants are concentrated in the highly industrialized province of Ontario, with the cities of Hamilton, Kitchener and London very much in the running.

American Railroads Go Electronic

Use of radio equipment increases. Industrial tv looms on the horizon

INDICATIVE of the growing use of electronics in the railroad business, the number of radio system licensees in this field increased from 97 in June, 1951 to 114 in June 1952. The number of transmitters used by railroad licensees reached a total of over 9,000.



▶ **Investments**—What the railroad market means to electronic manufacturers in terms of dollar volume can be judged from investment reports of representative roads.

The Pennsylvania has already invested $9 million in two-way telephone equipment and plans to expand its use. The Denver & Rio Grande Western has spent over $57,720 on radio and inductive communications systems since 1947. Investments prior to that totalled $109,524. The Missouri-Kansas-Texas invested $40,180 in radio systems in 1951 and Canadian Pacific spent about $34,000. This year, the Northern Pacific completed its $200,000 radio system and the Southern Pacific has announced plans for greater use of radio communications systems.

Industrial television enables this B&O yard clerk to record freight car numbers without walking among the cars and tracks. Unattended camera set up alongside the tracks does all the work as the trains pass in front of it

▶ **What's Ahead**—The railroad industry may become a substantial industrial television market in the future.

The Baltimore & Ohio recently conducted tests of such equipment in conjunction with RCA, to determine whether ITV could contribute to greater efficiency in the operations of a railroad classification yard.

Three new Vidicon cameras were used for the demonstration. One camera chain did the job pictured here. Two others gave an overall view of the classification yard so that the disposition and movement of all cars and switching engines could be watched and coordinated.

Military Plans Set For '54 Buying

ELECTRONICS buying for aircraft alone in fiscal 1954 will total at least $1.7 billion and may exceed $2 billion.

New defense appropriation requests will be delivered to Congress shortly after it convenes. The overall figure is about the same as that which the Pentagon requested for fiscal 1953, close to $50 billion. Major change will be in the items bought.

▶ **Flying Figures**—The military has accumulated inventories on

(Continued on page 10)

SPRAGUE® LEADS THE WAY WITH RELIABLE HIGH TEMPERATURE (250°C) MAGNET WIRE

250°C

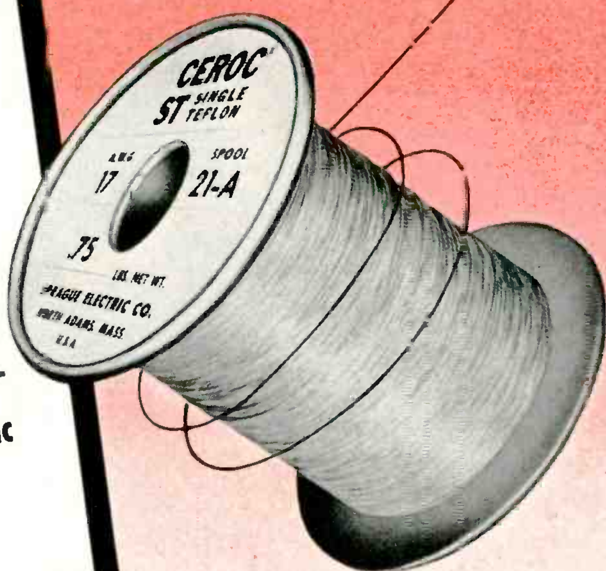
200°C

150°C

105°C

Ceroc ST®

Magnet Wire, with its combination of ceramic base insulation and a single Teflon overlay, eliminates most problems met with all-plastic insulations.

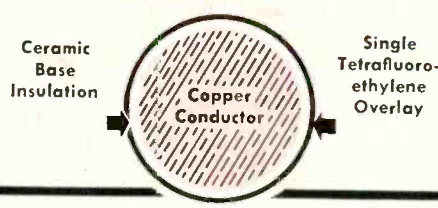


Designers of miniaturized transformers, motors, coils, solenoids, etc., are finding that Ceroc ST Magnet Wire leads the field in *tough* applications. Not only does Ceroc ST have superior abrasion resistance to commercial all-tetrafluoroethylene insulated wire, but it also has better cross-over characteristics, and a higher breakdown voltage. The Teflon overlay bonds more securely to the ceramic base insulation than is the case with Teflon bonded directly to copper. And with its years of experience in quality control, the Sprague Electric Company delivers to you a product of uniformly high quality.

Not only may Ceroc ST wire be operated *continuously* at temperatures up to 250°C, but it has been successfully used in short-time military applications at temperatures as high as 350°C. Sprague's Application Engineering Dept. is ready to assist you in working out any problems you may have on the proper use of high temperature magnet wire.

For details on Ceroc ST wire, write for Engineering Bulletin No. 404. Where design requirements necessitate a heavier Teflon coating, investigate Ceroc T wire, with its double Teflon overlay on ceramic base insulation. It's described in Engineering Bulletin No. 402-F. Copies available without obligation on letterhead request to the Application Engineering Dept., Sprague Electric Co., 35 Marshall St., North Adams, Massachusetts.

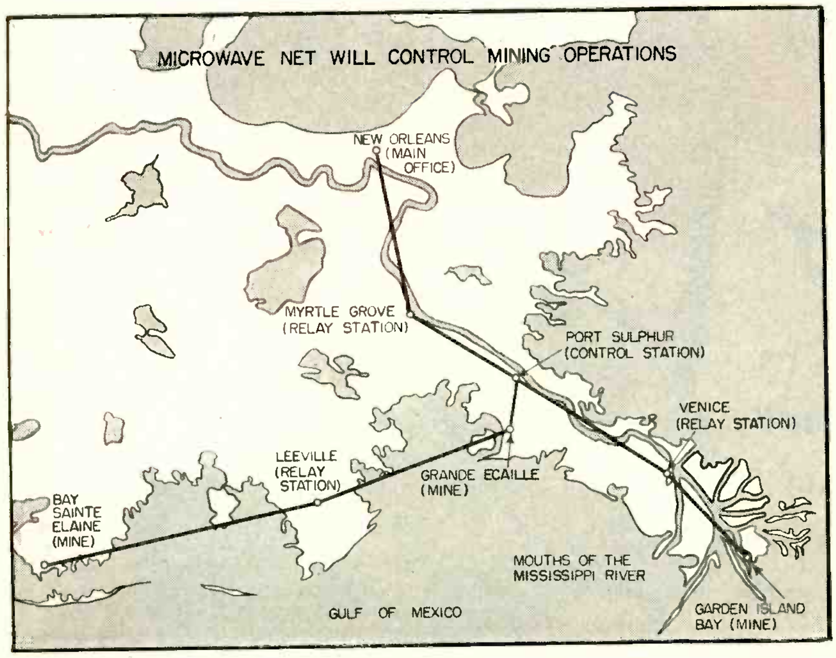
ENLARGED CROSS-SECTION OF CEROC ST



SPRAGUE . . . PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

some weapons like tanks, ammunition and motor vehicles. These will be eased off. However, with a 143-wing Air Force approved by Congress, the tab for aircraft procurement will be close to the $18-billion figure appropriated this year for Navy and Air Force planes.

Defense Secretary Lovett intends to leave government service but offers to break in his successor and has asked the presidential candidates to name a defense secretary right after election. This would allow the new Pentagon boss to do some spade work on the budget he will have to explain to Congress next year.



HURRICANE-prone marshland is no obstacle, as . . .

Microwaves Link Remote Mines

"Swamps rule out telephone lines in Louisiana delta," FCC rules in granting license

MICROWAVE system linking remote industrial operations has been approved by the FCC and will be installed this Fall. A $173,000 Motorola system will link mines operated by Freeport Sulphur in the 300-square-mile marshland of the Mississippi delta with the company's offices in New Orleans and a shipping point at Port Sulphur.

Granting the license, the FCC ruled that marshy terrain coupled with prevalent hurricanes make construction and maintenance of telephone lines impractical.

The microwave network will tie into existing ship-shore radio facilities for communication with the company's fleet of towboats and barges.

Work has already begun on preparing the tower foundations, which must be built on pilings. Equipment installation is scheduled for November.

▶ **Industrial Microwave**—Although most private microwave systems are owned either by electric-power companies or oil and gas pipeline operators, other industries are now finding them useful.

The Linton Summit Coal Co. of Terre Haute, Ind. is installing two stations for communication between their downtown office and the mine, 14 miles distant. In this case, according to the General Electric Co. who furnished the microwave equipment, the telephone company would not provide lines for a single customer.

Civilian Consultants Serve Uncle Well

Most make money on government contracts, but wrong choice can result in loss

THERE are three grades of consulting work in which electronic engineers assist the government's preparedness program. Remuneration for such work depends upon the kind of contract covering it.

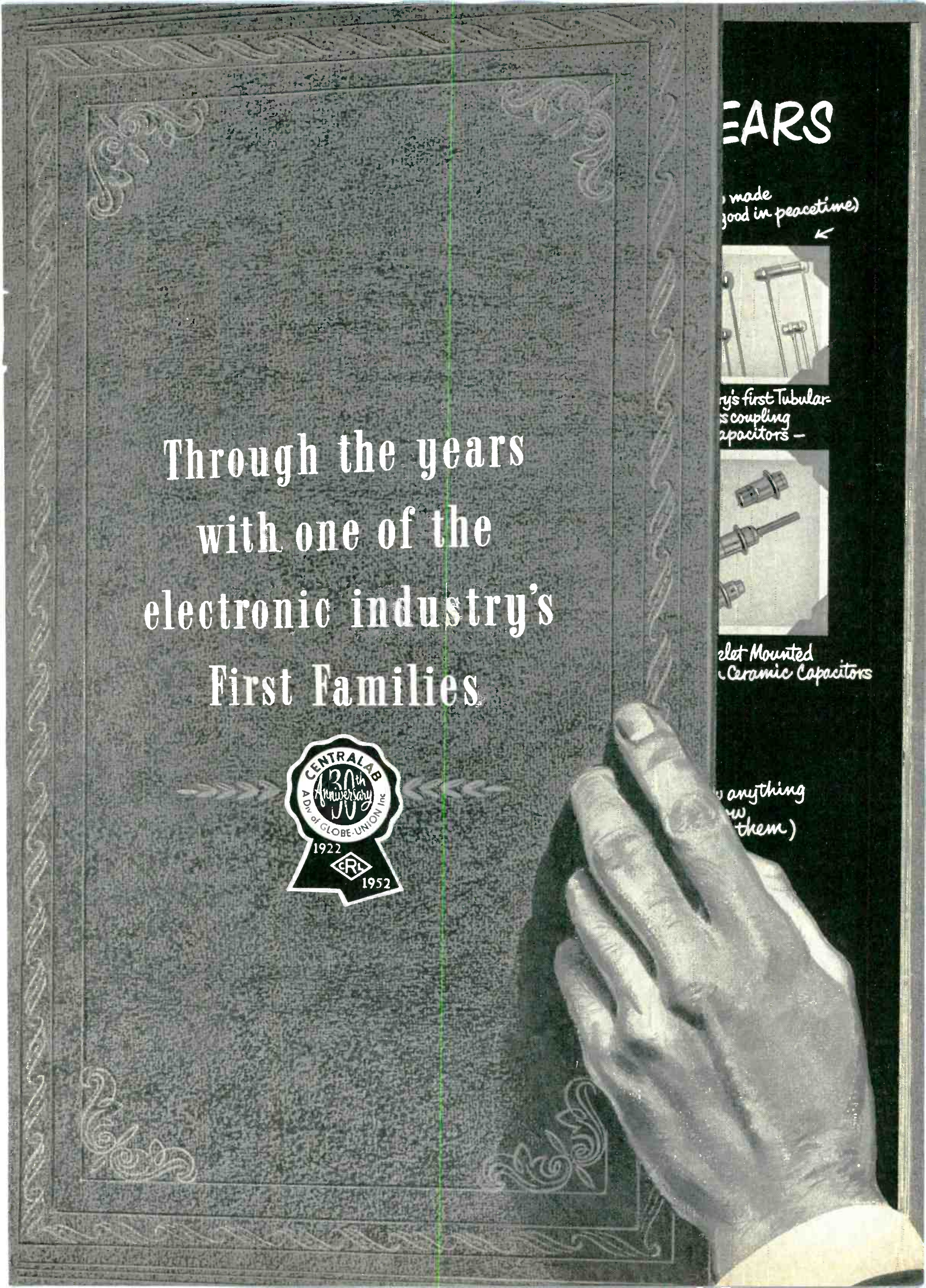
▶ **Top-Drawer Engineering**—Highly specialized is the work of a consultant who advises a project group on a short-term basis. Under a subcontract, such a specialist might earn between $100 and $200 a day, depending upon the attitude of the contracting officer in allowing these rates as direct costs. They are considered reasonable for the expert who maintains his own staff, laboratory and model shop. Often such men are not called in until a program bogs down and a trouble-shooter is needed.

▶ **Intermediates**—Typified by continuous work on a project for a week to several month, the intermediate specialist's work may be done alone or using a supplemental staff. Especially if the consultant maintains an office and laboratory, such work usually commands a rate well in excess of $50 a day.

▶ **Long-Term Consulting** — Least specialized is the work of a consultant working on a project from three months to several years. This type of work is exemplified by the so-called contract employee of some government agencies. No substantial overhead costs are involved since the consultant, often using space provided for him as, perhaps, a college professor, does not maintain a separate office. Compensation is limited, in general, to $50 a day at most. This is the only type of consultation commonly employed directly by government or in quantity under prime contracts with industrial agencies.

Recommended by many con-

(Continued on page 14)


Through the years
with one of the
electronic industry's
First Families
CENTRALAB
30th Anniversary
A Div of GLOBE-UNION Inc
1922
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good in peacetime)
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CENTRALAB'S ELECTRONIC FAMILY

Many members have made electronic history!

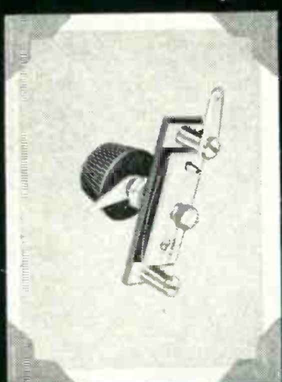
Today, many of the most advanced developments in electronic equipment -- from modern hearing aids to television, radar and X-ray -- are built around the revolutionary components pioneered and introduced by Centralab.

Tangible evidence of the ceaseless research that gives fresh emphasis to the fact that many products bearing your trademark serve better -- last longer ... thanks to the continuing engineering advances of Centralab.

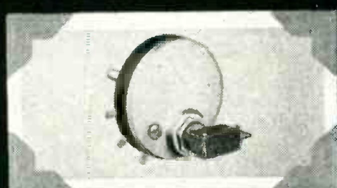
As in the past -- so in the future -- you can look to Centralab for leadership in electronic component research.

Variable Resistors

(Great grandad)

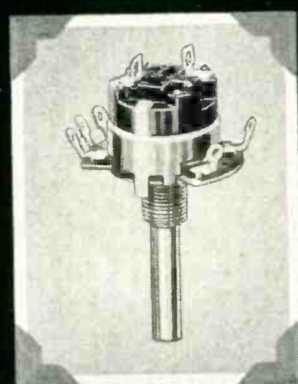


1922 First composition variable resistor ever built



1929 First combination variable resistor and switch

1946 Model 1 - World's smallest switch type variable resistor



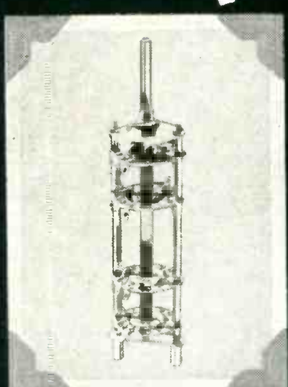
1949 Model 2 Radiohm the most modern high quality variable resistor

(Latest addition to this part of the family)

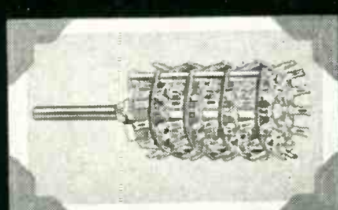
1951 New High Torque Variable Resistor - world's smallest - no bigger than a dime!

Switches

(She started this branch of the family)

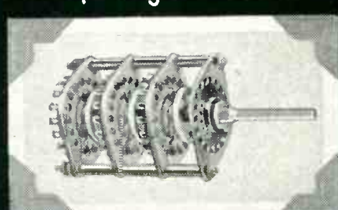


1936 A new and complete line of wave band switches

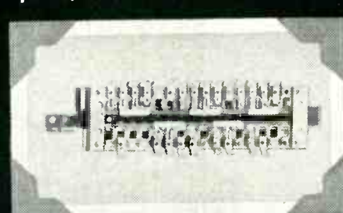


1938 The industry's first 24 contact per single section switch

1939 First multiple contact lever action switch

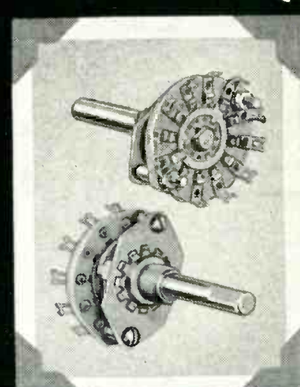


1943 The industry's first low-loss, high frequency medium duty power switch



1947 The first slide switch introduced to the industry

(our most beautiful babies!)



1951 New miniature rotary switch (1 1/16" dia.)

sultants is the sale of service on the basis of negotiated rates for personal services and direct reimbursement for special materials (the so-called time-and-materials subcontract).

Prime contracts are frequently avoided. The usual 7 percent fixed fee allowed on cost-plus-fixed-fee prime contracts runs the risk of being wiped out by disallowances of cost items.

Communications Firms Scrape Labor Barrel

DUE to defense expenditures and strong tv set demand, communications equipment manufacturers expect to hire 35,000 more workers by December 15, increasing by 10 percent the 365,000 employees in this branch of the industry at mid-year. They still face severe shortages of professional, technical and skilled workers, according to a Department of Labor survey.

More than 40 percent of the companies surveyed, employing two-thirds of the workforce, have had difficulty in finding qualified workers. However, only a few manufacturers reported that the shortages were seriously impeding operations.

▶ **Area Gains**—A major labor expansion program is projected by electronics manufacturers in Boston, who plan to increase their production staffs by 20 percent. The largest proportional increase is employment in the communications equipment industry during the last year was in New York, with a gain of 33 percent.

WCEMA Celebrates 10th Anniversary

BOARD of directors of the West Coast Electronic Manufacturers Association will commemorate the Association's tenth year at a dinner at the new Statler Hotel in Los Angeles on Thursday, November 13. The celebration will climax "Western Electronics Week" set for November 10 to 14.

Freshman Enrollment Increases

Early returns from schools show increased quantity and quality of new registrants

INDICATIONS are that freshman enrollment in engineering colleges this fall is up 10 to 20 percent over 1951. Overall male college student admissions may show a slight increase over last year's figure despite low tide in supply of high-school graduates that reflects the low birth rate of depression years. The trend towards engineering and away from less technical studies continues.

▶ **Informed Guesses**—These estimates are based upon statements of several college deans of engineering. U.S. Office of Education survey reports are not yet available, although preliminary returns indicate a 13 percent rise in overall college freshman enrollment. This figure, based largely on returns from smaller schools, will probably be pared down in the final analysis.

Indications, based upon entrance examination results, are that this year's engineering freshman is of slightly higher scholastic calibre than his 1951 predecessor.

▶ **Demand High**—Demand for young graduates stood at 40,000 this year. This reflected a leveling-off of the tooling-up stage of rearmament and improved utilization of engineers by industry. Engineering graduates totaled 30,000, with only 15,000 immediately available to industry. The balance sheet shows 16¼ percent commissioned through ROTC, 22 percent draft eligible, 6¼ percent headed towards advanced degrees and 4½ percent enrolled in enlisted reserve or national guard.

The future appears to hold 20,000 engineering graduates for 1953, 17,000 for 1954 and 20,000 for 1955. ROTC enrollees in these classes number 4,600, 7,650 and 11,000.

Tax Laws Favor Repair of Equipment

Maintenance costs can be deducted, but replacements must be capitalized or depreciated

EVEN though it may cost more to repair an old spot welder or electronic heating generator than to buy entirely new equipment, some tax-conscious executives are encouraging such work. The reason is that repair costs are deductible on income tax returns. Modifications, however, are not always classed as repairs by the U.S. Treasury Department.

▶ **Deductible Modifications**—If the intent is to continue ordinary operation or use of a piece of equipment, without appreciably prolonging its life or improving its performance, the cost of the repair is fully deductible on the tax return for the year in which the repair is made. The actual cost of a repair in relation to the cost of new equipment does not effect the tax interpretation if other facts prove it is a true repair.

Repairs made to avoid violating a law or requirement of a regulatory body are usually deductible. Thus, modifications of electron bombarders, diathery equipment and electronically controlled welding equipment to suppress radiation banned by the FCC could be considered deductible.

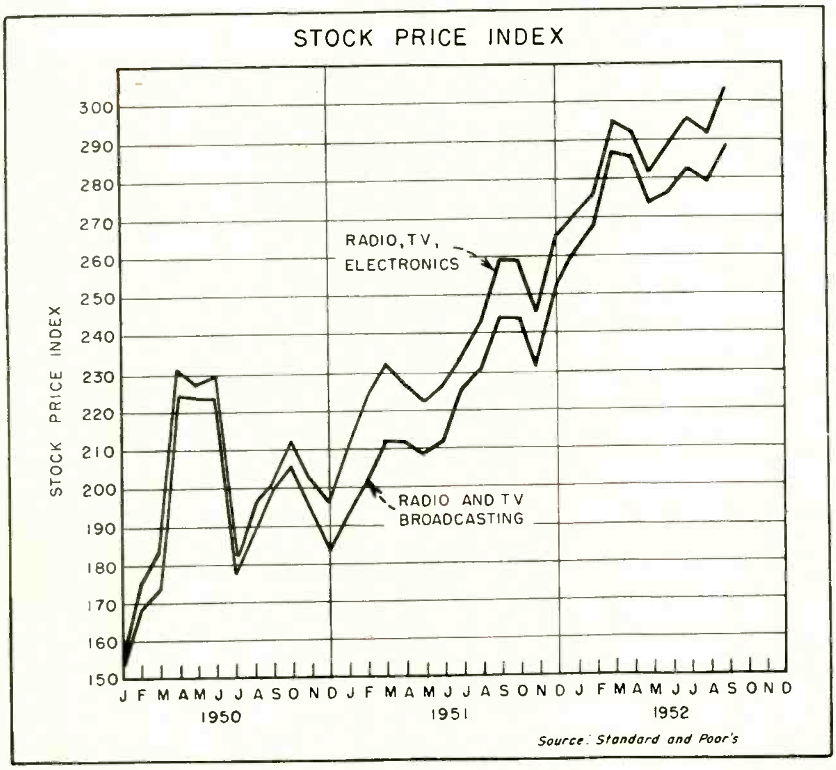
▶ **Not Deductible**—Whenever a so-called repair adds materially to the value of a property, appreciably prolongs its life, improves efficiency or gives added functions, it becomes an improvement or replacement in the eyes of the law. The cost must then be capitalized or changed to a depreciation reserve. In the latter case, cost is not deductible in a lump sum but must be spread or depreciated over the reasonable expected life of the equipment.

Proof of intent generally influ-

(Continued on page 16)

ences an examiner's decision on deductions. Here engineering memos and records become vital to prove intent to repair. Full records should be kept of transactions, contracts, notes of conferences, and other data pertinent to a repair job; even dictated personal thoughts on the issue are valuable if dated and filed.

Where repairs are part of an overall factory project, Treasury tendency is to lump the whole cost as an improvement requiring capitalization. Two contracts help to avoid this—one for repairs and the other for replacement, substantiated by detailed records.



ELECTRONICS investors benefit by steady growth of industry that makes . . .

Stock Price Averages Triple Pre-War Mark

RADIO, television and electronics stock prices soared to a new high in September, reaching an average value of three times that of immediate pre-war years, as shown in the accompanying chart. This increase compares with 1.9 times for all industrial stocks and 1.8 times for all stocks listed on the New York Exchange over the same period.

▶ **Source**—Stock price average figures are reported each month on page 4 of ELECTRONICS. They are based on a group of stocks selected as being representative of the industry. The figure for "Radio-TV and Electronics" is based on eleven stocks of the following corporations: Admiral, Cornell-Dubilier, Emerson, General Instrument, Magnavox, Motorola, Philco, RCA, Sylvania, Zenith and Raytheon. This list purposely omits certain large corporations, like General Electric and Westinghouse, whose electronic business is but a fraction of their total output. Only two stocks, those of RCA (NBC) and CBS, underly the "Radio Broadcasters" listing.

The values of the stock price averages are based on 100, which represents the equivalent aggregate market value of the stocks for the five year post-war period 1935-1939. The monthly average is computed from the closing price of each stock on the four or five Wednesdays of each month.

The chart shows the stock price trend from January 1950 to the present. These curves tend to show the state of the stock market in general and do not necessarily reflect the vicissitudes of the electronics and broadcasting industries as such.

Financial Roundup

BEST picture of the bread-and-butter side of the electronics business for the first six months of 1952 is reflected in the earnings statements of manufacturers in the field. In September five companies announced earnings for the period January-June:

Company	*'52 Net Income*	*'51*
American Cable & Radio ...	$ 377,408	$ 807,732
AT&T	14,938,168*	17,643,448*
IT&T	9,666,002	8,693,096
I-T-E Circuit Breaker .	1,332,418	864,721
Westinghouse ...	31,507,000	31,564,000

* Net operating income.

Tung-Sol, which recently made its bow on the New York Stock Exchange, announced earnings of $492,241 for the first quarter of 1952. For the 26-week period ending June 28, income was $889,843 compared to $1,305,113 for the same period in 1951.

IT&T received $4,844,000 from the Spanish Government in partial payment for the sale of its investment in the Spanish Telephone Company. The company plans to invest $12,000,000 in its Argentina subsidiary, Compania Standard Electric Argentina, for plant expansion and to supply the Government's telephone system with components and raw materials as part of a new agreement recently signed with the Argentine Government. Previous supply and advisory contracts were cancelled. As indemnification for the cancellation, IT&T

(Continued on page 18)

Impedance measurements

FROM 10 TO 1500 Mc

The General Radio V-H-F Bridge and U-H-F Admittance Meter enable measurements of a variety of impedance types over a very wide frequency range—from 10 to 1500 Megacycles.

Measurements on antennas, transmission lines, coaxial systems and networks, impedance components, and on both v-h-f and u-h-f television circuits may be made to a high degree of accuracy. Reflection coefficient and standing-wave ratio may be readily determined with the aid of either of these instruments.

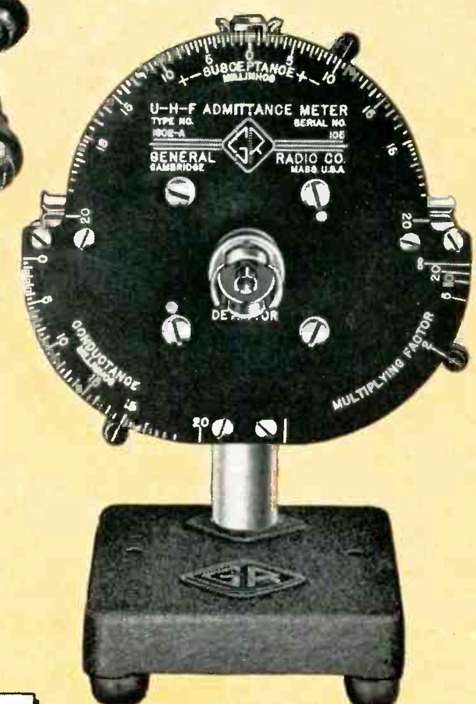
VHF BRIDGE

TYPE 1601-A . . . . $395.

Frequency Range: *10 to 165 Mc, direct reading*
Reactance Range: *± 230 ohms at 100 Mc*
Resistance Range: *0 to 200 ohms*
Accuracy: *Resistance — ±(2% + 1 ohm)*
Reactance — ±(5% + 2 ohms)

Features

- ★ *Resistive and reactive components are independent—no sliding balance*
- ★ *Direct-reading resistive and reactive indicators insure convenience, rapidity and unusual ease in operation*
- ★ *Accurate low impedance measurements with the V-H-F Bridge — measures high impedance indirectly*
- ★ *Accurate measurements over a wide impedance and frequency range with the U-H-F Admittance Meter*
- ★ *Terminal arrangements and accessories permit measurement of both coaxial and lumped circuits — new constant-impedance adjustable line and balun greatly facilitate measurements*
- ★ *Coaxial adaptors eliminate connecting lead and residual terminal capacitance errors*
- ★ *Small size and light weight facilitate use in cramped locations such as antenna towers*



UHF ADMITTANCE METER

TYPE 1602 . . . . $295.

Frequency Range: *66 to 1000 Mc, direct reading. Indirectly from 20 to 1500 Mc*
Conductance Range: *0.2 to 1000 millimho*
Susceptance Range: *±(0.2 to 1000) millimho*
Accuracy: *Conductance and susceptance*
0 to 20 millimho
± (5% + 0.2 millimho)
20 to ∞ millimho ± $5\sqrt{M}$ %
(M is scale multiplying factor)

®

GENERAL RADIO Company

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

received $3,800,000 from the Peron government.

▶ Stock Offerings—*Skiatron* offered 108,000 shares of additional common stock (par value 10 cents) of the Skiatron Electronics and Television Company at $2.50 per share. Proceeds will be used to carry on a public test of its pay-as-you-see television system known as Subscriber-Vision in the New York Metropolitan area. Plans call for a 90-day test of the system in 300 homes. An initial charge of $1.00 per show will be made during the test. In June, Skiatron entered into an agreement with Hanovia Chemical & Manufacturing Co. of Newark, N. J., a unit of Engelhard Industries and maker of ultraviolet medical and home equipment, which makes plant and production facilities of Hanovia and research and engineering facilities of the Engelhard companies available to Skiatron.

Admiral offers to exchange 1 share of its capital stock for 2 shares of Canadian Admiral Corp. A total of 42,654 shares of Canadian Admiral stock has been deposited in accordance with the exchange order. Admiral now owns 85.8 percent of the shares of Canadian Admiral.

RCA plans the acquisition of the Estate Stove Company of Hamilton, Ohio, a division of Noma Electric, subject to the approval of Noma Stockholders at a meeting scheduled for Nov. 5. RCA will form a new subsidiary, the RCA-Estate Appliance Co. Inc.

National Cash Register has a stock purchase agreement with the Computer Research Corp. of Hawthorne, Calif. under which it will acquire a controlling interest in the company. The transaction, involving $1,000,000, is subject to Federal Court approval. The computer company employs 140 people.

Electronic Computer Corp., Brooklyn, N. Y. is offering an issue of 52,500 shares of Class B (nonvoting) common stock (par one dollar) at $3.00 per share. Proceeds are to be used for development work and working capital.

Electro-Components Corp. of America offers an issue of 2,000,000 shares of common stock (par one cent) at 12 cents per share. Net proceeds to be used to repay a loan from Electronic Devices, Inc. and for new equipment and working capital.

▶ Stock Registrations and Filings—*Penn-Allen Broadcasting Co.*, Allentown, Pa. files with SEC for 4,014 shares of common stock (par $10) and 10,035 shares of Class A common stock (par $10) offered in units of two common and five class A shares at $70 per unit without underwriting. Proceeds will be used to construct and operate a television station.

Television Equipment Corp. files for 1,225,000 shares of common stock (par 5 cents) to be issued at 11 cents per share. Proceeds will be used for working capital.

Westinghouse registers with SEC a statement covering 150,000 shares of its $12.50 par common stock offered under its "Employee Stock Plan". Workers can buy the stock on the installment plan by payroll deductions. For six months after issue in May, 1953 the stock will be offered for $5.00 less than the average market price for it during the first days of April, 1953. The purchase price, in any event is not to be more than $42 or less than $30 a share.

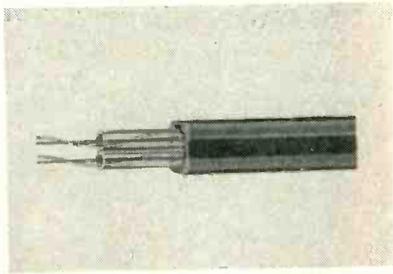
Electronic Micro-Ledger Accounting Corp., Boston, Mass., files notification covering 299,900 shares of common (par 10 cents) to be offered at $1. per share to pay for building equipment.

New UHF Lead-in Proves Out in Portland

Special design for tv works according to calculations of designers

TELEVISION engineers want an inexpensive, mechanically rugged, air-insulated two-wire waterproof cable to lead uhf picture signals from antenna to receiver. For vhf television they have found a useful compromise in the familiar 300-ohm ribbon. But losses in ribbon lead-ins at the new-channel frequencies are extremely high if the ribbon is damp and covered with soot or salt spray.

Engineers of Anaconda Wire and Cable Co., working with those of RCA Service Corp., have come up with a cable that received its baptism during the opening of KPTV in Portland, Oregon, recently. As shown in the illustration, a pair of Copperweld conductors carry the voltage. They are each wrapped with a spiral of polyethylene thread and then surrounded by a clear polyethylene tube. In the final manufacturing process, a brown polyethylene covering is extruded over



UHF-TV antenna lead-in uses maximum of air and minimum of insulation close to the conductors. They are wound with spiral plastic thread, inserted in tubes and the tubes are supported away from walls of outer casing

the pair of tubes laid side by side. In cross section, the cable resembles a rectangle with the corners rounded off. Inside each corner a ridge supports the round tubes away from the walls of the casing.

▶ Electrical Characteristics—Losses per hundred feet of dry cable range from 1.5 db at 100 mc to 5.2 db at 1,000 mc, which is above the high end of the uhf tv band. Wet, the losses run higher. Since there is no sure means, short of dumping the cable into a vat of salt water, to make comparable wet tests, engineers are cagey about mentioning figures in public. Based upon their experiences in Portland, they are content to say, "if reception is good when the line is dry, it is also good when the line is wet."

▶ Where Do We Get It?—The new line is now available in quantity, although probably not at the local radio store. It will cost, initially,

(Continued on page 20)

LABORATORY for ELECTRONICS, INC.

Research, Engineering and Production of Precision Electronic Equipment

MODEL 401 OSCILLOSCOPE

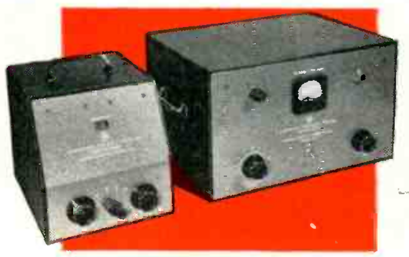
— a high gain, wide band, versatile, general purpose instrument for precise, quantitative studies of pulse waveforms, transients and other high or low speed electrical phenomena.

For complete information Ask for Bulletin O52

MODEL 101 MAGNETOMETER

Accurately measures magnetic field strength using the principle of nuclear resonance.

For complete information Ask for Bulletin M52



MERCURY DELAY LINES

Used for storage of information, comparison of two sets of information, correlations and sequential timing devices, they are the smallest, most compact lines available.

For complete information Ask for Bulletin MDL51

MODEL 802 STABLE MICROWAVE OSCILLATOR

Provides a highly stable source of microwave signals, suitable for use as a laboratory standard. Features a direct reading frequency dial, sine wave modulation input and self-contained power supply.

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Gerald B. Miller Company
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Overlook 6100

Atlanta, Georgia
W. A. Brown & Associates
1570 Northside Drive
Vernon 5395

Boston 15, Mass.
Walter T. Hannigan Company
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Garrison 7-2650

Chicago 45, Illinois
Hugh Marsland & Company
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L/F/E LABORATORY for ELECTRONICS, INC. 75 PITTS STREET BOSTON 14, MASS.

PRECISION ELECTRONIC EQUIPMENT • OSCILLOSCOPES • MAGNETOMETERS • COMPUTERS • MICROWAVE OSCILLATORS • MERCURY DELAY LINES three to four times as much as a good grade of ribbon line. Because it uses a copper-over-steel conductor, it saves critical material. The nearest comparable coaxial cable, for example, requires more than ten times the amount of copper.

When the serviceman installs this line he must seal off the outdoor end to prevent the air spaces filling with moisture. This is simply done by melting the polyethylene at the end with a cigarette lighter and pressing the molten material together into a mass.

Merrill In For Jones

FEDERAL Communications Commission is again up to team strength by the appointment of Eugene Hyde Merrill, Democrat of Utah, to fill the unexpired term of Robert F. Jones, Republican of Ohio. Although the position runs to June 30, 1954, Merrill's tenure is sure only until Congress reconvenes in January. His future depends both upon party in power and his future acceptability to his own party.

Commissioner Merrill graduated in 1932 from the University of Utah as a mining engineer. His experience in public utilities, from the government side, is extensive and he has held several positions under the Federal government. These include Office of Production Management, Foreign Economic Administration and most recently, in the National Production Authority.

TV Networks And CP Holders Press Bell

ANALYSIS of the locations of the first 68 new television-station construction permit holders reveals that more than half of them are not in cities on the Bell System's tv network routes, either planned, under construction or in operation. As a result, network broadcasters and new tv cp grantees are asking Bell for additional television network facilities.

▶ **Bell's Plans**—Bell says that its statement made when the freeze was first lifted still holds true: "Further expansion of the Bell System's network will be governed by the needs of individual stations and the network broadcasters. Future steps also may be influenced by the availability of critical equipment and material."

The company emphasizes the importance of receiving adequate advance notice of plans from the tv industry, to permit the scheduling of an orderly construction program, and requirements.

HELICOPTERS survey Brazilian jungle as . . .

Microwave Invades Latin America

LOFTY MOUNTAIN PEAKS with precipitous drops to steaming jungle make much of Latin America a line-of-sight propagation paradise. With notoriously bad interurban telephone service, it is not surprising that Latin America is turning to radio relay in a big way.

VHF has long-standing popularity in Latin America, aided in part by availability of channels. Microwave is catching on rapidly, however, with rising demand for increased channel capacity. Further, the Latin-on-the-street exerts much influence on his government's spending and tends often to favor most recent alternative systems.

▶ **Obstacles**—Major technical obstacles to microwave installation are lack of dependable power for unattended repeater stations and scarcity of trained technicians.

Financially, dollar-exchange restrictions are common and in some countries, import bans had to be met by shipping unfinished chassis to local assembly plants.

In spite of these problems, 16 microwave systems are either operating or planned in eight different Latin American countries. Fully half the systems are used for remote control, linking studios with distant radio transmitters or receivers.

▶ **Brazil**—A nine-hop, 24-channel microwave system linking Rio de Janeiro and São Paulo will be Brazil's longest. Ordered from International General Electric by Senhor João do Amaral, local newspaper and radio magnate, the system will provide two high-fidelity channels to serve Amaral's Rio and São Paulo a-m outlets. Remaining channels will be used for telephone, facsimile and leased-wire teleprinter. Most likely leasee . . . the Brazilian army.

Complete plans call for an 850-mile system extending southward to Porto Alegre. Senhor Amaral, who is currently installing televi-

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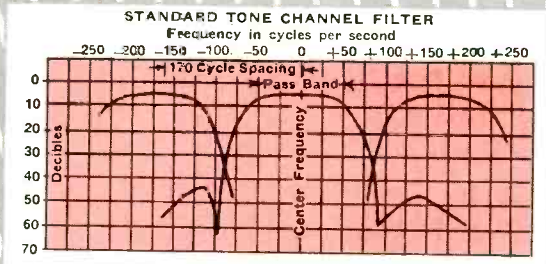
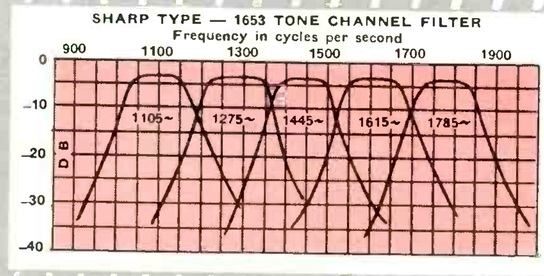
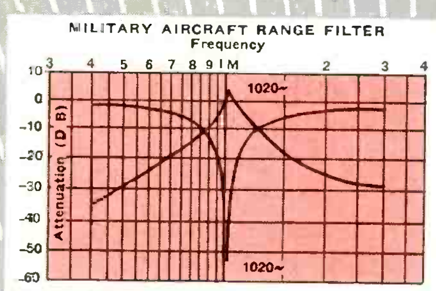
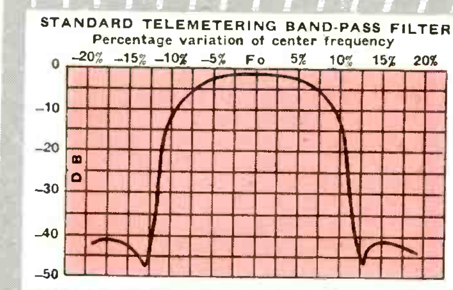
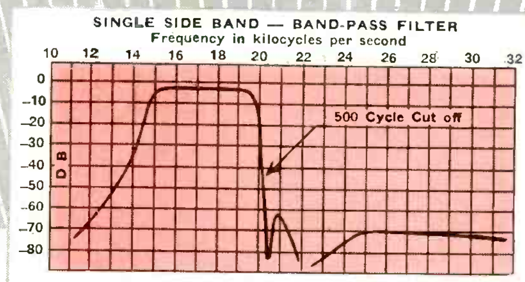
EXPERTS *in Filters for the Military*

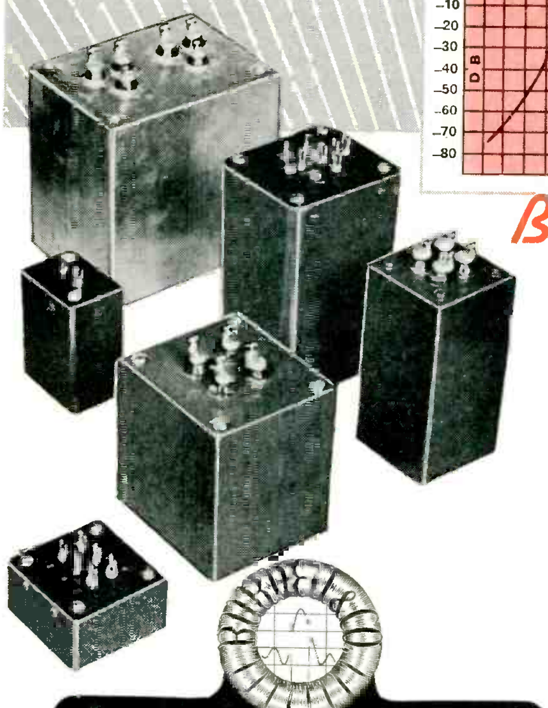












Burnell High Quality Toroids and Audio Filters

With each new technological advancement in military electronics the design engineer has had to cope with more difficult network problems.

Today it is not sufficient for the engineer just to know what signal to clean up or which to reject or separate.

His filter requirements have become increasingly complicated by other critical factors such as phase shift, linearity, transient response, extreme accuracy through wide temperature ranges etc.

True, these have always existed to a certain degree but their importance has become considerably amplified in such applications as Guided Missiles, Radar and Sonar.

The BURNELL & CO. engineering staff has won many friends among our customers through the valuable assistance they have rendered in the solution of their network problems. If YOUR application involves audio filters or similar networks write or call our engineers who will give prompt attention to your requirements.

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

EXCLUSIVE MANUFACTURERS OF COMMUNICATIONS NETWORK COMPONENTS sion transmitters in both Rio and São Paulo, plans eventually to parallel his system with a microwave television relay.

▶ **Cuba**—Two rival Cuban television networks are planning parallel microwave television relays from Havana to Santiago, 500 miles distant. Both systems will use Philco equipment.

Radiotelevision El Mundo has ordered a 5-station, 110-mile network from Matanzas to Santa Clara. The system will furnish one tv channel and a service channel.

Circuito CMQ is beginning its network with a 7-station system linking Havana with Santa Clara. It will provide three tv channels and three service channels.

Microwave Systems in Latin America

Remote Control		
Argentina (Army)	Federal	....
(Navy)	RCA	4 terminals
Brazil (Navy)	RCA	6 terminals
Chile (Government)	....	....
Cuba (Aeronautical Radio de Cuba)	Federal	2 terminals
Mexico (Government)	....	12 miles
Aeronautical Radio de Mexico	Federal	2 terminals
Guatemala (Tropical Radio)	Raytheon	2 terminals
Telephone		
Mexico (Telephones de Mexico)	Federal	2 term., 1 rep.
Puerto Rico Telephone Co.	Federal	....
Puerto Rico Water Resources Authority	Motorola	12 miles
Venezuela (Shell Petroleum)	Standard Elec. (Brit)	30 miles
Radio and TV Relay		
Brazil (Amaral)	GE	2 term., 8 rep.
Cuba (Circuito CMQ)	Philco	2 term., 5 rep.
(El Mundo)	Philco	2 term., 3 rep.
Telegraph		
Puerto Rico Communications Authority	....	2 term., 1 rep.

Denver's Second TV Station On Air

KBTV, Denver's second tv station, began regular programming on Oct. 12 with the programs of CBS and ABC. The station ran a series of engineering test programs previous to that date.

With its interim power of 12 kw erp, reception is reported at Cheyenne, Wyoming, Colorado Springs and across the continental divide at Granby, Colorado, indicating that eventual service will cover an area within a radius of 100 miles.

Wide coverage is attributed to the transmitter location on Lookout Mountain, 2,500 feet above Denver. TV receiver servicemen report that little adjustment of antennas is necessary to receive the channel 9 signal.

The Rocky Mountain Electrical League reports 57,964 sets in the area as of October 1. Predictions are that up to 100,000 sets will be sold there by January 1, next year.

Binaural Sound Is New Audio Market

Three-dimensional listening takes hold. Two-track discs and tapes appear

Demonstrations of new multiple-channel audio equipment in New York City's Broadway Theater and by many different electronic manufacturers at the Audio Fair presage a new market for radio and audio equipment. Possibilities are doubly enticing dollar-wise because everything must be in duplicate, from the microphones that serve as twin ears right on through the audio system to the speakers that reproduce the illusion of directional sound.

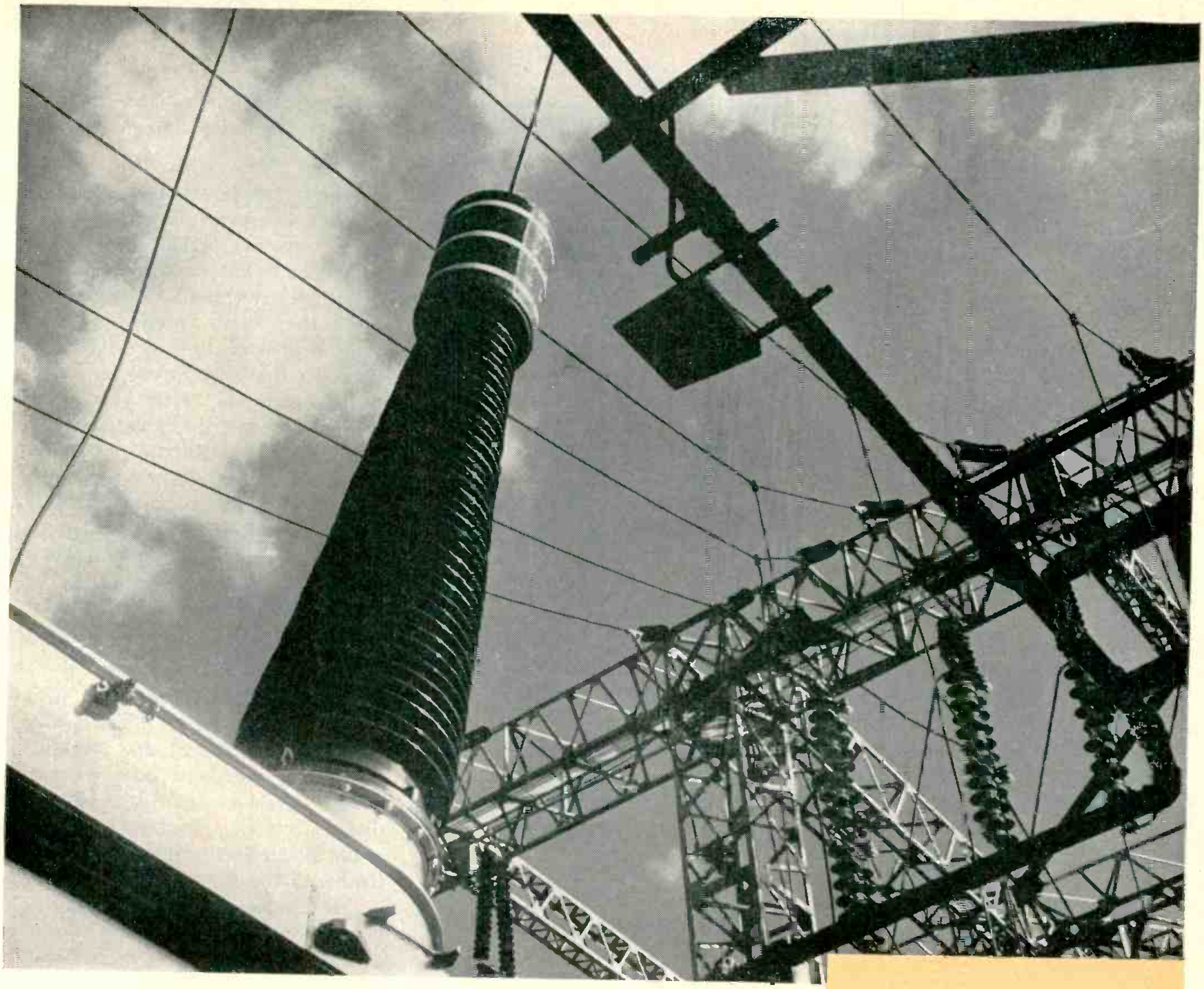
Purists maintain that true binaural sound reproduction (each instrumental sound appears to be coming from the location of that instrument in the orchestra) can be obtained only with earphones fed by separate channels. With loudspeakers spaced the recommended ten feet or more apart, each ear hears both sound sources to a varying extent, depending on listening position, and the effect is really stereophonic. However, industry favors the term binaural as a simpler designation.

▶ **Seven-Channel Theater Sound**—Most dramatic of all listening effects achieved to date is that of Reeves-backed 'Cinerama'. Here seven different magnetic sound tracks on 35-mm sprocketed film feed seven groups of speakers arranged behind a huge circular screen almost surrounding the audience. Synchronous motors insure lip-sync with the three projectors employed. During filming of scenes, microphone placement is carefully related to speaker locations in the theater. Thus, when filming the landing of a plane on an aircraft carrier, the seven microphones are equally spaced along the length of the carrier to pick up the sound as the plane roars past each. The resulting illusion in the theater is that the roaring plane goes right over the heads of the audience.

▶ **Two-Station Broadcasting**—Use of two separate microphones and sound channels when broadcasting a program simultaneously over an a-m radio station and its f-m affiliate permits reception on two receivers in opposite corners of a living room in a home, to give binaural broadcast reception. This technique was demonstrated by WQXR-AM and WQXR-FM in two broadcasts during the Audio Engineering Society's annual convention. Two wire lines were leased to carry one of the programs to Hartford for broadcasting there by F. M. Doolittle's f-m and a-m stations, to demonstrate feasibility of network binaural.

▶ **Twin-Groove Disc Recordings**—Use of two parallel grooves on 33⅓-rpm LP discs as a two-channel source for binaural sound was advocated by Emory Cook of Cook Labs in the opening paper at the convention. Two ordinary LP pickups are mounted one behind the other on a single arm, with their needles riding in adjacent grooves,

(Continued on page 24)



"More Power to You—Safely, with SYNTHANE"

Electrical energy is restless . . . would jump at any chance to escape—if it could.

The fact that voltage can be stepped up for transmission, stepped down for use; that current can be led to and from transformers, around switchboards, and steered into circuits safely you may credit to electrical apparatus builders. Important materials to them are Synthane laminated plastics.

Synthane laminated plastics are used in transformers for spacers and coil forms because it is an insulator unaffected by oils; in tap changer panels because it is a machinable insulator with high dielectric strength; in "Glowtectors" because of high insulation resistance and abuse-resistance; in circuit breakers and bus bars for its arc resistance.

Synthane, an unseen essential to power generation, transmission, and control, may be helpful to you. Send for your copy of the Synthane Catalog and learn all about Synthane's combination of electrical, chemical, physical and mechanical properties. Synthane Corporation, 6 River Road, Oaks, Pennsylvania.

PETTICOAT STANDOFF INSULATORS machined from Synthane square-hole tubing. Here, Synthane was specified for its good dielectric properties, machinability and rugged strength.

Synthane—one of industry's unseen essentials

SYNTHANE
S
LAMINATED PLASTICS

to play these records through two separate sound systems.

Several record manufacturers are coming out with binaural records, priced under $5 per 12-inch disc; this is comparable to present LP prices, though twin-track recording necessarily cut playing time in half. One large receiver manufacturer is considering production of binaural phonographs having dual amplifiers and one remote speaker.

▶ **Twin-Track Magnetic Tape**—Both Magnecord and Ampex have two-track tape equipment of high-fidelity professional quality, to sell in the $850 and $1,500 price ranges respectively. These models were widely used as signal sources for binaural demonstrations in the exhibit rooms at the Audio Fair. Both use standard magnetic tape and staggered heads to give two parallel tracks. Narrowed tracks give slightly poorer signal-to-noise ratio but do not affect fidelity.

The psychological effect of binaural listening on the ears is such that background noise and distortion become much less noticeable; the result is a tremendous impact on first-time listeners even with mediocre audio equipment.

Electronic Music Business Growing

Larger 1952 sales volume forecast as trend toward tube-equipped organs increases

ELECTRONIC musical instruments represent a substantial equipment market for manufacturers.

Instrument sales this year are expected to be at least 30 percent higher than 1951's substantial volume. Sales of electronic organs alone in 1951 were about $35 million, and amplifiers which are now available for virtually every stringed instrument reached a volume of over $1.5 million last year.

▶ **Assemblers**—Some musical instrument manufacturers assemble their own electronic equipment and have sizeable electronic departments in operation. During World War II, when instrument manufacturing was curtailed, many produced military electronic equipment.

This 93 tube all-electronic organ, used at the political convention in Chicago, turned out volume equal to 50 ordinary pipe organs or 3,000 home radios

Parts Distributors Get Ready For UHF

NEDA convention airs UHF problems of distributors and manufacturers alike

ELECTRONIC parts distributors at the recent NEDA Convention were uneasy about the uhf television picture. Big questions on their minds concerned deliveries of converters, antennas and lead-in for uhf. Even though most of the cities they represented did not have uhf cp grants, distributors wanted to be ready for it.

Several distributors at the convention did come from cities with cp grants for uhf stations. They reported that telephones began ringing as soon as the grants were announced. Customers wanted samples of uhf antennas, converters and lead-in as well as special servicing instructions. As a result, some parts distributors in markets that may not have uhf tv for years, find that the demand is substantial and supply is lacking.

▶ **On The Spot**—A panel of manufacturers representing antenna, lead-in, converter, tube and set companies were put on the spot at the convention to answer these delivery and supply questions. But on the whole they were unable to give definite answers. They did say, however, that by November such equipment would really start rolling, including full-channel tv sets as well. The manufacturers pointed out two main reasons why quantity deliveries of the equipment had not been made. First, they wanted to take up to the last minute to work on further improvements of the equipment; second, quantity demand was still very small, despite words to the contrary.

▶ **Outlook** — Regardless of uhf problems, electronic distributors and manufacturers are looking forward to increased sales volume. H. F. Bersche of RCA predicted that electronic renewal volume would reach $600 million this year. He based the figure on the following estimates of electronic equipment in use as of the end of the year: Radio (home, auto, portable sets)—110 million, television sets—20,250,000, AM-FM stations—2,940, tv stations—125, Non-broadcast communications—500,000 and amateur stations—110,000. By 1955 electronic renewal volume is expected to reach $1 billion and by 1960 a total of $2 billion. Thus the outlook is bright for electronic distributors despite present uhf problems.

Drive-in Theatre TV Makes Its Debut

USE of theatre television in a Rutherford, N. J. drive-in theatre, for the Walcott-Marciano title fight telecast, opened a new field for the growing medium and set new attendance records for the theatre even though admission was $10 per car. The pictures shown were said to be the largest ever projected (24 by 36 feet). The projection

(Continued on page 26)

NEW! Complete Line of ERIE BUTTON® MICAS for 150°C Operation

THE addition of a new complete line of ERIE Button Silver-Mica Condensers, designed for operation at 150°C, is important news to manufacturers of military electronic equipment and specialized commercial applications. The new line greatly extends the range of applications for the popular ERIE Button Micas. The new line is available in the eight standard terminal and mounting styles, and in other styles on special order. Write for samples and literature.

SPECIFICATIONS

Maximum Operating Temperature: 150°C.

Voltage Rating: 500 DC.

Capacitance Values: All standard decade values from 10 mmf to 1000 mmf.

Capacitance Tolerance: ± 20%, ± 10%, ± 5%, ± 2%, or ± 1 mmf, whichever is greater.

Q: 1000 minimum for values above 30 mmf.

Insulation Resistance: 10,000 megohms minimum.

Life Test: 750 volts DC for 1000 hours at 150°C.

Seal Test: Moisture resistance conditioning in accordance with MIL M745. After this the following shall be met:

- **Insulation Resistance:** 500 megohms minimum.
- **Q:** 500 minimum for values above 30 mmf.
- **Capacitance Change Limit:** 3% or 0.5 mmf, whichever is greater.

Temperature and Immersion Cycling: In accordance with ASESA Project 114. After this the following shall be met:

- **Dielectric Strength:** 600 volts DC.
- **Insulation Resistance:** 3000 megohms minimum.
- **Q:** 750 minimum for values above 100 mmf.
- **Capacitance Change Limit:** 3% or 0.5 mmf, whichever is greater.

TRADE ERIE MARK
RESISTOR CORP.

ERIE RESISTOR CORPORATION . . . ELECTRONICS DIVISION

Main Offices: **ERIE, PA.**

Sales Offices: Cliffside, N. J. • Philadelphia, Pa. • Buffalo, N. Y. • Chicago, Ill. Detroit, Mich. • Cincinnati, Ohio • Los Angeles, Calif.

Factories: **ERIE, PA. • LONDON, ENGLAND • TORONTO, CANADA** throw of 125 feet is the longest on record.

Equipment consisted of RCA's standard theatre television system mounted on a five-ton truck. The signal was microwaved to the mobile projection booth from the Empire State building, 5½ miles away.

MEETINGS

OCT. 29: Armed Forces Communications Association, New York Chapter, Officers Club, Governor's Island, New York.
NOV. 5-7: Sixteenth Annual Time and Motion Study and Management Clinic, Sheraton Hotel, Chicago, Ill.
NOV. 7: IRE Microwave Professional Group, Symposium On Microwave Circuits, Western Union Telegraph Co. Auditorium, New York, N. Y.
NOV. 7: AIEE Symposium, The Science of Music and Its Reproduction, Engineering Societies Bldg., New York, N. Y. Other lectures scheduled for Dec. 11, Jan. 15, Feb. 20, Mar. 12 and Apr. 16.
NOV. 10-13: NEMA, Haddon Hall, Atlantic City, N. J.
NOV. 10-30: International Radio and Electronics Exhibition, Bombay, India.
NOV. 17-18: AIEE, Technical Conference on Recording and Controlling Instruments, Benjamin Franklin Hotel, Philadelphia, Pa.
NOV. 19: American Standards Association, 34th Annual Meeting, Waldorf Astoria, N. Y.
NOV. 21-22: Fourth Annual IRE Regional Papers Technical Conference, President Hotel, Kansas City, Mo.
NOV. 24-25: Fifth Annual Conference on Electronic Instrumentation and Nucleonics in Medicine, New Yorker Hotel, New York, N. Y.
DEC. 10-12: IRE-AIEE Computer Conference, Park Sheraton Hotel, New York, N. Y.
JAN. 14-16, 1953: Joint AIEE-IRE Conference on High Frequency Measurement, Washington, D. C.
FEB. 4-6: Western Computer Conference, Hotel Statler, Los Angeles, Calif.
FEB. 5-7: IRE Southwestern Conference and Electronics Show, Plaza Hotel, San Antonio, Texas.
MARCH 9-12: NEMA, Edgewater Beach Hotel, Chicago, Ill.
MARCH 23-25: Sixth Annual Conference for Protective Relay Engineers, A & M College of Texas, College Station, Texas.
MARCH 23-26: IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N. Y.
APRIL 18: Seventh Annual Spring Technical Conference, Cincinnati IRE, Cincinnati, Ohio.
MAY 11-13: National Conference on Airborne Electronics, Dayton, Ohio.
MAY 18-21: 1953 Electronic Parts Show, Conrad Hilton Hotel, Chicago, Ill.
MAY 24-28: NAED, 45th Annual Convention, Conrad Hilton Hotel, Chicago, Ill.

Stretch-Out Hits New Panel-Instrument Firms

STRETCHING OUT of government contracts has adversely affected some manufacturers in the panel-instrument field.

The panel-instrument market is good, constituting about 90 percent of the total instrument business in this country in terms of units sold. Level of business activity has remained fairly steady for the past 12 months.

Old and established firms, in most cases, have not greatly increased their production capacity and are enjoying good business conditions. But new manufacturers built plants, anticipating a radical increase in demand due to military needs. This radical increase has not yet materialized.

Robot Stencil-Cutter

New photoelectric machine by Roneo Ltd., London, produces a ready-to-use stencil in a few minutes from almost any typewritten, drawn, printed or photographic copy. As a phototube scans the original line by line, an electric spark cuts a facsimile design spot by spot on the stencil

Business Briefs

► **Magnetrons** and klystrons will be manufactured in Europe under an agreement recently made by Raytheon with the Fabbrica Italiana Raddorizzatori Apparecchi Radiologici (F.I.R.A.R.) of Genoa, Italy.

► **FCC** may postpone the effective date of rules for medical diathermy equipment made before July 1, 1947 to June 30, 1953.

► **Import Quota** recently set by the Italian government limits shipments of U. S. tv receivers to 5,000 for the second half of 1952.

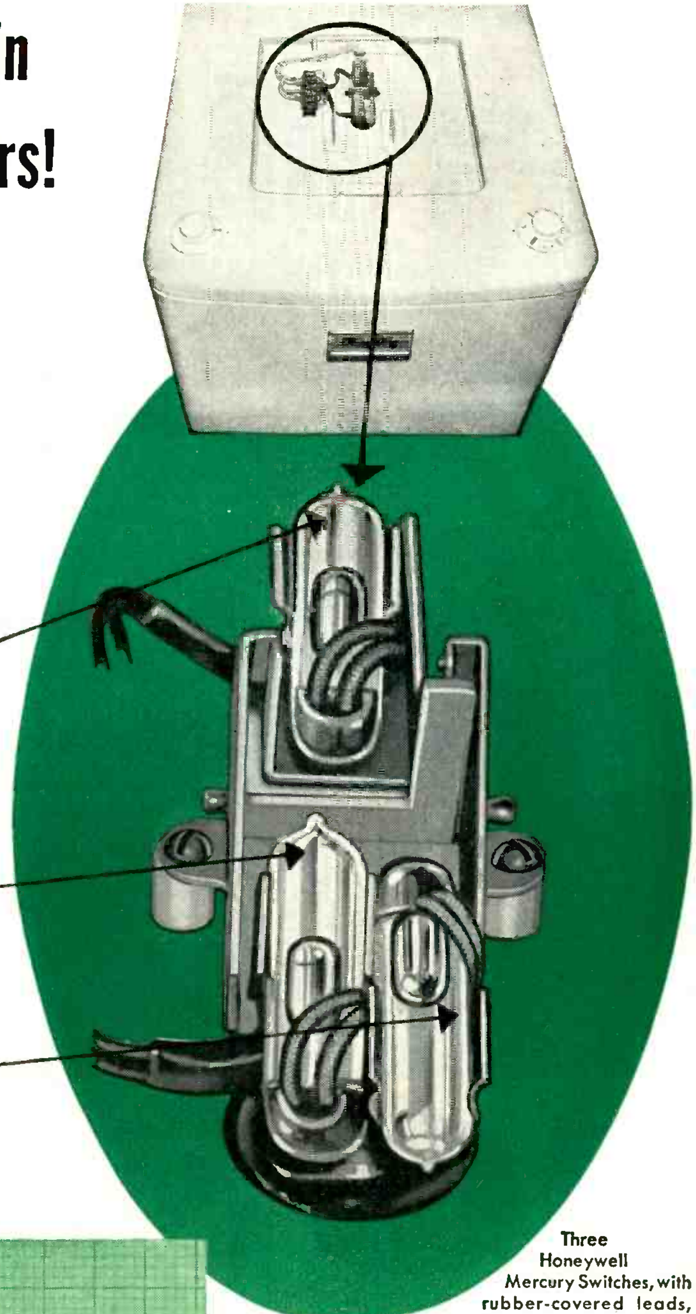
► **An Endless Loop** of magnetic tape is used by P. K. Tobin of Evanston, Illinois to teach his young parakeet to talk. The tape player is turned on when the family goes out for the evening, so only the parakeet has to endure the endless repetition.

► **Largest** train communications system in the world, representing an investment of \$9 million, is operated by the Pennsylvania Railroad. Nearly 1,300 radiophones are in service on trains and in wayside control towers along 2,000 miles of line.

► **Analysis** of one typical electronic equipment order placed with Westinghouse revealed that 44 percent of the \$16,965,288 contract had been passed along to subcontractors and suppliers. The largest of these subcontractors in turn spent 41.6 percent of his contract with 254 other firms. In all, a total of 381 firms participated in filling this one defense order.

How HONEYWELL MERCURY SWITCHES

help put the "automatic" in MAYTAG Automatic Washers!



Three Honeywell Mercury Switches, with rubber-covered leads, mounted in cover of the Maytag Automatic Washer.

An automatic washer must give safe, trouble-free service day after day. Water inflow must be accurately regulated and washing action begun at the proper time. The machine must never start while the lid is raised, must stop if the spin-drying basket becomes unbalanced during the drying cycle.

The Maytag Automatic Washer performs these vital functions unfailingly—with the help of three Honeywell Mercury Switches located in the machine's cover. Glass enclosures fully protect the switches from the effect of water vapor and splash which may vary from 60° to 150° F.

Prevents operation if lid is open or clothes in drying cycle are off balance

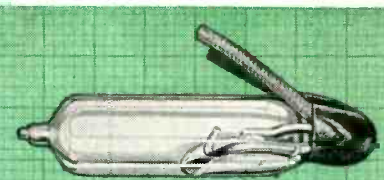
When the cover of the washer is lifted, this mercury switch tilts and stops the machine until lid is closed again. Actuated by a trigger, it also shuts off power if the spin-drying basket becomes unbalanced.

Controls water level

Proper water level is maintained automatically by a float which tips this switch to an angle causing it to shut off the inflow of water and hold desired water level within 1-16 of an inch.

Starts washing action

When the float reaches proper water level, this switch starts the washer agitator and begins the washing cycle.



Let a MICRO Engineer show you how you can **"use Honeywell Mercury Switches as a principle of good design"**

Your nearby MICRO field engineer will help select the *exact* mercury switch for your application from more than 90 Honeywell Mercury Switch designs. These include a wide variety of mountings, actuating linkages, lead supports, terminal blocks embedments and enclosures. Contact your nearest MICRO branch office for information.

MICRO

MAKERS OF PRECISION SWITCHES

FREEPORT, ILLINOIS

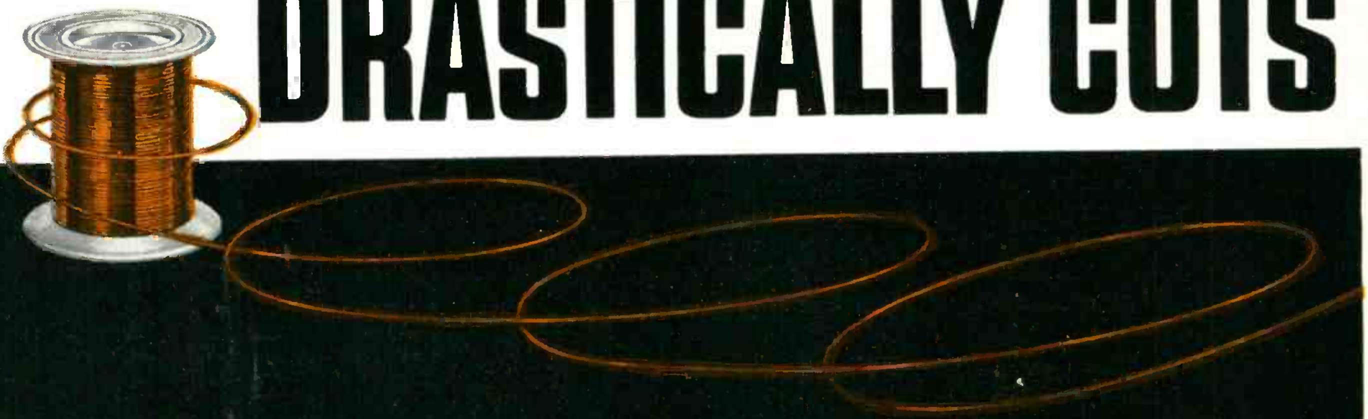
A DIVISION OF

MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

H HONEYWELL

Unique ***PHELPS DODGE*** *development*

DRASTICALLY CUTS



- FAST WIRE-TO-WIRE BONDING INTO RIGID COIL.
- REDUCES FORMING AND ASSEMBLY OPERATIONS.
- FAR FEWER STEPS IN WINDING TYPICAL TV YOKE COIL.
- MAKES POSSIBLE UNUSUAL SHAPE COILS.

"Bobbin-less" coil

Fly-back coil

TV yoke coil

Hoop-shaped coil

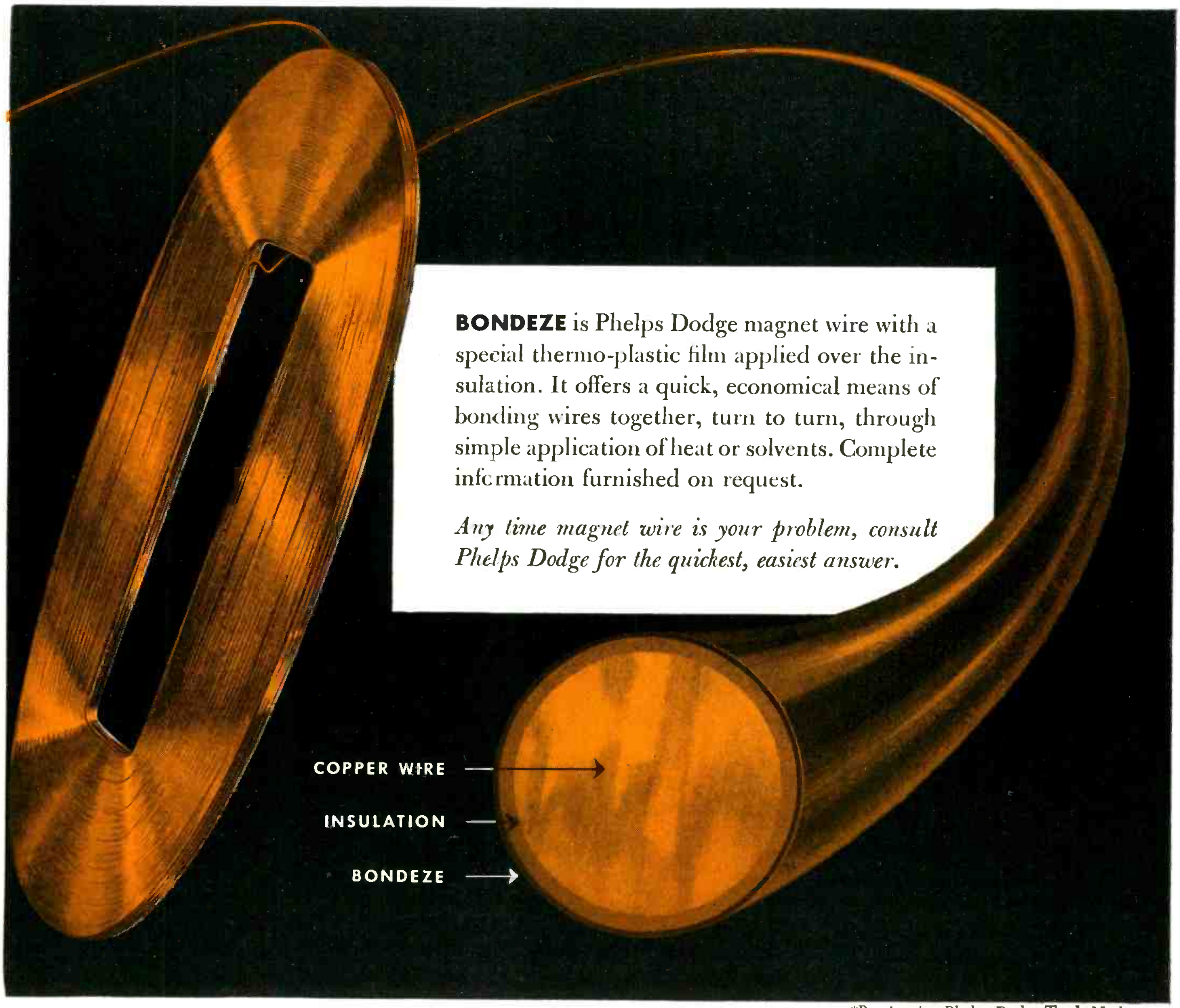
"It takes the best

PHELPS DODGE COPPER PRODUCTS

CORPORATION

in Magnet Wire--BONDEZE...*

COIL WINDING COSTS!

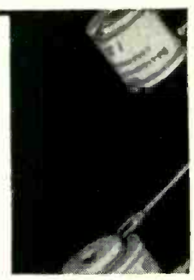


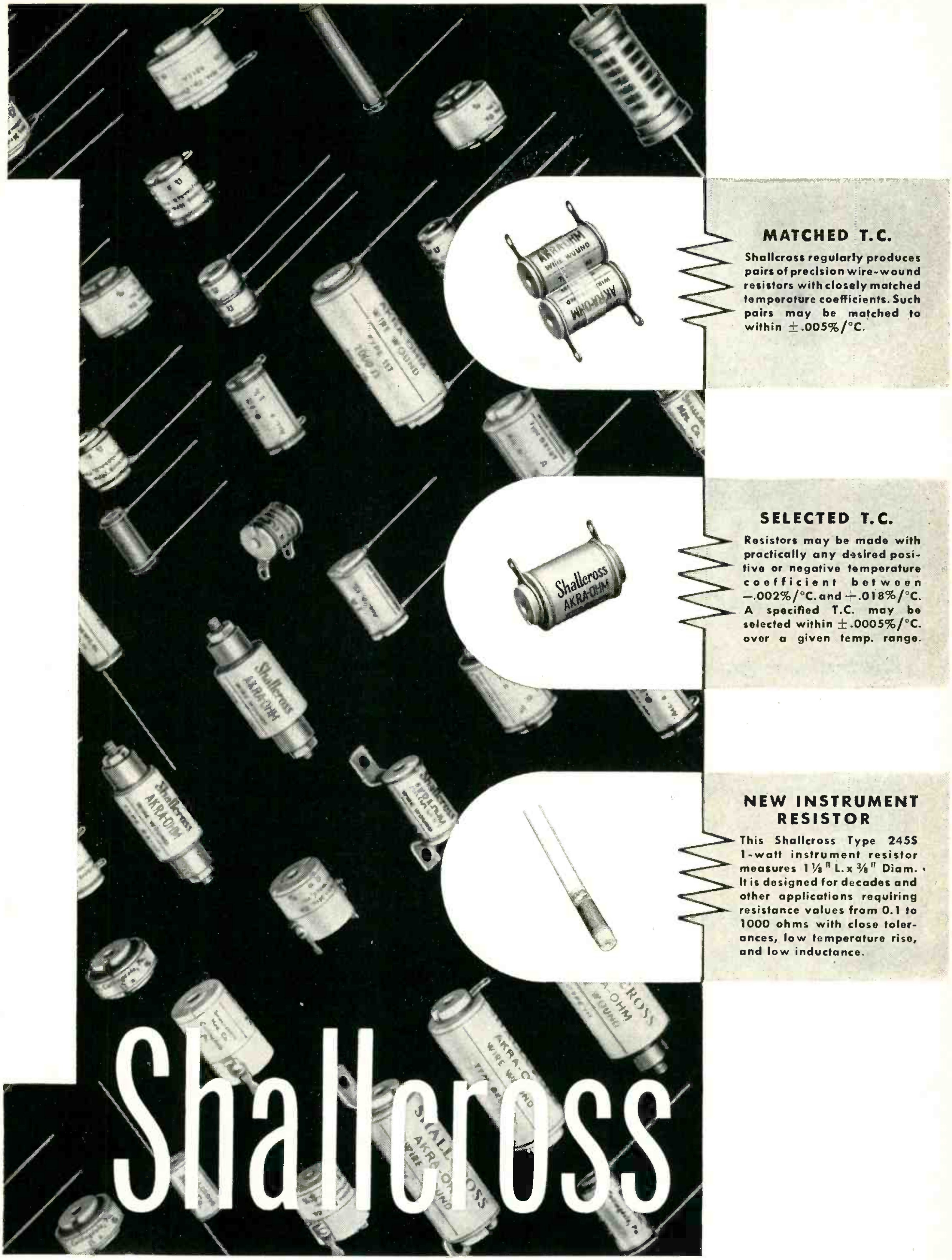
*Bondeze is a Phelps Dodge Trade Mark

to make the best!"

INCA MANUFACTURING DIVISION

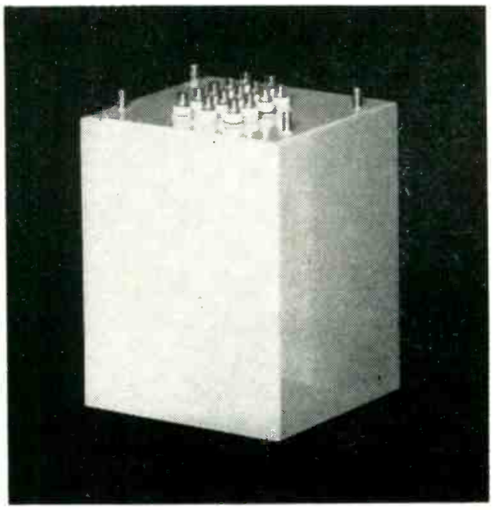
FORT WAYNE, INDIANA

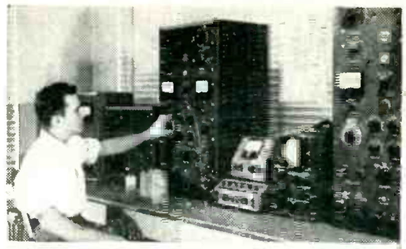



MATCHED T.C.
Shallcross regularly produces pairs of precision wire-wound resistors with closely matched temperature coefficients. Such pairs may be matched to within ±.005%/°C.
SELECTED T.C.
Resistors may be made with practically any desired positive or negative temperature coefficient between −.002%/°C. and +.018%/°C. A specified T.C. may be selected within ±.0005%/°C. over a given temp. range.
NEW INSTRUMENT RESISTOR
This Shallcross Type 245S 1-watt instrument resistor measures 1 1/8" L. x 3/8" Diam. It is designed for decades and other applications requiring resistance values from 0.1 to 1000 ohms with close tolerances, low temperature rise, and low inductance.
Shallcross
AKRA-OHM
WIRE WOUND

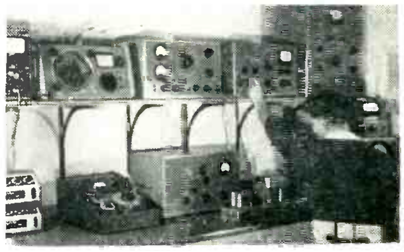
"ZERO" PHASE SHIFT

COMPUTER REFERENCE VOLTAGE TRANSFORMERS



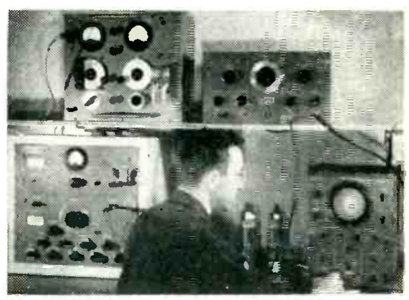


INDUCTANCE MEASUREMENT — Any operating condition can be simulated in the range of 0-1000V A.C. and 0-5 Amps. D.C.



DEVELOPMENT OF AUDIO TRANSFORMERS — All characteristics of audio transformers in the range of .01 cycle to 10 Megacycle can be measured and evaluated.

POWER LOSS MEASUREMENT — Losses as low as 15 micro watts in the range of 20 c to 200 K.C. can be measured and analyzed and possible improvements effected.



PULSE TRANSFORMER DESIGN — The cut and try methods commonly used in the design of pulse transformers has been largely supplanted by the use of special equipment.

LESS THAN 0.1 MILLIRADIAN PHASE SHIFT

$\pm$.02% ACCURACY OF VOLTAGE RATIOS

A radical new approach to the design and manufacture of precision transformers makes it possible to have calculable minimum errors.

The actual measurement of phase shift and voltage ratio is in complete agreement with the calculation to lowest value that measurement is possible.

MIL-T-27 TRANSFORMERS

TOROIDAL TRANSFORMERS
INSTRUMENT TRANSFORMERS
PULSE TRANSFORMERS
VIDEO TRANSFORMERS
INPUT-INTERSTAGE-OUTPUT
POWER TRANSFORMERS
MAGNETIC AMPLIFIERS

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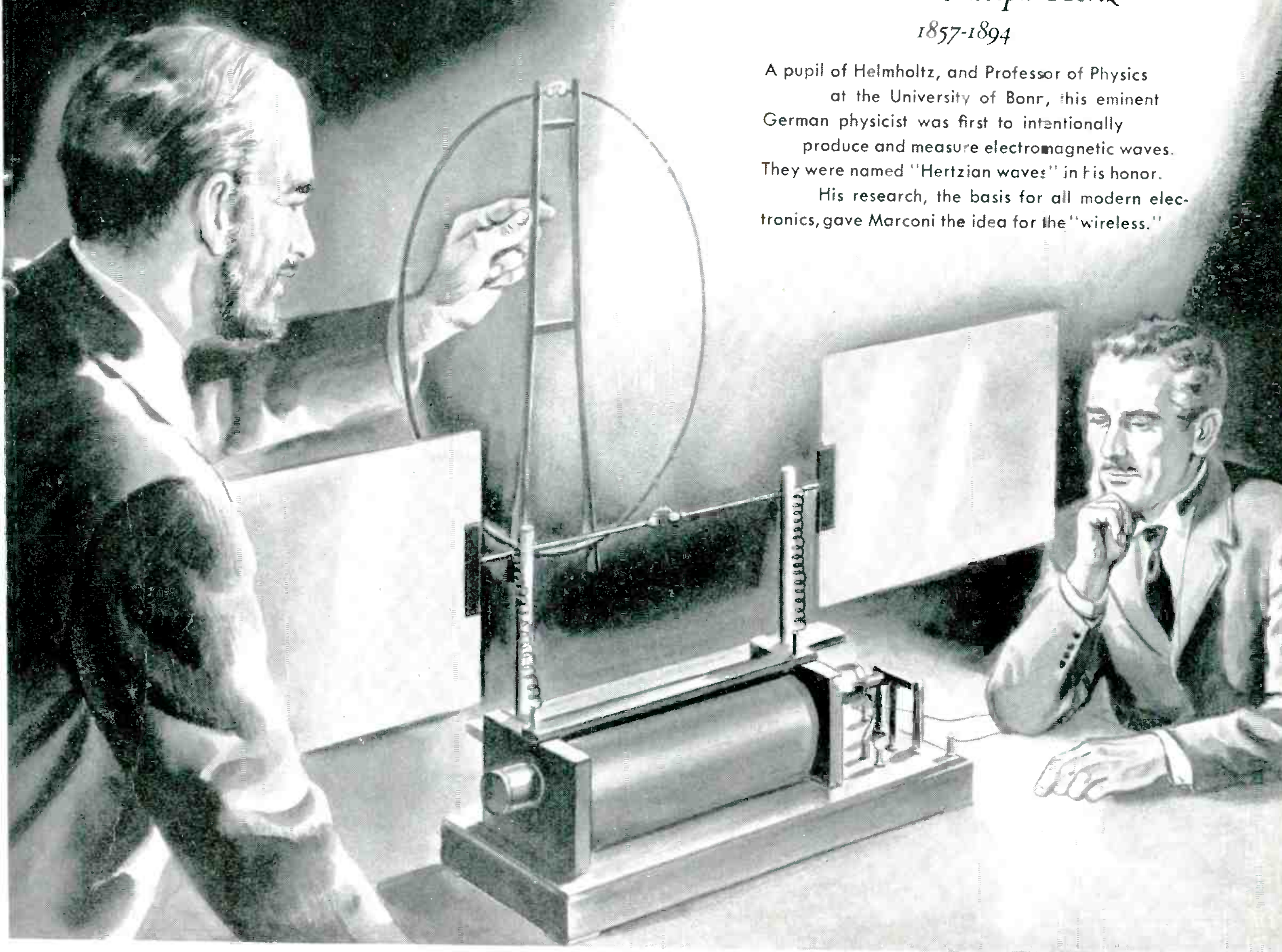
STATIC ELECTROMAGNETIC DEVICES

HERTZ ... FIRST to prove the existence of Electromagnetic Waves

Heinrich Rudolph Hertz

1857-1894

A pupil of Helmholtz, and Professor of Physics at the University of Bonn, this eminent German physicist was first to intentionally produce and measure electromagnetic waves. They were named "Hertzian waves" in his honor. His research, the basis for all modern electronics, gave Marconi the idea for the "wireless."



From an original drawing made for Ohmite

OHMITE® ... FIRST in Resistors ...today

Be Right with OHMITE

RHEOSTATS

RESISTORS

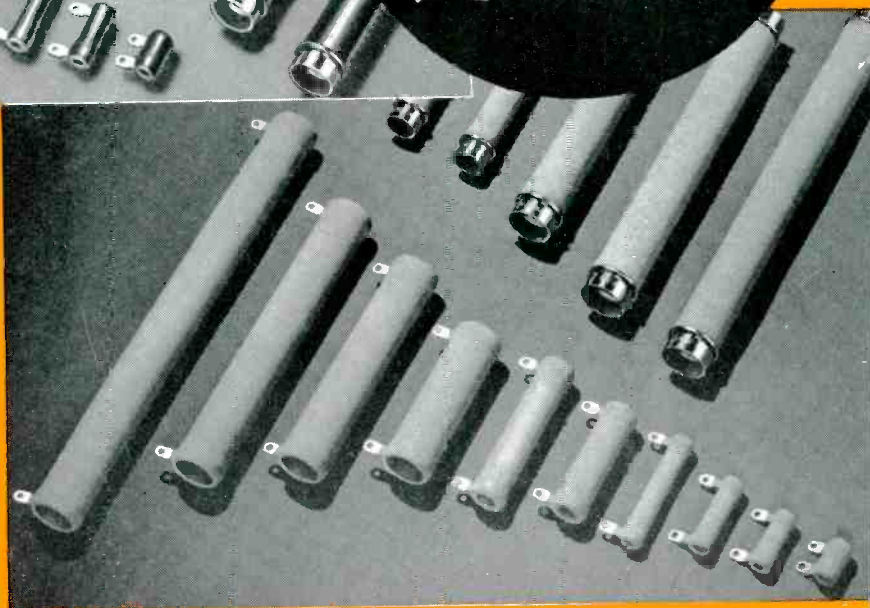
TAP SWITCHES

For its toughest resistance problems, industry turns to Ohmite wire-wound resistors . . . the most widely used resistors on the market today. Ohmite offers *greater dependability* and longer life, even under the most adverse conditions. Ohmite offers *wider assortment*, too—a complete selection of types and sizes for every need. Specify Ohmite resistors, and know you use the best!

The Ohmite line of tab-terminal, ferrule-terminal, axial-terminal, and flat type resistors that meet JAN-R-26A, Characteristics "G" and "J."

OHMITE JAN TYPE WIRE-WOUND *Resistors*

Ohmite tab-terminal and ferrule-terminal type resistors that meet JAN-R-26A, Characteristic "F."



STYLES AND SIZES

TAB-TERMINAL TYPE Characteristics G, J, and F

Style	Over-all length	Diameter	*Watts
RW-29	1-3/4"	1/2"	8
RW-30	1"	19/32"	8
RW-31	1-1/2"	19/32"	10
RW-32	2"	19/32"	12
RW-33	3"	19/32"	18
RW-34	3"	29/32"	30
RW-35	4"	29/32"	38
RW-36	4"	1-5/16"	60
RW-37	6"	1-5/16"	78
RW-38	8"	1-5/16"	110
RW-39	12"	1-5/16"	166

TAB-TERMINAL TYPE with terminal hole to clear No. 8 screw Characteristics G, J, and F

Style	Over-all length	Diameter	*Watts
RW-40	3"	29/32"	24
RW-41	4"	29/32"	37
RW-42	4"	1-5/16"	49
RW-43	6"	1-5/16"	74
RW-44	8"	1-5/16"	100
RW-45	12"	1-5/16"	160
RW-46	10-1/2"	1-5/16"	135
RW-47	10-1/2"	1-9/16"	145

FERRULE-TERMINAL TYPE Characteristics G, J, and F

Style	Over-all length	Diameter	*Watts
RW-10	11-7/16"	1-5/16"	140
RW-11	9-5/8"	1-5/16"	116
RW-12	7-7/16"	1-5/16"	86
RW-13	5-1/8"	1-1/16"	50
RW-14	4-7/16"	1-1/16"	40
RW-15	2-15/16"	3/4"	20
RW-16	2-3/8"	3/4"	14

FLAT TAB-TERMINAL TYPE (Stack Mounting) Characteristics G and J

Style	Over-all length	Width of Core	Thickness of Core	†Watts
RW-20	2-1/2"	1-3/16"	1/4"	15
RW-21	3-1/4"	1-3/16"	1/4"	22
RW-22	4-3/4"	1-3/16"	1/4"	37
RW-23	6"	1-3/16"	1/4"	47
RW-24	7-1/4"	1-3/16"	1/4"	63

AXIAL-TERMINAL TYPE Characteristics G and J

Style	Length of Core**	Diameter	†Watts
RW-55	1-3/8"	5/8"	5
RW-56	2"	5/8"	10

**2-1/2" wire leads

*Watts free air JAN Characteristic "F" or "G"

†Watts free air JAN Characteristic "G"

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(Amendment 3)

Ohmite offers an unusually complete line of resistors that meet the most rigid requirements (characteristics "G," "J," and "F") of Joint Army-Navy Specification JAN-R-26A. To meet these requirements, resistors must pass severe moisture resistance and thermal shock tests. They are required to withstand strenuous vibration applied for five continuous hours, and satisfy the requirements of many other tests.

Of the 38 different resistor styles listed in JAN-R-26A, Ohmite offers 33 styles that meet these specifications, in a complete range of resistance values.

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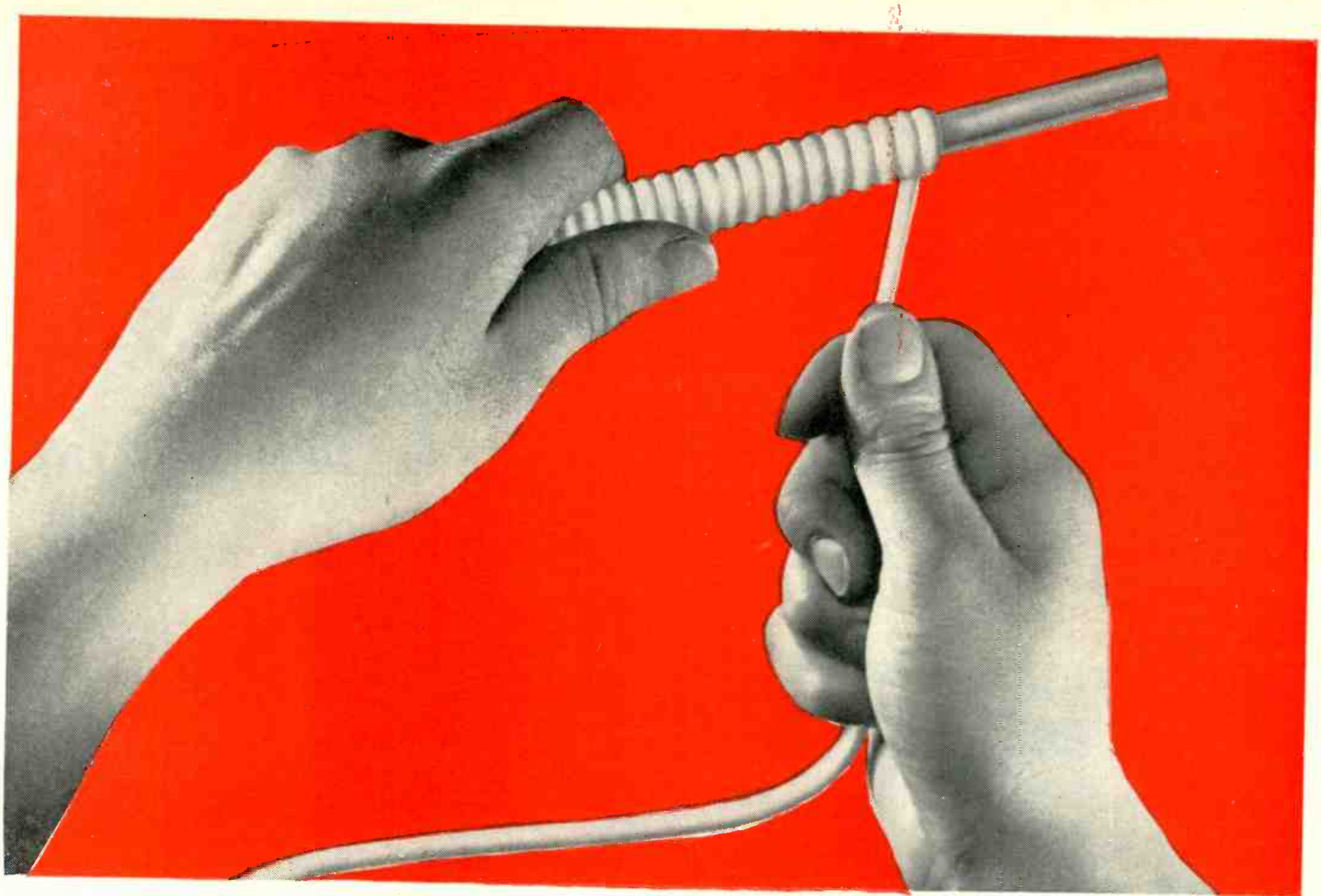

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AMPEX MODEL 500 SIMPLIFIES TELEMETERING

Entire output of FM-FM receivers is recorded on tape without detectable error or loss of data.

AMPEX magnetic tape permanently records data in electrical form. Data reduction can then be carried out any time, any place and in any way. This eliminates the need for complex filter and discrimination systems at each ground station. This frequently lowers ground station cost and complexity to one-third that of alternative installations. Use of fewer mechanical and electronic components also decreases the chance of losing any critical data.

The AMPEX Model 500 was developed to achieve the extremely steady tape motion and high frequency response required in FM-FM telemetering. This performance also serves other data recording fields that have similarly high demands. The Model 500 has a frequency response up to 100 kc. to simultaneously record all RDB telemetering bands. Its extremely low tape flutter and wow account for an overall playback error less than 0.7%, (using subcarrier frequencies deviated $\pm 7\frac{1}{2}\%$).

Features of the AMPEX Model 500

- *Records frequencies up to 100 kc. (including all RDB bands)*
- *Records the output of one to four receivers*
- *Overall playback error less than 0.7% on final data*
- *Less than 0.1% peak-to-peak flutter and wow*
- *Ruggedly constructed to meet military requirements*
- *16 minutes recording time at 60-inch tape speed*

Write for further information to Department E

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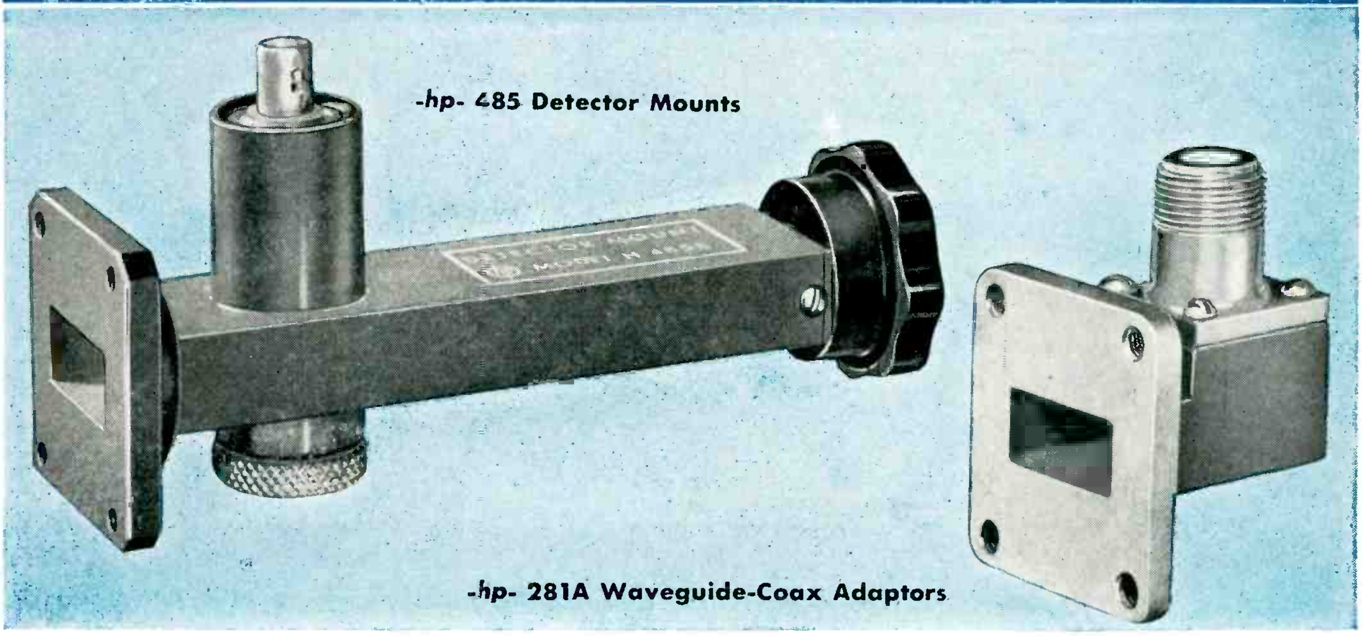
ELECTRONIC TEST INSTRUMENTS



New broad band Adaptors and Detector Mounts offer high accuracy, easy operation, low cost

Model 485 Detector Mounts and 281A Adaptors typify the new *-hp-* line of precision waveguide test instruments. Each has the simplest possible construction consistent with its basic function. Each covers the complete frequency range of its waveguide size and is wholly integrated with other equipment for the same band. Novel circuitry plus simple mechanical design insure highest accuracy and stability, provide utmost operating ease and permit quantity production at low cost.

-hp- 485 Detector Mounts

These mounts offer new convenience in measuring microwave power with a bolometer, or detecting rf energy with a crystal. A single tuning control adjusts match easily and quickly. (See Figure 1.) For optimum match, mounts may be preceded by a slide-screw tuner such as *-hp-* 870A. Detected output appears at a BNC jack, and may be measured with an *-hp-* 430B Microwave Power Meter or an *-hp-* 415A Standing Wave Indicator.

-hp- 485B Mounts are tunable and available in waveguide sizes 2″ x 1″, 1½″ x ¾″, 1¼″ x ⅝″, and 1″ x ½″. Maximum VSWR when used with a Sperry 821 barretter is 1.25. These mounts also accommodate 1N21 and 1N23 crystals.

-hp- S485A Mount is for use with 3″ x 1½″ waveguide, and employs only a Sperry 821 barretter. It requires no tuning, and maximum VSWR is 1.25 at any point in the frequency band.

-hp- 281A Adaptors

These adaptors provide a convenient means of transmission between waveguide and coaxial systems. Power may be fed in either direction, and each unit covers the full frequency range of its waveguide size with VSWR less than 1.25. (See Figure 2.) Coaxial connections are made to a standard Type N plug, and waveguide connections to a plain AN flange. *-hp-* 281A Adaptors are offered in all waveguide sizes covering the frequency range from 2.6 to 12.4 kmc.

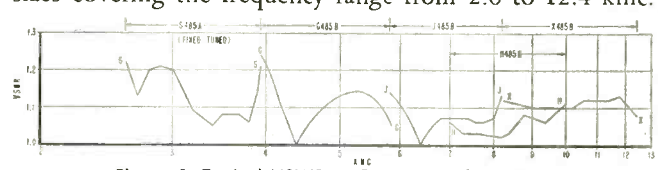


Figure 1. Typical VSWR vs. Frequency, -hp- 485A, when used with barretter.

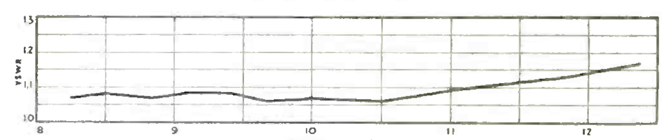


Figure 2. Typical VSWR vs. Frequency, -hp- X281A.

For complete details, see your -hp- field representative or write direct

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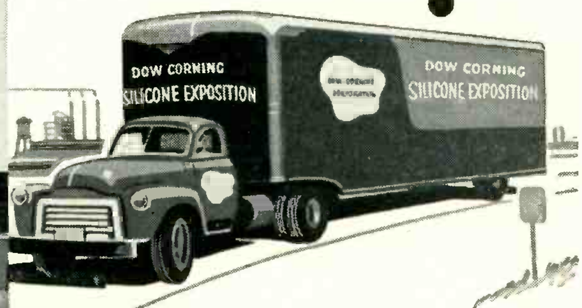

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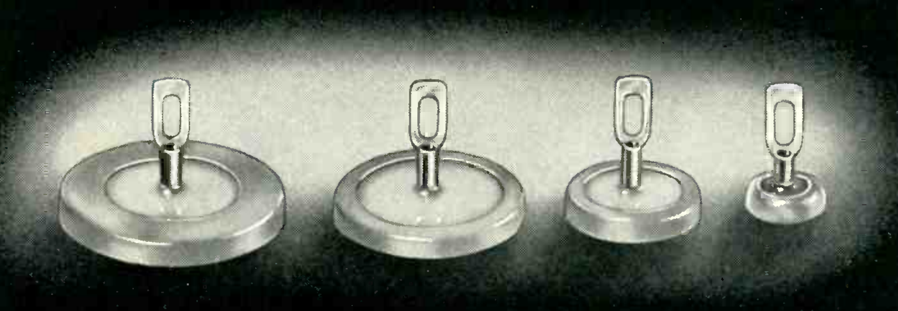

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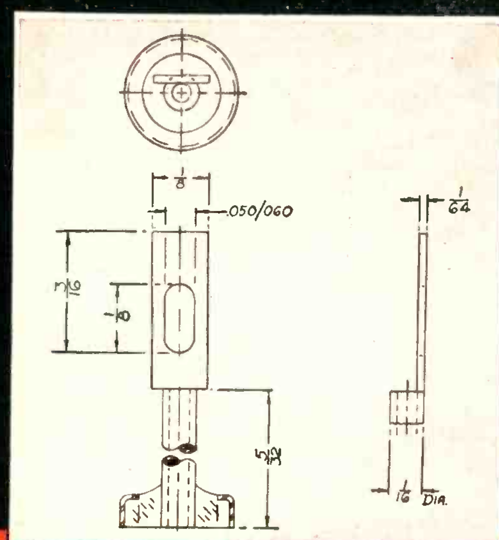

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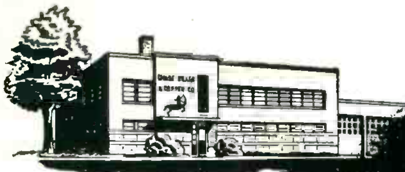

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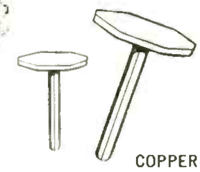

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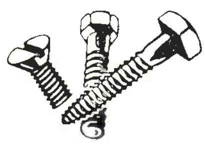

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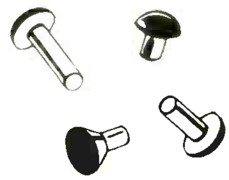

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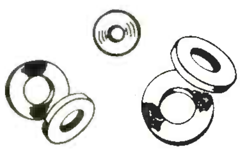

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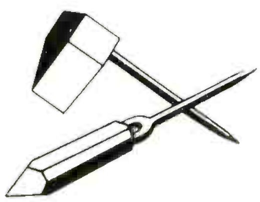

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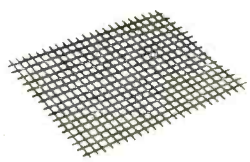

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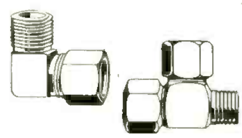

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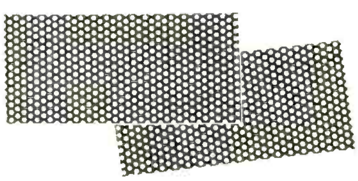

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NO OTHER textile for electrical insulation
resists oils and acids better than FIBERGLAS YARNS!
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IT WILL PAY YOU TO SPECIFY

FIBERGLAS* *insulating materials*

Many electrical insulating materials used in apparatus, wire or cable soon break down under the ravages of oils and acids. This means costly down-time for repairs or complete replacement.

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Fiberglas tapes, varnished cloths, sleeving and tubing, cords, wire and cable insulations, and laminates, as used in electrical apparatus resist rot and corrosion from oils and acids . . . deliver top service at higher operating temperatures.

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

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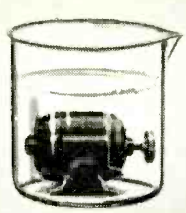
FIBERGLAS YARNS ALSO GIVE YOU THESE COST-SAVING ADVANTAGES



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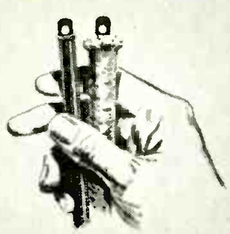
Wire, cable, and apparatus resist moisture better, if they're made with Fiberglas materials.

HEAT RESISTANCE
Fiberglas insulating materials resist break-down under heat.



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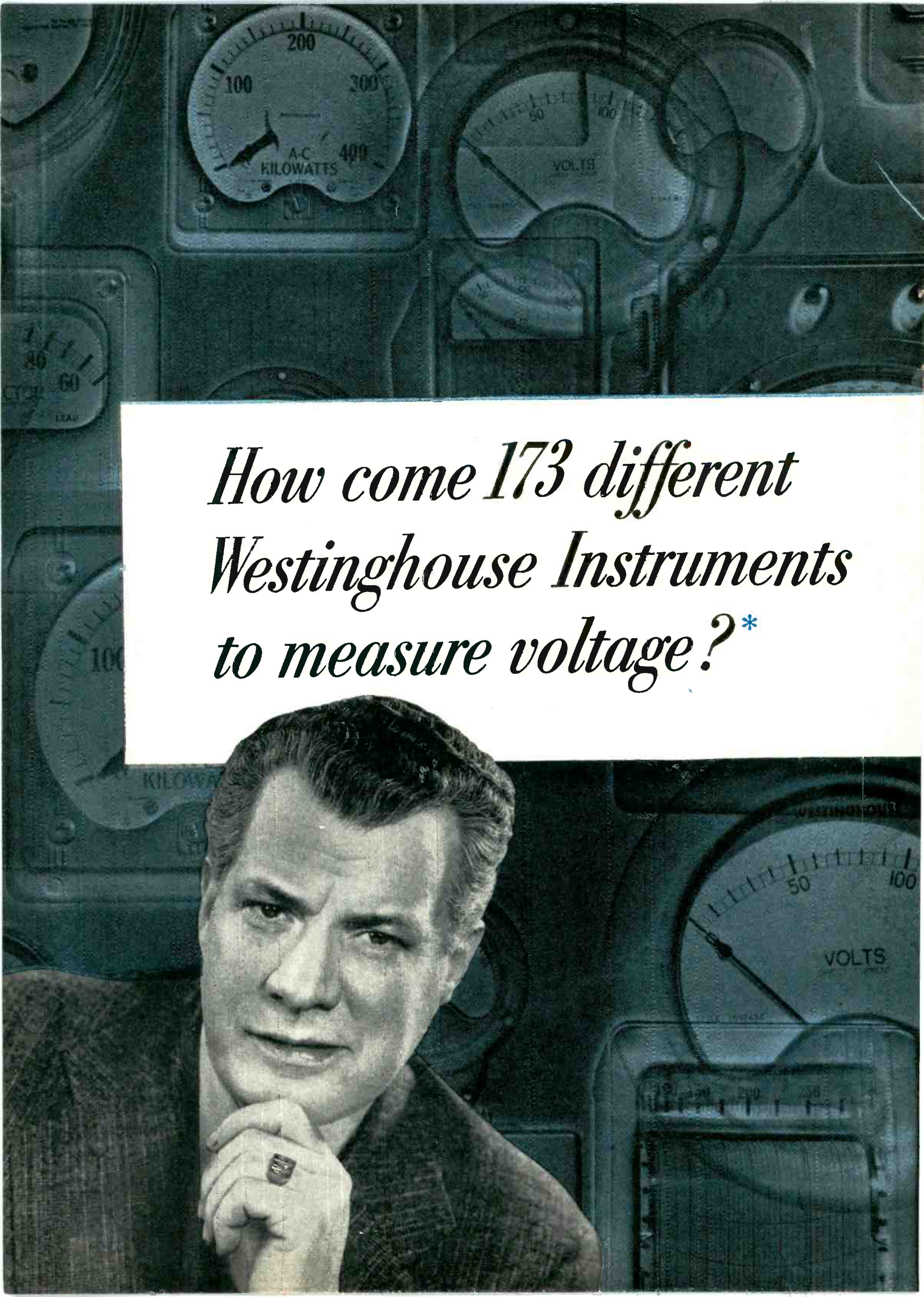
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You save engineering time and expense . . . gain more effective use of instruments when you have manufacturer's assistance in their application. A team of highly trained Instrument Application Engineers is available to work with you in applying all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

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The Type H-12

UHF SIGNAL GENERATOR

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(108 to 132 megacycles) for testing OMNI receivers on bench or ramp. Checks on: 24 OMNI courses, left-center-right on 90/150 cps localizer, left-center-right on phase localizer, Omni course sensitivity, operation of TO-FROM meter, operation of flag alarms.

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Dept. 1

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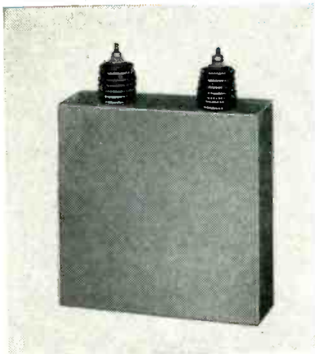
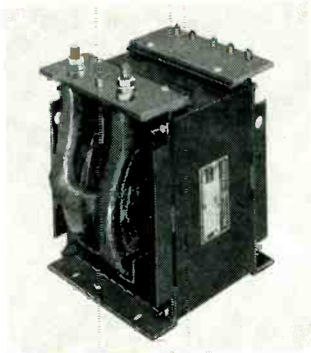
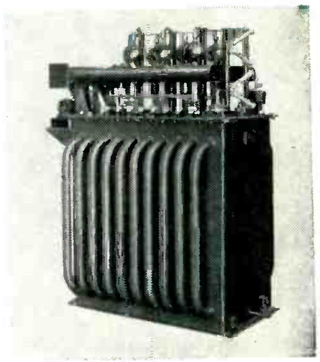

CAPACITORS

METERS AND INSTRUMENTS


TRANSFORMERS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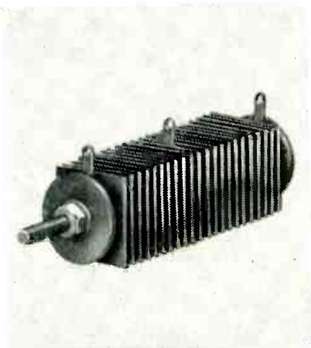
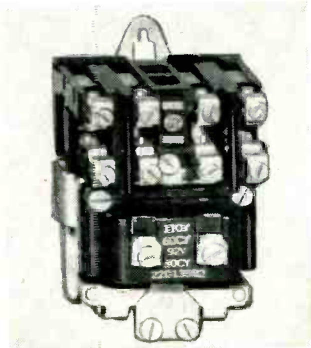
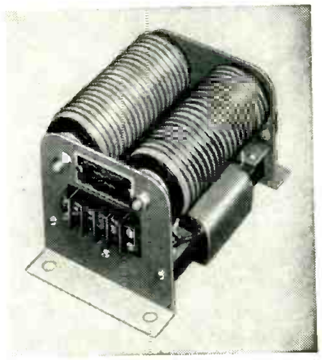

RECTIFIERS


CONTROL


AMPLISTATS

Ready to serve expanding tv industry—G-E components for transmitter builders

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To avoid costly delays, G.E. will plan output of its ample manufacturing facilities to match your production schedules. And recent design improvements and important new products resulting from continuing G-E research and development activities will add to the performance of your equipment.

If you are engaged in supplying the huge demand for new tv station equipment, you'll find it worthwhile time-wise, cost-wise, and quality-wise to investigate the full line of applicable General Electric products. Your G-E Apparatus Sales Engineer has the story. Get in touch with him today, or write, giving full details and quantities involved, to General Electric Co., Sect. 667-22, Schenectady 5, N. Y.

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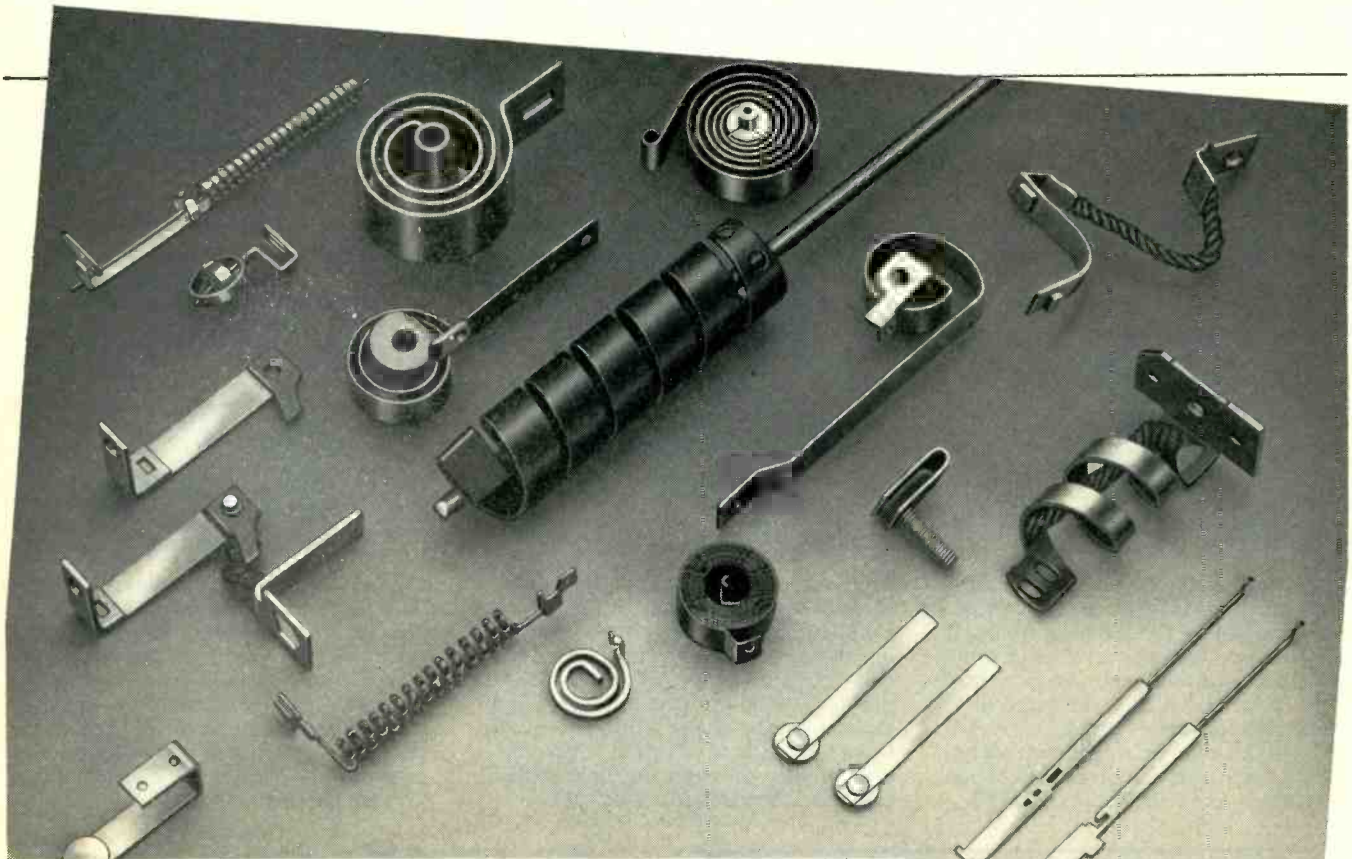
PROBLEM:

To get reliable automatic temperature control at low cost

SOLUTION:

GENERAL PLATE'S fabricated TRUFLEX® thermostat metal assemblies meet every temperature requirement



Recently a manufacturer was faced with a problem of obtaining a thermostat metal assembly. To fabricate the assembly himself meant expenditures for dies and specialized equipment . . . a costly proposition.

The problem was presented to General Plate who provided the necessary TRUFLEX assembly ready for installation. Result — necessary performance was obtained . . . costs were minimized.

You, too, can save money because General Plate fabricates, in accordance with your exact specifications, complete units which are supplied to you ready for installation. It means you eliminate costly fabrication problems and needless equipment costs . . . experimental and assembly adjustments are crossed from your books.

You get reliable performance because every order comes to you an exact duplicate of the original . . . consistently uniform in tolerances, temperature reaction and performance, thus preventing rejects and costly adjustments in assembly.

General Plate TRUFLEX Thermostat Metal Assemblies will be made to meet your specification requirements for temperature range, electrical resistance, corrosion resistance, etc. However, if you prefer to make your own assemblies, General Plate will produce sheet or strip to your material specifications. Write for information or engineering assistance.

Have You a Composite Metal Problem?
General Plate can solve it for you

GENERAL PLATE

Division of Metals & Controls Corporation

311 FOREST STREET, ATTLEBORO, MASS.

Westinghouse

announces a great new division to manufacture a full line of RELIATRON™ TUBES

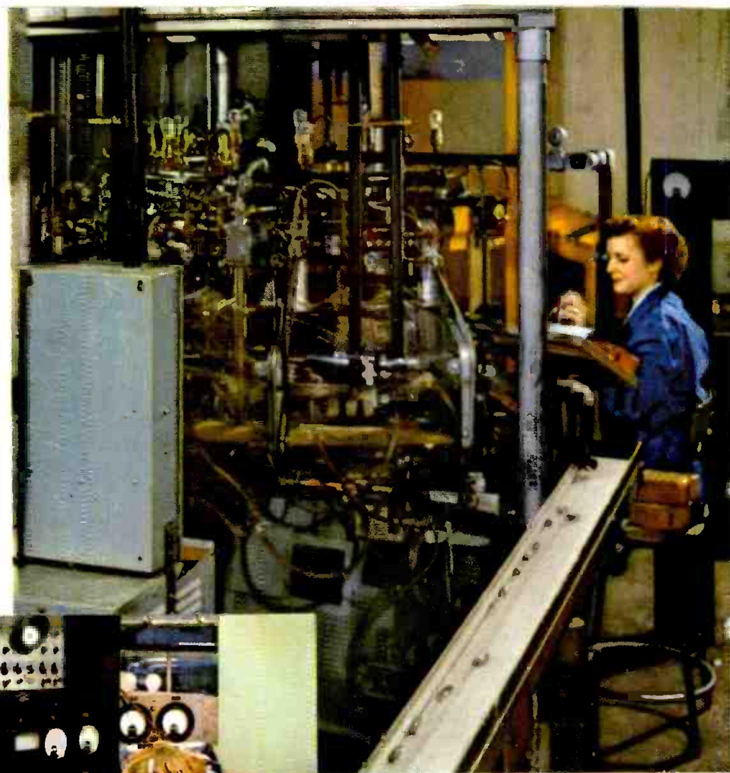
Receiving Tubes—
Television Picture Tubes—
Power Tubes

Westinghouse proudly announces a completely new division—*THE ELECTRONIC TUBE DIVISION.* Its aim is this: To become the leader of the industry in providing better electronic tubes and better service to all tube users.

To provide this new standard of service to all branches of the electronic tube industry, Westinghouse has equipped its new tube division with completely new production, research, and distribution facilities.

Westinghouse RELIATRON Tubes are now available; many types are on their way at this moment to distributors, dealers, equipment manufacturers, government, government contractors.

RELIATRON TUBES are backed by Westinghouse reliability



Sealex units at Bath, New York, turn out miniature tubes for government and commercial use. From here, tubes enter a rigorous program of checks and testing.

Here, an early Westinghouse WD-11 tube, one of the earliest types ever made, is shown just as it was used in the first commercial radio receivers.

TUBE RESEARCH AND DEVELOPMENT

The Westinghouse position of leadership in electrical and electronic manufacturing is founded on the untiring efforts of its research staff. The Electronic Tube Division is already at work improving present tube types and developing new types for superior service and new applications, including UHF.

QUALITY CONTROL

RELIATRON tube performance is assured by an exacting program of quality control. Every step in the manufacture of RELIATRON Tubes—from raw materials to finished product—must meet standards which are the toughest in the industry.

This exclusively Westinghouse quality control test set is one of a large battery of equipment which provide you with tubes of the highest quality and reliability.

Basic and applicat or research are of prime importance in the Westinghouse Electronic Tube Division's plans. Such research has helped build the tube industry, and has made Westinghouse dominant in development.

ENGINEERING AND SALES SERVICES

Whatever your problem, whether you are an equipment manufacturer, government laboratory, or parts distributor, you will find Westinghouse sales representatives and application engineers in your area at your service. Sales and engineering offices are located strategically throughout the country to serve you.

ADVERTISING

Trade acceptance of Westinghouse RELIATRON Tubes will be supported by a nationwide advertising campaign second to none. Technical data, pricing service and application information are available to all tube users. Sales promotion programs for distributors and service dealers will be hard-hitting, sure sales builders. Your product or service will profit from consumer acceptance built by the tremendous national advertising of the name "Westinghouse."

DISTRIBUTORS, EQUIPMENT MANUFACTURERS, WRITE NOW

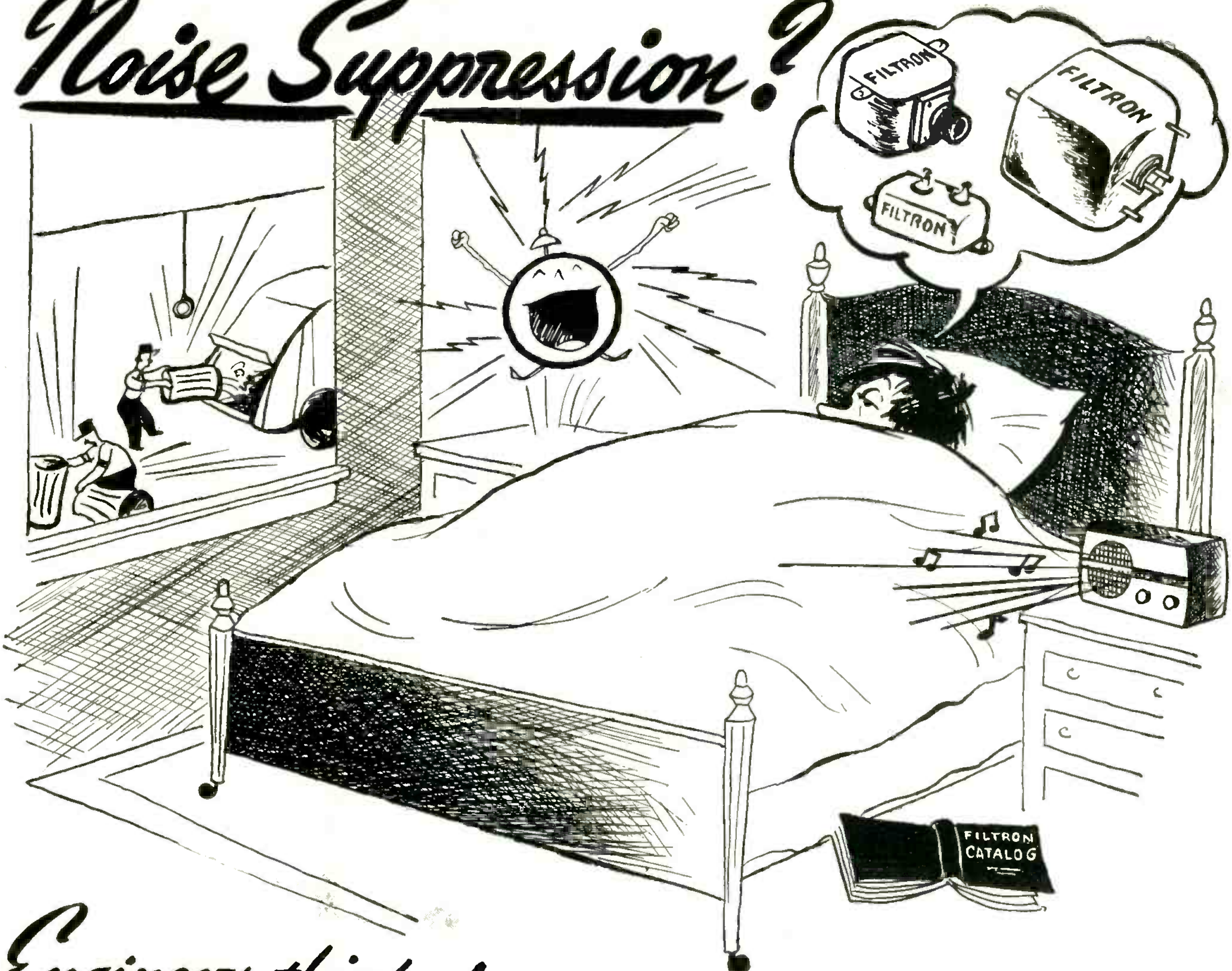
For complete information on the Westinghouse line of RELIATRON Receiving Tubes, Television Picture Tubes, and Power Tubes, write or wire Westinghouse Electric Corporation, Dept. 101, Elmira, New York. Or call your nearest Westinghouse Electronic Tube Division Sales Office.

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

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

EB-101 10-52 (250M) Printed in U.S.A.

Noise Suppression?



Engineers think of FILTRON for RF Noise Suppression!

Sorry, but we are only able to solve all your RF Interference Suppression problems on electronic equipment!

FILTRON will *custom design* the proper filter, tested for your circuit conditions, to meet size, weight and overall configuration—and meet military RF Interference Suppression limits and specifications.

FILTRON's advanced engineering, due to constant research and development, together with **FILTRON's** production know-how, insures quality components to meet your delivery requirements.

RF INTERFERENCE SUPPRESSION FILTERS FOR:

Motors	Dynamotors
Generators	Power Plants
Inverters	Actuators
Electronic Controls	Gasoline Engines

And other RF Interference producing equipment

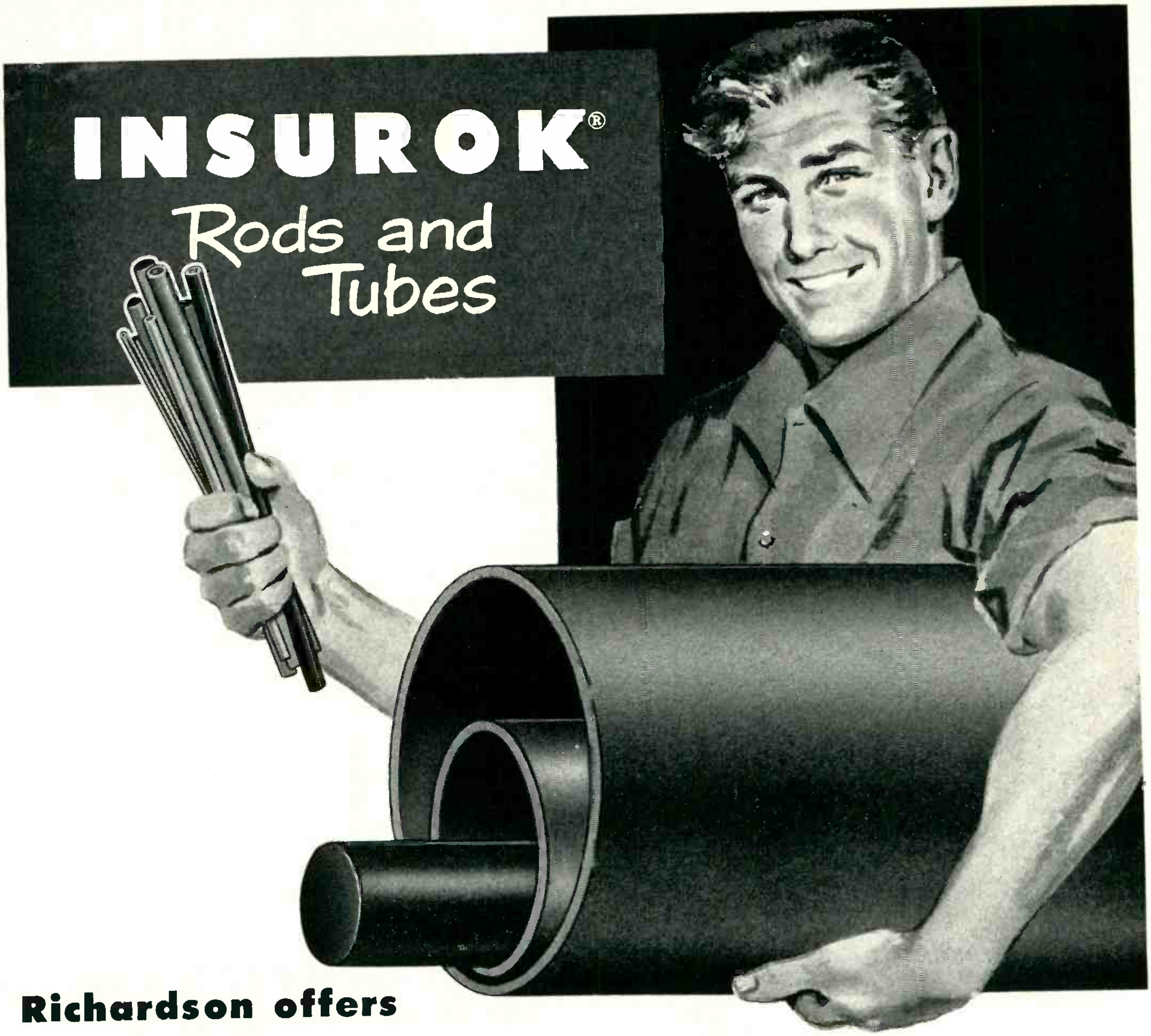
filtered by FILTRON

CONVAIR YB-60

An inquiry on your Company letterhead will receive prompt attention

THE FILTRON COMPANY, INC. · FLUSHING, LONG ISLAND, NEW YORK

LARGEST EXCLUSIVE MANUFACTURERS OF RF INTERFERENCE FILTERS



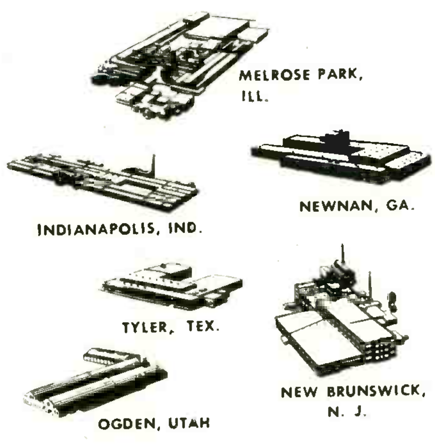
Richardson offers

a complete line of Laminated Plastic

Rods and Tubes to meet your needs

You'll find a large range of laminated plastic rods and tubes of various diameters in the Richardson line. Laminated tubes are available in fabric-base and paper-base grades, in 36″ lengths and in diameters from 1/8″ to 12 1/2″. Special larger sizes can be made upon request. Laminated rods are available in molded-paper or fabric-base grades in diameters from 1/8″ to 2″. Diameters from 2″ to 6″ can be machined from sheet stock.

Whatever your plastics requirements, consult The Richardson Company. Richardson offers a *complete* plastics service—embracing materials development, design, molding, laminating, and fabricating. Write for 20-page booklet—"Laminated INSUROK."



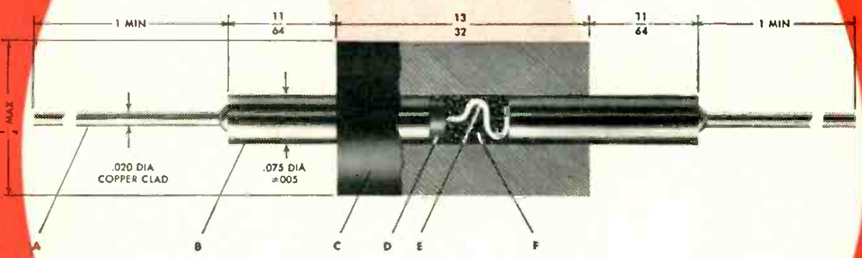
The RICHARDSON COMPANY

FOUNDED 1858 — LOCKLAND, OHIO

2797 Lake Street, Melrose Park, Illinois (Chicago District)

New CBS-HYTRON Germanium Diodes

Guaranteed Moisture-Proof!



Mechanical Specifications

A. .020" copper-clad wire
B. Nickel-silver "clip-in" pin
C. Glass-filled plastic case
D. Germanium crystal soldered directly to base
E. .005" tungsten cat whisker
F. Moisture-resistant impregnating wax

GENERAL PURPOSE TYPES

1N48
1N51
1N52
1N63
1N64
1N65
1N69*
1N70*
1N75
1N81*

*JAN TYPES

WHY CBS-HYTRON GERMANIUM DIODES ARE BETTER RECTIFIERS

1. ***MOISTURE-PROOF*** . . . eliminates humidity and contamination problems
2. ***SELF-HEALING*** . . . self-recuperating from temporary overloads
3. ***SUBMINIATURIZED*** . . . only ½ inch long, ¼ inch in diameter
4. ***SOLDERED WAFER*** . . . omission of plating eliminates flaking
5. ***LOW SHUNT CAPACITY*** . . . 0.8 $\mu\mu$fd average
6. ***SELF-INSULATING CASE*** . . . mounts as easily as a resistor
7. ***EXCEPTIONAL LIFE*** . . . 10,000 hours minimum under rated conditions
8. ***NO FILAMENTS*** . . . low drain, no hum

Vital germanium wafer in a CBS-Hytron diode is *guaranteed moisture-proof*. Sealed against deadly moisture . . . fumes . . . and contamination, a CBS-Hytron diode keeps moisture where it belongs . . . out! First, by a chemically and electrically inert impregnating wax. Second, by a glass-filled phenolic case. With *moisture-proof* CBS-Hytron germanium diodes, you can be sure of maximum trouble-free life.

Superior techniques also permit CBS-Hytron to omit plating of the germanium wafer. Soldering is directly to the base. Thus flaking is eliminated and quality improved. Universal design of CBS-Hytron diodes follows Joint Army-Navy specifications. "Clip-in" feature gives you versatility, ruggedness, and electrical stability. Flexible pigtails of copper-clad steel welded into sturdy nickel pins also insure you against damage by soldering heat.

Check the eight important-to-you reasons why CBS-Hytron *moisture-proof* germanium diodes are better rectifiers. Send today for complete data and interchangeability sheets. Specify CBS-Hytron *guaranteed moisture-proof* diodes for superior, trouble-free operation.

CBS HYTRON RADIO TUBES

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

SALEM, MASSACHUSETTS

Variable

BAND-PASS FILTERS

for

SELECTIVE AMPLIFICATION

★

KROHN-HITE

Models 310-A and 330-A

All Krohn-Hite Instruments fully guaranteed for one year against defective materials and workmanship. Prices net — f.o.b. Cambridge. *Write for free catalog.*

20 cps to 200 kc

Specifications Model 310-A

BAND WIDTH: Continuously variable up to the maximum width covering the entire range from 20 cps. to 200 kc.
FREQUENCY RANGE: High and low cut-off frequencies independently tuned, continuous from 20 cps. to 200 kc, in four decade bands.
FREQUENCY ACCURACY: Calibration ±10%.
GAIN: Unity (0 db) in pass band.
SLOPE: Each side 24 db/octave with peaking factor to reduce attenuation at the cut-off frequencies.
MAXIMUM ATTENUATION: Greater than 60 db.
INPUT CHARACTERISTICS:
IMPEDANCE: Approximately 6 megohms in parallel with 50 mmfd.
MAXIMUM INPUT AMPLITUDE: 5 volts rms.
OUTPUT CHARACTERISTICS:
IMPEDANCE: 500 ohms.
INTERNAL HUM AND NOISE: Less than 3 millivolts.
INPUT POWER: 105-125 volts, 50-60 cps, 40 watts.
FORM: Aluminum cabinet, overall dimensions: 12″ wide, 7″ high, 8″ deep. Weight 14 lbs.
PRICE: $275.00 Net, f.o.b. Cambridge, Mass.

.02 cps to 20 kc

Specifications Model 330-A

BAND WIDTH: Continuously variable up to the maximum width covering entire range: STANDARD MODEL: From 0.02 to 2,000 cps. MODIFIED UNIT: From 0.2 to 20,000 cps.
FREQUENCY RANGE: High and low cut-off frequencies independently tuned; continuous: STANDARD MODEL: From 0.02 to 2,000 cps. MODIFIED UNIT: From 0.2 to 20,000 cps.
FREQUENCY ACCURACY: Calibration ±5%.
GAIN: Unity (0 db) in pass band.
SLOPE: Each side, 24 db/octave with peaking factor to reduce attenuation at the cut-off frequencies.
MAXIMUM ATTENUATION: Greater than 80 db.
INPUT CHARACTERISTICS:
IMPEDANCE: Approximately 20 megohms in parallel with 200 mmfd.
MAXIMUM INPUT AMPLITUDE: 10 volts rms.
OUTPUT CHARACTERISTICS: IMPEDANCE: 500 ohms.
INTERNALLY GENERATED NOISE: 50 microvolts.
INPUT POWER: 105-125 volts, 50-60 cps, 50 watts.
PRICE: $450.00 Net, f.o.b. Cambridge, Mass.

KROHN-HITE INSTRUMENT COMPANY

580 MASSACHUSETTS AVENUE
DEPT. E, CAMBRIDGE 39, MASS., U.S.A.

OTHER INSTRUMENTS

FILTERS

Model	Type	Frequency Range	Noise & Hum	Price
310-A	Band-Pass	20 cps to 200 kc	3 mv	$275.00
330-A	Band-Pass	.02 cps to 2 kc	0.1 mv	$450.00
	Band-Pass	0.2 cps to 20 kc	0.1 mv	$450.00
340-A	Servo	.01 cps to 100 cps	10 mv	$350.00
350-A	Rejection	.02 cps to 2 kc	0.1 mv	$450.00
360-A	Rejection	20 cps to 200 kc	5 mv	$275.00

OSCILLATORS

Model	Frequency Range	Distortion	Output	Price
400-A	.009 cps to 1.1 kc	1%	25 mw/10 v	$350.00
400-C	.009 cps to 1.1 kc	1%	100 mw/10 v	$375.00
410-A	.02 cps to 20 kc	1/4%	10 mw/5 v	$950.00
420-A	.35 cps to 52 kc	1%	25 mw/10 v	$290.00
420-C	.35 cps to 52 kc	1%	100 mw/10 v	$325.00
430-A	5 cps to 520 kc	1%	50 mw/10 v	$145.00
440-A	.01 cps to 100 kc	1/10%	100 mw/10 v	$450.00

a *new* concept in

OSCILLOGRAPHY

the new **DU MONT**

Type 304-A

The new Du Mont Type 304-A, succeeding the world-famous Type 304-H, is more than simply a new instrument — more than a new combination of established circuits. It represents a significant development in the science of instrumentation. The Type 304-A is *a true electronic voltmeter*. This reflects a new concept in oscillography. Every feature of the Type 304-A has been evaluated with this concept in mind. All of the features that made the Type 304-H so valuable as a qualitative instrument have been preserved and augmented to enable not only qualitative analyses, *but rapid, accurate quantitative amplitude measurement* as well. The novel amplitude calibrating system of the Type 304-A permits signal measurements from the screen *directly in volts*. Unlike electro-mechanical devices, the new Type 304-A is not restricted to measurement of sinusoidal signals — or peak-to-peak values of voltage. The Type 304-A may be used to measure any amplitude portion of signals within its performance specifications.

SPECIFICATIONS:

CATHODE-RAY TUBE — New Flat-Face Type 5ADP-

ACCELERATING POTENTIAL — 3000 volts.

Y-AXIS: ***Deflection Factor*** — Through amplifier, 0.1 p-p volts FULL SCALE (equivalent to 0.025 p-p volt/inch). Direct, 32-39 p-p volts/inch.
Frequency Response — Direct coupling: flat to 0. Down not more than 10% at 100,000 cps. Capacitive Coupling: down not more than 10% at 10 and 100,000 cps. Down not more than 50% at 300,000 cps. Provision for balanced input on 0.1 VOLT-FULL-SCALE range.
Undistorted Deflection — More than 4 inches.
Expansion — Equivalent to 20 inches.
Input Impedance — *Amplifier:* (single ended) 2 megohms 50 μμf; (balanced) 2 megohms, 35 μμf. *Direct:* (single ended) 1.5 megohms, 20 μμf; (balanced) 3 megohms, 20 μμf.

X-AXIS: ***Deflection Factor*** — Through amplifier, 0.3 p-p volt/in. Direct, 40-50 p-p volt/in.
Frequency Response — Direct coupling: flat to 0. Down not more than 10% at 100,000 cps; down not more than 50% at 300,000 cps. Capacitive coupling: Down not more than 10% at 10 and 100,000 cps. Down not more than 50% at 300,000 cps.
Undistorted Deflection — More than 4 inches.
Expansion equivalent to 30 inches.
Input Impedance — *Amplifier:* 2.2 megohms, 50 μμf. *Direct:* (single ended) 1.5 megohms, 20 μμf; (balanced) 3 megohms, 20 μμf.

LINEAR SWEEPS: ***Sweep Frequency*** — Recurrent and driven sweeps continuously variable from 2 to 30,000 cps. Maximum sweep-writing-rate, 1"/μsec. Provision for sweeps of extra-long duration; ½ sec. of sweep obtained for each microfarad of external capacitance.
Synchronization — from signal of either polarity.
Sync Limiting — on both driven and recurrent sweeps.

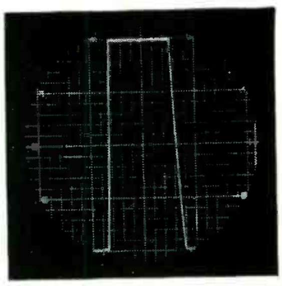
VOLTAGE MEASUREMENT — Squarewave standard applied for calibration by front panel push button.
Voltage Range: VOLTS FULL SCALE, 0 to 0.1, 1, 10, 100 volts.
MULTIPLIER: x1 to x10
Overall Accuracy: 5%

INTENSITY MODULATION — 15 volts blanks beam at normal intensity settings.

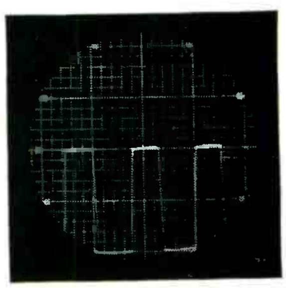
CALIBRATED SCALE — Variable illumination. Numbered calibrations for amplitude measurement.

PRIMARY POWER — 115 or 230 volts. 50-400 cps. 110 watts.

PHYSICAL CHARACTERISTICS — Metal cabinet with grey wrinkle finish. Dimensions: height 13½", width 8¼", depth 19½". Weight 50 lbs.



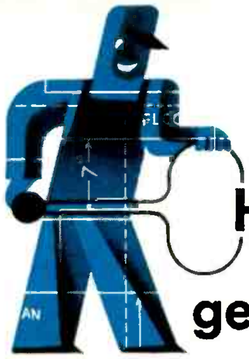
CALIBRATING the Type 304-A is as simple and easy as zeroing a vacuum-tube voltmeter. Depressing the CALIBRATOR push button on the front panel applies a square wave signal of precisely 0.1 p-p volt to the amplifier. The MULTIPLIER control is then adjusted for full scale deflection (4 inches) so that the peaks are at 0 and 100. Amplitude may now be read directly from the scale where four inches vertically indicate 0.1, 1, 10, or 100 volts, as determined by VOLTS FULL SCALE selector. Depressing the CALIBRATOR push button again, returns signal applied to Y-input terminals to the screen.



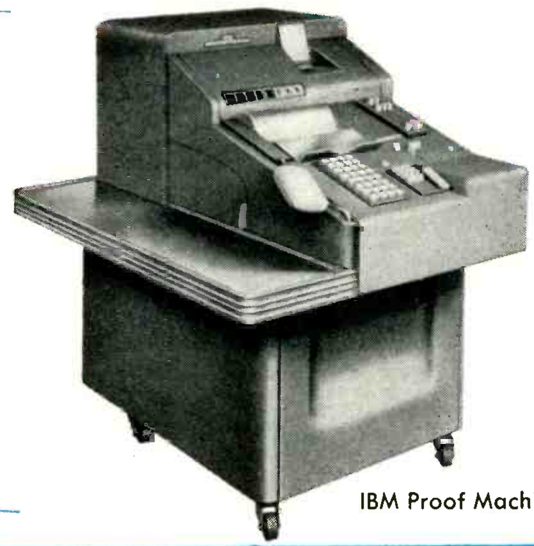
The MULTIPLIER control also permits calibration of the scale to other values. For, say, 200 volts-full-scale, the MULTIPLIER control is adjusted near 2 so peaks of squarewave are at zero and 50 on the scale. Amplitude may now be measured directly in volts simply by multiplying the scale reading by the setting of the MULTIPLIER control (2) and the VOLTS FULL SCALE setting (100). Use of the MULTIPLIER control extends the range of the Type 304-A to 1000 volts-full-scale.

DOMESTIC PRICE $333.00

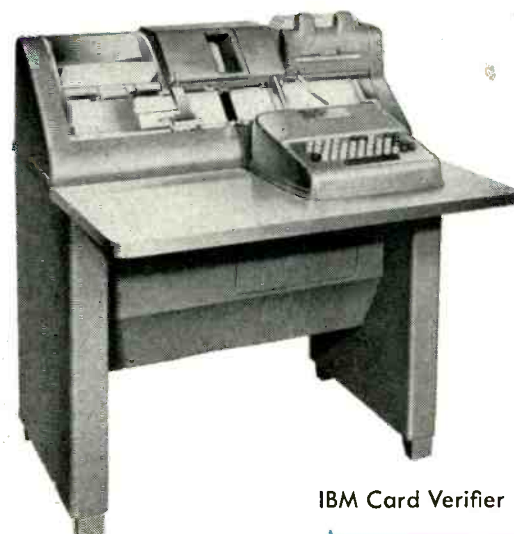
ALLEN B. DU MONT LABORATORIES, INC., INSTRUMENT DIVISION - 1500 MAIN AVENUE, CLIFTON, NEW JERSEY



How IBM gets perfection outside to match its precision inside



IBM Proof Machine



IBM Card Verifier

IBM business machines are known the world over for their precision. And they *look* the part, too.

But the modern lines which make these machines so attractive make their fabrication a challenge to Karp Metal Products Co., Inc., one of IBM's sheet metal fabricators.

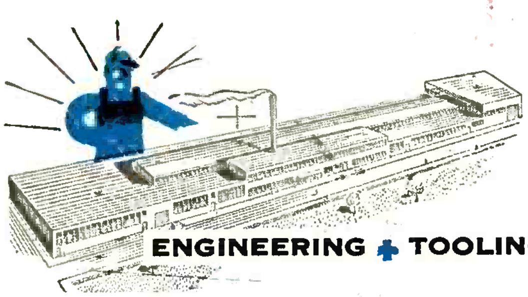
For only with its creative staff of sheet metal craftsmen...its ability to tool complex jobs...its 77,000 square feet of most modern plant facilities is Karp able to match IBM's precision inside with flawless fabrication outside.

These same facilities can solve *your* cabinet, housing or enclosure problems, too. Karp engineers can often show you the way to design modifications which cut initial costs and speed assembly; they can also show you how to take advantage of Karp's vast assortment of available dies.

Whether your needs are as large as IBM's or more moderate, you'll find it profitable to do business with Karp.

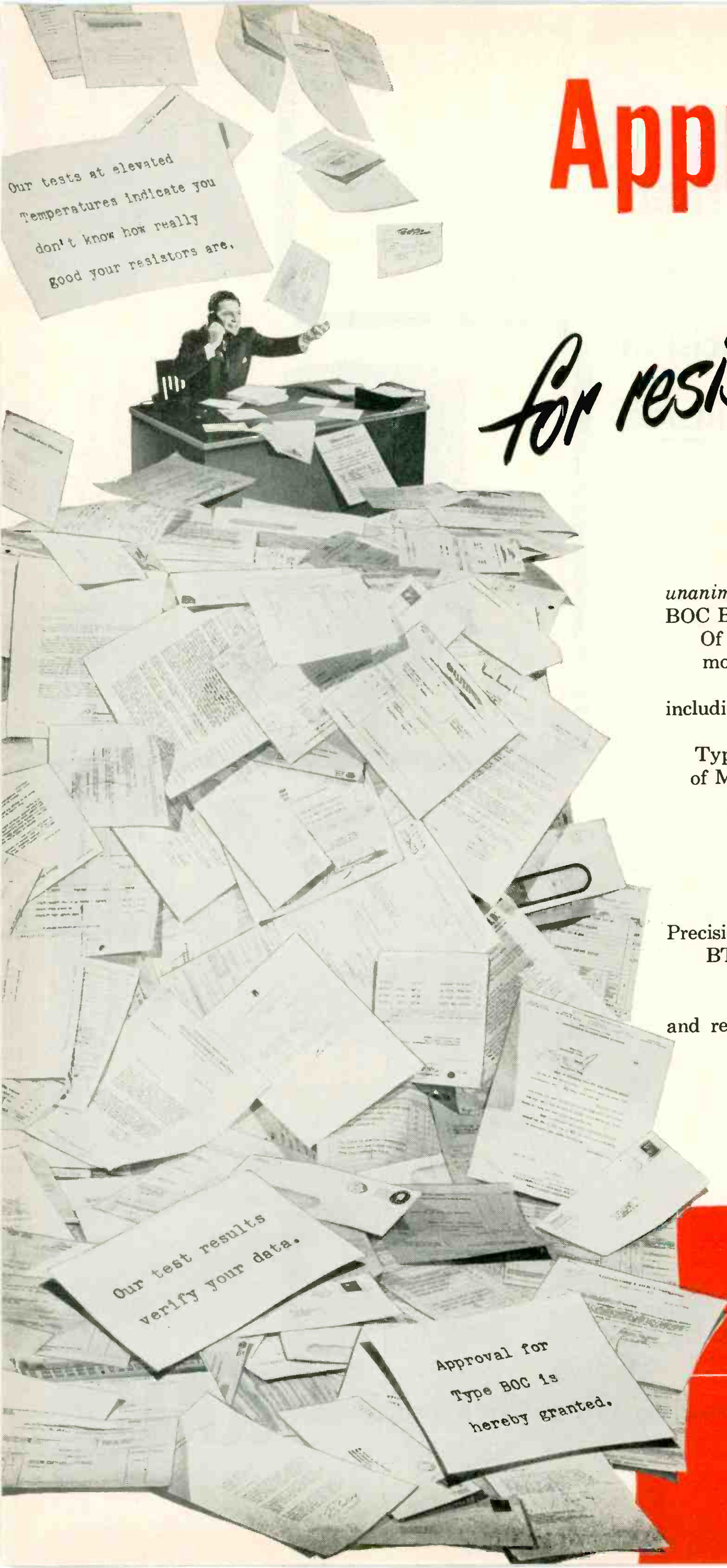
KARP METAL PRODUCTS CO., INC., 215 63rd ST., BROOKLYN 20, N. Y.

MOST COMPLETE FACILITIES FOR LARGE AND SMALL RUNS OF
ENGINEERED SHEET METAL FABRICATION



ENGINEERING + TOOLING + PRODUCTION + FINISHING = KARP

Approval is *for resistors too!*

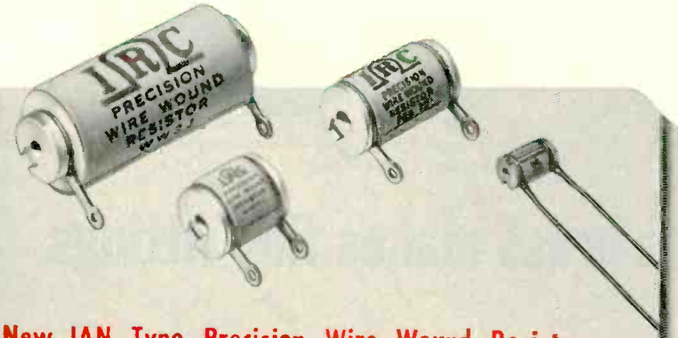


In all our experience, no resistor has been so extensively tested—*and so unanimously approved*—as IRC's new Type BOC Boron-Carbon ½-watt PRECISTOR. Of the 3,000,000 already manufactured, more than 100,000 were given the most stringent tests-in-production, including critical temperature cycling and 500-hour load-life tests. Result:—Type BOC conforms to *all* requirements of MIL-R-10509A! Also, customers have conducted their own laboratory and field tests—and they express their approval of Type BOC in letters like those shown here.

In the case of IRC's new JAN Type Precision Wire Wounds and Advanced Type BT Resistors, too, rigid quality control and continued testing have won industry-wide approval. Most stable and reliable of all precision wire wounds, Type WW's far surpass JAN-R-93 Characteristic B Specifications. And Type BT's continue to meet and beat JAN-R-11 Specifications.

IRC

important

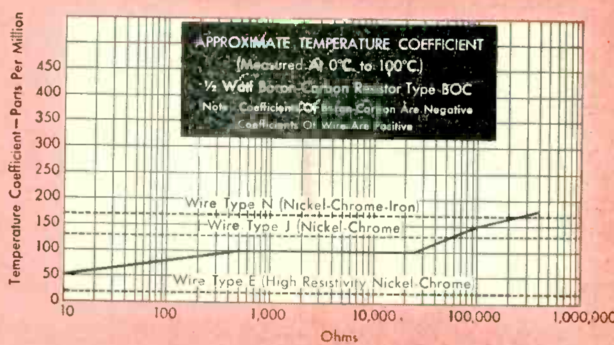


New JAN Type Precision Wire Wound Resistors Excel JAN-R-93 Characteristic B Specifications

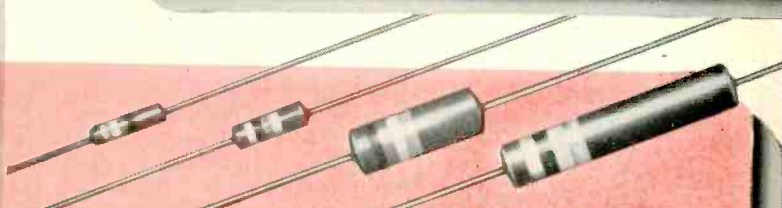
	Original Resist.	1st Cycle % Chge	2nd Cycle % Chge	3rd Cycle % Chge	4th Cycle % Chge	Resist at End of 100 hrs load	Total % Chge	% Chge from Last Temp Cycle to End of 100 hrs. load %	Resistance Chge at End of 100 Hrs Load only % (no cycling)	
1	100,010	+.04	+.04	+.05	+.05	100,050	+.04	—.01	100,040	—.02
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		

Most *reliable and stable* of all wire-wound precisions, these new Type WW's have proved their superiority in unbiased tests. Severe cycling and 100-hour load tests resulted in virtually zero changes in resistance. Other stringent tests proved JAN Type WW's high mechanical strength, freedom from shorting, resistance to high humidity. New winding forms—new winding technique—new type insulation—and new terminations assure long life, accuracy, ruggedness in service. IRC JAN Type WW's are becoming the choice of leading producers of military equipment. Get full technical data in Catalog Bulletin D-3.

Type BOC Boron-Carbon ½-Watt Resistor Surpasses Signal Corps Specification MIL-R-10509A



The ultimate in *stable, reliable* non-wire-wound resistors, Type BOC's are especially designed for military electronic equipment—radar, gunnery control, communications, telemetering, computing and service instruments. Greatly improved temperature coefficients of resistance permit their use in place of costlier wire wound precisions in many critical applications. Lower capacitive and inductive reactance suit them to circuits where wire-wound stability is needed. Small size makes them ideal in limited space. *Tolerance:*—1%, 2% and 5%. *Resistance Values:*—10 ohms to ½ megohm. Send for full technical data in Catalog Bulletin B-6.



Type BT Advanced Fixed Composition Resistors Meet and Beat JAN-R-11 Specifications

Type BTS Meets and Beats Rigid G Characteristic

These are the famous Advanced Type BT's whose characteristics set new performance records for fixed composition resistors. They combine a unique filament-type resistance element with exclusive construction features to assure extremely low operating temperature and excellent power dissipation. Yet they are compact, light in weight, fully insulated. Intensive tests by independent agencies have proved their superiority under actual field conditions. For full technical data, send for Catalog Bulletin B-1.

Boron-Carbon PRECISTORS • 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 • Selenium Rectifiers

Wherever the Circuit Says —⁄\/\/\—

INTERNATIONAL RESISTANCE COMPANY

403 N. Broad Street, Philadelphia 8, Pa.

In Canada: [illegible] Resistance Co., Ltd., Toronto, Licensee

Mail Coupon Today for Full Details of These IRC Resistors

INTERNATIONAL RESISTANCE COMPANY
403 N. Broad St., Philadelphia 8, Pa.

Please send me full data on the following checked items:—

- ☐ Type BOC Boron-Carbon PRECISTORS
- ☐ Type WW Precision Wire Wound Resistors
- ☐ Type BT Advanced Fixed Composition Resistors
- ☐ Name and Address of Nearest IRC Distributor

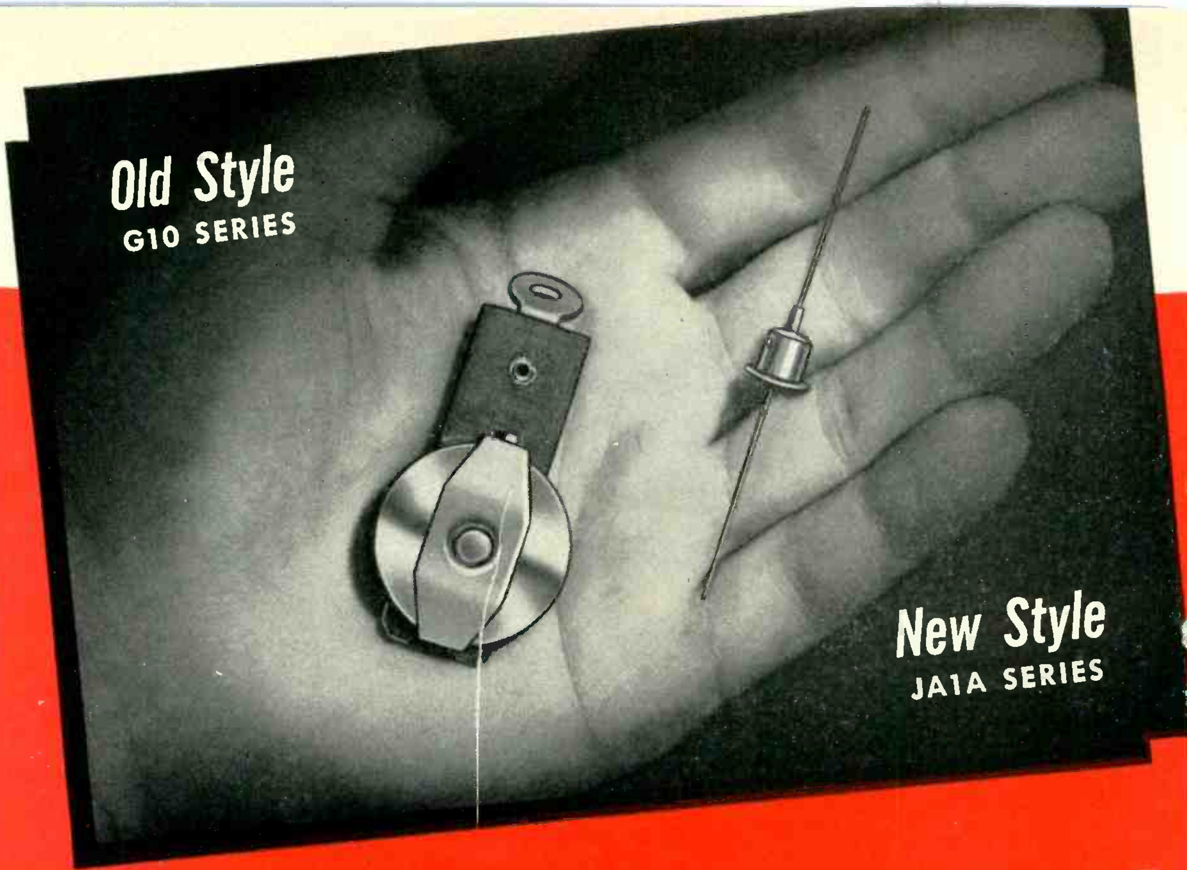
NAME ______________________

TITLE ______________________

COMPANY ______________________

ADDRESS ______________________

CITY ______________ ZONE ______ STATE ______



NEW IMPROVED G-E GERMANIUM

1. HERMETIC SEAL   **2. MINIATURE SIZE**

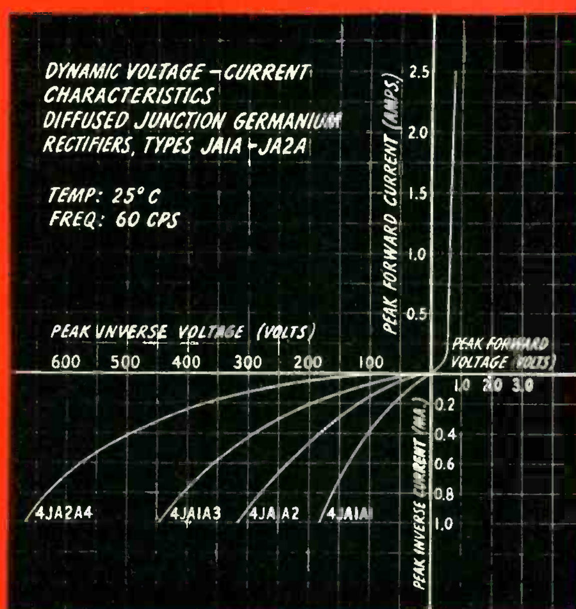
- **Hermetically Sealed** against deteriorating elements. Glass-to-metal seals throughout.
- **Miniature Size** to facilitate use in all electronic equipments, yet heat losses are dissipated efficiently.
- **Re-designed** to meet all military humidity tests and shock and vibration requirements.
- **High Output Voltage** and improved back current characteristics.

Model 4JA2A4 desgned for use in TV power supplies. DC output voltage 10 to 15 volts higher than with comparable selenium rectifiers in a typical voltage doubler circuit.

ABSOLUTE MAXIMUM RATINGS • T=25° C • RESISTIVE LOAD	4JA1A1	4JA1A2	4JA1A3	4JA2A4
PEAK INVERSE VOLTAGE (volts)*	100	200	300	400
PEAK FORWARD CURRENT (amps)*	0.5	0.5	0.5	1.3
D.C. OUTPUT CURRENT (Ma)*	150	150	150	400
D.C. SURGE CURRENT (amps)	25	25	25	25
FULL LOAD VOLTAGE DROP (volts)	0.6	0.6	0.6	0.7
OPERATING FREQ. (kc)	50	50	50	50

*Typical absolute maximum ratings. For other combinations refer to Fig. 1.

DIFFUSED JUNCTION RECTIFIER



Suggested Application Fields

Originally developed for military use, the new JA1A and JA2A Rectifiers may be adaptable to fields other than radar and military communications. Among them: Computers, magnetic amplifiers, TV receiver power supplies, telephone switchboards. Application information on other uses can be supplied. Write or wire us!

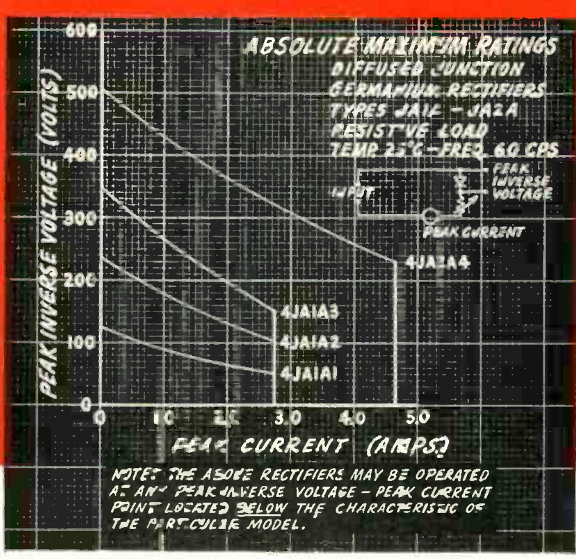
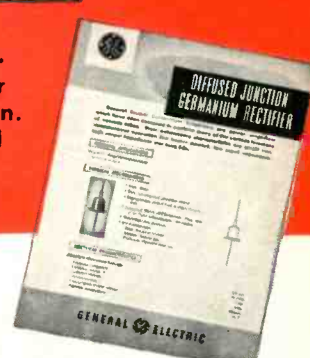
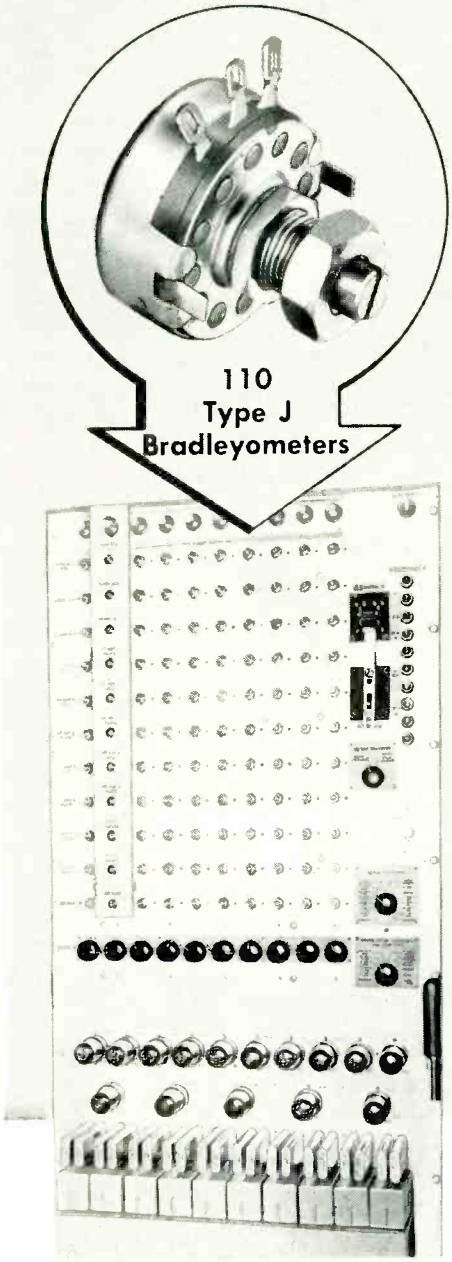


FIG. 1

NEW BULLETIN—Complete specifications on the diffused junction rectifier are contained in this illustrated bulletin. It's yours on request. Write: General Electric Company, Section 4112. Electronics Park, Syracuse, N. Y.

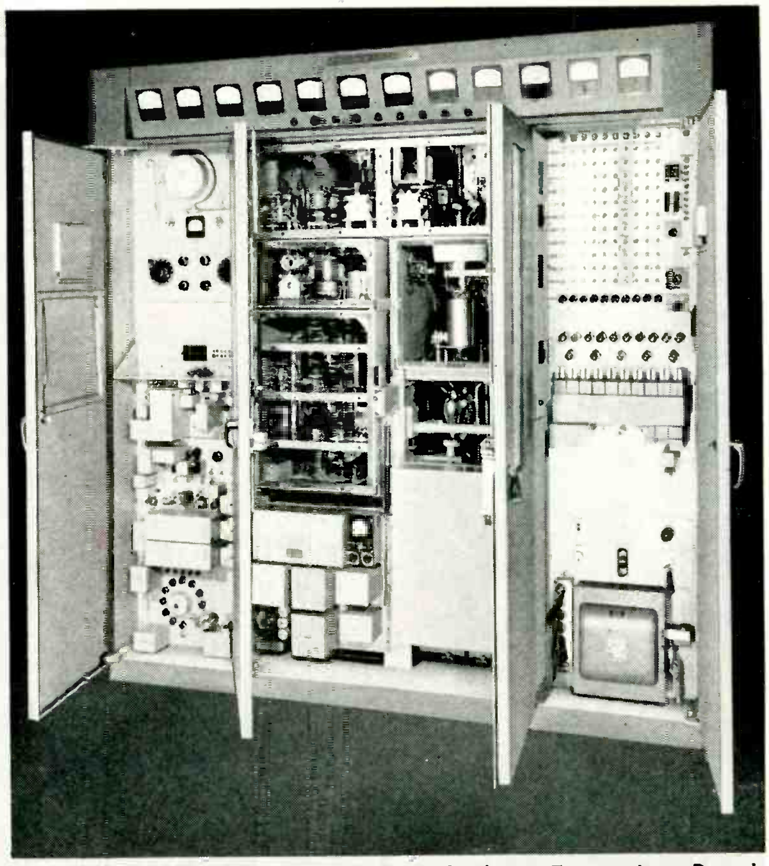




CLOSE-UP OF SERVO PANEL

The above panel contains 110 Allen-Bradley Type J potentiometers, each of which may be adjusted to meet transmitter operating requirements.

Type J Bradleyometers can be supplied in single, dual, or triple unit construction, with or without line switch.



Western Electric Overseas Radio Telephone Transmitter Panel

OVERSEAS TRANSMITTER has 110 Type J Bradleyometers

The Bradleyometers used in this Western Electric panel board assure stability of transmitter performance because the solid molded resistor elements of these Bradleyometers are not affected by heat, cold, moisture, or age. The contact brush, which actually improves with age, is always noiseless in operation.

Bradleyometers can be built to produce any resistance - rotation curve. During manufacture, the materials entering into the molded resistor can be varied in resistance throughout the circumference of the ring to meet your special electronic circuit requirements.

If you have a critical rheostat or potentiometer problem, be sure to investigate the Type J Bradleyometer.

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

ALLEN-BRADLEY

FIXED & ADJUSTABLE RADIO RESISTORS

Sold exclusively to manufacturers QUALITY of radio and electronic equipment

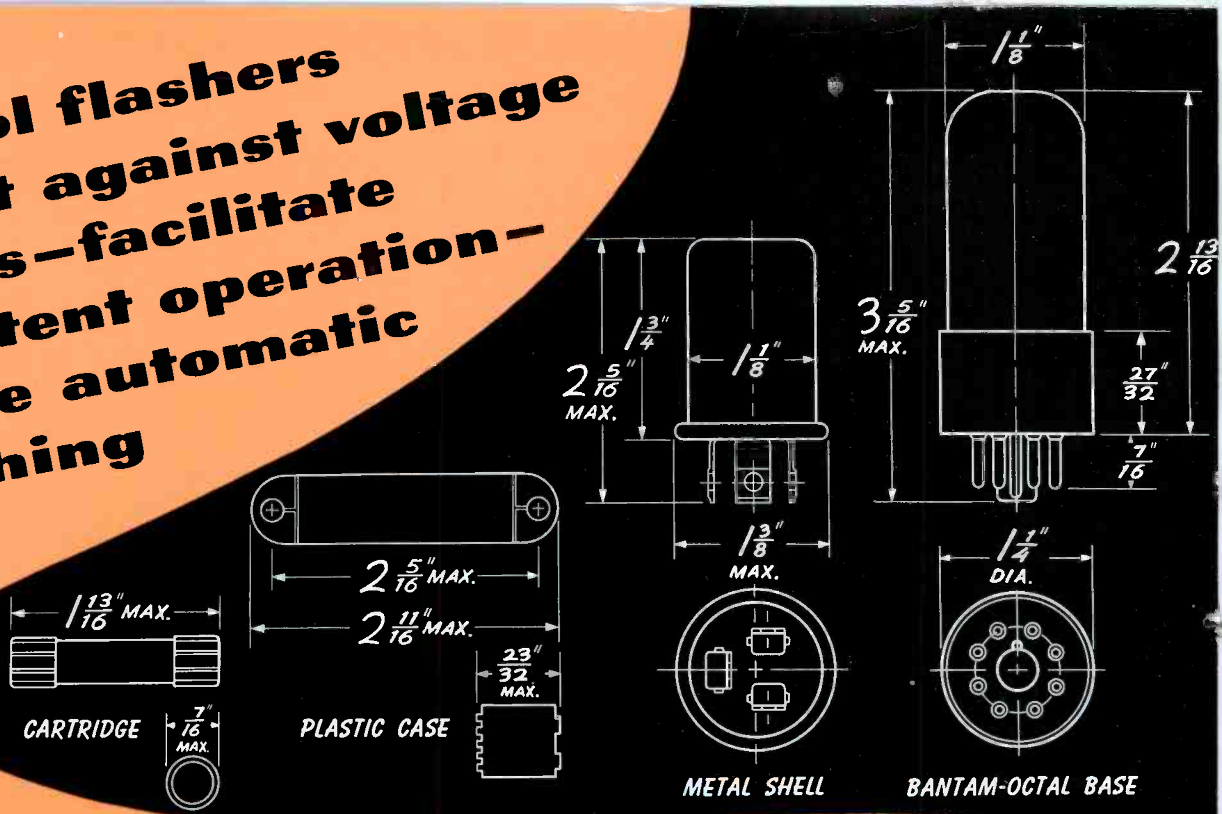
TUNG-SOL®

flashers

new,
low-cost
circuit control devices
for electronic equipment

see other side for additional information

Tung-Sol flashers protect against voltage overloads—facilitate intermittent operation—regulate automatic switching



"Flasher" is the automotive name for this Tung-Sol product. Actually, it is the most simplified, most reliable thermal-operated relay ever developed.

If you own an automobile made since 1939 and it has directional signals, then you have already witnessed first-hand the virtually unfailing performance of the Tung-Sol Flasher. Tucked away under the instrument panel, this tube-size mechanism makes the turn signal lights blink on and off.

After 13 years, the 13 million flashers in automotive use have demonstrated that this device usually outlasts the car it is on, and the average life of a car is 7 years! Tung-Sol Flashers not only are more reliable than conventional types of relays—they are more compact and they cost less.

Now then, where can you use a "circuit breaker" or "fuse" or "relay" in your electronic equipment?

As a circuit breaker? For this type of application, Tung-Sol Flashers are built with normally closed contacts. Under the effect of a short or overload, there is an almost instantaneous response and the contacts are opened. With equal rapidity the device cools and the contacts close. As long as the disturbance within the circuit exists the Flasher will continue automatically to sample the condition of the equipment, thus providing absolute safety against costly, damaging burn-out.

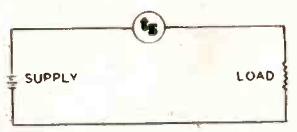
As a voltage limiter? When an overload surge raises voltage to a damaging level, the Tung-Sol Flasher will throw in a protective resistance. When the voltage returns to normal, the resistance is shorted out.

As a cycling control? Where it is desirable that equipment operate intermittently, the Flasher will cycle on and off at a predetermined rate.

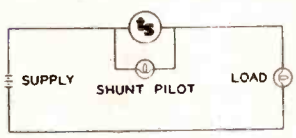
As a time delay relay? This type is non-operative until a given voltage or current is reached, when the Flasher will make contact and activate a switch.

As a warning device? Tung-Sol Flashers provide for visual or audible warning, as well as mechanical protection through use of a pilot light, horn, or siren which may be installed on the equipment or at a remote point.

The circuit protection, freedom from service interruptions and lower maintenance which you could offer your customers by installing Tung-Sol Flashers in the equipment you make, will certainly warrant your obtaining complete information. Our staff will be glad to work with your engineers. Write today.

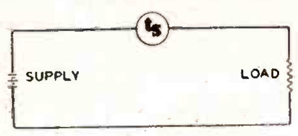


SINGLE CIRCUIT - SERIES ELEMENT

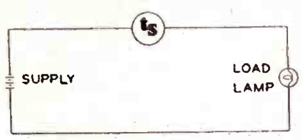


SINGLE CIRCUIT - SHUNT PILOT

TYPICAL SINGLE CIRCUIT FLASHER DIAGRAMS



SINGLE CIRCUIT - SHUNT ELEMENT



SINGLE CIRCUIT

FLASHERS FOR APPLICATIONS WITH VOLTAGES BETWEEN 3 and 32 VOLTS AC or DC.

LOAD	CARTRIDGE	PLASTIC CASE
150 ma.		627
175 ma.	606	
175 ma.		625
200 ma.		617
220 ma.		634
250 ma.		633
300 ma.		623
400 ma.		619
600 ma.		624
.05 amp 110V (6W lamp)	608	
.2 amp 110V (25W lamp)	607	
Switching relay		609

TUNG-SOL FLASHERS

TUNG-SOL ELECTRIC INC., Newark 4, New Jersey

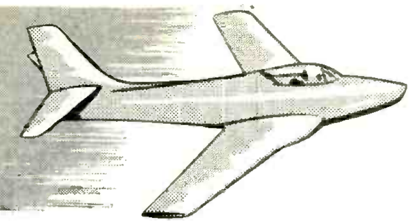
Sales Offices: Atlanta, Chicago, Culver City, Dallas, Denver, Detroit, Newark, Philadelphia

TUNG-SOL makes: All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes.

NOVEMBER, 1952

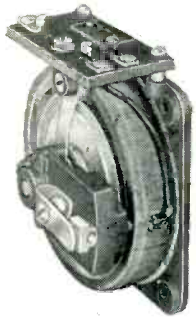
A COMPLETE

STANDARD LINE

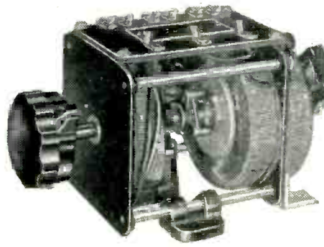


MIDGET FRAME SIZE—OPEN TYPE FOR 28 VOLT, 400 CYCLES, SINGLE PHASE DUTY; 0-28 VOLTS, 4 AMPS. OUTPUT

1 KVA FRAME SIZE—OPEN TYPE FOR 115 VOLTS, 400/800 CYCLES, SINGLE PHASE SERVICE; 0-115 VOLTS, 3.0 AMPS. OUTPUT

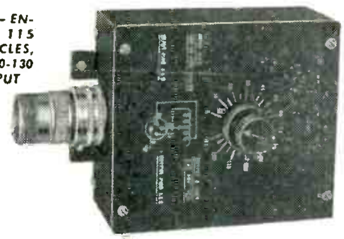


1 KVA FRAME SIZE—OPEN TYPE FOR 230 VOLTS, 400/800 CYCLES, THREE PHASE DUTY; 0-230 VOLTS, 3.0 AMPS. OUTPUT



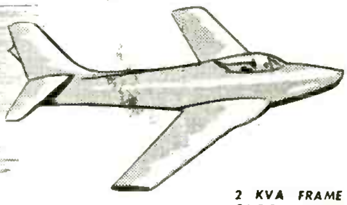
MIDGET FRAME SIZE — ENCLOSED TYPE FOR 120 VOLTS, 400 CYCLES, SINGLE PHASE DUTY; 0-120 VOLTS, 1.0 AMPS. OUTPUT

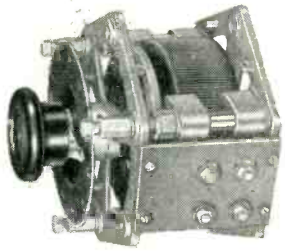
1 KVA FRAME SIZE — ENCLOSED TYPE FOR 115 VOLTS, 380/1600 CYCLES, SINGLE PHASE INPUT; 0-130 VOLTS, 4.0 AMPS. OUTPUT



POWERSTAT

Variable Transformers

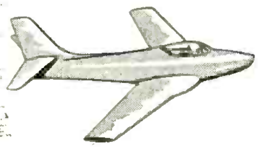




2 KVA FRAME SIZE — ENCLOSED TYPE FOR 115 VOLTS, 400/800 CYCLES, SINGLE PHASE INPUT; 0-130 VOLTS, 15 AMPS. OUTPUT

FOR 400-800 CYCLE OPERATION

... SHIPBOARD, AIRBORNE, GROUND, MOBILE EQUIPMENT WHERE SPACE AND WEIGHT SAVINGS ARE VITAL



THREE BASIC FRAME SIZES

MIDGET	1 KVA	2 KVA
ENCLOSED AND OPEN CONSTRUCTION IN RATINGS UP TO 1/2 KVA	ENCLOSED AND OPEN CONSTRUCTION IN RATINGS UP TO 1-1/2 KVA	ENCLOSED AND OPEN CONSTRUCTION IN RATINGS UP TO 2-1/2 KVA

Weight and space must be conserved in shipboard, airborne and allied equipment for national defense needs. By operating electrical apparatus at 400 cycles and higher frequencies, this is accomplished. Since variable transformers are a necessary component in much of this equipment, a complete standard line of POWERSTAT variable transformers is now available. A wide range of types is offered to meet BU Air, BU Ships, Air Corps and Signal Corps specifications. Standard types are built to fulfill the demands of adverse operating conditions including excessive shock, vibration, bounce; high humidity; low and high ambient temperatures.

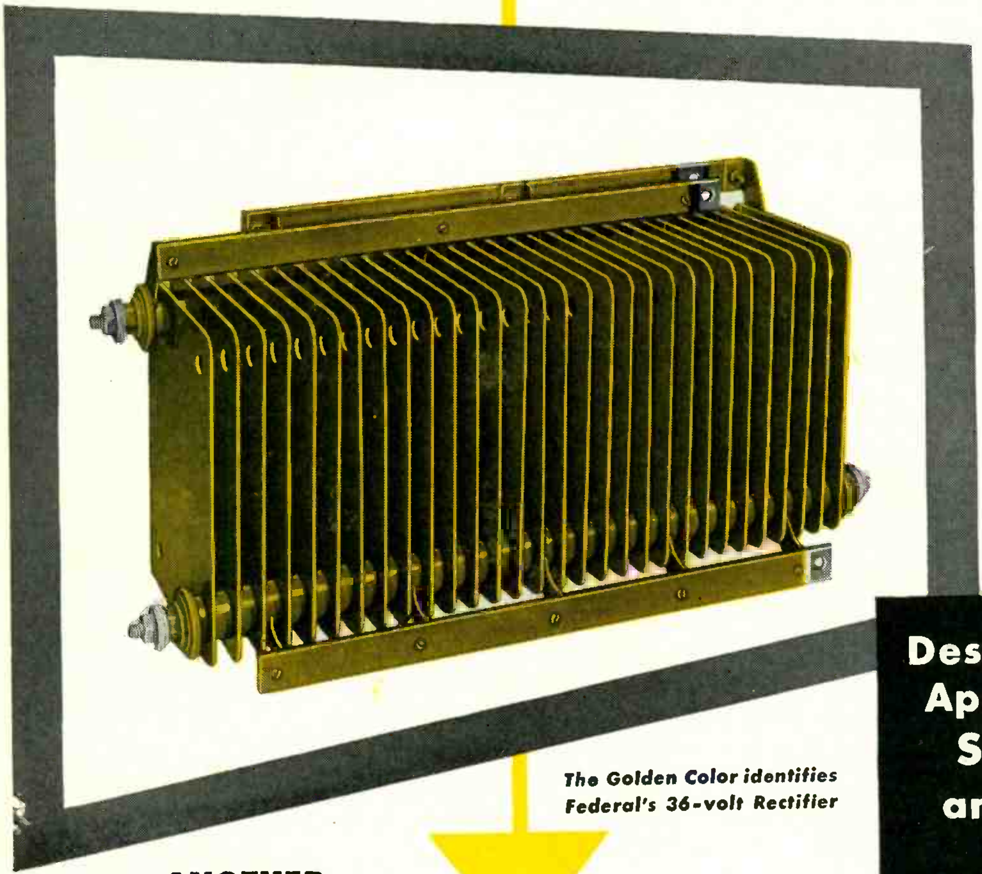
Standard types are described in Bulletin P552H. Send for your copy today. If a standard assembly does not meet your exacting requirements, our engineering department will work with you to build a POWERSTAT to your specifications.

WRITE TO:
211 THURE AVENUE,
BRISTOL, CONNECTICUT

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

• STABILINE AUTOMATIC VOLTAGE REGULATORS • POWERSTAT VARIABLE TRANSFORMERS • VARICELL D-C POWER SUPPLIES • VOLTBOX A-C POWER SUPPLIES • SUPERIOR 5-WAY BINDING POSTS • POWERSTAT LIGHT DIMMING EQUIPMENT

Announcing the NEW *Federal* SELENIUM RECTIFIER... with 36 VOLT (RMS) CELLS



The Golden Color identifies Federal's 36-volt Rectifier

Designed for Special Applications where SIZE—WEIGHT and EFFICIENCY are TOP CONSIDERATIONS

ANOTHER *Federal* CONTRIBUTION

- **Fewer plates**
- **Lighter weight**
- **Smaller size**
- **Greater Over-all Efficiency**
- **Dependable "Federal Performance"**

HERE'S THE ANSWER to your selenium rectifier stack requirements . . . for applications where *space* is at a premium . . . where *weight* is of prime importance. This is the ideal rectifier for many military end-use equipments . . . for aircraft . . . for compact, portable units.

Developed by America's *first* manufacturer of selenium rectifiers, you can depend on its quality, efficiency and economy.

Wherever you need DC from an AC source—look to Federal . . . *from milliwatts to kilowatts!* For details on Federal's new 36-volt rectifier cells of various sizes—or any other DC power requirement—write to Dept. F-113.

America's oldest and largest manufacturer of selenium rectifiers

Federal Telephone and Radio Corporation

SELENIUM-INTELIN DIVISION
100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

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

Ready for Your Circuit

Basic Foundation Components, Plug in, Connecting, Fastening Devices for the

ELECTRONIC CONTROL INDUSTRY

Making it possible to build quickly any electronic circuit into practical production design (you supply the circuit — we supply the components).

— by giving you basic components of tremendous flexibility which simplify layout time in production of your equipment.

— by providing you a technique to solve mechanical, space, connecting, interconnecting, fastening, sensing and indicating problems for you.

Giving you equipment that is easy to operate and maintain

— so that — with spares — your equipment never needs to be out of operation more than 30 seconds.

— so that non-technical personnel can set up, operate and maintain your equipment.

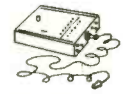
Suggestion to your Lab or Research Dept.

Numerous labs have seen the advantage of using Alden's components to build the particular pet circuits needed for the experimental or test circuits that they use over and over. It may be an assortment of unitized, plug-in power supplies, amplifiers, oscillators, modulators, connecting circuits, etc., to handle 'most any problem of research and experiment. With these on your shelf ready to plug in, you avoid using experimentally models that are completely unlike anything you'd use finally on equipment. Instead, you're using right from scratch units which illustrate directly what your final systems will be like: meeting production standards, servicing standards, appearance standards.

WORKING WITH "ALDEN'S HANDBOOK", THE DESIGN ENGINEER AUTOMATICALLY CREATES *PRACTICAL PRODUCTION DESIGN*, as follows —

1. **Anything electrical or electronic usually operates with an *outside* source of power and may be connected to outside circuits.** So Alden provides for this with the efficient Detachable Line Cord for bringing in 110V AC power. Available in lengths to your specs for making a neat connection. Sure grip plug is self-piloting for quick mating.

   SEE "ALDEN HANDBOOK" PAGES 4A & B FOR COMPLETE DETAILS

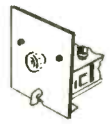


Avoid floorful of over-length cords.

Avoid midget cords that compel added extension cords.

2. **A great deal of equipment will have a front panel with such things as sensing controls, jacks for testing and fuseholders.** For this Alden provides a basic slide-in chassis with a detachable front and back panel so that rheostats, indicator lights, test jacks, interwiring, etc. are all easy-to-work subassembly operations.

   SEE "ALDEN HANDBOOK" PAGES PI-1E thru G FOR COMPLETE DETAILS



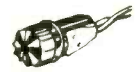
Front panel (various sizes) carries controls, indicators, sensing elements, with their interwiring.

Detachable front panel hinged giving accessibility for ease of assembly and servicing.

3. **Sensing Units — telltales that all is well or not — in simple indicator light — fuse holders that glow when blown — memory or pulse circuits including Static Magnetic Memory that sense — or command — or keep on repeating so that units or elements almost assume brain functions.**

   SEE "ALDEN HANDBOOK" PAGES ES-5A & B; DL-5A & B; TE-3A & B; CG — all pages

Fuses that indicate when blown.



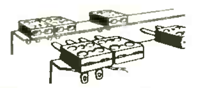
Indicator lamps always easily replaced so always functioning.

Insulated test point jacks for plate voltages up to 6,000V.

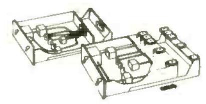
Plug-in Memory or Pulse Circuits.

4. **The telephone, telegraph, electric light companies have always brought the incoming circuits to a bus bar or terminal board so that the *incoming circuits could always be checked at one point* — and equipment connected not being condemned because of imperfect outside circuits.** So Alden provides in its Back Connectors and supporting Back Plates the one area in which all incoming circuits can be checked.

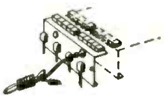
   SEE "ALDEN HANDBOOK" PAGES PI-2A & B; 4D FOR COMPLETE DETAILS



Alden Back Connectors, color coded, with accessible unconjested solder terminals — permit easy servicing and rapid circuit checks at central point.



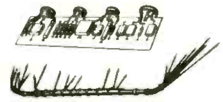
Back Connectors permit direct efficient wiring — avoid conventional rat's nest wiring.



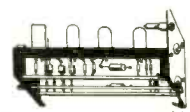
Back Connectors mount on Back Plate to give one point to check all chassis connections.

5. **The next problem is to house the components and have them do the electrical or electronic work required.** Any such circuitry will have certain main functions and branching from it other functions. Many of these functions can be layered—so circuits go direct from back connector to front panel. Alden provides: simple component mounting panels for putting any circuit in layers. (And incidentally such component panel simplify the thinking, should the circuits give sufficient volume to be printed.) So Alden has the Terminal Panel Boards to make equipment easy to lay out by putting any function in one plane—plus the unit cables of correct lengths with stripped ends ready for interconnecting the Terminal Panels.

   SEE "ALDEN HANDBOOK" PAGES PI-1B thru D FOR COMPLETE DETAILS



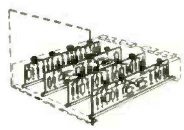
Terminal Panel Board with all components mounted in one plane, and Alden Unit Cable for interconnecting all panel elements with leads.



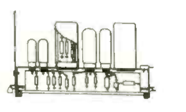
Layering of circuits using Alden Terminal Panels to segregate each main function and associate elements in one plane—for ease of assembly and check.

6. **Not all circuits can be a simple, straight circuit from back connector to front panel because there are auxiliary functions and branches that have to be in the main functions.** The usual chassis carries tubes, transformers and components that rise vertically from the chassis, often leaving vacant spaces. In these spaces can be placed the plug-in units which have these secondary circuits; using the plug-in technique usually removes the congestion of the wiring below the chassis, provides automatically for shielding and heat dispersion and yet gives you largest amount possible circuitry per cubic space, the circuits free from interaction.

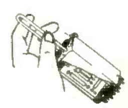
   SEE "ALDEN HANDBOOK" PAGES PI-1A thru H FOR COMPLETE DETAILS



Massing of essential electronic elements yet with efficient heat dispersion and freedom from interaction, in a Basic Chassis.



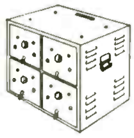
How Alden Terminal Panel groups main functions and how plug-in units have parallel functions for largest amount circuitry per cubic space.



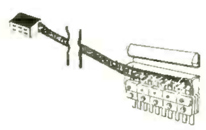
Alden "20" Packages house plug-in Units give independent shielding and heat dispersion.

7. **Again these techniques often lead to putting one function such as a power supply and amplifier on separate chassis and so the back connectors or the chassis itself may need interconnecting unit cables to either chassis or racks.** Alden provides sufficient variety of connectors to choose from—and designed so that any cable, no matter how involved, cannot be wrongly plugged in.

   SEE "ALDEN HANDBOOK" Sec. PC - Sec. MPS FOR COMPLETE DETAILS



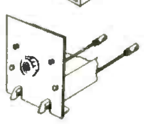
Separate chassis may be stacked in Alden Un-i-rack Cabinet. Cabinet can be interconnected within by Alden unit plug-in cables.



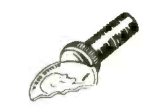
Alden Unit Cable — with variety of plug-in connectors. Carries wiring from chassis to chassis or rack to rack.

8. **To design so that no equipment — whether plug-in unit or slide-in chassis — needs to be out of operation for more than 30 seconds (having adequate spares on hand), Alden provides quick detaching and quick fastening devices for chassis.** The Serve-a-Unit locks that will move chassis against weight or the resistance of gaskets. There is the Target Screw (coin operated), a Tool-less screw—the Captive Screw which becomes part of the equipment.

   SEE "ALDEN HANDBOOK" PAGE PI-11 FOR COMPLETE DETAILS



A turn of the Serv-a-Unit Lock handle—located in front panel — draws in unit against pressure—reverse turn ejects.

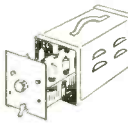


Alden Target Screw The Toolless Screw

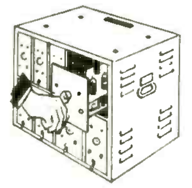
The Captive Screw, never lost.

9. **Government designers and those in the electronic control industry want elements of equipment so that they can be portably operated or tested, can be carried by one man with spares, parts easily sent by mail or airborne and also prefer that the same design equipment can be used in conventional racks.** Those designing for field operation use, at sea, prefer to have the equipment so it can be unloaded by two people, set up and immediately interconnected. This is provided by the Alden Basic Chassis using Back Connectors, Unit Cables and for the last purpose, the Uni-Rack which can be set on top of one another and immediately interconnected with each other.

   SEE "ALDEN HANDBOOK" PAGE PI-11 FOR COMPLETE DETAILS



Chassis in carrying or serviceman's case or case to house spare.



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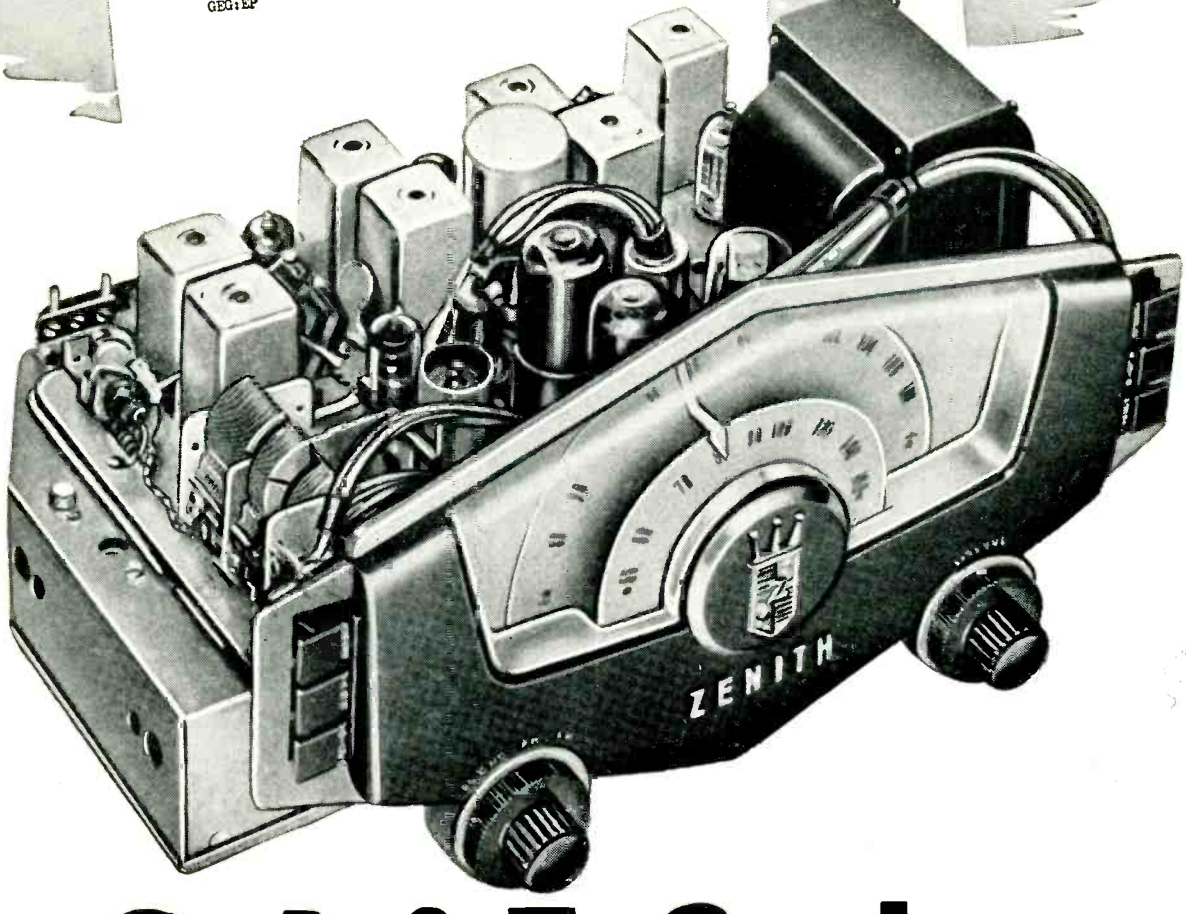
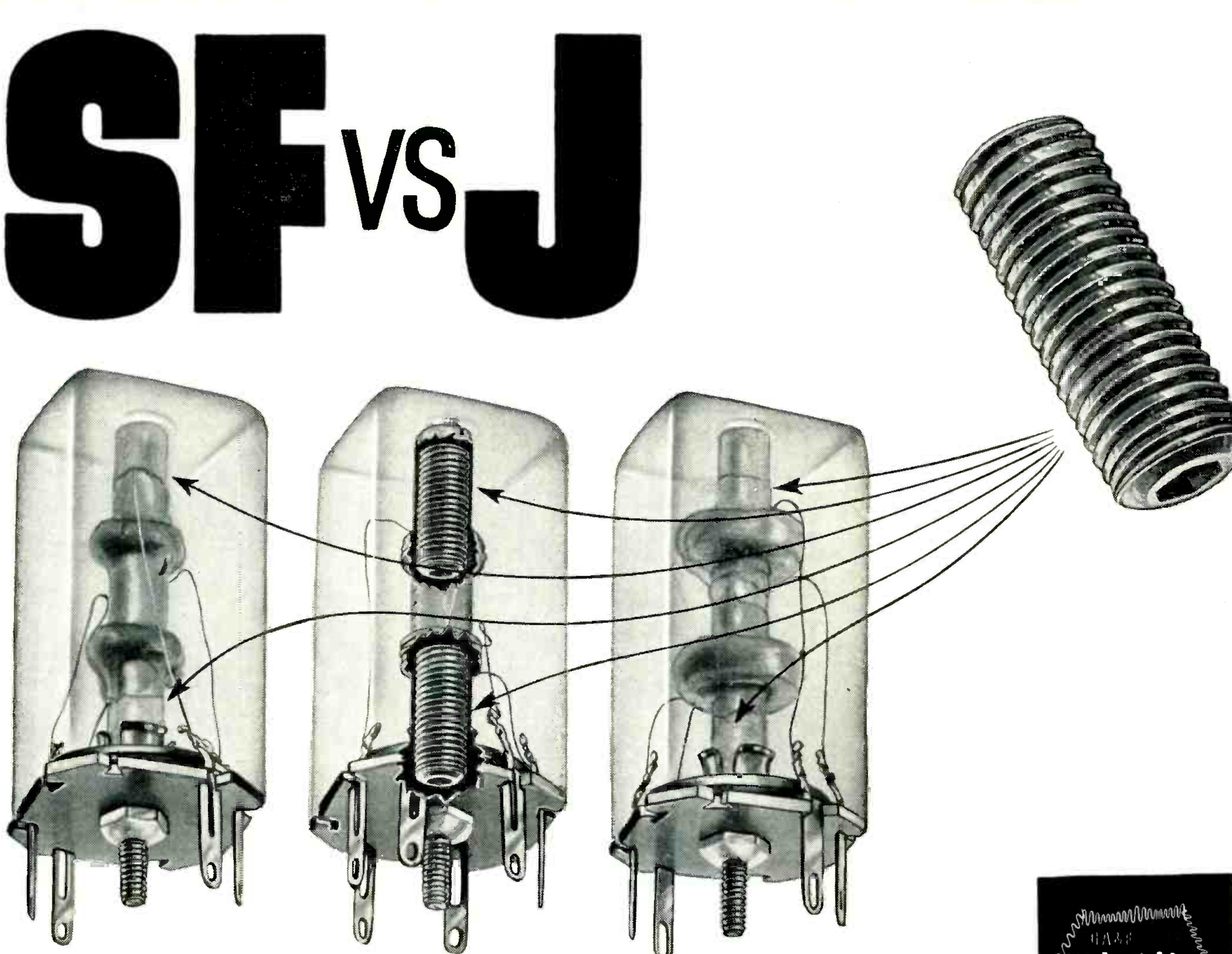


G A & F® Carbonyl

SF VS J



G A & F Carbonyl Iron Powders are used to produce cores for transformer and inductor coils of every form—to increase Q values, to vary coil inductances, to reduce the size of coils, to confine stray fields and to increase transformer coupling factors.

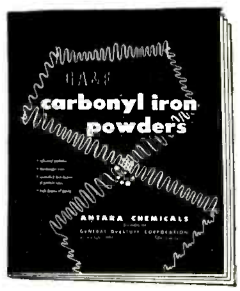
For use in TV and in Radio, including FM, the extremely small size of the particles is of enormous value, since eddy currents develop only within each particle—proportional to the square of the particle diameter. In core-making, the particles are insulated from each other by coating them, before compounding, with an efficient insulating agent.

These powders are microscopic, almost perfect spheres of extremely pure iron. They are produced in seven carefully controlled types, ranging in average particle-size from three to twenty microns in diameter.

Similarly, their properties vary, making them useful in many different applications. Engineers have commented on the fact that cores made from these powders lend themselves to smoothness of adjustment and to ease of grinding. The new Ferromagnetic Powder "J" was designed for high Q cored coils at VHF. At high frequencies, it has the lowest losses for its relatively high permeability.

* * *

We are proud to serve the Zenith Radio Corporation . . . 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.



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 33.

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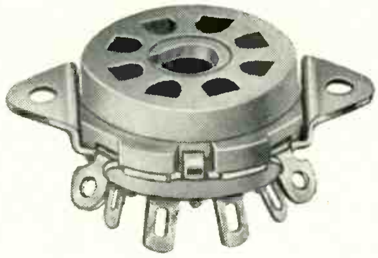
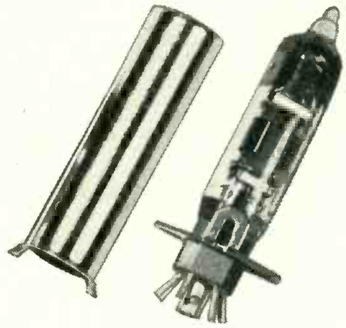
JAN OCTAL TUBE SOCKETS

Saddles of these sockets are nickel plated brass, either top or bottom mounted, with or without ground lugs. Body and contacts are of the same materials as the JAN miniature tube sockets. Contact tabs and saddle ground lugs are hot tin dipped.



JAN 7- AND 9-PIN MINIATURE TUBE SOCKETS

These sockets are available in grade L-4B or better ceramic, or type MFE low loss plastic. The contacts are either phosphor bronze or beryllium copper, silver plated. Contacts and center shield tab are hot tin dipped. Nickel plated brass shields equipped with sturdy springs are available for all 7- and 9-pin sockets.



BUTTON TYPE SUBMINIATURE (T3) TUBE SOCKETS

These sockets are available for round 8-pin subminiature tube types. Insulation is type MFE low loss plastic and contacts are beryllium copper silver plated with gold flash covering. Contacts especially designed for positive connection and high pin retention even after many insertions. Sockets are of rugged construction for long life.

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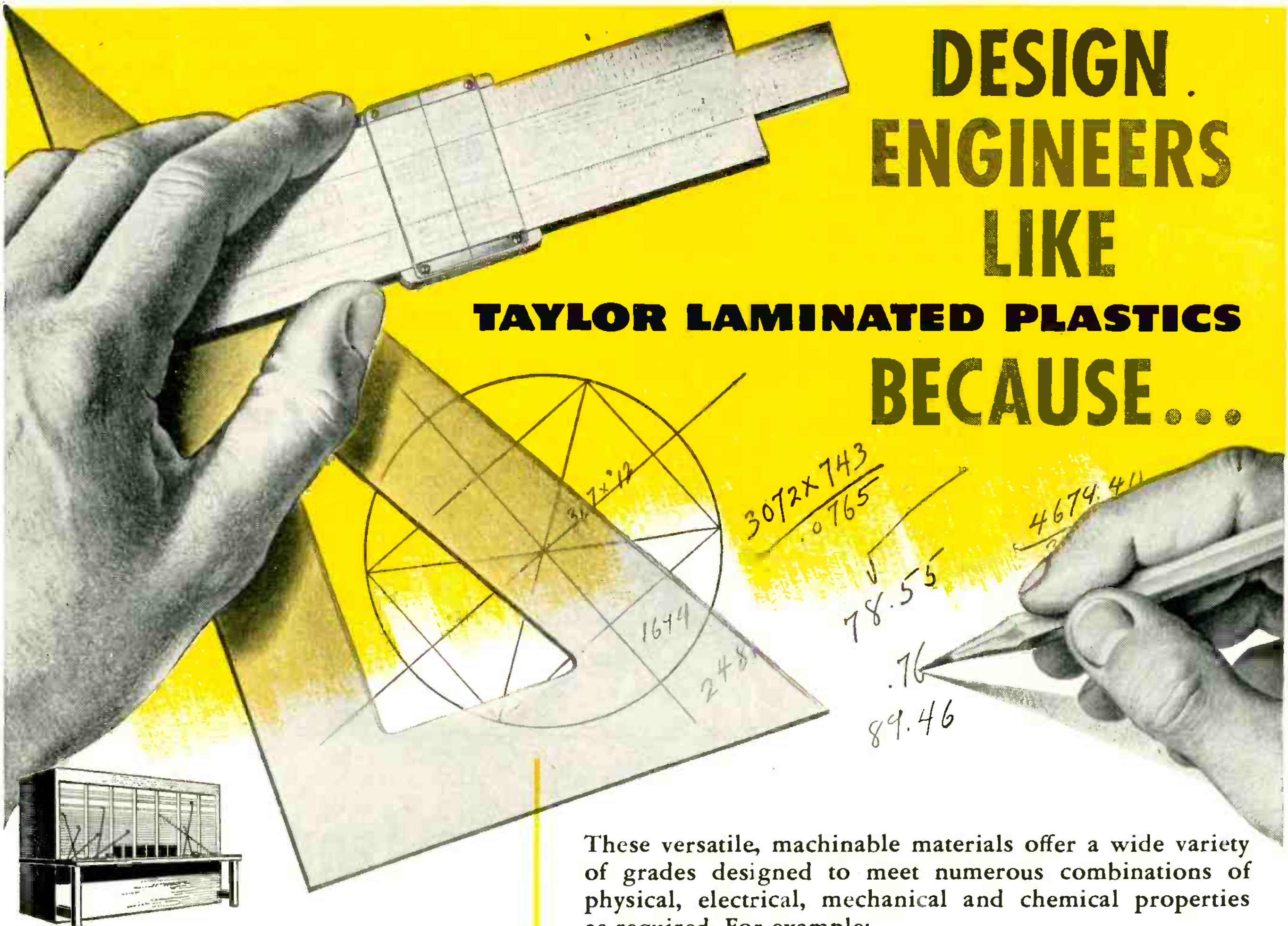

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TYPE 252, JAN-R-19, Type RA20

2 watt, 1 17/64" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19. Attached Switch can be supplied.

Resistance	RA20, JAN Shaft Type SD CTS Part	RA20, JAN Shaft Type SD JAN-R-19 TYPE	RA20 High Torque, JAN Shaft Type SD CTS Part	RA20 High Torque, JAN Shaft Type SD JAN-R-19 TYPE
50±10%	B8079	RA20A1SD500AK	X3496	RA20A2SD500AK
100±10%	W6929	RA20A1SD101AK	L9388	RA20A2SD101AK
250±10%	X3497	RA20A1SD251AK	M9879	RA20A2SD251AK
500±10%	W6931	RA20A1SD501AK	X3498	RA20A2SD501AK
1000±10%	W6932	RA20A1SD102AK	X3499	RA20A2SD102AK
1500±10%	W6933	RA20A1SD152AK	M9809	RA20A2SD152AK
2500±10%	W6934	RA20A1SD252AK	L9103	RA20A2SD252AK
5000±10%	W6935	RA20A1SD502AK	L9104	RA20A2SD502AK
10,000±10%	W6936	RA20A1SD103AK	H8979	RA20A2SD103AK

TYPE 25, JAN-R-19, Type RA30 (May also be used as Type RA25)

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.

Resistance	RA30, JAN Shaft Type SD CTS Part	RA30, JAN Shaft Type SD JAN-R-19 TYPE	RA30 High Torque, JAN Shaft Type SD CTS Part	RA30 High Torque, JAN Shaft Type SD JAN-R-19 TYPE
50±10%	X3502	RA30A1SD500AK	W2837	RA30A2SD500AK
100±10%	X3503	RA30A1SD101AK	X3504	RA30A2SD101AK
250±10%	X3505	RA30A1SD251AK	X3506	RA30A2SD251AK
500±10%	X3507	RA30A1SD501AK	M7566	RA30A2SD501AK
1000±10%	X3508	RA30A1SD102AK	S2444	RA30A2SD102AK
1500±10%	X3509	RA30A1SD152AK	X3510	RA30A2SD152AK
2500±10%	X3511	RA30A1SD252AK	S2736	RA30A2SD252AK
5000±10%	Q1409	RA30A1SD502AK	X3512	RA30A2SD502AK
10,000±10%	X3513	RA30A1SD103AK	R1561	RA30A2SD103AK
15,000±10%	X3514	RA30A1SD153AK	L9107	RA30A2SD153AK

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167 types

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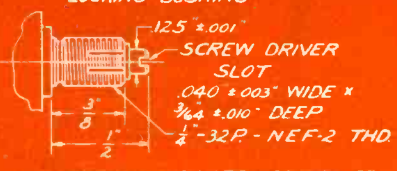
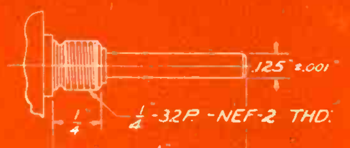
CTS SHAFT TYPE LT-2

LOCKING BUSHING



MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT 3/8 HEX x 3/32
LOCK NUT 3/8 HEX x 1/8
LOCK WASHER #1914A

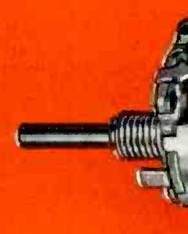
CTS SHAFT TYPE RE



MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT 3/8 HEX x 3/32
LOCK WASHER #1914A

TYPE 65

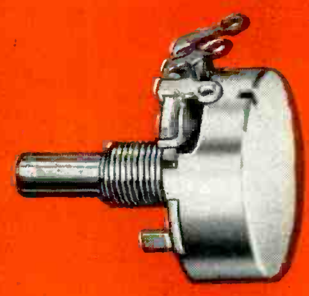
½ watt 70° C, ¾″ diameter miniaturized variable composition resistor.



Resistance	CTS Part CTS Shaft Type RE	CTS Part Locking Bushing CTS Shaft Type LT-2
250±10%	X3516	X3530
500±10%	X3517	X3531
1000±10%	X3518	X3532
2500±10%	X3519	X3533
5000±10%	X3520	X3534
10,000±10%	X3521	X3535
25,000±10%	X3522	X3536
50,000±10%	X3523	X3537
100,000±10%	X3524	X3538
250,000±10%	X3525	X3539
500,000±10%	X3526	X3540
1 Meg±20%	X3527	X3541
2.5 Meg±25%	X3528	X3542

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.



Resistance	JAN-R-94 TYPE RV4 JAN Shaft Type SD	JAN-R-94 TYPE RV4 JAN Shaft Type RJ	CTS Part Non-JAN Locking Bushing CTS Shaft Type LT-1
100±10%	RV4ATSD101A	RV4ATRJ101A	W3160
250±10%	RV4ATSD251A	RV4ATRJ251A	W3161
500±10%	RV4ATSD501A	RV4ATRJ501A	W3162
1000±10%	RV4ATSD102A	RV4ATRJ102A	W3166
2500±10%	RV4ATSD252A	RV4ATRJ252A	W3163
5000±10%	RV4ATSD502A	RV4ATRJ502A	W3164
10,000±10%	RV4ATSD103A	RV4ATRJ103A	W3167
25,000±10%	RV4ATSD253A	RV4ATRJ253A	W3168
50,000±10%	RV4ATSD503A	RV4ATRJ503A	W3169
100,000±10%	RV4ATSD104A	RV4ATRJ104A	W3170
250,000±10%	RV4ATSD254A	RV4ATRJ254A	W3171
500,000±10%	RV4ATSD504A	RV4ATRJ504A	W3172
1 Meg±20%	RV4ATSD105B	RV4ATRJ105B	W3173
2.5 Meg±20%	RV4ATSD255B	RV4ATRJ255B	W3165
5 Meg±20%	RV4ATSD505B	RV4ATRJ505B	W3159

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.

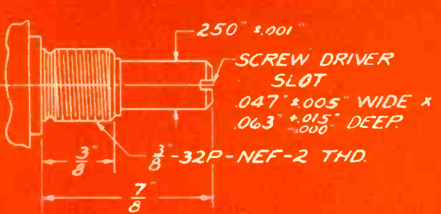
Resistance	RV2, JAN Shaft Type SD CTS Part	JAN-R-94 TYPE	CTS Part Non-JAN Locking Bushing CTS Shaft Type LT-1
100±10%	A5876	RV2ATSD101A	A5922
250±10%	A5877	RV2ATSD251A	A5923
500±10%	A5878	RV2ATSD501A	A5924
1000±10%	A5879	RV2ATSD102A	A5925
2500±10%	A5880	RV2ATSD252A	A5926
5000±10%	A5881	RV2ATSD502A	A5927
10,000±10%	A5882	RV2ATSD103A	A5928
25,000±10%	A5883	RV2ATSD253A	A5929
50,000±10%	A5884	RV2ATSD503A	A5930
100,000±10%	A5885	RV2ATSD104A	A5931
250,000±10%	A5886	RV2ATSD254A	A5932
500,000±10%	A5887	RV2ATSD504A	A5933
1 Meg±20%	A5888	RV2ATSD105B	A5934
2.5 Meg±20%	A5889	RV2ATSD255B	A5935

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.

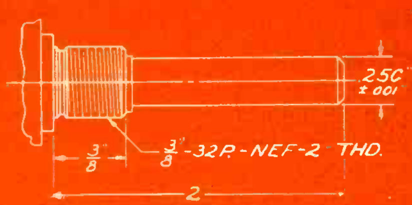
Resistance	RV3, JAN Shaft Type SD CTS Part	JAN-R-94 TYPE	CTS Part Non-JAN Locking Bushing CTS Shaft Type LT-1
100±10%	A5861	RV3ATSD101A	A5907
250±10%	A5862	RV3ATSD251A	A5908
500±10%	A5863	RV3ATSD501A	A5909
1000±10%	A5864	RV3ATSD102A	A5910
2500±10%	A5865	RV3ATSD252A	A5911
5000±10%	A5866	RV3ATSD502A	A5912
10,000±10%	A5867	RV3ATSD103A	A5913
25,000±10%	A5868	RV3ATSD253A	A5914
50,000±10%	A5869	RV3ATSD503A	A5915
100,000±10%	A5870	RV3ATSD104A	A5916
250,000±10%	A5871	RV3ATSD254A	A5917
500,000±10%	A5872	RV3ATSD504A	A5918
1 Meg±20%	A5873	RV3ATSD105B	A5919
2.5 Meg±20%	A5874	RV3ATSD255B	A5920
5 Meg±20%	A5875	RV3ATSD505B	A5921

JAN SHAFT TYPE SD



MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT 9/16 HEX. × 3/32
LOCK WASHER #1920A

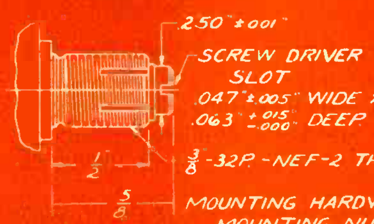
JAN SHAFT TYPE RJ



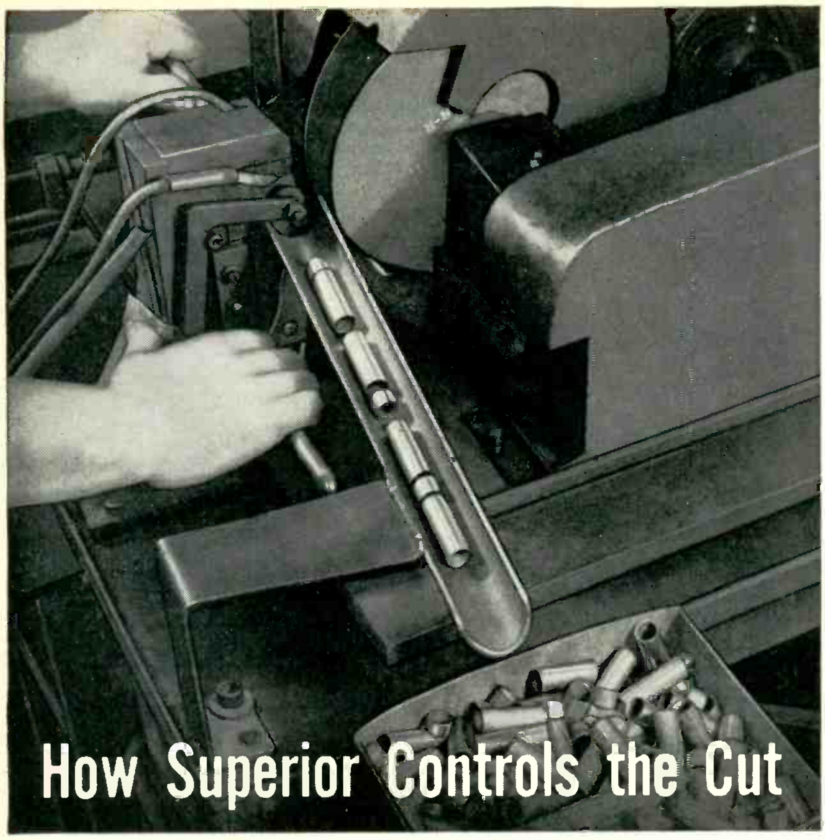
MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT 9/16 HEX. × 3/32
LOCK WASHER #1920A

CTS SHAFT TYPE LT-1

LOCKING BUSHING



MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT 9/16 HEX. × 3/32
LOCK NUT 1/2 HEX. × 5/32
LOCK WASHER #1920A



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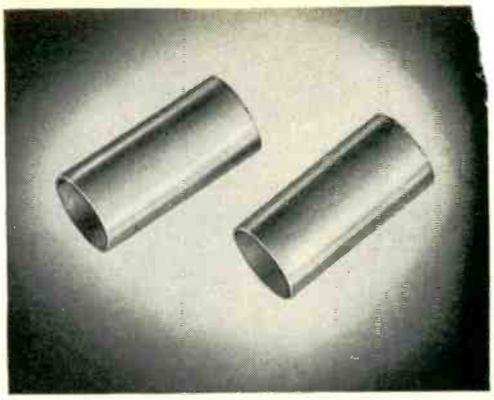

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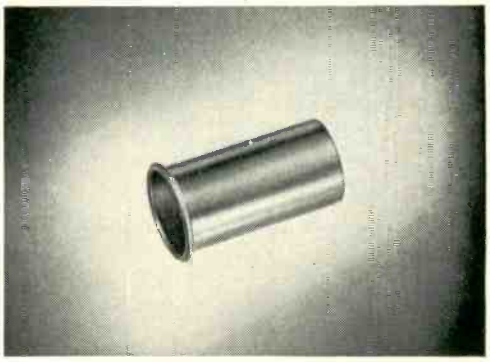

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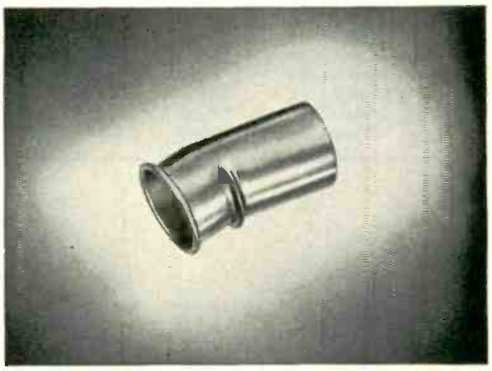

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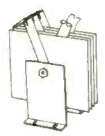

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Sales Dept.: 251 W. 19th St., New York 11, N. Y. • Factory: 84 N. 9th St., Brooklyn 11, N. Y.

Triple-thick plastic tape

It tames high voltage in Motorola TV shields

All plastic tapes are not alike! "Scotch" Electrical Tape No. 21 is *three times thicker* than ordinary plastic tape. That's why Motorola engineers find it ideal for insulating high-voltage shields.

Triple thickness means remarkable dielectric strength (22,500 volts). It means added mechanical protection—a cushion against shocks and scrapes.

And still this is a *tape* that sticks quickly, easily—right off the roll. Adhesive grips tight and *holds*.

No wonder that more and more manufacturers are turning to tapes—"Scotch" Electrical Tapes for all kinds of insulating and protecting jobs. Tape's a new tool, and "Scotch" Brand is America's most complete tape line.

Think of tape for *your* job! And for the *right* tape for your job, write Minnesota Mining & Mfg. Co., Dept. ES-112, St. Paul 6, Minn.

3M COMPANY — FIFTIETH ANNIVERSARY 1902 • 1952

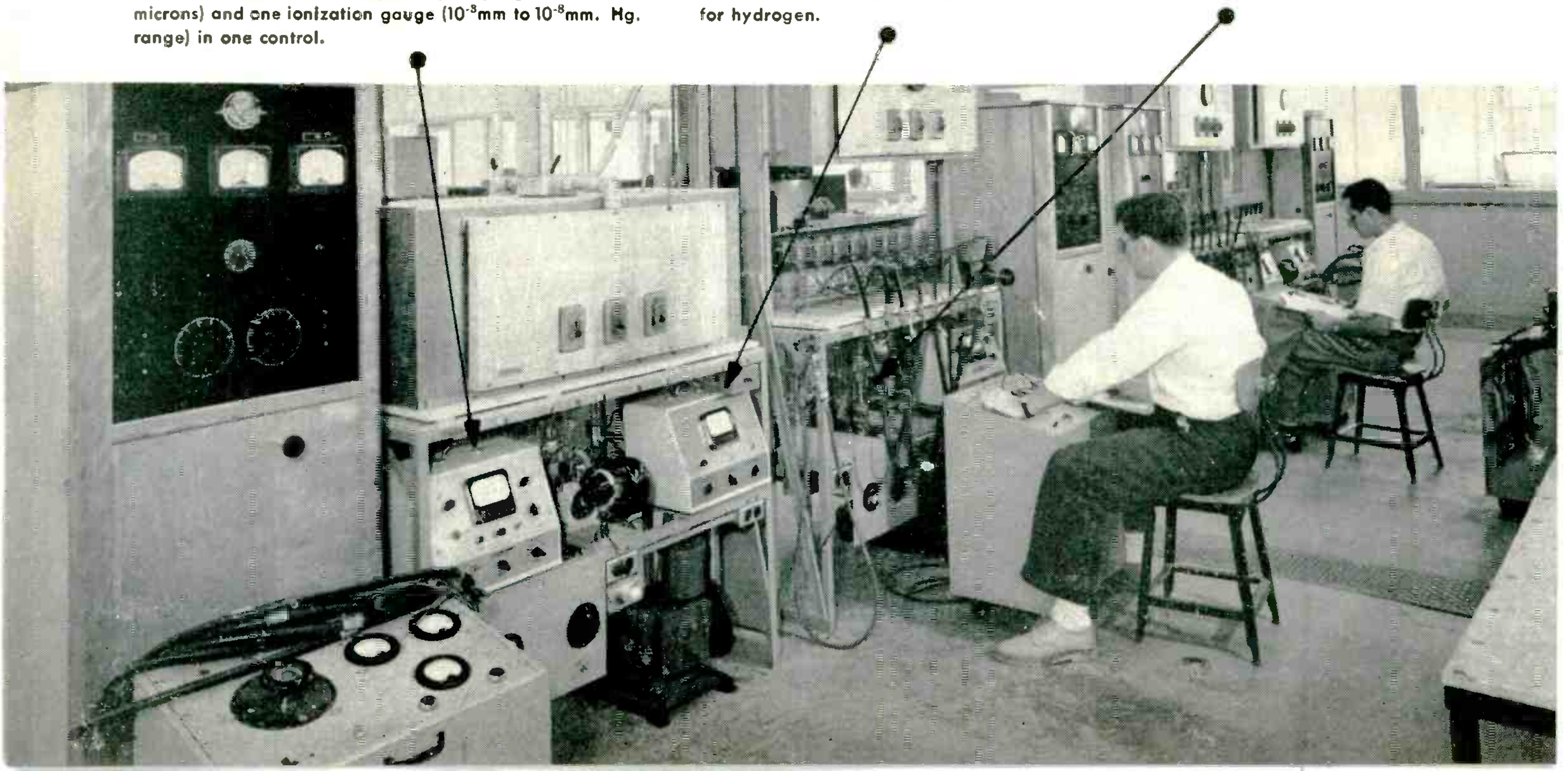
ONE OF U. S. A's LEADING MAKERS OF ELECTRONIC TUBES AND MICROWAVE COMPONENTS

Bomac is 100% High-Vacuum-Equipped by NATIONAL RESEARCH

Type 710 Thermocouple-Ionization Gauge Control. One instrument for scientific and industrial vacuum gauging. Incorporates two thermocouple gauges. (1-1000 microns) and one ionization gauge (10^{-3}mm to 10^{-8}mm. Hg. range) in one control.

Alphatron* Vacuum Gauge. Accurate gauging from 10 mm. to 1 micron. Specially fabricated for low leak rate and calibrated for hydrogen.

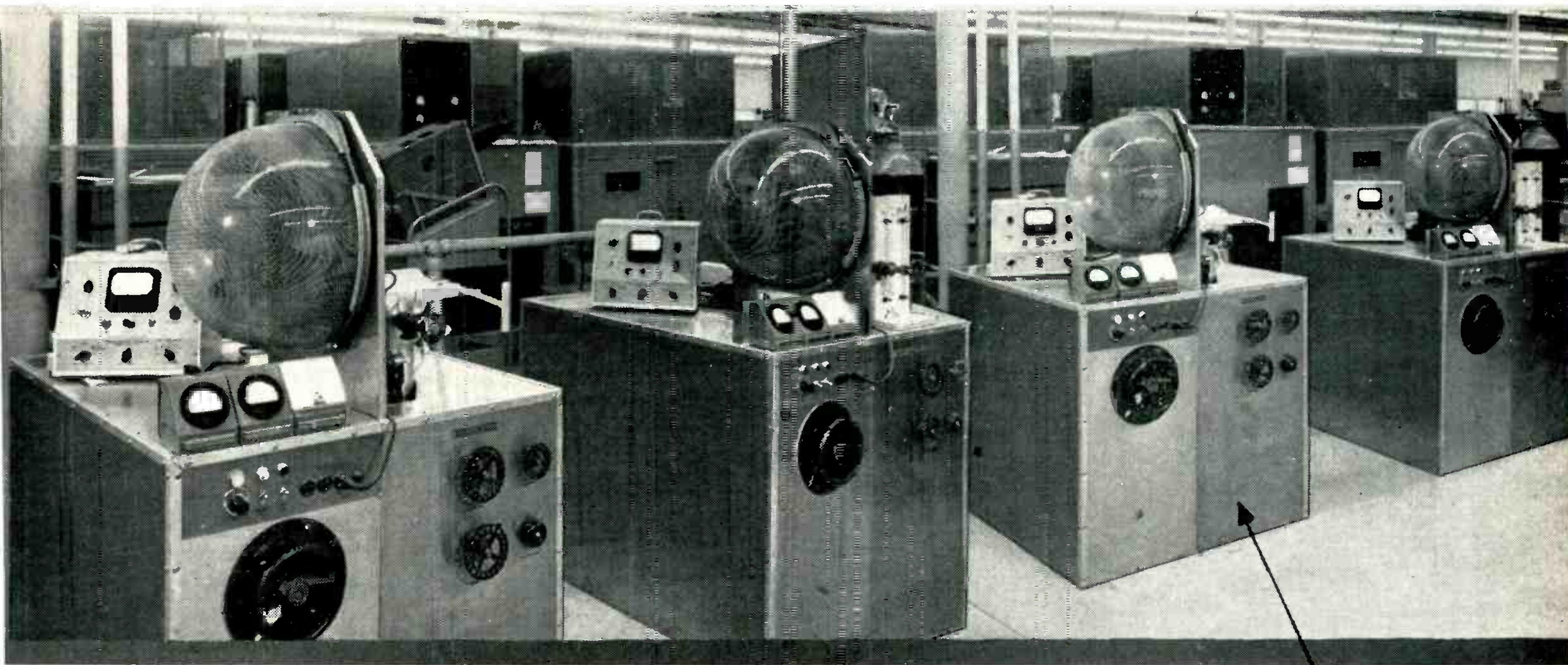
Vacuum Seals. For connecting pump and manifold.



As one of U.S.A.'s fastest growing electronic tube manufacturers, Bomac has established severe standards for their production equipment to assure an uninterrupted flow of tubes with minimum rejects.

National Research high vacuum equipment meets these rigid standards so well that it was again specified exclusively in Bomac's recent expansion of facilities.

When you want the same — a single source for all your high vacuum equipment needs . . with a single unexcelled standard of quality — look to National Research. For further details write National Research Corporation, Memorial Drive, Cambridge, Massachusetts.



H-2-P Purifying Diffusion Pump. Over 50 liters per second from 10^{-3} to 10^{-6} mm. range. Operates against forepressures as high as 0.300 mm. Blank-off 2×10^{-7} mm.

Standard Vacuum Furnace. A versatile packaged unit to melt, pour, heat treat, degas, sinter, and anneal under high vacuum or controlled atmospheres. Temperatures up to 2000°C.

INDUSTRIAL RESEARCH · PROCESS DEVELOPMENT
HIGH VACUUM ENGINEERING AND EQUIPMENT

METALLURGY · DEHYDRATION · DISTILLATION
COATING · APPLIED PHYSICS

National Research Corporation

Equipment Division

SEVENTY MEMORIAL DRIVE, CAMBRIDGE, MASSACHUSETTS

*Reg. U.S. Pat. Off.


RADAR
control
Test SET radar
S AND X BAND
MICROWAVE EQUIPMENT
FROM V. H. F. to S. H. F.
DERVEAUX
TEST SET RADAR
LABORATOIRES
LABORATOIRES
OFFICE AND FACTORIES
6, RUE JULES-SIMON, BOULOGNE-SUR-SEINE
TÉL. : MOLITOR 37-00 FRANCE
R. DERVEAUX
LABORATORIES
64, RUE DU CHATEAU-BOULOGNE-SUR-SEINE
TÉL. : MOLITOR 73-91, 92 et 93 FRANCE
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From the

HAMMARLUND LABORATORIES

The **SP-600-JX**

for selective channel operations

With its six crystal-controlled fixed-frequencies, the "SP-600" is the perfect receiver for point-to-point and network applications. Pre-arrange day and night fixed-frequencies. With crystal control you can select your desired channels immediately without searching. You'll always be on the nose because of crystal control.

The "SP-600-JX," built to JAN specs and specially ruggedized to provide years of day-in-day-out competent performance, is the most carefully engineered receiver available anywhere for selective channel operation.

But whether you want to operate on a fixed-frequency for contact with an individual station or network, or roam the entire receiver range from 540 Kc to 54 Mc in search of other contacts, you just can't operate a finer receiver than the "SP-600-JX."

Write to the Hammarlund Manufacturing Company for further details.

HAMMARLUND

HAMMARLUND MANUFACTURING COMPANY, INC.

460 WEST 34th STREET • NEW YORK 1, N. Y.

GLASSMIKES*

the capacitors with the exclusive glass housing and plastic dielectric film

Preferred where High Temperatures, High Resistance, and Low Loss are Essential!

Glassmike capacitors are wound with the plastic film which accentuates the electrical characteristics you require, and results in capacitor design of minimum size. The metal ferrules, soldered to silver bands at each end of the hermetically-sealed glass tubes, eliminate mounting problems.

Applications:

audio and RF coupling
pulse forming and de-spiking networks
radio frequency bypass
low and high pass filter networks
audio frequency coupling
electronic computers
electrometer and oscillator circuits
etc.

Send us your requirements and we will recommend the proper capacitor.

MANUFACTURERS
Glassmike Capacitors
Plasticon Capacitors
Hi Volt Power Supplies
Pulse Forming Networks

Condenser Products Company
Division of New Haven Clock & Watch Co.

7517 North Clark Street • Chicago 26, Illinois

• *Glassmikes* . . . an exclusive capacitor line originally designed by our engineers

ACME ELECTRIC CORPORATION REDUCES TRANSFORMER SIZE

Saves 40% on steel...

Saves 42% on copper...

Saves 44% on weight...

Acme reduces waste and speeds production by ordering Quinterra to exact width required—Production efficiency has been increased and waste has been reduced to an absolute minimum — without equipment changeover — by using Quinterra Type 6, factory-cut to Acme's dimensional specifications.

—by insulating coils with

Quinterra® TYPE 6

the purified asbestos electrical insulation

How have these tremendous savings in critical materials, weight, space, and production time affected the quality of Acme transformers?

The manager of Acme's Dry Type Transformer Division advises that not a single failure in operation of an Acme Quinterra-insulated transformer has been reported in the two years that they have been produced. Since several thousands of these units have been manufactured in this time, their quality is evident.

Here are the reasons why this Johns-Manville purified asbestos insulation has helped the Acme Electric Corporation, and many other well-known manufacturers, turn out better products and at the same time lower production costs.

Quinterra Type 6 possesses high thermal stability and lasting dielectric strength. It is a twin-ply, polyvinyl, acetate-treated, purified asbestos insulation with a dielectric strength of 300 VPM. Even when its saturant is baked out by continuous exposure to 200 C, it retains the inherent dielectric of the base sheet which is at least 200 VPM . . . and it remains a dielectric up to 400 C.

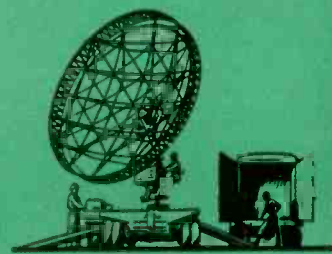
Type 6 has high mechanical strengths because it is made by combining and calendering two layers of Quinterra together into a dense, smooth-surfaced insulation. Its good tensile and bursting strengths enable operators to achieve favorable production rates. Further economies result from its large square-foot-per-dollar coverage.

If you are a manufacturer of magnetic or resistance devices, Quinterra Type 6 . . . or one of the other Quinterras . . . may enable you to lower production costs and also to improve your product's performance. For samples and additional information, write to Johns-Manville, Box 60, New York 16, New York.

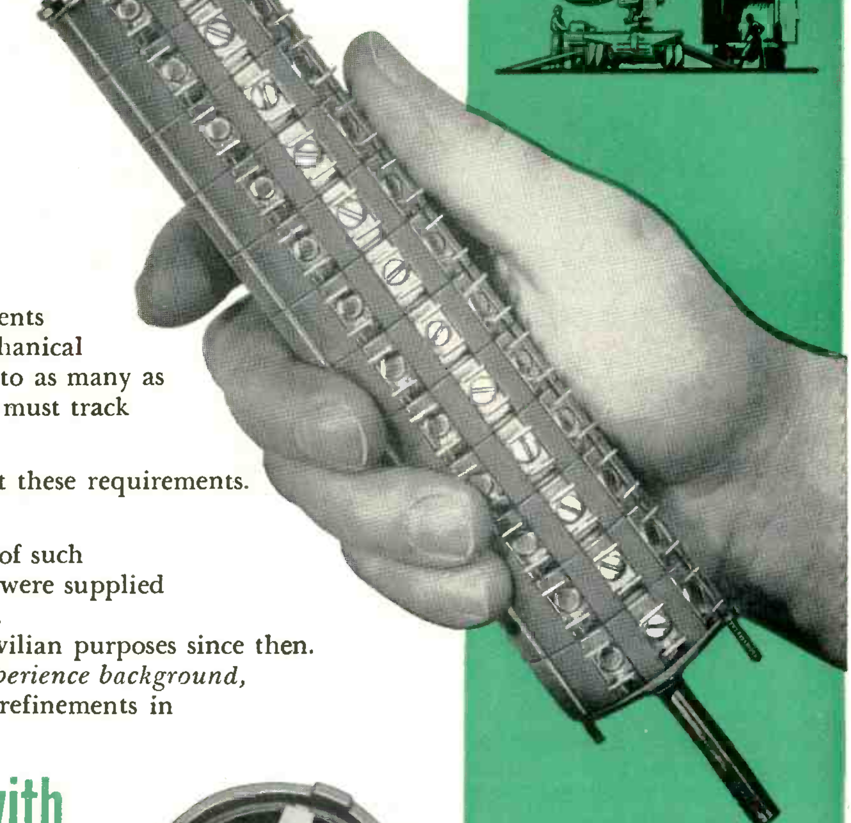
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville ELECTRICAL INSULATIONS

PRECISION



Controls



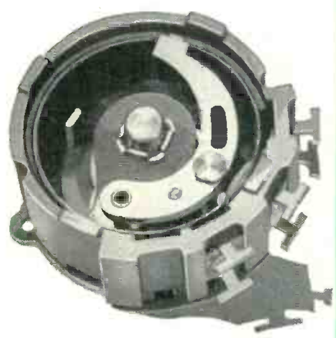
At the *very heart* of highly critical equipment such as electronic computers, electronic gunsights and radar assemblies, the control requirements call for outstanding electrical and mechanical precision. Indeed, from single section to as many as twenty sections, the precision controls must track with mathematical accuracy.

Clarostat Series 42 Controls fully meet these requirements. Thus *the climax in precision controls.*

Clarostat has made the major portion of such precision controls in use today. Many were supplied to the armed forces in World War II. Many more have been supplied for civilian purposes since then. And now, *based on an unparalleled experience background,* Clarostat engineers offer you further refinements in their latest Series 42 design.

You can stand pat with CLAROSTAT

Engineering Bulletin No. 142 sent on request. And remember, when your control or resistor requirements call for *quality, quantity* and *economy,* you can meet them with Clarostat's engineering and production facilities. *Submit that problem!*



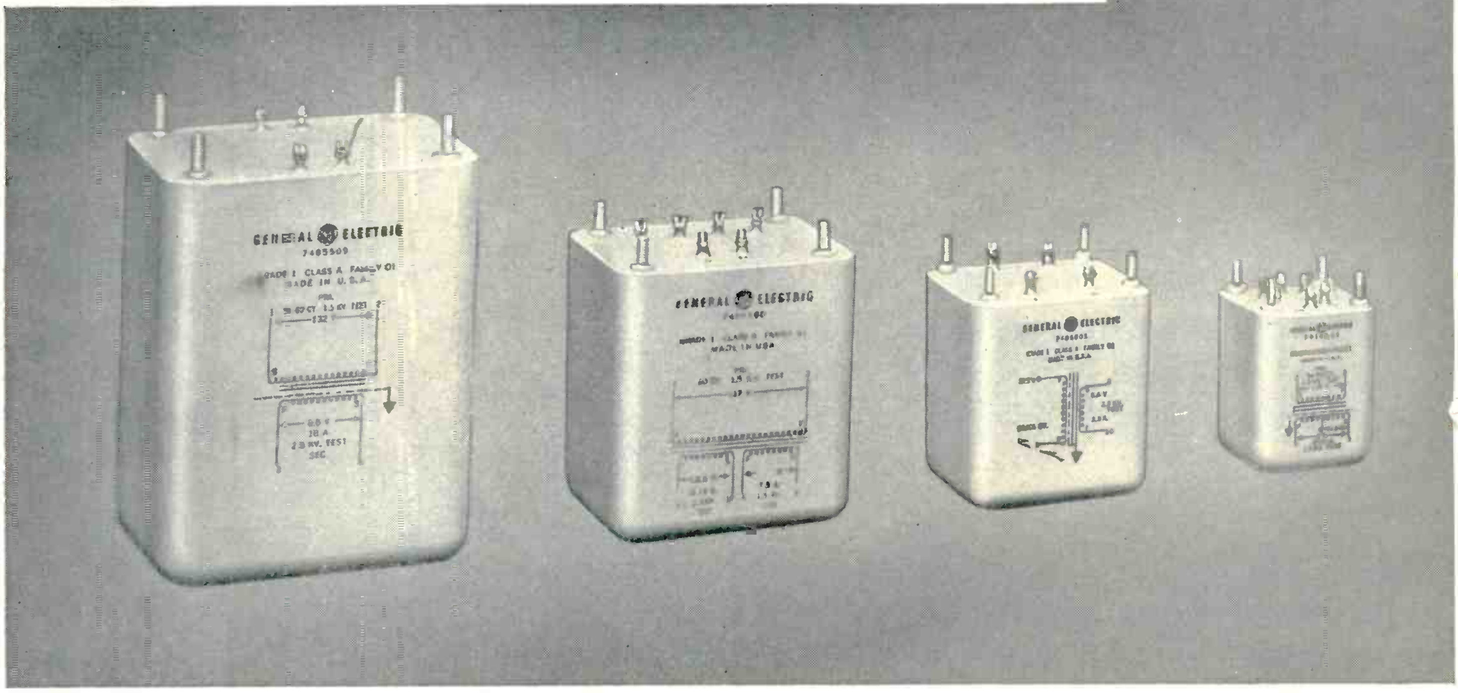
New Clarostat Series 42 potentiometer. Available in single and multiple assemblies up to 20 sections. Precision windings to plus/minus 0.5% and better. Positive contact rotor, smooth rotation, minimum wear. Perfect tracking of all units in assembly. No backlash or play. Rotor of each potentiometer mounted on centerless-ground shaft passing through all sections.

Controls and Resistors

CLAROSTAT

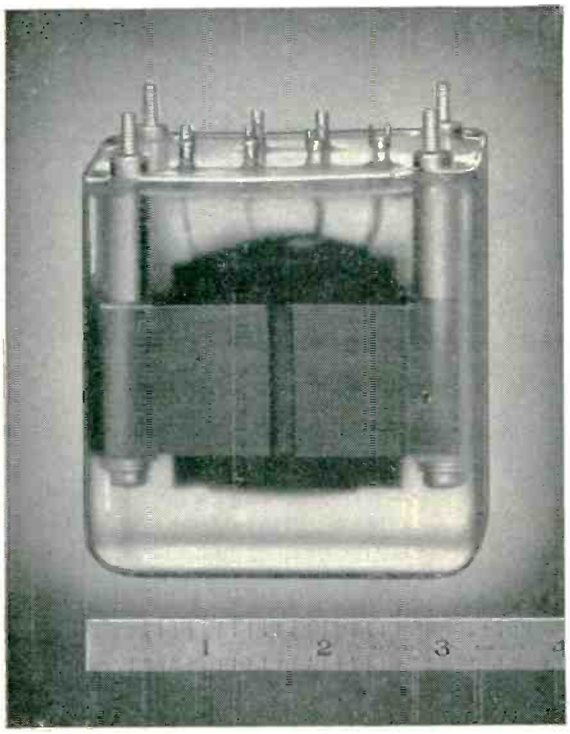
CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario

CAST-PERMAFIL TRANSFORMERS



NEW LINE of G-E cast-permafil electronic transformers does away with the need for hermetically sealed metal enclosures. Cast construction, lighter weight and smaller size offer the designer greater flexibility in many types of electronic designs.

New G-E designs available



SIMPLER CONSTRUCTION of G-E cast-permafil transformers shows up dramatically in this model cast in clear resin. Note how the resin anchors the terminals, eliminating need for a steel enclosure.

Smaller, Lighter Cast-Permafil Transformers Designed to MIL-T-27 "Specs"—Need No Fungus-Proof Coatings

Interchangeable with existing hermetic designs, General Electric's new line of cast-permafil transformers—solventless resin type—offer many design advantages.

MOISTURE PROOF—"Cast-in" construction seals transformer permanently against moisture as required in MIL-T-27 Grade 1 Performance Specifications. Permafil forms a tough, shatter-resistant, solid casing.

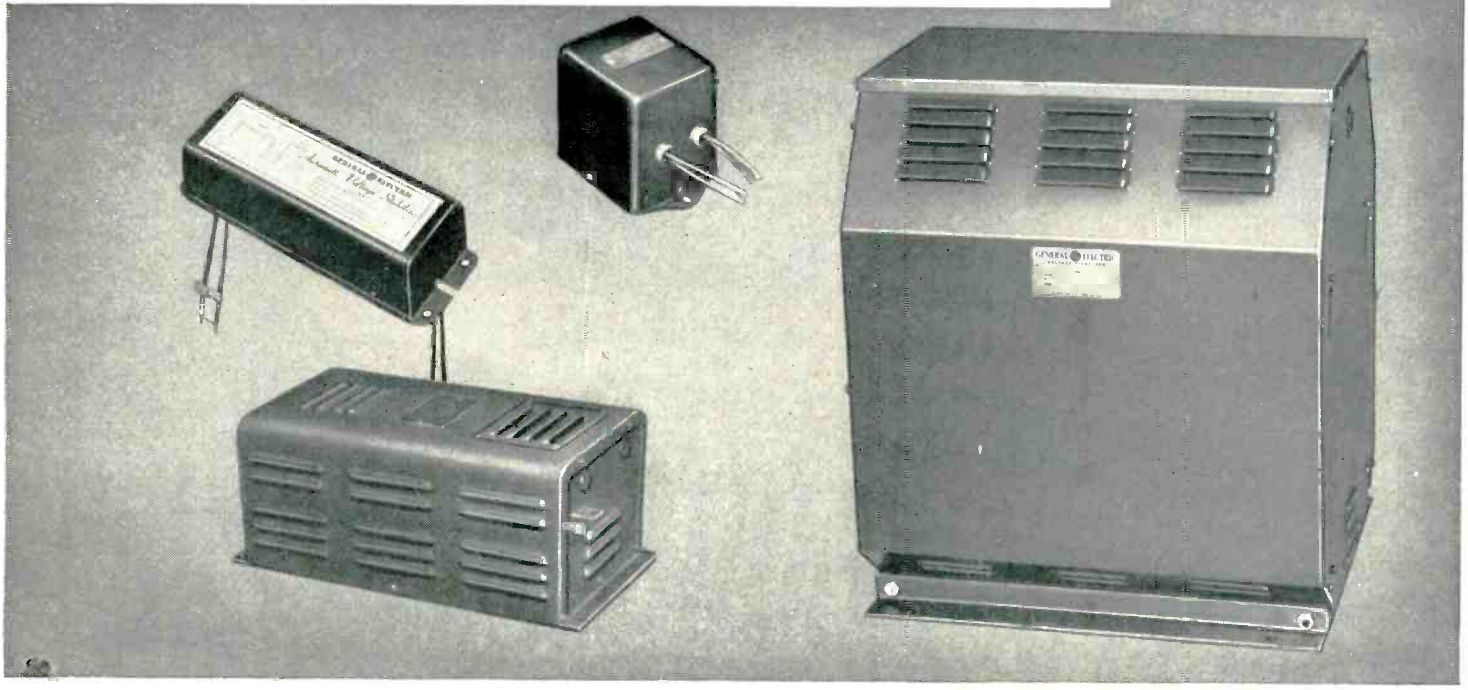
AVERAGE 20% SMALLER because they eliminate metal enclosures, and because their terminals can be anchored directly in permafil mixture, the new G-E cast-permafil transformers are smaller and lighter weight. The complete line—which includes 11 sizes, 9 of them in two heights—averages about 20% smaller than previous models.

MORE FLEXIBLE with fewer machined and punched parts, greater flexibility in design and construction is possible. Terminal arrangements can be varied. Color can be "built in" by adding pigment to the permafil mixture. Permafil makes fungus-proof coatings unnecessary.

ACCELERATED LIFE TESTS indicate that G-E cast-permafil transformers will stand up as long as Class A hermetics at 105 C. And at 130 C. ultimate, they have an expected life of 1000 hours or more.

For complete information on the application, ratings and availability of G-E cast-permafil transformers, write to ***Section 411-102, General Electric Company, Schenectady 5, N. Y.***

AUTOMATIC VOLTAGE STABILIZERS



NEW LINE rated from 15 VA to 5000 VA. Stabilizers feature totally enclosed, single-core construction, reduced weight and greater flexibility for designs involving voltage ratios other than 1:1. A wide range of voltage correction is offered.

for electronics use

Lighter G-E Automatic Voltage Stabilizers Feature Inherent Input-Output Isolation—More Voltage Ratios

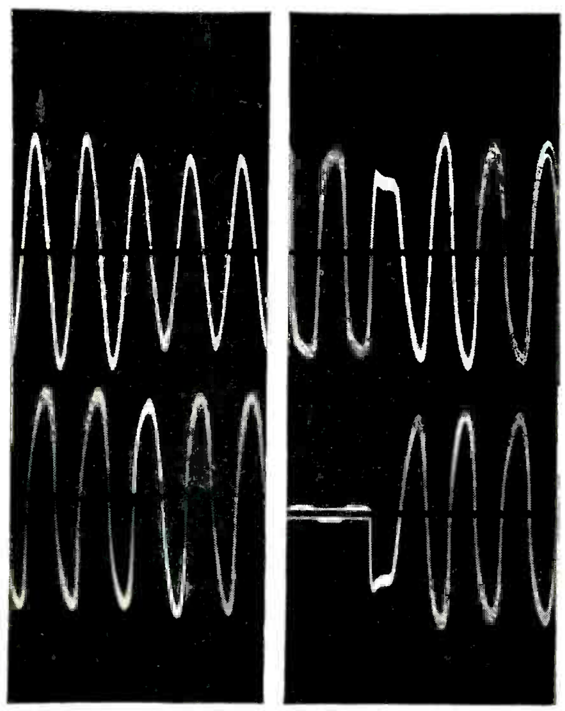
SINGLE-CORE CONSTRUCTION in General Electric's new standard line of 60-cycle automatic voltage stabilizers provides inherent input-output isolation—eliminates the need for an additional isolating transformer. You get substantial weight reduction over previous units in the 1000 to 5000 VA ratings.

TOTALLY ENCLOSED construction of the new design cuts down stray magnetic fields—allowing use near sensitive electronic devices like oscilloscopes.

VOLTAGE RATIO FLEXIBILITY has also been increased in the new line. Standard stabilizers—with ratings from 1000 VA through 5000 VA—are provided with series multiple input and series multiple output.

IN ADDITION, these new units offer a wide-range of voltage correction, plus rapid stabilization, ease of installation and maintenance-free operation.

For further information on this new line of standard automatic voltage stabilizers call your local G-E distributor. Or write for bulletin GEA-5754 G-E Automatic Voltage Stabilizers. *Section 411-102, General Electric Co., Schenectady 5, N. Y.*

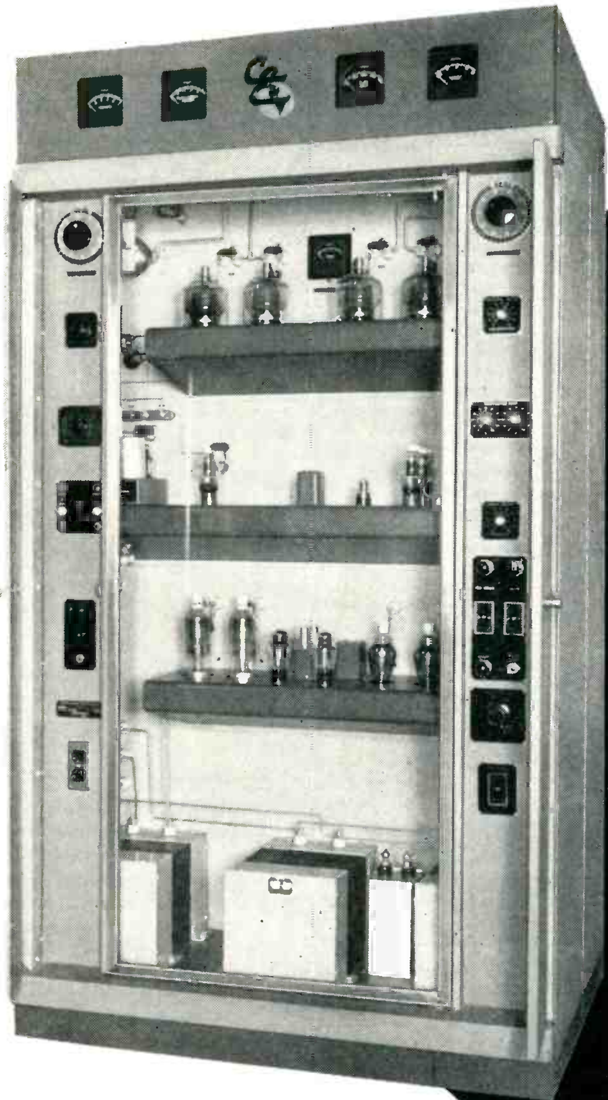


RAPID RESPONSE of G-E Automatic Voltage Stabilizers. *Left:* Stabilization within 1½ cycles as input drops from 130 to 95 volts. *Right:* Stabilization in 2 cycles as load current jumps from 0 to full load.

GENERAL ELECTRIC

NEW

To AM Broadcasting



Continental Electronics type 314-2 transmitter

Continental Electronics'
One kilowatt transmitter
goes
On the Air
with
Eimac Tetrodes

Eimac 4-400A's in high level stages.

By employing 4-400A radial-beam power tetrodes, and other up-to-the-minute developments in its one kilowatt transmitter, Continental makes a significant advancement in the field of AM broadcasting.

As power amplifiers a pair of Eimac 4-400A tetrodes give outstanding performance. Only two RF amplifiers are used in the 314-2, including the output stage which takes advantage of the low driving power requirements, high power gain and stability of Eimac 4-400A's.

As modulators two 4-400A's are driven by a high quality, resistance coupled audio amplifier with fixed audio feed-back. As in the power amplifier these tetrodes make possible the adaptation of simple, straight-forward circuitry.

For data about the 4-400A write Eimac's Application Engineering department.

Follow the Leaders to Eimac TUBES

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

CHATHAM

ELECTRONIC TUBES

Hydrogen Thyratrons

—for Pulse Voltage Generation

ELECTRICAL DATA*

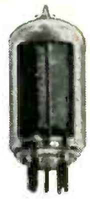
Type	VC-1258	5949/1907	5948/1754	VC-1257
Maximum Peak Forward Anode Potential	1000 volts	25000 volts	25000 volts	38000 volts
Maximum Peak Anode Current	20 amps	500 amps	1000 amps	2000 amps
Maximum Average Anode Current	0.05 amps	0.50 amps	1.0 amps	2.0 amps
Maximum Heating Factor (epy x prr x ib)	1.0×10^8	6.25×10^9	9.0×10^9	—
Nominal Filament Power	12.6 watts	95 watts	190 watts	230 watts
Hydrogen Reservoir	No	Yes	Yes	Yes

*More detailed information on electrical and mechanical data will be supplied on request.

TYPE VC-1257
Hydrogen filled, zero bias thyratron with hydrogen generator for generation of pulse power up to 40 megawatts.

TYPE 5948/1754
Hydrogen filled, zero bias thyratron with hydrogen reservoir for generation of peak pulse power up to 12.5 megawatts.

TYPE 5949/1907
Hydrogen filled, zero bias thyratron with hydrogen reservoir for generation of peak pulse power up to 6.25 megawatts.



TYPE VC-1258
Zero bias miniature hydrogen thyratron for the generation of peak pulse power up to 10 KW.

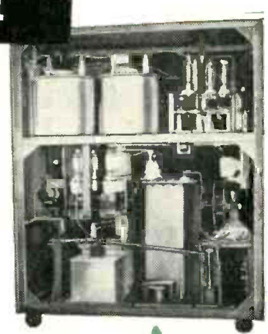
A NEW CONCEPT OF HYDROGEN THYRATRON DESIGN! The tubes illustrated represent a departure from conventional hydrogen thyratron designs and are a result of several years of concentrated development work. They are primarily employed in the generation of peak voltages with durations in the order of microseconds.

Custom-built Electronic Equipment

CHATHAM specializes in the development, design, and construction of custom-built electronic equipment to exactly meet customers' requirements. Our capable staff of engineers will furnish prompt estimates or, if desired, will call to discuss your problem personally. Call or write today.

20 Megawatt Hydrogen Thyratron Test Equipment built by CHATHAM to customers' specifications.

Pulse life test equipment built by CHATHAM checks receiver type tubes under pulse conditions.



5 Megawatt radar modulator built by CHATHAM to rigid government standards.

ELECTRONICS AND EQUIPMENT

Electronic Tubes

Ruggedized Type Tubes

The following tubes are JAN approved and can be supplied promptly, usually direct from stock:

5R4WGY	2D21W
6AL5W	OC3W
6H6WGT	OD3W
25Z6WGT	2050W

TYPE 719-A HIGH VACUUM CLIPPER DIODE

This tube is used primarily for clipper diode service in hard tube modulator circuits. Filament 7 volts, 7 amps . . . Inverse peak anode voltage 25 kv, Max., peak anode current 10 amps, Max., anode dissipation 75 watts.

TYPE 1Z2 RECTIFIER

A small bulb high voltage vacuum rectifier. Low cathode heating power and low dielectric losses make tube suitable for radio frequency supply circuits. Filament 1.5 volts, .290 amps . . . Inverse peak anode voltage 20,000, average plate current 2 ma. . . . peak plate current 10 ma.

TYPE 1B46 REGULATOR

A cold cathode glow discharge tube designed for voltage stability. DC operating voltage 82 volts, operating current range 1 ma minimum, 2 ma maximum. Regulation 3 volts.

TYPE 395-A COLD CATHODE GAS TRIODE

Requires no filament supply and is used in many grid controlled rectifier and relay applications. Maximum D.C. anode current— 10 ma. Maximum D.C. anode voltage—150 volts

TYPE 4B32 RECTIFIER

A rugged half-wave Xenon filled rectifier. Operates in any position throughout an ambient temperature range of −75°C to +90°C. Filament 5 volts, 7.5 amp . . . Inverse peak anode voltage 10,000 average anode current 1.25 amps.

TYPE 394-A THYRATRON

A Mercury vapor and Argon filled thyratron for grid controlled rectifier service. Operates over wide ambient temperature range. Heater 2.5 volts, 3.2 amps . . . Inverse peak anode voltage 1250, average anode current 640 ma.

TYPE 3B28 RECTIFIER

This rugged half-wave Xenon filled rectifier will operate in any position and throughout an ambient temperature range of −75°C to +90°C. Filament 2.5 volts, 5.0 amps . . . Inverse peak plate voltage 10,000, average anode current .25 amp.

Chatham Vacuum Switches

TYPE 1S22 (illustrated) is a mechanically actuated, single-pole, double-throw, glass vacuum switch. This and other types can be supplied.

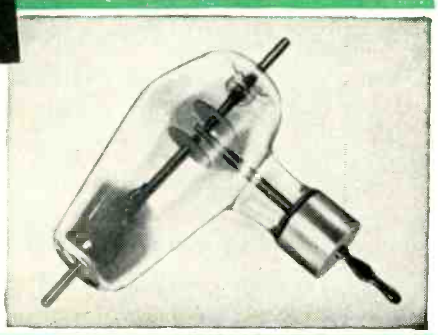
SPECIFICATIONS

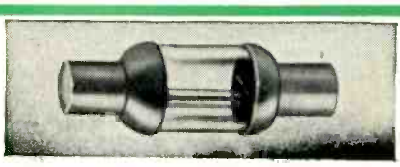
HOLD OFF VOLTAGE: Internal—10,000 volts rms; External* (at 27,000 feet altitude)—10,000 volts rms; External* (at 40,000 feet altitude)—7,500 volts rms.

INTERRUPTING RATING, RESISTIVE LOAD: 1,000 operations life at 10,000 v, ac, rms—10 amp, ac, rms; 1,000,000 operations life at 10,000 v, ac, rms — 2 amp, ac, rms; 500,000,000 operations life at 10,000 v, ac, rms—0.1 amp, ac, rms.

NET WEIGHT (approx.) .... 2 ozs.
MAXIMUM LENGTH (overall) .... 3 5/8 ins.
MAXIMUM WIDTH (overall) .... 4 1/16 ins.
MAXIMUM THICK. (overall) .... 1 9/16 ins.

*at 50% humidity





HIGH VOLTAGE VACUUM FUSES

Can be supplied by Chatham to exact customers' specifications if ordered in adequate quantity. Call or write for full particulars and quotes.

CHATHAM ELECTRONICS CORP.
475 WASHINGTON STREET • NEWARK 2, NEW JERSEY

CROSS TALK

▶ **SWITCH** . . . Most economists see good business ahead through this winter and next spring. Certainly all the signs point that way in the field of electronics.

Along about mid-summer on the 1953 calendar there appears to be a veil that even the keenest eyes cannot completely penetrate. One of the components of the veil is possible tapering off of military orders if the stretched-out procurement program gets on schedule and passes its peak.

Perhaps this is the reason why so many manufacturers to whom we have talked in the last month seem to be thinking about civilian rather than military equipment business, why so many are searching for new things to build at prices the public can pay, and why so many are increasing sales pressure behind items already designed.

It seems like the thing to do.

▶ **GROWTH** . . . West Coast electronics industry is rapidly coming of age. Noted on our most recent editorial swing through the area was the particularly heavy attendance at the Long Beach convention, substantial growth in the size of many plants visited less than a year before and a continued though more modest influx of new companies.

Even more significant from a long-range point of view is the far west's growing interest in the mid-west and even the east-coast market for its goods; manufacturing capacity in some instances already far exceeds the needs of local aircraft plants that gave many people in our field their start. Most significant of all, the first substantial signs of a west-coast component-parts business can now be seen; parts are in the main rather specialized, but new manufacturers must start where competition is not too keen and where required investment is not too large.

An indication of growth particularly visible to us is the sharp increase in the number of technical papers emanating from the west coast; ELECTRONICS itself has published 18 since January in its feature pages alone.

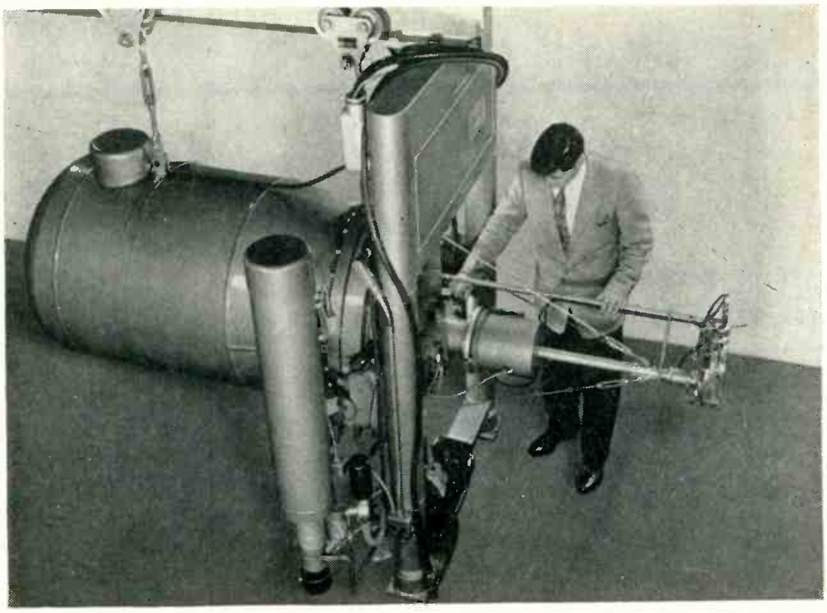
▶ **TWINS** . . . Use of the airplane in surveying and mapping has been one of the outstanding developments in that phase of civil engineering, according to the ASCE. "Furthermore," says the Society, "the use of electronics will be one of the dominant developments in the next quarter century."

▶ **MECHANIZATION** . . . Just a few short years ago people frequently asked us why so-called printed circuits, already widely used in military electronic apparatus, had not yet made a deep dent in civilian equipment design. We told them that in our opinion the chief reason was because they were inflexible; it was too hard or too expensive to modify existing circuits.

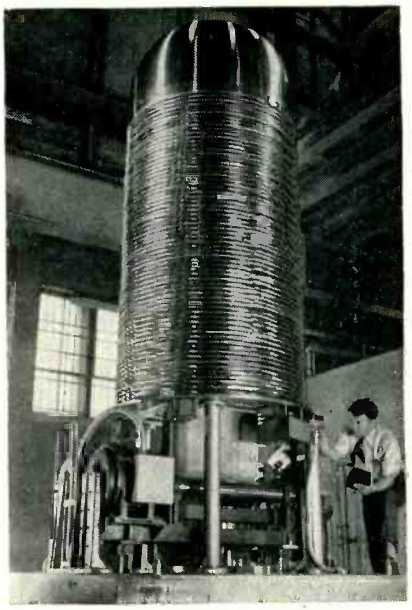
Now there are signs that all this is changing. Several manufacturers of radio and television sets are using such circuitry extensively in equipment already on the market. What has happened to bring about the change? Designers are beginning to concentrate upon the machinery for producing circuits, rather than upon the circuits themselves. And they are seeing to it that the machinery is sufficiently flexible so that the boss is not nailed to the cross for dies or other appurtenances every time the engineering department wants to alter wiring.

At least one large independent research organization is known to have an important contract calling for development of machinery for the production of printed circuits, and setup and alteration time is to be the criterion. The program still has a long way to go, but it is well on its way.

▶ **BAGS** . . . At this, the height of the convention and trade-show season, we are reminded that a friend of ours once had occasion to check the contents of bags provided for literature collectors. Estimating the cost of circulars contained therein at rock-bottom prepartion, printing and paper prices, he came up with the startling statistic that the average bag contained printed matter valued at $17.50!



Commercial version of small electron-beam sterilizer for research and limited production. Mounting 2,000,000-volt generator on its side permits use in average-height room



High-intensity 3,000,000-volt electron sterilizer with three charging belts and two acceleration tubes. Electron power is 12 kw

ELECTRON BEAMS

High-current coils sweep electron beam through 8-deg arc in air 200 times per second to give uniform sterilization of sealed products moving through beam on high-speed conveyor belt. Scanning circuit includes elaborate fail-safe provisions

THE USE of high-energy electron beams for the sterilization of foods, pharmaceuticals and sanitary products is being made practical by the Van de Graaff electron accelerator with a scanned electron-beam output. There are many inherent advantages in the electron-sterilization process, as shown in the considerable amount of research[1] that has been conducted to develop techniques for treating materials with ionizing radiations.

An electron accelerated by potentials of several million volts is capable of penetrating substances to a considerable depth. As it passes through the material, this high-energy electron upsets the natural electrostatic balance of the atoms or molecules, ionizing them so that their chemical relationships are momentarily altered. The complex high-molecular-weight chemical structures essential to living organisms are particularly sensitive to this type of ionization. Its results are accordingly fatal under treatment conditions producing far less, and often negligible, effect on nonliving material.

Advantages of Process

Interest in this method of preserving and purifying foods and drugs centers around the following characteristics:

(a) Electron sterilization of a product can be done in the final sealed package without damage to the container and with no possibility of recontamination prior to use.

(b) The temperature rise in the irradiated product, caused by the bombarding electrons, is negligible in comparison to the temperatures needed for normal heat sterilization; foods can be electron-sterilized while frozen.

(c) The packaged or bulk material to be sterilized can be conveyed in an uninterrupted flow beneath the electron beam, as contrasted with the normal batch-processing method.

(d) With a properly regulated electron beam, complete sterility can be reproducibly assured in each product.

(e) The electron dose received by each product can be metered, thereby providing a continuous record and control of sterility.

Electron Accelerator Design

A continuous, well-collimated beam of high-energy electrons is produced by a Van de Graaff electrostatic accelerator. This apparatus has been developed to commercial practicality out of the results of years of research at Massachusetts Institute of Technology and University of Wisconsin[2]. In principle, a controllable constant potential of millions of volts is generated by transferring electric

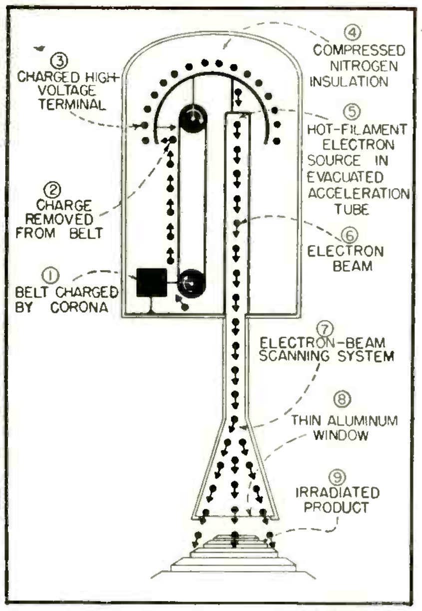


FIG. 1—Operating principle of Van de Graaff electron accelerator as used for sterilizing packaged products

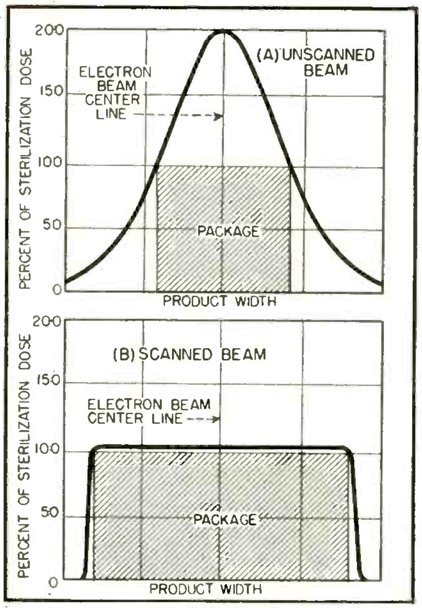


FIG. 2—Effect of scanning on distribution of ionization intensity. Area under both curves is the same

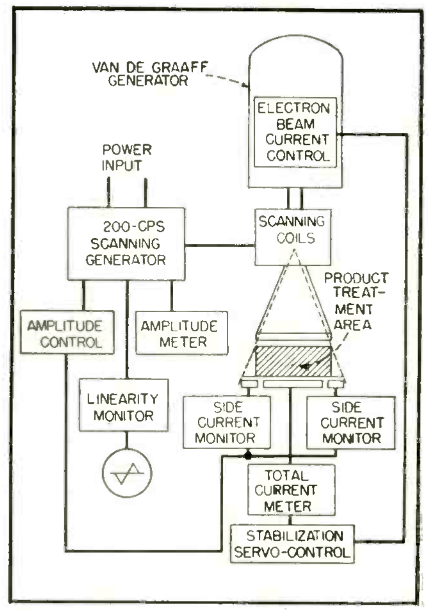


FIG. 3—Complete electron-irradiating system. Manual and automatic monitoring insures uniform sterilization

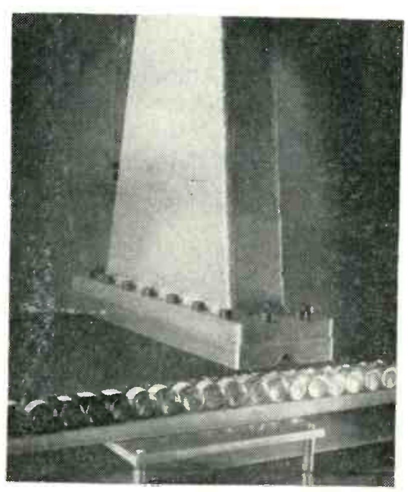
Sterilize Food and Drugs

By E. ALFRED BURRILL and A. JOHN GALE

Physics Department
High Voltage Engineering Corporation
Cambridge, Massachusetts

charges on a rapidly moving belt from ground to the inside of a high-voltage terminal, as shown in Fig. 1. By balancing the current into the terminal with that flowing back to ground through potential-dividing resistors and an evacuated acceleration tube, a direct current of electrons is accelerated to a homogeneous energy by the voltage drop established between the well-insulated high-voltage terminal and ground. This type of equipment has been widely used for the acceleration of electrons and positive ions and for the production of x-rays and neutrons. It finds applications in cancer therapy, industrial radiography, nuclear research, radiation chemistry, biology and food technology. Over one hundred of these electrostatic accelerators are in active use today in research laboratories throughout the world.

A compact, two-million-volt Van de Graaff electron accelerator has been developed for use in sterilization research and for small production-line irradiation of foods and drugs. This unit consists mainly of a voltage generator contained in a



Electron-beam scanner being used for irradiation of glass vials containing powdered pharmaceuticals at rate of about 2 a second using small 2-mev machine

pressurized housing 6 feet long and 3 feet in diameter, mounted horizontally for installation in a room with nominal ceiling height. A pressure of 25 atmospheres of nitrogen and carbon dioxide is used to insulate the high voltages generated within the relatively small pressure vessel. Protruding from the base of the generator is the grounded end of the acceleration tube, through which high-energy electrons are impelled by the high voltage inside the tank. For the production of penetrating x-rays, these electrons are stopped by a thick gold target at the end of the tube. This target can be retracted, however, to permit the electrons to emerge, with negligible loss in energy, into the atmosphere through a thin aluminum window.

The accelerator produces 0.5 kw of monoenergetic electron power at 2-mev energy, with an input power of 4 kw. About half the input

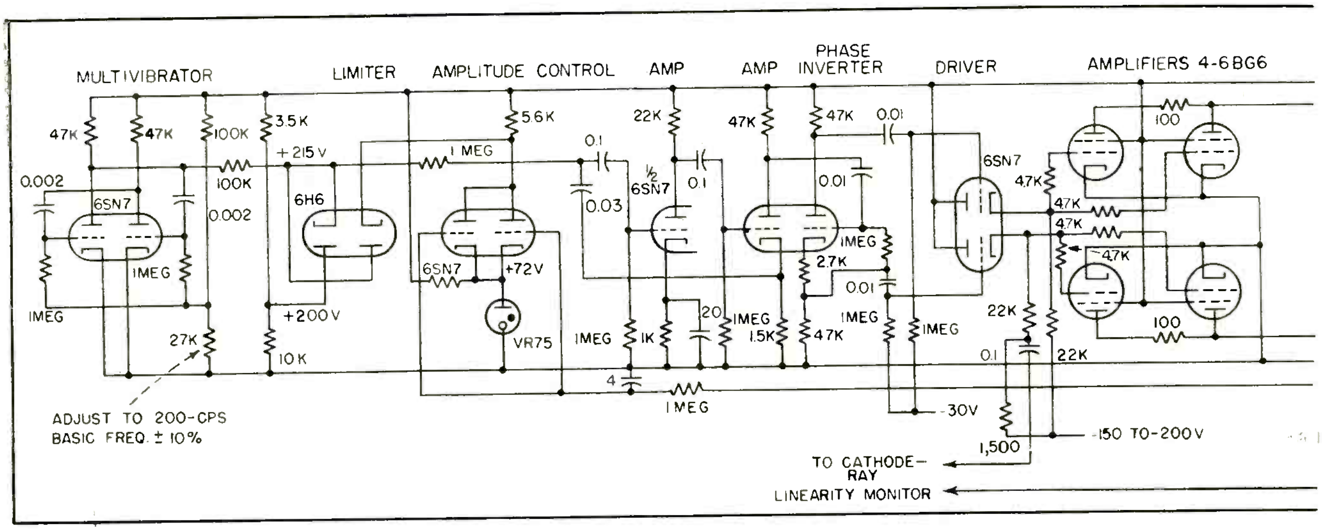


FIG. 4—Scanning circuit used for generating 3-ampere, 200-cps sawtooth current for sweeping electron beam through controllable angle up to 8 degrees to obtain uniform irradiation without wasting electron-beam power beyond outlines of the product. The conveyor-belt motion provides the equivalent of vertical scanning. To protect aluminum window against burning by stationary electron beam, full-

power is required for controls and for evacuating the electron-acceleration tube. The output power produces in materials an ionization equivalent to over 50 million gram-rep (roentgen-equivalent-physical units) per second, and can completely sterilize over 200 pounds of foods or drugs per hour. The 2-mev electrons have a practical penetrating range of about 0.3 inch in water. This range can be increased to 0.7 inch by the technique of bombarding the product from both sides. In general, the range of high-energy electrons in material is proportional to the electron energy and inversely proportional to the density of the material.

Electron-Beam Scanner

The high-energy electron beam, as it is normally propagated into the atmosphere, has a lateral intensity distribution that is roughly Gaussian, as shown in Fig. 2A. To deliver electron energy adequate for sterility to all regions of the product, some portions must receive an overdose, sometimes as high as a factor of four. If only the central region of the beam is used, the remainder is wasted energy, causing the process to be uneconomical. To irradiate a product with any appreciable lateral dimension, the beam must be allowed to be scattered by the atmosphere or by thin foils, to broaden the intensity distribution for adequate coverage. The scattering process is extremely wasteful in energy.

By magnetically deflecting the electron beam rapidly back and forth before it emerges from the aluminum window, the lateral intensity distribution can be controlled. Accurate regulation can be applied only to a continuous beam of monoenergetic electrons, obtainable with a Van de Graaff accelerator. A desirable mode of scanning is the linear sawtooth waveform, which causes the electron beam to be painted on the moving product in even strokes. Figure 2B shows the uniform intensity distribution obtained across the product when a scanned, concentrated electron beam irradiates the material directly below the window.

The scanning circuit is shown in Fig. 3 and 4. A driver supplies the alternating current to a pair of coils surrounding the electron beam in much the same manner as in a television set. The amplitude is manually controllable, so that the scanned beam can fit the type of product being irradiated.

Scanning System

The most straightforward check on the performance of the scanning circuit is to monitor the linearity. The extent of the scan is measured by differentiating the signal from the scanning-coil driver and reading the rectified signal on a milliammeter. The linearity can be checked by observing the differentiated signal on an oscilloscope. Details of the scanning-coil assembly and electron window are shown in Fig. 5.

An oscillation frequency of 200 cps is sufficiently rapid to prevent intensity striations on materials moving under the window as fast as 30 feet per minute. Higher frequencies would require heavy-duty electron tubes to drive the scanning coils. At 200-cps scanning frequency the coils carry about 3 amperes, sufficient to deflect a 2-mev electron beam through 8 degrees. The scan is limited to this value to prevent excessive penetration distortion by electrons entering the product at an angle. At 8 degrees, the effective penetration is reduced by only 1 percent.

For practical purposes the width of scan on the product depends only

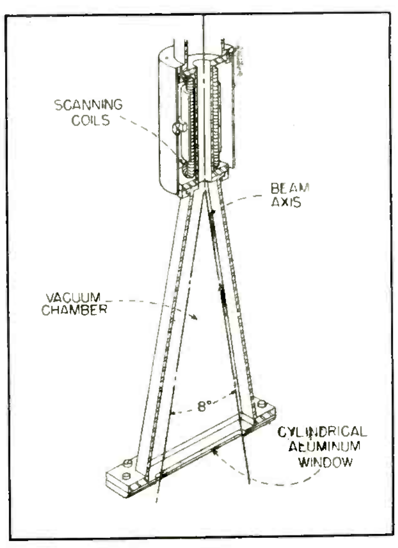
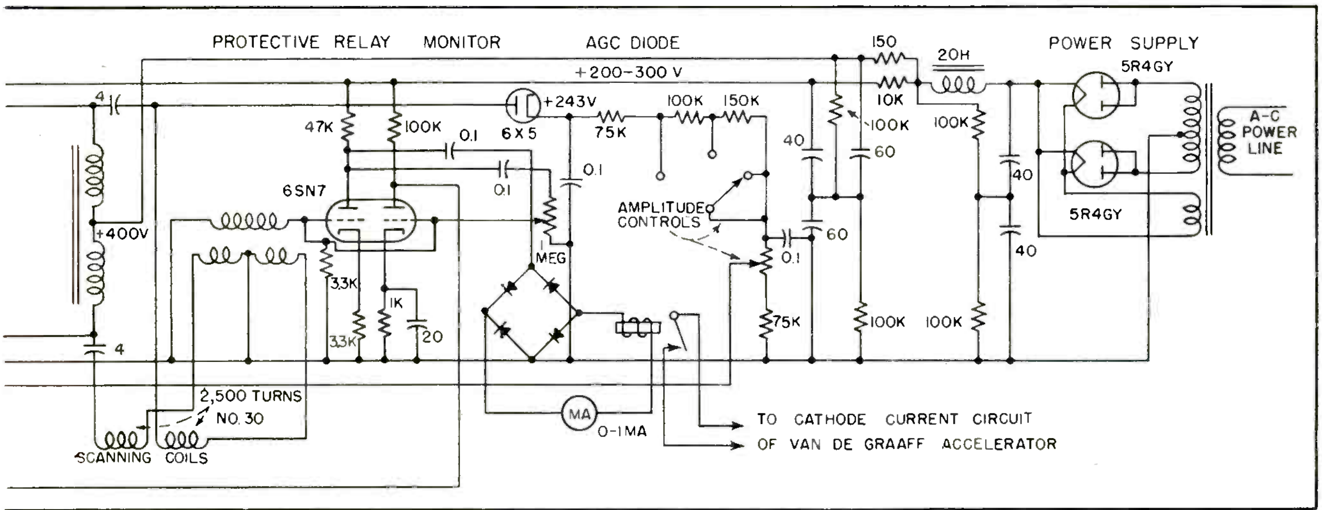


FIG. 5—Scanning assemble for 3-mev beam. Electron currents as high as 6 ma have been scanned and brought into the atmosphere through the window



wave dry-disk rectifier releases relay when scanning current fails, thereby breaking cathode circuit of accelerator. Tachometers on conveyor system generate power to energize other protective relays; if the belt stops for any reason, these relays similarly break accelerator cathode circuit. If product becomes jammed under electron beam, switches activate fail-safe protective relay system

on the distance between the scanning coils and the electron window. Scanned widths of over 10 inches are reliably obtained. The thin aluminum of the window is preformed into a semicylindrical configuration to withstand the atmospheric pressure without strain. The width of the window is one inch, which is ample to permit the 3/16-inch diameter beam to emerge.

Practical Electron Sterilization

The reduction to practice of the electron-sterilization process depends on careful research on individual products, because of the many characteristics which must be maintained or improved to satisfy the consumer and to meet the standards of the Food & Drug Administration. The potential advantages of the electron-sterilization process are attractive from both the economic and the packaging viewpoints. Products that cannot normally be sterilized today because of their heat sensitivity may be effectively processed by high-energy electrons in their final packages.

A complete Van de Graaff electron accelerator for sterilization research and small production-line use is being designed as shown in Fig. 6, with radiation protection surrounding only the product-treatment area. Interlocks in the generator circuits will shut the equipment off in the event of faulty operation, poor vacuum or extraneous radiation outside the protected zone. Larger accelerators, for heavier duty and the irradiation of thicker products, are under development. The most recent achievement in this field is a 3-million-volt Van de Graaff accelerator that produces more than 12 kw of scanned electron power into the atmosphere, a continuous ionizing radiation output greater by more than a factor of two than any other machine-produced source in the world. This equipment is capable of sterilizing over 5,000 pounds of material per hour, and can kill weevils and their larvae in over 340,000 pounds of flour per hour.

With apparatus of this scope, and with the technique of distributing the ionizing energy by a scanned beam, the electron-sterilization process is, for many products, in the range of commercially acceptable sterilization costs. Even at the present stage of development, total treatment costs, including capital amortization, are now resolved to a few cents per pound for the small units, and to a few tenths of a cent per pound for the largest.

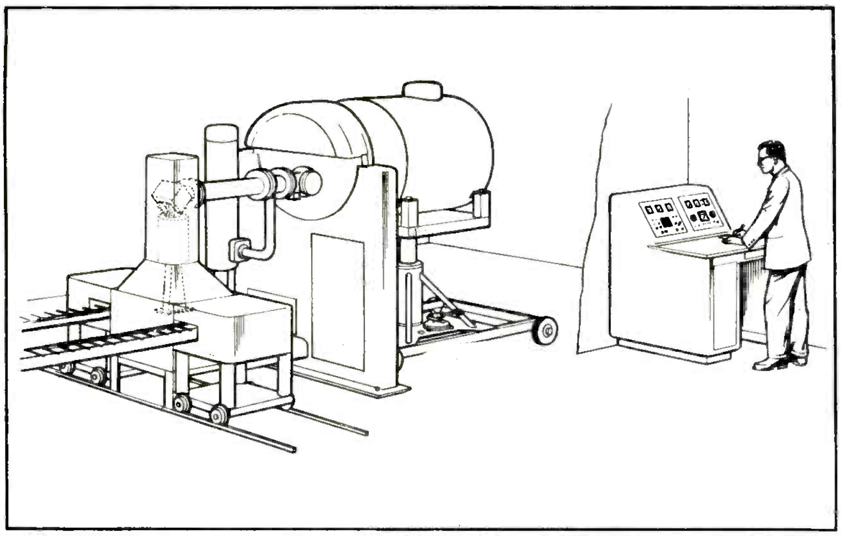


FIG. 6—Horizontally mounted Van de Graaff accelerator and electron sterilizer for research and small-scale production, rated at 2 mev and 0.5 kw electron output. Control console is located in adjoining room. With automatic electronic control, this accelerator is capable of continuous stable operation over extended periods of time

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Broadcasting TV

Survey of propagation data including experiments with tilting antenna shows that techniques for successful uhf broadcasting will differ from those currently employed at vhf. Lack of available power may require unidirectional transmitting antennas. Field distortion indicates need for small-aperture receiving antennas

How can radio energy be effectively broadcast in the hitherto unexploited ultrahigh frequency range?

Specifically the problem is to study propagation effects between 470 and 890 mc and to determine how to achieve an effective as well as efficient and economical television broadcasting service. This leads to a consideration of the use of high-gain transmitting antennas and examination of electric field-intensity conditions at probable receiving sites.

It has been shown that the disparity of such measured field strengths with respect to the predictions of simple theory increases with frequency.[1,2,3,4] Theoretical predictions, which must therefore be used with considerable caution, are useful in serving as a reproducible reference and to help explain some of the observations in a general way.

Important theoretical differences will be clarified by first examining theoretical field-intensity relations in both the lower vhf and the upper uhf ranges. The theoretical relations so oversimplify the case that practical field situations do not usually yield field strengths as high as predicted. A field survey will be cited to illustrate a practical comparison of measured with theoretical data. It is then shown that the vertical beam of the transmitting antenna may become so sharp as to reduce the effective gain of the antenna except at distance ranges where the maximum of the beam is employed.

This is illustrated in another theoretical comparison of propagation at a high and a low frequency with antennas of the same vertical dimensions and with respective vertical beams either horizontal or tilted downward. Experimental verification of the improvement in field strength available from tilting is then offered in a field survey. The data is divided into two distance ranges, a close range (1 to 5 miles) with important effects from antenna beam sharpness and tilt and a far range (5 to 21 miles) which is less affected by these factors.

It is helpful to review propagation theory curves for two widely separated frequencies, 85 mc and 850 mc. Because the theoretical relations are complicated by changes with frequency, there is no strictly fair comparison where there is wide separation of frequencies. Antenna power gain (for a given horizontal radiation pattern) is obtained by compression of the vertical radiation pattern into a narrow vertical angle. This is accomplished by distributing radiation sources over a vertical aperture with power gain linearly related to the length in wavelengths. The comparison of widely separated frequencies is difficult because two mutually exclusive criteria need to be satisfied.

In such a comparison the beam widths should be the same to make the effects of pattern shape identical. It seems fair to give the higher-frequency antenna the same vertical physical dimension as the low thereby making the power gain proportional and the vertical beam width inversely proportional to the frequency. The first choice penalizes the higher frequency with a smaller antenna than that of the lower frequency and consequently less power gain than it could justly have. The second choice inflicts a penalty, again on the higher frequency, by sharpness of the beam which may adversely affect close-in coverage.

It will be assumed that transmitting antennas have the same heights above smooth spherical earth and the same vertical, effective apertures. Both antennas consist of uniform, cophased current sheets. Transmitter power outputs are equal, and filters, diplexers, and transmission lines are assumed to

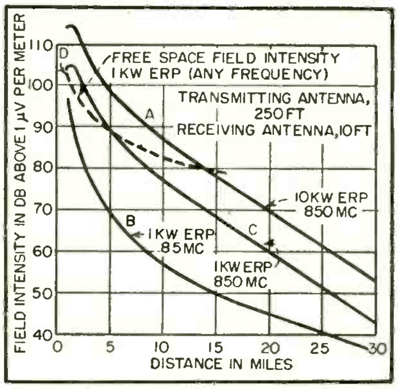


FIG. 1—Field intensities predicated upon a smooth spherical earth

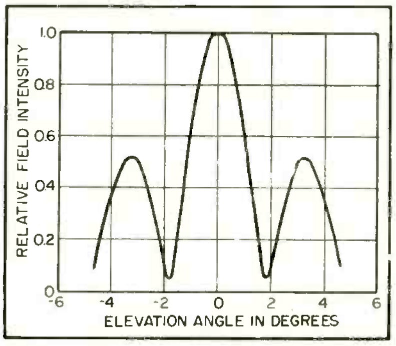
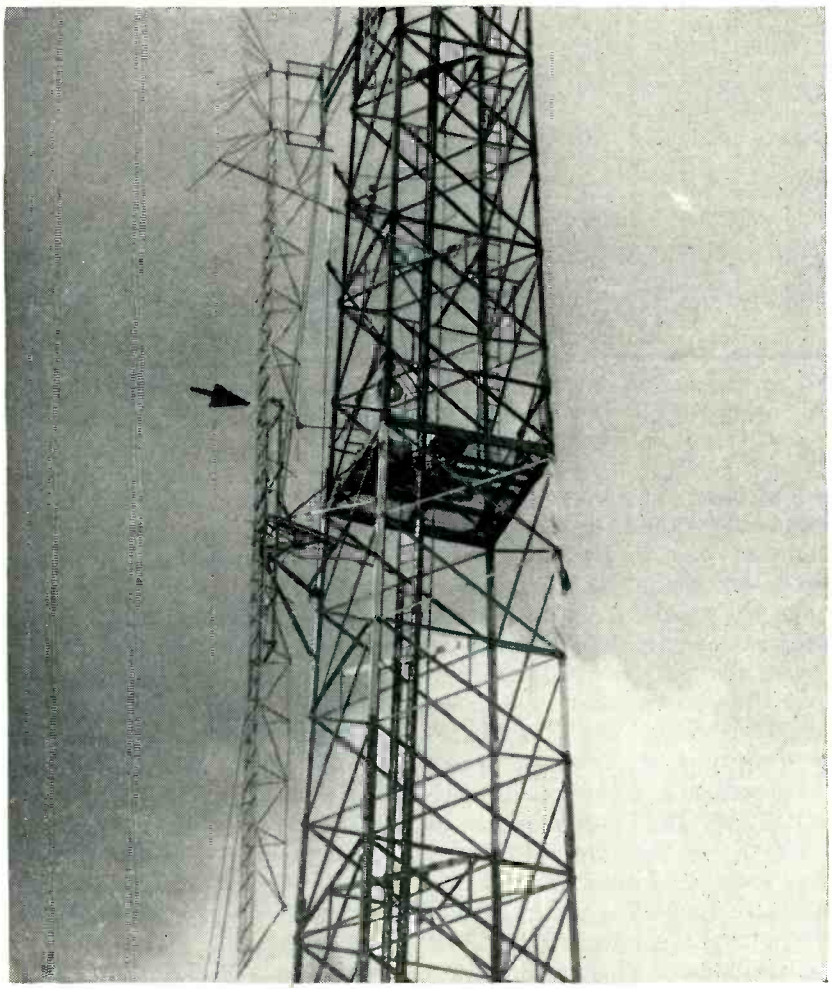


FIG. 2—Free-space vertical field pattern for omnidirectional antennas at 530.25 mc

in the UHF Band

By JESS EPSTEIN
and D. W. PETERSON
*RCA Laboratories Division
Radio Corporation of America
Princeton, N. J.*



Tilting antenna boom was mounted vertically on Success Hill tower near Bridgeport, Conn.

be lossless. Because the 850-mc antenna is ten times as many wavelengths in its vertical dimension as the 85-mc antenna, the high-frequency antenna free space gain will be theoretically 10-db greater than that of the low-frequency antenna. Thus, in Fig. 1 curves (A) and (B), very substantially higher fields are shown for the higher frequency, 10 db of which is attributable to antenna gain.

Phasing Improvement

In addition to the improvement from greater transmitting antenna gain (10 db) there is theoretical improvement from more favorable phase relations at the higher frequency. This occurs because at a given receiving antenna height (within the range of heights that are of concern) the earth-reflected and direct rays are more nearly in phase at the higher frequency. Thus according to Fig. 1, curves (B) and (C), the higher-frequency antenna yields greater fields even when both antennas have the same gain.

To evaluate the theoretical curves of Fig. 1 it is assumed further that the receiving antennas have the same effective apertures, in which case equal field strengths produce equal receiver terminal voltages. The receiving transmission lines are assumed lossless, and the receivers have the same noise factors.

Under the idealized postulated conditions, television receiver performance with respect to thermal noise in the picture is predicted by the two field-strength curves. Thus the difference of the two curves (A) and (B) represents improvement of theoretical performance of 850 mc over 85 mc. Along a line between one and twenty miles range, theoretically the median 850-mc field strength will be 28 db greater than the corresponding median for 85 mc for the specified conditions.

Smooth-Earth Calculation

The theoretical field-strength curves have been calculated for smooth spherical earth,[5,6] by K. A. Norton and others. The measured field data[7] more closely approach this smooth-earth theoretical data at 85 mc than at 850 mc. This may be taken as evidence that the postulated theoretical conditions are more adequately satisfied under practical operating conditions at 85 mc than at 850 mc. However, sufficient smoothness to corroborate simple theory has also been obtained under special conditions at 530.25 mc and 850 mc.

Other data measured under more typical receiving conditions have shown wide departure from smooth spherical earth theory. An analysis of data shown in "Comparative Propagation Measurements; Television Transmitters at 67.25, 288, 510, and 910 megacycles"[7] will show that for a specified effective radiated power the median field intensity is actually inversely proportional to frequency under some conditions.

Because of the present difficulty in obtaining high transmitter power at ultrahigh-frequencies and the apparent propagation handicaps, it seems reasonable to make a

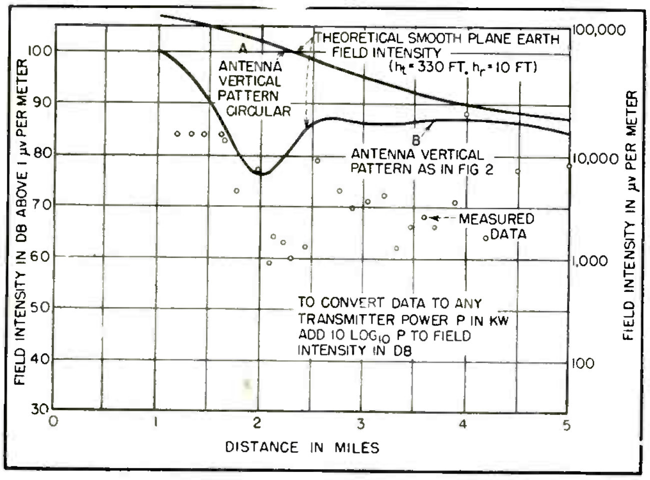


FIG. 3—City field intensity for 1 kw erp (based on actual 13.9-kw erp) at 530.25 mc

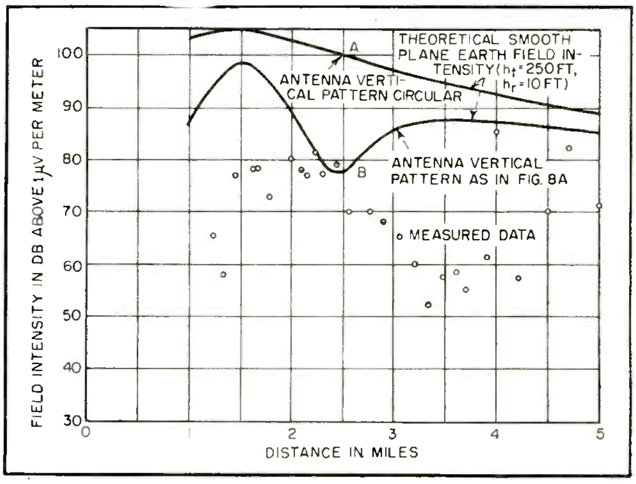


FIG. 4—City field intensity for 1-kw effective radiated power at 850 mc

careful study at ranges relatively close to the transmitter. A distance range of one to five miles was chosen for special study since this range has special interest and can encompass a city in the order of several hundred thousand population. The frequencies used are 530.25 mc and 850 mc. The 530.25-mc transmitting antenna, which was described in a previous investigation[8] of the performance of KC2XAK, is omnidirectional and has a gain of 12.4 db referred to a half-wave dipole. The vertical radiation pattern is shown in Fig. 2. The 850-mc antenna, illustrated, is unidirectional and has a gain of 19.2 db. The horizontal radiation pattern is 65 degrees at the half-field points and the vertical pattern is shown in Fig. 8A.

The theoretical smooth-plane-earth fields for the two frequencies and the respective antenna heights are shown in Fig. 3 and 4. The curves designated (A) in the two figures were calculated by assuming that the antennas had no vertical directivity and adding in db the respective nominal antenna gains. An antenna with gain independent of vertical angle is thus supposed. Such a procedure might have been valid at low frequencies for apertures commonly used.

Because of the vertical directivity of the antennas, however, it will be necessary with the 530.25-mc and 850-mc antennas to reduce the theoretical fields by an antenna-pattern factor as has been done for curves designated (B), Fig. 3 and 4. The field intensities were measured along a line through Bridgeport, Connecticut, at the maximum of the pattern, using a method to be described below. The normalized measured fields are also shown in Figs. 3 and 4. The 530.25-mc measured data is lower than the theoretical curve by a median value of 13 db along the one-to-five-mile line.

The 850-mc measured data is correspondingly 17 db below its theoretical curve. This means that 50 per cent of the measured field strengths are lower than the smooth - plane - earth theoretical curves by the specified value or more. It should be remembered in comparing measured data of the two frequencies with their respective theoretical curves that propagation from the 530.25-mc antenna may have been favored by its greater height.

Although exhibiting reduction of field strength at the distance range of the null of the vertical pattern, the close-in coverage of KC2XAK was quite adequate. The erp was 13.9 kw or 11.4 db above 1 kw. By adding 11.4 db to the measured data of Fig. 3, the null of the vertical pattern yielded close to grade-A service of 74 db above 1 μv per meter.

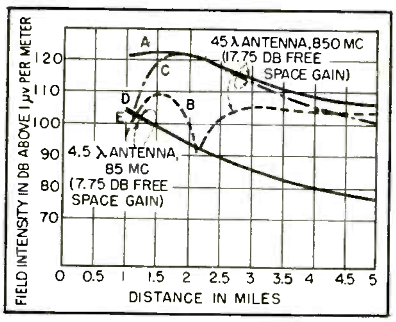


FIG. 5—Theoretical curves for 1-kw transmitter using 250-foot antenna and receiver at 10 feet. Curves *A* and *D* are vertical pattern for maximum field at all distances; curves *B* and *E* are for zero tilt; *C* is for 1.25-degree downward tilt

Effective Power Concept

The importance of the antenna's vertical directivity has been shown in Fig. 3 and 4. Substantial reduction in theoretical field strength results from sharpness of the vertical beam of the transmitting antenna. There is evidently need to review the meaning of effective radiated power. The effective radiated power is commonly considered to be the transmitter power increased by the free-space maximum gain of the transmitting antenna and is not, under the conditions here described, really *effective* radiated power.

The theoretical data of Fig. 3 and 4 suggest beam tilting for improving coverage in a limited distance range by aiming the maximum of the vertical radiation pattern at some point within the range served by the transmitter. In this manner the nominal effective radiated power becomes actually realized within some limited but useful range. Such a beam-tilting procedure has been used in a number of instances but usually there has been no opportunity to study the results.

To look into the possibilities of

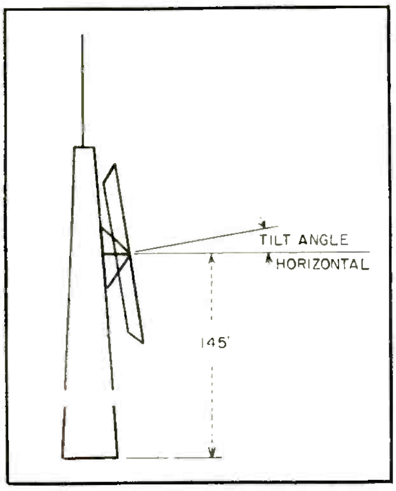


FIG. 6—Tilting-beam antenna with 6-minute period of oscillation

beam tilting, another comparison of the theoretical fields at 850 mc and 85 mc will be made. Assume an 850-mc antenna of 45λ vertical dimension and an 85-mc antenna of 4:5λ vertical dimension. The vertical radiation patterns will be as calculated for a constant co-phased current sheet, Fig. 11. The gains will be 17.75 db and 7.75 db respectively with the vertical physical dimensions the same for the two antennas.

Calculating the smooth-plane-earth fields in the 1-to-5 mile range produces curves (A) and (D) of Fig. 5. It has been assumed that the antenna gain is fully realized as it would be if the antenna maximum were aimed by tilting at the receiving antenna in every instance.

If the beam is aimed horizontally as in conventional practice, the field-strength curves are shown in Fig. 5B and 5E. At 85 mc the resulting reduction in field is negligible, but at 850 mc the field is considerably below that obtainable by tilting the beam.

Since for a broadcast service, the antenna cannot be tilted a different amount for every distance along the 1-to-5 mile radial line, there must be a compromise. Suppose the 850-mc antenna is arbitrarily tilted down 1.25 deg., then curve (C) describes the theoretical field. It can be seen in Fig. 5 that in a 1.1-to-4.3-mile range the theoretical field is increased by tilting the antenna down 1.25 deg. At greater distance there will be reduction of field, which is the price paid for improved field from 1 to 4.3 miles.

Beam Tilting Experiments

To learn if the improvement in performance predicted by the theory can in fact be realized in a practical situation, beam-tilting patterns were made at 530.25 mc and 850 mc. The antennas, mounted as in Fig. 6, were 49 feet in height, which is 26.4λ at the lower and 42.3λ at the higher frequency. The 850-mc antenna has been described above. The 530.25-mc antenna consisted of another set of dipoles previously mounted on the same frame with the horizontal pattern nearly the same as that for the 850-mc antenna and the vertical pattern as shown in Fig. 7A. Unidirectional antennas were used to eliminate supporting tower effects. Mechanical rather than phase-shift tilting was used for ease of measurement of tilt angles. This involved a single measurement of the vertical radiation pattern and a simply obtained tilt calibration.

Similar beam tilting could have been accomplished by phase shifting with the attendant complications not warranted for this experiment. To facilitate measurements the beam was tilted periodically ± 6 deg over a 6-minute period. The transmitter was keyed off 10 seconds once during each tilting cycle to communicate to the receiving site the time of an exactly predetermined angular position of the transmitting antenna. In this manner recordings of relative field strength as a function of time could be made at any receiving site with a recorded time reference. From a tilt-angle-versus-time calibration of the transmitting antenna, the relative field intensity as a function of tilt angle could thus be readily determined.

Data obtained in this manner for both frequencies are shown in Fig. 7 and 8. It was found that in the city and at distances up to about 20 miles the field intensity maximized with the free-space beam aimed at the receiving antenna. It was also learned that at distances well beyond line-of-sight, 90 miles and 140 miles, the field maximized with the transmitting antenna beam aimed horizontally. Figure 9 shows the 90-mile patterns, which were recorded under unusually high field-strength conditions.

To profit from these facts the 850-mc antenna beam was tilted down 1.3 deg to direct horizontally the first null above the main beam. The improvement in field strength

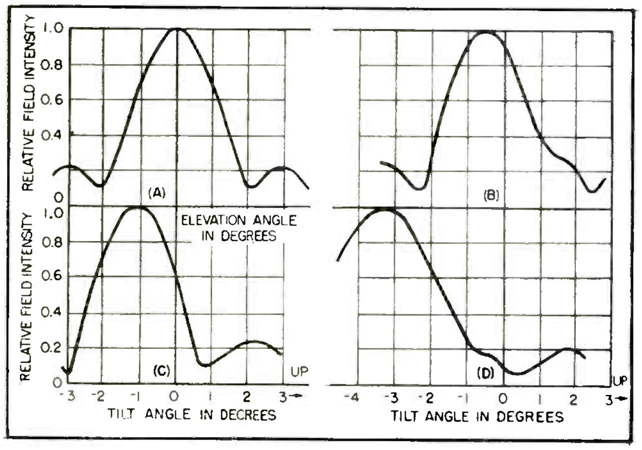


FIG. 7—Unidirectional 530.25-mc antenna free-space field pattern for (A) elevation 60 feet at 12 miles (B) at 3 miles (C) and 1.1 miles (D) from the transmitter

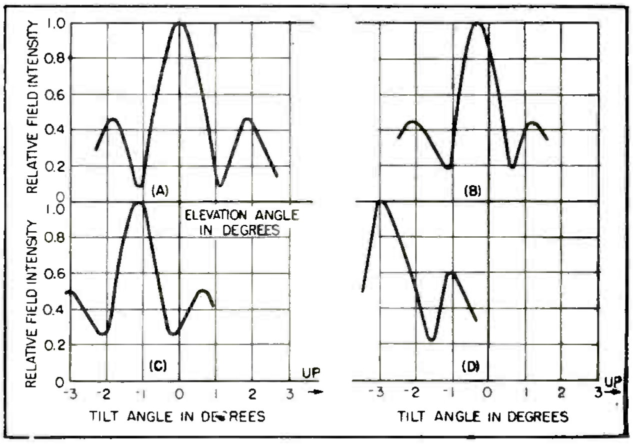


FIG. 8—Unidirectional 850-mc antenna free-space field pattern (A) elevation 20 feet at 15 miles (B) 120 feet at 3.7 miles (C) and 60 feet, 1.2 miles (D)

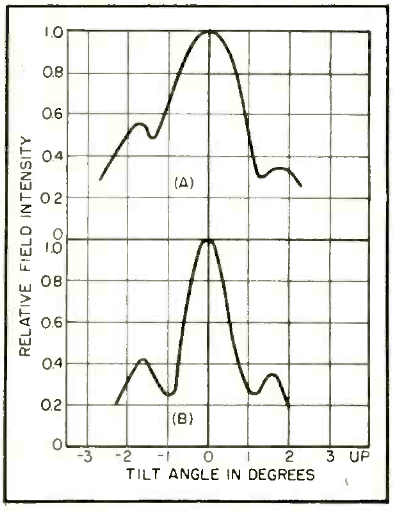


FIG. 9—Tilt pattern, 530.25 mc at 90 miles, elevation 50 feet (A) and for 850 mc (B)

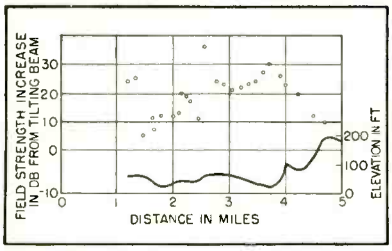


FIG. 10—Effect of beam tilting from antenna 330 feet high tilted downwards 1.3 deg

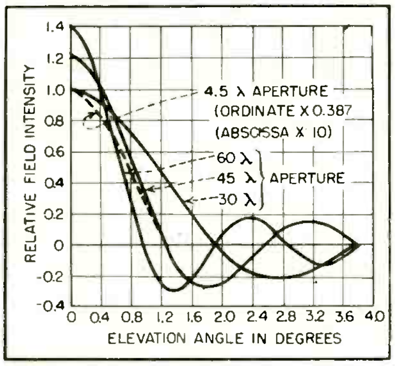


FIG. 11—Free-space radiation patterns for constant cophased current distribution

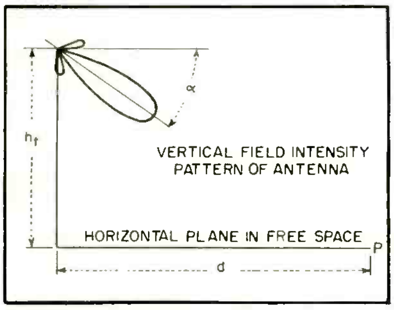


FIG. 12—Propagation curves of Fig. 13 are based upon these antenna characteristics

in the 1-to-5-mile range from tilting is shown in Fig. 10. The median value of improvement was 11 db. From recordings of field strength at 90 miles the tilting also yielded a reduction of troposphere-propagated field in the order of 12 db because the vertical radiation pattern null was directed horizontally.

Beam Tilting In Free Space

The tilt patterns of Fig. 7 and 8 look somewhat like free-space theoretical patterns that would be measured in an imaginary plane in free space below the transmitting antenna. In Fig. 11 are free-space calculated patterns for various apertures. Relative field versus distance for these theoretical patterns as calculated for a plane h feet below the transmitting antenna, see Fig. 12, are shown in Fig. 13.

The antenna pattern for a 45λ aperture and the transmitting antenna height 250 feet cooresponds approximately to the pattern and height for the 850-mc surveyed radial. A reasonable correspondence for improvement from tilting between measured data of Fig. 10 and the free-space theoretical data of Fig. 13 will be seen. Reference to the plane-earth theoretical data of Fig. 4 may also be made.

The propagation curves of Fig. 13 illustrate the range of array apertures and heights for which the sharpness of the vertical radiation pattern may be of concern. The limitations of beam tilting are also evident.

It may be concluded from foregoing measured data and theoretical considerations that for limited-area coverage of improved efficiency and for reduced tropospheric signals (at least some of the time) uhf transmitting antennas can be designed to take advantage of narrower vertical beams than heretofore used.

Shaped Beam Antennas

The field intensity throughout the area to be served should probably be constant. This assumes that there will be no high interference zones. The experience with vhf television has been that the downtown city areas require higher field strengths than the suburban areas. The lessened interference at higher frequencies from local sources makes it appear likely that the same requirement need not be imposed on uhf television.

The beam-tilting experiments show how average field distributions in an area the size of a fair-sized city depend on vertical beam shape. It follows that one may sometimes use specially shaped vertical beams to obtain constant field strength in a limited area. A somewhat idealized free-space vertical radiation pattern is shown in Fig. 14A, which in a plane 500 feet below the antenna yields nearly constant field from 0 to 6 miles, as in Fig. 15A and reduction of troposphere propagated field.

A similar but conventional radiation pattern main beam is also shown in Fig. 14B and the resulting field as a function of distance for $h = 500$ feet and tilt angle $= 0$ is given in Fig. 15B. This would be the coverage data of conventional practice. The efficiency of the shaped pattern for limited-area coverage is quite apparent by comparison in Fig. 15 with curve (B') and the coverage data of Fig. 15C for a tilted conventional beam. The additional feature of reduction of tropospheric propagated fields could be advantageous in allocations.

Unidirectional Telecasting

In the establishment of any broadcast service the choice of the radiation pattern is governed both by the location of the antenna and the service area that it is desired to cover. In the vhf range the common practice has been to use an omnidirectional antenna placed on the highest available structure centered in the service area.

Although one might conclude that the same factors would govern the choice of a site for the uhf range there are several reasons that strongly indicate some use of unidirectional radiating systems. The most obvious reason is that a number of stations will be forced to find locations on one side of their service area because of the lack of suitable structures centrally located or because of the financial problems associated with constructing one. Although we lack a comprehensive study of all the propagation factors involved in such a situation we do have sufficient experimental data to indicate that adequate coverage can be obtained with such an arrangement.

In general the technical and constructional problems of building a high-gain uhf unidirectional antenna are considerably easier than for an omnidirectional antenna.

Because tilting for improved coverage in a limited-distance range may be accomplished with either uni- or omnidirectional antennas mechanical or phase-shift tilting can readily be used with the former types while the latter antennas will usually require phasing networks.

The concept of designing a telecasting system to serve a specified area with constant field strength can be employed with either type but the indications are that it can more easily be accomplished with a unidirectional type of antenna.

It cannot be emphasized too strongly that the problems associated with uhf coverage should be approached without bias. Experience and practice of vhf are not an adequate guide for procedures in this new range. The compelling reason that makes serious consideration of unidirectional telecasting as well as other innovations advisable is the present technical difficulty of obtaining sufficient radiated power to perform on a par with vhf systems.

Measurements Beyond Five Miles

Field-strength measurements beyond five miles are shown separately from the 1-to-5-mile data because with the conventional practice of aiming the beams horizontally the received signals come from on or near the maximum of the vertical pattern. This was the result of the choice of transmitting antenna heights and the vertical beam widths. From 5 to 20.7 miles the average terrain elevation was 80 feet. The 530.25-mc antenna was 340 feet and the 850-mc antenna 260 feet above the average 5-to-20.7-mile terrain elevation.

The smooth spherical earth theoretical field strengths and the measured data are shown in Fig. 16 and 17. The 530.25-mc measured data have a median value of 19 db below the theoretical curve. The 850-mc data are correspondingly 25 db below the theoretical curve. The difference between 19 and 25 db may be in part due to more favorable propagation conditions from the higher 530.25-mc antenna because of its greater height.

Also shown in Fig. 17 are the measured field-strength data with the 850-mc beam tilted down 1.3 deg. The median value of reduction cost of the 11-db increase in median field strength that was measured in mile range was 5 db. This is the the 1-to-5-mile range.

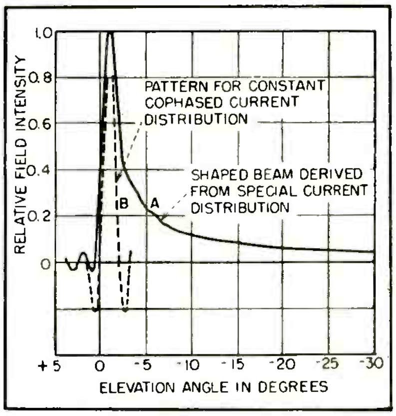


FIG. 14—Free-space vertical field patterns for 50-wavelength aperture

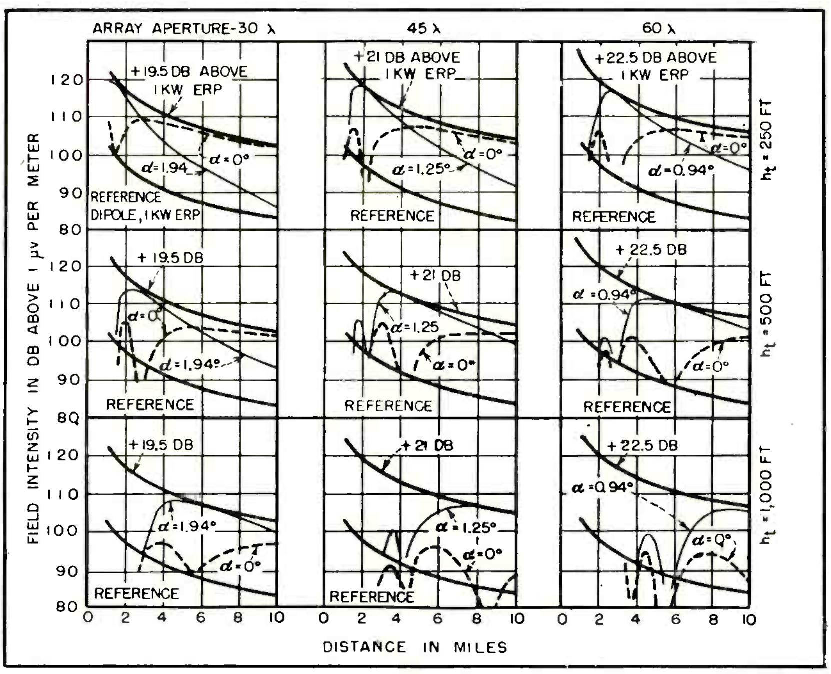


FIG. 13—Free-space propagation for antenna characteristics shown in Fig. 12 and explained in text

Method of Making Survey

The ultimate objective in field surveying is to study the capability of a given transmitter and transmitting antenna to serve the homes of the area in question with useful television signals. For this purpose no fully satisfactory method of sampling fields in a uhf survey has been devised. A method used in vhf surveys is to make continuous recordings from which sector medians are plotted. The radial plots of sector medians are used to derive constant-field contours. Experience indicates that the use of these methods in the uhf range will be misleading.

Some observations about the nature of uhf fields in and above a residential area will help to choose a sensible method of making the survey measurements and show inadequacies of vhf methods. Of great importance is the fact that even in sparsely settled residential areas the field distributions are exceedingly complicated. Every object in sight apparently contributes to the net field either by reflection or diffraction. In a locality consisting of well-spaced one-story houses relative receiver terminal voltages as a function of position along a straight line are shown in Fig. 18A. At a 40-foot height, which is 25 feet or more above the roof tops, there is apparently as much varia-

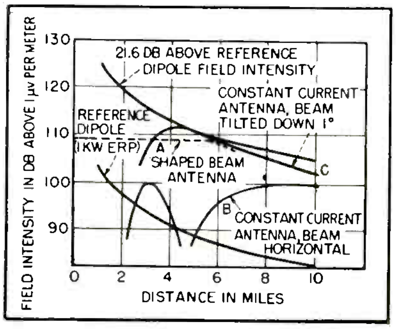


FIG. 15—Free-space field intensity in plane 500 feet below antenna

tion as at 10 feet. These data are typical; in fact, one may usually expect comparable or greater variations in a city. Terminal voltage as related to height in Fig. 18C shows similar quite unpredictable variations.

An ideal receiving site would have field strength proportional to height, substantially constant field strength in any horizontal plane, and constant phase in a plane normal to the line of propagation. Under these conditions the field strength indicated by either a dipole or an array will be the same provided the ratio of the height of the array to its vertical aperture is large.

With distorted fields as usually encountered, a dipole indicates a field strength that is extremely variable with position. An array exhibits normal gain only with the ideal receiving conditions. Thus, the two antennas will indicate different apparent field strengths.

A little consideration of the nature of reflections from a simple planar reflector in free space will help to show why the effectiveness of receiving antennas diminishes with frequency. Such a reflector, if perpendicular to the line of propagation, produces standing waves with maxima every half wavelength in space. The reflector acts like a uniformly excited antenna and thus the standing wave produced will exist in a space corresponding in shape to the radiation pattern of such an antenna. Thus, a given reflector produces a beam of standing waves that increases in sharpness with frequency.

The evidence from probing at receiving sites at say 850 mc, is that the field distributions are exceedingly complicated configurations as if many reflecting objects made contributions to the net field. To again compare 850 mc and 85 mc, one may reasonably consider a half wavelength 85-mc dipole as a standard. An 850-mc antenna to deliver the same terminal voltage if exposed to a uniform field distribution requires 10 times the area (in square wavelengths) of uniform field as the 85-mc antenna.

Antenna Comparisons

Having started with an antenna that was practical at 85 mc because it required a relatively small area of uniform field (in square wavelengths) it becomes evident that in fields as commonly distorted by reflecting objects and diffraction the comparable 850-mc antenna will suffer from field distortion because it will require a much larger area of uniform field (again in square wavelengths).

At a given receiving site one may either probe with a small antenna for maxima of the field distribution or use an unwieldly, large antenna that will ordinarily be subjected to fields so far from the uniform field for which it was designed as to be rendered almost useless. A small unidirectional antenna like a half-wave dipole employing a sheet reflector appears to be a reasonable compromise and such antennas were used in all measurements described. This antenna may reduce many reflected components of field and does not require a large area of uniform field.

The amount of probing done at each site in a field survey is arbitrary and, of course, will affect the results. The maximum receiver terminal voltage obtainable along a 25-foot line 10 feet above the ground has been chosen as a practical value from which to compute effective field strength. A similar amount of probing may ordinarily be done on the roof of a house in actual installations if found necessary.

The receiving antenna for the survey should be on the roof tops but since this is impractical, it appears that a ten-foot height above ground is as good a value as can be used and has the advantage of convenience for automobile measurements. Peak values are here used instead of the more usual medians because peaks are available for use in practical installations and the ineffectiveness, bulk, and cost of large-aperture antennas make it likely that small antennas will be used ultimately in most installations.

Field vs Receiving Antenna Height

The theoretical relationship of field and height becomes increas-

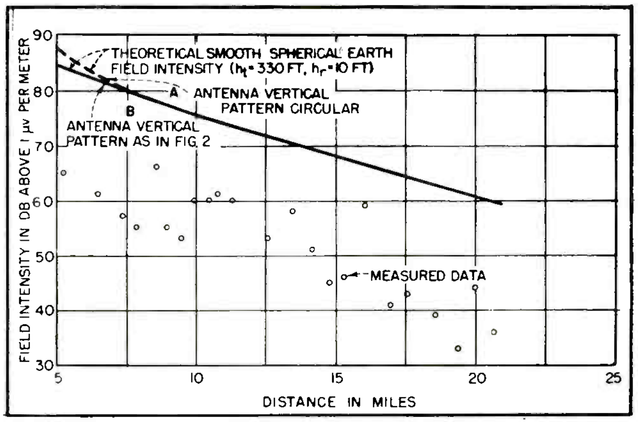


FIG. 16—Country field intensity for 1 kw erp at 530.25 mc

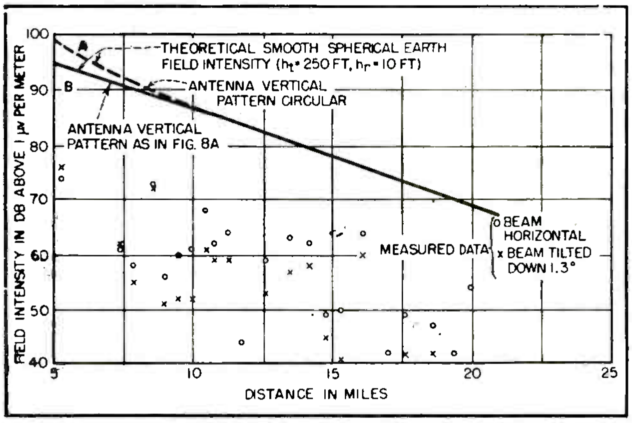


FIG. 17—Country field intensity for 1 kw erp at 850 mc

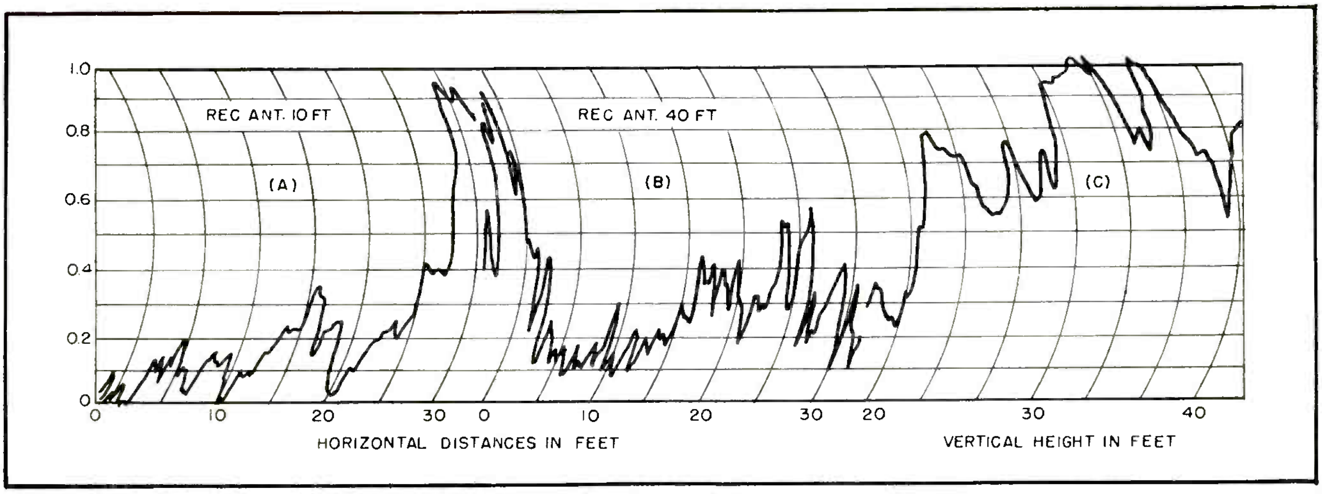


FIG. 18—City field-intensity distribution for receiving antenna at 10 feet (A) at 40 feet (B) and with vertical height at a fixed location (C)

ingly complicated at heights and distances that here concern us, as frequency is increased. Smooth, curved-earth theory yields the curves of Fig. 19 for 850 mc and 85 mc. Transmitting antennas having the same vertical radiation patterns of circular form have been assumed.

Field measurements under the most ideal conditions confirm the theoretical relations but with surroundings ordinarily encountered at receiving sites no such simple relations exist.[8] If there is any connection at all between the idealized theory and the actual field-height relations commonly existing, it is well obscured by diffraction and reflection from nearby objects.

Summary of Tests

The establishment of television broadcasting service in the uhf range must contend with different fundamental limitations than those of vhf broadcasting: (1) uhf propagation is demonstrably poorer under practical receiving conditions than predicted by smooth-spherical-earth theory; (2) vertical beam sharpness reduces the effectiveness of the power gain of large-aperture high-frequency broadcasting antennas; (3) field distortion reduces the effectiveness of large-aperture receiving antennas.

Important differences with respect to lower frequencies that may be advantageous for uhf telecasting are: (1) unidirectional telecasting is more easily accomplished in the uhf range than previously at lower frequencies so that unidirectional antennas will probably find increasing application; (2) The lack of man-made interference in the uhf range is of importance and may affect the approach to uhf telecasting by relaxing the usual requirement of higher field strength in built up areas.

To compensate for inherent limitations of conventional practice, beam tilting and shaping can evidently be employed. Tilting and shaping techniques may be desirable for three reasons: (1) improved system efficiency (more receiving sites get usable signals); (2) field strength may be made independent of distance in the service area; (3) troposphere-propagated signals may be reduced. Vertical half-field beam widths in the order of two degrees become possible and may be practical if properly employed, to improve system performance in the uhf range.

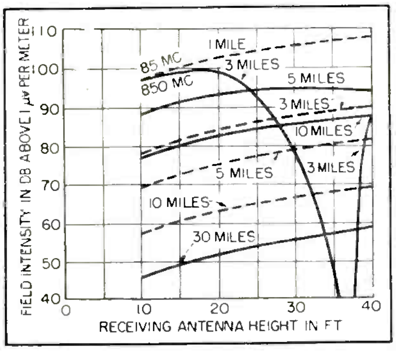


FIG. 19—Smooth-spherical-earth field intensity based upon 1 kw erp from a dipole antenna

There are still unresolved questions about uhf broadcasting. We can be assured, however, that there will be uhf television service on a large scale. The feasibility has been convincingly demonstrated by KC2XAK in Bridegport. Proper use of high towers, high transmitting antenna gains, and shaped, tilted beams will be of increasing importance.

Acknowledgment

The field tests in the Bridgeport area were conducted with the co-operation of John L. Seibert of the National Broadcasting Company. The special transmitter used was built by George Olive and William Behrend of RCA Laboratories. Transmitters were operated by Victor Bary and others of the National Broadcasting Company.

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Experimental

A low-power uhf television transmitter installed at Stratford, Conn., near Bridgeport for propagation and antenna tests uses a triode grounded-grid power-output tube and single-tuned cavity. Neutralization suitable for cavity circuits is detailed

LATE in 1949, RCA and NBC put into operation in Bridgeport, Connecticut, an experimental uhf television transmitter, Station KC2XAK, operating in the frequency band 529-535 mc.[1] In the period of over two years that it was in operation a great deal of information about many phases of uhf television has been obtained.[2,3] In the case of the beam-tilt experiments by Peterson and Epstein, the data from the low end of the uhf television band was obtained using the KC2XAK transmitter. It was felt desirable to continue these experiments in the upper end of the band for the purpose of obtaining comparative data. Accordingly a television transmitter for the upper end of the band was built and installed, under the call letters KC2XCY, in the same building as KC2XAK. The carrier frequencies were 850.00 mc visual and 854.50 mc aural.

Final Stage

The type 5588 tube was selected for the final power amplifier, because at the time of construction of the transmitter it was the tube with the highest power capabilities at 850 mc that was readily available. Although it is a triode requiring neutralization it was decided that this disadvantage compared to the multiple operation of tetrodes was outweighed by the advantage of the compactness and convenience of a single-tube cavity. Before the transmitter was finished, however, a new tube, the type 6161, was made available. The type 6161 tube is electrically similar and mechanically identical to the 5588, the difference being that the 6161 has an improved cathode that makes possible higher maximum plate voltage and higher maximum cathode-current ratings. The type 6161 triode is used in the Bridgeport transmitter. It has a coaxial construction that makes it suitable for use in cavity type circuits.

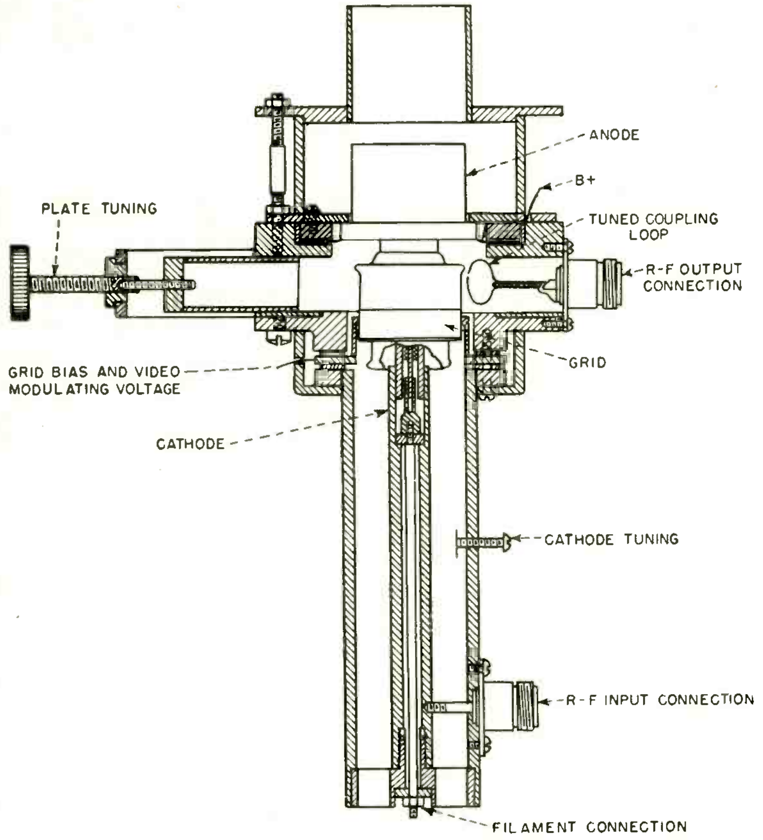


FIG. 1—Cross-section of final power amplifier stage

The final stages in both visual and aural transmitters are identical and consist of one type 6161 tube operated with grounded grid. The final stage in the visual transmitter is grid modulated.

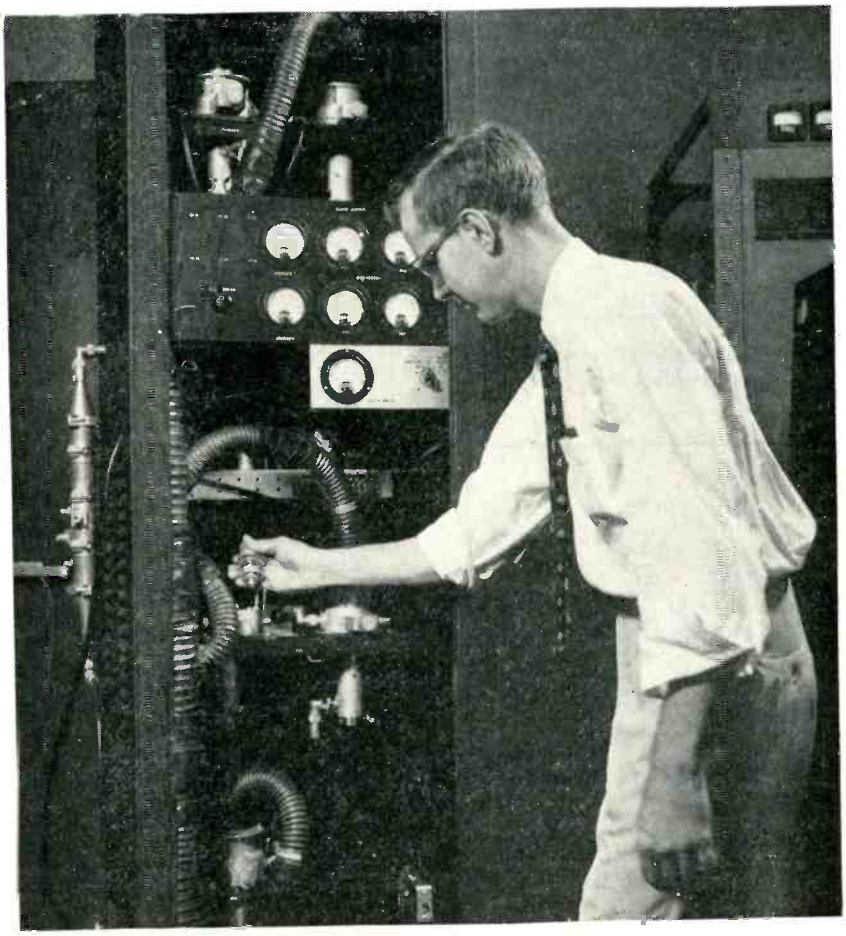
A cross-sectional view of this stage is shown in Fig. 1. The input (cathode) circuit is a shorted three-quarter-wavelength coaxial line, foreshortened by tube capacitance. The output (plate) circuit is a reentrant cavity. The driving power is coupled directly to the inner conductor of the cathode tank at a point that gives a nominal 50-ohm input impedance. The output power is taken from the plate cavity by means of a tuned coupling loop.

The cathode circuit is tuned by means of a movable plate that changes capacitance at a point of maximum voltage in the cathode

50-Mc TV Transmitter

y G. A. OLIVE
a Laboratories Division
.o Corporation of America
Princeton, N. J.

circuit. The plate circuit is tuned by means of cylindrical plungers that move radially into the plate cavity.



Bridgeport experimental transmitter final amplifiers. Ducts blow air into r-f cavities

Neutralization

It is known that a grounded-grid amplifier cannot easily be plate modulated 100 percent. With the plate voltage zero there are intervals during the r-f cycle when the cathode is negative with respect to the plate and grid owing to the driving voltage. During these intervals pulses of plate current flow to the plate and develop r-f power in the load. The source of this power is the driver of the stage. It is characteristic of grounded-grid amplifiers that a portion of the driving power appears in the load.

In Fig. 2 is an equivalent circuit of a grounded-grid amplifier, which is useful in a qualitative way. It is seen that the load impedance Z_2 is in series with the driving voltage and that unless r_P can be made very large by the action of a modulating voltage, deep modulation cannot be obtained. Conventional plate modulation alone will not increase r_P sufficiently to secure 100 percent modulation. Normally, if a grounded-grid amplifier is to be plate modulated, its driver must be modulated simultaneously.

If the grounded-grid amplifier is to be grid modulated, as in Fig. 3, it is possible to make μ go to zero and r_P go to infinity by the action of a modulating voltage on the grid simply by swinging it sufficiently negative to cut the tube off regardless of the cathode swing. It is therefore possible to grid modulate a grounded-grid amplifier and obtain 100-percent modulation, without the necessity of simultaneously modulating the driver amplifier stage.

Considering the interelectrode capacitances of the tube, it is seen that with the tube cut off there is still the network shown in Fig. 4A connecting the input and output circuits. In general it is necessary to neutralize the plate-cathode capacitance, for it adversely affects the performance of the modulated amplifier in three ways. It prevents the attainment of 100 percent modulation, causes the phase of the carrier to vary with power level and decreases its stability. There are several methods by which complete neutralization can be achieved.[4, 5] In this transmitter a system of partial neutralization[5] was used that is particularly well adapted for single-tube cavity circuits for grounded-grid operation.

In Fig. 4B the interelectrode capacitances are arranged in their equivalent wye. In Fig. 4C there is inserted a neutralizing inductance, L_n, between grid and ground, which effectively isolates the input and output circuits under cutoff conditions. The neutralization is not complete however for an element has been introduced that causes a voltage to appear in the input circuit in response to a current in the output circuit and vice versa. The addition of this neutralizing inductance has made 100 percent amplitude modulation possible. The effect of the inductance on the stability and incidental phase modulation will be analyzed further.

Consider the equivalent circuit in Fig. 5. Here are included the interelectrode capacitances in their equivalent wye form and a neutralizing inductance. This network

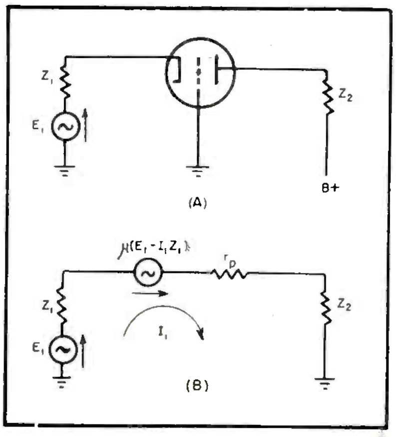


FIG. 2—Grounded-grid amplifier (A) and equivalent circuit (B)

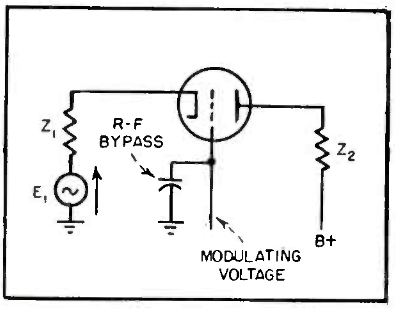


FIG. 3—Grid-modulated grounded-grid amplifier

is solved at a single frequency ω_o, where $\omega_o^2 L_n C_3 = 1$, $\omega_o^2 L_1 C_1 = 1$, $\omega_o^2 L_2 C_2 = 1$ and Y_1 and Y_2 are pure conductances.

The stability under more general conditions will be discussed later.

Corollaries of the above restrictions are

$$E_3 = 0$$

$$E_g = -[\omega_o^2 L_n C_1 E_1 + \omega_o^2 L_n C_2 E_2]$$

$$= -\left[\frac{C_1}{C_3} E_1 + \frac{C_2}{C_3} E_2\right]$$

Since $E_3 = 0$, the system is described by the equations

$$E_1\left[Y_1 + \frac{1}{j\omega_o L_1} + j\omega_o C_1\right] + (E_1 - E_2)\, g_p + (E_1 - E_g)\, g_m = I_1 \quad (1)$$

$$E_2\left[Y_2 + \frac{1}{j\omega_o L_2} + j\omega_o C_2\right] + (E_2 - E_1)\, g_p - (E_1 - E_g)\, g_m = 0 \quad (2)$$

$$E_g = -\left[\frac{C_1}{C_3} E_1 + \frac{C_2}{C_3} E_2\right] \quad (3)$$

By substituting Eq. 3 in Eq. 1 and Eq. 2

$$E_1\left[Y_1 + g_p + g_m + \frac{C_1}{C_3} g_m\right] - E_2\left[g_p - \frac{C_2}{C_3} g_m\right] = I_1 \quad (4)$$

$$-E_1\left[g_p + g_m + \frac{C_1}{C_3} g_m\right] + E_2\left[Y_2 + g_p - \frac{C_2}{C_3} g_m\right] = 0 \quad (5)$$

The solution of Eq. 4 and Eq. 5 for E_2 is

$$\Delta = \left[Y_1 + g_p + g_m + \frac{C_1}{C_3} g_m\right]\left[Y_2 + g_p - \frac{C_2}{C_3} g_m\right] - \left[g_p + g_m + \frac{C_1}{C_3} g_m\right]\left[g_p - \frac{C_2}{C_3} g_m\right]$$

$$= Y_1\left[Y_2 + g_p - \frac{C_2}{C_3} g_m\right] + Y_2\left[g_p + g_m + \frac{C_1}{C_3} g_m\right] \quad (6)$$

$$\Delta \times E_2 = I_1\left[g_p + g_m + \frac{C_1}{C_3} g_m\right] \quad (7)$$

Equations 6 and 7 can be written in terms of the tube interelectrode capacitances as follows:

$$\Delta = Y_1\left[Y_2 + g_p - \frac{C_{pk}}{C_{gk}} g_m\right] + Y_2\left[g_p + g_m + \frac{C_{pk}}{C_{gp}} g_m\right] \quad (8)$$

$$\Delta \times E_2 = I_1\left[g_p + g_m + \frac{C_{pk}}{C_{gp}} g_m\right] \quad (9)$$

The equations describing an amplifier using an ideal tube, that is, one with no plate-cathode capacitance (and no neutralizing inductance) can be obtained from Eq. 8 and Eq. 9 by setting $C_{pk} = 0$

$$\Delta = Y_1\,[Y_2 + g_p] + Y_2\,[g_p + g_m] \quad (10)$$

$$\Delta \times E_2 = I_1\,[g_p + g_m] \quad (11)$$

We can now draw several conclusions about the operation of the properly tuned amplifier from Eq. 8, 9, 10 and 11. If the amplifier is to be stable the system determinant, Δ, must not be zero. Equation 10, where Δ can never be zero, is a mathematical expression for a fact we already know, namely that a grounded-grid amplifier with no plate-cathode capacitance in the tube is absolutely stable. If the amplifier has plate-cathode capacitance in the tube and has a neutralizing inductance, the determinant is modified by the addition of the terms

$$-Y_1 g_m \frac{C_{pk}}{C_{gk}} + Y_2 g_m \frac{C_{pk}}{C_{gp}}$$

as in Eq. 8. The negative term indicates the possibility of instability. However the added ter tend to cancel and moreover t ratios $\frac{C_{pk}}{C_{gk}}$ and $\frac{C_{pk}}{C_{gp}}$ are usuall very small; in the type 6161 they are $\frac{C_{pk}}{C_{gk}} \cong \frac{C_{pk}}{C_{gp}} \cong 0.025$ so that the likelihood of the neutralized stage taking off is quite remote.

Equation 3 is the grid voltage developed across the neutralizing inductance. It is seen from Eq. 3 that a plate voltage E_2 causes a grid-cathode voltage that reinforces E_2. The neutralizing inductance is therefore a regenerative impedance.

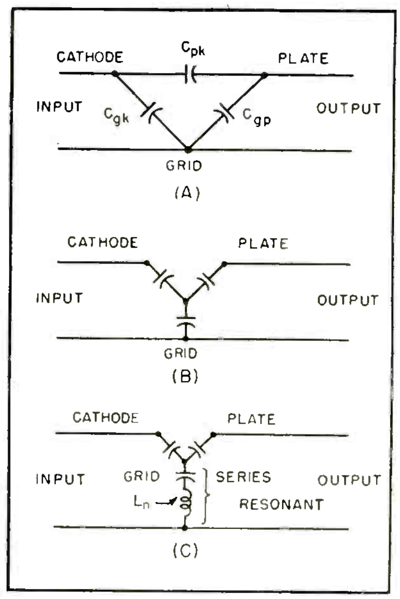


FIG. 4—Tube interelectrode capacitances (A) arranged in equivalent wye (B) with input and output decoupled with inductance (C)

By comparing Eq. 9 and 11 it can be seen (with tubes for which C_{pk}/C_{gp} is small) that the regeneration is small. This is consistent with the conclusion that the neutralized amplifier is stable. A further conclusion that can be drawn, since all terms of Δ and $\Delta \times E_2$ are real, is that the addition of the neutralizing inductance does not cause incidental phase modulations.

We will now investigate the stability of the amplifier under more general conditions. Referring to Fig. 5, if, because of the limited tuning range of the input and output circuits, we assume that any sustained oscillations have a frequency close to the carrier frequency, ω_o, then (with tubes with $C_{pk} << C_{gp}$ and $C_{pk} << C_{gk}$) we can neglect E_3 as we did before. The feedback voltage is a function of frequency

$$E_g = -\frac{\omega^2}{\omega_o^2}\left[\frac{C_1}{C_3}E_1 + \frac{C_2}{C_3}E_2\right]$$

We can further simplify the solution by letting $\omega^2 L_1 C_1 = 1$ and $\omega^2 L_2 C_2 = 1$ at all frequencies and making Y_1 and Y_2 complex functions of frequency.

The system determinant under these conditions becomes

$$\Delta = Y_1\left[Y_2 + g_p - \frac{\omega^2}{\omega_o^2}\frac{C_{pk}}{C_{gk}}g_m\right] + Y_2\left[g_p + g_m + \frac{\omega^2}{\omega_o^2}\frac{C_{pk}}{C_{gp}}g_m\right]$$

For oscillations to exist, Δ (both real and imaginary parts) must be zero. This indicates again that oscillations are unlikely, at least near the carrier frequency.

This analysis gives no information about parasitic or higher-mode oscillations that might occur at frequencies far removed from the carrier frequency. However oscillations of these types are not likely to occur in small single-tube cavities.

In practice, the neutralizing inductance is quite small. In the type 6161 amplifier in this transmitter, contact was made to the grid terminal of the tube by a number of spring fingers. To insert an inductance between grid and ground these fingers were bent away from the grid terminal (thus increasing the inductance) one at a time until neutralization was achieved.

It should be emphasized that the foregoing discussion based on equivalent circuits is useful in a qualitative way only. With large signals a vacuum tube is decidedly nonlinear, and can be represented by an equivalent circuit only approximately. Furthermore, at high frequencies, transit-time effects become important. Transit-time effects cause an increase in driving power requirements and cause the cathode current pulses to be unsymmetrical. The degree of symmetry of these pulses varies over the modulating cycle, resulting in some incidental phase modulation of the carrier. The unsymmetrical pulses also cause some peculiar operating conditions. For example, the maximum efficiency and power

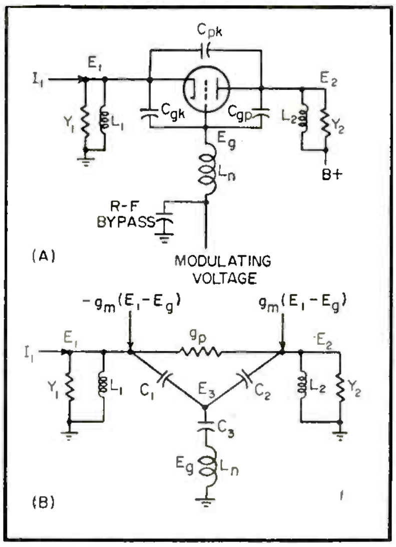


FIG. 5—Neutralized grounded-grid amplifier (A) and equivalent (B)

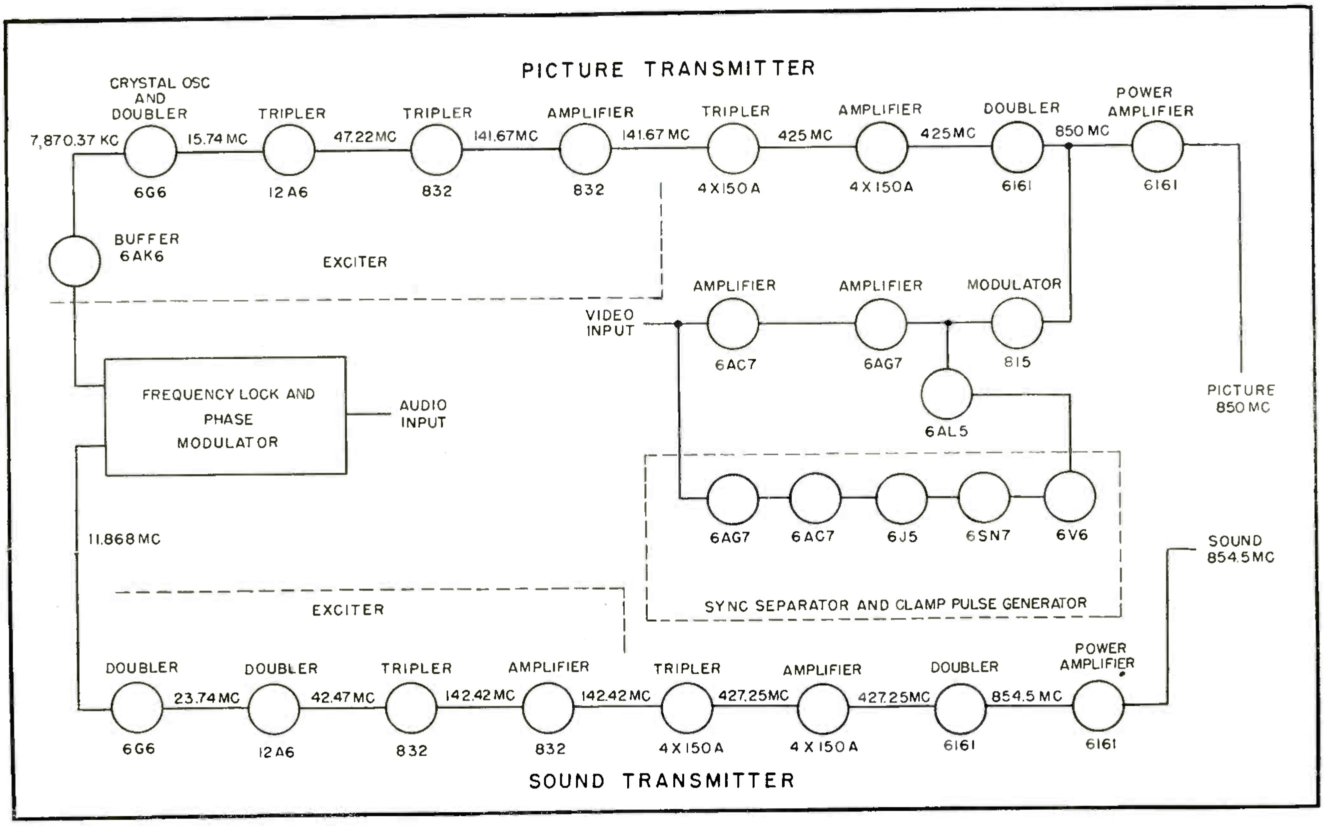


FIG. 6—Block diagram of the picture and sound transmitter frequency control

do not occur when the plate is tuned for a plate-current dip.

Cooling

The type 6161 is a forced-air-cooled tube. The following provisions were made in the tanks for circulation of cooling air. Air is forced into the air chamber at the top of the tank. From there all the air flows through the cooling fins on the anode of the tube into the plate cavity. Most of the air in the plate cavity flows out through the hollow tuning plungers. A portion of the air in the plate cavity flows into the cathode cavity through holes at the base of the spring fingers on the grid connector. These holes are at such an angle that the air stream is directed at the glass seal on the cathode terminal of the tube. The air leaves the cathode cavity through holes in the bottom of the cavity.

Power

The aural transmitter runs with a power output of 150 watts into an antenna with a gain of 16.2 db, giving an effective radiated power of 6.2 kw. When modulated with a video signal the visual transmitter has a peak power output of 300 watts into an antenna with a gain of 19.2 db, giving an erp of 25 kw. However, like most commercial transmitters, this transmitter cannot put out peak power continuously and still stay within the tube ratings. During most of the propagation tests the visual transmitter has been run unmodulated with a continuous power output of 200 watts. At this power the final power amplifier stage has a plate circuit efficiency of about 58 percent and the tube is operating well within its ratings.

Drivers

The block diagram of the transmitter is shown in Fig. 6 and 7. The two stages using type 4X150A's and the doubler stage using a type 6161 all of which drive the finals are of the resonant-cavity type. The type 6161 doublers are operated grounded grid and have plate cavities identical with those on the final stages. The cathode cavities are resonant half-wave coaxial lines.

The 4X150A cavities are operated grounded cathode. The plate cavities are identical and are a type that is best described as being the transition between foreshortened coaxial and re-entrant cavities. The grid tanks of the 4X150A amplifiers are resonant half-wave coaxial lines. The final power-amplifier stages were the only cavity type amplifiers that required neutralization. The rest of the transmitter utilizes conventional lumped-constant circuits.

Generation of Carriers

The frequency lock and phase modulator portion of the transmitter deserves special discussion both because of its advantages and pitfalls.

Receivers employing intercarrier sound require that the difference between picture and sound carriers be accurately maintained at the transmitter. Present FCC regulations require that the picture carrier be maintained within 1 kc of its assigned value and that the difference between picture and sound carriers be 4.5 mc ± 5 kc. The frequency stabilities corresponding to these tolerances on the upper vhf channels are approximately ±0.0005 percent for the picture carrier and ±0.002 percent for the sound carrier. The frequency stabilities required for the upper uhf channels are four times as great or approximately ±0.0001 percent for the picture carrier and ±0.0005 percent for the sound carrier.

The frequency lock is a circuit, shown in Fig. 7, that causes the picture and sound carriers to drift together, always maintaining the difference accurately. The picture carrier is generated by a chain of frequency multipliers (×108) following a crystal oscillator at 7,870.370 kc. This picture crystal frequency is also used in the frequency lock in generating the sound carrier. On the frequency lock chassis a 100-kc crystal oscillator is doubled to 200 kc and phase modulated.

This 200-kc signal is mixed with a signal from a second crystal oscillator at 1,798.843 kc. The upper sideband of 1,998.843 kc is selected and doubled to 3,997.686 kc. This signal is then mixed with a signal from the picture crystal oscillator in a second mixer. The upper sideband of 11,868.056 kc is selected and multiplied 72 times to produce the sound carrier. A little arithmetical manipulation will show that this process has reduced the sensi-

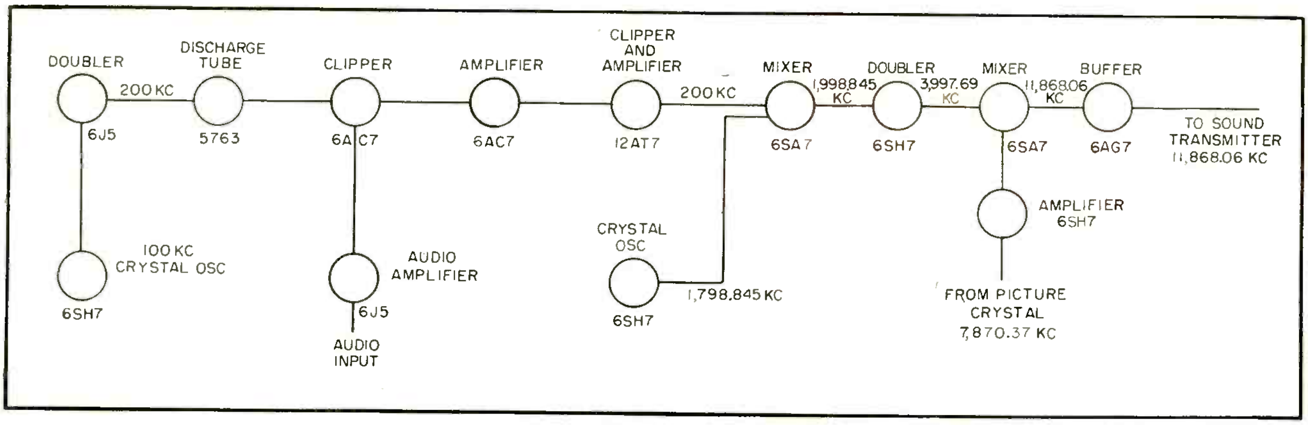


FIG. 7—Frequency-lock and phase modulator for sound transmitter

tivity of the difference between picture and sound carriers to drift in the picture crystal by a factor of one third.

There are other arrangements of the frequency lock that give more stability to the difference between picture and sound carriers. For example, it can be seen that if the frequencies in the frequency lock are chosen such that the multiplying factor following the second mixer is the same as the multiplying factor following the picture crystal that the difference between picture and sound carriers is entirely independent of drift in the picture crystal. This possibility dictates a different arrangement of the block diagram to circumvent the limited selectivity obtainable in mixer plate circuits. Since only the difference between the two auxiliary crystal frequencies is of interest, we have a great deal of leeway in choosing these frequencies. Furthermore, the block diagram can be arranged in many ways that further increase the leeway in the design of the frequency lock. That it is desirable to have several possibilities from which to choose will be shown below.

Undesired Modulation

One unfortunate and unanticipated difficulty was encountered in the frequency-lock unit. It was found that the sound carrier was frequency modulated with a large frequency deviation at a modulating frequency of 125 kc. This undesired modulation of the sound carrier caused noticeable bars in the picture on receivers, especially if the receivers were not properly tuned. The trouble was found to arise in the second mixer in the frequency lock portion of the transmitter.

In this mixer a 3,997.686-kc signal is mixed with a 7,870.370-kc signal to produce an 11,868.056-kc signal that is multiplied up to obtain the sound carrier. Now there also appears in the plate circuit of this mixer an 11,993.058-kc signal derived from the product of $3\times$ 3,997.686 and an 11,743.054-kc signal, the product of $2\times$7,870.370—3,997.686. Both of these differ from the desired frequency by 125 kc. The presence of these higher-order mixer components results in a phase modulation of the desired signal.

Furthermore, this undesired phase modulation must be kept to a very small value in order not to affect adversely the performance of the transmitter. This is especially true if the beat is at an audio rate. In this transmitter the frequency deviation at the sound-carrier frequency due to this beat in the mixer was nearly 2 megacycles.

There are at least three methods by which trouble from higher order mixer components can be minimized. The first, of course, is by adequate filtering, although in many cases selectivity requirements will be too great for practical circuits. A second method is by selecting the mixer frequencies so that all higher order components fall far away from the desired frequency. This is why, as is pointed out above, it is desirable to have several methods from which to choose. There are a great many possible ways of laying out the block diagram so that this can be done. The searching for the right frequencies is greatly facilitated by the use of a mixer frequency chart.[6] A third method is by the use of true square-law mixers. This condition, like the adequate filtering, is also usually difficult to achieve in practice.

The sound transmitter is frequency-modulated by a phase-modulation system. The audio modulating voltage is passed through an inverse-frequency network so that true f-m results. The method of phase modulation that was used for the sound transmitter has been described previously[7,8,9] but will be briefly explained here. References will be made to Figs. 7 and 8.

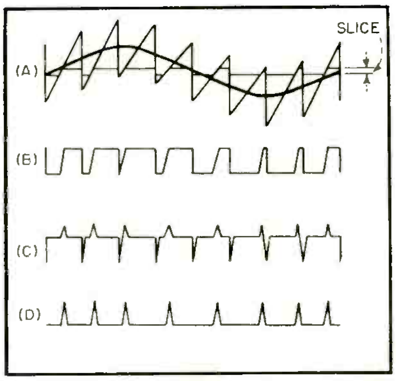


FIG. 8—Audio modulation with crystal sawtooth superimposed showing slicer action (A) sliced wave (B) differentiated (C) and resultant pulses of slope portion

Serrasoid Principle

The output of the discharge tube is a 200-kc sawtooth wave whose frequency is controlled by the 100-kc crystal oscillator. This sawtooth wave superimposed upon the modulating voltage, Fig. 8A, is fed to the 6AC7 clipper which takes a thin slice, amplitudewise, out of the sawtooth. The position of this slice in the sawtooth varies according to the audio modulating voltage. This slice is amplified. The output of the amplifier is a trapezoidal wave, Fig. 8B, with width varying according to the audio modulating voltage. The edge of the trapezoidal wave corresponding to the steep side of the sawtooth wave has a relatively constant phase.

The edge of the trapezoidal wave corresponding to the sloping side of the sawtooth wave has a phase that varies up to nearly 180 deg from its center position, depending on the amplitude of the audio modulating voltage. A pulse is derived from the phase-modulated edge of the trapezoidal wave by means of differentiators, as shown in Fig. 8C, and clippers, Fig. 8D, and is used to drive a 200-kc amplifier. This phase-modulated signal is used in the generation of the sound carrier as described above. The inverse-frequency network is contained in the audio amplifier.

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Transistors Operate at 300 MC

With proper control of germanium resistivity and spacing between the emitter and collector, point-contact transistors have been made to oscillate as high as 302 mc. This development opens the field for high-frequency transistor applications

By G. M. ROSE and B. N. SLADE

Tube Department
Radio Corporation of America
Harrison, N. J.

MANY engineers, as well as laymen, have an impression that transistors are simple to make. This impression of simplicity has led to a considerable amount of impatience because transistors are not more readily available.

Inside the transistor, however, is a complex electrical system that is as yet far from being fully understood. Many investigations are currently being made to determine the nature and cause of a variety of phenomena observed during transistor operation. It is apparent that transistors intended for use in certain classes of applications should be specifically designed for those applications. For example, transistors designed for r-f systems will probably be different from those for computer applications because the basic requirements for the two uses are not altogether similar.

Requirements for transistors used in r-f systems are gradually being met in developmental types.[1] This article discusses recent progress made in this direction on developmental point-contact transistors.

For use in r-f systems, transistors must meet two primary requirements. They must amplify substantially at the intended operating frequency and they must be electrically stable. Other desirable characteristics such as low noise, long life and low power drain are important but are of necessity secondary to the two primary requirements—frequency response and stability.

Frequency Response

Power gain of 20 db or more can readily be obtained at frequencies of a few hundred kilocycles with point-contact transistors. As the operating frequency is increased to megacycles or tens of megacycles, however, maintenance of gain becomes an important problem for consideration.

At elevated frequencies, gain is affected by several factors. Some of these factors are included in the expression given by Shockley[2] for the transit time of electrons or holes through the germanium of

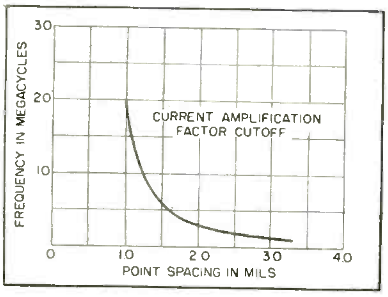


FIG. 1—Effect of variation in point spacing on frequency response of a point-contact transistor

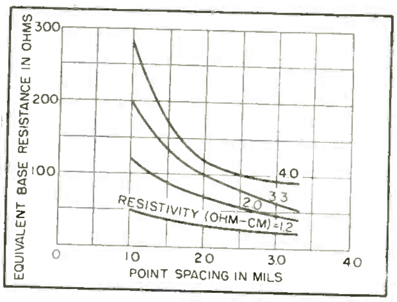


FIG. 2—Effect of variation in point spacing and germanium resistivity on equivalent base resistance

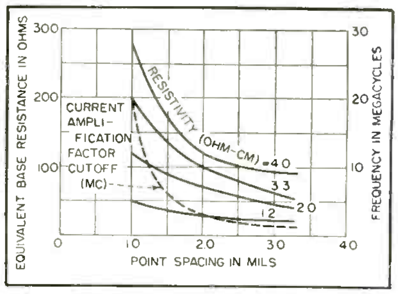
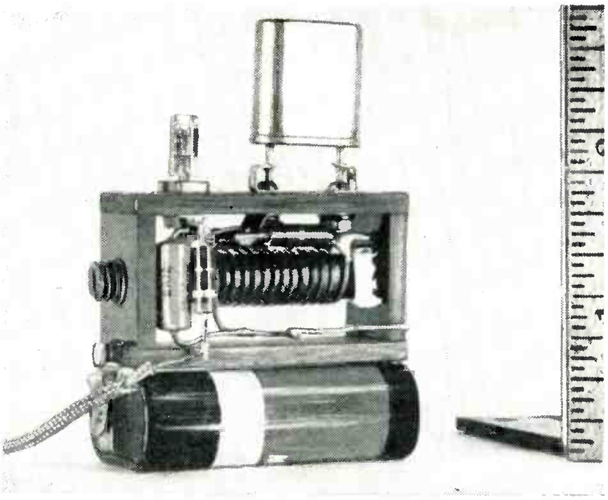
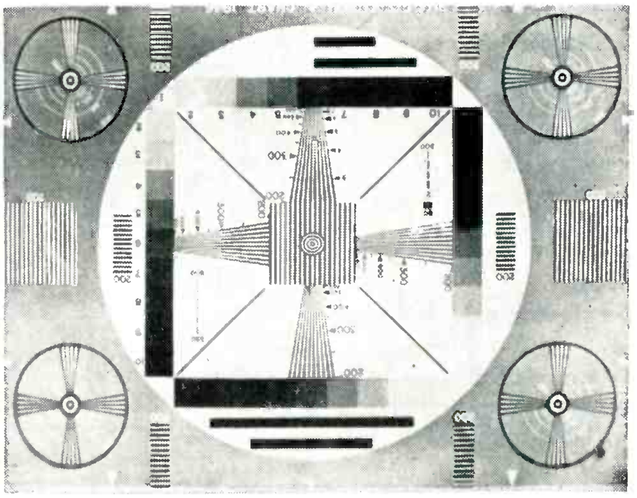


FIG. 3—Effect of variation in point spacing on frequency response and equivalent base resistance



A crystal-controlled 110-mc transistor oscillator. Developmental point-contact transistor (left), quartz crystal in metal can (right)



Test pattern illustrating frequency response of developmental point-contact transistor in a 20-mc video amplifier system

point-contact transistors. In this expression $T = \frac{S^3\sigma}{\mu I_e}$, T is the time in seconds required for the holes or electrons to travel from the emitter to the collector, S is the contact spacing or the distance between the emitter and collector in centimeters, σ is the conductivity of the germanium in reciprocal ohm-centimeters, μ is the mobility of the holes or electrons in centimeters squared per volt-second and I_e is the emitter current in amperes.

Qualitatively, this expression indicates that the spacing between the emitter and the collector plays a major role in determining the frequency response of transistors. Other factors remaining constant, the transit time decreases rapidly as the spacing is decreased and the frequency response increases to a corresponding degree.

Because actual power gain involves considerations of circuitry, it has been found more informative to express the frequency response of transistors in terms of a current amplification factor α which is a characteristic of the transistor alone. The cutoff frequency is then defined as the frequency at which the current amplification factor is three db down from or 70 percent of, its low-frequency value.

Figure 1 shows a curve giving the variation of frequency cutoff with point spacing for germanium specimens having resistivities within the range of 1.2 to 4 ohm-centimeters. It would appear from the expression for transit time that, as the germanium resistivity increases, the frequency response also increases. Actual measurement, however, indicates that an increase in resistivity from 1.2 to 4 ohm-centimeters has little effect on the frequency response. These measurements were made by varying the spacing of two point contacts on specimens of single-crystal germanium.

The curve in Fig. 1 follows the S^3 function fairly closely. Because the frequency-cutoff values increase rather rapidly as the contact spacings become relatively narrow, it might be assumed that there would be almost no limitation to frequency response if extremely narrow spacings could be achieved. Extremely narrow spacings, however, introduce both mechanical and electrical problems. The mechanical problem lies in the difficulty of maintaining adequate control of such small spacings. The electrical problem involves considerations of transistor gain and stability.

Stability

Both the stability and the frequency response of point-contact transistors are affected by the characteristics of the germanium as well as by the contact spacings. These transistors have a tendency to become unstable and to oscillate in amplifier circuits in which there is little or no impedance in series with the emitter or the collector. This oscillation is undesirable in r-f stages having parallel-tuned circuits in both the input and output of the transistor because the impedance of the tuned circuits approaches zero during off-resonance.

Feedback Considerations

The instability of the point-contact transistor is due to an internal positive feedback that is a function of both the current amplification factor and an internal feedback resistance. The value of this feedback resistance is a measure of the effect of the output current on the input voltage. The stability of the transistor can be improved by reducing either the feedback resistance or the current amplification factor. If the latter becomes equal to or less than unity, the transistor is unconditionally stable.

In junction transistors, the current amplification factor is always equal to or less than unity and, therefore, there is no problem of instability. In point-contact transistors, however, it is not practical to obtain very low values of current amplification factor because a corresponding loss in power gain would result. Current-amplification-factor values for point-contact transistors usually are greater than two. By properly controlling the resistivity of the germanium, the feedback resistance may be maintained at sufficiently low values to permit stable amplifier operation at radio frequencies.

Figure 2 shows a measured relationship between the feedback resistance and the point spacing for several pieces of monocrystalline germanium having varying resistivities. These curves illustrate two facts. At the higher values of resistivity, the feedback resistance increases rapidly with decreasing point spacing. At values of resistivity of two ohm-cm or less, the feedback-resistance values approach a more linear relationship with the point spacing.

For a given value of point spacing, the feedback resistance decreases with decreasing resistivity values. If Fig. 1 and 2 are superimposed, as shown in Fig. 3, it becomes apparent that if a very small value of point spacing (say 0.001 inch) is selected in order to get a high value of frequency cutoff, it would be necessary to use a low value of germanium resistivity to maintain a low value of feedback resistance.

A feedback resistance of 100 ohms or less will usually be sufficiently small to assure stable transistor amplifier operation. With a spacing of 0.001 inch, a resistivity less than 2 ohm-cm would be necessary to obtain such a value of feedback resistance. Figure 4 shows the frequency-response characteristic of a stable transistor having a frequency cutoff of 30 mc made using these techniques.

Switching Circuits

Although the technique of proper selection of point spacing and germanium resistivity discussed is used primarily to produce the stable transistors required for r-f applications, this technique is also useful in the design of point-contact transistors for certain other applications such as switching circuits. In such applications the internal feedback of the transistor can be high because short-circuit stability is not required. Suitable values of resistivity and point spacing for this type of application may also be selected by this technique.

Transistors will oscillate at frequencies somewhat higher than the frequency at which the current amplification factor drops three db.

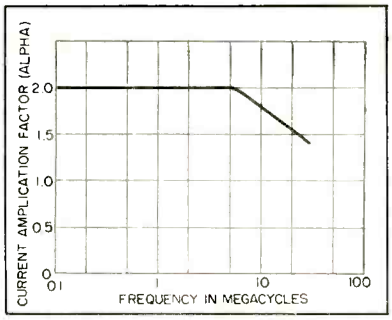


FIG. 4—Frequency-response characteristic of developmental point-contact transistor

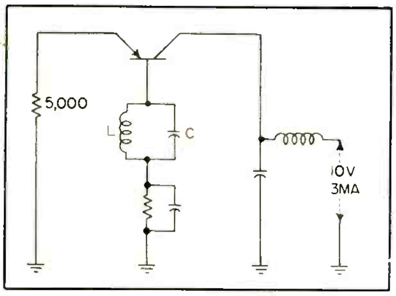


FIG. 5—Schematic diagram of transistor oscillator circuit

For instance, a transistor having a frequency cutoff of four mc may oscillate at frequencies as high as 10 megacycles or more because the current amplification factor and the power gain at these higher frequencies would be sufficient to enable oscillations to occur. By utilizing point spacings of less than 0.001 inch, it is possible to achieve cutoff frequencies of 30 mc or more and thus make possible oscillations at even higher frequencies.

With spacings of approximately 0.0005 inch, transistors have been made that will oscillate at frequencies well above 100 mc. A number of units have oscillated at frequencies greater than 200 mc and the highest oscillation frequency reached to date has been 302 megacycles.

Oscillator Circuit

Figure 5 shows the schematic diagram of the oscillator used in these tests. This circuit is interesting in that the emitter is apparently isolated for r-f by the 5,000-ohm resistor. The feedback required for oscillation is provided by the internal capacitance between emitter and collector. The bypassed resistance in the base circuit together with the series resistance in the emitter circuit determines the emitter bias. With suitable choice of L and C, an oscillation range from 5 to 300 mc has been achieved, with a single transistor.

One photograph shows a crystal-controlled demonstration oscillator that operates at 110 megacycles. The seventh-overtone quartz crystal, operating in its low-impedance mode, replaces the bypass capacitor across the series base resistor.

Transistor R-F Amplifier

Performance of transistors in r-f amplifiers is more difficult to evaluate than oscillator performance because of the more complicated circuitry. There are indications, however, that stage gains of 20 db at frequencies well above five mc are possible with no instability arising from internal feedback in the transistor.

Developmental point-contact transistors have been tested in a wide-band video system. A second photograph shows a television test pattern after transmission through a 20-mc chain, one stage of which was a point-contact transistor. The gain of this stage was not maximized and was only slightly greater than the α, or current amplification factor of the transistor. Nonstandard scanning rates were used to give an equivalent balanced resolution of almost 900 lines. The presence of the transistor stage did not visibly degrade the pattern.

From the data given in this paper, it is apparent that the point-contact transistor can be successfully used in r-f applications. At the present time, junction transistors are somewhat superior to point-contact types with respect to stability and thus promise greater flexibility in amplifier applications. So far, point-contact transistors are capable of operation at higher frequencies than junction transistors, particularly as oscillators. With the proper control of point spacings and germanium resistivity, point-contact types can be made having a high degree of stability in suitable applications.

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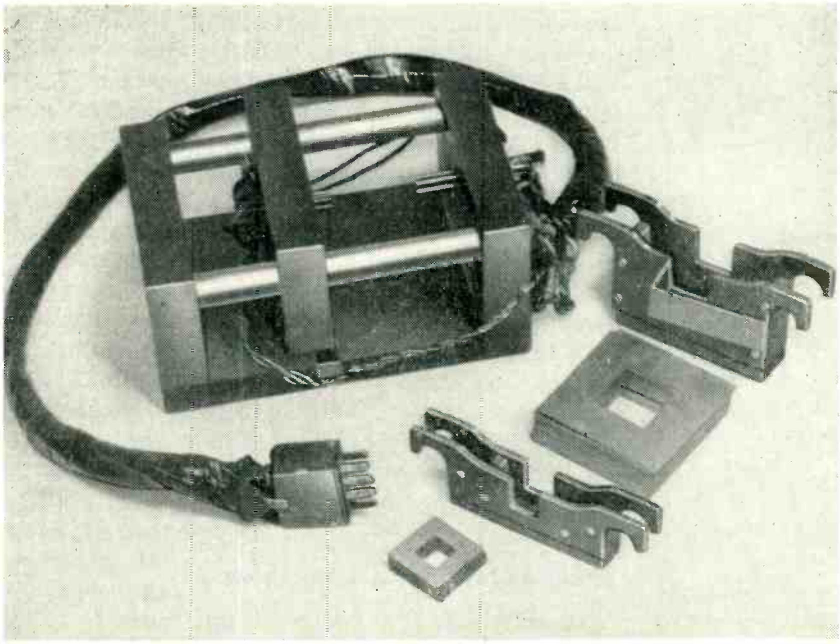

Fixture incorporating the four-contact plug. Two sizes of cores of square gapless laminations together with the appropriate jigs for holding them are shown

Magnetic-Amplifier Gapless-Core Tests

Production test method approximates actual amplifier operating conditions without requiring use of test coils on closed cores. Provides basis for matching sets of cores for balanced amplifiers as well as for acceptance or rejection of individual cores

By J. R. CONRATH
Vickers Electric Division
Vickers, Inc.
St. Louis, Missouri

AN IDEAL METHOD of testing cores for magnetic amplifier reactors would be one providing sufficient data to predict accurately the control characteristic of the amplifier.

Some early analyses replaced the actual B-H relationship in the core with the normal d-c magnetization curve while others employed simplified curves consisting of three straight-line portions. Neither of these assumptions gives satisfactory results for materials having rectangular hysteresis loops since they do not predict maximum output for zero control current.

A more realistic analysis[1] employs the d-c hysteresis loop of the core material in predicting the control characteristic of a self-saturating amplifier. It is assumed that the flux at the start of the supply-voltage cycle, the premagnetization, varies along the back flank of the d-c hysteresis loop as the control current is varied. Although there is a substantial correlation between predicted and measured curves, this method is in error because it neglects the effect of eddy currents. When high-permeability core materials are used, the eddy-current effect is important even with lamination thicknesses of a few thousandths of an inch and at a frequency of 60 cycles.

It has been shown[2] that the premagnetization in a self-saturated magnetic amplifier is indicated not by the back flank of the d-c hysteresis loop nor by the symmetrical a-c loop, but by an intermediate curve. This has been called the control magnetization curve. It is the locus of the tips of the biased dynamic hysteresis loops through which the core material is driven

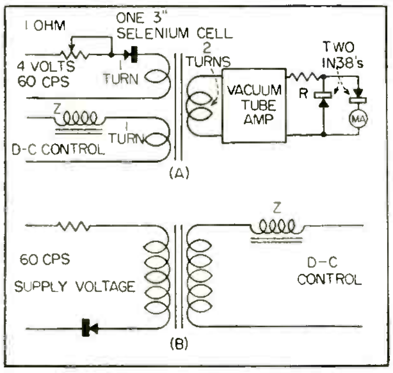

FIG. 1—Core test circuit (A) and half-wave amplifier circuit (B)

when the control current of the amplifier is varied.

If the foregoing is accepted, the choice of an efficient core-test method may be reduced to consideration of the most convenient way of measuring the control magnetization curve. This can be done readily by operating the reactor in an actual half-wave self-saturating amplifier. The voltage induced in a pickup coil can be integrated by an R-C network to provide the flux wave and permit the tracing on a cathode ray oscilloscope of the dynamic hysteresis loops.

Test-Winding Requirements

The foregoing method, in common with other test methods involving hysteresis curve tracing, requires a pickup coil of a considerable number of turns. The induced voltage at 60 cycles is only a few millivolts per turn for small magnetic amplifier reactors, particularly those employing core materials such as Mumetal, which has a low value of saturation induction. Since there is necessarily a high attentuation in the integrating networks of circuits for hysteresis curve tracing, the need for a pickup coil of many turns is apparent.

This requirement may present no serious difficulty in the case of cores in which an air gap is present because the laminations may be stacked around coil forms on which any desired number of turns have been wound. If only a limited number of closed cores are to be tested, the expense of winding the requisite number of turns might not be too great. Where thousands of amplifiers employing closed cores are produced and where each core must be individually tested, it is impractical to provide a winding of many turns. Instead of using coils for these closed cores a winding for test purposes may be obtained by passing a plug through the window of the core and into a socket.

Since it is necessary in the production of Vickers magnetic amplifiers to test cores having window openings as small as about ⅜-in. square, a plug having four contacts was deemed the most practical. This can be used to provide one or more windings having a total of four turns.

Plug-and-Socket Arrangement

An early core test method using the plug-and-socket arrangement involved measuring the normal a-c magnetization curve. Two of the turns were used as an excitation winding through which a specified sinusoidal alternating current was passed. The other two turns were employed as a pickup winding and the voltage induced in them was measured with a vacuum-tube voltmeter. In this way several points on the magnetization curve were obtained.

A single four-turn winding could have been used for both excitation and pickup, but the isolated windings are better because they avoid errors due to voltage drop in the contact resistance of the plug and socket. This type of test is useful in matching sets of cores for balanced amplifiers and provides some indication of the performance of cores in self-saturating amplifiers. The correlation between test results and amplifier characteristics was not considered satisfactory since this method gives no indication of either coercive force or residual induction.

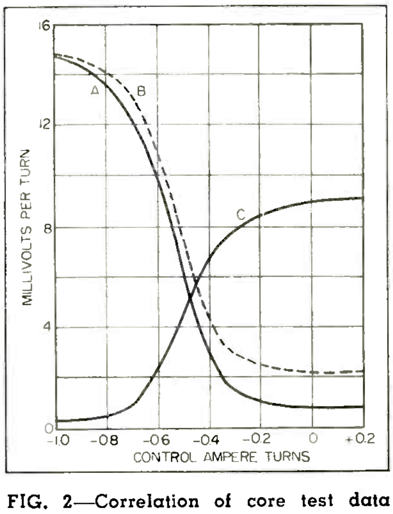

FIG. 2—Correlation of core test data with performance of half-wave magnetic amplifier. Pickup voltage in core test at 60 cycles (curve A), maximum supply voltage to amplifier for cutoff (curve B) and d-c output voltage times 2.2 of amplifier with supply voltage of 13.2 mv per turn (curve C)

Another circuit requiring only a few turns to test a magnetic amplifier core is shown in Fig. 1A. The circuit configuration here resembles that of an actual half-wave self-saturating magnetic amplifier. An a-c potential of a few volts is applied to an excitation circuit consisting of a half-wave rectifier and a current-limiting resistor. Voltage is held to a low value so that rectifier leakage will be negligible. A control winding is provided through which an adjustable amount of pure d-c is caused to flow. This circuit contains a high impedance to prevent appreciable current from flowing as a result of voltage induced in the control winding. A vacuum-tube amplifier and a germanium diode rectifier voltmeter permit the measurement of the voltage induced in the pickup winding.

Control Current

The control current sets the initial value of flux in the core. A half-wave current flows in the excitation winding which, during each cycle, drives the flux from this initial value into saturation and back again. The amplitude of this flux wave is indicated by the diode voltmeter since it measures the average value of the induced voltage. By measuring the flux change for several values of control current and subtracting it from the saturation flux, points on the control magnetization curve may be obtained. It is more convenient, however, to plot the induced voltage per turn against the control ampere-turns.

The pickup voltage curve is a good indication of the maximum supply voltage which can be used in an actual half-wave magnetic-amplifier circuit, Fig. 1B, as a function of control ampere-turns at cutoff. An experimental illustration of this is offered in Fig. 2. Curve A represents the pickup voltage per turn at 60 cps of a AEM4750 core having a cross-section of 0.08 square inch and a mean-length magnetic path of 3 inches, when an average half-wave excitation of 1.3 ampere-turns is applied. Curve B shows the measured value of supply voltage per turn in the amplifier of Fig. 1B which for each value of control allows a load current to flow whose mmf corresponds to that used in testing the core. The fact that the measured supply voltage slightly exceeds the pickup voltage can be ascribed mainly to the forward voltage drop of the rectifier in the amplifier circuit.

The control swing required to drive the amplifier from cutoff to full output with a given supply voltage may be determined from this type of core test, if rectifier leakage is negligible. The control ampere-turns for cutoff are determined from the pickup voltage curve, Fig. 2, curve A, knowing the supply voltage per turn of the output winding and making a suitable allowance for rectifier forward voltage drop. The control ampere-turns for full output of the amplifier can be found by taking the abscissa of a point at the lower knee of the pickup voltage curve.

The control characteristic of a half-wave self-saturating amplifier using the same core appears as curve C of Fig. 2. In this case, the output is plotted on a voltage-per-turn basis and the load resistance is assumed to include the output winding resistance. Sufficient cells were used in the rectifier to insure negligible leakage current.

A definite correlation can be noted between the shape and position of the control characteristic and the pickup voltage curve. This can be seen from the fact that in the amplifier, the sum of the reactor voltage, the output voltage and the rectifier forward voltage drop should equal the supply voltage. Therefore, the output voltage of the amplifier increases as the reactor voltage decreases and the knee of the control characteristic occurs at the same value of control mmf as the lower bend of the pickup voltage curve.

The difference between the amplifier full output voltage and the supply voltage is due to rectifier forward voltage drop and to the fact that the reactor still possesses appreciable inductance at points above the knee of the control characteristic.

To get a direct comparison of curves A, B and C of Fig. 2, certain conventions must be observed. The vacuum-tube amplifier and diode voltmeter combination is calibrated on sine wave a-c, therefore the voltmeter indications show 1.1 times the average value of the induced voltage. The load voltage for curve C was obtained by multiplying by 2.2 the actual load voltage as measured with a d-c meter. The use of these factors results in the comparison in Fig. 2 of 1.1 times the average value of each voltage taken over the forward half cycle of supply voltage.

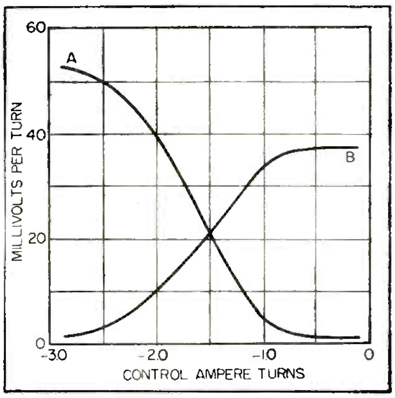

FIG. 3—Correlation of core test data with performance of half-wave magnetic amplifier with Deltamax core. Pickup voltage in core test at 60 cycles (curve A) and d-c output voltage times 2.2 of amplifier with supply voltage of 52.8 mv per turn (curve B)

Figure 3 shows the pickup-voltage curve obtained in the core test and a control characteristic for a half-wave amplifier using a reactor wound on a core of square Deltamax laminations. The cross-section of this core is 0.174 square inch and the mean length of magnetic path is 4.4 inches. The output winding has 700 turns. As before, there is a good correlation of results in the core test and the amplifier characteristic.

It should be pointed out that operating conditions in this core test circuit differ in at least two respects from those in the actual amplifier. In the amplifier the core excitation varies with control signal; at cutoff the core is driven only slightly beyond the knee of the hysteresis curve, while at full output it is driven far into saturation.

In the core test, a constant excitation was used for all values of control. It corresponds to that at cutoff in the amplifier. For this reason, the pickup voltage curve as measured in the core test has a somewhat lower value than the induced voltage in the amplifier for the full output condition. It would probably be worth while to increase the excitation in obtaining points at the lower end of the curve in the core test.

Since the reactance of the excitation winding is negligible compared with the current-limiting resistor, the excitation current will have the waveform of a rectified sine wave. This means that if the excitation is sufficient to drive the core considerably beyond the knee of the hysteresis curve, the core will traverse the steep part of the curve in a relatively short part of the cycle. The flux wave in the core test circuit will then be much steeper than that in the amplifier circuit, and the induced voltage wave will be sharply peaked instead of being a sine wave or portion of a sine wave. The more sudden change of flux will evidently modify the effect of eddy currents in the core test circuit as compared with the actual amplifier circuit. However, in view of the test results obtained, this difference in the eddy-current effect is not thought to be of great importance.

It is believed that the method described in this paper provides a test which satisfactorily approximates actual amplifier operating conditions without requiring the use of test coils on closed cores. It provides a basis for matching sets of cores for balanced amplifiers as well as for the acceptance or rejection of individual cores.

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Diode Limiters Simulate

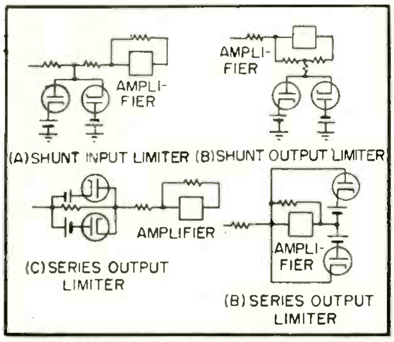

FIG. 1—Basic amplifier-diode circuits

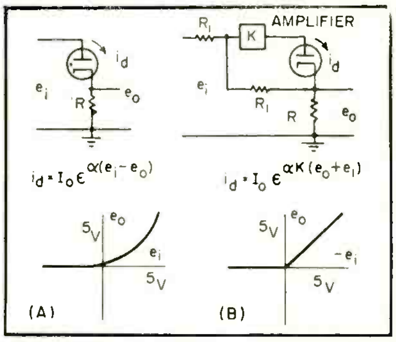

FIG. 2—Idealized diode circuits

By C. D. MORRILL
and
R. V. BAUM

Goodyear Aircraft Corp.
Akron, Ohio

THERMIONIC DIODES are useful in analog computers for simulation of nonlinear characteristics. Amplifier-diode circuits may be used to represent systems having two or more discrete operating regions. They may be made accurate and precise and their speed is better than that of corresponding relay circuits. Standard stabilized computing amplifiers may be used.

Basic Circuits

Figure 1 shows four basic amplifier-diode circuits that will be used as prototypes of other electronic switching circuits to be described. Input limiters are amplifier-diode circuits employing one or more diodes in the input circuit. Output limiters are those employing one or more diodes in the feedback circuit. Shunt limiters decrease current through the summing node by diode conduction. Series limiters increase current through the summing node by diode conduction.

The shunt-input limiter shown in Fig. 1A is probably most familiar to users of electronic differential analyzers. Normal scale changing is provided until the input voltage reaches a certain value above or below which one or the other diode conducts. For inputs in excess of this limiting value, output is nearly constant. Similar performance is obtained with the series-output limiter which is approximately the dual of the shunt-input limiter. The advantage of the shunt-input limiter is that single-ended, low-impedance bias sources are easily furnished. An advantage of the series-output limiter is its higher switching speed and greater operational flexibility. The circuit of Fig. 1D may have extremely high gain for small signals and almost zero incremental gain for large signals. This type of operation is less feasible with the circuit of Fig. 1A.

The circuits of Fig. 1B and 1C perform similar operations. Incremental gain is small for small signals and large for large signals. The series limiter, however, offers greater flexibility since, by eliminating the resistor shunting the diodes of Fig. 1C, zero gain for small signals is possible.

Many variations of the four basic circuits are possible. A resistor may replace a short circuit, or a short or open circuit may replace a resistor. One important variation is shown in Fig. 2, which illustrates a method of idealizing the characteristics of a thermionic diode. The departure from the ideal, neglecting leakage, is twice the voltage across the diode divided by the gain of the amplifier. This error will usually be on the order of tens of microvolts. The idealized diode will be applied in some of the computing circuits to follow.

The circuit shown in Fig. 3A is a dead-space simulator. Its operation is analogous to devices having a definite threshold of sensation or activity. The circuit of Fig. 3B has similar characteristics but offers

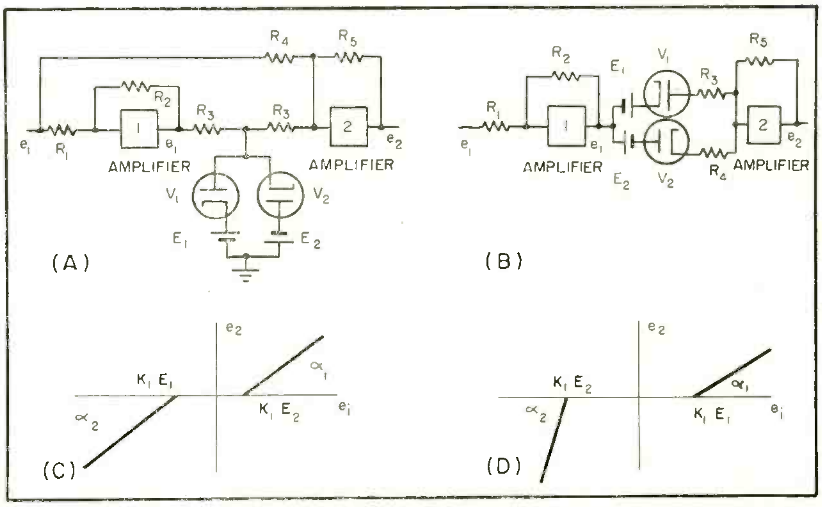

FIG. 3—Electronic dead-space simulator is analogous to mechanical devices having definite threshold of sensation or activity

Mechanical Phenomena

Analog computers use diode limiters to simulate apparatus characterized by two or more discrete operating conditions. Basic limiter circuits are described. Applications are shown in study of cam-operated engine valve and simulation of static and coulomb friction

two advantages. First, no resistor matching is required to produce zero gain at small input signals. In some applications, mismatched resistors in the circuit of Fig. 3A may cause an undesirable drift. Second, in the series limiter it is more convenient to control independently the gains for positive and negative signals. This effect is shown in Fig. 3D.

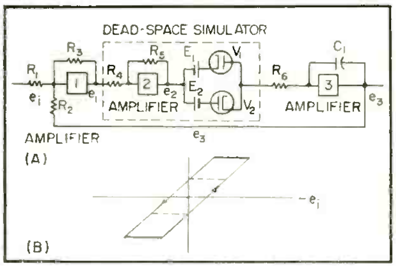

FIG. 4—Dead-space simulator presents analogy of backlash in gear assembly

Figure 4A illustrates a circuit for simulating backlash as may occur in a gear assembly. It employs the dead-space simulator. Assume that R_1, R_2, R_3, R_4 and R_5 are equal and that the time constant R_6C_1 is very small. Assume further that the voltage across C_1 is initially zero. If the input voltage is zero and increasing positively, the output voltage e_3 will remain zero until the input voltage is equal to E_2. At this point, V_2 conducts, and amplifier 3 integrates until the output voltage e_3 is just large enough to cause V_2 to cut off. Further increases in e_i result in equivalent decreases in e_3, and voltage e_3 may be said to follow e_i. This action continues until e_i reverses direction; e_3 then remains constant until e_i has changed by a quantity sufficient to turn on V_1. The action continues in this way, tracing a loop or loops, as shown in Fig. 4B.

Figure 5A is a simple comparator circuit. Amplifier gain is sufficiently high that the output e_B is limited by either V_1 or V_2 except for negligibly small inputs. Thus, e_B must be either E_1 or E_2, depending on the sign of $(e_i + K)$. The circuit has high gain during the transition from one state to another and almost zero gain in either of the stable states. The voltages e_A, e_B and e_C are shown in Fig. 5B, 5C and 5D respectively. Any one of the three output voltages may be used to switch other amplifier-diode circuits or may be applied to an integrator for initiating a timing operation. It should be noted that K may be replaced by a variable to obtain an indication or initiate a process when one variable exceeds another.

The comparator is applied in a bistable multivibrator as shown in Fig. 6A. Comparison voltage is zero. Positive feedback is provided by amplifier 2 during the transitions and stability is reached when e_1 is either E_1 or E_2. If R_2 is equal to R_3, switching will occur whenever e_i is equal to e_1. A graph of the output voltage is given in Fig. 6B.

Sweep Generator

The bistable multivibrator is used in the sweep generator shown in Fig. 7A. Assume all resistors are equal, and that E_1 is equal to E_2. If e_1 is positive, the output of amplifier 3 will decrease until it is equal in magnitude to e_1. At that point, e_2 changes sign and e_1 steps to a negative voltage, reversing the process. Steady-state waveforms are shown in Fig. 7B.

Figure 8A is a precision version of the sweep generator shown in Fig. 7. It shows that precision versions of amplifier-diode circuits are generally possible. The trick in

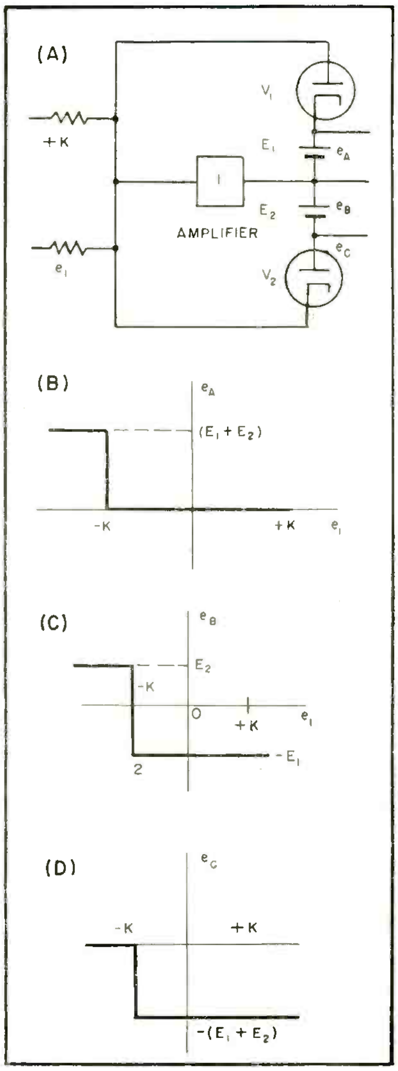

FIG. 5—Comparator circuit shows diodes used in another switching operation

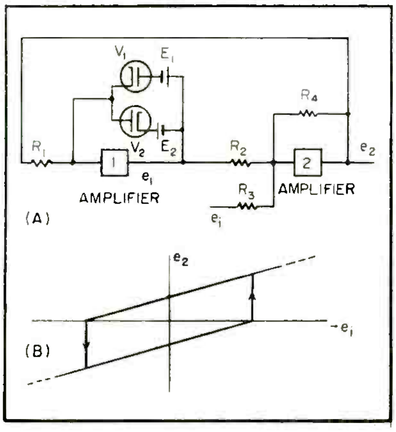

FIG. 6—Bistable multivibrator uses comparator circuit

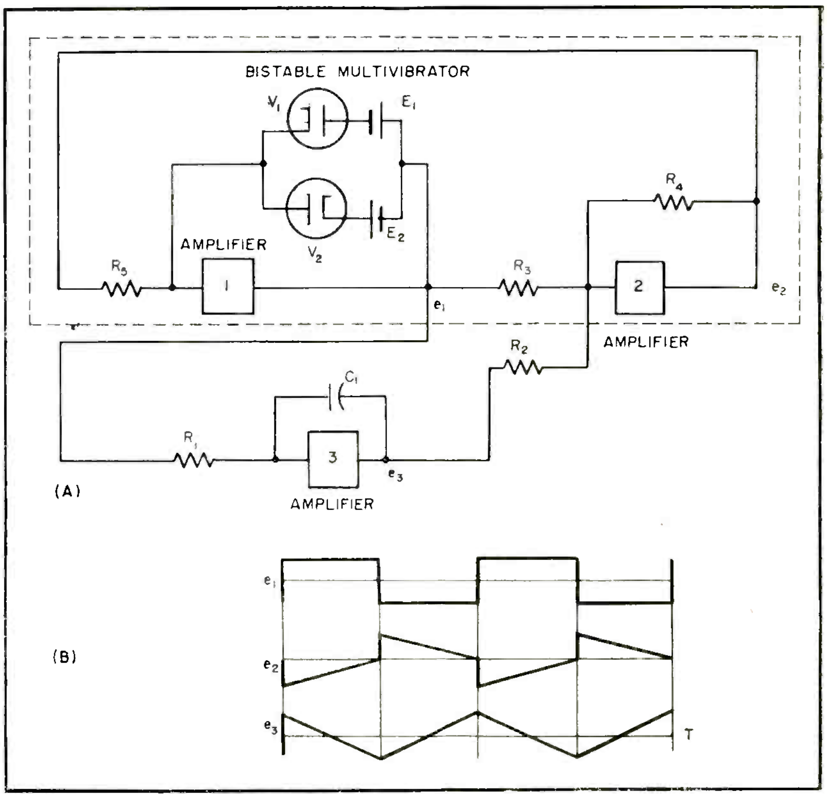

FIG. 7—Sweep generator employs bistable multivibrator circuit. Steady-state waveforms are shown

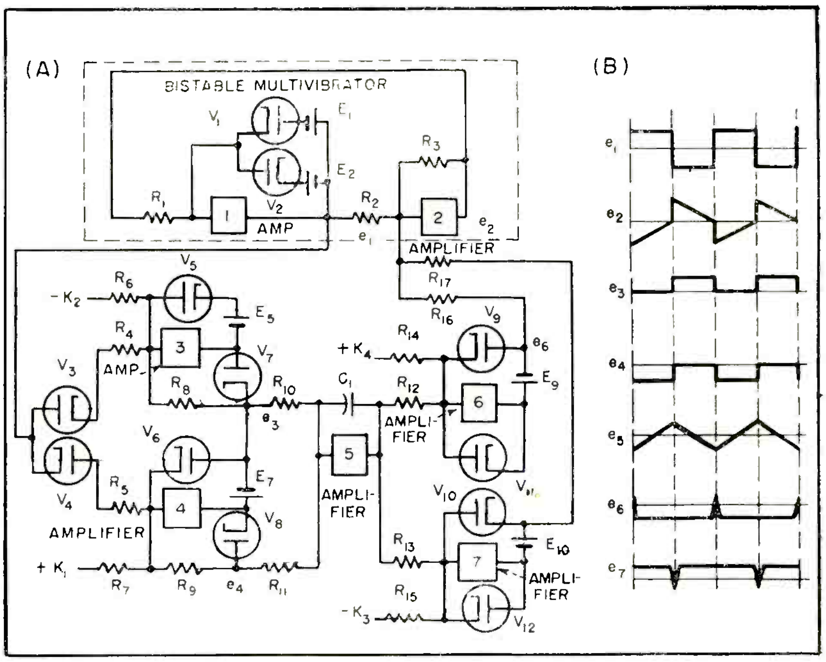

FIG. 8—Precision sweep generator uses ordinary diodes as switches to control idealized diodes

such applications is to use ordinary diodes as switches to control idealized diodes. This basic method may be used to turn a variable voltage on or off as a result of coincidence of two other variables.

Usually the use of the idealized diode to secure precise operation will require more equipment. Quite often, however, precision circuits may require no more, or even less, equipment. Figure 9A is a modification of the idealized diode and produces the absolute value of a variable voltage. Amplifier 1 is called a sign-separator since each of the two outputs, *A* and *B*, furnishes only one sign of the variable. The output of amplifier 1 is applied to the input of amplifier 2 only if e_i is positive. The gain from input to output through amplifiers 1 and 2 is +2 if the input is positive and zero if the input is negative. The gain from input to output through amplifier 2 is always −1. Under these conditions the output is the absolute value of the input, as in Fig. 9D. Variations of this circuit permit the rotation and translation of the origin.

Examples

One application of amplifier-diode circuits is the simulation of static and coulomb friction. A typical situation is illustrated in Fig. 10. Two cases are considered: the first involves use of a double-acting spring that provides a restoring force for both positive and negative deflections. In the second case, a single-acting spring is used. The equations of motion for each case are shown. These equations imply statements such as: the frictional force is equal and opposite to all applied forces as long as the velocity of the block is zero, and until the sum of the applied forces is equal to or greater than some fixed value.

The circuit for solving the double-acting spring problem is shown in Fig. 11. It is assumed that stiction is equivalent to infinite viscosity, a condition which may be simulated by a short circuit across C_1 for zero velocities. A very close approximation to a short circuit across C_1 is effected by a high-gain negative-feedback path around amplifier 1 provided by amplifiers 3 and 5. The effective resistance across C_1 is then R_1 divided by the gain through amplifiers 3 and 5. Since this gain may easily be 10,000 or more, the effective resistance across C_1 may be approximately 100 ohms. The error due to this approximation is less than that which would be caused by an amplifier 2 grid current of 10^{-9} ampere.

Spring Problems

When the velocity, $\dot{X}_o$, is zero, all diodes are off. As X_i is increased, a point is reached when the output of amplifier 3, which is following X_i, is limited by either V_1 or V_2. At this point the large damping is removed and the velocity is free to change. A very small change in X_o turns on one diode of each pair. Diodes V_3 and V_4 prevent overloading of amplifier 3. When V_3 or V_4 is on, V_5 and V_7 or V_6 and V_8 are also on, and the limited outputs of amplifiers 3 and 4 provide a steady opposing voltage corresponding to the coulomb friction. Voltage dividers have replaced the batteries used with diodes in previous illustrations.

The input and output functions are also shown in Fig. 11. No motion occurs until the wheel has moved sufficiently far to break static friction. There is overshoot and restoring action due to the spring. The block comes to rest with a small positive force still applied. In this particular example, sliding friction was approximately half static friction.

Figure 12 shows the single-acting spring problem. Amplifier 5 is sensitive only to positive errors. Because of gating action of amplifier 5, a separate feedback path must be provided for frictional forces. This is accomplished by amplifier 6. Results of this simulation are also shown in Fig. 12. The block moves in spurts and although there is overshoot, there is no restoring action.

Cam Problems

As a second example of the use of diodes in computing circuits, consider the motion of a valve operated by a cam. This problem involves stiffness ratios on the order of 2,000 to 1. The data for this problem were obtained from the HAL engine, well known in the racing engine field. Top speed of this engine is about 4,000 rpm.

Figure 3 illustrates the problem, defines the quantities and lists three

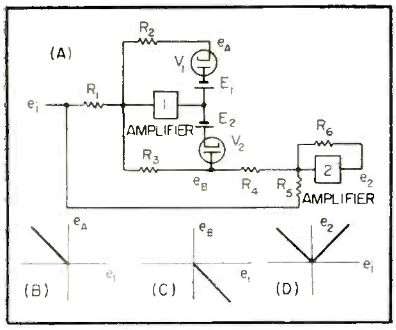

FIG. 9—Idealized diode gives absolute value of variable voltage

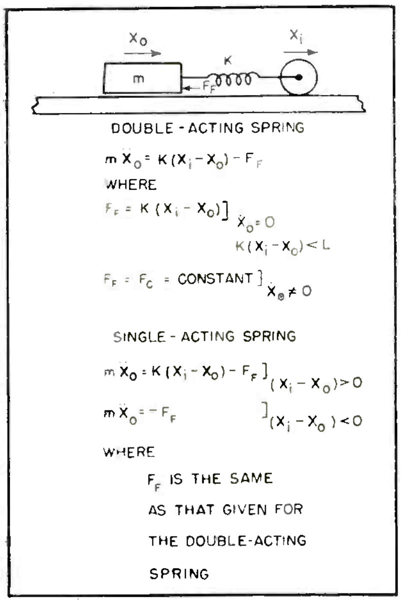

FIG. 10—Problem requiring simulation of static and coulomb friction

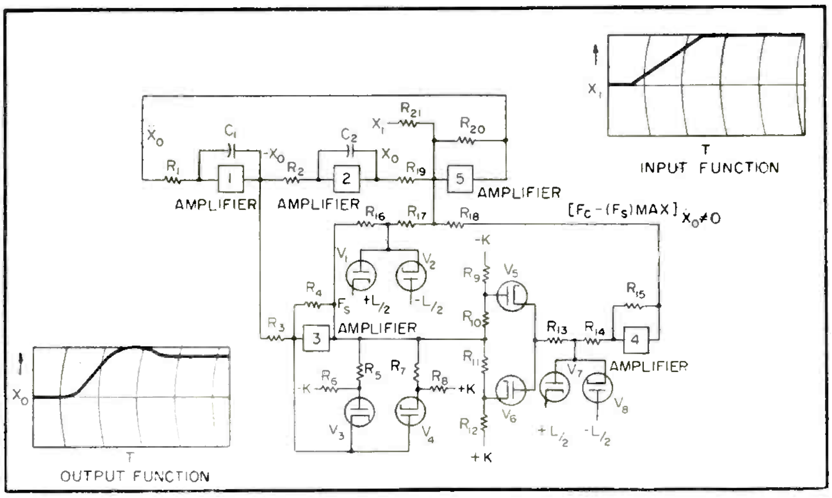

FIG. 11—Solution for case wherein block is accelerated from rest by force applied through double-acting spring

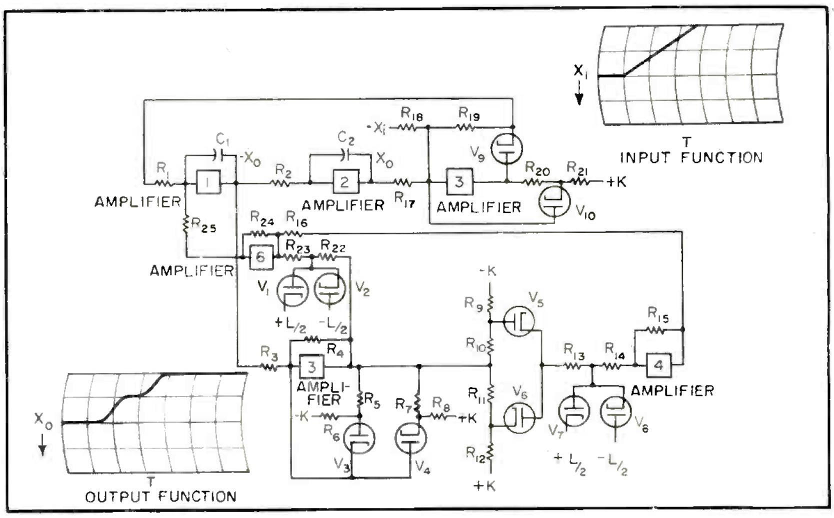

FIG. 12—Solution for case wherein block is accelerated from rest by force applied through single-acting spring

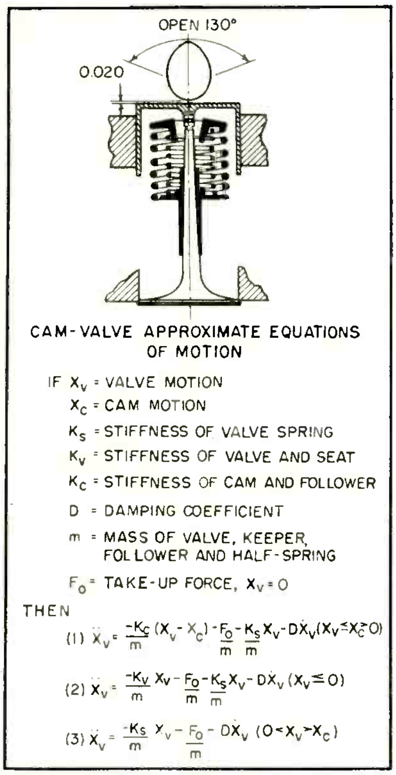

FIG. 13—Problem involving cam-operated engine valve

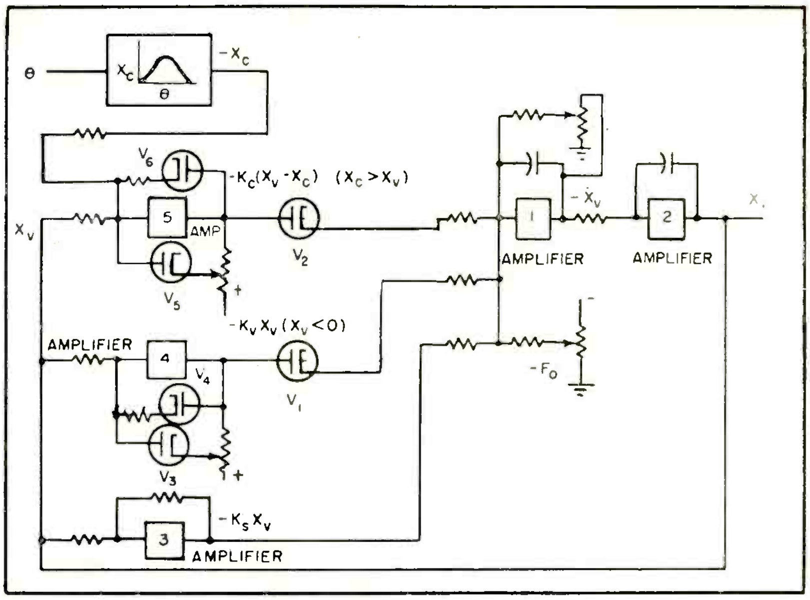

FIG. 14—Solution of cam-operated engine-valve problem using amplifier-diode circuits. Cam motion is provided by function generator

equations of motion only one of which is valid at any particular instant. When the X-position of the cam is greater than that of the valve, Eq. 1 holds. If the cam follower and cam are not engaged, Eq. 3 holds unless the valve is seated, in which case Eq. 2 holds.

These equations are solved as shown in Fig. 4. Amplifiers 1 and 2 are the two integrators required for solution of second order equations. The terms common to all three equations, those due to the valve-spring, are provided by amplifier 3 and the potentiometer marked F_0. Cam motion is provided by a function generator. When the magnitude of X_C is greater than that of X_V, the difference is amplified by amplifier 5 and applied to the input of amplifier 1, thus solving Eq. 1. When the valve position is equal to or less than zero, the valve is seated and X_V is amplified by amplifier 4, thus solving Eq. 2. The gains through amplifiers 4 and 5 are high. When neither of the above conditions pertain, both V_1 and V_2 are cut off and Eq. 3 is solved.

Amplifiers 4 and 5 may be replaced by idealized diodes thereby eliminating the need for V_1 and V_2. This further shows that the more precise method will often be the simpler one.

The results of the cam-valve simulation are shown in Fig. 15. The solid line is a development of the cam surface and is also the path traced by the cam follower and valve. As the speed of the engine is increased, a point is reached beyond which the valve cannot follow the cam. Hammering, override and bounce result as shown by the broken line. Since this was part of a racing engine, it was running near top speed much of the time. It had been observed that the cam showed very little wear on one side and there was evidence of hammering near the peak of the cam. This fact had not previously been explained. Furthermore, valve stems had occasionally broken, due, perhaps, to the final bouncing. In the simulated valve, the bouncing rapidly increased in magnitude as the speed of the engine was raised. Increasing the engine speed by about 10 percent increased the height of bouncing about 300 percent.

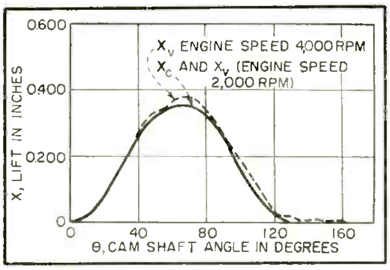

FIG. 15—Results of cam-valve simulation

Conclusions

The thermionic diode is a useful circuit element in simulating nonlinear characteristics. Amplifier-diodes may be used to simulate systems characterized by two or more distinct operating regions or conditions separated by abrupt boundaries. They can be made quite accurate and precise. Their speed is at least of an order of magnitude faster than that of corresponding relay circuits and standard stabilized computing amplifiers may be used.

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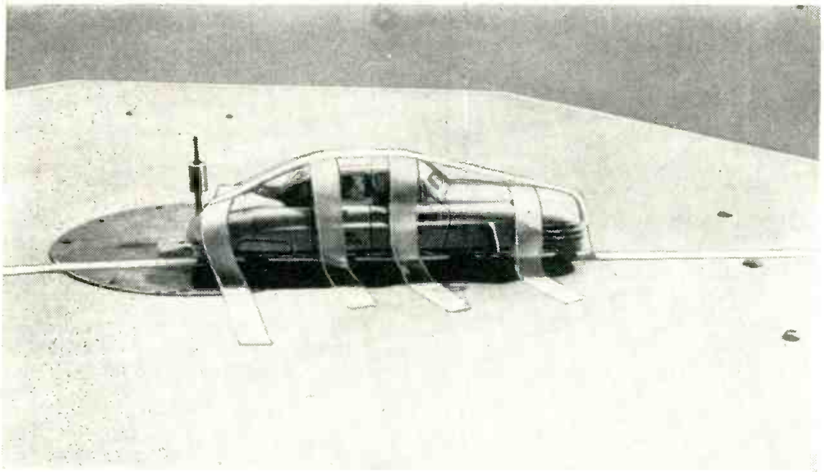
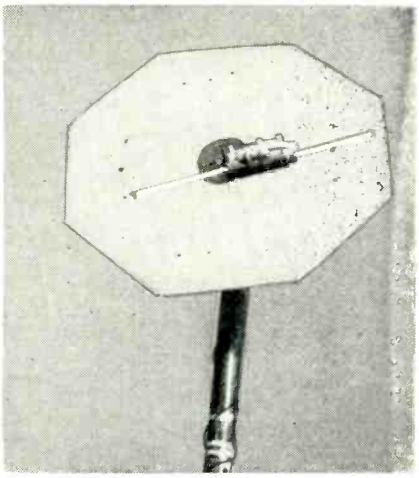


Toy auto provides scaled-down vehicle for antenna measurements using microwaves to check vhf and uhf systems



Turntable ground plane permits use of stationary measuring equipment

Investigating Antennas For UHF Mobiles

Scale-model test setup using inexpensive toy car mounted on turntable ground plane yields useful information on radiator characteristics for mobile services in present 150-mc band and new 450-mc band

By EDWARD F. HARRIS

Chief Engineer
Mark Products Company
Lincolnwood, Illinois

WHEN the mobile services were confined to frequencies below 30 megacycles the antenna problem was mainly one of providing enough physical length to obtain a reasonable degree of radiation efficiency. Pattern considerations were secondary and almost nonexistent since there was little choice in the mode of operation.

The move to higher frequencies in the 150-mc region came as the mobile services were about to experience a large expansion and vehicular antennas seem to have evolved from their low-frequency predecessors to the familiar quarter-wave roof mounted whip. Recently, units such as the bumper mounted coaxial dipole have seen application but so far as is known there has been no real effort to manufacture more useful radiators or even to investigate thoroughly the pattern properties of those in general use with a view toward an evaluation of system efficiency.

450-Mc Mobile

At this time the field is about to experience another expansion to still higher frequencies in the 450-mc region. Early experimenters have carried the old antenna techniques a step further and are employing the quarter-wave whip antenna with fair results. The physical length of this unit is now about 6 inches overall and it becomes apparent that some means of increasing the aperture and thus gain is generally to be desired. The physical length of an 18-inch whip has been well accepted and it is possible that even longer units would not be objectionable from an appearance standpoint.

This paper approaches the an-

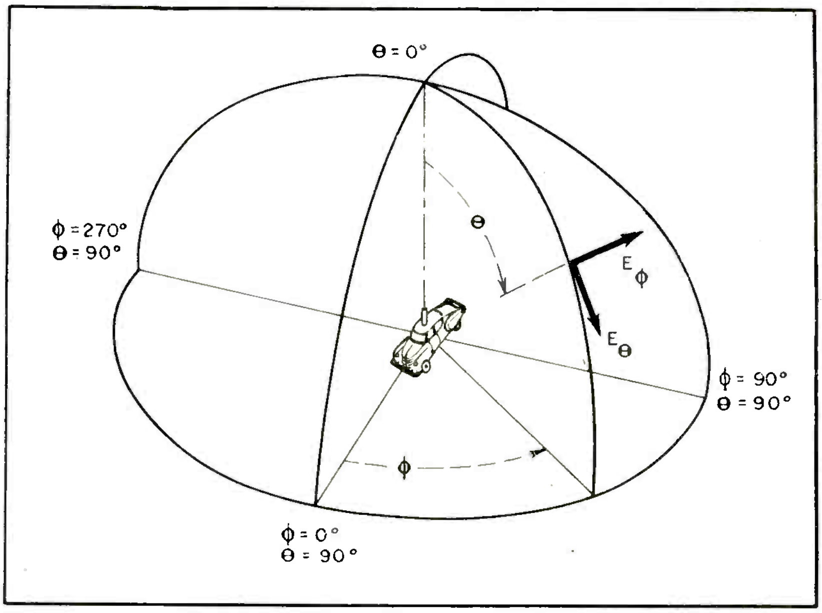
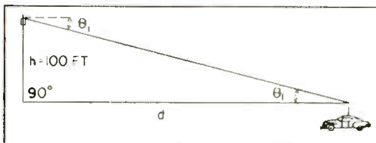


FIG. 1—Vehicle is assumed to be in center of co-ordinate system as shown



d MILES	d FEET	θ DEG-MIN
0.5	2,640	2° 10′
1.0	5,280	1° 5′
2.0	10,560	0° 34′
10.0	52,800	0° 6.5′
20.0	105,600	0° 3.5′
30.0	158,400	0° 25′

FIG. 2—Over flat earth, most direct-ray communication takes place within one degree of horizon

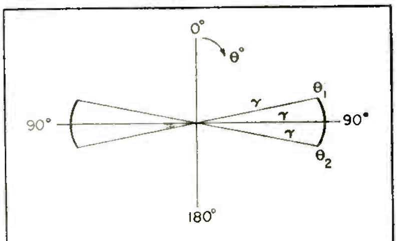
tenna problem from the standpoint of an analysis of systems in use today with the thought that an understanding of the properties available at the present state of the art will point the way to avenues of attack in an effort to improve performance. Such antenna design work is now feasible in view of the small wavelengths involved and the opportunities for the antenna engineer to exercise his ingenuity are unlimited.

The problem generally involves vertical polarization exclusively, omniazimuth coverage in general, with land station to mobile unit and mobile unit to mobile unit communications. Figure 1 shows the generalized coordinate system used and the positioning of the mobile unit and antenna within the coordinates.

In considering the primary coverage area of a central station communicating with mobile units, refer to Fig. 2 which shows a simplified flat earth consideration of the path of propagation. Although the direct and reflected ray are to be considered, the important point is that at ranges over a mile, communication via the direct ray takes place within an angle of plus or minus one degree from the horizon.

In a service that requires uniform or omniazimuth coverage, the only avenue for the increase in gain is that which narrows the beam width in the vertical or θ-plane. To provide for the analysis of arrays which might produce a narrow vertical pattern, and also illustrate the effects of beam width in the vertical plane upon the gain for the omniazimuth radiator, Fig. 3 has been prepared. A hypothetical radiation pattern has been assumed which is completely omniazimuth in its radiation and furthermore its vertical pattern is uniform between specified limits (θ_1 to θ_2) and then drops off immediately to zero beyond these limits.

This radiator will be termed to



$$G_0 = \frac{2}{\int_{\theta_1}^{\theta_2} \sin\theta \, d\theta}$$

$\theta_1° - \theta_2°$	BEAM	G_0-ISOTROPIC	G-OVER DIPOLE
50 - 130	80°	1.94 DB	− 0.22 DB
60 - 120	60°	3.0 DB	0.84 DB
70 - 110	40°	4.66 DB	2.5 DB
80 - 100	20°	7.6 DB	5.44 DB
85 - 95	10°	10.62 DB	8.46 DB

FIG. 3—Gain analysis for hypothetical omniazimuth isovertical radiator

have an isovertical pattern which is unattainable in practice but is very convenient for analysis. The table in Fig. 3 permits evaluation of the theoretical system gain to be expected under several conditions of reduction in the total vertical beamwidth of the omniazimuth radiator.

From the data shown in Fig. 2 it may be concluded that it is entirely practical and desirable to confine the radiation within 10 degrees or even less. Such a radiation pattern should produce somewhat over 8-db gain over an ideal dipole. In practice an array which produces a 10-degree vertical beam width would not be isovertical by any means and its actual gain must be evaluated by other means. Figure 3 however is an excellent guide in the discussion of system improvements by restriction of vertical radiation.

Scale Models

Radiation patterns of mobile units have been investigated by conventional scale model techniques. The average automobile is about 20 feet long. A scale model auto was obtained at the local dime store, which was 1 foot long or 1/20 the full size. Therefore a scale frequency of 20 times 150 or 3,000 mc was employed (9,000 mc for the 450-mc band) for the model pattern measurements.

The auto was mounted at the center of a large ground plane and both the quarter-wave whip and the rear bumper mounted coaxial dipole were modeled and measured. There are limitations to this technique in that the ground plane is finite and that the conductivity of the ground has not been modeled perfectly, however, surprisingly good results were obtained. The measurements shown are necessarily a first approach to the problem.

The photographs show the model auto in position on the ground plane and the assembly mounted on the tower for measurements. Figure 4 contains sets of the principal plane patterns for the two cases of the roof-mounted quarter-wave whip antenna and the bumper-mounted coaxial dipole. These are relative patterns in that the relative values of voltage are recorded at each angle. Note that in both cases a large proportion of the radiation is propagated at the higher angles and that a rather small part is in the useful directions as shown in Fig. 2.

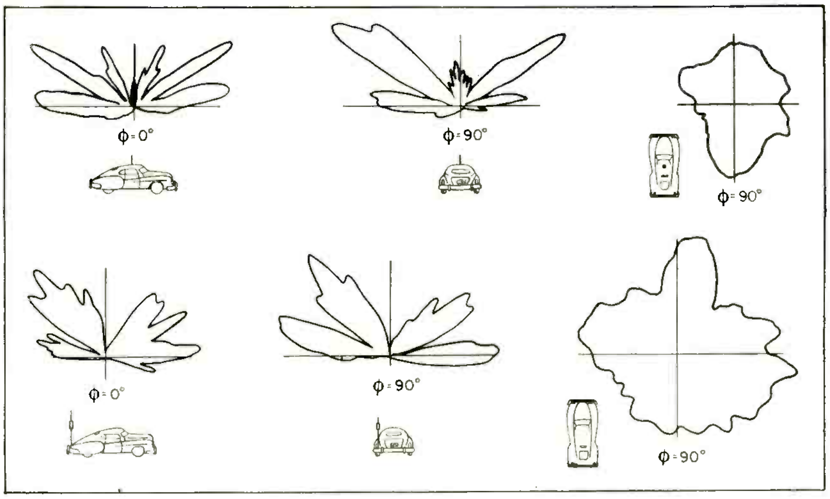


FIG. 4—Typical patterns of roof-top quarter-wave and bumper-mounted coaxial vehicular antennas scaled 20 to 1

Test Results

To reduce the data to an absolute basis so that actual gain figures may be assigned to the patterns it is necessary to take a complete set of integration patterns to show the space distribution of radiation. This has been done for the case of the roof-mounted quarter-wave whip antenna and the set consisting of ϕ patterns taken for ten-degree steps in θ from zero to 90 degrees is shown in Fig. 5. Referring to the $\theta = 90$ degree pattern of Fig. 5, the gain of this pattern varies from 1.1 db above a dipole at the maximum of the pattern to 6 db below a dipole at the minimum point of the pattern. These figures of gain result from planimeter integrations of the θ pattern areas and the proper numerical summations to reduce the pattern data to absolute values. Due to the high angle radiation and the power lost at these unusable angles, the gain in the $\theta = 90$ degree plane (the azimuth or horizon plane) suffers considerably. The fact that the pattern is not perfectly circular is of secondary importance since there is appreciable radiation in all directions of azimuth. However the fact that the level is down due to the higher angle radiation is a serious consideration in design.

On the basis of the data presented it is felt that proper design of the mobile-mounted antenna can produce effective gains over presently used systems of the order of 6 to 10 db at those angles which are effective in the communication zone. From past experience it is known that the factors causing high-angle radiation will become more severe at the new 450-mc range than at the 150-mc range studied so that the need for improvement of the vehicular antenna system becomes even more important and the possibilities for improvement proportionately greater.

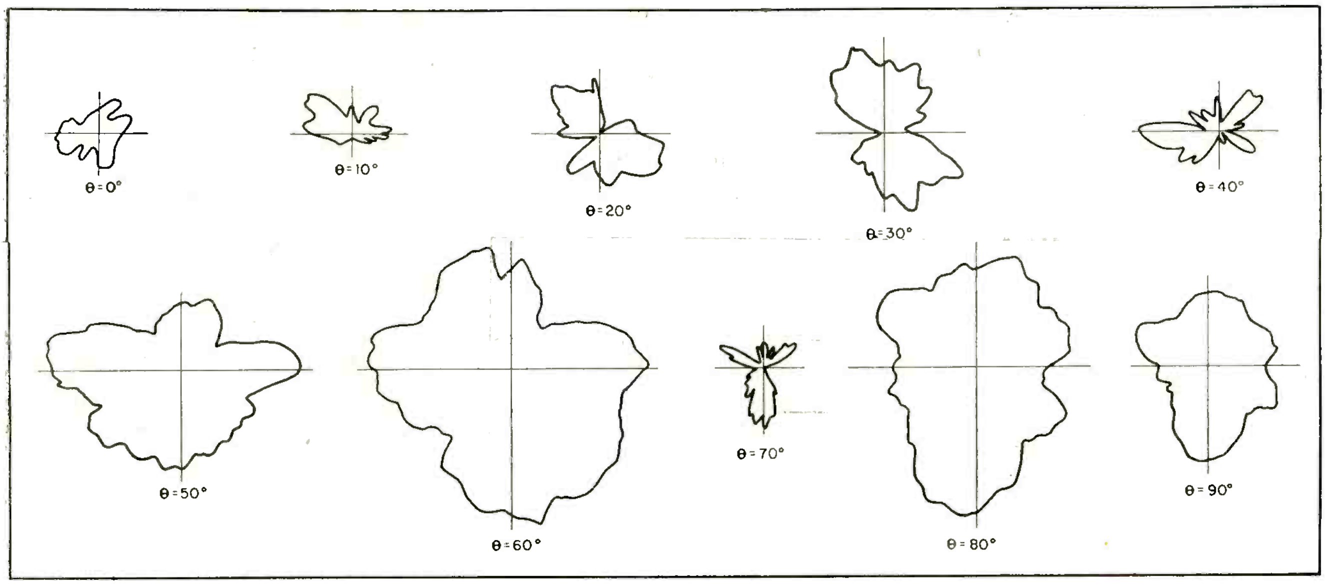


FIG. 5—Typical patterns for roof-top quarter-wave whip at different vertical angles made with scaled system agree closely with measurements on full-size equipment

Industrial Frequency

Locked oscillator-divider synchronized directly with 5-mc carrier from WWV provides inexpensive but accurate source of frequencies for industrial or communications laboratory. System depends upon trf receiver equipped with selective input filter and clipper-limiter to make device independent of noise

SYNCHRONIZED directly by the 5-megacycle carrier received from WWV, Beltsville, Maryland, a novel type of frequency standard has been placed in operation in a laboratory of the General Electric Company at Schenectady. The 5-mc carrier received from WWV is divided to 1 mc by use of a locked-oscillator-divider. The output from this divider is then reduced to lower frequencies by means of conventional multivibrator dividers.

This standard eliminates the necessity of maintaining crystal-frequencies that must be regularly checked and which at best serve as subfrequency standards. The system preserves the original stability obtained by the Bureau of Standards for the 5-mc carrier that is maintained at ± 1 cycle in 10^8 cycles.

During the course of developing this unit, an extended recording of signals from WWV was made. A tuned-radio-frequency receiver with limiter was used in making records. The limited 5-mc, radio-frequency signal was rectified by a crystal diode and the output fed to a d-c amplifier. A photoelectric recorder was connected in the plate circuit of the d-c amplifier and the gain of the amplifier adjusted until the limited value approached full scale of the recorder. The receiver contained three stages of trf with a three-stage input filter.

Reception Characteristics

The recordings show appreciable signal level over a twenty-four hour period. There are short-period fades around midday and more numerous short-period fades between the hours of 10 p.m. and 5 or 6 a.m. Throughout the working day, however, the signals were substantially up to the limited value.

The antenna used was a 5-mc dipole mounted 30 feet above the roof. The antenna was oriented broadside to Beltsville, Maryland. It was delta-matched to 300-ohm, ribbon-type transmission line.

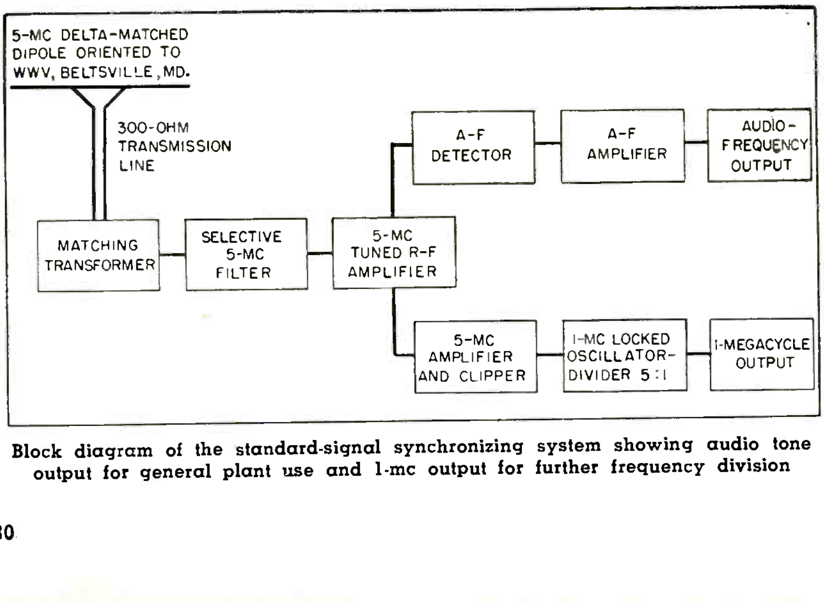
Since the signal levels were substantial over normal working hours, it was decided to proceed further with the system. In the development, it was foreseen that it would be desirable to employ limiters to clip approximately 90 percent of the receiver output envelope, thus giving a wide range of agc and elimination of unwanted modulation, which in this case consists of the clock ticks, audio tones and voice modulation of WWV.

It will be noted from the block diagram that an audio-frequency branch is taken from the trf output for purposes of aural monitoring and to furnish audio signal service to the various parts of the plant requesting it. This signal does not pass through a limiter.

Owing to the noise level of industrial equipment operating in the plant, a high degree of selectivity is required. For this reason, a selective input filter was carefully designed and matched. Further to increase the selectivity, it was decided to employ a 5-mc crystal filter in the trf amplifier.

Certain fast transients of noise had a tendency to get through to the synchronizing grid of the locked-oscillator-divider at amplitudes higher than the limiting level. This effect seemed to depend upon the time constant of the limiter. It was found, however, that such transients could be greatly attenuated by the insertion of a resistor in series with the coupling capacitor to the synchronizing grid of the locked-oscillator-divider. Practically all momentary loss of synchronization was, by this means, eliminated.

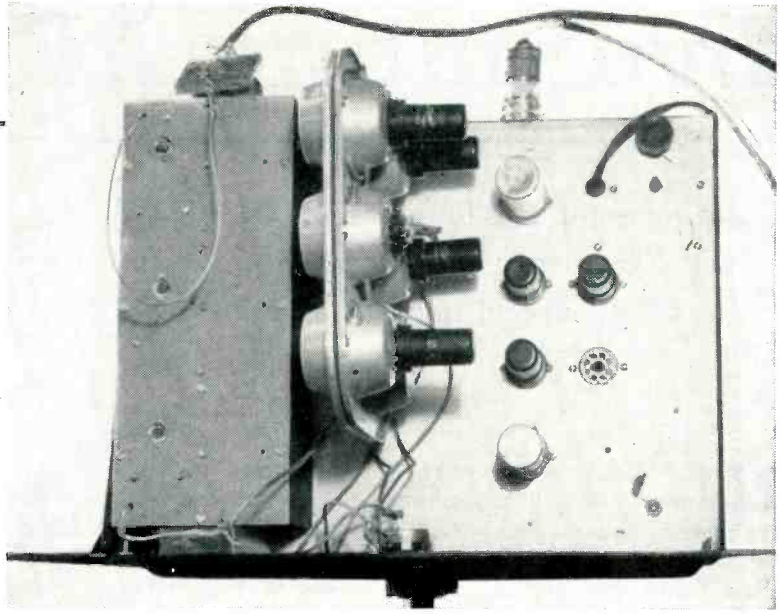
The photograph shows a top view



Block diagram of the standard-signal synchronizing system showing audio tone output for general plant use and 1-mc output for further frequency division

Standard

By H. W. KLINE
General Engineering Laboratory
General Electric Co.
Schenectady, N. Y.



Top view of model synchronized standard with three-stage filter at left, trf receiver in center and locked oscillator-clipper components at right

of the equipment containing all essentials up to the locked, 1-mc output. Equipment for further division of the 1-mc output is not shown. It consists essentially of conventional multivibrator dividers or multipliers, as desired at lower frequencies. It is practicable to reduce the 1-mc output to 10 kc, multiply by 3 to 30 kc and by a chain of multivibrators divide by 500 to get 60 cycles. This output could be used to operate a clock directly synchronized by WWV.

The standard, including multivibrators providing outputs of 1 mc, 100 and 10 kc or other frequencies, can be built as compactly as the better class of communication receiver and with about equivalent weight.

Synchronization

In normal operation, during instants when the signal-to-noise ratio becomes unfavorable, there are instantaneous losses of synchronization that do not seriously interfere with employing the output for accurate frequency measurements. Such periods would affect the operation of a clock, however, and where clock operation is the end result desired, antenna equipment should be erected in quiet zones and where sufficient signal level is available.

It is also possible to multiply directly the 5 or 1-mc outputs of the unit to higher frequencies for use in calibrating microwave equipment throughout the spectrum.

Another application of the system when good signals from WWV are obtained could be in the direct control of transmitting stations by means of the emissions direct from WWV. For example, radio broadcast station WGY transmits on a carrier frequency of 810 kc. The 10-kc output of a synchronized frequency standard could be reasonably multiplied by 81 to produce 810 kilocycles for directly regulating the transmitter frequency.

In practice, a receiver, with bfo tuned to 1 megacycle, is used to pick up the 1-mc signal from the locked-oscillator-divider. Synchronization is observed by slowly varying the frequency of the oscillator within a small audio tolerance. When synchronous frequency is attained, the oscillator abruptly falls into step giving a constant beat note over part of its vernier scale.

A further test of synchronization can be obtained by disconnecting the antenna line. The first oscillator then operates unsynchronized and a change in beat-note is observed at the receiver. Further observations have been made employing a 1-mc commercial frequency standard. The frequency beats between the commercial standard and the synchronized oscillator of the standard could be reduced to zero only by extremely careful tuning of the zero-set of the commercial standard. It was found that adequate stability in standards of this type was not reached until after more than two hours of continuous run. This disadvantage is not present in the synchronized frequency standard.

Limits of Usefulness

Certain limitations of this system should be pointed out. Reliability of operation depends upon adequate signal strength being obtained from WWV. Thus, it should not be installed until it is known for certain that the signal intensity will be sufficient. Furthermore, reliability depends upon freedom from interfering signals of injurious strength in the 5-mc channel used for the frequency standard emissions. One of the major problems involved in the design of the input filter to this equipment was the elimination of broad interference from experimental telephone signals on an adjacent channel.

The major problem is, of course, to obtain that degree of selectivity necessary to produce a favorable signal-to-noise ratio owing to the level of industrial plant noise. However, the system has been installed to operate under probably the most adverse conditions that would be encountered. The most favorable conditions would be in isolated regions using an antenna of good directional characteristics and possibly diversity pick-ups.

Evaluating AFC Systems

Measuring techniques for obtaining useful performance data on various types of horizontal automatic frequency control systems. Resulting curves and values facilitate comparison of system and improve evaluation of design changes in a given receiver

WITH the increased desire to improve fringe-area performance and to decrease the cost of a television receiver, it has become increasingly important to the designer to be able to evaluate quantitatively the operation of a receiver's individual circuits. This paper presents some essential characteristics of a horizonal afc system and a means to measure and examine them.

Typical System

A block diagram of an afc system is shown in Fig. 1. It represents a conventional system in which the relative time of occurrence of the incoming sync-signal information T_1 is compared to the relative time of occurrence of the system's output T_2 and applied to a phase detector. The phase detector output is a d-c voltage E, which is proportional to the relative difference T_d in time of occurrence of T_1 and T_2. The voltage E controls the frequency of the local oscillator and under proper operating conditions locks it to the incoming sync-signal frequency.

The low-pass filter serves to integrate out horizontal sync pulses and noise, and thereby improve the system's noise immunity. Balanced phase detector operation, in which the sync pulses and associated noise tend to cancel out, will make further improvement in noise response.

The phase detector characteristic θ is the change in the d-c output voltage E due to a change in the relative time difference T_d between local oscillator and transmitter. The value of $\theta = dE/dT_d$ may be measured in volts per microsecond.

The video amplifier, sync clippers and horizontal output circuits will alter the relative time of occurrence of picture-to-sweep information by adding a constant though different time delay to each. However, the change in time delay, with the small frequency changes (15,750 cps $\pm$ 5 percent) that are involved, will be very small for all the circuits except the afc and therefore may be neglected.

The value of T_d may be measured as the difference in relative time of occurrence of two events, the sync-signal information at any point before the afc circuit and the sweep information at any point after the afc circuit.

The static time delay T_s may be defined as the relative time difference of the sync-signal information at the cathode-ray tube and the sync-signal information at the input to the afc system. It is well to keep this value small, for the afc system must compensate for it to keep the picture information properly phased in the raster.

The local oscillator characteristic β may be defined as the change in the local oscillator frequency due to a change in the phase detector output voltage E. The value of $\beta = df/dE$ may be expressed in cps per volt.

The overall transfer function α may be defined as the change in the local oscillator frequency f due to a change in T_d. The value of $\alpha = df/dT_d$ may be expressed in cps per microsecond. It is the product of the oscillator characteristic and the phase detector characteristic, hence

$$\alpha = \beta\,\theta = \left(\frac{df}{dE}\right)\left(\frac{dE}{dT_d}\right) = \frac{df}{dT_d}$$

The concept of α, β and θ may be used only when the local oscillator is in synchronism with the transmitter. They represent the steady-state characteristics of the system.

Picture Phasing

Some idea of the values of α necessary may be gotten by a simple calculation. Assuming that the maximum return time of the horizontal trace is 8.5 microseconds and the transmitted sync-signal has minimum allowable horizontal blanking of 10.15 microseconds as recommended by the Federal Communications Commission,[1] the amount of picture phasing allowable is 1.65 microseconds. Since the FCC does not specify the allowed horizontal sync-signal frequency tolerances, the recommendations of $\pm$ 1 percent by the RTMA Studio Facilities Subcommittee[2] may be used. There-

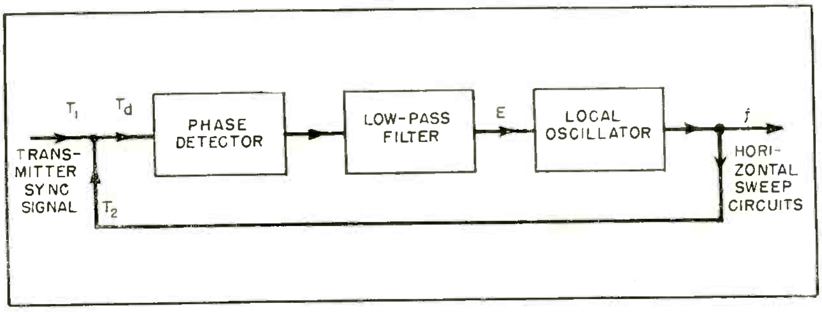


FIG. 1—Block diagram of typical afc circuit used in television receivers

for Television Receivers

By GEORGE HOWITT
Television Receiver Division
Allen B. DuMont Labs., Inc.
E. Paterson, N. J.

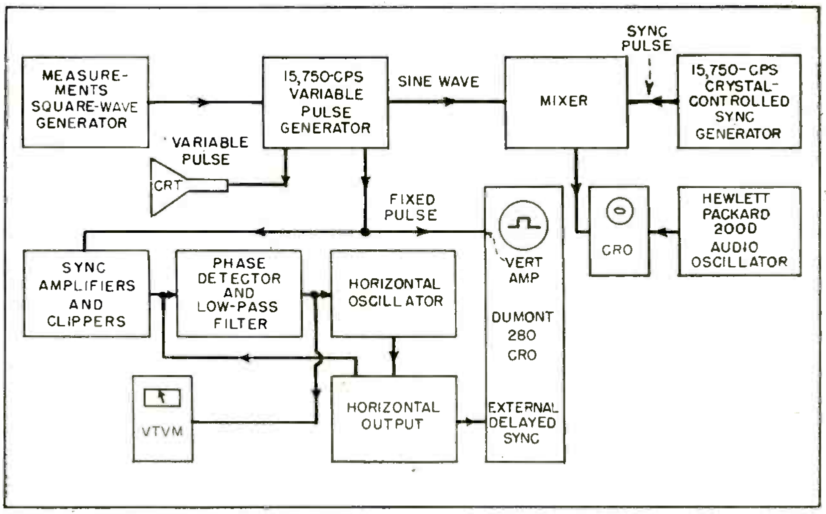


FIG. 2—Arrangement of equipment for measuring performance of afc systems

fore the value of α necessary to produce no picture foldover is 191 cps per microsecond. If it is desired to restrict the amount of phasing to a $\frac{1}{16}$-inch shift on a 21-inch cathode-ray tube, α must be approximately 1,700 cps per miscrosecond.

The above values assume no attempted change in local oscillator frequency. When changes in the oscillator try to take place, due to temperature, voltage, humidity or time effects, the value of α must be increased. It is possible to lower the value of α required, by either allowing foldover to occur and applying a pulse to the cathode-ray tube to blank it out or by using a front-panel horizontal hold control.

Typical values of α used in the field are approximately 100 cps per microsecond for the Synchro-guide type of afc, 200 cps per microsecond for the balanced phase detector-multivibrator type of afc and 700 cps per microsecond for the sine-wave oscillator-reactance tube type of afc.

Lock-in Range

The lock-in range may be defined as the difference between the maximum and minimum frequency that the system will always synchronize to from the nonsynchronized state. The value of the lock-in range required depends on the amount of change of transmitter sync-signal frequency allowed and the amount of local oscillator drift due to the causes listed above. Ideally, the lock-in range should allow the system to synchronize over the full range of expected frequency variations. However, it is possible to reduce the amount of lock-in range required by using a front-panel hold control.

If the lock-in range is greater than the $\pm$ 1 percent transmitter frequency stability recommendation plus the expected local oscillator drifts, and if the transfer function α is great enough to prevent foldover from occurring during the lock-in range, then a horizontal hold control that is readily available to the customer is not necessary.

If sufficient lock-in range is available, but the α of the system is low enough so that foldover can occur within the lock-in range, then a front-panel hold control is necessary. The system need not drop out of synchronization for any setting of this control and it is essentially a phase correction control.

However, if sufficient lock-in range is not available, then it is necessary that the system go out of synchronization for some setting of the front-panel hold control range if proper operation of the receiver is to be expected without service adjustments.

In addition, a front-panel hold control will allow the consumer to minimize horizontal shape distortions due to field frequency components or other frequency transients in the input sync-signal wave-form.

The following range may be defined as the difference between the maximum and minimum frequency at which the system will remain in synchronism, starting from a synchronized state. The ratio of the following range to lock-in range will give an indication of the relative noise immunity of the system as compared with other systems of the same type. The low-pass filter must pass some information at the difference frequency between the received horizontal frequency and the local oscillator frequency for the system to be brought into synchronism. The higher the cutoff frequency of the filter, the closer the lock-in range will approach the following range. However, with a high cutoff frequency, the filter will pass more noise components and consequently the noise immunity of the system will be poorer.

Noise Response

The response of the low-pass filter is only one factor affecting the noise response of the system. The ratio of the time interval during which the incoming transmitter signal has an effect on the circuit, to the total period and any balancing effects such as occur in bilateral type phase comparators will influence the noise immunity of the afc system. The effects of noise are usually evaluated by subjective tests, generally involving comparisons of the systems of interest under the same conditions.

The response of the afc system to a square-wave frequency modulation of the incoming sync-signal is of great interest. The FCC recommendation is that the maximum rate of transmitter horizontal frequency change to be allowed is 0.15 percent per second. This rate of change is often greatly exceeded, particularly when the transmitter is locked to a power line whose generators are driven by a governor-controlled gasoline engine.

If all transmitters used crystal-controlled sync-signal generators, the problems of transient response, lock-in range and transfer function would be considerably simplified.

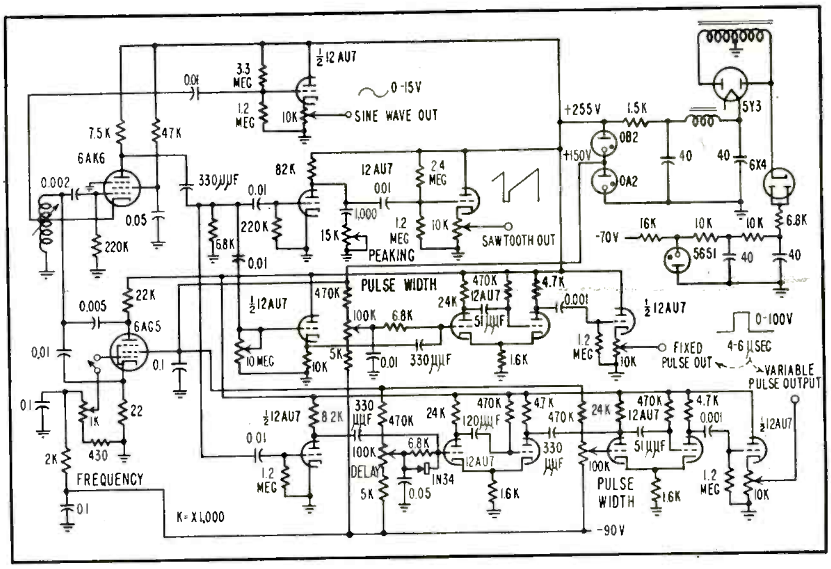


FIG. 3—Circuit of 15,750-cps pulse generator suitable for use as source of sync signals for measurements of afc performance

Measuring Setup

To measure the characteristics of an afc system, the setup of Fig. 2 is used. A pulse generator is the source of the sync-signal. It should be able to cover the frequency range of 15,750 cps ± 10 percent with good stability. The pulse width should be adjustable over the range of maximum to minimum allowable sync pulse width.

The pulse generator circuit of Fig. 3 is useful in this application. The frequency of a very stable sine-wave oscillator is controlled by varying the bias of an associated reactance tube. The output of this oscillator is used to control a variable pulse-width cathode-coupled multivibrator whose output is fed to a cathode-follower output and is used to supply the sync-signal. The sine-wave output is also applied to a similar chain as above, but with a delay multivibrator to provide another pulse occurring after the sync-signal pulse to be used for monitoring on the face of the picture tube. In addition, a sine-wave output for frequency-monitoring purposes and a saw-tooth output with variable peaking are provided.

The sync-signal pulses from a crystal-controlled 15,750-cps sync generator are used as the primary frequency source in the frequency monitoring system. These pulses control a reactance-tube sine-wave oscillator afc system in the mixer (Fig. 2). The output of this sine-wave oscillator is mixed with the sine-wave output from the pulse generator and the beat frequency is measured by displaying a Lissajous pattern on a cro.

The fixed pulse output from the pulse generator is applied to the sync chain in the receiver to provide suitable synchronizing information for the afc system. The fixed pulse is also applied to the vertical amplifier of a DuMont type 280 cro. The flyback pulse from the deflection yoke or some other suitable source is applied to the external delayed sync input of this cro. The calibrated delay is then used to obtain the time difference between the sync-signal pulse and the flyback pulse.

The phase detector output is measured by the vtvm attached to the output of the filter. In addition, a square-wave generator may be applied to the reactance tube in the pulse generator for square-wave checking of the afc system.

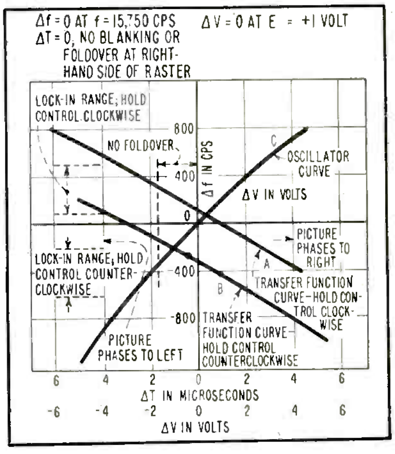


FIG. 4—Typical performance curves of afc system, showing operating ranges

Characteristic Curves

To describe the data which may be obtained from this measuring setup, it is best to refer to the curves of Fig. 4. The relative difference in phase ΔT between sync pulse and flyback pulse is measured throughout the following range and ΔT is plotted as the abscissa. It is convenient to make $\Delta T = 0$ when there is no foldover or blanking visible on the right-hand side of the raster. The frequency difference between 15,750 cps and the actual incoming sync-signal frequency is Δf and is zero when the sync-signal frequency f is 15,750 cps.

In this example, the afc system is aligned so that $\Delta f = 0$ when $\Delta T = 0$. This means that when the incoming frequency is 15,750 cps the picture is phased such that no foldover or blanking is apparent on the right-hand side of the raster. Plotting Δf vs ΔT gives curve *A*. The slope of this curve at any point is the transfer function α at that point.

If the system has a front-panel hold control, a family of curves of Δf vs ΔT may be plotted, each curve representing a different setting of the hold control. Curves A and B of Fig. 4 are obtained with the hold control at its extremes, representing the limits of the system.

The lock-in range may be obtained by measuring the maximum and minimum frequency at which the system falls into lock. These points are indicated on the graph for both the clockwise and counter-clockwise settings of the hold control.

The relative voltage output ΔV from the low-pass filter is shown as zero when $\Delta f = 0$. This is done for simplicity of plotting. Actual values of the voltage E at the output from the filter, when the incoming frequency is 15,750 cps, are approximately 0 volt for balanced phase detectors and in the order of 50 volts for unilateral phase detectors such as are used in the Synchro-guide.

When Δf vs ΔV is plotted as in curve C of Fig. 4, the slope of this curve at any point is the oscillator characteristic β at that point. The phase detector characteristic θ may be gotten at any point by dividing the α of the point by the β of the point.

The static time delay T_s may be obtained by measuring the time difference, at any locked-in frequency, between the sync-signal at the input to the afc system and the fly-back pulse, then getting the same data for the sync-signal at the cathode-ray tube and the flyback pulse and taking the difference between these measurements.

Since the horizontal blanking interval and the horizontal retrace time are known, the amount of phase shift without foldover occurring may be indicated on the graph in Fig. 4. For this example, as was calculated above, the value is 1.65 microseconds. This afc system will be able to lock-in to a maximum sync-signal frequency of $\Delta f = +$ 500 cps and a minimum sync-signal frequency of $\Delta f = -$ 600 cps. A picture without fold-over can be obtained, by adjustment of the hold control, from a maximum frequency of $\Delta f = +$ 310 cps and to a minimum frequency of $\Delta f = -$ 320 cps.

Performance Data

Figure 5 shows the values of α, β and θ, for the curves of Fig. 4, plotted against Δf. The maximum value of α within the lock-in range occurs at $\Delta f = -$ 600 cps and is 145 cps per microsecond for the hold control full counterclockwise. For the hold control full clockwise, the corresponding values are $\Delta f = +$ 100 cps and $\alpha = 113$ cps per microsecond. The maximum value of the oscillator characteristic β within the lock-in range occurs at $\Delta f = -$ 600 cps and is 222 cps per volt. The phase detector characteristic is a constant over the frequency range covered. This is generally true of the typical afc systems now in use. Its value in this case is 0.666 volt per microsecond.

An increase in transmitter sync-signal frequency corresponds to an attempted decrease in local oscillator frequency and vice versa, so that these curves may be used to find the effect of a frequency change at either location or both. The direction moved along the curve with a given change in incoming frequency is the same direction that the picture information on the face of the cathode-ray tube will phase.

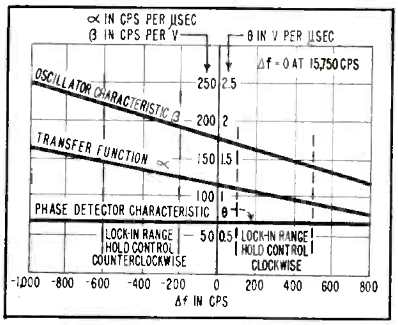


FIG. 5—Curves obtained by plotting frequency change against values obtained from curves of Fig. 4

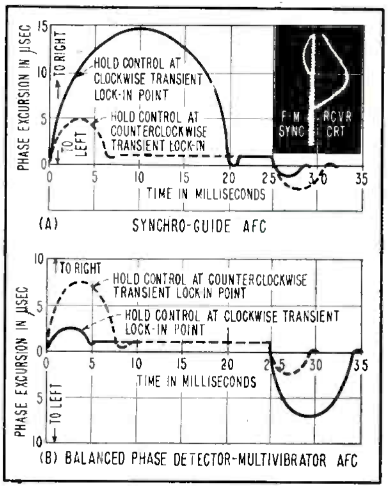


FIG. 6—Transient response of two types of afc systems to 100 cps total deviation at a 20-cps modulating frequency. Oscillogram at upper right shows phase displacement due to square-wave frequency modulation of the sync signal

To check the transient response of the system, the reactance tube in the pulse generator is modulated at a 20-cps rate with a square wave of sufficient amplitude to give a total frequency deviation of 100 cps. The phase displacements are viewed on the face of the cathode-ray tube as shown at the upper right in Fig. 6A. These displacements may be converted into time when the sweep width and sweep time are known, and may be plotted as in Fig. 6. The transient lock-in point is the point at which the maximum phase excursion, with a given square wave of frequency modulation, remains in synchronism. This point is found by varying the front-panel hold control.

AFC Systems

Figure 6A is typical of a unilateral sync-signal input afc system such as the Synchro-guide. It is not possible to balance the phase excursions under any conditions. This means that abrupt changes of sync-signal frequency in one direction will always have a much greater effect than changes in the other direction.

Figure 6B is typical of a bilateral sync-signal input afc system such as the balanced phase detector-multivibrator type. In this case it is possible to get phase excursions that are balanced or unbalanced, depending on the setting of the hold control and the incoming sync-signal frequency.

Complete correlation between some of the characteristics, particularly transient response, and some types of field conditions has not yet been achieved. Additional work still needs to be done.

The author is indebted to E. Campbell of the Allen B. DuMont Laboratories for his constructive criticism and his continued interest, and to A. Bissonette, also of the Allen B. DuMont Laboratories, who obtained the necessary data involved in the experimental work.

REFERENCES

(1) Federal Communications Commission, "Standards of Good Engineering Practice Concerning Television Stations".

(2) RTMA Engineering Department, "Draft of Electrical Performance Standards for Television Studio Facilities."

Ratio Meter Measures

Measurements may be made directly and continuously while making adjustments in the line with system employing two electronic voltmeters, a conventional ratio meter movement and two directional couplers

THE RATIO meter described consists of two vacuum-tube amplifier-voltmeter channels working into a ratio meter movement. The meter deflection depends solely on the ratio of the full rectified average values of the channel signals. In addition, the individual signals can be determined when desired by a voltmeter inserted in either channel. Attenuators in each channel adjust the signal level and at the same time extend the instrument's range.

A particularly interesting application of the instrument is for reflection-coefficient measurements on high-frequency transmission systems. The meter indication can be calibrated in reflection coefficient or voltage standing wave ratio, as desired.

Meter Movement

The ratio meter movement as a d-c indicating instrument, has found noteworthy applications as a stretch indicator and as a temperature indicator.

Two versions of the meter movement are commercially available. Figure 1 indicates schematically their operating principles. The nonuniform air-gap instrument[1] has two coils rigidly connected together and free to rotate about the inner core axis. By keeping the spring restoring forces at a minimum, the coil currents I_A and I_B will produce torques which tend to move the coils to an air-gap position where the torques balance. At an equilibrium position torque side A = torque side B and

$$KI_A\Phi_A = KI_B\Phi_B$$

The coils will move to an air-gap position where

$$\Phi_A/\Phi_B = I_B/I_A$$

The deflection characteristic and sensitivity depend on the air-gap flux distribution. In a recent variation of this type of movement, the air gap is kept constant while the axial length of the pole pieces[2] is varied. In the Edison meter, as shown in Fig. 1, two orthogonal fields will produce a resultant field which is in the direction

$$\theta = \tan^{-1} \Phi_B/\Phi_A$$

The small magnet attached to the pointer will orient itself in the direction of the resultant field. In the actual movement, the field coils are wound so that one encloses the other. Individual coil connections allow for an improved driving circuit. The maximum sensitivity is fixed by the field-coil positions and the deflection follows an arc-tangent function. This Edison movement is employed in the described instrument.

A complete circuit diagram of the electronic ratio meter is shown in Fig. 2. Each channel consists of a pentode voltage amplifier driving a triode power amplifier. The full rectified signal current passes through the movement coil and is returned to the input of the amplifier for overall feedback. With this circuit arrangement the crystal nonlinearities are minimized and the meter is driven by a virtual constant-current source.

Without feedback, the overall circuit can be thought of as having a transconductance of

$$g_{mo} = A_o g_m$$

where A_o is the gain of the first stage and g_m is the output triode's transconductance.

Feedback results in a transconductance

$$g_{mf} = \frac{g_{mo}}{1 + g_{mo}R_F}$$

where g_{mf} is the channel transconductance with feedback and R_F is the feedback resistor. This equivalent transconductance, with 20 db

Front-panel view of the experimental model of the ratio meter. Meter indication may be calibrated in reflection coefficient or vswr

Reflection Coefficient

By L. A. ROSENTHAL, J. L. POTTER and G. M. BADOYANNIS

Department of Electrical Engineering
Rutgers University
New Brunswick, N. J.

of feedback, is insensitive to tube aging and supply voltage variations and is not affected by crystal nonlinearities. The experimentally measured value of g_{mf} was 0.126 mhos; 100 millivolts at the input would cause 12.6 ma of a-c feedback current. The average value of this current (assuming a sine-wave signal) is obtained by multiplying by the factor $2\sqrt{2}/\pi$.

Coil-Current Level

The ratio meter movement requires a coil-current level of at least one ma for accurate readings. This value of current is sufficient to overcome the meter's assymmetry due to spring restoring forces and stray fields. The 5687 output tube is designed to pass a quiescent current of 37 ma. This corresponds to 26 rms ma of feedback current and 23.5 d-c ma of coil current at the clipping level, an input signal level of 0.187 volts.

The clipping level can vary with potential variations but is nearly twice the nominal full-scale sensitivity of 100 mv. For sinusoidal input signals the direct current is related to the rms input signal by

$$i = 0.113\ e_S$$

and 10 millivolts represents a minimum signal level for accurate meter indications. Further channel amplification and reduction of the feedback factor will result in higher sensitivities with the same accuracy and stability.

To equate channel gains, the feedback resistors R_F are adjustable by means of the 50-ohm potentiometer which simultaneously increases R_F for one channel as R_F for the other channel is decreased. Each channel current is measured by means of a pair of matched precision resistors R_v. A 0 to 150-μa meter, connected as a voltmeter, is placed across this resistor in either channel, and the meter calibration is adjusted to correspond to the values 0 to 150 millivolts at input.

A variable resistor is placed across the inner coil of the ratio meter movement. The inner coil has a slightly stronger field than the outer coil and some of the current must be by-passed for zero scale calibration. The three adjustments described are located at the rear of the ratio meter chassis. To adjust the instrument, the same signal is fed into both channels. The feedback resistor is then set to give the same voltmeter reading (channel current) in each position. With equal channel currents, the ratio-meter indication should be zero at center scale and can be so adjusted by the coil-current shunt. The voltmeter can be calibrated by knowing the input signal level.

The input attenuator is a potentiometer type of 100,000 ohms impedance. Signals can be attenuated by a factor of 1/10, 1/100, 1/1,000 or the voltmeter reading must be multiplied by a factor of 10, 100

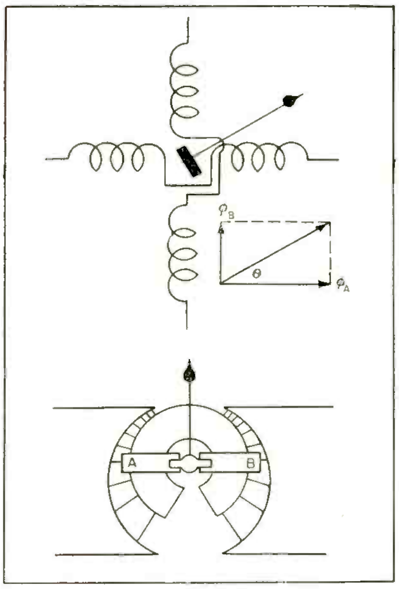


FIG. 1—Edison (upper) and Weston (lower) ratio meter movements

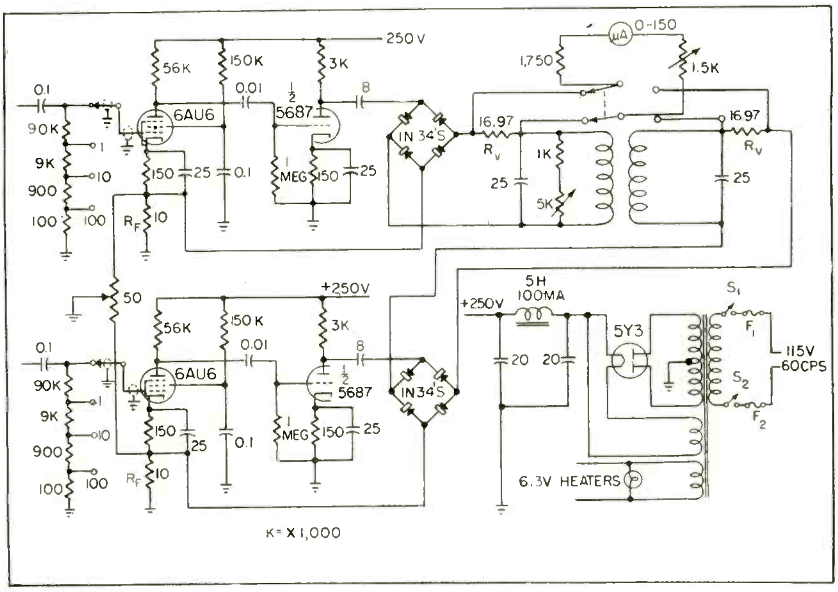


FIG. 2—Complete circuit diagram of the electronic ratio meter. Each channel consists of a 6AU6 voltage amplifier driving a 5687 power amplifier

or 1,000 for the individual voltage measurements.

The voltmeter serves two important functions. Besides measuring the individual channel voltages, it indicates the channel current level. As long as the voltmeter reads above 10 mv and is on scale, the ratio-meter coil current is above the one-ma level and below the amplifier's clipping level. The circuit power supply is conventional and capable of supplying 90 ma at 300 volts.

Performance Characteristics

The Edison ratio-meter movement had been intended for temperature measurements and is calibrated symmetrically from −50 to +50 with the center of the scale marked 0. A calibration curve of meter reading versus coil-current ratio is shown in Fig. 3 and the meter can accommodate a ratio of 0.16/1 to 5.5/1. There is a slight assymmetry due to stray magnetic fields. In the vicinity of the center, the scale is linear to ± 7.5 db (scale reading ± 30) and the extremities of the scale correspond to ± 15 db.

Frequency response of each channel is down by one db at 40 and 200,000 cps. The input attenuator may slightly alter this response characteristic at the high-frequency end. These effects are not significant at frequencies under 100 kc.

Moderate line-voltage variations have little effect on the voltmeter indication and no effect on the ratio indication. Changing the line voltage from 100 to 130 volts resulted in a three-percent voltmeter error while the ratio meter error was not measurable. The meter is readable to one percent at center scale and is slightly poorer at the ends of the scale. Since in all cases the −50 to +50 scale will be recalibrated into other units, the final accuracy is controllable.

Minimum Level

Signal amplitudes must be above a certain minimum level. Whereas a 100-mv signal applied to both channels will result in a ratio indication of 1.00, reducing the level to 10 mv will introduce an error of 5 percent (0.95). The error decreases rapidly above 10-mv levels

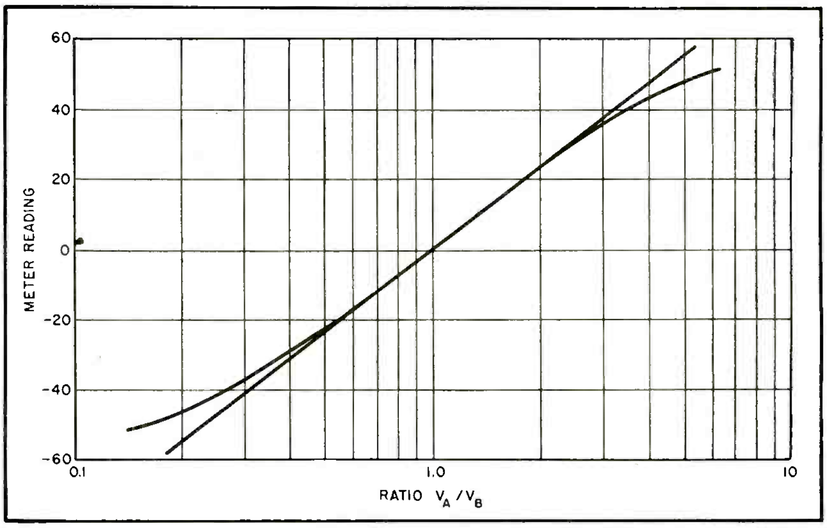


FIG. 3—Basic meter calibration curve

and 20 mv results in an error of two percent (0.98).

To extend the usefulness of the instrument to d-c applications, the accessory shown in Fig. 4 converts d-c to a-c signals. The signal at *A* is periodically shorted to ground at *A′* by means of the 60-cps contact modulator. The d-c component of the signal is lost in passing through the high-pass filter on to *A″*. Waveforms are shown in Fig. 4. The same operation is repeated in channel *B*, 180 deg out of phase. The signals at *A″* and *B″* are directly proportional to the *A* and *B* input signals and can be applied directly to the ratio meter.

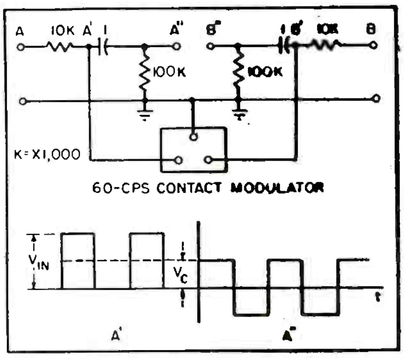


FIG. 4—The d-c to a-c converter and resulting waveforms extend the usefulness of the instrument to d-c measurements

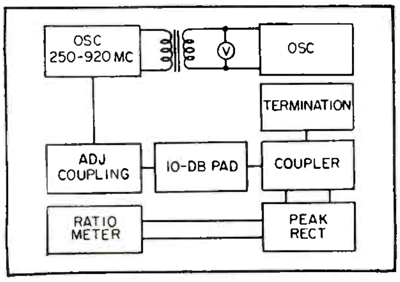


FIG. 5—Block diagram of the experimental setup for reflection-coefficient measurements

Reflection Coefficients

A specific application of the electronic ratio meter is the measurement of reflection coefficient or vswr. A block diagram of the method is shown in Fig. 5. The impedance to be examined terminates a Federal Impedometer[3] (bi-directional coupler), driven by a General Radio r-f oscillator that can be amplitude modulated. Two signals that are proportional to the incident and reflected waves are obtained from the coupler, passed on to peak rectifiers and then sent into the ratio meter. It is the modulation components of the incident and reflected signals that are compared.

As shown in Fig. 6, an r-f signal with a particular modulation can yield different outputs depending on the detection efficiencies. The curves shown relate output voltage as a function of r-f amplitude. Differences in slopes M_1 and M_2 can be equalized in the ratio meter by adjusting the channel gains. It is desirable that these detection characteristics be as linear as possible.

In Fig. 7, a method of linearizing the detectors is shown. The peak rectifier will be most linear when the load resistance is large compared to the crystal resistance. Three curves taken for various loads indicate this fact. As the load resistance increases, the output current decreases while the output voltage is nearly constant.

Since the ratio meter has a high

input impedance, large load resistances can be tolerated. The highest resistance produces the most linear detector but the improvement is slight because the crystal resistance can vary through wide limits as the input voltage varies from 0 to 0.1 volts. A load of 10,000 ohms was found to be convenient.

Modulation of the r-f source may not be necessary if the signal level is sufficiently large to minimize crystal nonlinearities. In this case, the signal can be peak-rectified and then passed through the described d-c to a-c converter. In all cases, loads presenting a reflection coefficient close to zero are bound to produce errors since the reflected signal may operate the crystal in its nonlinear region.

For greatest accuracy, it is desirable to keep the power level sufficiently high so that the crystal voltages are not less than 0.1 volt in average amplitude. If the crystal nonlinearities are predictable and, for example, are square law, the scale can be recalibrated with some loss in accuracy.

To evaluate the technique, a series of loads was made by mounting small half-watt resistors coaxially in a type-N connector with the end of the fitting short-circuited. The vswr for each of these loads was first measured on a slotted line. It was observed that resistors above the characteristic impedance of the line appeared partly reactive (capacitive) and resistors below the characteristic impedance were resistive but measured larger than the d-c resistance. At one extreme

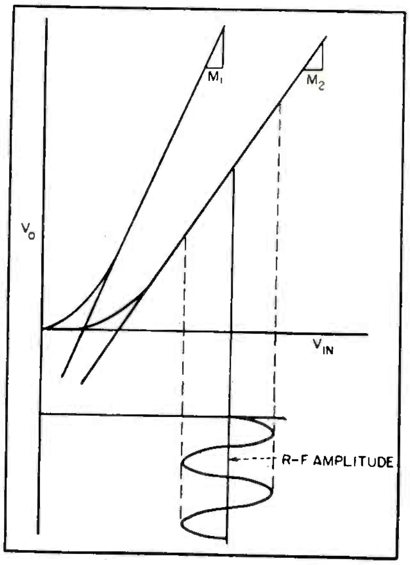


FIG. 6—Indication of the problem of demodulation efficiency and linearity

the mounting throws capacitance across the load and at the other extreme the short circuit losses become apparent. These loads were then measured as shown in the circuit of Fig. 5, and the results obtained are given in Table I.

The theoretical vswr is based on a pure resistance termination equal to that of the resistor value. Slotted-line results compare very favorably with those of the ratio meter. It was observed in setting up the apparatus that the Impedometer can be terminated better in an open circuit than short circuit. Results were more accurate when based on an open-circuit presetting. With no load on the bidirectional coupler, the reflection coefficient should be unity and the ratio meter should read zero, Fig. 3. This adjustment was made by setting the channels' feedback resistors R_F to equalize any differences in the coupling coefficients and in the detection efficiencies.

It is practical to calibrate the ratio meter directly in vswr. By attenuating the incident signal, the center-scale position, which corresponds to a ratio of unity or infinite vswr, can be shifted off scale to the meter's right. Small vswr values would be located at the left. Since the meters full-scale ratio is fixed at about 35 to 1, the vswr scale limits are fixed. A convenient range can be readily found for the vswr readings of interest and this range is selected by the proper attenuation of the incident signal. A typical set of scales chosen for one application are 1.02 to 1.3 and 1.13 to 10.0, using the region from −40 to +40. Best resolution is obtained for small vswr values.

Application of the ratio meter to vswr measurements is practical for cases where termination adjustments are to be made on a transmission system. When permanently installed in the line, it offers a continuous performance monitor.

The authors wish to thank the Rome Air Development Center, Griffiss Air Force Base, who sponsored this work under contract AF28(099)-33.

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(1) "Electrical Aircraft Instruments," Weston Electrical Instrument Co. Publication, p 33.
(2) E. W. Clark, A Ratio Instrument for Resistance Thermometers, *Elec. Engr.*, p 406, May 1952.
(3) B. Parzen, Impedance Measurements with Directional Couplers and Supplementary Voltage Probe, *Proc. IRE*, 37, p 1,208, Oct. 1949.

Table I—Standing Wave Ratios for Varying Loads

Load in ohms	Theoretical vswr	Slotted-Line vswr	Ratio Meter vswr
10	5.2	3.95	3.90
18	2.88	2.91	2.88
27	1.92	1.90	1.96
100	1.93	2.04	2.01
150	2.88	2.76	2.67
220	4.23	3.46	3.45
330	6.35	5.20	5.25

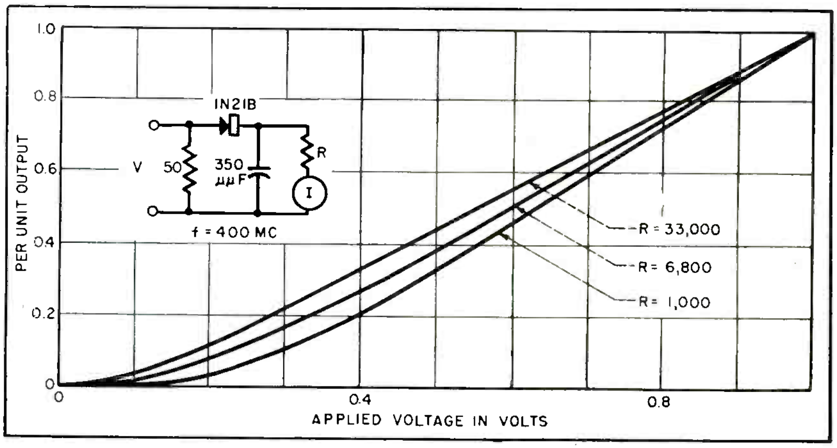
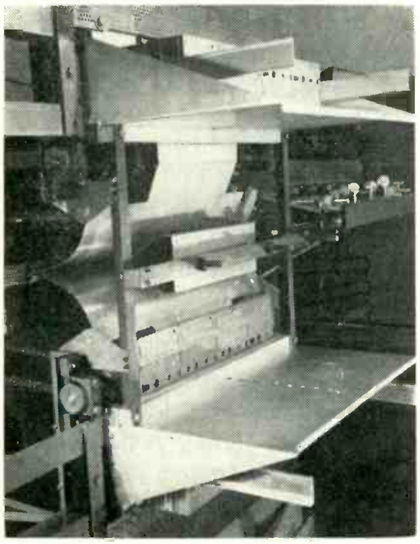
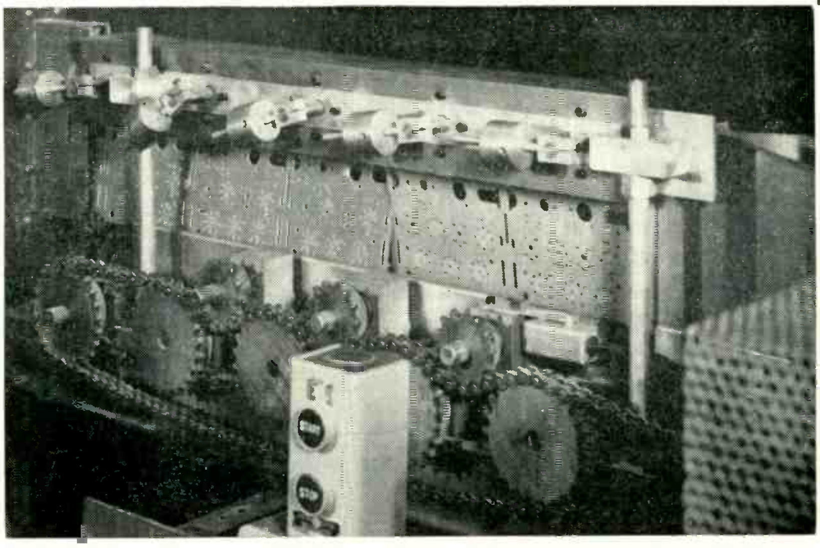


FIG. 7—Linearity can be improved by increasing load resistance. The curves have been normalized to indicate the improvement

Printed Circuits for



Starting point of nearly automatic plated circuit production line is machine that forms strips containing several bases



Strips proceed into processing where partial punching of holes and edges to be left unplated is achieved. Extreme accuracy in mechanical positioning is of paramount importance in the system

ALL METHODS of printing electronic circuits depend upon some means of delineating the conductor areas on an insulator. The method to be described uses a plating process (called "Pla-cir") that offers several advantages by providing through-hole metal.

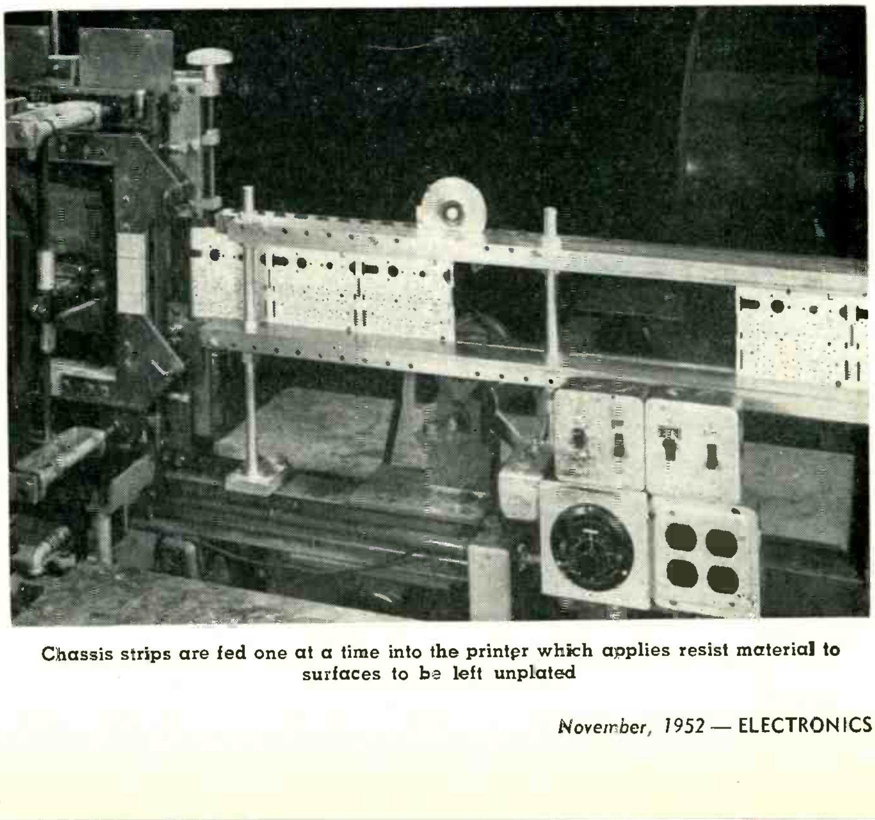
In this process, foil-thickness copper is electroplated on the insulating base where conductors are desired and concurrently on the walls of previously punched holes through the base. Circuits are continuous from hole to hole, and through holes to the other side for further extensions of the circuits or to component tie points. Component leads are preformed to match hole separations. The resulting accurate mechanical placement of parts permits the use of machine soldering with its attendant advantages.

Circuit Design

Careful circuit layout is necessary to make most advantageous use of the potentialities of the system. Conductor widths become important only when they are reduced to fine lines, as in the case of plated coils where the most compact line-space arrangement will provide the best inductance to area ratio.

Voltages encountered in the circuit dictate insulating space between conductors. Proximity of signal-carrying metal and grounded portions of the circuit must also be considered where undesirable bypassing of the signal may result from the presence of large grounded areas. Holes must be accurately placed for use as component tie points, tube sockets and conductor anchors.

As in other printed circuit techniques, layout work is greatly simplified by the use of photographic copying. The desired circuit is drawn to a large scale and photographed down to size. Circuit changes, such as route alterations and modifications of conductor sizes, may be made in this intermediate stage without going back to the original. Through this means



Chassis strips are fed one at a time into the printer which applies resist material to surfaces to be left unplated

Home Radio Receivers

Plating process passes commercial test in 5-tube superheterodyne and shows promise for future use in other equipment including tv sets. Circuits are electroplated on plastic base. Holes through base provide machine-soldering terminals for components and through-chassis paths for circuit connections

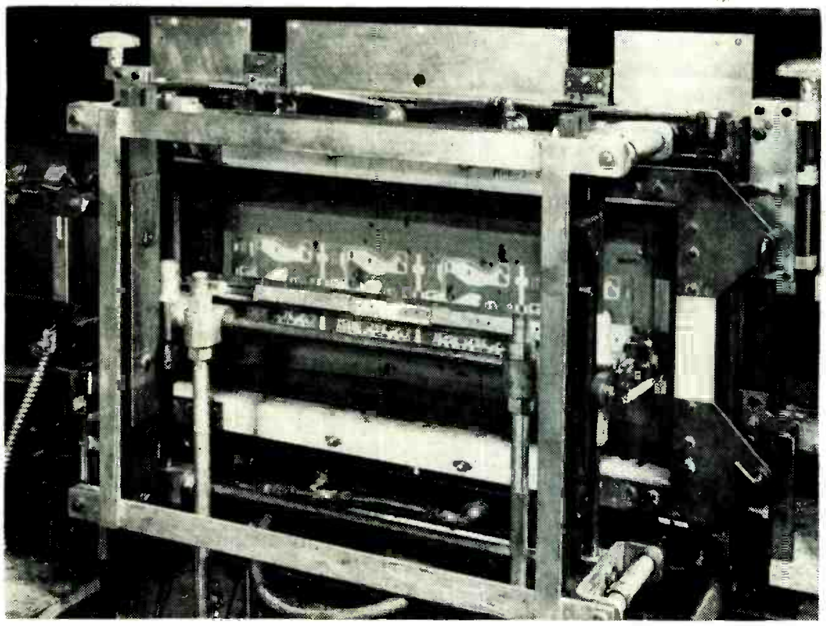
By ELMER WAVERLING

Vice-President
Products Division
Motorola, Inc.
Chicago, Illinois

new circuits may be evaluated quickly and easily.

Fabrication

The layout gives the punching information for making the chassis base. To produce an outline shape from flat sheet with any internal cut-outs, without having plating on the edges, the cutting machines employ partial punching and flush re-insertion while in the die, never losing orientation of internal parts to the piece or of the piece to the scrap. This technique is highly useful since it is convenient to carry pieces in a chassis-carrying strip until finished. Punched registry marks are provided in the edge of the strip, so that printing can be done without removing the chassis from the strip.



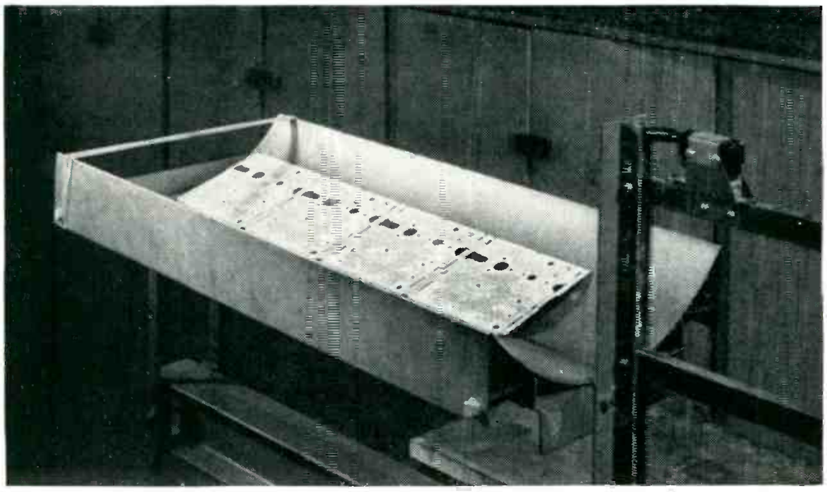
In the printer all action is automatic. Accurately positioned strips are printed using exactly-registered precision stencils

From the punched piece to the final chassis bases, the steps are carried out largely by machine as shown in the photographs. Strips of bases are fed from a stack into a conveyor and through stations that do all the work of surface preparation, conductive coating, and printing the resist material. Resist is stencilled in accurate registry with punching by means of a centering action in the two-sided screen printer, using the registry marks of the strip made in the punching process.

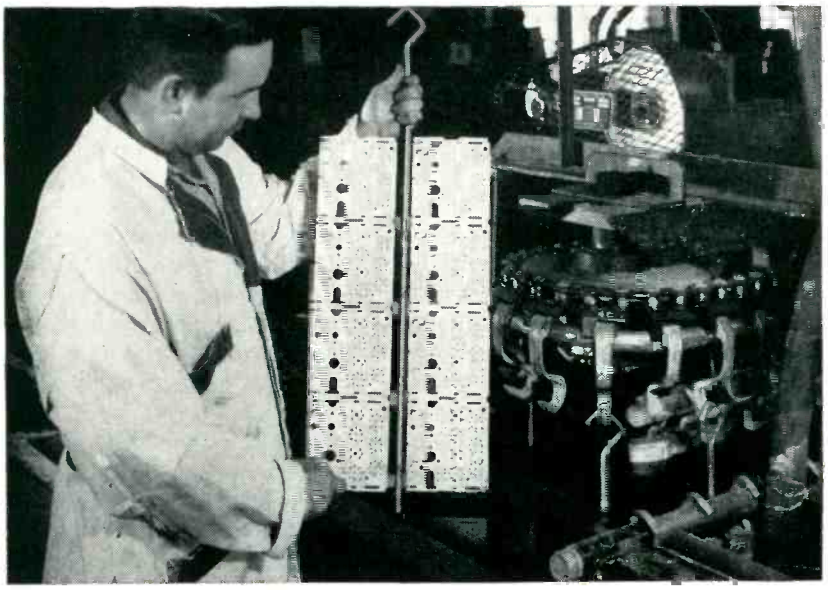
Plating follows, with a controlled process of solution maintenance, timing and current-density to form the required deposit. This forms the copper circuit. Subsequently the resist and the underlying unplated conductive coat are removed, also by travel through mechanical stages, to expose the insulator surface again. It is possible to overplate the copper with another metal, if desired, before removal of resist and coating, while all areas still are electrically joined.

The chassis and partially punched cutouts are knocked out in a die as a final operation. Pieces occupying the whole of the strip in multiple are sheared apart.

Shapes other than flat may be made on special machinery, but



After ejection from printer, strips are ready for plating. Cylindrical trough holds strip without touching surface



Strips are hung in dipping tank so that metal is applied to both surfaces of base and on walls of holes through base

Finished cut-apart bases are checked in two seconds by a stepped test set that picks up leakage, shorts and opens

plane pieces will probably be more useful, since three-dimensional construction is obtainable by joining flat sections.

Assemblies

Components used with the plated-circuits can be those now commonly in use or special new or adapted versions.

Where lugs are provided, they are plugged into appropriately spaced holes. In a volume control, reversal of lugs from the customary allows setting the control in a mounting hole with its lugs in terminal holes of the circuit. Intermediate-frequency transformers already carry terminals generally suited to the purpose. Pig-tail coils, resistors and capacitors lend themselves to dimension forming in U shapes for staple-like insertion.

Tube sockets are made up from clips which are soldered or pressed into the metal-lined circuit terminal holes.

Automatic soldering is practically a requirement for the full utilization of the system. With other methods, all parts must be arranged on one face, so that floating the plane assembly on molten solder effects the joining. The present scheme is predicated upon spot soldering, only where needed, unhampered by a rigid requirement of single-sided mounting. Metal-lined holes send the solder through to the opposite face by capillary action completely filling the hole. Spot soldering leaves room between points for projection of mechanical parts such as shafts and for placement of components at convenience even on the side presented to the soldering equipment.

Application

Connection of units may be accomplished by plating interconnecting terminals along common chassis edges. The formation of perfectly identical bus-bar strips with specialized points of contact and dispersion of circuits is a further possibility for ultra-complex equipment.

Using techniques such as these, a wide variety of equipments of any conceivable degree of complexity could be produced by machine methods.

Grey-Scale Generator

Television studio equipment, kinerecordings and overall system performance can be standardized using a generator to produce composite synthetic grey-scale signals. Testing can be done under normal conditions for picture signal without disabling clamp circuits

By G. EDWARD HAMILTON and RALPH ILOWITE

Eastern Div. Television Engineer *Television Recording Engineer*

American Broadcasting Co.
New York, N. Y.

IN ATTACKING the problem of measurement and control of the transfer characteristic in tv picture-signal systems[1] a means is needed for obtaining the relationship between the grey tones or brightness scale and the output—a means for determining the system or individual element performance. A standard electronic grey scale whose individual steps may be determined and measured is essential. The equipment to be described is such a device.

The function of the grey-scale generator is to produce a linear step-function signal combined with blanking and synchronizing impulses in a manner such that a synthetic television signal results. Figure 1 shows all the waveforms. Figures 1H and 1I show the composite output signal during the vertical and horizontal intervals. Figure 2 is a photographic reproduction of (A) the picture tube raster presentation, and (B) a sample strip of 16-mm control film.

From a paper presented at the Sixth Annual Broadcast Engineering Conference, NARTB, Chicago, 1952.

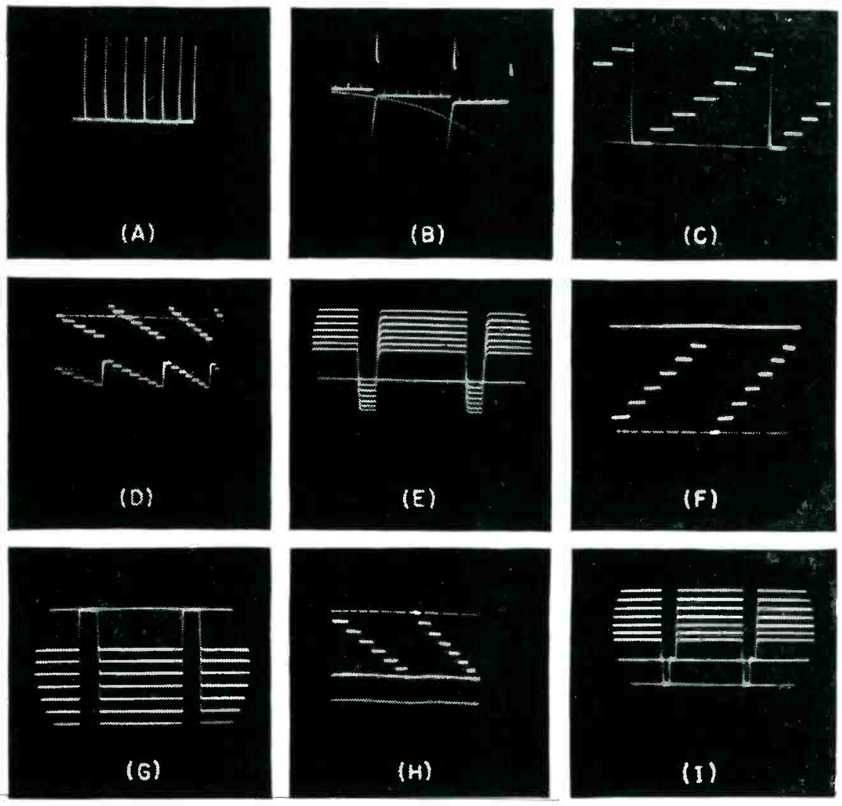


FIG. 1—Waveforms appearing at various points in the grey-scale generator as noted on the circuit diagram (Fig. 3) and described in the text

Circuit Diagram

The manner in which the step-function, synchronizing and blanking signals are mixed, to produce the composite signal, is shown schematically in Fig. 3. Three input signals are used to control and generate the synthetic signal, namely: vertical timing pulses, composite blanking and sync pulses. The vertical timing pulses are used to trigger the step-generating oscillator and to re-establish the zero base of the step-function signal. Blanking pulses are used to provide for pedestal and clipping functions. Sync pulses are mixed with the non-composite output signal so that a complete television signal is available.

The number of steps in the grey scale is derived from a thyratron pulse generator (V_1), which is a controlled relaxation oscillator. Capacitor C_1 charges exponentially until the firing potential is reached (as a function of the bias-control potential) at which time C_1 is discharged through V_1 and R_6, which develops a positive pulse across R_6 as shown in Fig. 1A. The frequency of discharge is determined by the thyratron bias potential, the plate circuit constants and the vertical driving pulses applied to the grid of V_1.

The pulse is coupled through C_2 to a capacitive accumulator circuit consisting of two diodes V_2 and capacitor C_5. The diode V_{2A} reestablishes normal quiescent potential across C_2 while V_{2B} conducts, charging C_5 in steps of equal increment. Capacitor C_5 is discharged during the vertical blanking interval by V_{3A} which conducts when its grid is driven positive by differentiated vertical driving impulses from V_{3B} as shown in Fig. 1B. Tube V_{3A} is nonconducting during the vertical interval. A linear stair-step signal is thereby produced at the plate of V_{3A} as shown in Fig. 1C.

The stair-step signal is coupled through C_7 to V_4, a cathode follower with provision for control of signal amplitude by potentiometer R_{15}. The other half, V_{4B}, serves as a mixer for blanking and stairstep signals. Negative blanking signals

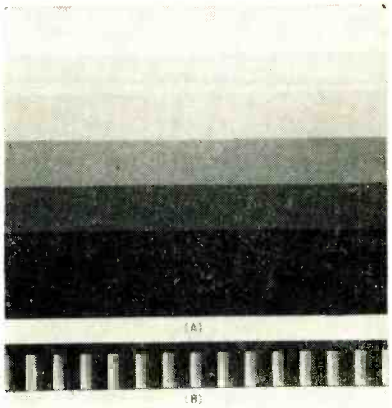


FIG. 2—Photograph of picture-tube raster (A) obtained from generator and sample of 16-mm control film strip

are obtained from V_{17A}, which is coupled to the cathode of V_{4B} while the cathode of V_{4A} is coupled to the grid. The output of V_{4B} contains mixed blanking and step-function signals as shown in Fig. 1D and 1E.

Clipper System

The output of V_{4B} is coupled to the clipper amplifier V_6 in whose plate circuit is a biased diode clipper system. The clipper waveform containing the step-function signal plus mixed blanking is shown in Fig. 1F and 1G.

The clipping level is determined by adjustment of the blanking clipper bias control R_{30}. The clipped output of V_6 is coupled to V_7, which serves as video signal amplifier and phase inverter, providing an output signal of black negative.

Sync Amplifier

Tubes V_8 and V_9 constitute a two-stage sync amplifier, the output of which comprises a complete synthetic signal composed of stair-step, blanking and synchronizing components.

Amplitude of sync is adjusted by the sync input potentiometer R_{35}. The resulting synthetic signal is shown in the oscillograms of Fig. 1H and 1I.

This test signal has numerous uses. Currently it is an operations tool used for periodically testing overall system performance. As

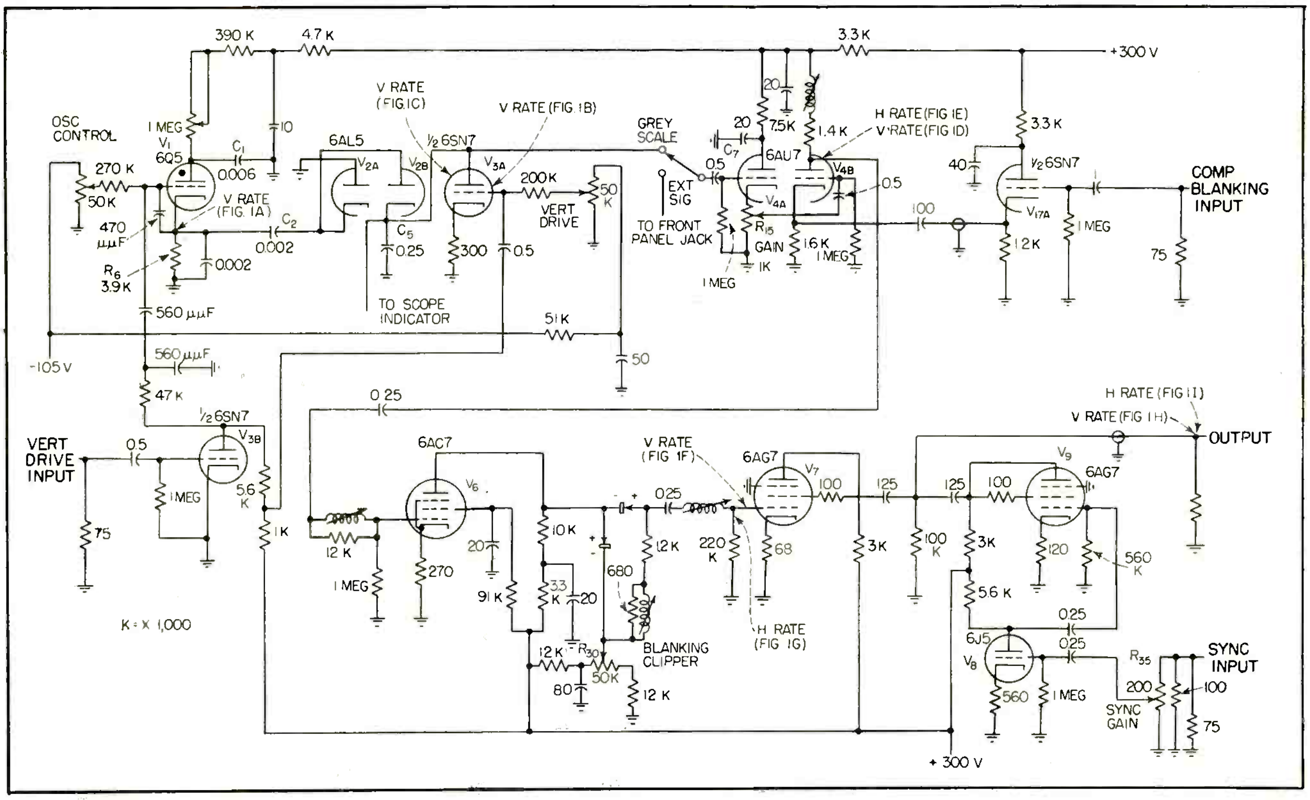


FIG. 3—Sources of detailed oscillographs shown in Fig. 1 are indicated at various points on this complete circuit diagram of the grey-scale generator

such, the signal is fed into a typical studio input and passed through all normal equipment to and including the transmitter. Since the steps may be easily adjusted to coincide with the IRE standard oscilloscope video scale, any discrepancy can be easily detected and observed either at the end of the transmission system or at any of the junction points.

Long-Line Test

Of special value is the ability it provides to appraise the transfer characteristic of long-line circuits because any tendency of the circuit to introduce compression, frequency discrimination or phase shift is immediately apparent. Since the number of steps is adjustable and occupies a time duration in the order of 60 to 600 cycles, a relatively low-frequency square-wave test is simultaneously available which, by virtue of tilt and overshoot, describes deficiencies in the system. This, too, is useful in determining the low-frequency response of long lines since the harmonics required to pass this frequency range accurately may fall in the region of discrimination.

Kinerecording Standards

Of prime importance for the standard grey-scale generator is its usefulness in television recording. Knowing the input characteristic, the light output characteristic of a recording kinescope may be determined. The standard input signal allows adjustment for absolute exposure control over the entire latitude.

Inclusion of the standard signal on each television recording film negative provides a means for signal control within close limits with respect to film processing. Printing the grey scale onto the positive film gives an overall control measure of the system performance.

All circuits following V_4 are frequency compensated. A selector switch at the input to V_4 permits use of an external signal input. This arrangement furnishes a means for injecting any type of test signal into the unit and deriving a composite television signal at the output. Typical special inputs are: square waves, sine waves and sweep-generator signals.

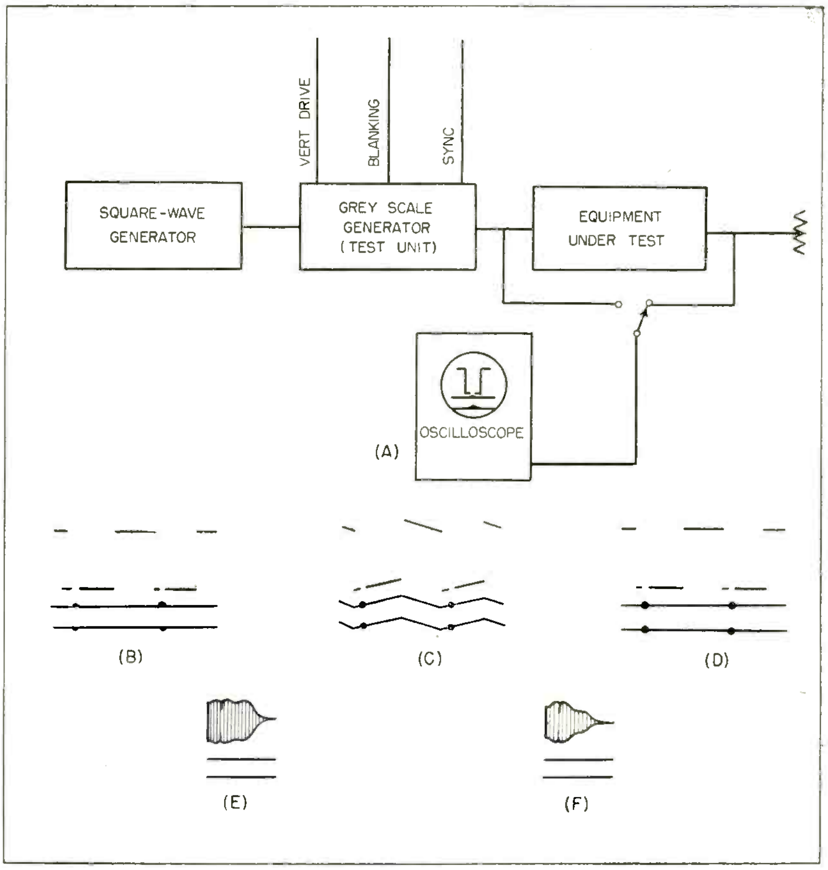


FIG. 4—Block diagram (A) shows use of grey-scale generator with conventional test signals. Input signal (B) and output signal (C) show low-frequency degradation owing to equipment malfunction. Output signal at (D) after replacing faulty component. Sweep-generator presentations (E) input and (F) output of video equipment are described in text

Clamped Tests

The desirability for such a composite synthetic signal is immediately apparent when it is realized that under test conditions all of the television system components are operating in their normal manner. Especially does this apply to clamp circuits where it is usual practice to disable the clamp circuit while making frequency-response measurements. Figure 4A shows a block layout for determining square-wave system performance as well as the input and output characteristic of a tv studio system. The trace at (B) shows the input signal, that in (C) shows severe low-frequency degradation, and (D) shows the system performance after correction was effected. Curves of Fig. 4E and 4F show the test instrument being used as a swept frequency-synthetic-composite tv signal where (E) represents the input response to a video amplfiier and (F) shows high-frequency degradation at the output. A note of caution is injected at this point to consider the response characteristics of particular oscilloscopes used for the presentation since deficiencies therein will also be apparent by the test method described.

Appreciation is expressed to Charles A. Younger, New York supervisor of television recording and to Arthur Nace for their valuable suggestions and aid in bringing about the described generator, and to Joseph R. Lewis for the photographs.

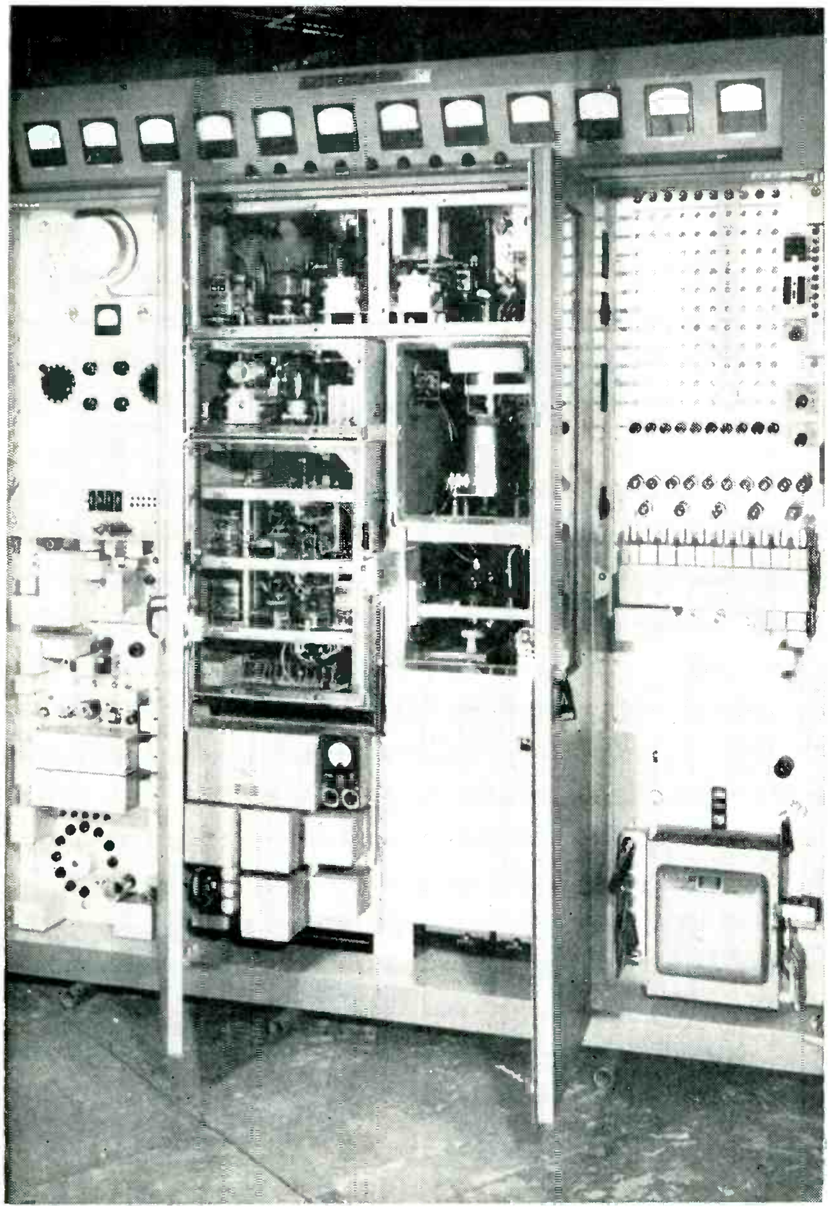
Reference

(1) D. G. Fink, "Television Engineering," Second Edition, McGraw-Hill Book Co., Inc., New York, 1952.

Single-Sideband System

Single-sideband transmitter furnishes four voice channels for overseas telephone service. Pushbutton tuning permits rapid frequency shifts and load-control circuit minimizes interchannel crosstalk and out-of-band radiation. Copper-oxide and germanium varistors replace modulator tubes

By N. F. SCHLAAK
Bell Telephone Laboratories
Deal, N. J.



Single-sideband transmitter consists of four bays. Modulators are at extreme left followed by the six-stage, high-frequency amplifier (center). Automatic tuning circuits fill right-hand bay

DESIGNED to furnish long-distance, point-to-point, radiotelephone service, the multichannel, single-sideband transmitter to be described incorporates several innovations of interest to design engineers.

The transmitter provides four-kilowatts peak envelope power in the frequency range from four to 23 mc. Improvements over earlier single-sideband transmitters include: automatic selection of any of 10 preselected output frequencies, use of varistors instead of vacuum tubes for modulators, and ability automatically to utilize its full output whether transmitting only one or all four of its voice channels. The performance of the transmitter likewise has been improved with respect to out-of-band radiation and interchannel crosstalk.

Sideband System

The complete LD radiotelephone system, of which the LD-T2 transmitter is one unit, includes the LD-R1 receiver and LD-B1 branching amplifier. The transmitter accepts, and the receiver delivers, two independent voice-frequency bands from 100 to 6,000 cps, which appear as upper and lower sidebands in the radio-frequency signal. A reduced carrier is transmitted for automatic frequency control and automatic volume control at the receiver.

The two voice-frequency bands may be used for program channels or for group transmission of several narrower channels for either tele-

For Overseas Telephony

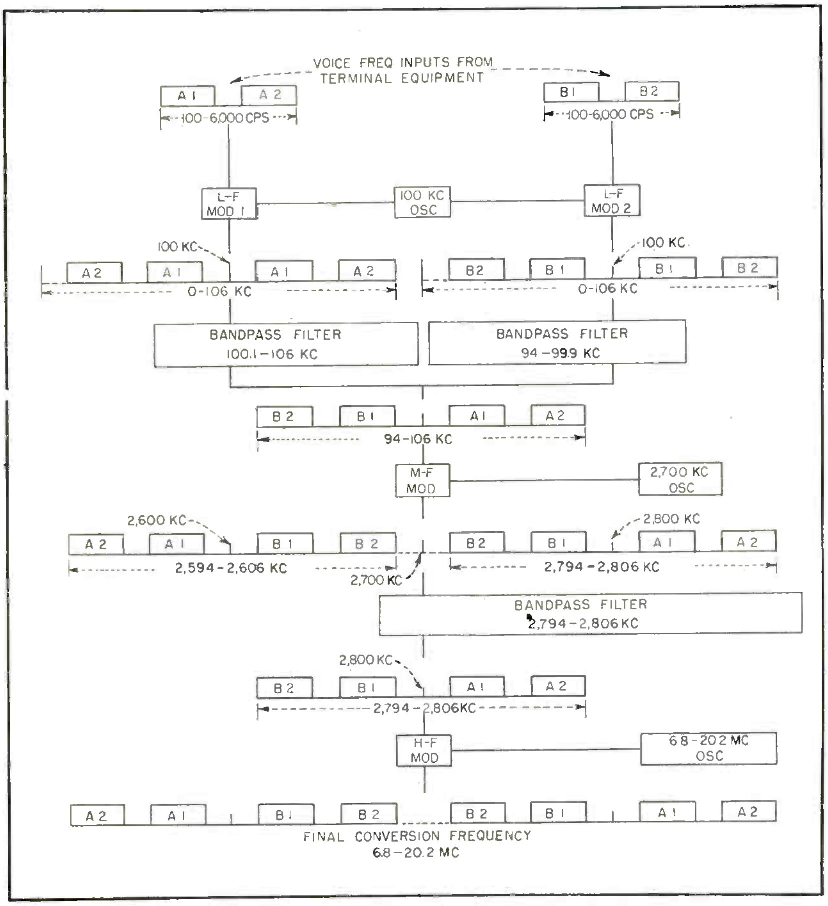


FIG. 1—Frequency block diagram shows action of modulators and filters. High-frequency amplifiers are tuned to accept either upper or lower sideband from h-f modulator. Group-interchange relay (see Fig. 2) when actuated interchanges position of *A* and *B* bands

phone or tone-telegraph circuits. Channel grouping must be accomplished by suitable terminal equipment. Any type of terminal equipment and speech-privacy equipment suitable for single-sideband service may be used. Rhombic antennas are usually employed for both transmitting and receiving. Figure 1 shows frequency allocations in the single-sideband system.

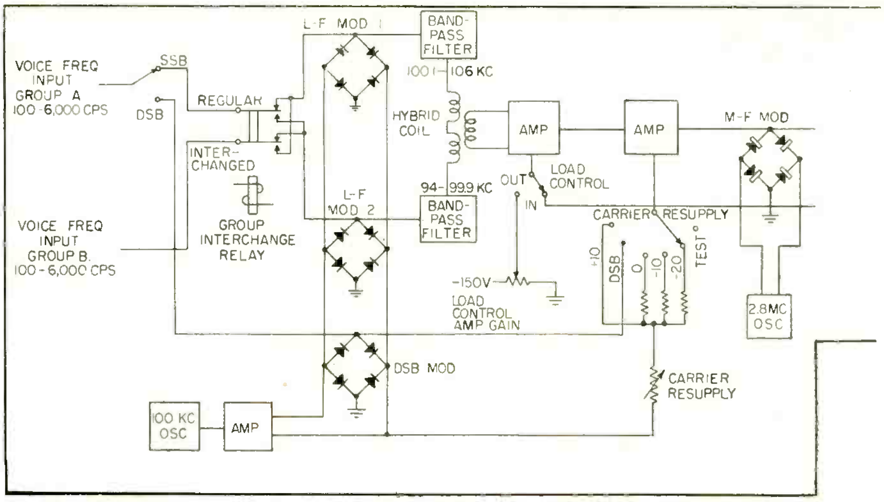
The transmitter employs three low-level modulation stages followed by a six-stage linear amplifier. For selection of the desired sidebands, this transmitter, like earlier equipment, uses bandpass filters because of their increased stability and greater selectivity as contrasted with the Hartley balanced-phase system[1]. Each of the 10 preselected frequencies, after calibration, will remain within ±0.003 percent of assigned frequency for long periods of time.

A block diagram of the transmitter is shown in Fig. 2. The two voice-frequency inputs are shown at the top left as Group *A* and Group *B*. A gain control, not indicated in the diagram, allows the inputs to the two modulators to be adjusted to their proper value. A relay allows them to be interchanged when necessary to comply with international practices relating to single-sideband transmission.

L-F Modulators

In the low-frequency modulator, the two voice-frequency inputs modulate the 100-kc carrier in separate modulators employing copper-oxide varistors. The upper sideband extending from 100.1 to 106 kc is selected from the output of modulator No. 1 by a crystal filter while the lower sideband extending from 99.9 to 94 kc is selected from the output of modulator No. 2 by another crystal filter. This frequency allocation is portrayed in the upper part of Fig. 1.

The outputs from the filters are combined in a hybrid coil and impressed on the load-control amplifier. This is a variable gain device that operates with its gain either fixed or controlled by the magnitude of the combined sideband peaks. The gain is controlled by the grid bias. When the amplifier gain is controlled by the magnitude of the sideband peaks, its bias is obtained from the load-control rectifier, located at the output of the transmitter. Its value, accordingly, varies with the peak amplitude of the output signal. The gain reduction rate is fast, whereas the gain recovery rate is much slower. This helps reduce cross modulation and out-of-band radiation, since it virtually prevents the transmitter from being overloaded at any time. Its effect on quality and intelligibility of speech has been found by rapid comparisons made with and without the device to be negligible.



M-F Stages

The output of the load-control amplifier is impressed on the combining amplifier where it is further amplified and combined with the desired amount of carrier. Since the carrier is introduced after the signal has passed the load-control amplifier, the action of the load-control amplifier has no direct effect on the carrier output level. One of the positions of the carrier-level control switch permits the transmitter to be used for double-sideband transmission by connection to the double-sideband modulator. The double-sideband modulator, is a copper-oxide varistor without any crystal filter in its output. Bandwidth with double-sideband transmission is limited principally by the bandwidth of the medium-frequency equipment.

Following the reintroduction of the carrier, the signal is next impressed on the medium-frequency modulator, where it is used to modulate a 2,700-kc conversion frequency. The upper sideband resulting from this modulation, centered at 2,800 kc, is selected by a series of bandpass filters in tandem with three medium-frequency amplifiers. The medium-frequency modulation products and the resulting signal are shown in the center of Fig. 1. The second modulator uses germanium varistors. All of the equipment up to this point in the circuit remains fixed, regardless of the final operating frequency.

The signal is next impressed on the high-frequency modulator where it modulates a selected conversion frequency in the range from 6.8 to 20.2 mc depending on the desired output frequency. This modulator employs germanium varistors. The correct conversion frequency is selected by a switch that connects one of 10 piezoelectric crystals into the oscillator circuit. Since, at the input to the high-frequency modulator, the original 100-kc carrier is at 2,800 kc, it will be at four megacycles when the lower sideband of a 6.8 mc conversion frequency is selected, and will be at 10 mc when the lower sideband of the 12.8 mc conversion frequency is selected. The carrier will be at 23 mc when the upper sideband of a 20.2 mc conversion frequency is selected. For conversion frequencies higher than 12.8, the second harmonic of a crystal is employed.

H-F Amplifiers

The h-f modulator is followed by a gain-control potentiometer and a six-stage, linear amplifier. The tuned circuits associated with this amplifier are set to select either the upper or lower sideband as desired. The output of the h-f modulator is portrayed at the bottom of Fig. 1. The first three amplifier stages employ 807 tubes and the circuits are gang tuned. The fourth stage uses two 4E27s and has a π-type output circuit to permit impedance transformation. Amplifier No. 5 uses two 4-400A tubes and the final stage uses one 3X2500F3 forced-air-cooled triode operating with its grid grounded. The last two stages also employ the π-type output circuit. Each of the amplifier tuning coils is provided with eleven taps and the circuit inductance may be switched. An unbalanced to balanced line converter follows the π-type tuned output circuit of the final amplifier. A shielded dummy load, which will dissipate the full output of the transmitter, is supplied for checking transmitter performance before connection to the antenna.

A built-in monitor consisting of a simple triple-detection, single-sideband receiver utilizes the conversion frequency and carrier sources in the transmitter to demodulate the signal and recover the original voice frequencies. Figure 3 is a block diagram of the monitor. No facilities are provided in the monitor for selection of sidebands since the monitor is usually used for making two-tone distortion measurements. The monitor incorporates a carrier alarm that is actuated if the carrier amplitude falls below a predetermined value.

Automatic Tuning

Selection of the operating frequency is by a servo system with pushbutton control. Tuning information is stored in a bank of 110 potentiometers connected into the servo system in groups of 11 by means of relays and a selector switch. Ten continuous servos and six switching servos are employed. Each of the sixteen small shaded-pole, reversible motors that are used to change circuit elements is located

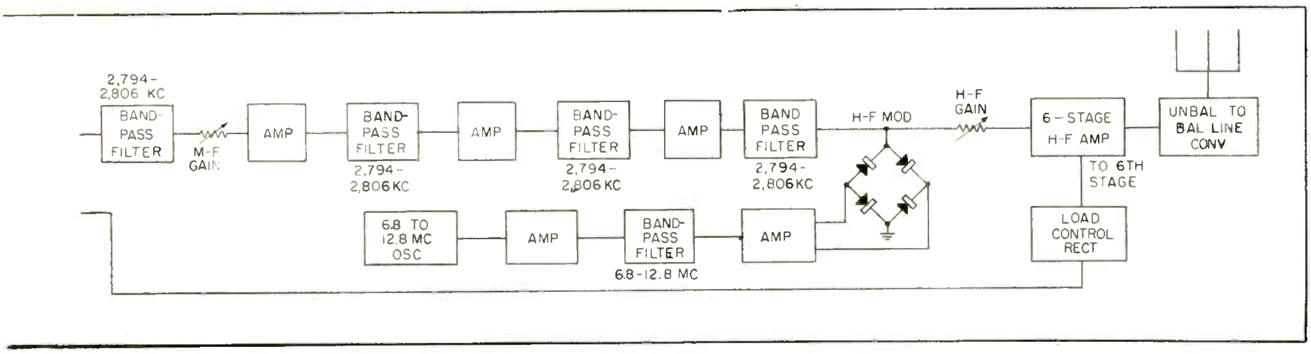


FIG. 2—Multichannel, single-sideband transmitter uses varistors instead of vacuum tubes for modulators. Double-sideband emission is available if desired. Load-control circuit minimizes interchannel crosstalk and out-of-band radiation

near the element to be switched. The servo system thus gives the designer freedom to place each circuit element in its most advantageous location from a circuit-design standpoint without regard to the problem of bringing out a mechanical control in a convenient location. About fifteen seconds are required to select any one of the ten available frequencies, and about the same time is required to put the transmitter into standby condition or to remove it from standby condition.

The transmitter will operate under temperature and humidity conditions encountered in a normal station building, including locations in the tropics. It will operate satisfactorily in ambient temperatures between 15 and 50 degrees C and at altitudes up to 5,000 ft. It requires 10 kva of three-phase power at 230 volts, 50 or 60 cycles.

Receiver

The companion single-sideband receiver is of the triple detection type with intermediate frequencies the same as in the transmitter. This permits the same type of bandpass filters to be used as are used in the transmitter. To give adequate selectivity, the receiver has additional filters not required in the transmitter. The receiver has several novel features, such as the choice of either a crystal-controlled or variable-frequency first beating oscillator, limiters for reconditioning the received carrier, an automatic-frequency-control circuit requiring few adjustments, a squelch circuit that prevents false operation of the automatic frequency control during periods of poor signal-to-noise ratio, a common main amplifier for both sidebands and carrier, and a distribution of selectivity and automatic-volume-control action that minimizes cross modulation and maintains maximum signal-to-noise ratio. The nominal input impedance of the receiver is 75 ohms unbalanced.

The receiver is seven feet high, 21½ inches wide and 17 inches deep. It operates on 115 volts, 50–60 cycles.

Branching Amplifier

Since it is often advantageous to connect more than one receiver to a single antenna without interaction or appreciable loss of signal-to-noise ratio, the complete equipment includes a branching amplifier. This consists of six independent, two-stage amplifiers with their input grids connected to the 75-ohm coaxial transmission line by the same type of wide-band transformer used with a rhombic antenna to transform its impedance to the 75-ohm unbalanced transmission line impedance. Six independent 75-ohm output connections are provided to connect as many as six receivers to the same antenna. More receivers can be connected by connecting branching amplifiers in tandem. The branching amplifier is 19 inches wide, 5¼ inches high and 8 inches deep. It has no controls and operates on 115 volts, 50–60 cycles.

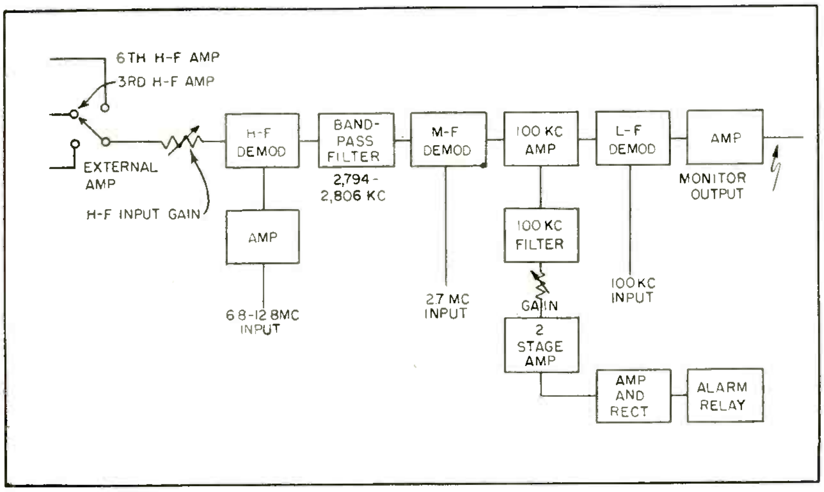


FIG. 3—Output monitor restores original voice channels. Alarm is actuated if transmitter output falls below desired level

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(1) U.S. Patent No. 1666206 application filed Jan. 15, 1925.

Germanium Photodiodes

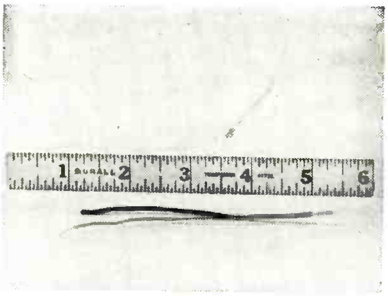
By LEROY PACKER

Columbia University Engineering Center Electronics Research Laboratory New York, New York

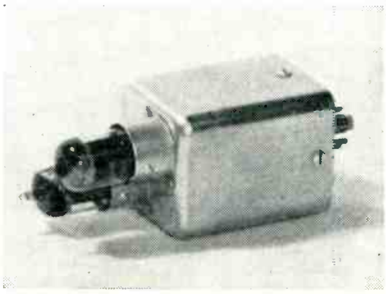
and

WILLIAM J. WRAY, JR.

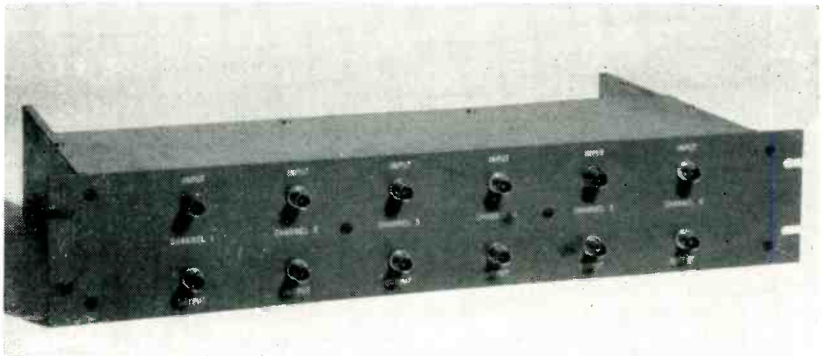
Research Activity Burroughs Adding Machine Company Philadelphia, Pa.



Evidence of the small size of the 1N77 photodiode, visible here between 5 and 6



One of the six plug-in amplifier units used in the equipment



Front panel of the six-channel amplifier for the punched-tape reader

TELETYPEWRITERS are the logical choice for use as input-output units in many digital computers because of reliability, economy and availability. However, it is often desirable to feed tape into an electronic computer at speeds higher than those obtainable with the mechanical sensing elements used in such equipment. By using photoelectric sensing elements, input speeds high enough for most applications can be obtained.

The difficult task of constructing a photoelectric reader for tape has been simplified by the advent of the germanium photodiode and the photo transistor. These semiconductor transducers are much smaller and more sensitive than the smallest phototube commercially available.

A typical germanium photodiode measures 0.080 inch in diameter and 5/16 inch long. Since the incident light is applied to the 0.080-inch diameter face, six of these photodiodes can be mounted directly above six-channel tape. Such a mounting eliminates the need for lenses and reduces the problem of packaging the device. With the type of construction used, repairing is easy. If the equipment fails, it can be put back into operation simply by replacing a plug-in amplifier.

Germanium Photodiode

The 1N77 diode used in the punched-tape reader makes use of the photo effects found in high-resistivity germanium. The photoconductivity is most pronounced in the boundary region separating *n*-type and *p*-type germanium[1]. The type 1N77 is made by doping a small layer of *p*-type germanium onto the surface of an *n*-type germanium crystal. The point contact is then made to the *p*-type layer. The photosensitive region is in the immediate vicinity of the point contact and is about 0.005 inch in diameter[2].

The back resistance of the photodiode is sensitive to the pressure of the point contact. Twelve type 1N77 diodes showed variations in back resistance of from 0.12 to 1.8 megohms. The back resistance is also quite sensitive to changes in temperature. After the initial decrease in back resistance when the light is turned on, the back resistance continues to decrease at a slow rate. When the light is turned off, the back resistance suddenly increases because of the sudden decrease in the generation of photoelectrons and then decreases more slowly, due to the decrease in the temperature of the photodiode.

Dependence of the back resistance and the quiescent operating potential of the 1N77 on temperature and contact pressure restrict its use to situations in which the presence or absence of light is important. Sensitivity of the 1N77 to chopped light has been found to be fairly constant over a wide range of quiescent operating potentials.

Variation of output signal with twelve photodiodes tested under the same operating conditions was found to be 60 percent about the mean value. The maximum noise inherent in the photodiodes was 50 millivolts. An increase in temperature did not affect the noise generation appreciably. The signal-to-noise ratio in the present application is not limited by the noise generated in the photodiode, since the mean signal level is 2.5 volts.

Amplifier Circuit

A simplified schematic diagram for the six-channel plug-in amplifier is shown in Fig. 1. This circuit shows one amplifier with its power supply connections. It does not indicate the plug-in arrangement.

The amplifier has been designed

Read Computer Tapes

Light-sensitive semiconductor elements and plug-in amplifier units, together provide continuous reading of paper tapes at speeds up to 1,000 characters per second and quick, easy maintenance. Photodiodes are mounted side by side directly under the character holes of six-channel tape

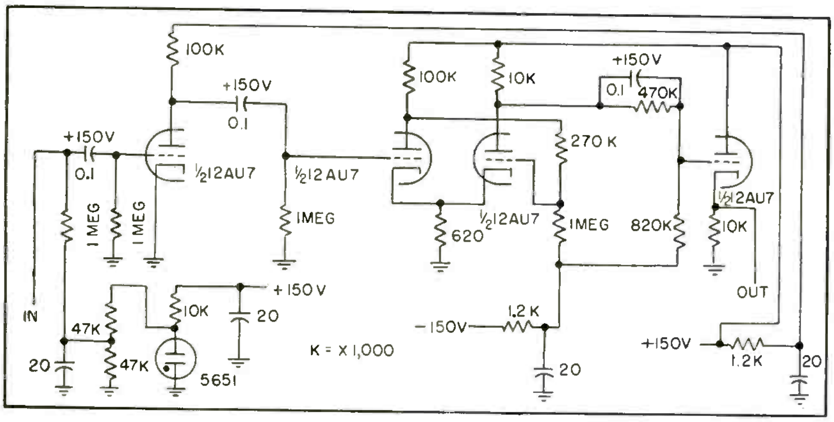


FIG. 1—Simplified schematic diagram of an amplifier channel

to produce a uniform output for 1N77 photodiode input pulses of varying waveforms and with peak values of from one to four volts negative. The output is a square pulse, 60 volts peak, with a rise time of about two μsec and somewhat less fall time. The input is supplied as a negative pulse to the first stage, which reverses polarity and provides an amplification of about 12.

Output from the first stage is supplied to a Schmitt trigger circuit based on feedback between two triodes. With no signal, the first triode is cut off by the voltage across the common cathode resistor, maintained by the conduction of the second triode. When the input pulse reaches a value determined by the circuit parameters, the first triode conducts and cuts off the second. This state is maintained until the input pulse falls below a value determined by the circuit parameters, at which point the second triode conducts, and the first is again cut off.

If the value of the cathode resistor is too low, both tubes conduct, the trigger action is not present and the circuit is a sensitive d-c amplifier[3]. The output from the trigger circuit is supplied to a cathode follower biased to cutoff to allow d-c coupling.

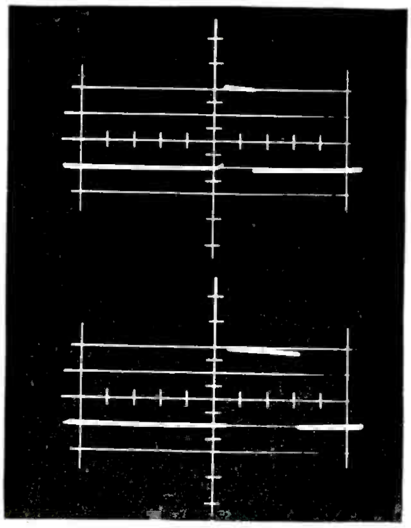


FIG. 2—Amplifier output waveforms at input pulse repetition rate of 100 per second. Scale: ordinate is 20 v per cm and abscissa is 930 μsec per cm. Input for the upper graph is —2 v peak and for the lower is —20 v peak

The circuit, intended for use at 100 pulses per second, operates in the range of from one to 35,000 per second. Higher repetition rates are possible with modification of the trigger circuit. With negative input pulses of from one to four volts peak at 100 per second, the square output pulse occupies 15 percent of the period. As the input increases in magnitude, the output pulse widens. At 22 volts input the output pulse occupies about 35 percent of the period, as shown in Fig. 2.

Regardless of the input, output pulses maintain the two-μsec rise time and the 60-volt peak value. For input voltages less than 0.28 volt, there is no triggering. This is the maximum allowable noise figure. In the range of from 0.28 to 0.92 volt at the input terminals, the output fails to include a percentage of the input. Above 0.92 volt, the output is reliable.

Tests indicate that in a practical device, 1.75 volts is a reasonable value of peak signal from a 1N77. A value of less than 1.5 volts indicates a poor photodiode or, what is far more likely, a poor light adjustment.

The circuit has been operated into loads from open circuit to 10,000 ohms with no change in output waveform or magnitude. At lower load resistance, the magnitude is reduced.

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Universal Skin-Effect Chart

Gives skin depth, napier depth and depth of penetration of current in various metals, solutions and ground at frequencies ranging from 1 cps to 1,000,000 mc. One use is estimating transmission between underwater loop antennas, such as for sub-to-sub or sub-to-ship radio communication through salt water

By **HAROLD A. WHEELER**

Wheeler Laboratories, Inc.
Great Neck, N. Y.

THE CHART in Fig. 1 and the accompanying equations present the skin effect over a wide range of frequencies in various conducting mediums such as metals, water solutions and the ground.

The simple skin effect fails above a certain transition frequency depending on the product of electric ratio × magnetic ratio of the material. The 45-deg dashed lines at the top mark the corresponding upper limits of validity determined by the indicated values of these ratios.

The transmission between two loop antennas in a conductive medium may be estimated on the basis of the napier depth given on the chart, if the dimensions of the loops are much smaller than the napier depth. Add to the free-space attenuation (based on usual formulas) an attenuation of 1 napier (8.7 db) for every napier depth of distance between the loops.

All changes of conditions required for similar skin effect in scale models may be read on the chart by a simple rule. Through the point representing one set of conditions, draw a line parallel to the 45-deg dashed lines at the top. Any other point on this line represents another set of conditions for a scale model with length dimensions changed in proportion to the napier depth.

The chart is supplemented by a variety of formulas and by tables of conductivity and electric ratio (dielectric constant) for metals, solutions and ground.

Symbols and Terminology

(mks units unless otherwise specified)

d = napier depth (skin depth, depth of penetration) (meters)

λ = Wavelength in free space (meters)

f = frequency (cps)

ω = $2\pi f$ = radian frequency (radians per second)

σ = $1/\rho$ = conductivity (mhos per meter)

ρ = $1/\sigma$ = resistivity (ohm-meters)

G_o = $1/R_o$ = 0.00265 = wave conductance in free space (mhos)

R_o = $1/G_o$ = 377 = wave resistance in free space (ohms)

μ = magnetivity (henrys per meter)

ϵ = electrivity (farads per meter)

k_m = μ/μ_o = magnetic ratio (unity for all nonmagnetic materials)

k_e = ϵ/ϵ_o = electric ratio

sub-o = free space

sub-c = transition between simple skin effect and electromagnetic-wave propagation.

Formulas

Napier Depth (skin depth, depth of penetration). The depth at which the current density is $1/e$ or 0.368 of its value at the surface; the effective thickness of the layer of current just under the surface. It is equal to the radian depth, at which the phase angle of the current density is retarded one radian from its value at the surface.

$$d = \sqrt{\frac{2}{\omega \mu \sigma}} = \frac{1}{\sqrt{\pi f \mu \sigma}} = \sqrt{\frac{\lambda G_o}{\pi \sigma k_m}} = \sqrt{\frac{\lambda}{\pi R_o k_m}} \text{ meters} \quad (1)$$

The last two forms involve only the dimensions of length and conductance or resistance. Substituting numerical values for G_o and R_o:

$$d = \frac{1}{2\pi}\sqrt{\frac{\lambda}{30\,\sigma k_m}} = \frac{1}{2\pi}\sqrt{\frac{\lambda\rho}{30\,k_m}} = \frac{1}{34.4}\sqrt{\frac{\lambda}{\sigma k_m}} = 0.0291\sqrt{\frac{\lambda}{\sigma k_m}} \text{ meters} \quad (2)$$

As an example, at 1 mc $d = 0.503/\sqrt{\sigma k_m}$ meters. Units of d and σ are meters and mhos per meter or millimeters and megamhos per meter. The former units are convenient for ground and water, the latter for metals. This formula is convenient for plotting the intersections used in drawing the chart. As another example, the napier depth in copper (σ = 58 megamhos per meter) is

$$d_{Cu} = \frac{0.066}{\sqrt{f_{mc}}} \text{ mm} = \sqrt{\frac{4.36}{f_{kmc}}} \text{ microns} = \sqrt{\frac{4.36}{f_{kc}}} \text{ mm} = \sqrt{\lambda_m}\, 3.81 \text{ microns} \quad (3)$$

d_{Cu} = 0.066 mm	at 1 mc
1 mm	at 4.36 kc
1 mil-inch	at 6.8 mc
1 micron	at 4.36 kmc

Frequency and Wavelength.

$$f = \frac{1}{\lambda\sqrt{\epsilon_o \mu_o}}\,;\ \lambda = \frac{1}{f\sqrt{\epsilon_o\mu_o}} \quad (4)$$

Transition Frequency. The frequency at which the simple skin effect (at lower frequencies)

for Conducting Materials

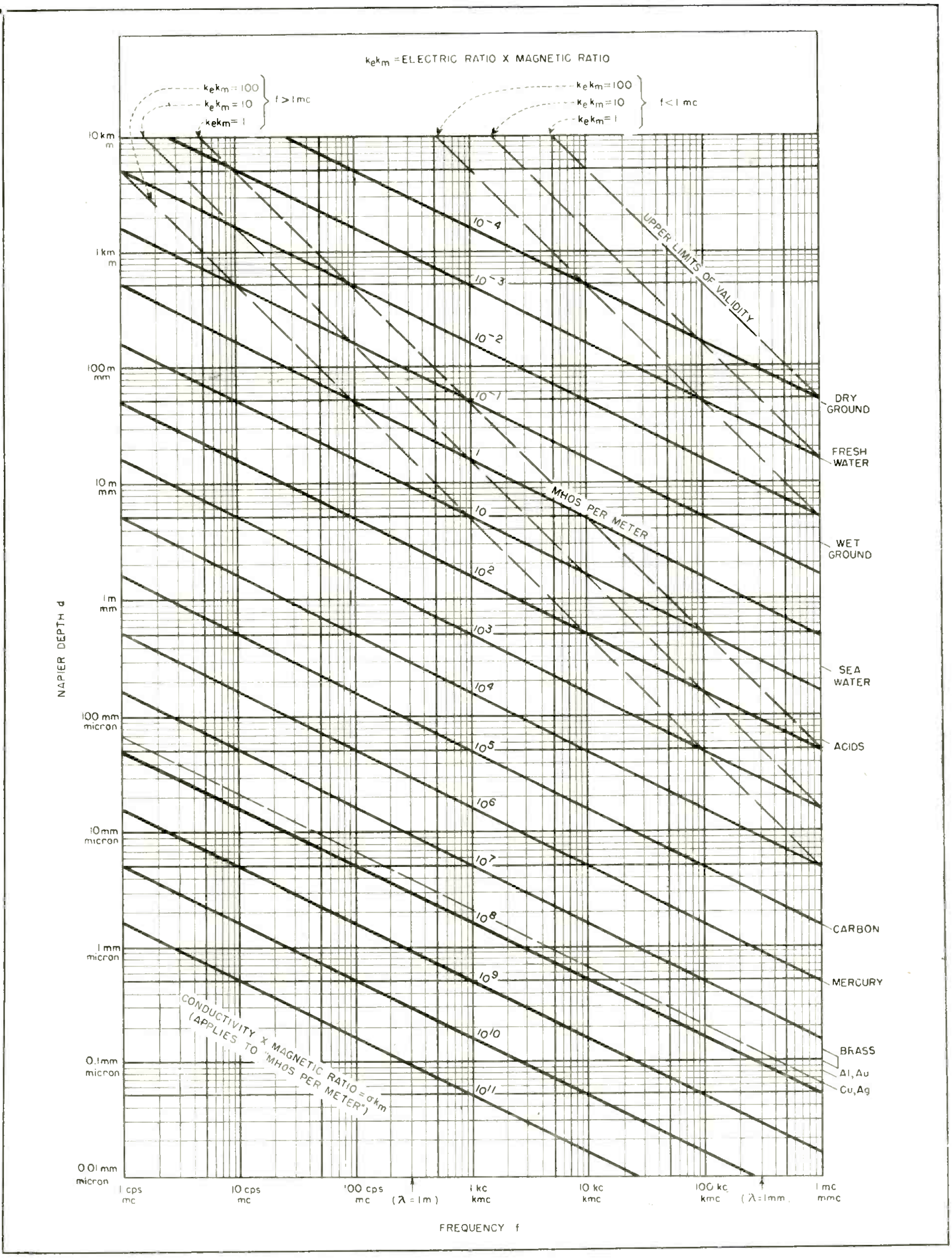

FIG. 1—Solid lines are contours of conductivity × magnetic ratio, identified for typical materials in right-hand margin. Dashed lines give transition frequency above which dielectric currents complicate the simple conduction-current skin effect in poor conductors. Horizontal scale of frequency and vertical scale of napier depth have two sets of units, divided at 1 mc; use upper set of units for lower frequencies, and lower set for higher frequencies

merges with wave propagation (at higher frequencies). At this frequency, the average loss tangent of the magnetic and electric fields is unity. In low (poor) conductors, it is assumed that the material is nonmagnetic and hence has no magnetic loss. Therefore, at the transition frequency, the loss tangent ($1/Q$) of the dielectric is 2 (or $Q = 1/2$).

If the dielectric had uniform effective conductivity at higher frequencies, the napier depth would be constant, but usually the effective conductivity increases at higher frequencies, reducing the napier depth. The transition frequency in the ground is of particular interest, determining the upper limit of validity of the simple skin effect based on conduction currents exceeding the dielectric currents.

$$f_c = \frac{\sigma}{4\pi\epsilon_0 k_e} \quad \text{cps} \qquad (5)$$

$$f_c = 9{,}000\,\sigma/k_e \quad \text{mc} \qquad (6)$$

$$\lambda_c = \frac{4\pi G_o k_e}{\sigma} = \frac{4\pi\rho k_e}{R_o} \quad \text{meters} \qquad (7)$$

$$\lambda_c = \frac{k_e}{30\,\sigma} = \frac{\rho k_e}{30} \quad \text{meters} \qquad (8)$$

$$d_c = \frac{\lambda_c}{2\pi\sqrt{k_e k_m}} = \frac{47.7}{f_{c(mc)}\sqrt{k_e k_m}} \quad \text{meters} \qquad (9)$$

This transition value of the napier depth (d_c) is equal to one radian-length in the material at the transition frequency. It is used for plotting the 45-deg dashed lines at the top of the chart for several values of the electromagnetic product ($k_e k_m$). In the dielectric:

$$\text{Loss tangent} = \frac{\sigma}{\omega_c \epsilon} = \frac{\sigma\lambda}{2\pi G_o k_e} = \frac{R_o\lambda}{2\pi\rho k_e} \qquad (10)$$

$$\text{Loss tangent} = \frac{60\,\sigma\lambda}{k_e} = \frac{60\,\lambda}{\rho k_e} \qquad (11)$$

Table I—Nonmagnetic Metals

Material (Temp 20° C)	Conductivity σ megamhos per meter	Napier Depth d at 1 mc mm
Silver	61	0.064
Copper	58	0.066
Gold	42	0.078
Chromium	36	0.084
Aluminum	35	0.085
Brass (red; 91 Cu, 9 Zn)	26	0.10
Tungsten	23	0.10
Magnesium	22	0.11
Manganin (84 Cu, 12 Mn, 4 Ni)	21	0.11
Constantin (60 Cu, 40 Ni)	20	0.11
Rhodium	18	0.12
Zinc	17	0.12
Brass (yellow; 66 Cu, 34 Zn)	15	0.13
Cadmium	13	0.14
Phosphor Bronze	12	0.14
Beryllium Copper (2% Be)	11	0.15
Platinum	10	0.16
Palladium	9	0.17
Tin	9	0.17
Nickel Silver (64 Cu, 18 Ni, 18 Zn)	3.0	0.29
Silicon (approx)	1.7	0.39
Mercury	1.04	0.49
Carbon (approx)	0.1	1.6

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Table II—Water Solutions and Ground

Material (Temp 20° C)	Conductivity σ mhos per meter	Napier Depth d at 1 mc meters	Electric Ratio k_e	Max Freq f_c mc
Acids (20%) HCl, HNO_3, H_2SO_4	70	0.059	81 (?)	8,000
Alkali (20%) NaOH	33	0.086	81 (?)	3,700
Salt (20%) NaCl Great Salt Lake	20	0.11	81 (?)	2,200
Salts (3.5%) Atlantic Ocean	4	0.25	81	450
Fresh water (approx) lakes, rivers	0.001	16*	81	0.11*
Distilled water	0.0002	36*	81	0.022*

Material	Conductivity σ mhos per meter	Napier Depth d at 1 mc meters	Electric Ratio k_e	Max Freq f_c mc
Wet ground (max)	0.03	2.9	25	11
Wet soil	0.02	3.6	32	5.6
Fertile land	0.005	7.1	15	3.0
Average ground	0.002	11	16	1.1
Rocky ground, dry soil	0.001	16	7	1.3
Very dry soil	0.001	16	4	2.2
Dry ground (min)	0.0001	50*	9	0.10*
"Good conductors" minerals such as some sulfides and oxides	$10^5 - 1$			
"Intermediate conductors" clay, shale, stone, rocks, ores	$1 - 10^{-8}$			

* d(1 mc) is not valid if $f_c < 1$ mc, but is still useful as a basis for computing d at $f < f_c$.

DIGITAL COMPUTER Plays NIM

Engineers design glorified pinball machine in breather from classified work. Binary-counter system may be set to win regardless of opponent's skill, or to allow opponent to win if he plays a perfect game

By **HERBERT KOPPEL**
W. L. Maxson Corp.
New York, N. Y.

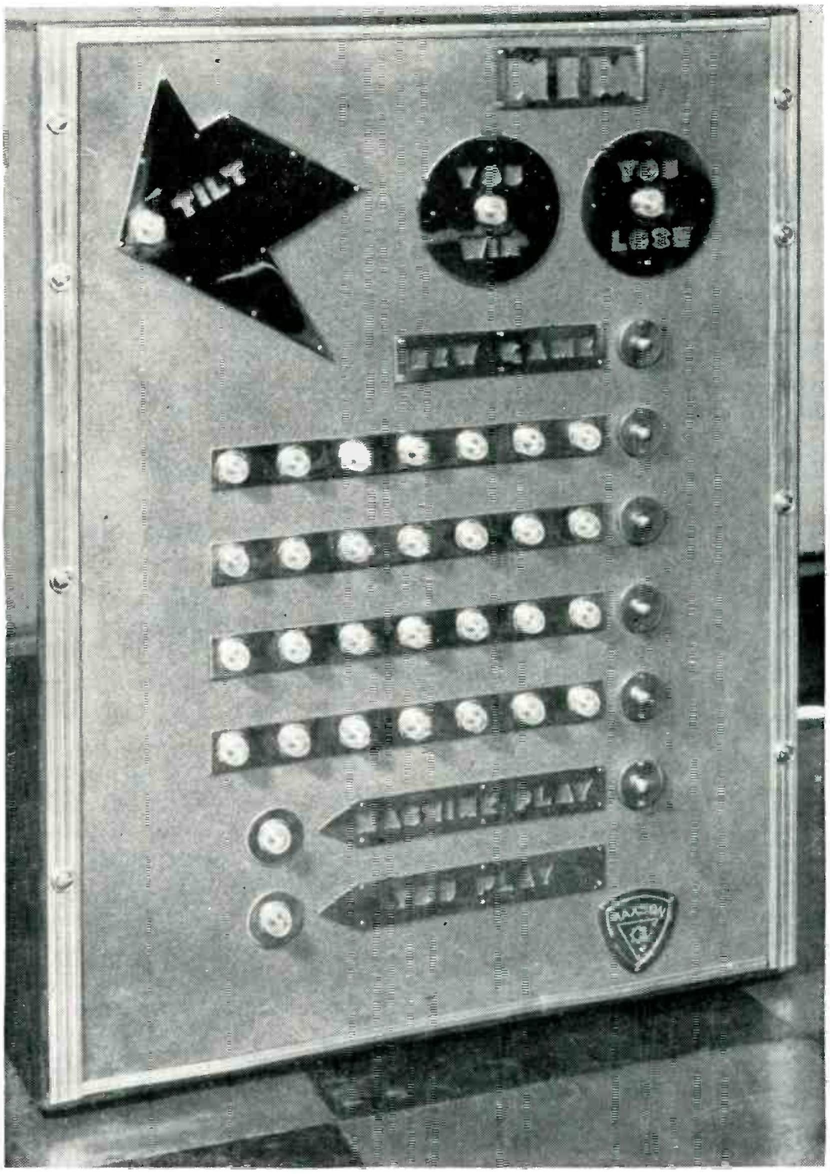
An automatic digital computer matches wits with its human operator in playing the old game of NIM.

Only perfect play by the operator can defeat the machine and its moves are sufficiently random to minimize the possibility of defeat by mere memorization of a particular sequence of play. If desired, the starting conditions of the game can be so adjusted that it is impossible for the player to defeat the machine.

The game of NIM is played with stacks of chips, each stack having a random number of chips. The two players take turns removing chips from the stacks. The player removing the last chip from the table wins. During his turn, a player removes chips from one stack only. He may remove any desired number of chips, from one to the whole stack

How To Win at NIM

The number of chips in each stack can be expressed in binary notation as the sum of different powers of two. If a safe condition is defined as one where, in the sum of all the stacks, each power of two appears an even number of times, with zero considered an even number, then[1]: Any safe condition, followed by any legal move, must bring about an unsafe condition. Any unsafe condition may be turned into a safe condition by re-



Game-playing digital computer is a skillful and relentless opponent

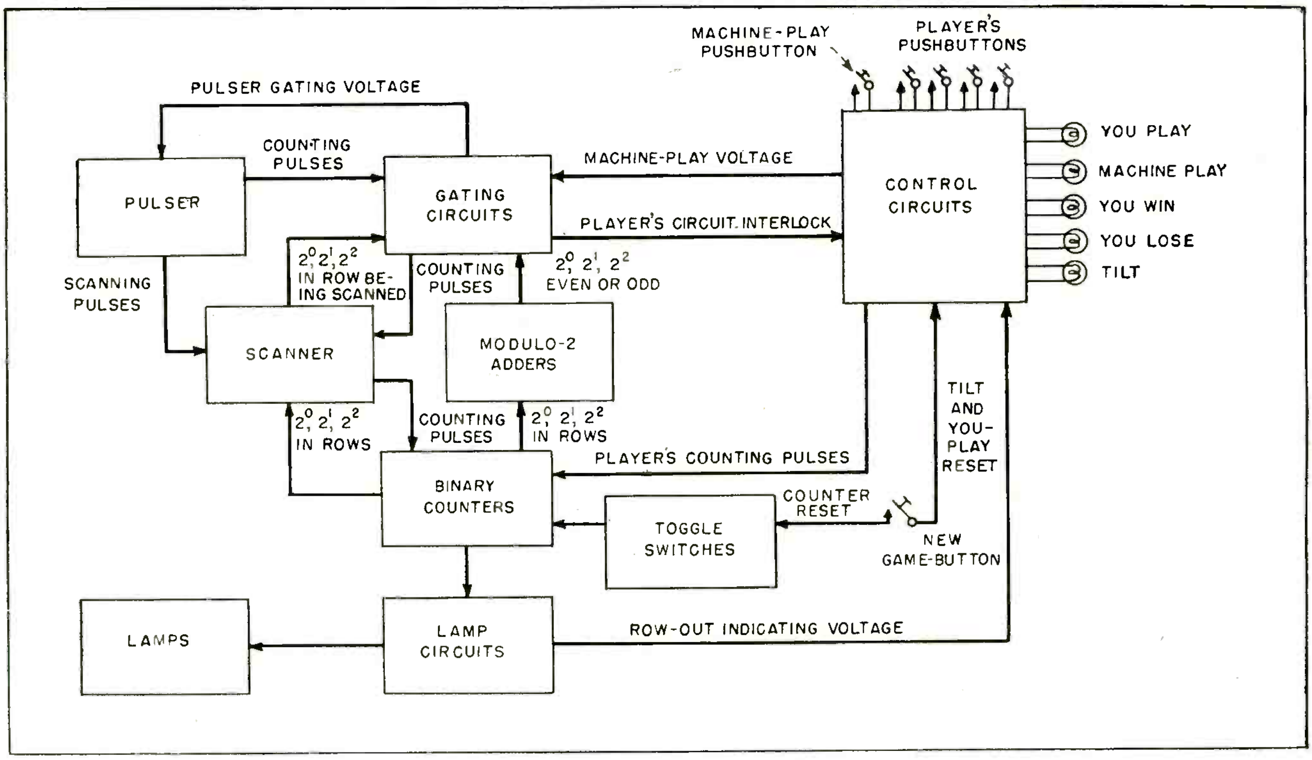


FIG. 1—Block diagram shows circuits that comprise the NIM machine's electronic brain

moving from any group containing the highest power of two appearing an odd number of times, a number of chips such as to cause all powers of two to appear an even number of times. The player who presents his opponent with a safe condition, and continues to do so at each turn of play, will win.

Operating the Machine

The front panel of the machine contains four rows of seven neon lamps each. These serve as stacks of chips, removal of which is accomplished by extinguishing the lamps. A pushbutton is provided for each row. The player pushes the button corresponding to the row that he selects once for each lamp he wishes to extinguish. If he attempts to cheat by operating upon more than one row during any one turn of play, the TILT indicator lights and the game is automatically ended.

When the player has made his move, the MACHINE PLAY indicator lights, and the machine is ready to take its turn. When the MACHINE PLAY button is pushed, the machine automatically selects the row upon which it wishes to operate, and extinguishes a number of lamps in that row. The player's next turn is then indicated as the MACHINE PLAY indicator goes out and the YOU PLAY indicator lights.

When presented with an unsafe condition, the machine will always move to bring about a safe condition. It will read the number of lamps lit in each row as a binary number, select a row containing the highest power of two appearing an odd number of times in the total of all the rows, and remove a number of lamps from the selected row such as to cause every power of two to appear an even number of times. Since its human opponent must then convert this safe condition into an unsafe condition, the machine will consistantly maintain its advantage and eventually win the game.

When presented with a safe condition, the machine must in turn present its opponent with an unsafe condition. It therefore selects a row at random and extinguishes one lamp, thus prolonging the game in the hope that its opponent will eventually make a mistake. The entire machine-play cycle takes less than 0.4 second.

If the human player is successful in extinguishing the last of the lamps, the YOU WIN indicator lights. If the last lamp is extinguished by the machine, the YOU LOSE indicator lights.

Player Beaten At Start

The NEW GAME pushbutton sets up the game by lighting certain lamps and the YOU PLAY indicator. The initial configuration of lamps is determined by the settings of a bank of toggle switches at the rear of the machine.

Since the human player must make the first move, presenting a safe condition at the start of the game will force him to lose, while starting the game with any unsafe condition will enable him to win by playing properly throughout the game. Having all lamps lit in each row constitutes a safe condition.

Interlock circuits prevent improper or unfair play, such as attempting to make the machine take two consecutive moves, or actuating the MACHINE PLAY and player's pushbuttons simultaneously. Figure 1 is a block diagram of the NIM machine.

Lamp and Counter Circuits

A three-stage binary counter, using the conventional Eccles-Jordan circuit, controls each of the four rows of seven lamps. The number of lamps lit in each row corresponds to the condition of the three-stage counter controlling that row. All seven lamps are lit when the counter is in zero position. The lamps are extinguished in sequence from left to right as the counter is triggered. Each lamp is connected in the plate circuit of a triode. Counter-tube plate voltage is used to bias the triodes to cutoff in proper sequence. The lamp circuit for each row also provides a "row-out" indicating voltage when the row has been completely extinguished.

Pushing the NEW GAME button causes a predetermined number of lamps to light in each row by opening the grid return circuit of one of the two tubes in each binary-counter stage. Twelve toggle switches (one for each of the three stages that actuate each of the four rows) permit selection of either of the two tubes in each stage. Thus any combination of counter settings, and therefore any desired configuration of lamps, may be chosen. In addition, the NEW GAME button de-energizes the tilt circuit if it has been activated previously.

Control Circuits

Each time one of the player's four pushbuttons is actuated, a pulse is sent to the binary counter of the corresponding row of lamps. Thus each push of the button extinguishes one lamp. The row-out indicating voltage from the lamp circuits prevents formation of pulses for any row after that row has been completely extinguished.

The player may end his move after extinguishing only one lamp in the selected row. Therefore the first push of any of the player's four buttons actuates a change-over relay that prepares the machine to take its turn. This does not, however, prevent the player from finishing his move by putting out additional lamps in the selected row if he so desires. The row-out voltage prevents actuation of the change-over relay if the player makes his move in a row already empty. Otherwise the player could cheat by forcing the machine to make two consecutive moves.

Tilt Circuit

If the player attempts to extinguish lamps in more than one row without allowing the machine an intervening move, the tilt relay is actuated. This lights the TILT indicator and extinguishes all other indicators.

The MACHINE PLAY button applies voltage to gating circuits, causing the machine to make its move. A relay continues application of this voltage for the duration of the machine-play cycle. The player's pushbuttons are disabled throughout this cycle. At the conclusion of the cycle, the player's pushbuttons are reactivated.

Why Engineers Play Games

With most of the Maxson Corporation's computer business under security wraps, the NIM machine was designed principally as a demonstration device to show a few of the many things computer circuits can do

Row-out indicating voltages are applied to end-of-game adder circuits. When all lamps in all rows have been put out, these adders extinguish the YOU PLAY and MACHINE PLAY indicators, and illuminate either the YOU WIN or YOU LOSE indicator, depending upon whether the player or the machine has extinguished the last of the lamps.

Pulser and Scanner

The pulser utilizes multivibrators and shaping circuits to generate pulses used by the machine to actuate the binary counters and thus extinguish lamps. Scanning pulses are also generated. These cause the scanner to sample the rows until it finds one upon which the machine wishes to operate. The pulser is gated by a voltage from the gating circuits.

The scanner is a four-position ring counter actuated by scanning pulses from the pulser. One of four scanning relays is closed in each scanner position. Each relay corresponds to one of the four rows of lamps.

Voltages taken from the binary-counter plates are used to indicate the powers of two contained in the number of lamps lit in each row. This information is fed to the scan relays. In each scanning position, the closed scan relay conveys this information to the gating circuits. Since the number of lamps lit in any row cannot exceed seven, 2^0, 2^1, and 2^2 are the only powers of two that may appear.

The scan relays serve also to connect the pulse output from the gating circuits to the input of the binary counter that extinguishes lamps in the row being scanned.

There are three sets of modulo-2 adders, one for each power of two used. Information as to whether any of these three powers of two appears in a given row is obtained in terms of voltage from each counter-stage plate circuit and fed to the adders. The adders compare these voltages and feed to the gating circuits information that indicates whether or not each power of two appears an even number of times.

Gating Circuits

Gating circuits perform logical operations that enable the machine to play NIM with greatest possible proficiency.

The gating circuits continuously receive information as to which powers of two appear in the row being scanned, and whether each power of two appears an odd or even number of times in the aggregate of all rows. They use this information to control the transmission of pulses to the counters and to the scanner.

Design of this computer resulted from the joint efforts of several members of the W. L. Maxson Corp. engineering staff, particularly F. Alterman, J. Fishel, E. F. Grant, and S. Schmerler.

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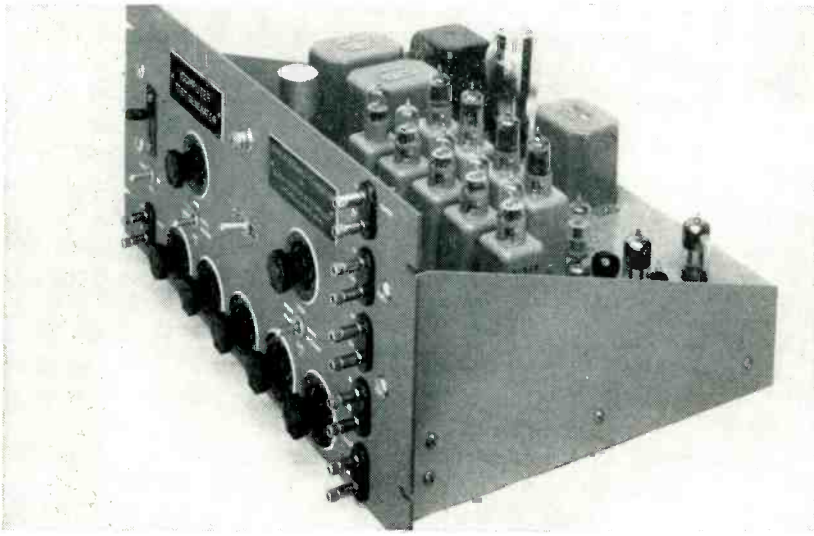
Test Pulse Generator



Photograph of digital computer test pulse generator shows multiple output terminals, front-panel adjustments and plug-in units on chassis

By ALBERT A. GERLACH

Armour Research Foundation
Illinois Institute of Technology
Chicago, Illinois

IN THE DEVELOPMENT and testing of digital computer components and systems, a generator which can simulate digital information becomes an invaluable tool. Such an instrument must be quite versatile to handle the many situations required in digital computer work. The pulse generator described was designed for such a purpose.

Available Outputs

There are a total of five outputs, two source outputs *A* and *B*, and a clock output. The two source outputs each have a direct output and a complement output where the complement output provides a pulse (one) where the direct output has a no-pulse (zero), and a no-pulse (zero) where the direct output has a pulse (one). The clock output provides a pulse for each input trigger. Provisions have been made for random statistical output for each source.

The pulse width of each output is individually variable from about two to forty microseconds by an internal adjustment. The amplitude of each output is variable by a front panel control up to a maximum output of about sixty volts. The clock output may be advanced to occur ahead of the source outputs by as much as forty microseconds by an internal control. Statistical randomness of the *A* and *B* outputs is achieved by periodically opening and closing gates in the *A* and *B* initiating channels and the rate of this operation is controlled by two independent front panel controls from about 1,000 cps up to about 20 k.c.

Provision is made to trigger the outputs either manually (by a front-panel lever switch), from an internal sixty-cycle source, or by an external source where the rate of initiation may be varied over a wide range of frequencies.

The basic idea of the pulse generator is illustrated in Fig. 1. The trigger initiator is activated by an internal 60-cycle sine wave, by a manual lever switch, or by a ten-volt external source, and supplies a sharp output pulse to trigger the delay multivibrator. The latter is a monostable multivibrator whose pulse width is variable by a potentiometer located on the chassis. The output pulse of the delay multivibrator is differentiated and the positive leading edge pulse is used to trigger the clock output multivibrator while the negative trailing-edge pulse is first inverted and then fed to the four gates of the source *A* and *B* outputs.

By a front-panel switch, either or both pairs of gates may be left

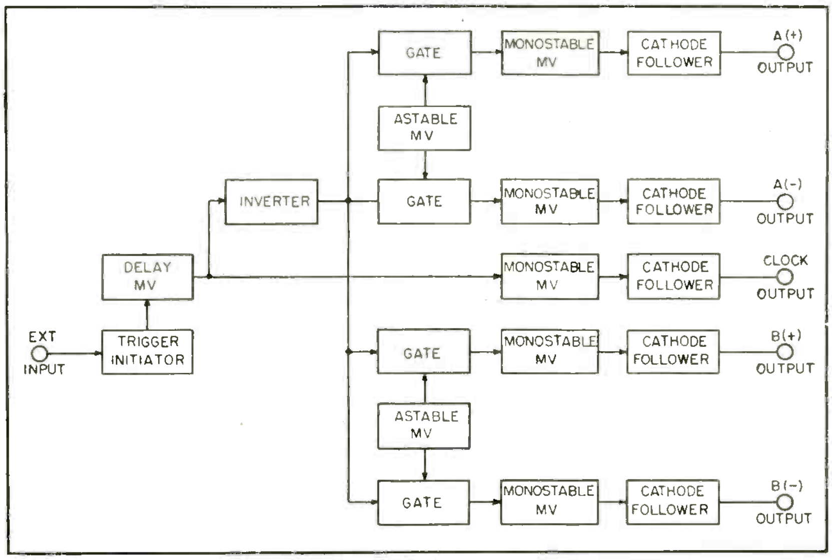


FIG. 1—Pulse generator block diagram. Symbols $A+$, $A-$, $B+$ and $B-$ refer to positive and negative pulse outputs from complementary sources *A* and *B*

for Digital Computers

Random pulses simulating digital information are made available for testing computer elements without tying up actual computer to produce appropriate signals. A wide variety of outputs is obtainable including a pulse coinciding with each input trigger for actuating any auxiliary test equipment

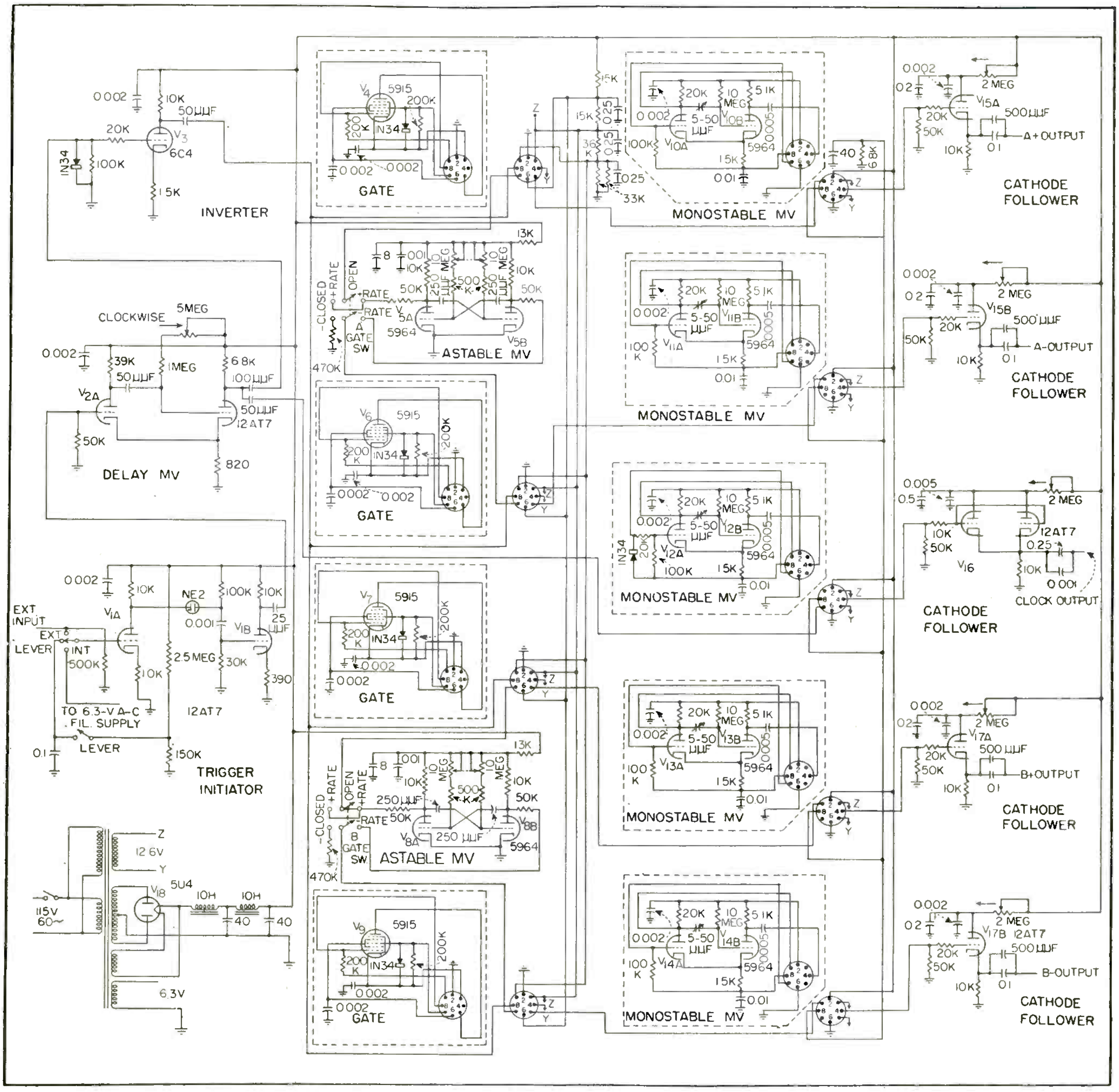
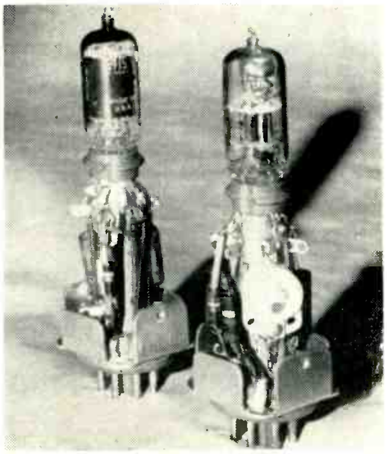


FIG. 2—Complete circuit diagram of pulse generator shows use of plug-in circuits for quick servicing and compactness. Circuit layout follows form shown in block diagram of Fig. 1



Typical plug-in units containing gate (left) and width (right) circuits. Similar plug-in assemblies are used for other circuits, as shown in Fig. 2

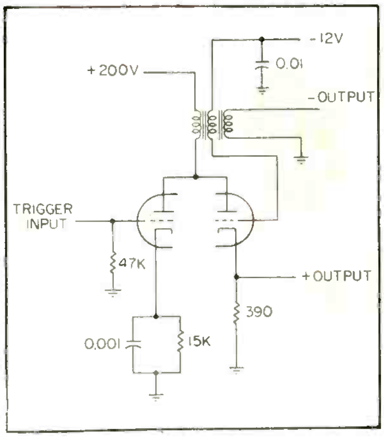


FIG. 3—Blocking oscillator pulse former for producing low-impedance pulses of 0.1-μsec duration for special testing purposes. Tube is a 12AU7 dual triode

always in the open position, or the astable multivibrators may be employed to alternately open and close the + and − outputs respectively at a rate determined by two independent front-panel controls. The gates that are open at the time the initiator pulse occurs will pass the pulse on to the output monostable multivibrators which produce the output pulses.

Cathode followers are employed to provide a low-impedance output. A photograph of the completed generator is shown on the first page of this article.

Circuit Details

The circuit diagram of the pulse generator is illustrated in Fig. 2. The trigger initiator consists of an amplifier, a neon discharge tube, and a differentiating amplifier. A positive voltage input to the first amplifier will lower its plate voltage and cause the gas discharge tube to fire.

The steep wave front so created is differentiated and amplified by the second amplifier and used to trigger the delay multivibrator. This circuit is a conventional monostable multivibrator whose pulse width is variable by the potentiometer in the grid circuit of the tube. The leading and trailing edge of this pulse in differentiated and used for further triggering.

Gate Circuits

The gate circuit utilizes a pentagrid converter as a transfer tube with the third grid acting to control the transmission or rejection of a pulse occurring at the first grid.

The gate is normally in the open position when it is disconnected from the astable multivibrator.

However, when connected to the astable multivibrator, negative pulses alternately close the + and − gates so that when one is closed the other is opened and vice versa. Thus the − output is the complement of the + output. The output pulses are generated by monostable multivibrators with the pulse width adjustable by a small trimmer capacitor in the grid circuit as shown in Fig. 2.

For layout convenience, interchangeability of components, and ease of circuit modification the gate circuits and output multivibrators were constructed as plug-in components.

Refinements

The pulse generator has proved to be exceedingly useful as a tool for the testing of digital computer systems and components. However, with such a broad field as computers there are times when even greater versatility is desirable. One such instance in the author's experience occurred when it was desired to produce output pulses of about 0.1 microsecond width.

To get the desired pulses, the cathode follower outputs (see Fig. 2) were replaced by blocking oscillators of the type illustrated in Fig. 3. This circuit provides low-impedance positive and negative pulses of 0.1-microsecond duration and about fifty volts amplitude.

Typical Test Signals

As an example of the statistical output of the pulse generator Fig. 4 illustrates a series of output sequences which were stored in an eighty bit sonic delay line storage register.

In each of the nine sequences there are eighty possible positions for a pulse (one) or a no-pulse (zero), each spaced one microsecond apart. The clock output of the pulse generator was used to index the positions over one microsecond, and for each clock output there was equal probability for a pulse (one) or a no-pulse (zero) entering the storage register. The resulting binary numbers may be considered random.

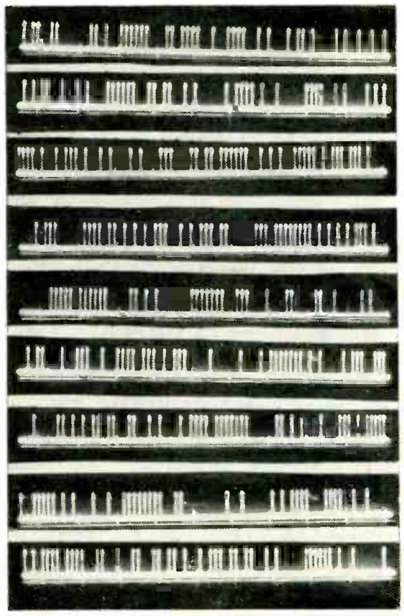


FIG. 4—Samples of random outputs from test generator

Acknowledgments

The author acknowledges the valuable assistance of Joseph J. Miller who constructed and assisted in the final testing of the pulse generator. This work was performed under contract with the United States Department of Defense, Washington, D. C.

Continuous Recorder Keep-Alive Circuit

Multiple-output unit injects 10-cps signal into recording systems to improve performance by keeping pens in constant motion. High reliability and long life are ensured by conservative circuit design and construction

By **RONALD L. IVES**
Williamsville, N. Y.

MORE than a decade ago, several users of chart-recording milliammeters discovered, independently, that the pen response to position changes was greatly improved if the movement was kept in oscillation.

Various-mechanical and electrical oscillation injectors were studied and applied.

Perhaps the simplest oscillator consists of an electric bell movement, with bell removed, bolted to the back of the instrument case. This supplies the desired oscillation mechanically, and also generates electrical noise detectable for several hundred feet from the instrument. Another expedient is to inject a small 60-cycle component into the meter circuit, usually by use of capacitors. This also worked after a fashion, but switching transients in the line were recorded along with the desired signal.

Relay Oscillators

For field use, where recorders are clock-driven, and instruments battery operated, a very effective keep-alive, using a relay oscillator, was developed by S. W. Grinnell in 1942.[1,2,3] This type of keep-alive is so satisfactory, for field use, that it is being incorporated in modern field meteorological instruments.[4] Two workable relay-type keep-alive circuits, with their output characteristics, are shown in Fig. 1. Frequency is usually between five and fifteen cycles per second.

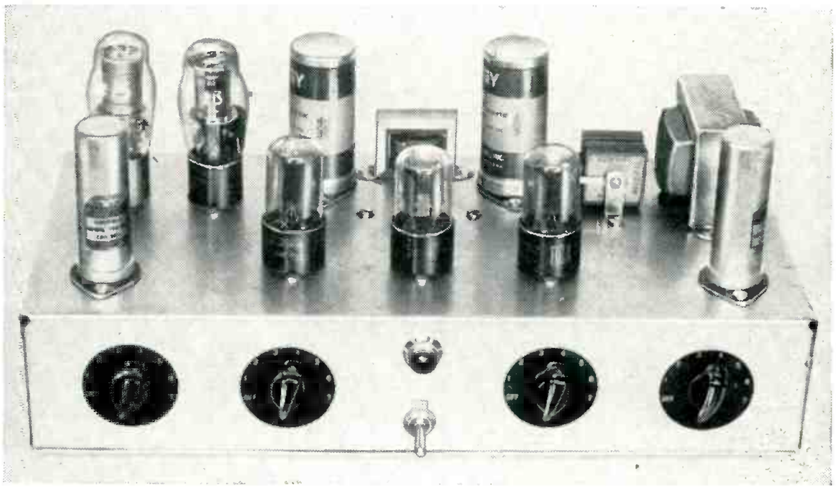
Station Recording

Although the relay-type keep-alive is very satisfactory for field use, its life is not great enough for continuous recording at a fixed station.

The nominal life of a good telephone-type relay (10,000,000 operations) is completely used up, at ten cycles per second, in about 11.6 days (of 24 hours). In consequence, when continuous records are required for a period of months or years, some other keep-alive system is economically desirable.

Various tests indicate that the keep-alive frequency should be between five and fifteen cycles per second, and that the wave form should be nonsinusoidal, but symmetrical. Frequencies of less than five cycles per second require considerable amplitude to be effective, and insert sawteeth into the record. Frequencies of much more than fifteen cycles per second interfere with ink flow in pens of several designs, converting the recorder into a very efficient ink-thrower. When frequencies are in the range from 400 cycles per second and up, the pen makes a continuous excavation in the chart, instead of a continuous trace.

Frequency and continuity re-



Conventional tubes should be replaced every 1,000 or 1,500 hours. Red tubes may be used continuously for as long as 13 months quirements for station operation having indicted that a symmetrical multivibrator would be suitable for this use, several experimental models were made and tested. All of them worked, but only the model having the widest application will be described.

The station model keep-alive for general use consists of a symmetrical multivibrator, with a nominal frequency of ten cycles per second, and four independent cathode-follower outputs. The circuit is shown in Fig. 2.

The multivibrator, used as a square-wave generator, uses a high-mu dual triode, conventionally connected for low-frequency operation. The 100,000-ohm resistors, shunted by 0.001-μf capacitors between the grids and the plate capacitors of the opposite triodes are to limit the grid current flow without rounding the voltage peaks. If these R-C elements are omitted, the multivibrator may mode or block.

Frequency of this oscillator, determined by actual test, is found from

$$F = \frac{1}{4.5\,RC}$$

R being in ohms and C in farads.

So that the outputs will not interact, four separate cathode-follower outputs are provided, each being one half of a 6SN7 or 5692. Output peaks are approximately 100 volts, exact waveform being a function of the properties of the load, and an almost perfect square wave when the load is a pure resistance of more than 0.25 meg.

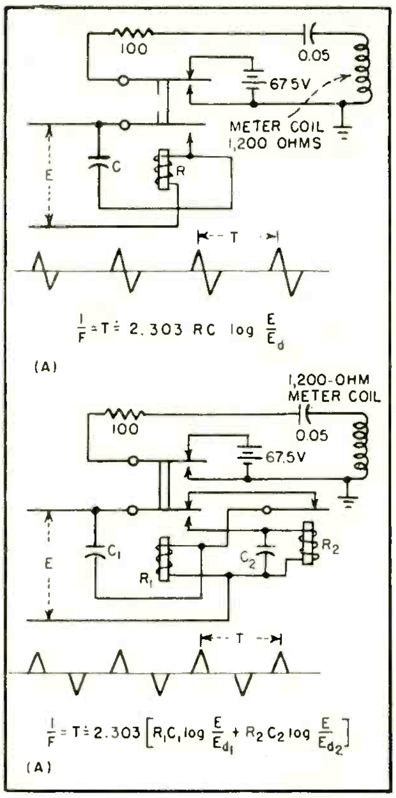


FIG. 1—Relay keep alive's have disadvantage of short life. Typical circuits are shown with waveforms and equations for frequency of operation in terms of supply voltage E and relay drop-out voltage E_d

The two halves of each triode buffer tube are connected in opposite phase to equalize the load on the power supply. With the circuit used, almost any number of dual triodes can be controlled by a single multivibrator. Practical limitations, such as the capacity of standard power transformers, space available on a standard chassis, and heat dissipation suggest that not more than a dozen dual triodes (24 outputs) be embodied in a single unit.

The power supply consists of a conventional voltage doubler isolated from the line, a pair of OD3 tubes in series to provide a regulated voltage for the multivibrator, and a single-section L-C filter in the plate supply for the buffer tubes. Filter capacitors are made much larger than theoretically necessary to reduce the effects of line surges and switching transients, and so that the filter will still be effective after the electrolytic capacitors age.

Allowing for heat radiation and servicing ease, a completely self-contained four-channel keep-alive can be constructed on a 3 x 9 x 15-inch chassis, as shown in the photographs. Eight channels can be built in the same space without undue crowding or overheating in use. Because uninterrupted service was important, rugged constructional methods were used, with all components rigidly tied down, and connections cabled. In general, any shock that will not damage the tubes will not hurt the other components. Smaller components were mounted on socket turrets, making terminal strips unnecessary.

Performance

Operational tests of this keep-alive indicate that its performance leaves little to be desired. Its versatility makes it suitable for a large number of instrument applications.

Test runs of a square wave, both

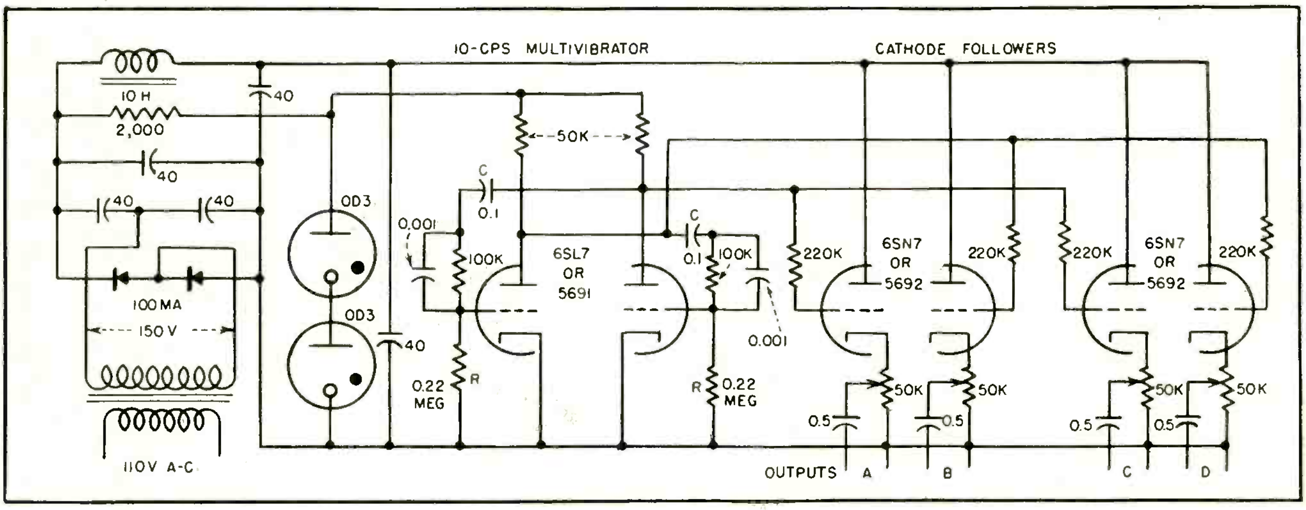


FIG. 2—Complete circuit of electronic keep alive. Additional outputs may be obtained by adding cathode followers

with and without a keep-alive are shown in Figs. 3 and 4. Similar results were obtained by West[4] and both of these parallel findings by Grinnell.[1] Note, in Fig. 3, the rounded noses on the leading edges of the curves, and the asymptotic approach of the tops of the waves to their ultimate maximum position. In Fig. 4 the maximum values are reached in much less time, and retained thereafter until the current through the instrument changes. Both curves were run on the same instrument, an Esterline-Angus 0-to-1 recording milliammeter, that had been adjusted for optimum operation prior to running the curve of Fig. 3.

Connections are quite simple. Instruments that have one side grounded are connected across any desired output, with the hot side of the instrument connected to the hot side of the output, from which it is isolated with respect to d-c by a capacitor in the keep-alive chassis. When both sides of the instrument are hot with respect to ground, as in a difference amplifier, each side of the instrument is connected to a hot output terminal, the phases of the terminals being opposite. As constructed, adjacent hot output terminals are of opposite phase.

With continuous recording, standard tubes should be checked weekly, and replaced when they test about 10 percent low. An average tube life of 40 days of continuous service is to be expected from manufacturers' ratings (1,000 hours), and actual tube life, when operation is truly continuous, usually exceeds 1,500 hours if the tube survives its first 200 hours of service. When red, or 10,000-hour, tubes are used, testing once a month is indicated, and replacement every 13 months is suggested by manufacturers' ratings.

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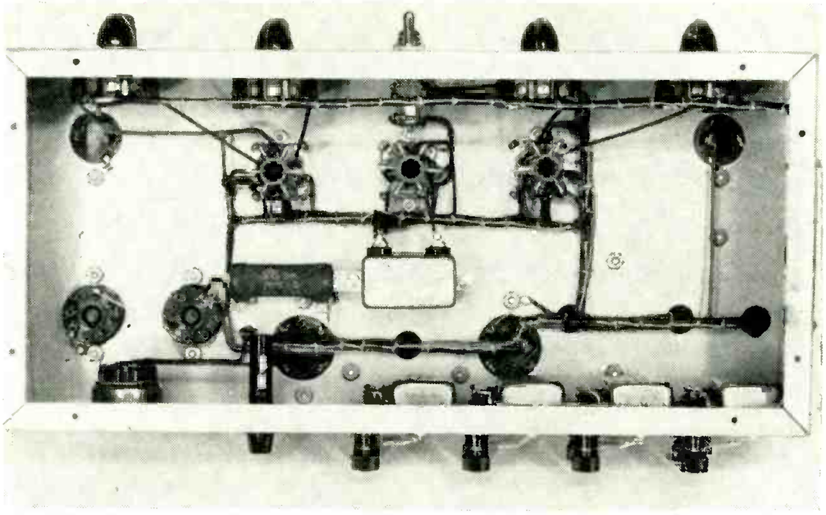


Under chassis view shows simplicity of electronic keep alive. Turret-type tube sockets hold small parts

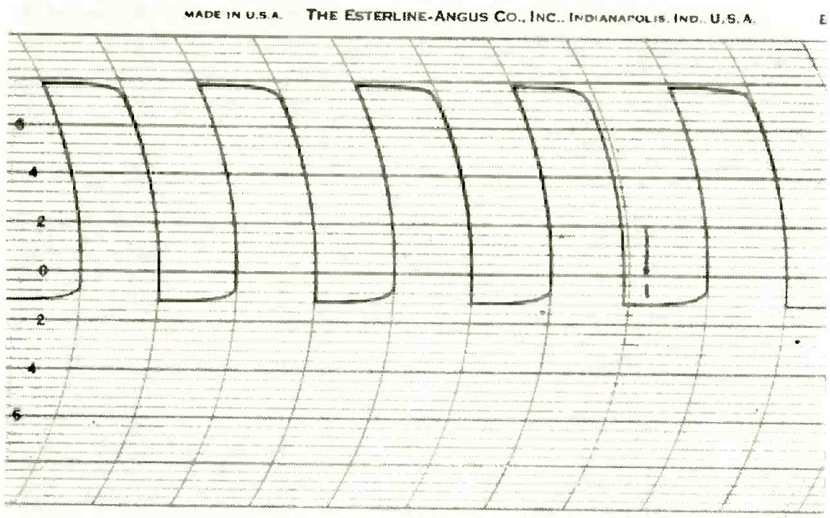


FIG. 3—Recordings made of square wave at 3-inch per minute chart speed without keep alive

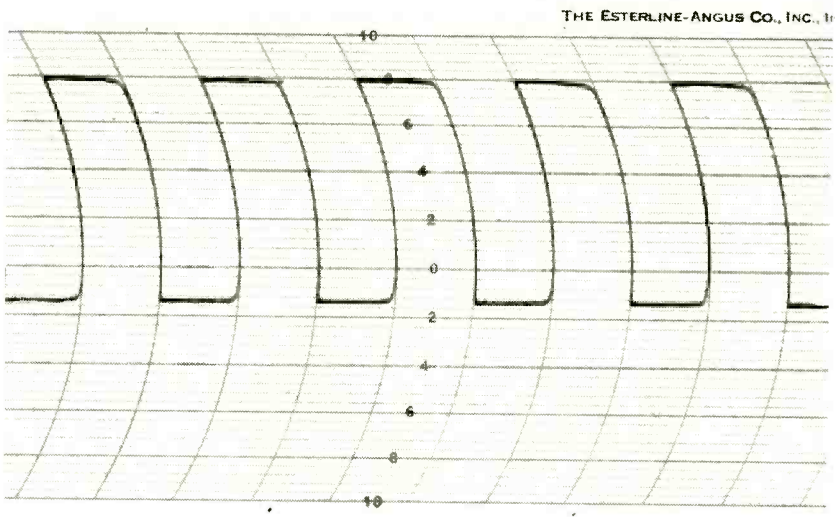


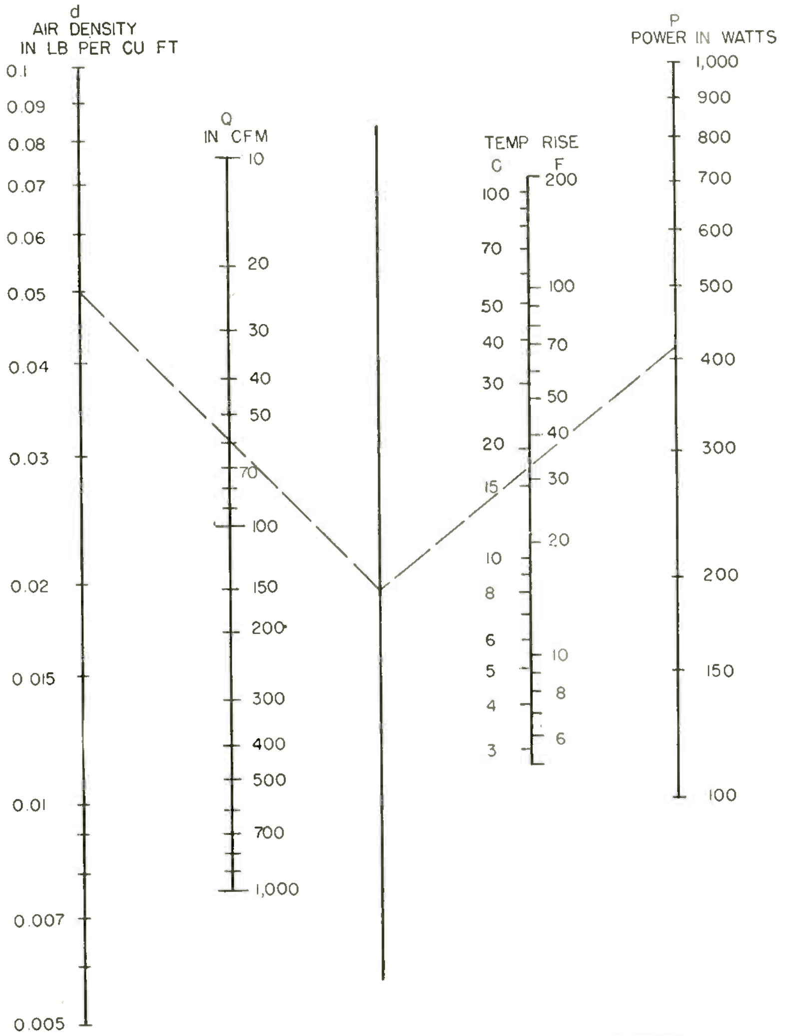
FIG. 4—Recording made under same conditions as Fig. 3 but with keep alive

Air-Cooling Nomograph

Gives cubic feet per minute of air flow needed to keep temperature rise in electronic equipment at specified value when wattage dissipation and air density are known. Supplementary graph gives air density at any altitude and temperature

By EUGENE SLUSSER

Northeast Electronics Corp.
Tuckahoe, N. Y.

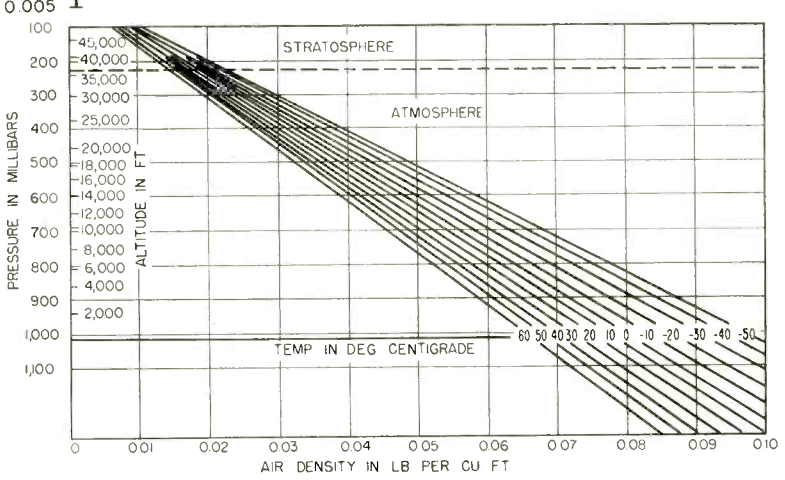


AT SEA LEVEL under standard conditions (760 mm mercury, 0 deg C and 0.079 lb per cu ft air density) the temperature rise in deg F is approximately 3,000 P/Q, where P is the power dissipated in the unit in kw and Q is the air flow through the unit in cubic feet per minute. The nomograph gives this rise on a dual Centigrade-Fahrenheit scale.

Variation of air density with pressure and temperature is shown in the graph. For operation at high altitude, the air density at the maximum altitude should be used to compute the maximum temperature rise or the blower capacity.

As an example, it is desired to determine the blower capacity required to cool a unit which dissipates 420 watts. To maintain a minimum wattage derating on certain resistors and selenium rectifiers, temperature rise must be held to 18 deg C. The equipment must be designed to operate at 10,000 feet and 30 deg C. For these conditions, the graph gives an air density of 0.05 lb per cubic ft, and the nomograph gives a minimum air circulation of 60 cfm.

The temperature at a given altitude can be estimated by assuming a dry adiabatic lapse rate of 3 deg C per thousand feet. On this basis a sea-level temperature of 20 deg C would correspond to −10 deg C at an altitude of 10,000 ft.

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High Q Measurement

Decay of oscillations in pulsed resonant circuit is measured oscillographically, and result is applied to nomograph to obtain Q directly. Technique has been applied to measure values of Q of resonant circuits at frequencies as high as 15 mc

By **WILLIAM J. SPAVEN**

Government Division
Fada Radio and Electric Company
Belleville, New Jersey

HIGH VALUES of Q (in excess of 1,000) cannot easily be determined under steady-state conditions, however, the transient characteristics of a resonant circuit suggest a method.

When a series resonant circuit is excited by a unit impulse, a train of damped oscillations is generated, as indicated by the waveform shown on the accompanying nomograph. The amplitude of the envelope of this wave train at time t_1 may be expressed as

$$A_1 = A_0 \epsilon^{-\frac{R t_1}{2 L}} \qquad (1)$$

where A_1 = the amplitude of the envelope at time t_1, A_0 = the amplitude of the envelope immediately following excitation, R = total equivalent series resistance of the circuit, and L = the equivalent series inductance of the circuit.

The Q of a shock-excited series circuit may be expressed by

$$Q = \frac{2 \pi f_0 L}{R} \qquad (2)$$

where f_0 is the natural series resonant frequency. Combining Eq. 1 and 2 and choosing an excitation pulse repetition frequency such that

$$prf = 1/t_1$$

then

$$Q = \left(- \frac{\pi}{\ln (A_1/A_0)} \right) \left(\frac{f_0}{prf} \right) \qquad (3)$$

The accompanying nomograph solves this equation.

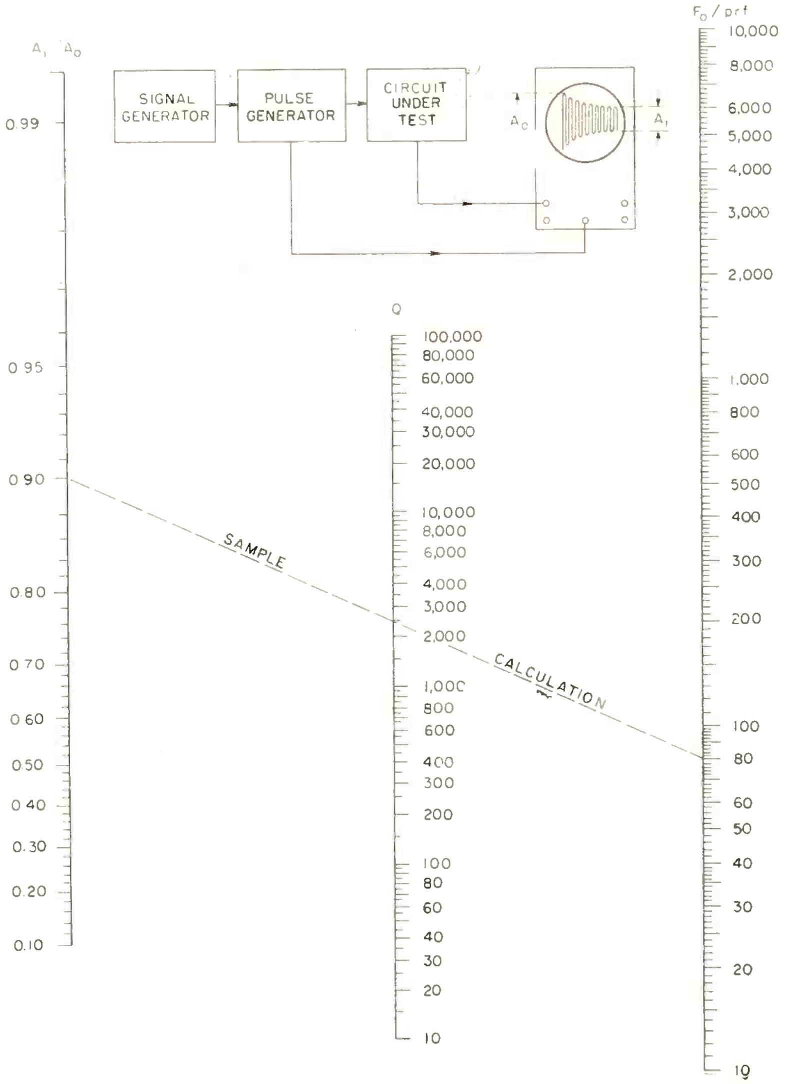
Sample Measurement

The laboratory equipments required to obtain the necessary data are a signal generator to set the prf, a pulse generator, and an oscilloscope to measure the train of damped oscillations.

The equipment is arranged so that the signal generator drives the pulse generator at the required prf. The pulse generator drives the circuit under test, and the oscilloscope reads the output of the circuit, as shown in the block diagram on the nomograph.

A high-Q circuit, resonant at 20 kc, was to be tested. The ratio A_1/A_0 was determined from the oscilloscope pattern to be 0.90. The prf was 250 cps, or f_0/prf = 80. A straight line drawn from A_1/A_0 = 0.90 to f_0/prf = 80 intersects the Q line at Q = 2,500. Verifying with Eq. 3,

$$Q = \left(- \frac{\pi}{\ln 0.90} \right) \left(80 \right) = 2,420$$



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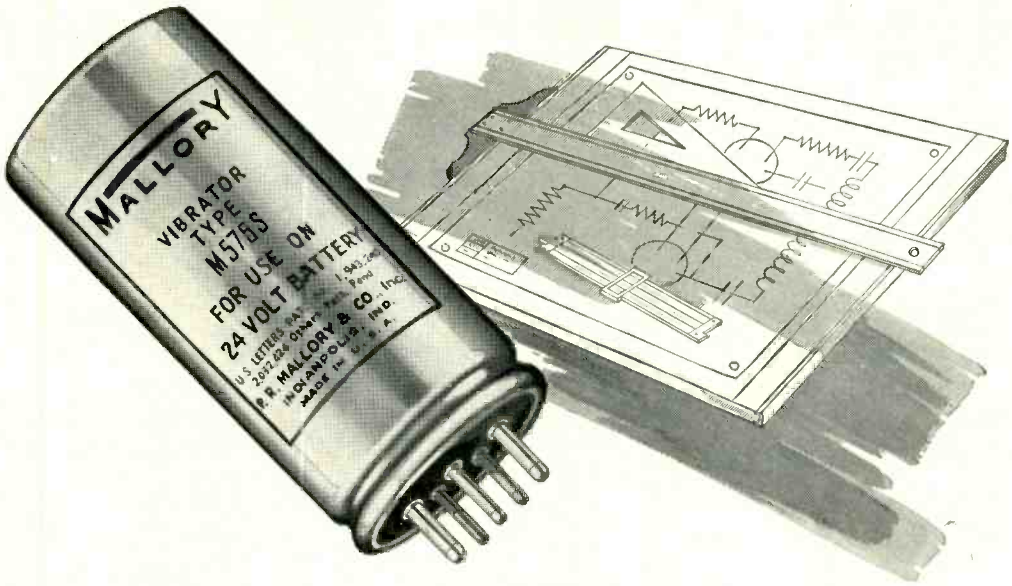

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ELECTRONS AT WORK

Including INDUSTRIAL CONTROL

Edited by RONALD K. JURGEN

OTHER DEPARTMENTS featured in this issue:

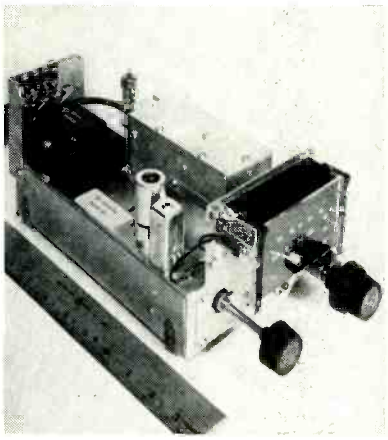
Experimental UHF Broadcast

BY ROBERT P. WAKEMAN
Head, Propagation Department
Allen B. Du Mont Laboratories, Inc.
Passaic, New Jersey

A STEP IN the determination of the efficacy of television as an educational tool was made on April 30, 1952. On this day, a complete set of programs designed for classroom use were originated at the State Teachers College, Montclair, New Jersey, relayed to New York City and broadcast over uhf Channel 54. These programs were received in the classrooms of 13 Montclair and Bloomfield schools.

From the point of view of a practical problem in uhf television, the technical aspects are of interest and will be reviewed here.

Figure 1 is a block diagram showing the equipment and transmission paths utilized. The Teachers College gymnasium served as a combined studio and master control room. The video equipment was a standard Du Mont dual orthicon camera chain.



Continuously tuned uhf converter used in the experiment

The composite video signal was fed over a 200-foot line to a 7,000-mc microwave transmitter, utilizing a 4-foot parabolic antenna located in a cupola atop the building. The 12-mile transmission path to 515 Madison Avenue in New York City is well above line of sight and a noise-free picture was received in New York. The demodulated signal was simultaneously fed to the tele-transcription unit and to the uhf transmitter.

The uhf transmitter has been described elsewhere.[1] The power output is of the order of 275 watts. The transmission line and sideband filter losses total approximately 0.2 db. The antenna consists of two slot waveguide antennas back to back, each having 20 half-wave slots along one flat side. This structure is mounted vertically and has a power gain in the vertical plane

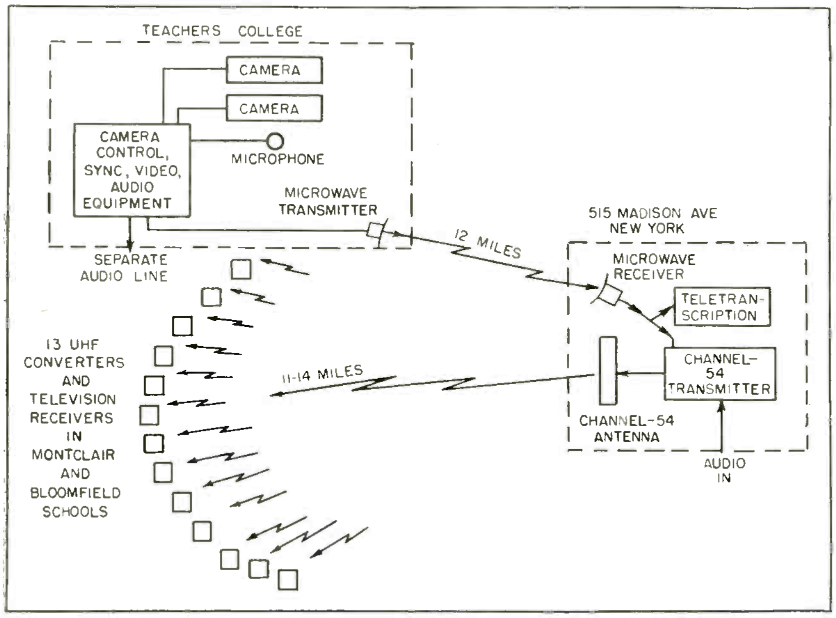
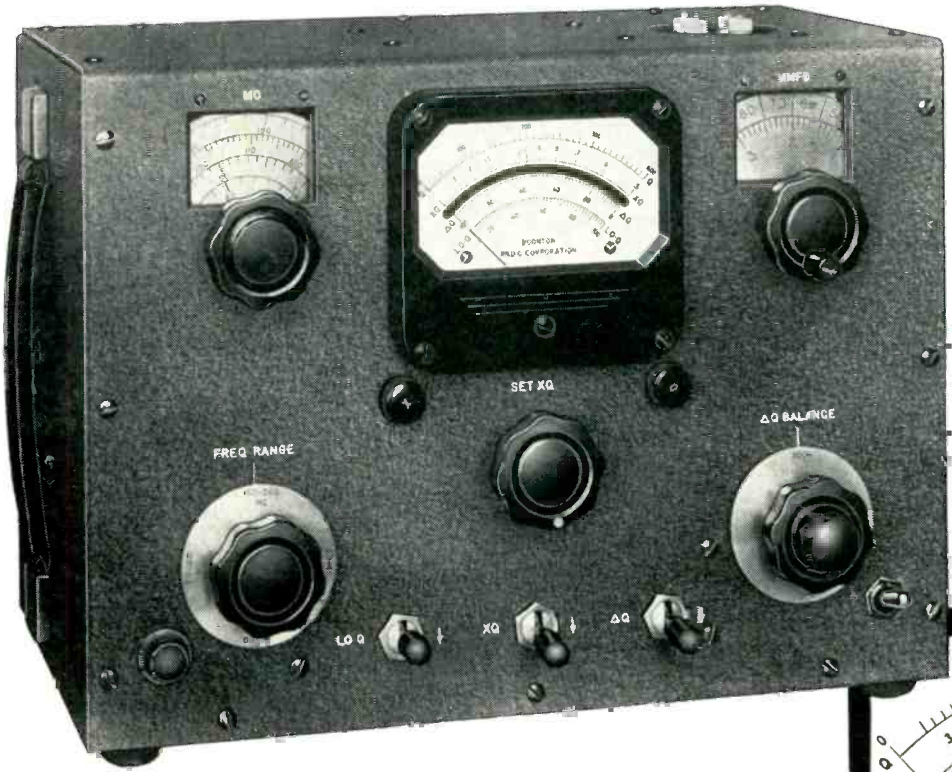
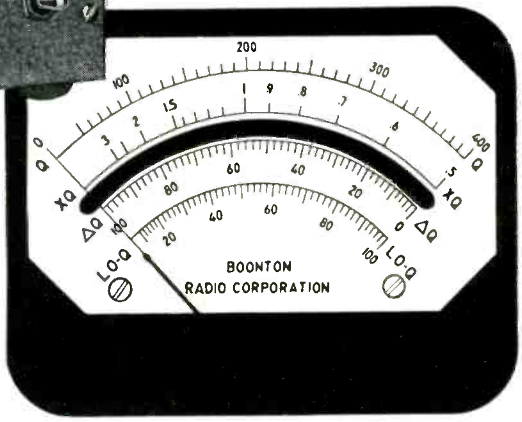


FIG. 1—Block diagram showing equipment used and transmission paths

Measure Difference In Q

with The Q METER Type 190-A





In Designing Tuned Circuits the effect on Q of adding capacitors, iron cores, or resistors must frequently be determined. The Q of the separate components is also often needed. These measurements made on Q Meters formerly available required the use of a small difference between two large Q values in various formulae. This led to large errors. The Q Meter Type 190-A reads the difference between the Q of a reference circuit and the Q of this circuit when new components are added. The scale that indicates this *Differential Q* has a sensitivity 4 times as great as the scale which reads *Q*. The accuracy and ease with which *Differential Q* can be read is greatly improved by use of the *190-A Q Meter*.

The Q Meter Type 190-A has a "Lo Q" scale which reads Q down to a value of 5. The internal resonating capacitor is directly read and has a vernier arrangement for accurate reading of capacitance. The dial rotates approximately 10 times in covering the capacitance range. All readings are made on a single meter corrected for parallax.

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FREQUENCY COVERAGE: 20 mc to 260 mc. Continuously Variable in Four Ranges.

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ACCURACY OF Q MEASUREMENTS: Circuit Q of 400 read directly on meter can be determined to accuracy of ± 5% to 100 mc and to ± 12% to 260 mc.

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ACCURACY OF RESONATING CAPACITOR: ± 0.2 mmf to 20 mmf
± 0.3 mmf to 50 mmf
± 0.5 mmf to 100 mmf

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of approximately 17 (12.3 db) over a dipole. The horizontal pattern is essentially omnidirectional with the exception of two small areas in the plane of the surface containing the slots where nulls appear.

The area covered in this experiment was well within the major lobe of the west element and effective radiated power in this direction was approximately 4.5 kw.

The uhf receivers used in this experiment were standard commercial vhf receivers with the addition of a continuously tuned uhf converter. Some trials were made using a uhf strip in place of one of the regular vhf strips. It was found that the noise figure of this arrangement was much too high in view of the relatively low transmitter power and the long receiving transmission lines. These lines varied from 50 to 200 feet and at 700 mc, with the cable available, represented a prohibitive loss. The noise figure of the uhf converter was much better and the converters could be placed in the antenna locations.

The ultimate receiver setup was as follows: A uhf 12-element broadside array antenna and reflector having a gain of 15 db was installed at a selected point on the school roof. A short length of RG-8/U (10 feet or less) connected the antenna and converter. The output of the converter (channel 6) was fed to the long RG-59/U tranmission line. This line terminated at the receiver in the classroom.

Drift Considerations

After an initial 15-minute warm up period, the drift of the converter was found to be negligible. Any slight residual drift during the day could readily be compensated by adjusting the fine tuning control on the vhf receiver.

Technically, this experiment confirms the feasibility of uhf television broadcasts over an area of near line-of-sight conditions. Three of the receiving antennas were actually below line of sight. Considerable effort was required to obtain satisfactory pictures but the pictures finally received were of excellent quality and entirely free of multipath effects.

Much of the difficulty encountered will be automatically eliminated when stations have an effective radiated power of 1,000 kw instead of the 4.5 kw used for this experiment. As the art advances, noise figures will almost certainly improve with the resulting effect being the same as a further increase in erp. There will always be fringe areas and it is anticipated that under these adverse conditions, home installations will present somewhat more of an engineering problem than is currently true of fringe area vhf installations.

REFERENCE

(1) Engineering Staff of Varian Associates. High-Power UHF-TV Klystron, ELECTRONICS, 24, p 117, Oct. 1951.

High-Voltage Power Supplies

INTERESTING DESIGN factors are illustrated in the circuits of two high-voltage power supplies developed by North American Philips Company, Inc., Mount Vernon, N. Y.

Figure 1 shows the first supply under discussion. This circuit was originally designed for the 3NP4 picture tube and has an output of 25 kv. Basically, the supply is an interrupted r-f oscillator with a rectifier-tripler combination. The r-f oscillator is pulsed by a blocking oscillator at 1,000 cycles.

Damped wave trains set up by the triggering action have a frequency of approximately 25 kc. These wave trains result from the shock excitation of a circuit containing a low-loss step-up transformer with a peak r-f output of about 8.5 kv. This peak output is tripled and rectified by three EY51 tubes which derive filament power from separate transformer winds.

Transformer Design

Functioning of the transformer was made possible by designing it with a Ferroxcube core and a molded enclosure of the same material. Regulation of the output was accomplished by coupling an additional winding to the high-voltage transformer. The rectified and filtered output of this winding controls bias on the driver tube which has the primary of the high-voltage transformer as its plate load.

Power input for the circuit consists of a 6.3-v heater supply and a 350-v d-c source with a capacity of approximately 55 ma. The character of the circuit permits variation of the 350-v supply to an extent without interfering with operation. This makes it possible to control

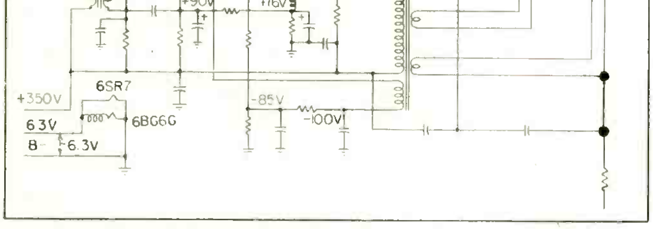

FIG. 1—Schematic diagram of the oil-immersed high-voltage supply

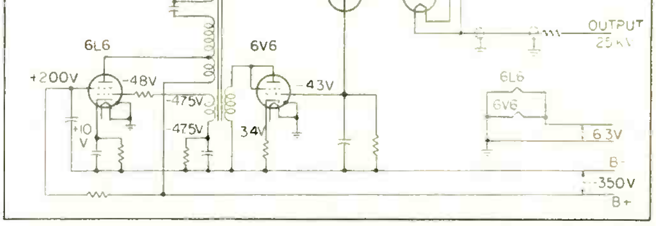

FIG. 2—Schematic of second supply free from an oil dielectric

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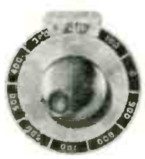

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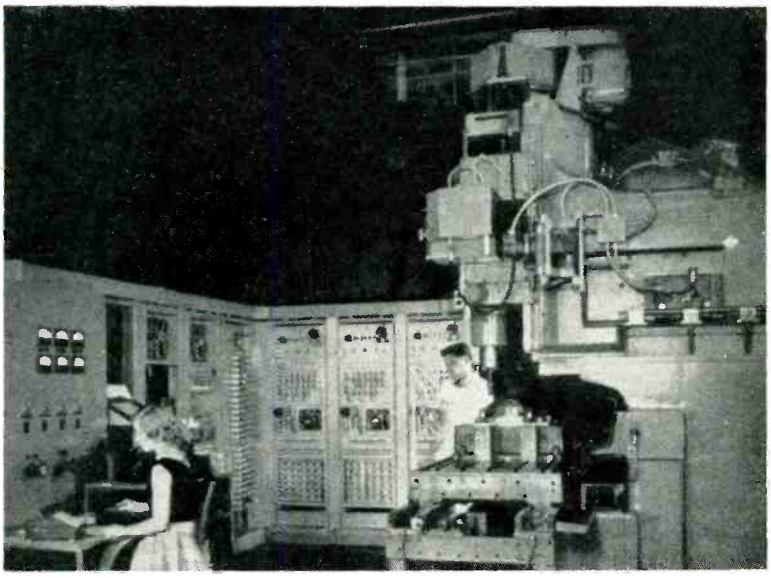


THE tube-controlled milling machine shown in the cover and accompanying photographs comprises a converted 28-inch Cincinnati Hydro-Tel and a director containing 250 electron tubes and 175 relays. The contouring equipment removed from the miller has been replaced by three servomechanisms that move the table, cross slide and spindle head.

The director consists of a data-input system that operates from the pattern of holes punched in a paper tape, a data-interpreting system and a set of three decoding servomechanisms. Directions punched into the tape are, therefore, converted into shaft rotations. Checking pulses are fed back from the rotating shafts.

The so-called numerical control technique used in this system is particularly attractive for machine-tool applications in that the numerical instructions may be of unlimited precision.

nominal output voltage for different applications. Normal output is approximately 25 kv with a capacity of 200 microamperes. Regulation is about 600 volts from no load to full load.

The output curve for the supply is such that voltage falls off rapidly after the maximum output current is reached. This was a deliberate part of the design to protect the tube and to afford some measure of safety to personnel. Output is obtained from a shielded high-voltage lead with a connector which incorporates a one-megohm resistor for additional protection.

All of the high-voltage circuits are housed in an oil-filled metal container. This includes the high-voltage transformer, the EY51 tubes and the filter capacitor. The metal container measures 3 by 3 by 3¾ in.

Although no field complaints were encountered due to presence of oil in the unit, it was considered objectionable by the Underwriters Laboratories, so a new design was developed.

New Supply

The second high-voltage unit is completely free from oil dielectric but, of necessity is somewhat larger. Electrical characteristics are practically the same as for the oil immersed unit since the device was designed primarily to supply anode voltage to the same tube.

The r-f oscillator in the new circuit, Fig. 2, is continuous in its operation at approximately 28 kc. The ferroxcube-core transformer was used again both to supply coupling from oscillator plate to grid and to step up the r-f output to a peak value of approximately 12.5 kv. This is then rectified and doubled to furnish approximately the same output as that obtained from the previous unit.

With regulation circuits working, potential varies about 600 volts between no load and full load of 200 microamperes. This is accomplished by means of a loss circuit in which a triode-connected 6V6GT is coupled to the r-f transformer.

Adjustment of coupling and plate current reduces no-load voltage to a desired value. Rectified output current flows through a resistor in the grid circuit of the regulator tube. As output current increases, bias on the regulator is increased until the tube cuts off at a desired value of load current. Above this value, the power-supply unit operates on an unregulated curve. Where very close regulation is required for a specific purpose, it is not difficult to choose tubes which make the curve flat from no load to full load.

All-Triode Electronic Switch

By CHARLES W. SPINDLER, JR.
Engineering Department
Leeds and Northrup Co.
Philadelphia, Pa.

IN THE COURSE of investigation of servo-systems, a need was felt for a simple low-gain electronic switch to allow the simultaneous observation of two signals. The following circuit has proved satisfactory for the purpose and may be refined by the addition of amplifier stages to extend its range of application.

The heart of the unit is a cathode-coupled gate circuit, Fig. 1, which uses a high-mu tube (V_{2A} and V_{2B}) as an amplifier, cathode-coupled to a high-g_M tube (V_{3A} and V_{3B}). If the grids of V_3 are R-C coupled to opposite plates of a free-running multivibrator (V_{1A} and V_{1B}) the two halves of V_3 will be alternately cut off and driven to a high level of current. As a result of this high level of current, the voltage on the common cathode resistors is more than enough to cut off the high-mu tubes.

When V_{3A} and V_{3B} are cut off by the multivibrator, the amplifiers operate as current-feedback circuits;

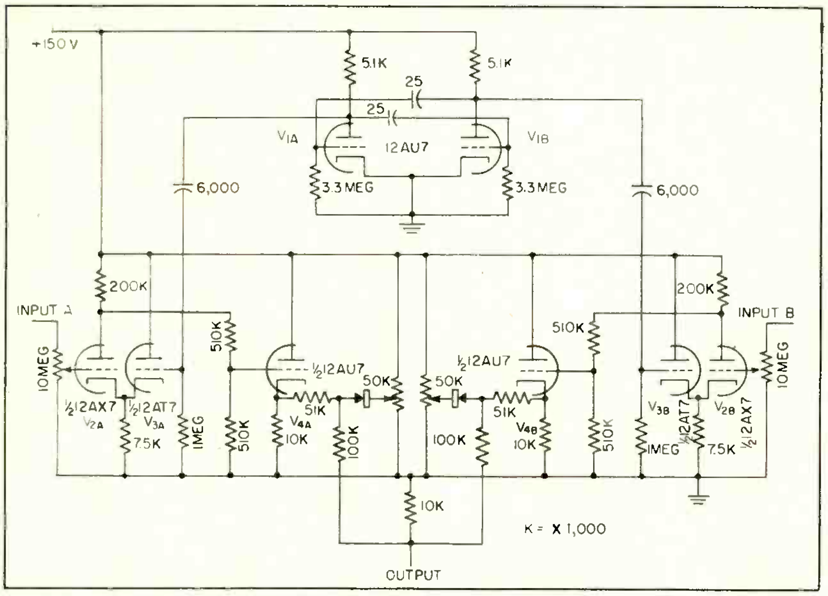


FIG. 1—Schematic diagram of the electronic switch

in this way, square waves are generated by the gate circuits. The level of the positive half cycle is determined by the plate supply voltage and is constant. The level of the negative half cycle is set by the grid-cathode voltage of the amplifier tube at that time.

Square waves generated by the two gating circuits are 180 deg out of phase and, if the amplitudes are made different, linear mixing will result in a square wave in which the level of the positive half cycle is fixed by the input to one gate and the negative by that on the other gate.

To achieve the decoupling necessary for mixing, outputs of the two gates are fed to cathode followers V_{4A} and V_{4B}. Signals from the cathode followers go to biased clippers in which the clipping levels are adjusted by potentiometers. Since the clippers remove only the positive portion of the waves, only the peak amplitude is affected and the variations on the negative part are undisturbed.

Passing the outputs of the clippers through a mixing circuit results in a square wave which, when applied to an oscilloscope, shows a reproduction of the input signals to the electronic gate unit. Spacing of the traces may be adjusted by varying the relative peak amplitudes of the individual gating-circuit outputs by using the potentiometers in the clipping circuits.

The unit, exclusive of power supply, was built on a 5 by 4 by 3-in. box and the output terminated in banana plugs. The unit is arranged so that it plugs directly into and is supported by the input terminals of the oscilloscope.

Speed-Sensing Relay

By John H. Porter
Office of Naval Inspector of Ordnance Rochester, New York

For a certain laboratory application, it was desired to develop a relay which would trigger an external circuit at certain predetermined speeds of a motor. The motor speed is sampled photoelectrically by light bands on the shaft and the resulting alternating voltage fed to a thyratron through an adjustable frequency sensitive network.

Negative d-c voltage developed by a rectifier in the output of this network, Fig. 1, is used as hold-off bias on the thyratron grid, so that when the combination of grid and fixed cathode bias voltages becomes a minimum, the tube will fire. An a-c anode supply is used for the thyratron in order that the grid may retain control of the tube.

Because of the difficulty in obtaining the same attenuation from a parallel-T network at all null frequencies, the network, Fig. 1, was designed to present a constant input impedance to the phototube at

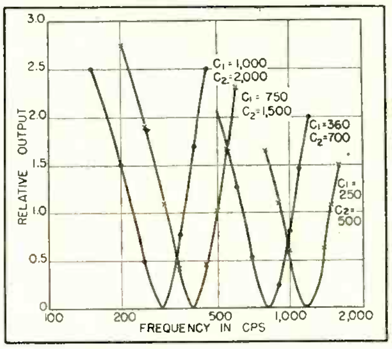


FIG. 2—Relative output vs frequency for different capacitor values. All C's are in $\mu\mu$f

all such frequencies considered. At balance

$f = 1/2\pi R_1 C_1$

and the usual design equations hold

$R_1 = 2R_2$
$C_2 = 2C_1$

If the network is terminated in a sufficiently high impedance, in this case 10 megohms shunted by a crystal rectifier, the input impedance can be approximated by

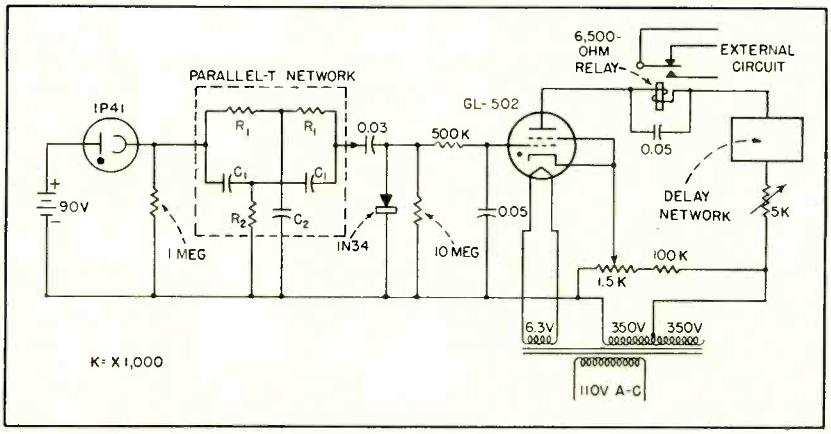
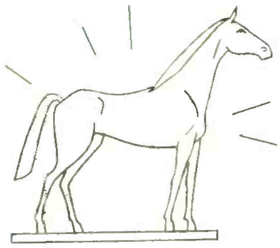


FIG. 1—Schematic diagram of the speed-sensing relay circuit



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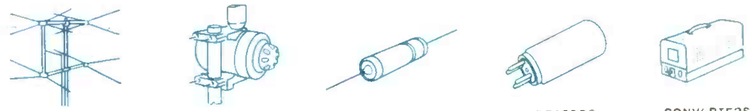

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Table I—Component Values vs. Frequencies

Freq. (cps)	R_1	R_2	C_1 ($\mu\mu$f)	C_2 ($\mu\mu$f)
260	669K	333K	900	1,800
400	669K	333K	600	1,200
600	669K	333K	400	800
900	669K	333K	265	530

$$Z_{in} = \frac{(R_2 + X_{C1})\,(R_1 + X_{C2})}{(R_2 + X_{C1}) + (R_1 + X_{C2})}$$

Making the proper substitutions from the balance equations

$$Z_{in} = \frac{3}{4} R_1$$

An input impedance of 500,000 ohms was chosen for this circuit, and Table I shows the values of R and C used for the various null frequencies to be encountered.

The network sensitivity with silver mica capacitors is such as to produce a d-c voltage of approximately 0.1 volt at a frequency 5 percent from any chosen null. Selectivity is shown on the curves of Fig. 2.

A slight amount of phase shift is obtained on the fixed cathode bias by the R-C grid network to increase the sensitivity of the grid to small changes in the negative d-c from the parallel-T. A delay network is shown in the anode circuit of the thyratron, Fig. 1, to keep the tube from firing at zero speed. This delay is initiated by the motor starting switch.

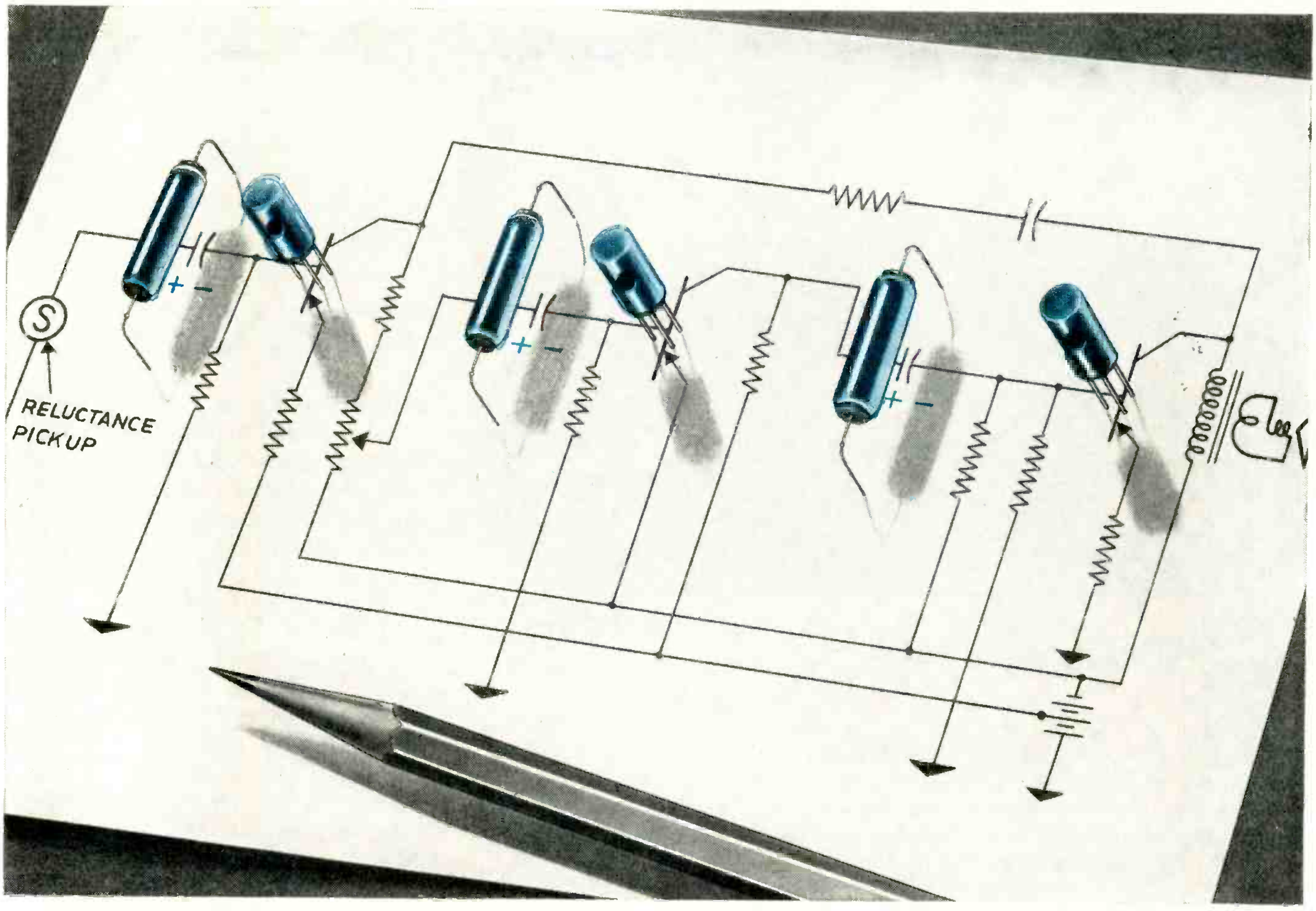
Design of Slug-Tuned Superheterodyne Receivers

By Philip S. Wessels

Electronics Engineer
Guided Missile Division
Consolidated Vultee Aircraft Corp.
San Diego, Calif.

Miniaturization of receiver components has made the iron-core tuning unit a necessity in the continuously tuned superheterodyne front end. Some developments in experimental technique that proved of considerable value are presented in this article.

In the absence of external influences, such as tickler coils and



TRANSISTORS . . . TANTALYTIC CAPACITORS

teamed in 100-milliwatt tubeless amplifier

General Electric engineers at Electronics Park, Syracuse, have developed a new tubeless audio amplifier circuit that utilizes three junction transistors and three Tantalytic capacitors.

Although still experimental, this 3-stage amplifier promises significant advances in miniaturized equipments. It has a power output of 100 milliwatts—less than 10% distortion—and a power gain of 70 db.

Tantalytic capacitors were a "natural" for interstage coupling in the circuit because of their small size, large capacitance and low leakage current. They match the transistors in ruggedness and long operating life. And they will operate over a wide temperature range (−55°C to +85°C with at least 65% capacitance at −55°C). Other features include light weight, long shelf life, and hermetic sealing.

If you have a capacitor application where you need small size and superior performance, it will pay you to investigate Tantalytic capacitors. They're available in polar and non-polar construction and in ratings from 175 muf at 5 VDC to 12 muf at 150 VDC. For additional information use the convenient coupon below.

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GENERAL ELECTRIC

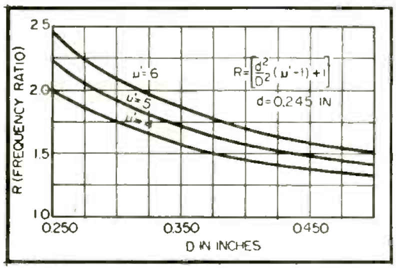


FIG. 1—Graph for predicting frequency ratios obtained by plotting right side of Eq. 1 in text versus coil diameter

antenna coupling circuits, two slug-tuned coils with their associated capacitors can be made to tune with a constant frequency difference within reasonable limits by a simple adjustment of their diameters to give the proper frequency ratio to each unit.

If the tuning range of the low-frequency unit is to be f_2 to f_1 giving a ratio of f_2/f_1, then the high-frequency unit will tune over the range of $f_2 + f$ to $f_1 + f$ giving a ratio of $(f_2 + f)/(f_1 + f)$ where f is the constant difference frequency, or i-f frequency, to be maintained.

It has been shown that the inductance ratio obtainable from a powdered-iron-core coil is given by

$$L_1/L_o = d^2/D^2\,(\mu' - 1) + 1 \qquad (1)$$

where L_o is the inductance without iron, μ' is effective permeability of iron, d is core diameter, $D = \frac{D_1 + D_2}{2}$, D_1 is outer diameter of winding and D_2 is inner diameter of winding.

When μ' is relatively large and d^2/D^2 does not differ greatly from unity, it is apparent that the in-

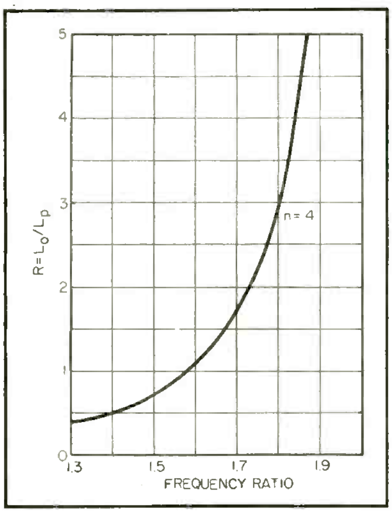
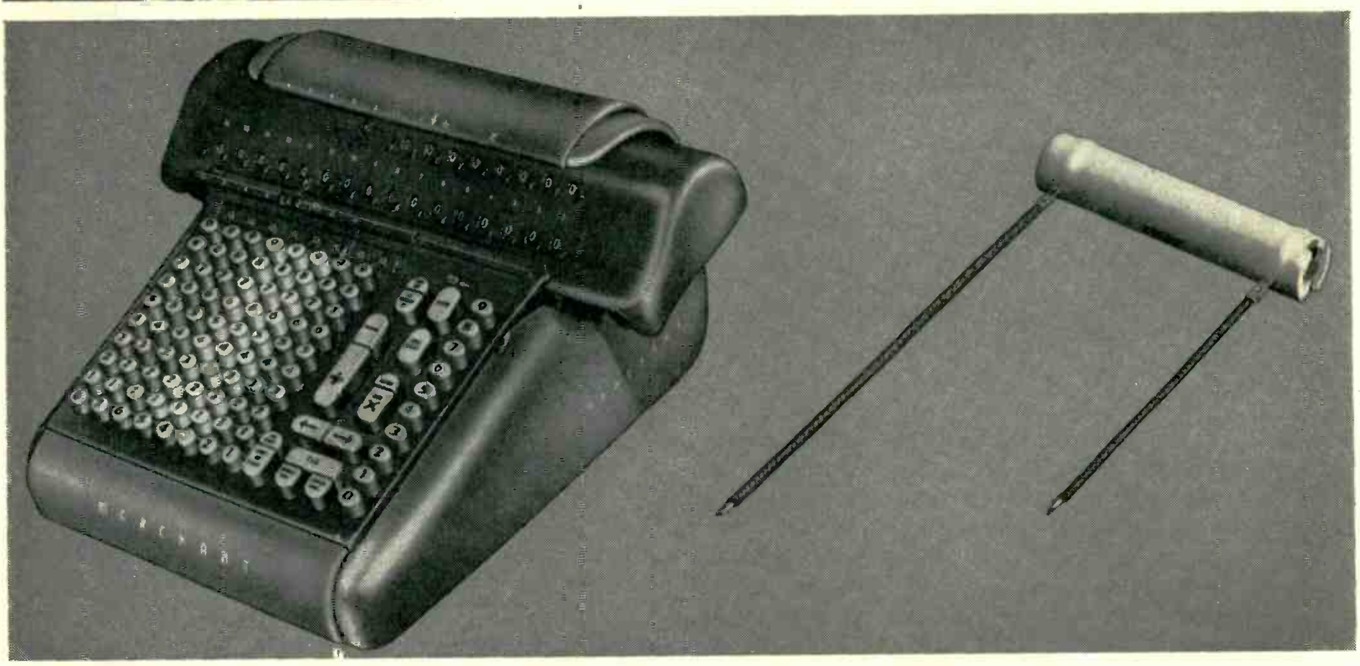


FIG. 2—Frequency ratio versus L_o/L_p

Marchant Calculating Machine Company

"They make no mistake in figuring resistor costs"

says L. F. Church, L. F. Church Company, San Francisco, representative for Ward Leonard Electric Company



It's *cost in terms of performance* that counts with the makers of Marchant calculators.

A lot of arithmetic would be delayed if resistors failed to work in these push-button multiplication calculators. That's why Marchant insists upon quality resistors, rather than taking a chance with bargains.

How do you *tell* a quality resistor?

It's true that most resistors look alike. A resistor is a simple piece of equipment—really nothing more than a piece of ceramic tubing . . . a couple of terminals . . . a piece of resistance wire . . . and a protective coating.

But there the similarity ends, because in the *important* things that really count, resistors are miles apart! And the biggest difference is that all of the resistor is actually *made* by the company that sells it.

The only way to be sure that all components will react the same to changes in temperature is to balance their thermal characteristics.

Take the tube. Companies like Marchant are depending on that high-density, non-porous, high-dielectric strength, perfectly cylindrical Ward Leonard ceramic core, with smooth surface and straight ends.

They also know the terminals are made of the right alloy to permit proper expansion . . . and that they're securely, rigidly, clamped to the core.

They know the wire is drawn especially for their type of resistor . . . is capable of withstanding great overloads . . . has uniformly low coefficient of resistivity. They also know the coating provides a complete hermetic seal, highly resistant to thermal shock and to high humidity, acids, alkalies, electrolysis.

You can be sure of quality, by buying your resistors from the *one* manufacturer who manufactures, not just assembles, all the components that go into resistors. Play it safe and sound—insist upon VITROHM resistors.

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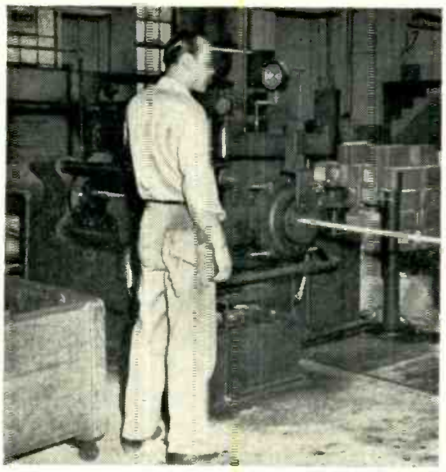

CERAMIC CORES are made by extruding refractory material from hydraulic presses such as this in Ward Leonard's plant.

RESISTANCE WIRE sample is being processed in the combustion furnace to insure accuracy of alloy formula.

VITREOUS ENAMEL for coating is fritted, then ground to exact fineness in these revolving "ball mills."

VITROHM vitreous enamel is measured by interferometer for coefficient of thermal expansion, melting and annealing points.

Uniform Quality—Matched Thermal Characteristics—Long Service Life of VITROHM Resistors—Result From Unified Manufacture

All components of a VITROHM resistor are made by Ward Leonard, the only manufacturer who *makes,* not just assembles, all parts.

Vitreous enamel coating and ceramic cores are formulated and made by Ward Leonard—wire is drawn to their specifications.

This means that all parts are uniform in quality, balanced in respect to thermal coefficient of expansion.

There's no loosening, no failure, due to unbalance of thermal characteristics, heat affects all parts the same way, which in turn means longer life.

VITROHM resistors will stay on the job under the most adverse operating conditions where a less carefully made resistor would break down. Thermal shock, vibration, corrosive atmosphere, overloads, even prolonged exposure to humidity and electrolysis will not affect their performance.

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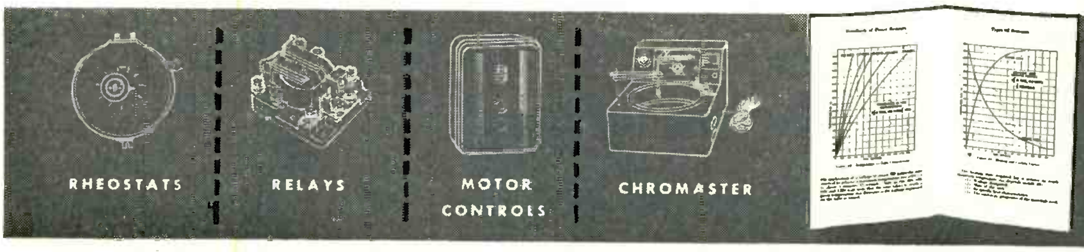

Ward Leonard's complete engineering textbook, "Handbook of Power Resistors," $3. per copy.

ductance ratio of Eq. 1 is approximately proportional to d^2/D^2, giving a frequency ratio of d/D, since f is proportional to $1/\sqrt{L}$. If the low-frequency unit, generally the r-f circuits, has a core-to-coil diameter ratio of

$$d/D = f_2/f_1 \qquad (2)$$

the high-frequency unit, or the local oscillator, will have a ratio of

$$d/D' = (f_2 + f)/(f_1 + f) \qquad (3)$$

where it is assumed that other dimensions and physical constants are the same for both units and D' is the diameter of the larger oscillator coil.

A graph such as shown in Fig. 1 is a convenient method of predicting frequency ratios and recording experimental data. The curves are theoretical and are obtained by plotting the square root of the right side of Eq. 1 versus the diameter of the coil.

Padding Inductance

Adjustment of tuning ratio may be accomplished also by the use of a series inductance that is not tuned by the main slug. If this external series inductance is variable, it will function in the same manner as the padder in the capacitor tuned case so that the antenna and oscillator coil can be identical. Its value is found as follows.

Assuming the main oscillator inductance has no magnetic coupling to the padding inductance, their combined inductance with the slug removed will be

$$L = L_o + L_p \qquad (4)$$

When the slug is inserted, the inductance of L_o will be increased by a factor $n = L_1/L_o$ as determined from Eq. 1. This gives a new total inductance of

$$L' = nL_o + L_p \qquad (5)$$

The ratio of L' to L will be propor-

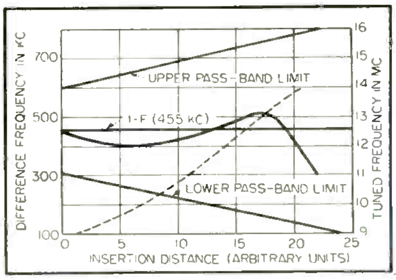

FIG. 3—Typical results obtained from Colpitts circuit

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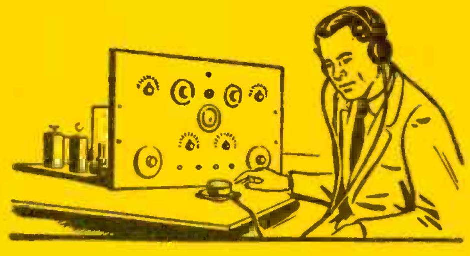

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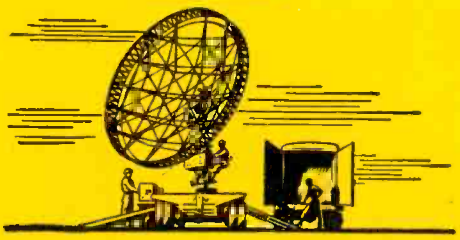

1952 Today, giant atom-smashing betatrons . . . radar gear spotting unseen targets . . . transoceanic radio-guided rocket bombs . . . world-wide radio communications . . . electronic computers reducing thousands of calculation man-hours to mere seconds . . . the modern miracle of television — for all facets of the Electronic Age, Aerovox capacitors are still engineered to customer specifications.

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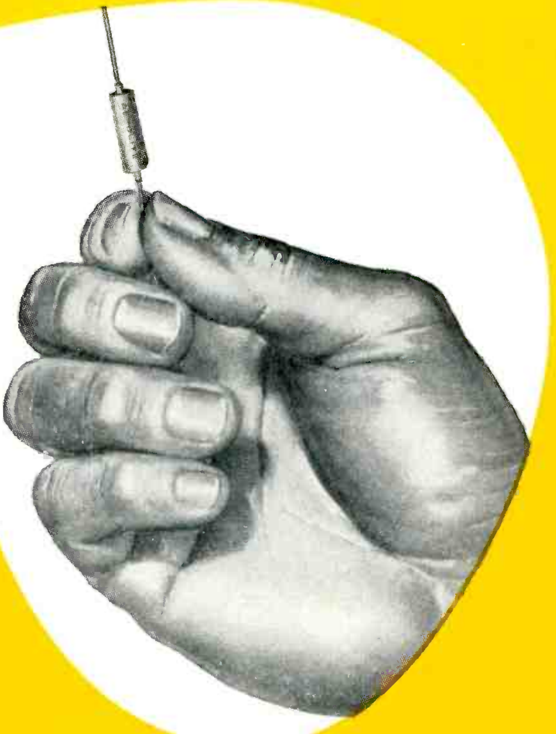

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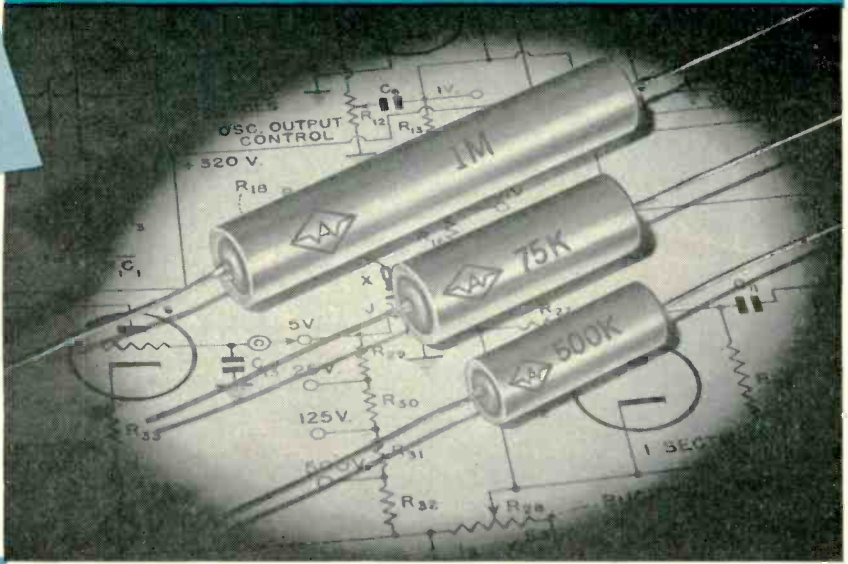

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1. **Hermetically sealed.** Metal case. Vitrified ceramic end seals, pigtail leads. Thoroughly protected – mechanically, electrically, climatically.
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3. **Voltage Coefficient** does not exceed .002% per volt.
4. **Overloads** up to 200% of rated voltage, without showing permanent change in resistance.
5. **Accuracy:** guaranteed tolerance of plus/minus 1% of 25°C. (77°F.).
6. **Aging Changes** negligible. Average change in resistance for self-aging, approximately 0.2% in a year.
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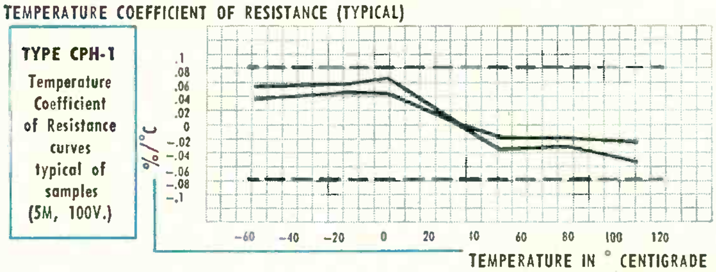

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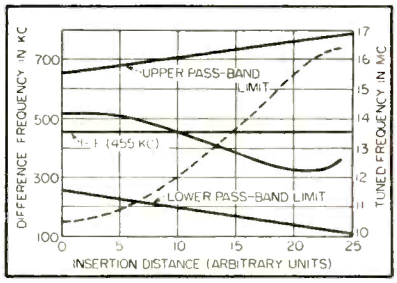


FIG. 4—Typical results obtained from tickler-type circuit

tional to the square root of the frequency ratio as determined by Eq. 3. If Eq. 5 is divided by Eq. 4 and the resulting equation is solved for L_p, there results

$$L_p = L_o\,(n - R)/(R - 1) \qquad (6)$$

where R is the ratio of L' to L, and L_p is the desired value of the padding inductance. Figure 2 is a plot of the square root of R, or frequency ratio, versus L_o/L_p for $n=4$. This construction provides a convenient means of calculating the value of L_p and will be used subsequently in choosing a value for the loop-antenna inductance.

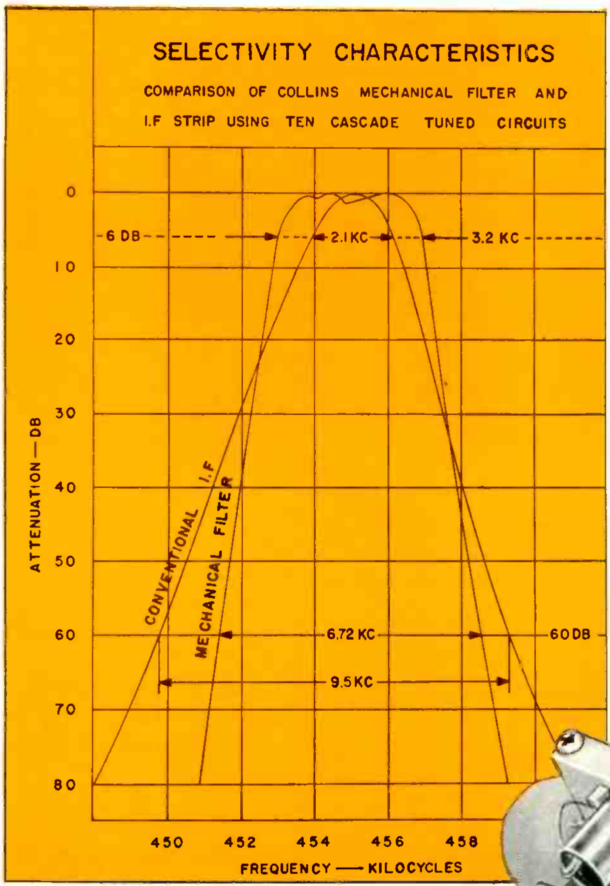
From a more rigorous point of view, an adjustment of tuning ratio as described does not result in what is considered an optimum error curve.[1] While the systems described have the necessary three degrees of freedom for three-point tracking, it was not of practical importance to consider anything but the tuning ratio.

An examination of Fig. 3 and 4 reveals that three-point tracking was approached in both cases. The two figures suggest that any change could have given only a slight improvement in gain. The degrees of freedom are diameter or padding inductance adjustment, capacitance adjustment and adjustment of the relative slug positions.

Available Band Coverage

In the design of a specific unit, reference can be made to a manufacturer's table of recommended frequency ranges and approximate permeability of iron cores. After a particular mix is chosen as recommended for a desired frequency range, the approximate permeability may be referred to Fig. 5 and 6 to determine the effective permeability in terms of the length to

The *NEW* Collins Mechanical Filter...



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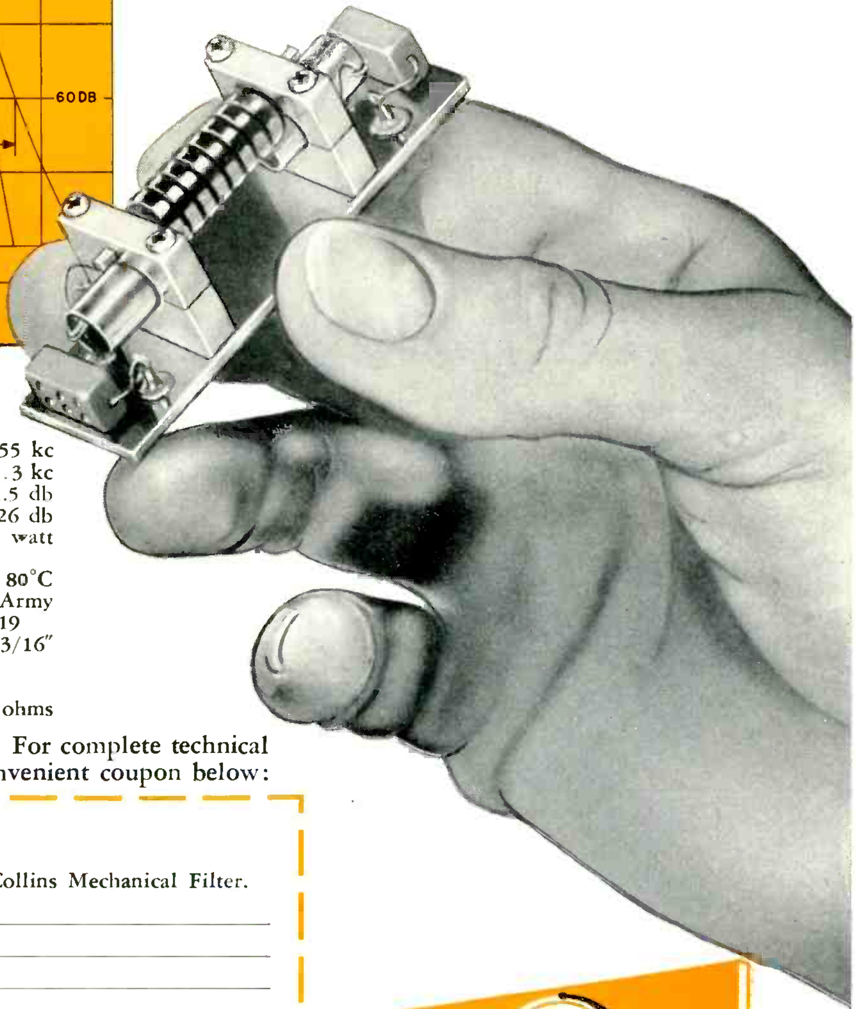

SPECIFICATIONS

Operating Frequency .... 455 kc
Nominal Band Width .... 3 kc
Peak to Valley Ratio .... 1.5 db
Insertion Loss .... 26 db
Overload Input Power Level .... .035 watt
Operating Temperature Range (without temperature compensation) .... 15°C to 80°C
Vibration .... Satisfies Requirements of Army Navy Specification AN-E-19
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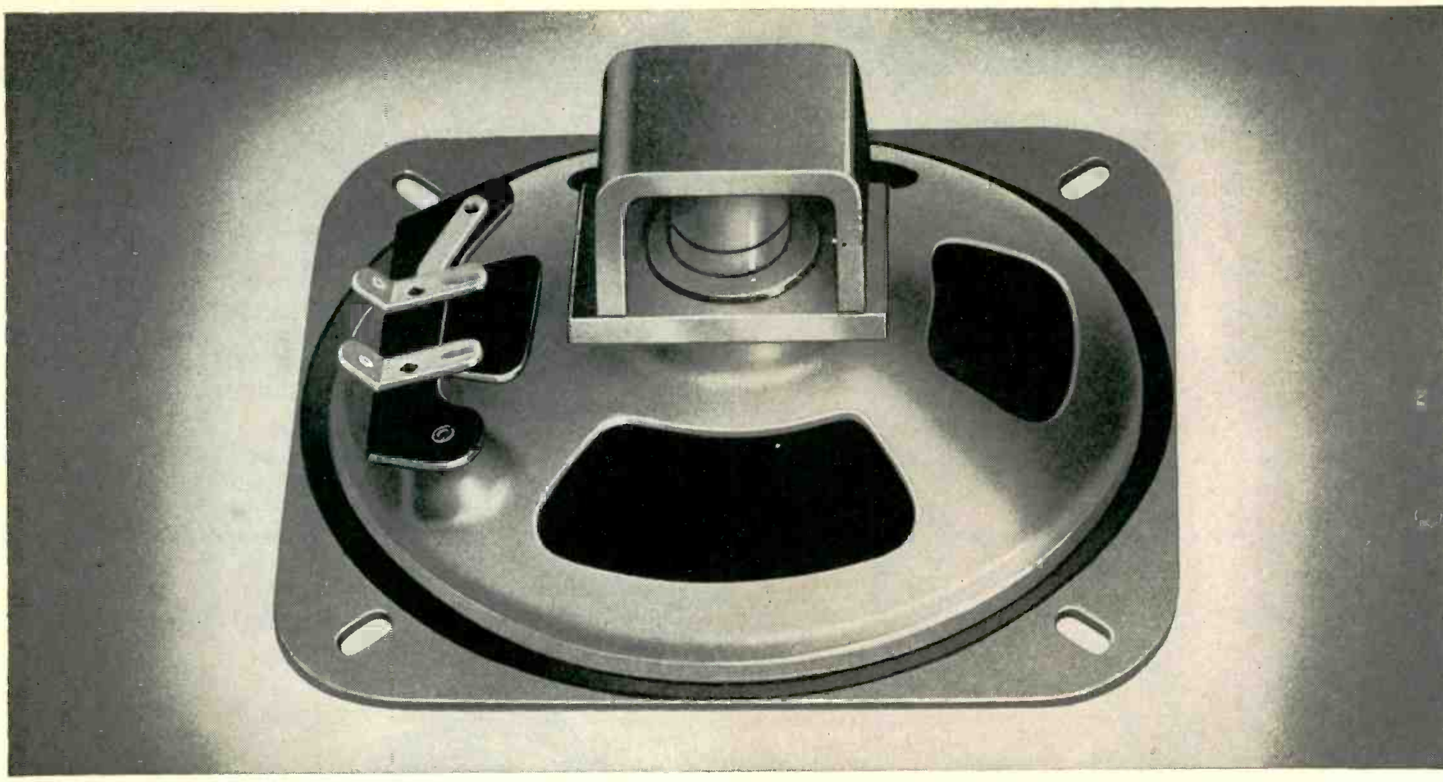

SPEAKERS—In radio and TV speakers, Carboloy Permanent Magnets replace larger electro magnets in the field structure. Current passing through *uniform* field of these high-energy magnets causes voice coil and cone to vibrate in proportion to voltage; *tone is truer!* Carboloy Permanent Magnets never fail; never need maintenance. Are also used in TV focusing assemblies.

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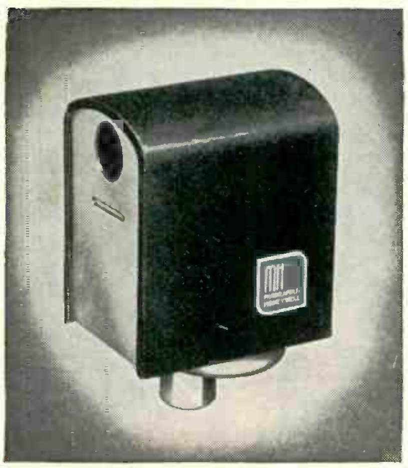

CONTROLS—Switches in compact Minneapolis-Honeywell controls use permanent magnets to give safer snap action, help quench arcs. The magnets are exceptionally stable; provide uniform high energy for the life of the control.

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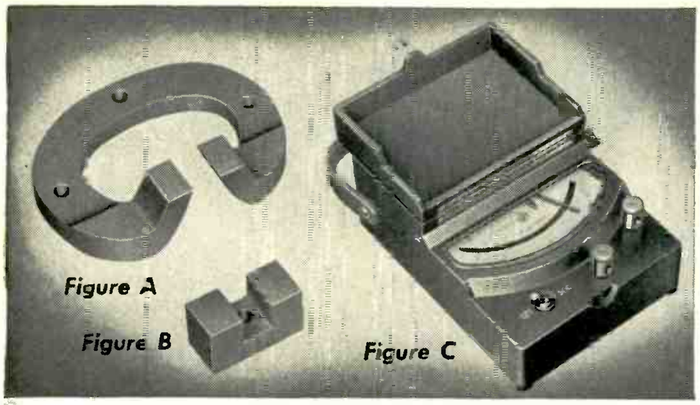
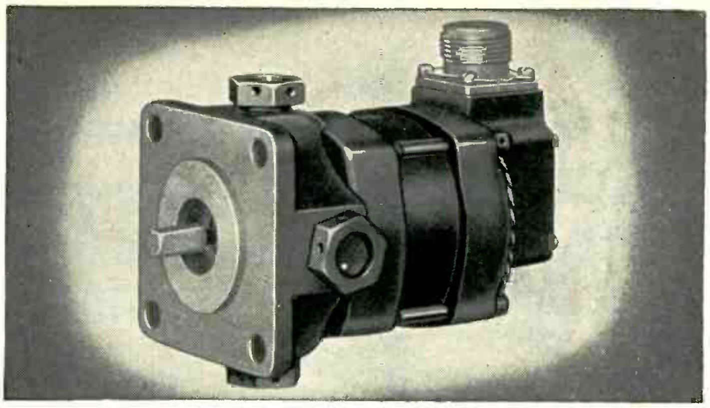
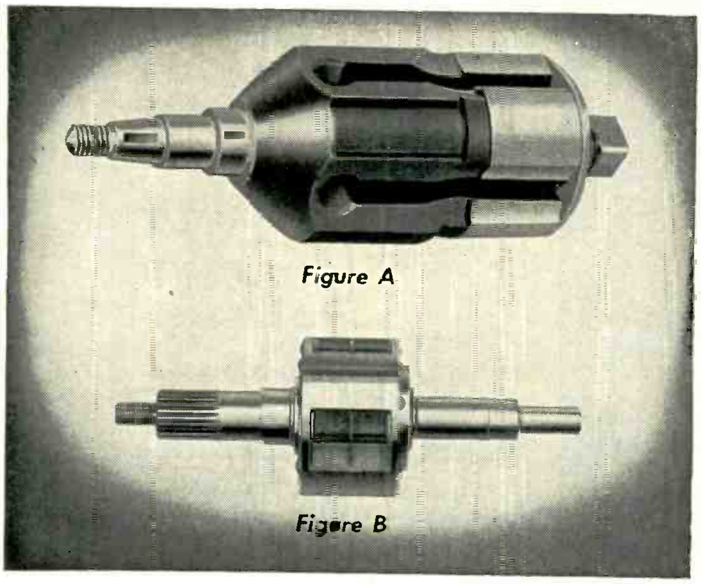


INSTRUMENTS—Fig. A is damping magnet once used in GE indicators. Fig. B is tiny Carboloy magnet now used. It permits smaller indicator design (Fig. C), cuts materials and assembling costs . . . speeds up calibrations.



GENERATORS—When GE engineers had only 6″ x 6″ area for jet's tachometer generator, they whipped design problem with a tiny permanent magnet. It eliminated coils and wires, supplied the powerful energy required.



MAGNETOS— To Scintilla Magneto Division, Bendix Aviation Corp., weight savings are vital in their aircraft products. Fig. A shows chrome rotor weighing approximately 4 lbs. 9 ozs. Fig. B shows newer model rotor using Carboloy Alnico. It weighs only 2 lbs. 4 ozs.

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diameter ratios or form factors. The approximate inductance range may then be determined by substituting this value of μ' into Eq. 1. The frequency ratio will then be approximately the square root of this value.

Since the interpolar distance of an iron core is less than its length, the core should be approximately 1.18 times longer than the coil when the winding consists of a few layers close to the core and greatest inductance ratio is desired. If the core length is different from this optimum value, the value of μ' should be altered according to the following relation:

$$\mu'' = \mu'(L/l)^{1/3} \qquad (7)$$

Where L is the length of the core, l is the length of the coil and μ'' is the corrected value of the effective permeability.

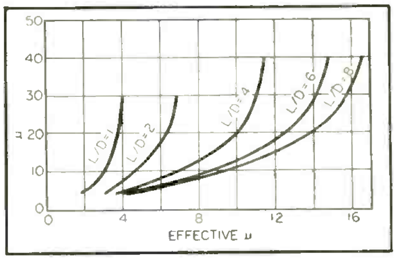

FIG. 5—Approximate permeability as a function of effective permeability for a range of L/D ratios

A procedure which facilitates checking these suggested solutions has been described in a previous article.[2]

Oscillator Circuits

The local oscillator in a permeability-tuned system can be of almost any type. Since the circuitry used required the use of a filament-type mixer tube, the Colpitts and tickler type of oscillators proved most suitable. When an interwound tickler is used, its grounded end should be at one end of the coil as opposed to locating the grounded end toward the coil center. When this precaution is not observed, serious deviations from what would be considered a normal insertion distance versus resonant-frequency curve are experienced. In general, it will still be necessary to correct for the distortion caused by the

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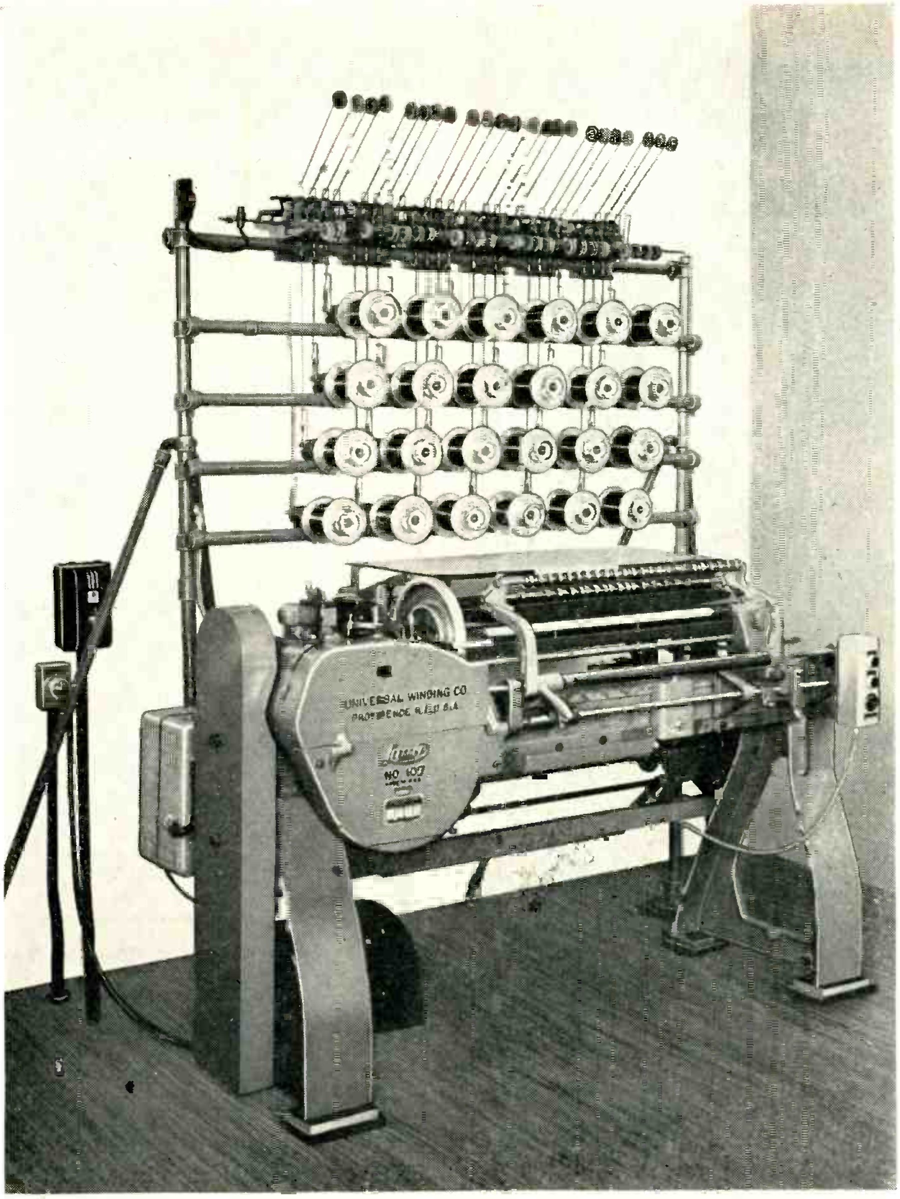


Automatic features

SPEED UP COIL WINDING

Assure accuracy and low cost

Leesona® No. 107 Coil Winder Offers Many Advantages

1. Automatic Delivery Shelf does it! New shelf feeds the paper inserts to the coils, exerting uniform tension on the paper as it is fed into the coil. This means tighter finished coil. Staggers overlaps to insure perfectly round or square coils. Delivery shelf automatically lengthens each insert as the coil diameter increases. This makes certain that the coils produced are within the maximum allowable outside diameter.

2. Automatic Electronic Speed Control. Slow, cushioned start . . . gradual speed build-up . . . constant high running speed for uniform wire tension and coil density.

3. Automatic Stop Motion — stops the machine whenever a spool runs out or a wire break occurs.

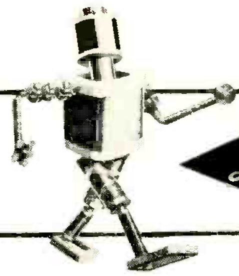
4. Automatic Counter stops the machine when the required number of turns have been reached.

Send for Bulletin 107 — get the details on this fully automatic Leesona® No. 107. It will show you how to get the exact electrical characteristics you want in either paper or acetate insulated coils, at the highest production rate, and lowest cost.

UNIVERSAL WINDING COMPANY

P. O. Box 1605, Providence 1, R. I.

Chicago office and Demonstration Room, 9 So. Clinton St., Chicago 6, Ill.



LEESONA®

For winding coils in quantity accurately . . . automatically use Universal Winding Machines presence of the tickler winding on the oscillator coil especially if a high degree of selectivity is employed.

The graphs of Fig. 3 and Fig. 4, respectively, give typical results obtained from the Colpitts and tickler-type circuits. It was found that one of these graphs could be constructed in about ten minutes using the procedure described. The points along the solid line are read along the left-hand ordinate and represent the signal generator reading when its beat note with the local oscillator rests on the peak of the response curve of the r-f amplifier.

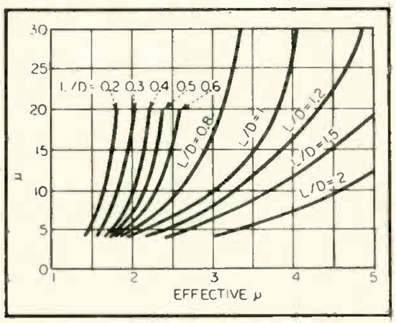


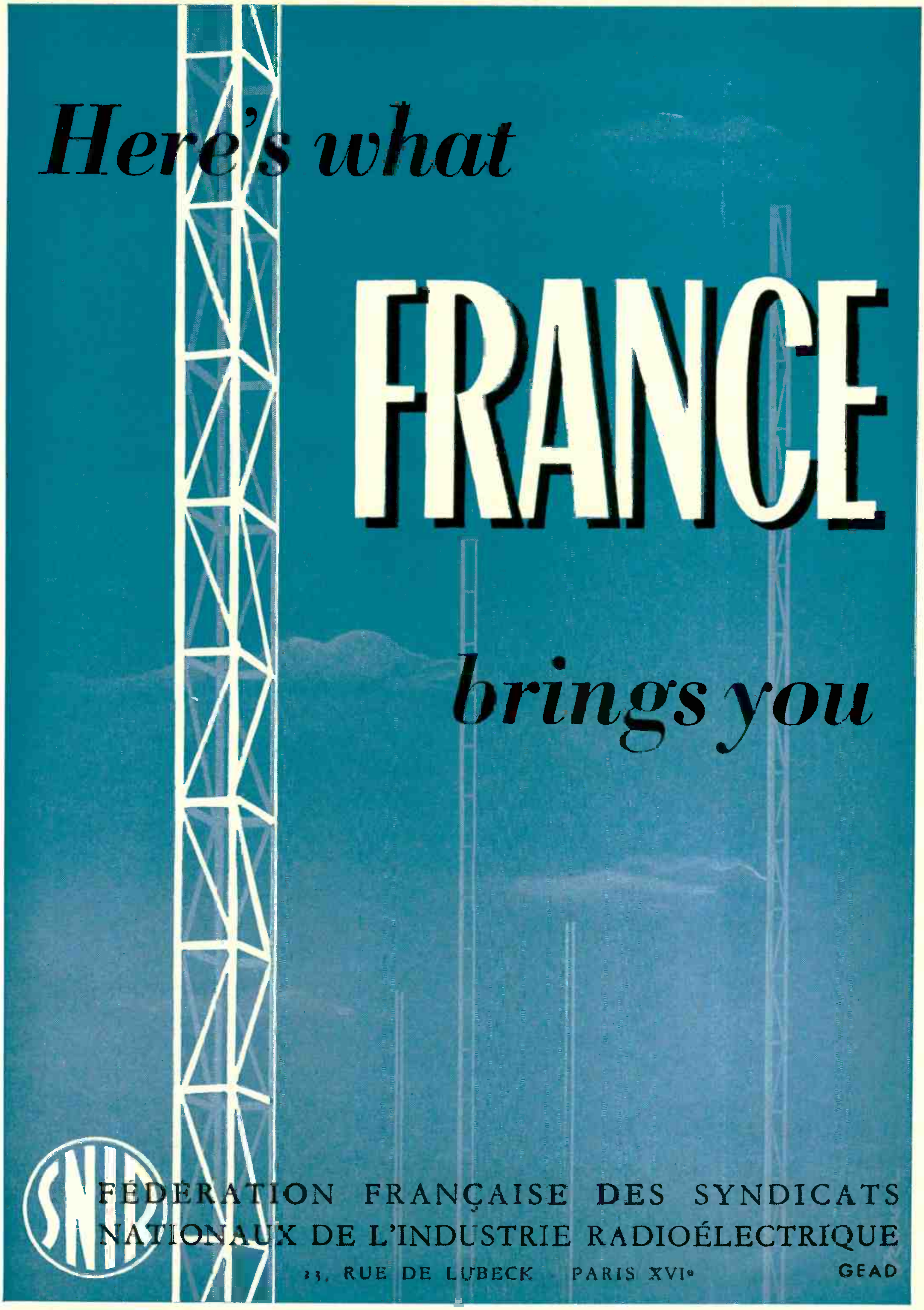
FIG. 6—Curves similar to those in Fig. 5 but for different L/D ratios

The horizontal straight line through the center of the graph is drawn at the i-f frequency as read along the left-hand ordinate. The distance between this line and the solid curved line represents tracking error as a function of insertion distance, which is plotted along the abcissa. The two lines diverging to the right represent the approximate passband of the antenna coil on the assumption that it has a Q of 25. Since the Q is not necessarily constant across the band, these lines would actually be curved but are for the sake of simplicity drawn here as straight lines. They represent minimum rather than true passband. The dash lines are read along the right-hand ordinate and represent the resonant frequency of the antenna coil as a function of insertion distance.

The author acknowledges the consideration of W. J. Polydoroff of the Stackpole Carbon Company.

References

(1) K. R. Sturley, "Radio De-
(*Continued on page* 202)


Here's what
FRANCE
brings you
SNIR
FÉDÉRATION FRANÇAISE DES SYNDICATS
NATIONAUX DE L'INDUSTRIE RADIOÉLECTRIQUE
23, RUE DE LUBECK PARIS XVI°
GEAD

sign," John Wiley & Sons, Inc., New York, p. 273.

(2) Philip S. Wessels, Visual Tracking of Superheterodyne Front Ends, ELECTRONICS, p 153, July 1952.

Ultrasonic Therapy Unit

By THOMAS A. DICKINSON
Los Angeles, Calif.

A PRODUCTION-TYPE unit for ultrasonic therapy is now being manufactured by The Birtcher Corporation of Los Angeles.

In essence, this unit comprises an electronic oscillator and crystal transducer. The transducer is installed in a chrome-plated brass gun so that its output vibrations can be utilized manually, like the output of an electrical scalp-massage vibrator.

The potentialities of ultrasonic therapy have been known to the medical profession in general since 1927, and ultrasonic therapy units have been commercially manufactured and used in Europe for at least ten years.

The therapeutical effectiveness of ultrasonic energy in alleviating tuberculosis, arthritis, ulcers and many other organic diseases is in many respects due to the ability of the human nervous system to conduct high-frequency vibrations. This process causes damaged portions of the body to resume their normal functions.

Compared with the ultrasonic generators that have been produced for therapeutical usage in Europe,

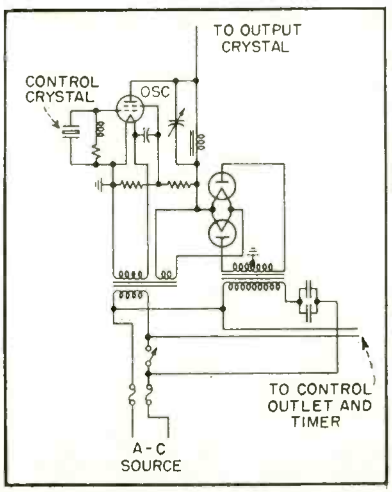


FIG. 1—Simplified schematic diagram of the therapy equipment

this unit is remarkably simple and inexpensive. It can be powered by means of a plug-in attachment on any alternating power circuit, and its ultrasonic output can be regulated accurately for values of 0.14 to 3½ watts per square centimeter at a constant frequency of one megacycle.

The basic electronic power circuit, Fig. 1, includes a high-voltage transformer, filament transformer, a pair of half-wave rectifier tubes and an oscillator. The output of the oscillator is conveyed to a quartz crystal in the aforementioned gun by means of a coaxial cable and may be limited to periods of 1 to 30 minutes by means of a mechanical timer.

Aside from the timer, only two manual knobs are used in operating

Quartz crystal being inspected prior to installation in output gun

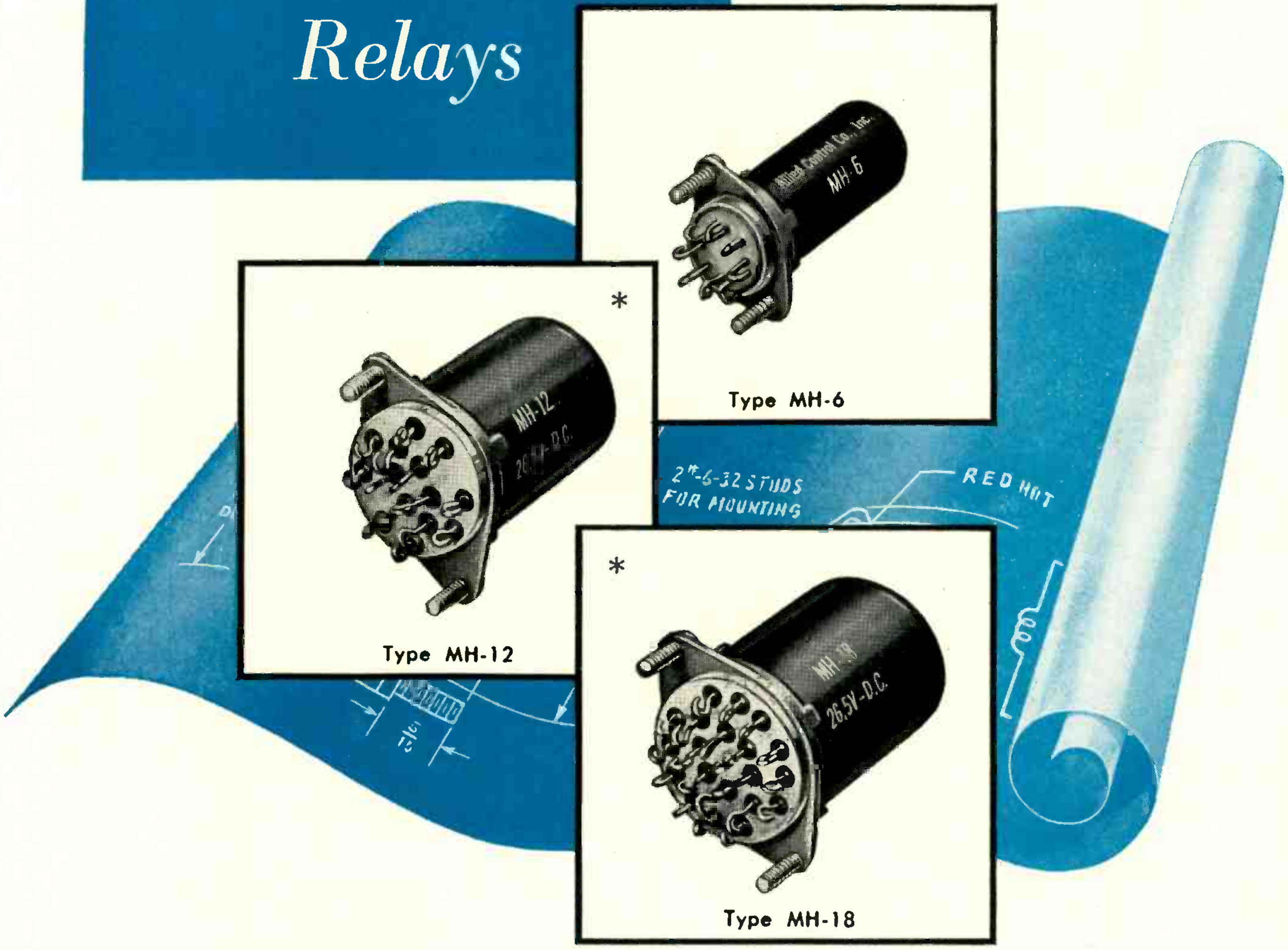
the unit. Of these, a primary control knob actuates filament and plate switches as required while an output control knob determines the amount of ultrasonic power that will be produced.

A pair of signal lights on the instrument panel glow when the filament and plate circuits are properly energized, while a milliammeter indicates the actual output of oscillating current at all times.

The normal method of using the ultrasonic gun consists of smearing vaseline or a similar substance over the skin area to be treated, so that there will be no air space between the gun and the skin. The vibrating head of the gun is then rotated gently over the grease-coated skin;

ALLIED'S NEW 50 G *Sub-Miniature Relays*

*
Approved by U.S.A.F.
Spec. MIL-R-5757A



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 MH-6 (2-pole). • 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.

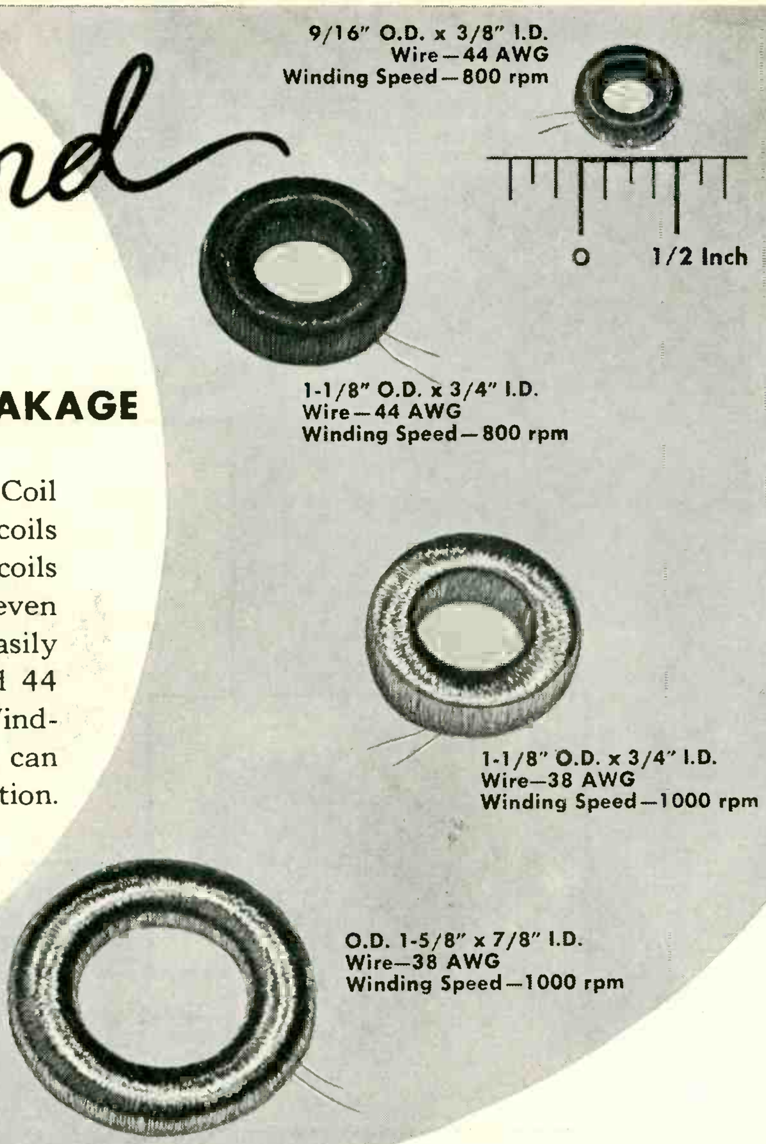
For detailed specifications and drawings of these new relays, write for Bulletin 1002

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

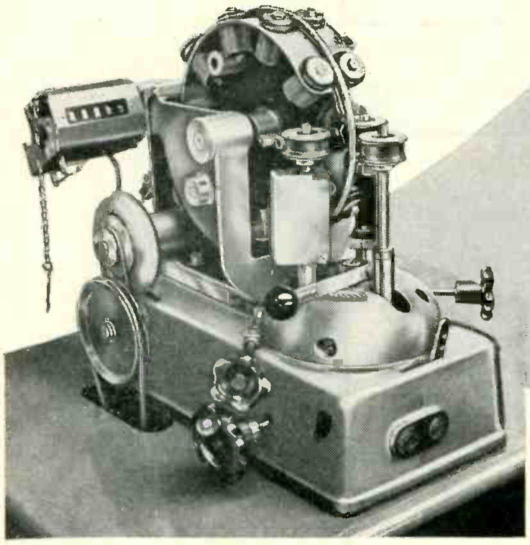
AL 149

EVENLY *Wind*

SMALL TOROIDAL COILS AT HIGH SPEEDS WITH MINIMUM WIRE BREAKAGE



The MICAFIL Model RW-0 Toroidal Coil Winder automatically winds toroidal coils continuously around 360° and sector coils from 30° to 270°. To produce smooth, even layers of wire, the winder is adjusted easily to wind any wire size between 26 and 44 AWG and to obtain the proper pitch. Winding direction can be changed and feeds can be adjusted while machine is in operation.



CAPACITY

Coil Sizes	
Minimum finished I.D.	¼"
Maximum finished O.D.	2"
Minimum finished O.D.	½"
Wire Sizes	26 to 44 AWG
Winding Speed—according to wire size	up to 1000 rpm
Shuttle Capacity—according to wire size	60 to 800 feet

MICAFIL Toroidal Coil Winders are made in three larger sizes for winding coils up to 8" O.D. and with 10 AWG Wire.

SPIRALING DEVICE—Device winds spirals for shuttle loads—in advance . . . Newly developed to permit continuous operation of Coil Winder . . . Winds to predetermined lengths.

SHUTTLES—Made in four different ring diameters to accommodate range of spiraled wire sizes . . . Larger wire capacities . . . *More than one coil can be wound with single loading* . . . Changed within 30 seconds . . . Loaded in less than a minute.

ACCURATE TURNS COUNTER—Preset for required number of turns . . . Automatically stops winder when turn count is reached.

Let Cosa Engineers study and recommend the winder for your needs. Or, write for Literature.

COSA CORPORATION
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Your source for all Precision Machine Tools—from Small Bench Lathes to Large Boring Mills

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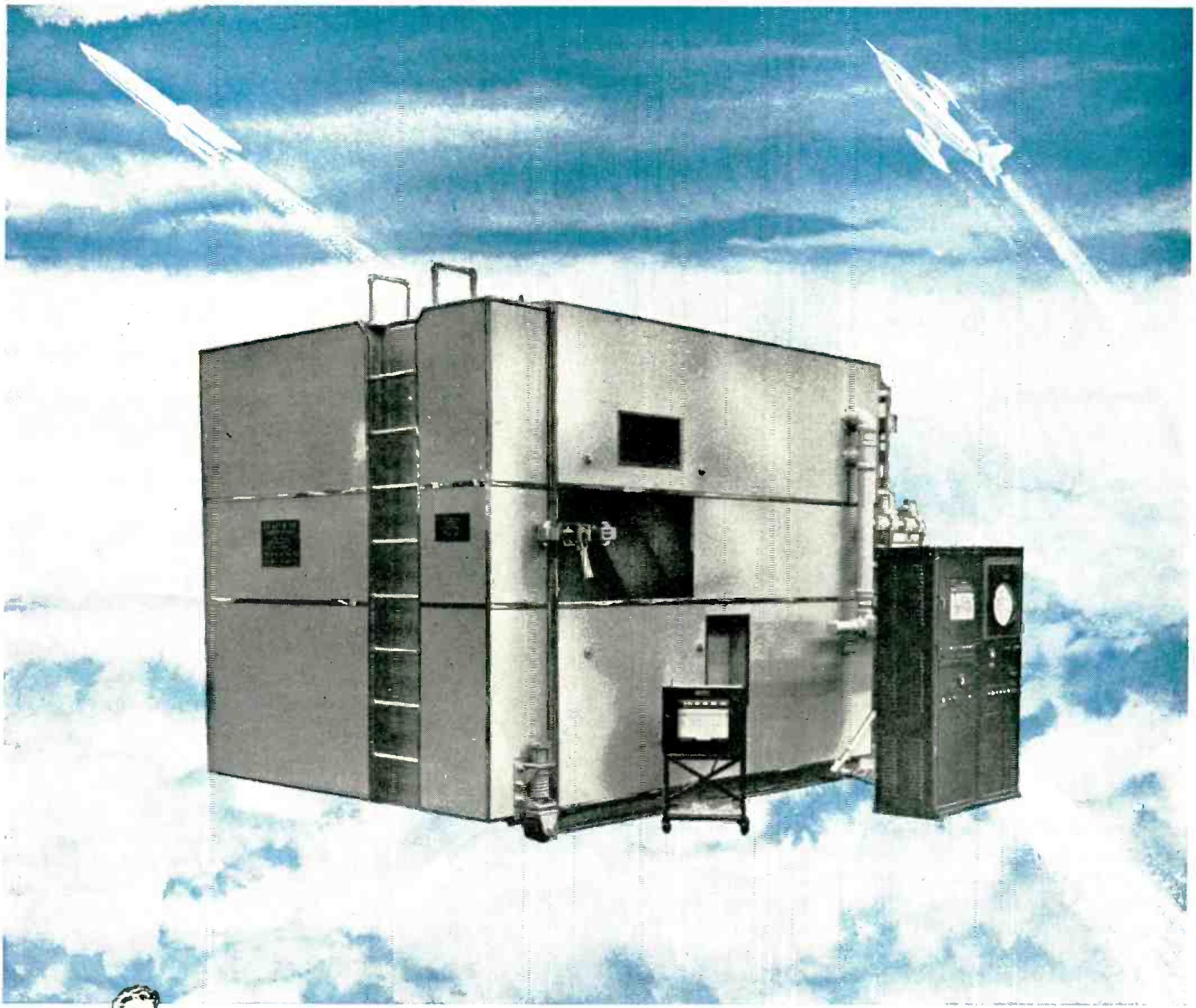

cabin in the SKY?

Not quite . . . but this "cabin" duplicates the conditions of pressure, temperature and humidity found from sea level to 100,000 feet *plus* with a temperature range of —100 to +200°F. It is Consolidated Vultee's new high altitude test chamber . . . designed, developed and produced by Merritt & Zaleski. This complete environmental duplication facility enables test engineers at Convair's Fort Worth plant to predetermine the effects of environmental conditions on aircraft parts and assemblies in accordance with JAN and MIL specs. The importance of its contribution to avionic design, development and production is beyond calculation.

This is but one of the many Merritt & Zaleski test chambers serving industry today. Both stock and custom-built models are available with virtually limitless ranges . . . low and high temperature, humidity, pressure and complete environmental duplication. Discover, without obligation, how Merritt & Zaleski can solve your particular testing problem. *Write, in detail, for an analysis and specific proposal.*

MERRITT & ZALESKI INC. ATMOSPHERE UNLIMITED

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massaging action is necessary to prevent cavitational effects which might cause pain.

In some circumstances, vibrations are applied directly over damaged areas of the body. In most cases, best results have been attained by ultrasonically massaging the spinal column near the base of the neck.

Definitions for Color Tv

THE FOLLOWING are approved working definitions for color television, submitted by Panel 19 to the N.T.S.C. at the meeting of June 23, 1952.

BLACK-AND-WHITE

Deprecated (see Monochrome)

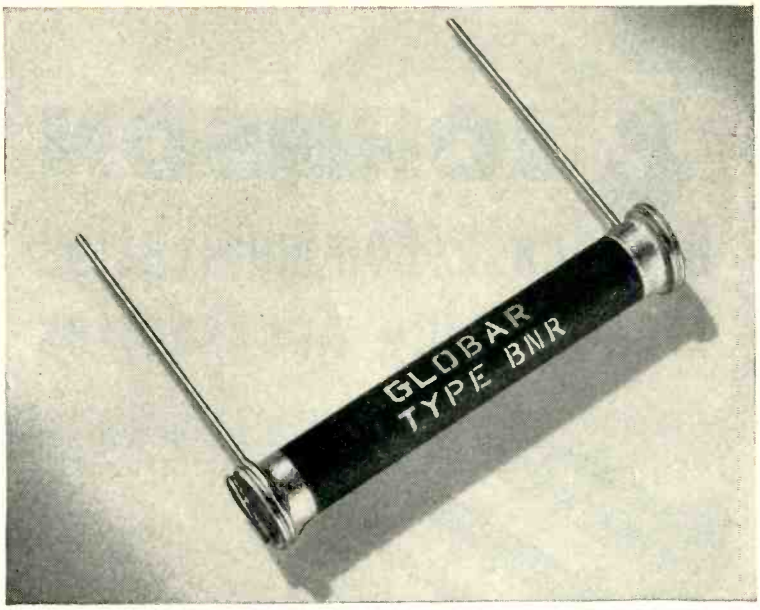
BRIGHTNESS

The attribute of visual perception in accordance with which an area appears to emit more or less light.

Note: Luminance is recommended for the photometric quantity which has been called brightness. Luminance is a purely photometric quantity. Use of this name permits brightness to be used entirely with reference to the sensory response. The photometric quantity has been confused often with the sensation merely because of the use of one name for two distinct ideas. Brightness will continue to be used properly in nonquantitative statements, especially with reference to sensations and perceptions of light. Thus, it is correct to refer to a brightness match, even in the field of a photometer, because the sensations are matched, and only by inference are the photometric quantities (luminances) equal. Likewise, a photometer in which such matches are made will continue to be called an equality-of-brightness photometer.

A photoelectric instrument calibrated in foot-lamberts should not be called a brightness meter. If correctly calibrated, it is a luminance meter. A troublesome paradox is eliminated by the proposed distinction of nomenclature. The luminance of a surface may be doubled, yet it will be permissible to say that the brightness is not doubled, since the sensation which is called

Minimize Effects of varying supply voltage the simple way

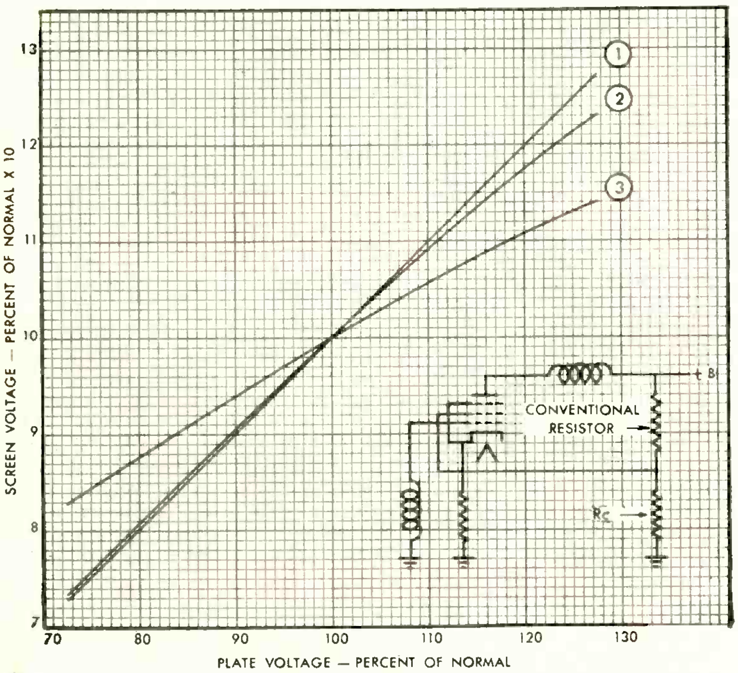


Performance of Various Voltage Reducers for Pentode Screen Supply

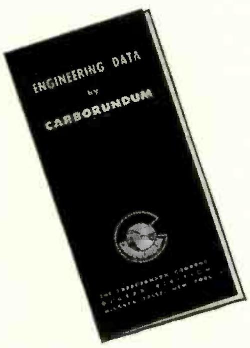
1 Divider with conventional composition Resistor at R_c.

2 Plain series dropping Resistor (R_c omitted).

3 Divider with GLOBAR type BNR Resistor at R_c.



● Variation in supply voltage which impairs pentode amplifier performance is especially serious in cathode ray tube applications where the effect on sweep amplifier output is visible. This is where the voltage sensitive characteristics of GLOBAR type BNR resistors prove extremely valuable. Employed in a voltage divider as shown here, they help to stabilize gain of amplifiers against supply voltage variations. Often, they reduce screen voltage variations by as much as *one half.*



● WRITE to Dept. E 87-121 for a copy of Bulletin GR-2 which contains useful engineering data on GLOBAR type BNR resistors.

GLOBAR

TRADE MARK

TYPE BNR

VOLTAGE SENSITIVE

Ceramic Resistors

by **CARBORUNDUM**

Engineered today for your needs tomorrow!

MYCALEX

PRECISION-MOLDED MYCALEX 410 ®

TRANSISTOR SOCKETS

—now in the pilot production stage
—engineered in advance of actual need

In keeping with the MYCALEX policy of progressive design in advance of needs, these Transistor Sockets were engineered months ago and are now in small scale pilot production. They'll be available in quantity in advance of actual needs.

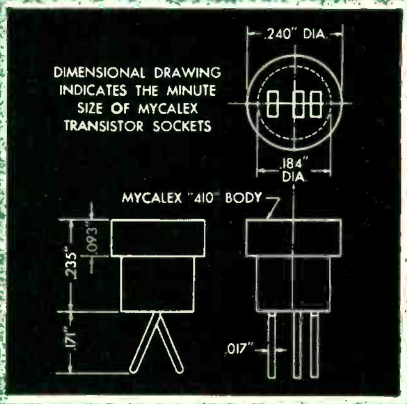
Achievement in

PRECISION MOLDING!

The production of Mycalex Transistor Sockets is a real accomplishment of precision molding in miniature. The holes for the leads are the smallest ever molded. All tolerances are exceedingly close. Mycalex production engineers are proud of their achievement . . . particularly because low-cost, mass production techniques can be adhered to.

The body is precision-molded of MYCALEX 410, glass-bonded mica insulation for lasting dimensional stability, low dielectric loss, immunity to high temperature and humidity exposure combined with maximum mechanical strength. The loss factor is only 0.014 at 1 MC and dielectric strength is 400 volts/mil.

Contacts can be supplied in brass or beryllium copper. The sockets are readily solderable. The socket bodies will not warp or crack when subjected to high soldering temperatures. They function in ambient temperatures up to 700° F.



Mycalex Low-loss Tube Sockets and Multiple Headers

A complete line of tube sockets including sub-miniature types is available in Mycalex 410 and Mycalex 410X glass-bonded mica insulation. Comparative in cost to ordinary phenolic sockets they are far superior in every respect. Dimensional accuracy is unexcelled. For complete information on standard and custom Tube Sockets or Multiple Headers, call, wire or write . . . there is no obligation, of course.

MYCALEX TUBE SOCKET CORPORATION
Under Exclusive License of Mycalex Corporation of America
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SINCE 1919 MYCALEX THE INSULATOR ®

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brightness is generally judged to be not doubled.

BRIGHTNESS CHANNEL

Deprecated (see Monochrome Channel, Luminance Channel)

BRIGHTNESS SIGNAL

See Monochrome Signal

BURST PEDESTAL
(Color-Burst Pedestal)

The rectangular pulse-like component which may be part of the color burst. The amplitude of the color-burst pedestal is measured from the a-c axis of the sine-wave portion to the horizontal pedestal.

BYPASS MIXED HIGHS

The mixed-highs signal that is shunted around the color-subcarrier modulator or demodulator.

BYPASS MONOCHROME SIGNAL

A monochrome signal that is shunted around the color-subcarrier modulator or demodulator.

CAMERA SPECTRAL CHARACTERISTIC

The sensitivity of each of the camera color separation channels with respect to wavelength.

Note: It is necessary to state the camera terminals at which the characteristics apply.

Because of nonlinearity, the spectral characteristics of some kinds of cameras depend upon the magnitude of radiance used in their measurement.

Nonlinearizing and matrixing operations may be performed within the camera.

CAMERA TAKING CHARACTERISTICS

Deprecated (see Camera Spectral Characteristic)

CARRIER COLOR SIGNAL

The sidebands of the modulated color subcarrier (plus the color subcarrier, if not suppressed) which are added to the monochrome signal to convey color information.

CHROMINANCE

The colorimetric difference between any color and a reference color of equal luminance, the reference color having a specified chromaticity.

Note: In N.T.S.C. transmission, the specified chromaticity is the

Sangamo's dry tubular electrolytic capacitor

that fits anywhere

Type MT and MTD electrolytic capacitors, "Chieftains" of the Sangamo line, are built to provide longer life, greater dependability, and better electrical characteristics in television and other electronic applications. Their small physical size makes them a "natural" for application in tight spots beneath a chassis, and the bare tinned-copper wire leads make them easy to mount.

Sangamo "Chieftains" are contained in hermetically-sealed round aluminum cans and are tightly encased in heavy cardboard sleeves on which polarity is clearly indicated. Double, pure paper spacers assure adequate breakdown characteristics and all sections are tightly held in place within the container. Multiple staking connects the terminal tabs to the electrodes, providing permanent low resistance contact throughout the life of the capacitor. The low voltage units are supplied with etched cathodes to maintain uniform capacity when the capacitor is subjected to heat and high ripple currents.

"Chieftains" are manufactured under controlled conditions of almost surgical cleanliness, utilizing the very finest materials and production procedures available in the industry, for your assurance of quality in every respect.

Your own trial-use will convince you that new standards of dependability and longevity have been built into Sangamo Electrolytics. Order from the new Sangamo Capacitor Catalog No. 800A which is yours for the asking, and without obligation.

Those who know ... *choose Sangamo*

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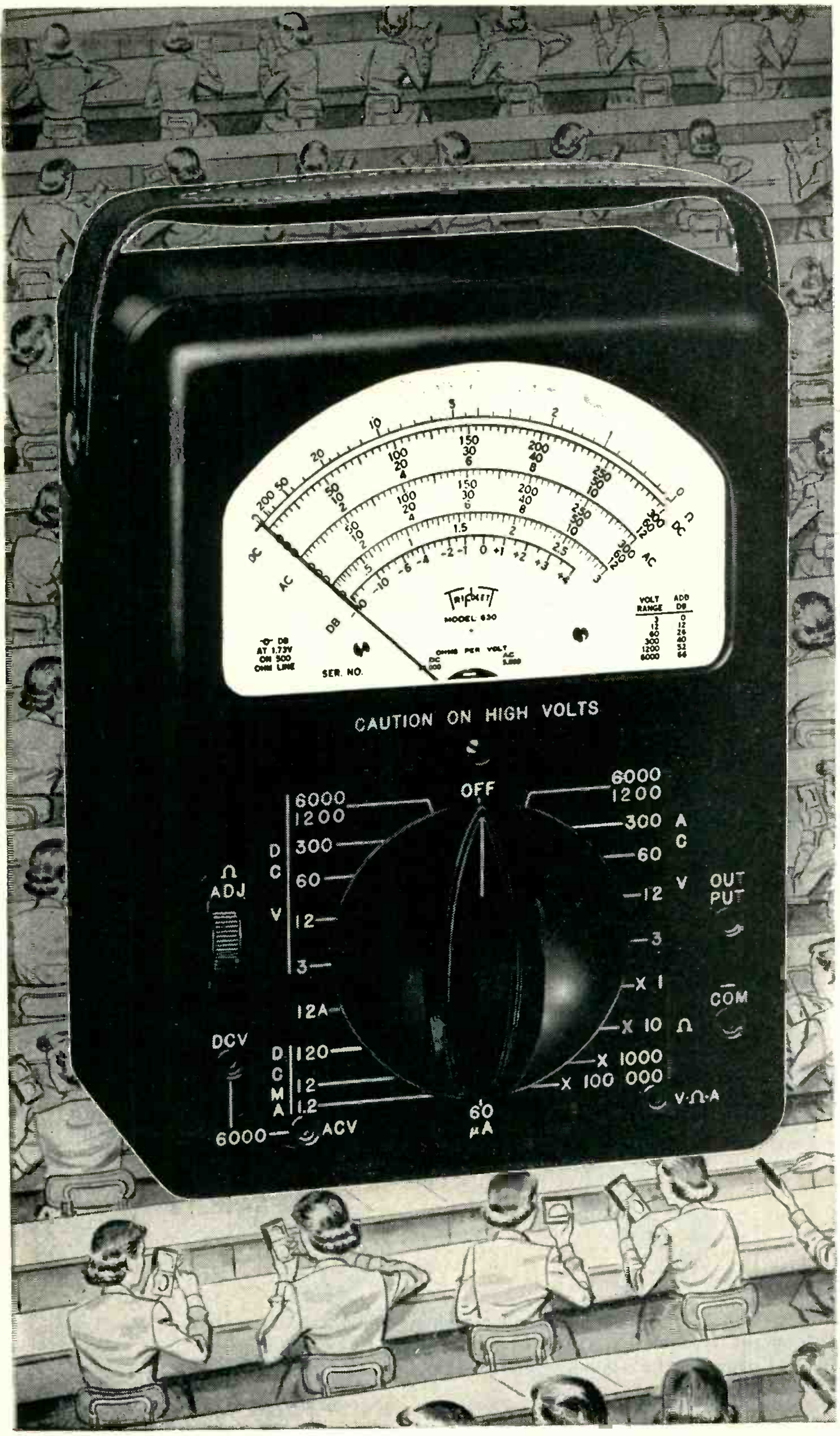

Your dollar buys more "instrument" ...in our Model #630

Volt-Ohm-Mil-Ammeter

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PRESIDENT

Because we build every major part of our instruments the quality is carefully controlled. For example, we know we have more torque driving our pointers because we designed and built the complete instrument. We know we have sustained dependence in the shafts and switch contacts of our test equipment for the same reason. Cycle tests for switches exceed several times the rigid requirements of the armed forces.

There is another important value to you. Because we make our own components we eliminate the profit another manufacturer would make in selling them to us. And this "profit" is passed on to you.

Consider these features of Model 630 V.O.M., for example—

One Hand Operation—One switch with large recessed knob has a single position setting for each reading. Leaves one hand free. Eliminates switching errors, trouble, saves time.

Ranges—AC-DC Volts: 3-12-60-300-1200-6000 (AC, 5000 Ohms/Volt; DC, 20,000 Ohms/Volt). 60 Micro-Amps. 1.2, 12, & 120 Mil Amps. DB scales at 1.73V on 500 Ohm line, 0-66 DB output.

Highest Ohm Reading—To 100 Meg. in steps of 1000-10.000-100,000 Ohms—100 Megohms.

Yes, with us it's a matter of personal pride to make "Triplett" stand for better construction and more service for your test equipment dollar.

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PRESIDENT
TRIPLETT ELECTRICAL INSTRUMENT CO.
Bluffton, Ohio

TRIPLETT 630 V.O.M.
only $39.50

For service, accuracy, highest dependability, buy **Triplett**

zero subcarrier chromaticity.

CHROMINANCE CHANNEL

In a color-television system, any path which is intended to carry the carrier color signal.

COLOR BURST

That portion of the composite color signal comprising the few sine-wave cycles of color subcarrier frequency (and the color burst pedestal, if present) which is added to the horizontal pedestal for synchronizing the color-carrier reference.

COLOR CARRIER

See Color Subcarrier

COLOR-CARRIER REFERENCE

A continuous signal having the same frequency as the color subcarrier and having fixed phase with respect to the color burst. This signal is used for the purposes of modulation at the transmitter and demodulation at the receiver.

COLOR COORDINATE TRANSFORMATION

Computation of the tristimulus values of colors in terms of one set of primaries from the tristimulus values of the same colors in another set of primaries.

Note: This computation may be performed electrically in a color television system.

COLOR DIFFERENCE SIGNAL

An electrical signal which when added to the monochrome signal produces a signal representative of one of the tristimulus values (with respect to a stated set of primaries) of the transmitted color.

COLOR EDGING

Spurious color at the boundaries of differently colored areas in the picture.

Note: Color edging includes color fringing, misregistration, etc.

COLOR PHASE
(of a given subcarrier component)

The phase, with respect to the color-carrier reference, of that component of the carrier color signal which transmits a particular color signal.

COLOR PHASE ALTERNATION (CPA)

The periodic changing of the color phase of one or more compo-

Series AJ Helipot models are only ¾" in diameter and 1⅜" long; weight 1.0 oz. Ten-turn 18" slide wire gives adjustment accuracy of 1/3000 in a 100-ohm unit—1/6500 in a 50,000-ohm unit.

Helipot achieves "HIGHEST PRECISION" with DRIVER-HARRIS RESISTANCE WIRE

Cutaway view of Model A 10-turn Helipot precision helical potentiometer. Resistance element 45" long is contained in case 2" x 1-13/16" diameter. On element are wound 3000 to 9800 turns of resistance wire, depending on total resistance value required. Adjustment accuracy is 12 to 14 times that of conventional single-turn potentiometer of equal diameter.

To win consumer preference and assure customer satisfaction, Helipot Corporation is guided by a basic policy that has proved as effective as it is simple. It is: (1) to produce components of the highest precision, and (2) to realize the economies inherent in mass production.

By following these objectives, Helipot has become the world's largest maker of precision potentiometers, producing the widest selection of single-turn and multi-turn units available anywhere.

States Helipot: "Our policy of mass producing the highest precision potentiometers practicable, in order to deliver top quality at moderate cost, is reflected in the fact that standard linearity accuracy of all our stock models, selling competitively, is held to $\pm 0.5\%$. Our reliance on Driver-Harris alloys such as Nichrome V, Advance, and Karma to provide resistance windings for many of our products constitutes a strong endorsement of Driver-Harris skills and reliability."

Driver-Harris takes particular pride in having played so important a role in the Helipot story, and is fully conscious of the responsibility the confidence of this famous manufacturer imposes.

Nichrome*, Advance*, and Karma* are at your service, too; as are more than 80 other alloys developed exclusively by Driver-Harris for application in the electrical and electronic fields. We feel confident that, like Helipot, you will realize outstanding advantages by putting one or more of them to work for you. Let us have your specifications. We'll be glad to make recommendations based on your specific requirements.

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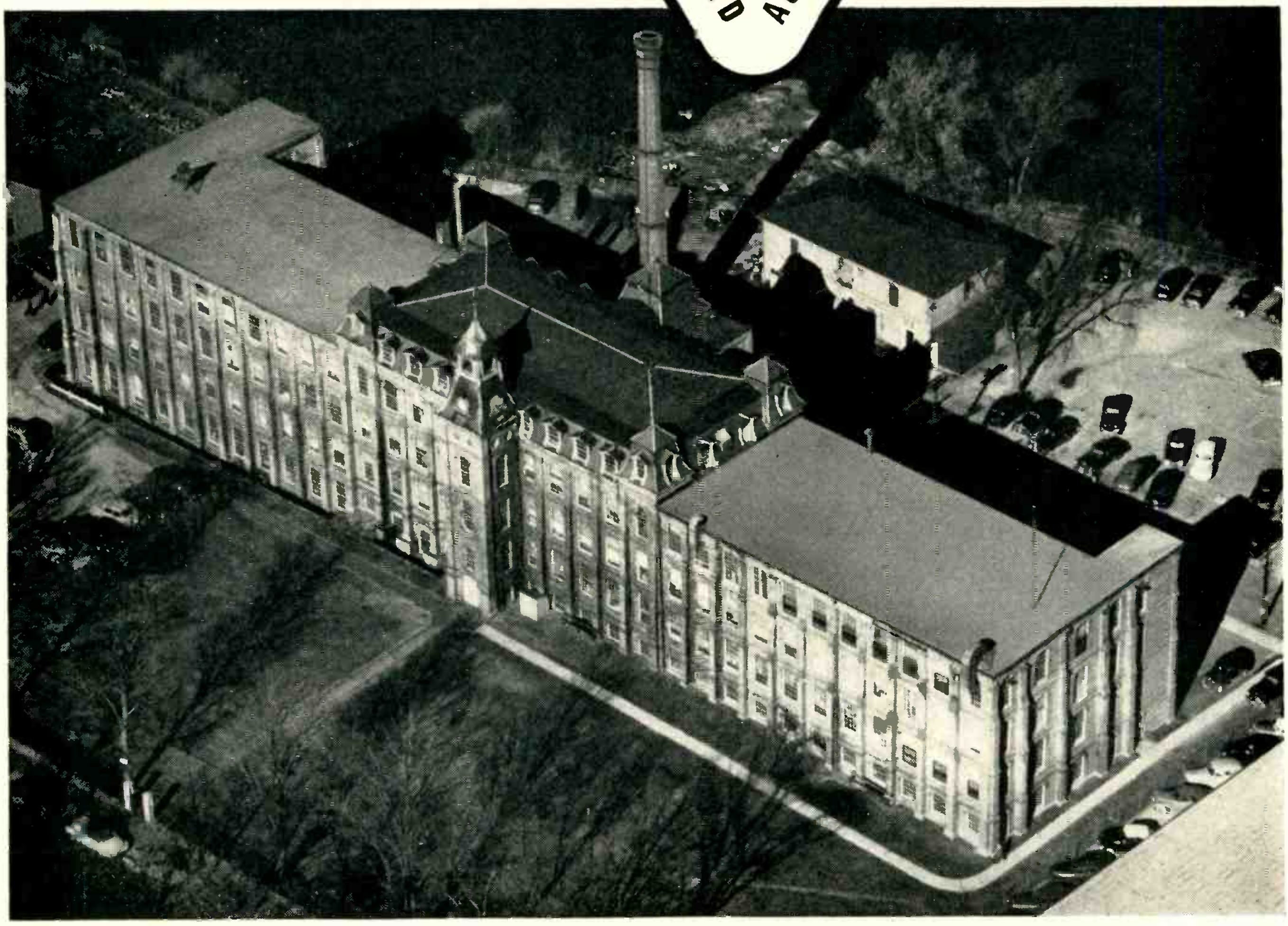


The UCINITE COMPANY

NEWTONVILLE 60, MASS.
Division of the United-Carr Fastener Corp.

nents of the color subcarrier between two sets of assigned values.

Note: In the N.T.S.C. system, the color phase is changed after every field.

It is recommended that the term "Color Phase Alternation" be used in place of the terms Oscillating Color Sequence and Flip-Flop, which have been used with this same meaning.

COLOR PICTURE SIGNAL

The electrical signal which represents color picture information, consisting of a monochrome component plus a subcarrier modulated with color information, excluding synchronizing signals.

COLOR SUBCARRIER

The carrier whose modulation sidebands are added to the monochrome signal to convey color information.

COLOR SYNC SIGNAL

See Color Burst

COLOR TRANSMISSION

In television, the transmission of a signal wave for controlling both the luminance values and the chromaticity values in a picture.

COMPATIBILITY

The nature of a color television system which permits substantially normal monochrome reception of the transmission by typical unaltered monochrome receivers designed for standard monochrome.

COMPOSITE COLOR SIGNAL

The color picture including blanking and all synchronizing signals.

CONSTANT LUMINANCE TRANSMISSION

A method of color transmission in which the carrier color signal controls the chromaticity of the produced image without affecting the luminance, the luminance being controlled by the monochrome signal.

DELAY DISTORTION

That form of distortion which occurs when the envelope delay of a circuit or system is not constant over the frequency range required for transmission.

ENVELOPE DELAY

The first derivative of the phase

When it comes to making a *Real Saving* in space...

Stackpole cup cores with their self-shielding characteristic can be mounted close to the chassis or any other metal part for maximum results in extremely close quarters. In some instances, the high Q circuits made possible through their use permit reduction in the number of tubes needed.

Standard types include numerous shapes and sizes, each available in a wide range of permeability possibilities. Highly specialized types to meet the most critical specifications can be engineered and produced from a broad background of experience in this exacting field.

Electronic Components Division

STACKPOLE CARBON COMPANY

St. Marys, Pa.

STACKPOLE *Cup Cores*

Other Stackpole core types include:

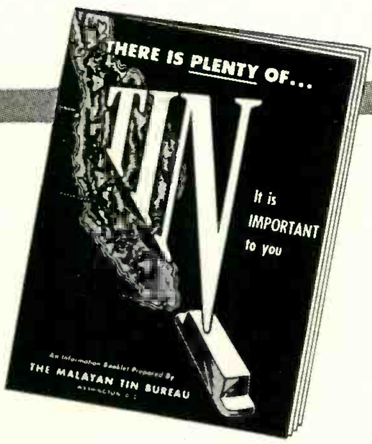
ALL STANDARD MOLDED IRON CORE TYPES, SIDE-MOLDED, CHOKE COIL CORES, SLEEVE TYPES, THREADED TYPES and COIL FORMS . . . also Stackpole CERAMAG® CORES (FERRITES).

Write for Electronic Components Catalog RC-8

THERE IS PLENTY OF

TIN

IN MALAYA



Only a deliberate distortion of facts could give rise to the false impression that tin is in short supply.

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MALAYAN

TIN

BUREAU

shift with reference to the frequency.

Note: If the phase is measured in radians and the frequency in radians per second, the envelope delay will be in seconds.

FIELD

One of the two (or more) equal parts into which a frame is divided in interlaced scanning.

FLIP-FLOP

Deprecated (see Color Phase Alternation)

FREQUENCY OVERLAP

In a color television system that part of the frequency band which is common to the monochrome channel and the chrominance channel.

Note: Frequency overlap is a form of band-sharing.

GAMMA

In color or monochrome channel, or part thereof, the coefficient expressing the selected evaluation of the slope of the used part of the log vs log plot relating input (abscissa) and output (ordinate) signal magnitudes as measured from the point corresponding to some reference black level.

Note: As the log vs log plot is usually not entirely straight in the used region it is necessary to formalize that evaluation of the slope, for example, by the use of the value at a particular point, maximum, mean, or other value. The method of evaluation must be stated.

At some points the signal may be in terms of light intensity or light transmission.

GAMMA CORRECTION

The modification of a transfer characteristic for the purpose of changing the value of gamma.

LUMINANCE

Luminous flux emitted, reflected or transmitted per unit solid angle per unit projected area of the source.

Note: Usual units are the lumen per steradian per square meter, the candle per square foot, the lambert, the millilambert and the footlambert.

This quantity is also called photo-

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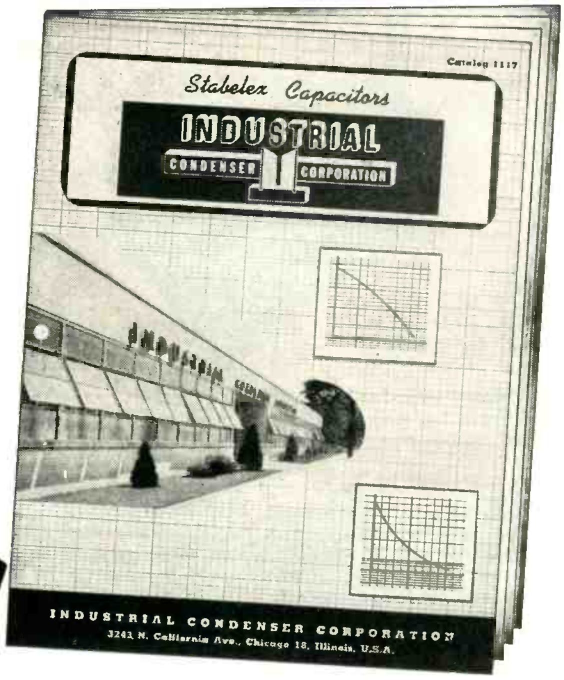

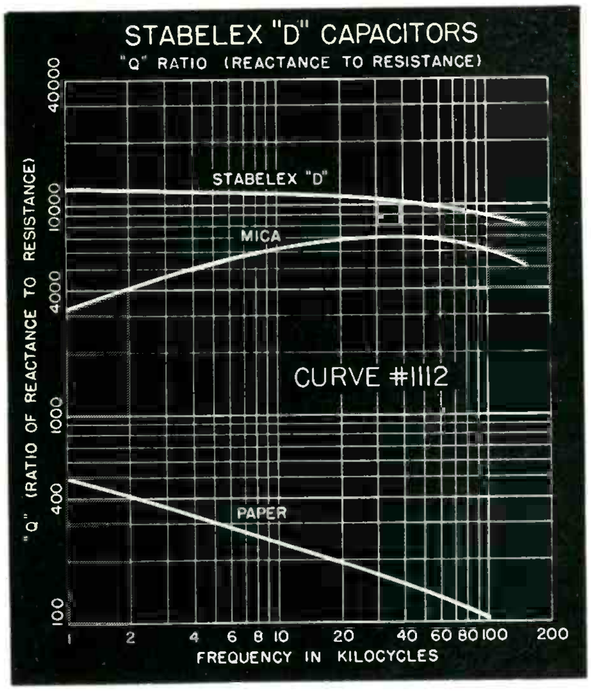

The low losses of Stabelex "D" capacitors are shown in Curve # 1112, which indicates the effect of frequency on the "Q" and also compares it with mica and paper capacitors.

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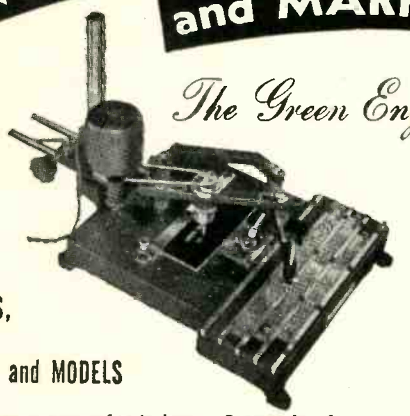
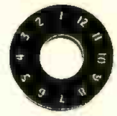
The Green Engraver

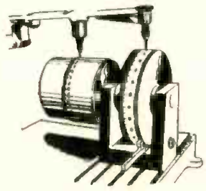


ENGRAVES,
ROUTS,
PROFILES and MODELS



STENCIL

NUMBERED RING



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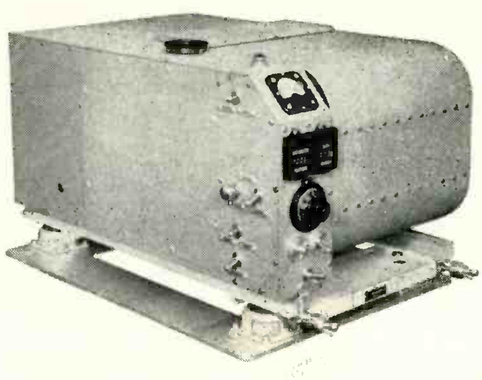
FOR VIBRATION, TEMPERATURE, STRESS, STRAIN ANALYSIS



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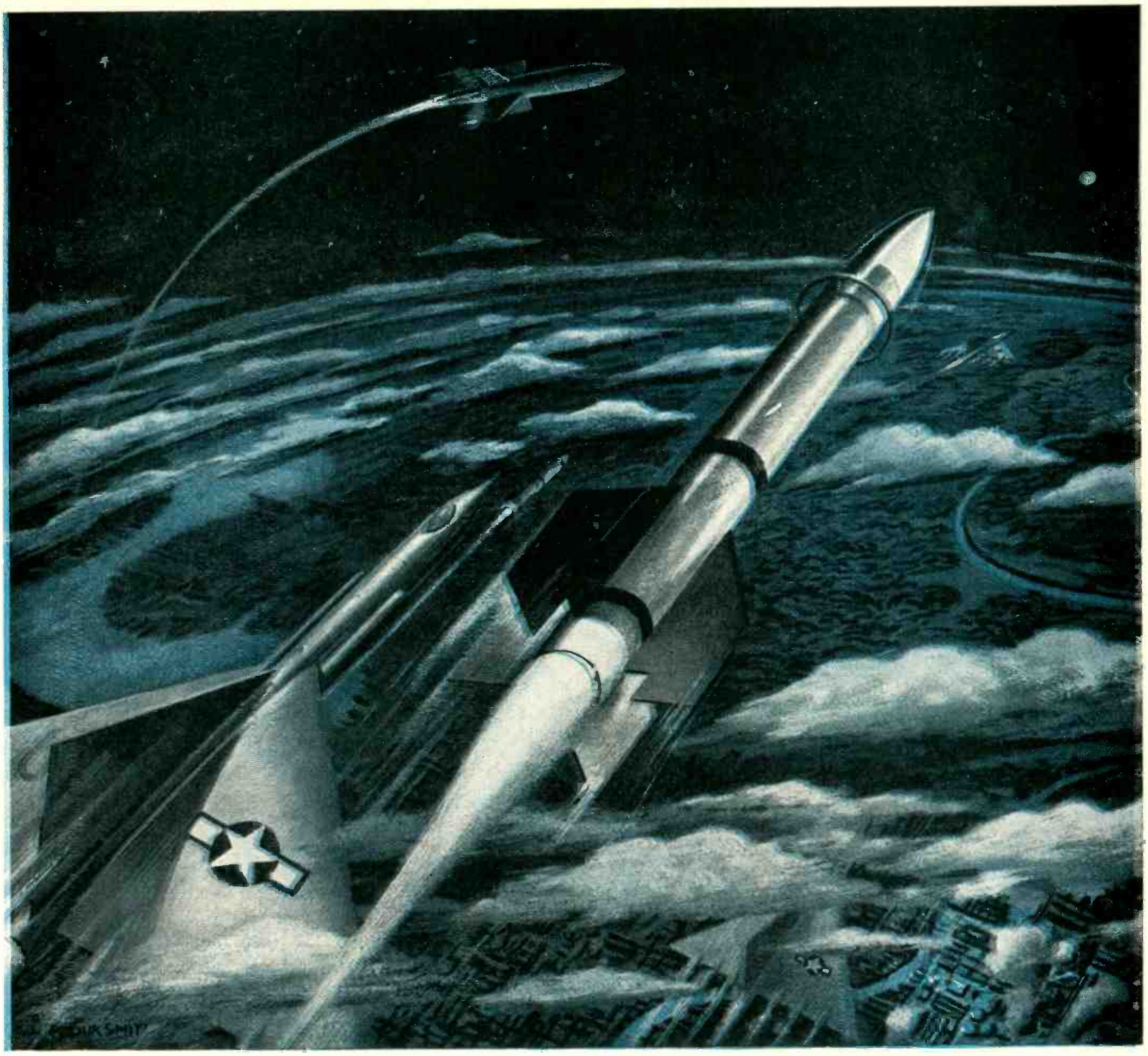

Missile with a "one track mind"
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Defensive guided missiles launched from supersonic aircraft will depend upon electronic marvels that come as close to simulating human intelligence as any mechanism ever devised. Important functions of these "weapons of the future" are typical of those entrusted to systems made by Arma Corporation.

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ARMA

ADVANCED ELECTRONICS FOR CONTROL

metric brightness.

LUMINANCE CHANNEL

In a color-television system, any path which is intended to carry the luminance signal.

Note: The luminance channel may also carry other signals; for example, the carrier color signal, which may or may not be used.

LUMINANCE SIGNAL

A signal wave which is intended to have exclusive control of the luminance of the picture.

LUMINOSITY

Ratio of photometric quantity to corresponding radiometric quantity in standard units (lumens per watt).

LUMINOUS FLUX

The time rate of flow of light. When radiant flux is evaluated with respect to its capacity to evoke the brightness attribute of visual sensation, it is called luminous flux, and this capacity is expressed in lumens.

MATRIX

(Noun) In color television, an array of coefficients symbolic of an operation to be performed, which operation results in a color coordinate transformation. (This definition is consistent with mathematical usage).

(Verb) In color television, to perform a color coordinate transformation by computation or by electrical, optical or other means.

MATRIXER (Matrix Unit, Matrix Circuit, etc.)

A device which performs a color coordinate transformation by electrical, optical or other means.

MIXED HIGHS

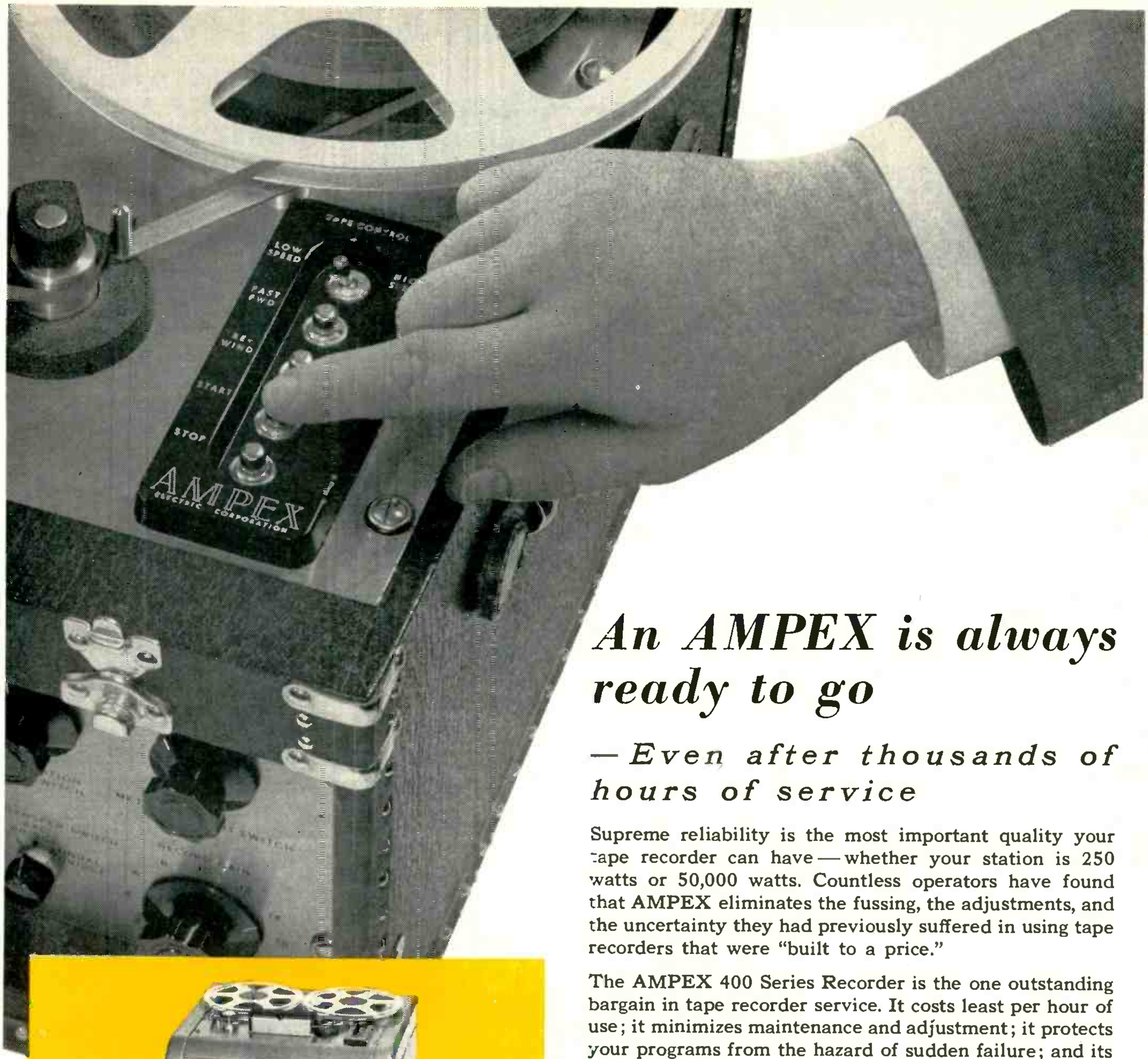
Those high frequency components of the picture signal which are intended to be reproduced achromatically in a color picture.

MODULATED COLOR SUBCARRIER

See Carrier Color Signal

MOIRE

In television, the spurious pattern in the reproduced picture resulting from interference beats between two sets of periodic struc-



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Regulated Power Supply
0-600 VDC @ 300 MA

OUTPUT VOLTAGES: #1 0-600 VDC @ 300 MA Regulated. #2 0-150 VDC @ 5 MA Regulated. #3 6.3 VAC @ 10 Amps Unregulated.

REGULATION: Within .5% from 20-600 VDC. From no load to full load. At 10 volts. Regulation 1%.

HUM VOLTAGE: Less than 8 millivolts.

METERS: High Voltage and Bias Voltage readable on voltmeter. Milliammeter included.

OUTPUT TERMINATIONS: Positive or Negative ground.

OUTPUT IMPEDANCE: Less than 2 ohms at 20 cycles or more for all output voltages.

DIMENSIONS: Length 19" x Height 10½" x Depth 13". Panel size 19" x 10½". WE Notching.

2 MODEL 308-A

Regulated Power Supply
0-600 VDC @ 200 MA

OUTPUT VOLTAGES: #1 0-600 VDC @ 200 MA Regulated. #2 0-150 VDC @ 5 MA Regulated. #3 6.3 VAC @ 10 Amps Unregulated.

REGULATION: Within .5% from 20-600 VDC from no load to full load. At 10 volts Regulation 1%.

HUM VOLTAGE: Less than 5 millivolts.

METERS: High Voltage and Bias Voltage readable on voltmeter. Milliammeter included.

OUTPUT TERMINATIONS: Positive or Negative ground.

OUTPUT IMPEDANCE: Less than 2 ohms at 20 cycles or more for all output voltages.

DIMENSIONS: Length 19" x Height 8¾" x Depth 13". Panel size 19" x 8¾". WE Notching.

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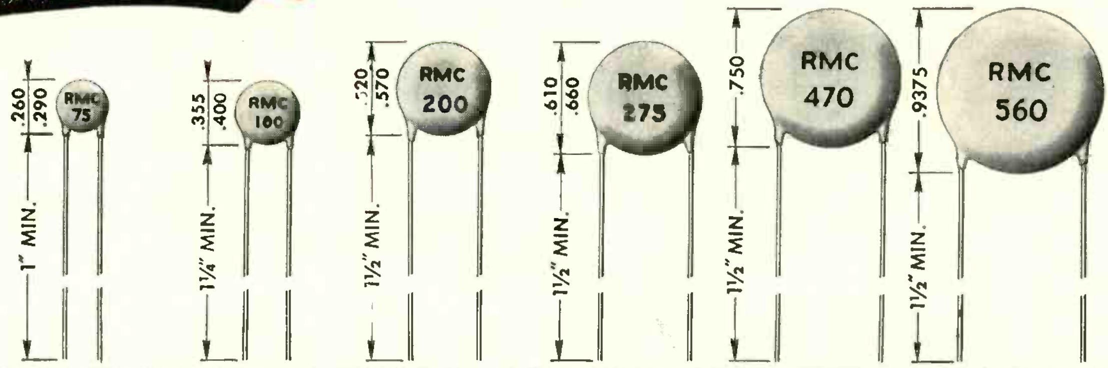

TC	1/4 Dia.	5/16 Dia.	1/2 Dia.	5/8 Dia.	3/4 Dia.	7/8 Dia.
P-100	—	2– 9 MMF	10– 30 MMF	—	—	—
NPO	2– 12 MMF	13– 27	28– 60	61– 75 MMF	76–110 MMF	111–150 MMF
N– 33	2– 15	16– 27	28– 60	61– 75	76–110	111–150
N– 80	2– 15	16– 27	28– 60	61– 75	76–110	111–150
N– 150	2– 15	16– 30	31– 60	61– 75	76–110	111–150
N– 220	2– 15	16– 30	31– 75	76–100	101–140	141–190
N– 330	2– 15	16– 30	31– 75	76–100	101–140	141–190
N– 470	2– 20	21– 40	41– 80	80–120	121–170	171–240
N– 750	5– 25	26– 50	51–150	151–200	201–290	291–350
N–1400	15– 50	51–100	101–200	200–250	251–470	480–560
N–2200	47– 75	76–100	101–200	201–275	276–470	471–560

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Note: Moires may be produced, for example, by interference between regular patterns in the original subject and the target grid in an image orthicon, between patterns in the subject and the line pattern and the pattern of phosphor dots of a three-color kinescope, and between any of these patterns and the pattern produced by the carrier color signal.

MONOCHROME BANDWIDTH (of the signal)

The video bandwidth of the monochrome signal.

MONOCHROME BANDWIDTH (of the monochrome channel)

The video bandwidth of the monochrome channel.

MONOCHROME CHANNEL

In a color television transmission, any path which is intended to carry the monochrome signal.

Note: The monochrome channel may also carry other signals; for example, the carrier color signal which may or may not be used.

MONOCHROME SIGNAL

In monochrome television transmission, a signal wave for controlling the luminance values in the picture but not the chromaticity values.

In color television transmission, that part of the signal wave which has the major control of the luminance of the color picture and which controls the luminance of the picture produced by a conventional monochrome receiver.

MONOCHROME TRANSMISSION

In television, the transmission of a signal wave for controlling the luminance values in the picture, but not the chromaticity values.

OSCILLATING COLOR SEQUENCE

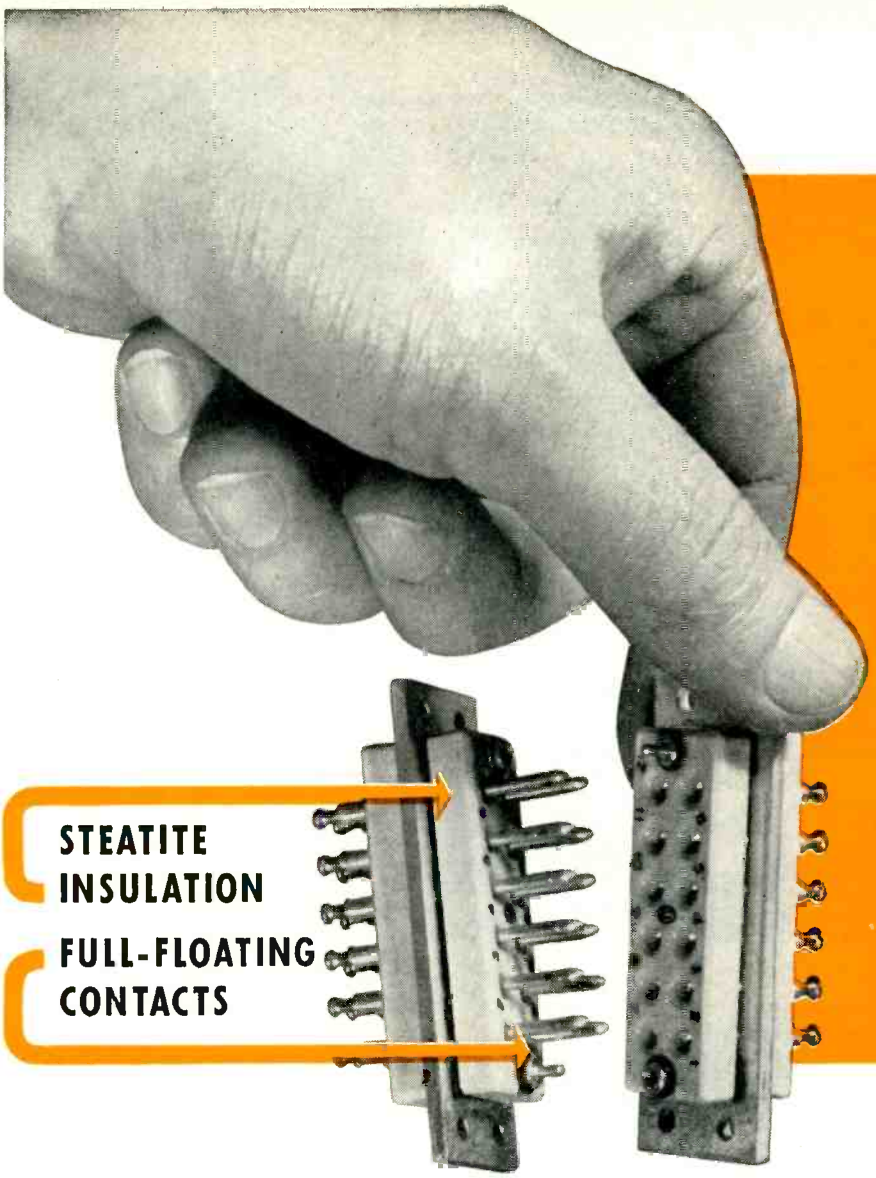
Deprecated (see Color Phase Alternation)

PICKUP SPECTRAL CHARACTERISTIC

The set of spectral responses of the device, including the optical parts, which converts radiation to electric signals prior to any nonlinearizing and matrixing operations.

RECEIVER PRIMARIES

The colors of constant chromati-



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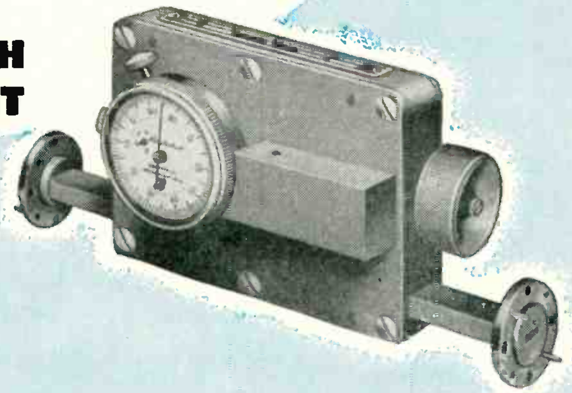


city and variable luminance produced by the receiver which, when mixed in proper proportions, are used to produce other colors.

Note: Usually three primaries are used: red, green, and blue.

STATIONARY CPA AXIS

A fixed reference phase with respect to which a carrier color signal of constant chrominance makes equal and opposite angles for successive fields, this reference phase being the same for all chrominances.

TAKING CHARACTERISTIC

See Camera Spectral Characteristic

ZERO SUBCARRIER CHROMATICITY

The chromaticity which is intended to be displayed when the subcarrier amplitude is zero.

Latest Disc-Cathode Developments

RECENT electronics research and development at Superior Tube Company, Norristown, Pa. have made significant advances in disc cathodes.* Manufacturing techniques have been perfected for maintaining a critical E dimension tolerance, Fig. 1, ± 0.0005 in. during long production runs. New and more efficient alloys for electron-emitting cathode caps have been developed. Sublimation effect leakage of electrons across the ceramic disc of the cathode and heater-to-cathode electron leakage has been reduced. Heater shrinkage due to improper insertion during assembly has been eliminated.

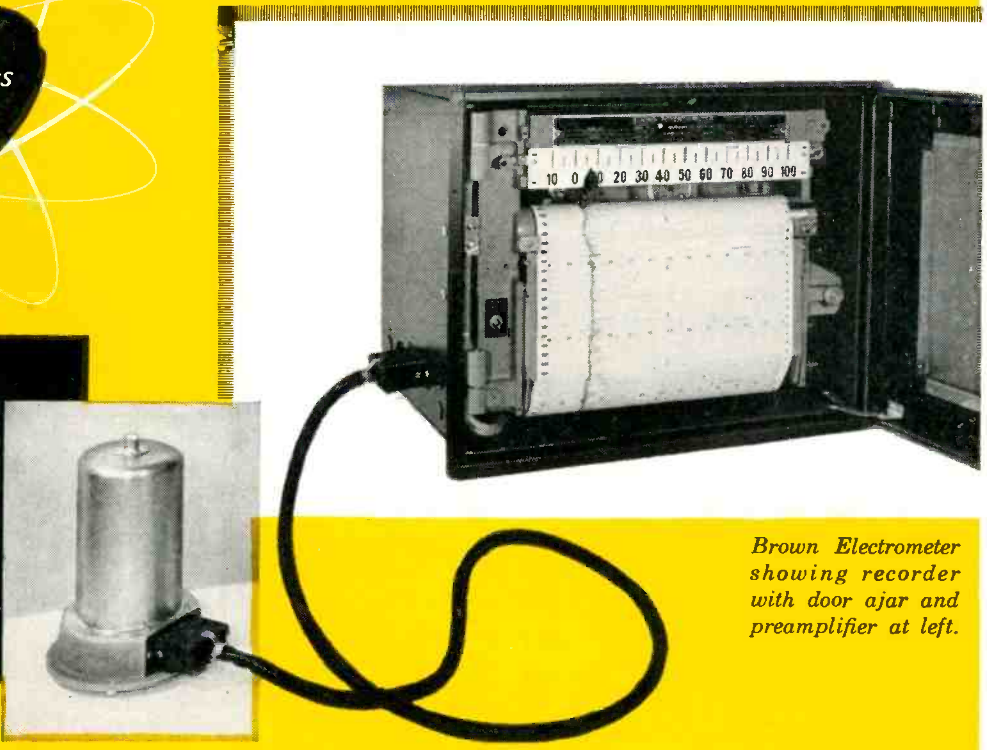
As a result of these five basic innovations, the disc cathode now seems to be ready for the more stringent electronic tasks to which it may be applied in the near future.

The disc cathode may be described as a cathode sleeve material which is crimped or fastened to a ceramic disc. The disc part of the name comes from the ceramic disc used as an insulator between the cathode and the grid No. 1 electrode.

The disc cathode is used in the

* Manufactured under U. S. Patents No. 2551871 and 2608743.

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.

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MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS

First in Controls

● *Important Reference Data*

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The Type 205 FM Modulation Meter For Multiple Mobile Frequencies.

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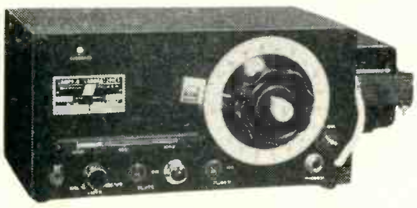
For Any Number of Frequencies, AM or FM. The Type 105-B Micrometer Frequency Meter



The Type 105-B Micrometer Frequency Meter measures center frequency deviation on any number of transmitters, AM or FM, from 0.1 MC. to 175 MC. The accuracy, determined by over 500 field tests, is conservatively guaranteed better than 0.0025%, surpassing FCC requirements. Readily checked against WWV. $220.00

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- ☐ Type 205 FM Modulation Meter
- ☐ Type 105-B Micrometer Frequency Meter

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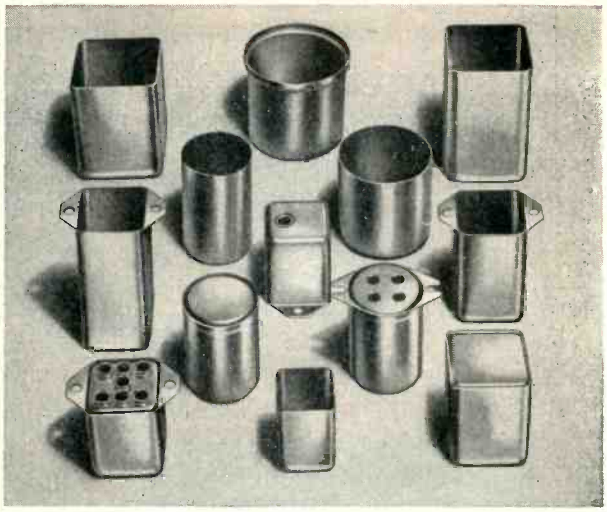

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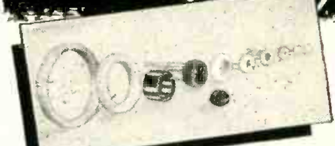

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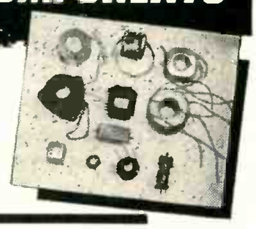

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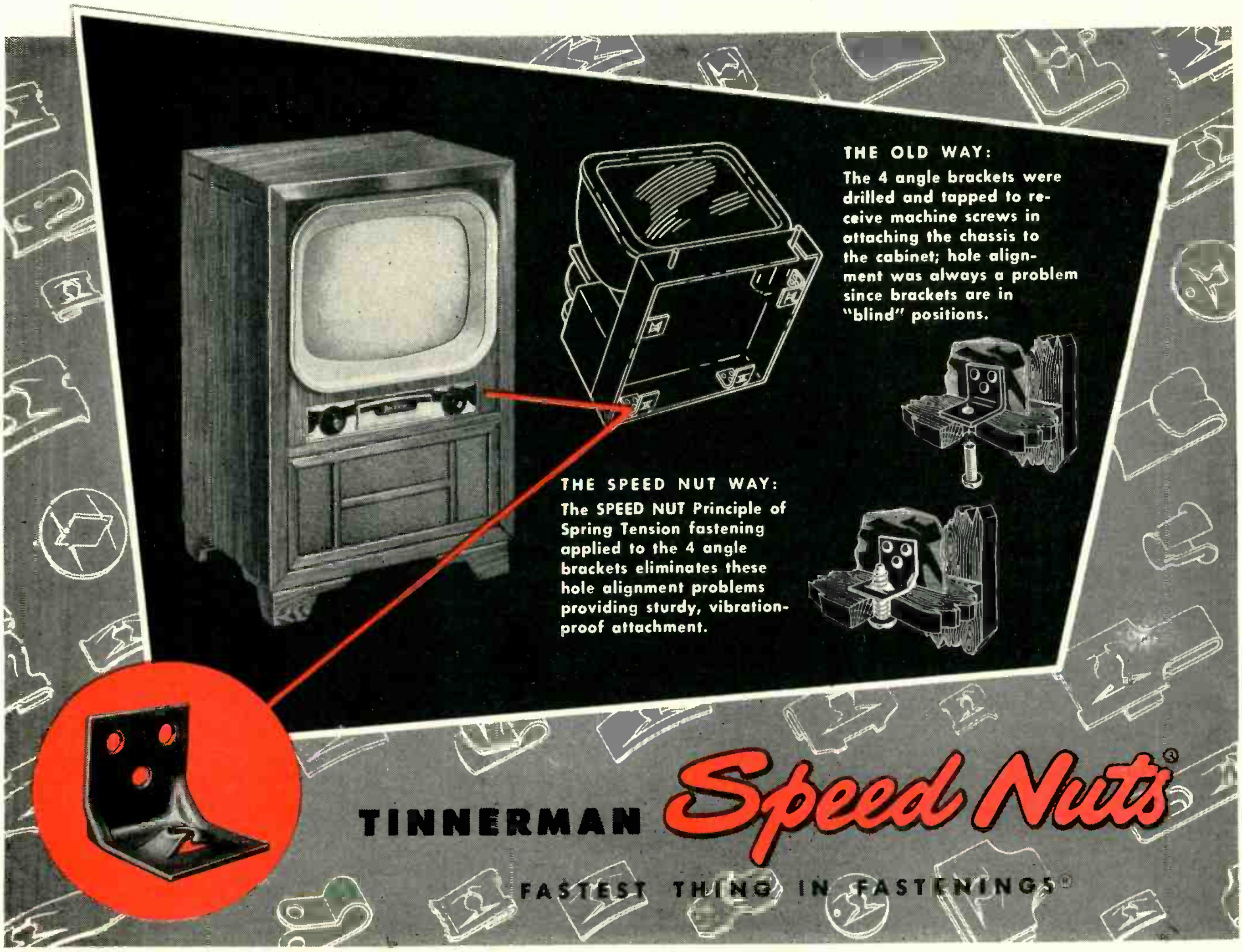

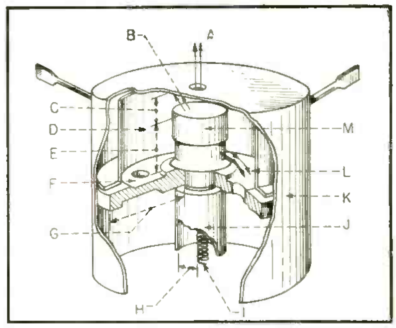

FIG. 1—Construction of a disc cathode. Electrons emitted to gun structure (A), barium sublimes to give grid emission (B), grid-cathode spacing (C), spacer (D), E dimension (E), shaded groove (F), ceramic insulator (G), heater-cathode leakage current (H), heater (I), alloy sleeve (J), grid cup (K), nickel sublimes to give low-resistance path across ceramic (L) and alloy cap (M)

cathode-ray picture tube as a source of electrons. Electrons are emitted from the cap or top surface of the disc cathode.

The cathode sleeve is hollow, so that it can be beaded easily to the ceramic disc and a heater may be conveniently inserted. The heater maintains a temperature of approximately 775 C, the usual operating temperature at which electrons are emitted from the surface. The electron-emitting end of the cathode sleeve or cylinder is closed by continuous metal or by a special cap. The metal cap or closed end of the cathode sleeve is coated with a barium-strontium oxide coating which emits electrons in the same manner and practice that is used in the receiving-tube industry.

The disc cathode is spaced within the grid cup during assembly where care must be taken to maintain a fixed grid-to-cathode spacing. This spacing, in turn, is controlled by a critical E dimension of the disc cathode.

E-Dimension Tolerances

As applied to the final assembly of a disc cathode, the E dimension is the critical distance between the ceramic surface and the surface of the emitting cap. In operation of the cathode-ray tube, the E dimension controls the cut-off voltage since it determines the grid-to-cathode spacing. It is necessary to control the E dimension to within narrow limits to add uniformity to the characteristics of cathode-ray tubes in production and circuit

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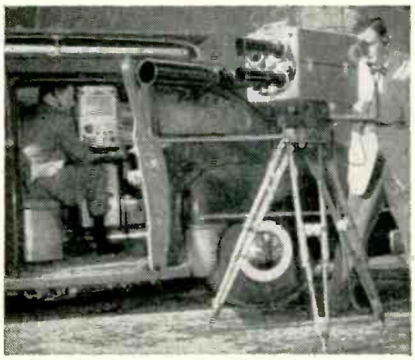

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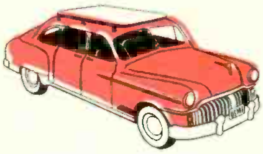

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This is the kind of ruggedness you may have for both studio and field operations, PLUS all the precision of GPL camera design. This unit is engineered for smooth, fast control, from pushbutton turret change to remote adjustment or iris and focus.

For the stations just starting, it has many special advantages: in compactness of chains, ease of operations.

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TV Camera Chains • TV Film Chains • TV Field and Studio Equipment • Theatre TV Equipment work. During assembly, it is desirable to control to ±0.0005 in. tolerance limits the spacing between the surface plane of the ceramic disc and the parallel plane of the emission cap.

With the shank and cap separated until final assembly, manufacturing operations may all be accomplished prior to establishment of the *E* dimensional tolerance. In the final step of disc-cathode assembly, the subassembly containing the seamless shank crimped to the ceramic disc and the cap are positioned by special equipment. Four electric spot welds are applied at 90-deg intervals around the cap, fastening it to the shank at a position well within the required tolerance of the *E* dimension.

By establishing the precision of the *E* dimension spacing in the disc cathode itself, the necessity for matching spacers with disc-cathode assemblies of the proper *E* dimension to produce the desired grid-to-cathode spacing corresponding to a given cut-off voltage is eliminated. The interchangeability of disc cathodes and uniform spacers now employed in cathode-ray-tube assembly virtually eliminates waste and has reduced labor costs by more than 20 percent for this operation.

Choice of Cap Alloys

The choice of various alloys in the cap material allows a greater specialization in application of the disc cathode. Active, normal or passive alloys can be used to meet the various needs of rapid cavitation, high emission level, reliable long life or undesirable rigid emission.

Sublimation Effect

The tendency of all nickel alloys to sublime slightly during processing and activation of the disc cathode, when the metal is held at high temperatures, causes a movement of metal molecules from a cathode shank to the surface of the ceramic disc to occur. This sublimation effect, occuring over long periods of time, may result in a significant buildup of deposited metal across the surface of the ceramic insulator disc. As this metal film deposits, electrical leakage occurs between the cathode shank and the

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Over 200 manufacturers of electronic products for ultimate use by the U. S. Government are now using Moloney HiperCore Cores for Electronic Transformers.

More than 1000 standard sizes are available in quantity to such manufacturers in thicknesses from 1 mil to 12 mil and in widths from ¼". HiperCore Electronic Cores are of wound core construction using oriented-grain, cold-rolled silicon steel which results in greater flux carrying capacity and lower losses than other type cores of comparable sizes. These smaller, lighter cores perform better and permit increased production by savings in assembly time.

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ME-52-27

STANDARD TESTS

All 12 mil cores are tested for core loss (true watts) and exciting volt-amperes (apparent watts) at 60 cycles. 4 mil cores are tested at 400 cycles. Following table gives maximum test values. Average values are approximately 20% less than maximum.

	12 Mil—60 Cycle @ 15000 gauss	4 Mil—400 Cycle @ 10000 gauss
Core Loss (TW)	0.95 x lbs.	4.4 x lbs.
Exciting Volt-Amps (AW)	1.75 x lbs. + 6.25A*	5.0 x lbs. + 16.6A*
* A = Gross Area of core face in Sq. In.		

All 2 mil cores are tested for pulse permeability by using a 2 microsecond pulse width at 400 P. P. S. and maximum flux density of 10000 gauss. The minimum permeability will be 500.

All 1 mil cores are tested for pulse permeability by using a 0.25 microsecond pulse width at 4000 P. P. S. and maximum flux density of 3000 gauss. The minimum permeability will be 175.

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No. 1 grid electrode, with eventual change in grid bias and short circuiting.

In order to reduce this undesirable tendency, a shadow groove is molded around the ceramic disc face at a prepositioned radius between the shank and tube. The side of the groove falls within the shadow of the subliming shank material so that very few molecules can be deposited on the unexposed groove side. A clean ceramic surface having the original high resistance of the ceramic is left in the shadow groove to give a large resistance between grid and cathode electrodes.

The sublimation or deposition of metal film during processing operation of the cathode ray tube can be further reduced by the choice of alloy in the seamless shank material. It is desirable to use cathode alloys of normal or passive materials whose sublimation rate is very much less than some active alloys. Thus, thinner films and smaller grid cathode resistances are obtained in the normal activation and use.

With the successful overcoming of cathode-ray-tube failures due to sublimation short circuiting, the life expectancy and service potential of these tubes has been greatly increased.

Heater-Cathode Leakage

The newest and most promising solution to the heater-to-cathode leakage problem involves the relatively simple expedient of assuring absolute cleanliness of the cathode-shank inside-diameter surface. During repeated experiments, both in the laboratory and in end-product use, good results have been obtained with disc cathodes whose shank inside-diameter surface has been carefully polished and chemically cleaned to remove all surface contamination. The use of seamless nickel tubing in the shank does provide a clean metal surface to aid in the reduction of heater-cathode leakage.

Flared Shank

To reduce direct shorts between the heater and the cathode shank, the uncapped open end of the cathode shank should be flared.

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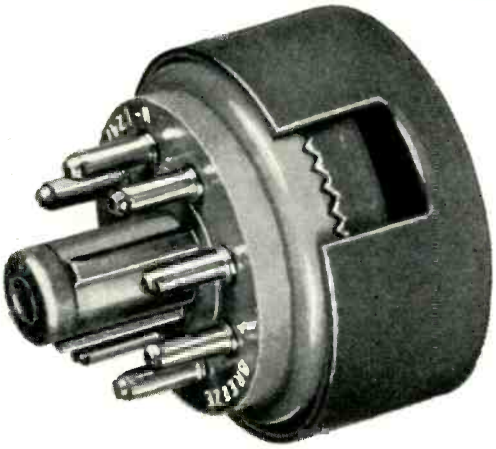
Two Special Purpose Connectors by BREEZE MARK



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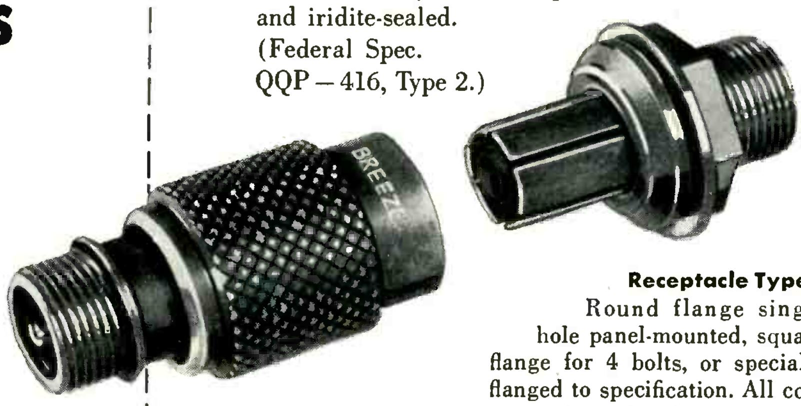

Receptacle Types: Round flange single hole panel-mounted, square flange for 4 bolts, or specially flanged to specification. All contacts silver plated.

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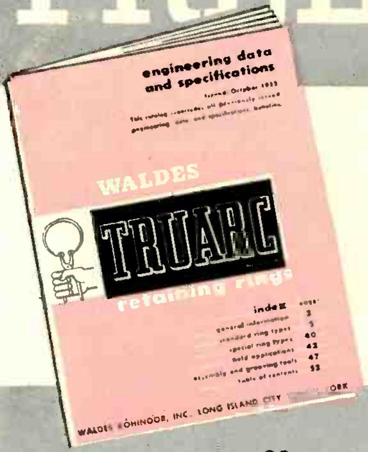
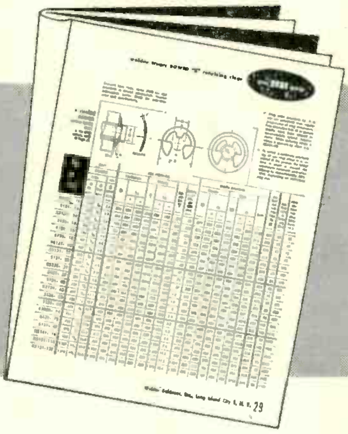
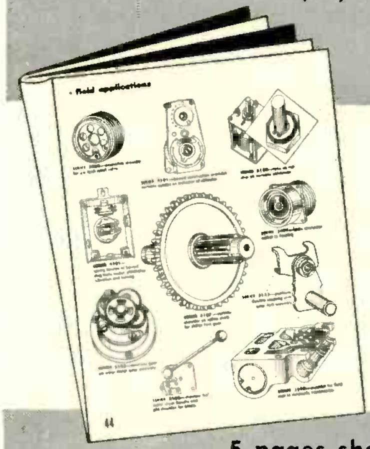


This encyclopedia of retaining rings combines—*in one 52 page volume*—engineering specifications and data for 17 different ring types—more than 600 different sizes. Gives assembly data, typical applications, everything you need to know about selection and use of Waldes Truarc Retaining Rings.



28 pages of charts giving complete engineering data and specifications. Dimensions of Rings, Grooves, Shafts, and Housings; Clearances; Allowable Thrust Loads; Safety RPM Limits. Data on end-play take-up. Countless other engineering data, arranged in easy-to-read, easy-to-use table form.



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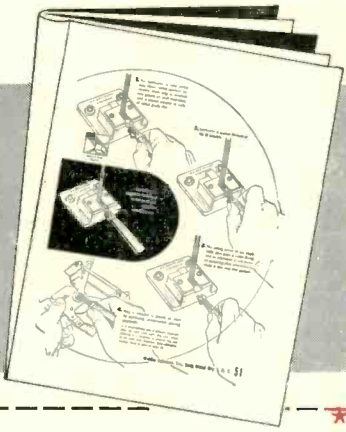

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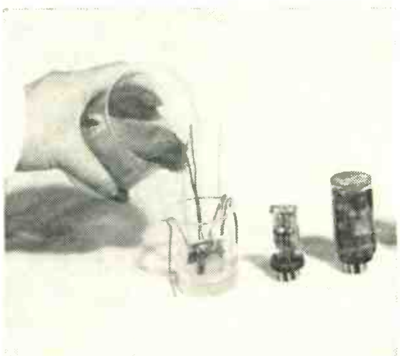
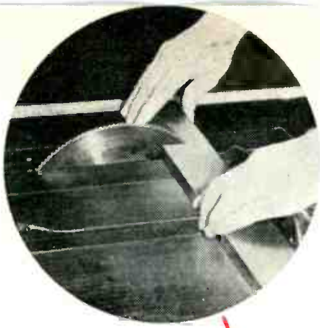
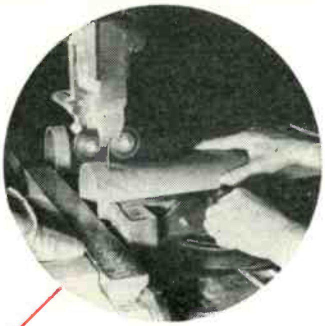
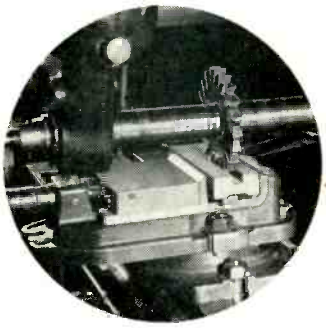


Shown from left to right: a two-stage printed-circuit amplifier being potted with casting resin; a complete two-stage plug-in amplifier before potting and the two-stage plug-in amplifier after potting







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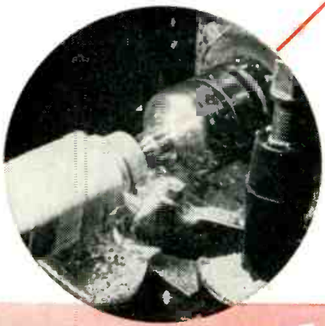

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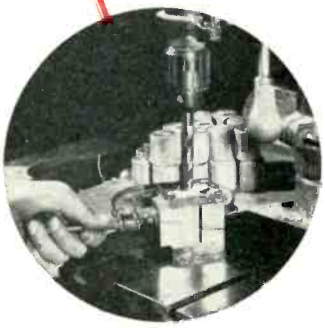

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Max. Reverse Current	6.0 *ua* at 26V
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Maximum Ratings

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Peak Rectified Current	2.6 ma
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Max. RMS Input Current	500 *ua*
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Max. Average Rectified Current	1.5 ma
Peak Rectified Current	20 ma
Max. Surge Current (1 sec)	80 ma
Ambient Temp. Range	–50 to 100° C
Max. RMS Applied Voltage	26 volts
Max. RMS Input Current	3.75 ma
Max. DC Output Voltage	20 volts
Voltage Drop at Full Load	1 volt
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be obtained at room temperature within several days, the curing rate is hastened by the application of a moderate amount of heat. At 50 C, the resin gels in about two hours and is almost completely cured in about 20 hours. Choice of curing technique depends on the type of component being embedded and on the amount of resin required.

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LINEARITY of current control provided by the circuit shown in Fig. 1 depends only upon a single helical potentiometer available, inexpensively, to linearity tolerances of 0.1 percent or better.

The circuit is similar to conventional current regulators but uses an a-c supplied thyratron followed by a diode and an integrating circuit in place of the usual d-c amplifier. Because the thyratron plate current is either zero or some constant value, the operating point of the thyratron does not change over the controlling range and may be regarded as accounting for the linearity of the circuit.

When there are no thyratron pulses, the load current I increases gradually toward its zero bias value as the grid potential of the 6L6 decays through the integrating network. A point is reached eventually beyond which the thyratron is allowed to fire on each peak of its alternating plate voltage. The negative pulses which appear on the plate of the diode recharges the 6L6 grid-leak capacitance until the thyratron grid returns to the cut-off region and I drifts toward saturation again. If R_1 is rotated slowly, the controlled current follows in a linear manner.

The original regulator model was used to provide a linear time variation of magnetic field in a nuclear

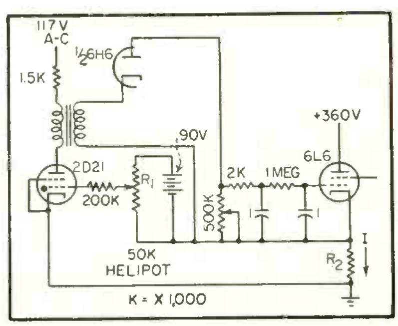

FIG. 1—Current regulator circuit

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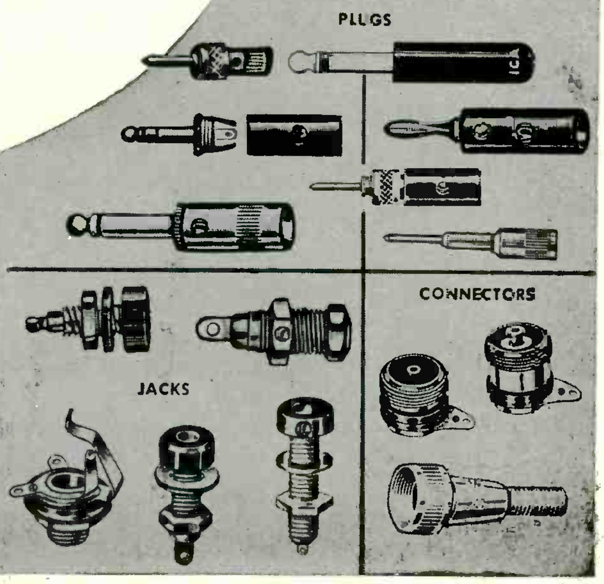

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Jeffers Electronics Division
Speer Carbon Company
Du Bois, Pennsylvania

magnetic resonance spectrometer. Circuit values shown in Fig. 1 were used. Component R_2 is a magnet winding of several thousand henrys inductance. A one-rpm synchronous motor operating through a gear train drove R_1.

This material was abstracted from an article entitled "A Linear Current Regulator" by John S. Waugh, James N. Shoolery and Don M. Yost which appeared in the August, 1952, issue of *The Review of Scientific Instruments*, page 441.

Improved Blanking Circuit

By Seymour Cuker
Chief Engineer
Gem Radio and Television Corp.
Jersey City, N. J.

With the advent of higher voltage requirements for large picture tubes, it has become necessary to relax the retrace time requirements of the horizontal sweep circuits. To maintain a short retrace, the number of components in the sweep and high-voltage circuits must be increased. The only economical procedure at present is to allow longer retrace time.

Allowing longer retrace time creates the problem of horizontal foldover, introducing an objectionable flaw in the picture presentation. To counter this defect, television engineers have utilized horizontal retrace blanking. This device introduces a so-called curtain effect on the left half of the picture because of horizontal transformer leakage reactance. The effect is most prominent and annoying at low and medium brightness levels. At high brightness levels it becomes

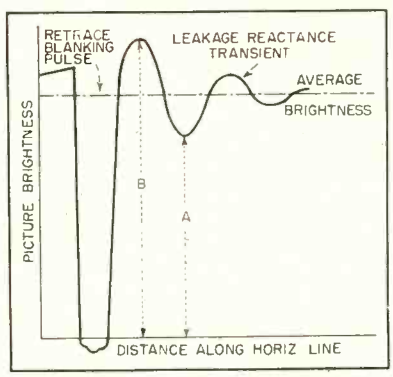
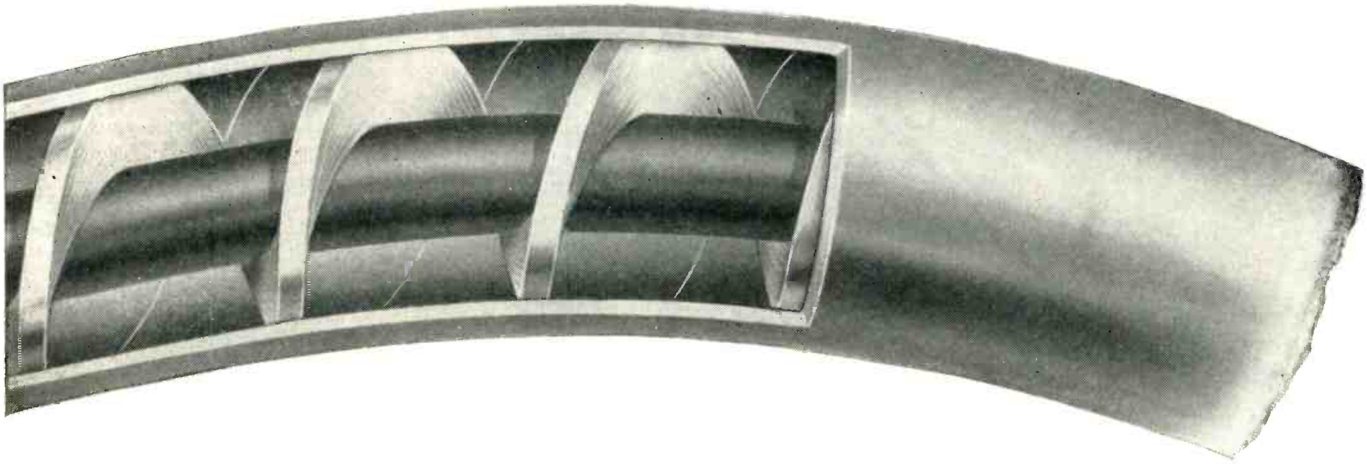


FIG. 1—Relative brightness on left side with flat subject and superimposed retrace blanking

Styroflex Coaxial Cable



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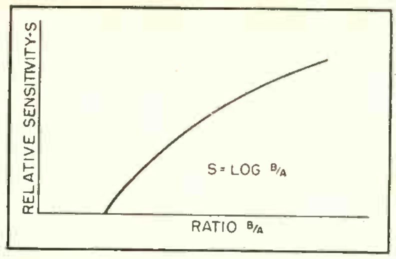

FIG. 3—Schematic diagram of the circuit with improved blanking

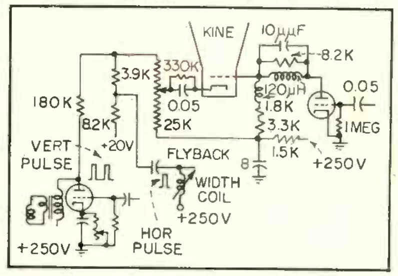

FIG. 2—Relative response to two brightness levels

almost invisible to the naked eye.

The idea described herein proposes that the retrace blanking should be reduced proportionally with the brightness level. Figure 1 shows the curtain effect in terms of a flat picture and the superimposed retrace blanking component. If the average brightness level were reduced to near zero, the half cycles above the average brightness would be light and those below the average brightness would be dark.

The eye responds to brightness logarithmically. Response is proportional to the logarithm of brightness. The relative response to two brightness levels is shown in Fig. 2. To reproduce a flat picture faithfully, the ratio B/A, Fig. 2, must be close to unity. With varying picture brightness, the perturbation must be reduced proportionally to maintain the near unity ratio of B/A.

A circuit which accomplishes the desired effect is shown in Fig. 3. This circuit also includes vertical blanking. The main advantage of vertical blanking is the complete removal of the vertical retrace lines.

Vertical blanking also introduces vertical shading at low brightness levels. Here again, the thinking applied previously to horizontal perturbation is valid. The circuit shown in Fig. 3 is one which gives, in a single stroke, positive blanking minus the usual defects attributed to blanking circuits.


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Production Techniques

Edited by JOHN MARKUS

OTHER DEPARTMENTS

featured in this issue:

Automatic Transformer-Testing Turntable

POWER transformers for television and radio receivers are automatically run through six different types of tests by a new six-foot-high machine having a 15-foot diameter motor-driven turntable. On this turntable are 32 small platforms, each having a set of terminal clip-boards into which the leads of a transformer are quickly inserted. The contact clips are made of spring brass or phosphor bronze, and are so arranged that a downward pressure with a lead gives a good electrical contact. After testing, a simple upward sweep of the hand under the leads disconnects them all.

Behind each terminal clip-board are contact arms. As a particular transformer-bearing platform passes a test position, these arms make contact with conducting bars that connect the transformer into the test circuit.

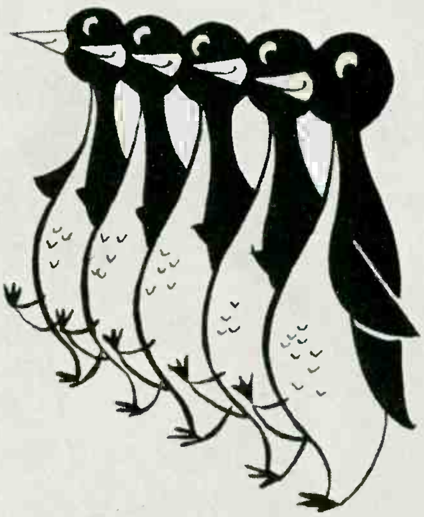
As designed by test equipment engineers of the RCA Victor Division plant in Camden, N. J., the machine has 8 test positions in all, for the following six different types of tests: turns ratio, exciting current, impedance, core loss, induced voltage breakdown and polarity, and three separate high-potential breakdown tests. Exciting current and core loss are measured only on the primary.

Each of the 32 platforms has its own roll of marking tape for indicating and identifying the nature of a reject. At each of the six test positions is a marking solenoid

Tested transformers are placed on a conveyor belt which carries them to the packaging department. At the same time, the operator reloads the machine with untested transformers from the lift in the foreground. Other operators connect the transformer leads to the terminal clip board

Over-all view of transformer tester. The six different test positions are located above the turntable at the left

that is actuated when a transformer fails to meet specifications for that test. The solenoid brings an inked brush in contact with the paper tape when actuated by the electronic test circuit. A different color of ink is used at each test position, to identify the nature of the reject. The inking brushes are set at six different levels so that marks do not overlap, eliminating the need



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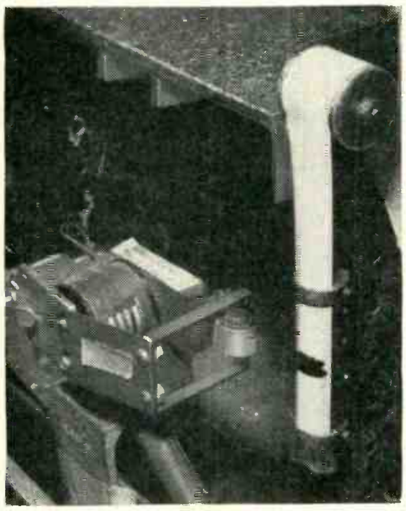
for automatic paper feed. For each reject, the operator tears out the marked paper and places it with the defective transformer, then pulls down more paper to the marking position.

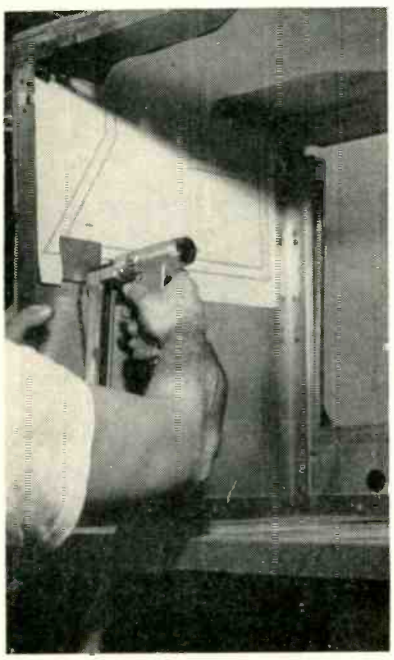
The number of transformer-carrying platforms has little bearing on the number of test positions. Some of the factors considered in arriving at this 32-platform design were rotary speed, desirable turntable size, sufficient time and working space for loading and unloading transformers, and provisions for installing additional test positions later if needed. The present design is entirely flexible, and can be quickly readjusted for testing various other types of transformers. The machine has increased testing efficiency more than 200 percent over previous manual testing methods.



Marking solenoid at one of the test positions. One reject mark has already been made on the paper tape at the right by the inked brush of an actuated solenoid. Ordinary relay was converted to give solenoid action by bolting extension arm on armature

Transformer-carrying platform, showing how leads are inserted in terminal clips

Printed TV Antenna Applied with Air-Gun Stapler



Fastening printed antenna to inside of steel-reinforced console television receiver cabinet with air-gun stapler

A BUILT-IN television receiver antenna made by silk-screening aluminum paint onto heavy waterproof paper is fastened inside the cabinet of a television receiver in less than a minute with an air-operated stapler. Each time the trigger is pulled, a staple is automatically fed to driving position and driven into the wood walls of the cabinet.

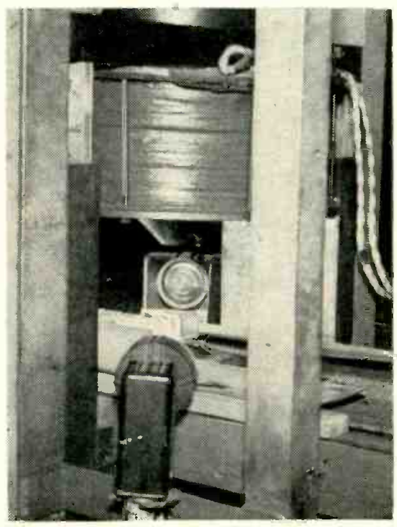
A heavier power stapler and larger staples are used in assembling the cabinet itself. The cabinet framework consists of angle irons welded together. Previously punched holes in the angle-iron members are appropriately positioned so that staples can be driven through them into the plywood side walls and top of the cabinet. This eliminates costly, time-consuming gluing operations and at the same time gives a sturdy steel-reinforced cabinet construction. The chassis shelf is all steel, welded to the angle-iron uprights.

Use of combination wood and steel construction was started in the Crosley Division of Avco Mfg. Corp. because of a wood shortage some time ago. The new technique proved so successful that it is being continued.

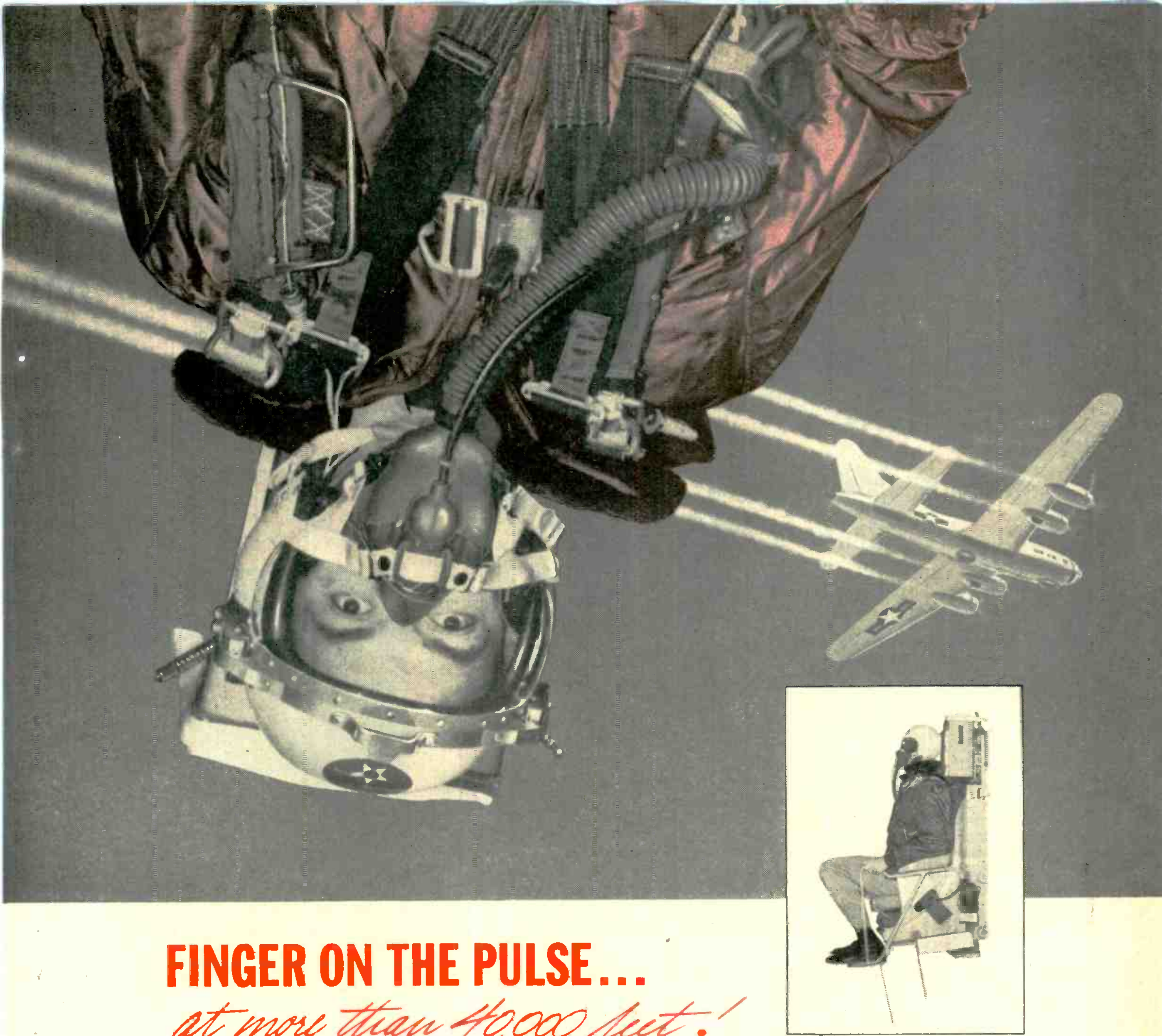
Wood screws are used to supplement the staples for fastening the front of the cabinet. Glued reinforcing blocks are still used behind the joining of front and top panels, this being the most exposed joint in the cabinet. For additional cabinet rigidity, the bottom steel framework is screwed to a wood base. This has the added advantage of eliminating the need for a wood pallet when shipping these consoles in corrugated cardboard cartons.

Photoelectric System Controls Loudspeaker Magnetizer

COMPLETED loudspeakers in a variety of sizes are placed face down on a heavy canvas conveyor belt for transport between the poles of the huge electromagnet used in Crosley's Cincinnati television receiver plant to magnetize the Alnico permanent-magnet fields. As a speaker moves under the electromagnet, it breaks the light beam of a GE photoelectric control system, thereby actuating the contactors that



Loudspeaker magnetizing position on conveyor line. Light source is in foreground, and phototube housing is on far side of conveyor



send magnetizing current through the electromagnet.

Flat copper guide sheets mounted over the belt in the magnetizing region serve to move off-center speakers into position. The copper sheets also hold down speakers that might otherwise be pulled up to the magnet pole.

Twisting Coil Leads

A MOTOR-DRIVEN chuck with a hook in its jaws is used in Crosley's Cincinnati plant to twist a tap coil lead for about two inches of its length, during production of 45-mc oscillator coils for uhf television tuners. During winding, the operator puts in only two or three turns when pulling out a loop of wire for this tap. Twisting the wires by machine reduces operator fatigue and increases production about 370 percent over manual operation.

Motor-driven setup for twisting tap coil lead prior to tin-dipping

In the twisting operation, the operator loops the wire over the hook in the chuck and presses a foot switch to start the winding motor. After twisting, the wire is cut off the hook.

Assembly Fixtures

DURING final assembly of the components and subassemblies for a military radio transmitter having a cast aluminum housing with deep, narrow compartments, several different types of fixtures are used to hold the units outside of the chassis while wiring and soldering the master cable harness.

Tubular wire-wound resistors

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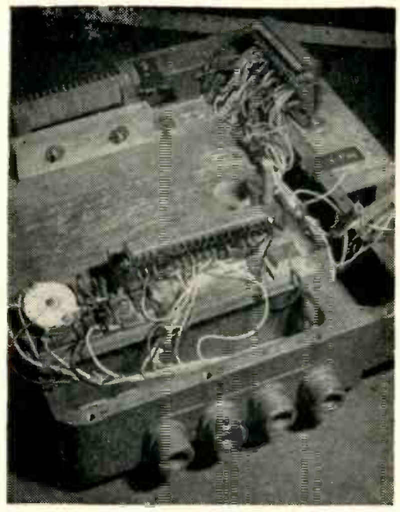

Use of fixtures to permit soldering of wiring harness outside of combination housing and chassis. All wood is treated to prevent warpage. With wood fixtures, reworking is usually possible when specifications are changed

are slipped over metal pegs on the fixture board. Controls are supported by inserting their shafts in drilled holes. Two small, closely-spaced wood blocks grip the soldering-lug termination of a lead. Swinging metal tabs hold other parts in position for this operation in the Clifton, N. J. plant of Federal Telephone and Radio Corporation.

Socket Terminal Spreader

AFTER completion of socket terminal wiring for an IBM electronic calculator panel having over 200 closely spaced tubes, the terminals are spread outward at a uniform angle with a special conical-face tool de-

Using conical tool to spread out tube socket terminals after wiring is completed

NEW 27EP4 PROVIDES GIANT-SCREEN TV AT A PRICE YOU CAN AFFORD!

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27EP4

Picture width	24 inches
Picture height	18½ inches
Deflection angle	90 degrees
Tube length	24 inches
Recommended operating voltage	16,000 v
Focus	magnetic
Screen	Filter glass, aluminized

GENERAL ELECTRIC

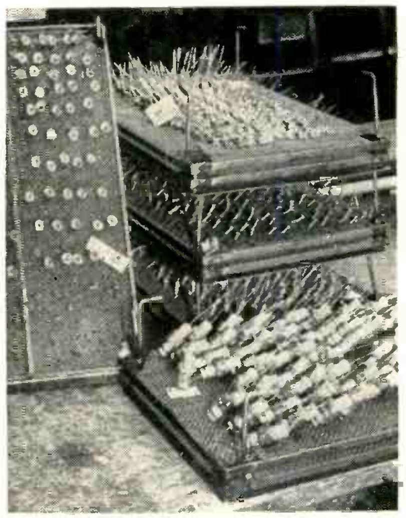
162-1A6

vised for this purpose.

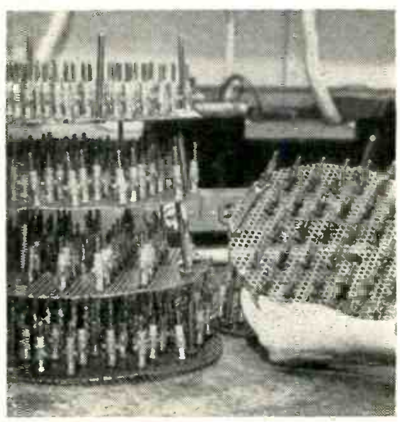
This tool is pushed against the bottom of each socket in turn and twisted slightly. It serves to spread out terminals that may have been bent inward during wiring, insuring exactly uniform clearance between all terminals. With this tool, the operation takes only a few minutes for an entire panel in the Poughkeepsie plant of International Business Machines Corp.

Coil-Handling Trays

FOUR different types of Crosley-designed trays are used to protect television receiver coils from damage while they are being transported from one assembly station to another in this firm's Cincinnati plant. The trays also serve for transporting the coils in large



Wire-screen trays for holding, moving and storing coils and other parts having axial leads



Coil-holding trays made from perforated metal and stove bolts. Round shape permits use on stem of spinner in wax-impregnating tank

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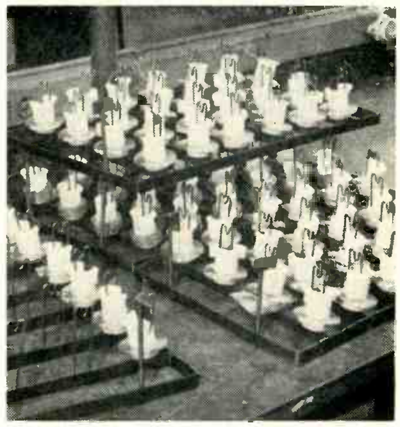
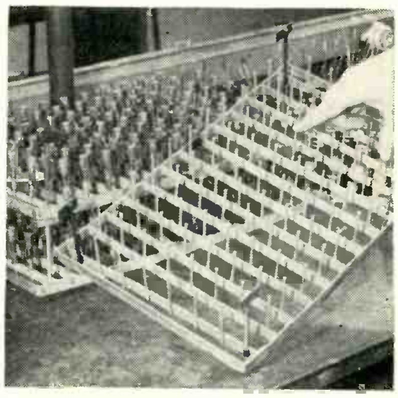


Welded tray using lead-holding wire loops as coil supports

batches through a wax-impregnating operation.

For coils with pigtail leads, such as those wound around a resistor, a paper capacitor or a plain coil form, the tray consists of two layers of $\frac{3}{16}$-inch-mesh wire screen. The layers are spaced about an inch apart on a metal framework. The leads of the coils are pushed through the holes in the screen. Metal studs with bent tops are welded to each corner of a tray to permit stacking without risk of crushing coils.

Another type of tray, used for small coils having center holes, requires no welding. The tray is a single disk of perforated sheet metal. Bolts inserted in the punched holes serve as individual supports for the coils. Each bolt is locked in position with a single nut. Four longer and heavier bolts spaced equidistant around the circumference serve as standoffs to permit stacking of the trays. Each tray has a large center hole that goes on the stem of the spinner in the impregnating tank, so that excess



All-welded tray construction using metal rods as coil supports

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Model CA-71


Lobing Switch
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Model CA-36


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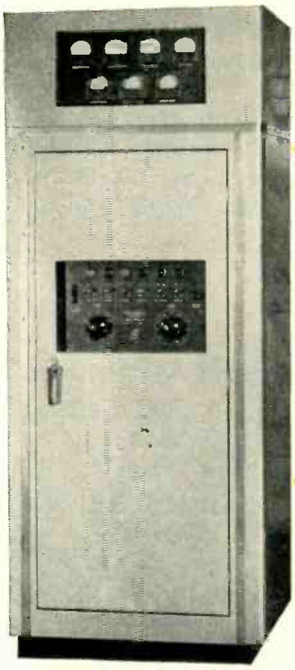
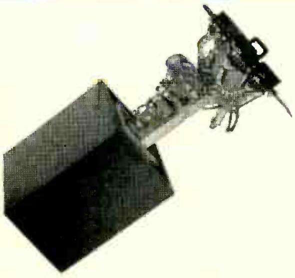
Model CA-20


High Voltage Power Supply Unit
Model BP-01

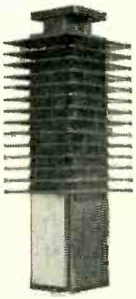

RF & Power Switch
Model CA-60


Antenna Switch
Model CA-57


Polar Recorder
Model BU-02


Transfer Switch
Model CA-19


Logarithmic Amplifier
Model BA-01


Dummy Load
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ELECTRONICS DIVISION

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wax can be driven out from all coils on a stack of trays in one operation.

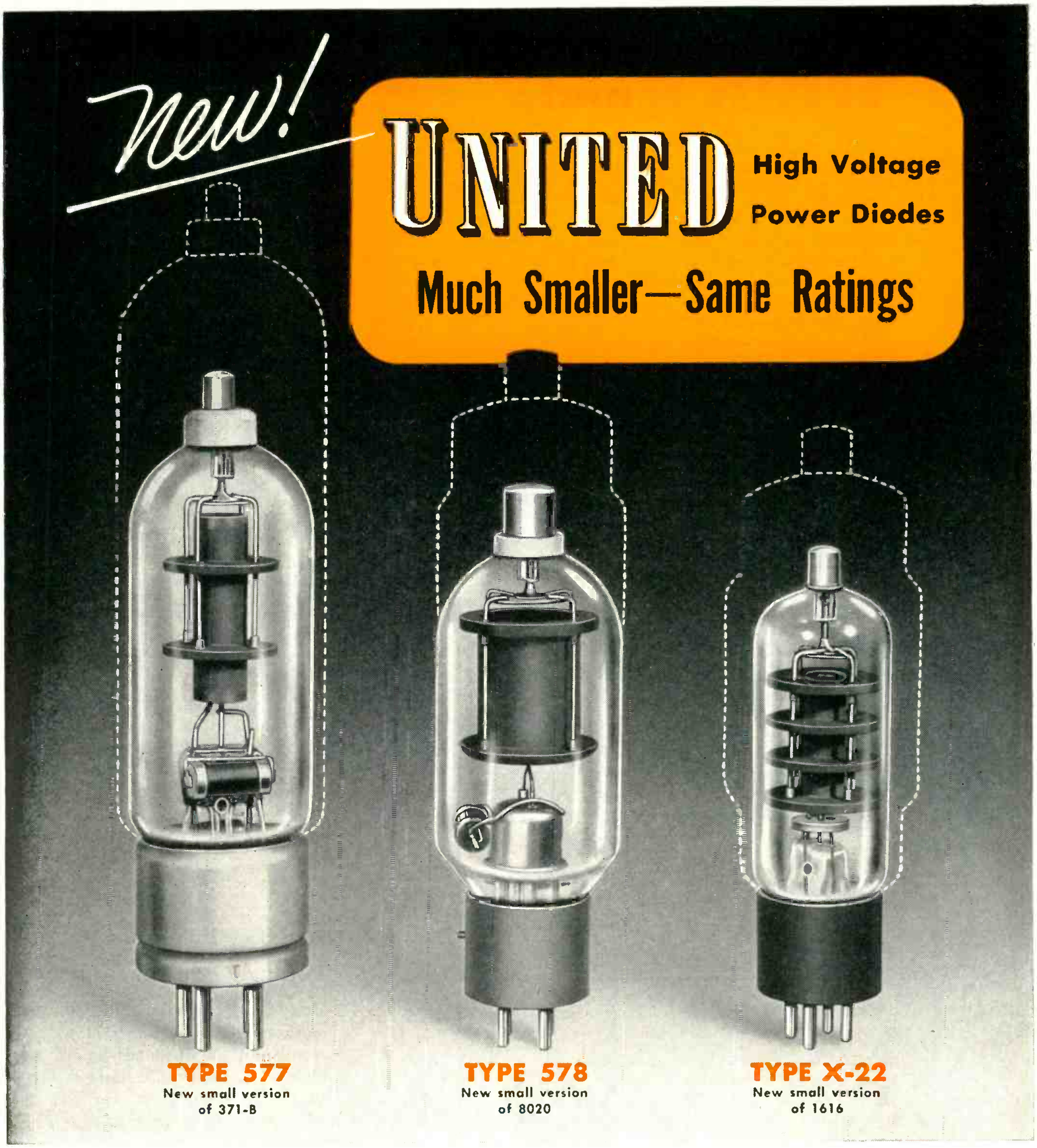
All-welded construction is used on a rectangular tray also intended for coils having center holes through the forms. Coil-supporting metal rods are welded to strap iron strips and these in turn are welded inside a rectangular strap iron frame. Larger rods welded to the four corners serve as standoffs; these have sign-like metal pieces welded to their tops to get greater bearing surface.

A modified rectangular tray uses wire loops instead of rods as supports for larger coils. The loops have double peaks to provide a valley in which the delicate leads of the coils can be placed, to prevent these leads from getting tangled and broken.

Window-Washing Rack

CLEANING of safety glass windows for television receivers is speeded by use of a grooved wood frame which holds the glass rigidly in a vertical position. The operator can then clean and dry both sides of the glass simultaneously, using both hands. A better cleaning job is obtained because any remaining spots and smears can be cleaned from both sides without trying to figure

Window-cleaning rack. Safety dispenser for cleaning fluid can be seen on other side of glass



Illustrations show relative sizes

AIRBORNE radar and other electronic equipment can be made much smaller and lighter by use of these modern, smaller tubes. UNITED has designed types 577, 578 and X-22 as exact electrical replacements for JAN preferred list types 371-B, 8020 and 1616, in applications where space and weight conservation is important.

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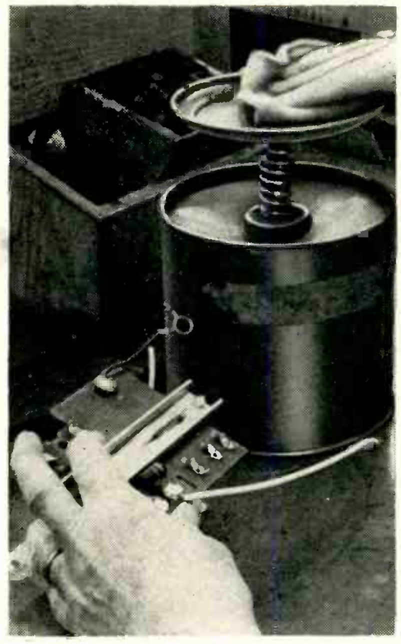
(TRANSMITTING TUBES EXCLUSIVELY Since 1934)



Safety dispenser for cleaning fluid, being used here with a solvent for removing smeared rubber-stamp markings from a subassembly panel

out on which side of the glass they are.

The cleaning fluid used for this operation is So-Clear, made by SOHIO Labs. in Cleveland. The fluid is kept in a special dispensing can made by Protectoseal Co., Chicago. The operator merely presses the cloth down on a sprinkler-type head to actuate a pump inside that forces the fluid up into the cloth.

Metering Pump for Potting Compound

FILLING of television divider network molds with Plastisol potting compound is speeded up in the plant of LaPointe-Plascomold Corp., Windsor Locks, Conn. through use of a metering pump made by E. E. Robinson Inc., Nutley, N. J. Accuracy of metering resulted in a saving of material along with increased production and reduced unit costs.

The pump employs a thermostatically-controlled heated tank that can liquify most solid waxes in less than an hour from a cold start. The pump has a positive gear drive which forcibly ejects fluid compounds with a volume accuracy of three percent and a rate of up to 88 ejections per minute.

In this example, the potting com-

MICROTRAN®

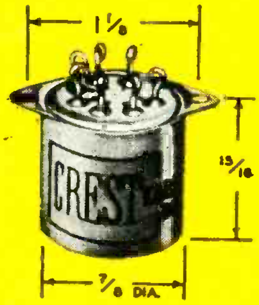
hermetically sealed transformer

available as stock items

These ruggedized military type units were developed to meet demands of a growing miniaturization program.

All units are available from stock in hermetically sealed cans, although open frame units may be ordered. Open frame units are Epoxy Resin impregnated to provide thorough protection from adverse climatic conditions and are supplied with flexible 3" color coated leads.

Also available on special order for MIL applications are standard MIL type cases.



Open Frame Construction

MINIATURE TRANSFORMERS

PART NO.	MIL TYPE	APPLICATION	PRIMARY IMPED.	SECONDARY IMPED. Ω	RESPONSE ±2 db. (C.P.S.) MAX. LEVEL 10 db.	LIST PRICE
M1	TF1A10YY	Mike pickup or line to 1 grid	50, 200, 500	50,000	20-20,000	$15.40
M2	TF1A10YY	Mike pickup or line to 2 grids	50, 200, 500	50,000	20-10,000	15.40
M3	TF1A10YY	Dynamic mike to 1 grid	7.5, 30	50,000	20-20,000	14.30
M4	TF1A15YY	Single plate to 1 grid	15,000	60,000	20-15,000	12.10
M5	TF1A15YY	Single Plate to 1 grid	15,000 4MA.D.C.	60,000	200-20,000	12.10
M6	TF1A15YY	Single plate to 2 grids	15,000	95,000	20-15,000	14.30
M7	TF1A15YY	Single plate to 2 grids	15,000 4MA.D.C.	95,000	200-20,000	14.30
M8	TF1A13YY	Single plate to line	15,000	50, 200, 500	20-20,000	15.40
M9	TF1A13YY	Single plate to line	15,000 4MA.D.C.	50, 200, 500	150-20,000	15.40
M10	TF1A13YY	Push pull p ates to line	30,000 ohms P.-P.	50, 200, 500	30-50,000	15.40
M11	TF1A10YY	Crystal mike to line	50,000	50, 200, 500	20-20,000	15.40
M12	TF1A16YY	Mixing and matching	50, 200	50, 200, 500	30-40,000	14.30
M13	TF1A20YY	Reactor 300 HYS. - No D.C.: 50 HYS - 3MA. D.C.		6,000 ohms D.C. res		11.00
M14	TF1A10YY	50: 1 mike or line to 1 grid	200	1/2 Megohm	80- 3,000	15.40
M15	TF1A15YY	10: 1 single plate to 1 grid	15,000	1 Megohm	100-2,500	15.40

SUB MINIATURE TRANSFORMERS

PART NO.	MIL TYPE	APPLICATION	PRIMARY IMPED. Ω	SECONDARY IMPED. Ω	RESPONSE ±2 db. (C.P.S.) MAX. LEVEL 6 db.	LIST PRICE
SM1	TF1A10YY	Input	200, 50	250,000, 62,500	80-10,000	$12.90
SM2	TF1A15YY	Interstage 3:1	10,000	90,000	100-10,000	12.90
SM3	TF1A13YY	Plate to line	10,000(3MA.)-25,000(1,5MA.)	200, 500	150-10,000	12.90
SM4	TF1A13YY	Output	30,000 1MA.D.C.	50	70-10,000	12.90
SM5	TF1A20YY	Reactor 50 HY at 1 mil D.C.	4,000 ohms.D.C. res.			10.90
SM6	TF1A13YY	Output	100,000 .5MA.D.C.	60	100-10,000	12.90

MICRO MINIATURE TRANSFORMERS

PART NO.	MIL TYPE	APPLICATION	PRIMARY IMPED. Ω	SECONDARY IMPED. Ω	RESPONSE ±2 db (C.P.S.) MAX. LEVEL 0 db.	LIST PRICE
MM1	TF1A10YY	Input	200, 50	250,000, 62,500	200-10,000	$12.90
MM2	TF1A15YY	Interstage 3:1	10,000	90,000	150-10,000	12.90
MM3	TF1A13YY	Plate to line	10,000(3MA.)-25,000(1.5MA.)	200, 500	150-10,000	12.90
MM4	TF1A13YY	Output	30,000 1MA.D.C.	50	150-10,000	12.90
MM5	TF1A20YY	Reactor 50 HY at 1 mil D.C	3,500 ohms.D.C. res.			10.90
MM6	TF1A13YY	Output	100,000 .5MA.D.C.	60	200-10,000	12.90

TRANSISTOR TRANSFORMERS

PART NO.	MIL TYPE	APPLICATION	PRIMARY IMPED.	SECONDARY IMPED.	LIST PRICE M	LIST PRICE SM & MM
*T1	TF1A10YY	Input-Line to emitter	500	500	$14.50	$14.15
*T2	TF1A10YY	Input-Hi impedence mike to emitter	50,000	500	15.70	14.15
*T3	TF1A15YY	Interstage-collector to emitter	50,000	500	15.70	14.15
*T4	TF1A13YY	Output-collector to line	50,000	500	15.70	14.15
*T5	TF1A13YY	Output-collector to speaker	50,000	[illegible]	14.50	14.15

* Add M Prefix to indicate miniature size, SM for sub-miniature size, MM for micro-miniature size. Size to be used depends on D.C. current, frequency response and power output requirements. Write for full details.

Immediate delivery of stock items!

Our circuit design department can assist you in your miniaturization problems. Our recent developments of HI "Q" audio transformers for single frequency applications have permitted substantial reduction in equipment complexity.

Write for Catalogue M and name of nearest representative.

CREST LABORATORIES, INC.

Whitehall Building, Far Rockaway 91, N. Y.

Method of using metering pump for filling large number of Vee-D-X television divider network molds one after another. Molds are held rigidly in metal frame having locking nut at one end

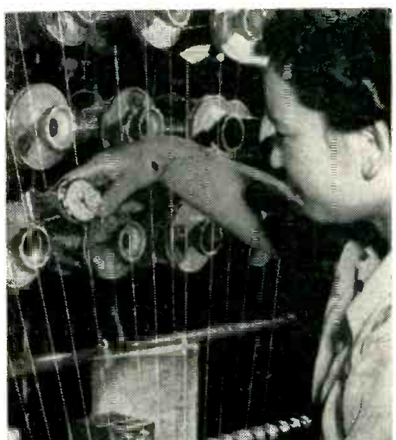
pound is a vinyl copolymer dispersion made by New England Tape Co., Hudson, Mass. When subjected to fusing heat of about 375 F and allowed to cool, it jells to a solid mass that is thermoplastic. Cooling may be hastened by immersing in cold water.

Wire Tension Meter Reduces Coil Rejects

By Erwin J. Saxl

President, Saxl Instrument Co. Harvard, Mass.

In winding coils, wire-wound resistors and tube grids, the tension of the wire is a critical factor affect-

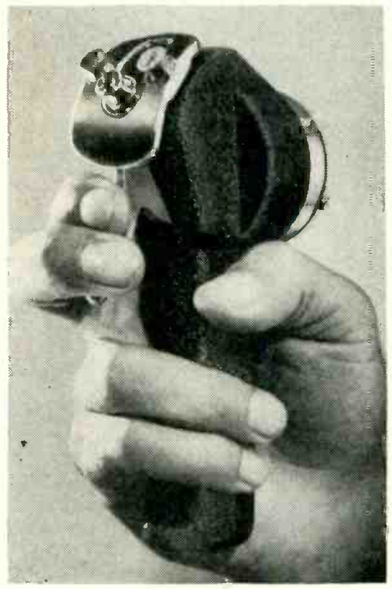


Saxl tension meter in use on coil winder in plant of New England Transformer Co.

ing product quality and output.

If tension is excessive, the wire breaks and has to be butt-welded, resulting in down-time of the machine and a pieced-up wire of lower quality. If the tension is not sufficiently high, the machines are not running at their greatest speed and efficiency; here the cost of direct labor and overhead per foot of wire is increased, and the loose or uneven windings impair quality as well. There is a comparatively limited range of correct tension tolerances within which wire-processing methods should be engineered.

The finer the wire, the greater is the importance of uniform tension during the winding of precision coils. In wire-covering machines also, whether for enamel, tin or yarn insulation, maintenance of standard tensions means freedom from insufficiently covered wires and better yield from wire and insulation materials.



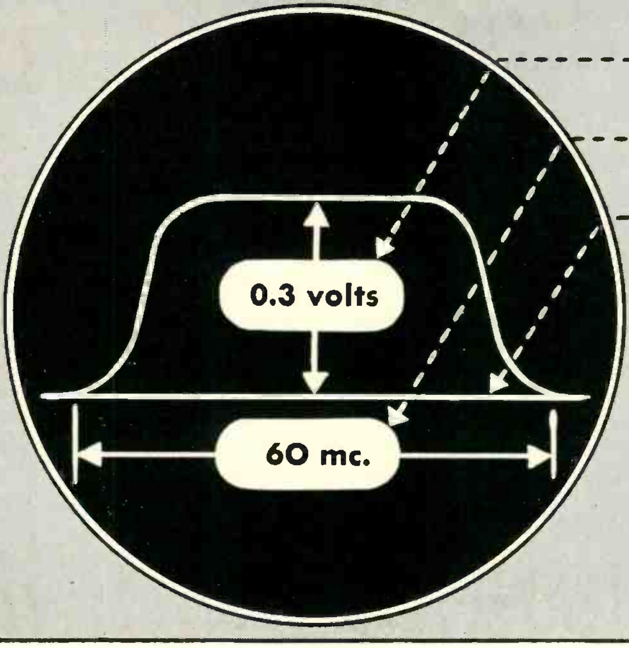
Closeup view of tension meter, showing the three rollers around which the wire runs. Trigger is in released position; when pulled, outer two rollers come down below sensing roller

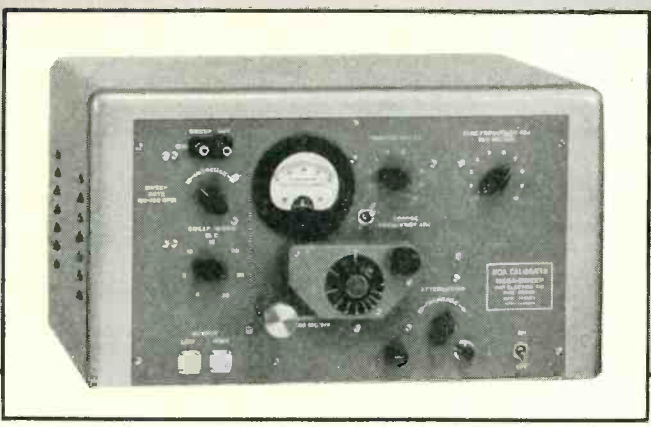
The best wire tension for a particular component is generally known to at least one experienced operator. The problem then involves measuring that tension in order to maintain it during the entire run and to achieve it on other similar machines or on reruns at some future date, independently of availability of the experienced operator. For this purpose, a tension-measuring instrument called the tension

THREE WAYS BETTER!

A New Calibrated Mega-Sweep

1. Much Higher Output
2. Wider Sweep Width
3. Zero Level Baseline





111A CALIBRATED MEGA-SWEEP

FOR MILITARY PROJECTS

VHF-UHF TELEVISION and COUNTLESS LABORATORY APPLICATIONS

This new model of the Calibrated Mega-Sweep has, for work in the UHF range, many advantages over the standard model. The output impedance is 70 ohms unbalanced (over the whole frequency range) or 300 ohms balanced (for the range 450-900 mcs). The output of 0.3 volts into a 300 ohm balanced termination in the UHF range is adequate for frequency response testing of TV converters or tuners. The zero level baseline provides convenience in measuring gain of the circuits being tested. The great sweep width allows viewing the response of several channels at one time.

SPECIFICATIONS

Frequency Range	Output Impedance	Output Voltage
10 mc-950 mc	70 ohms unbalanced	0.15 volts
450 mc-900 mc	300 ohms balanced	0.3 volts

SWEEP WIDTH: Continuously variable to approximately 60 mc maximum.

BLANKING: Provides zero level reference baseline.

GENERAL SPECIFICATIONS: Similar to those of standard model Calibrated Mega-Sweep.

PRICE: $575.00 f.o.b. factory.

NOW IN DEMAND MORE THAN EVER!

Standard Calibrated Mega-Sweep

- ★ FREQUENCY RANGE: 50 kc. to 950 mc.
- ★ SWEEP WIDTH: Variable to 30 mc.
- ★ OUTPUT: 0.05 volt into 53.5 ohms
- ★ CALIBRATED TUNING DIAL: Easy operation.
- ★ AMPLITUDE MODULATION: Less than 0.1 db per mc.
- ★ RUGGED CONSTRUCTION: Reliable performance.

Price: $425.00 f.o.b. Factory

KAY

KAY ELECTRIC COMPANY

25 Maple Avenue — Phone CAldwell 6-4000 — Pine Brook, New Jersey

meter is being used in many coil-winding departments. This instrument is a simple hand-operated dial indicator that can be quickly inserted in the path of the running wire by simple trigger action.

Pulling the trigger of the meter lowers the outer two guide rollers, so that the wire to be checked can be easily inserted between these and the sensing roller. Releasing the trigger brings the moving wire automatically into measuring position. The rollers maintain the correct angle at which the wire passes the center sensing roller, regardless of how the meter is held.

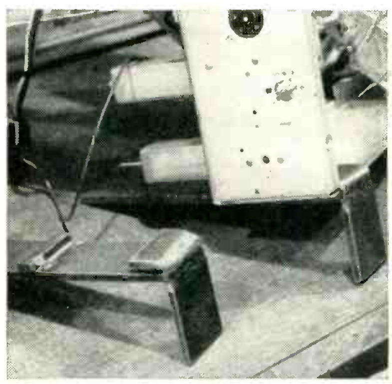
Motion of the sensing roller is kept at a minimum to insure lasting accuracy of the restraining spring in the meter. This small motion is amplified through a zero-backlash gear train to actuate the dial pointer. The scale range is 0-250 grams tension; another meter model has a 0-1,000 gram range for larger wires.

Other factors indicating the necessity of tension measurement and adjustment are the build-up of multilayer coils and the continually reducing diameter of the wire supply spool.

With the aid of a tension meter, the operator can make such adjustments as will keep tensions within practical limits throughout the entire winding operation. This results in better quality, faster production, better utilization of a given quantity of materials and fewer rejects.

Chassis-Holding Fixtures

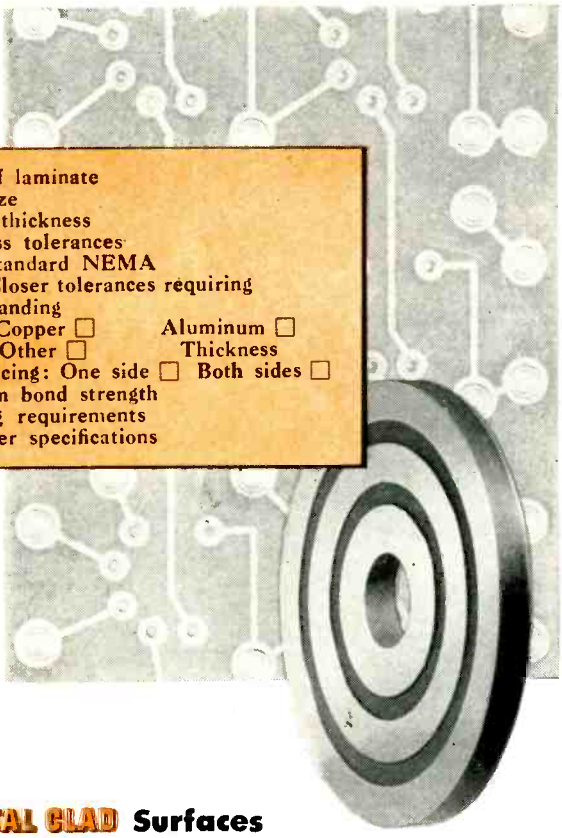
A SIMPLE strap iron fixture holds a television receiver chassis at a pitched angle on a moving conveyor line in Crosley's Cincinnati plant. After bending the iron strap at



Crosley-designed chassis-holding fixture

Information Wanted...

about your uses for C-D-F METAL CLADS



Grade of laminate
Sheet size
Overall thickness
Thickness tolerances
a. Standard NEMA
b. Closer tolerances requiring sanding
Metal: Copper ☐ Aluminum ☐ Other ☐ Thickness
Metal facing: One side ☐ Both sides ☐
Minimum bond strength
Punching requirements
Any other specifications

Did you know that C-D-F supplies a full range of metal clad laminates in both Dilecto and Teflon grades? With mounting interest in printed circuits it pays to consider the respective advantages of these new C-D-F materials . . . it also pays to line up all the Information Wanted facts and discuss your specific application with your C-D-F sales engineer (Offices in principal cities). He's a good man to know!

Dilecto METAL CLADS

Printed circuits depend upon stable, uniform core material and Dilecto has years of proven insulation service (Dilecto is a laminated thermosetting plastic made only by C-D-F from paper, cotton, glass or asbestos fabric base, or a mat base). Normally phenolic or melamine impregnating resins are used for METAL CLAD sheet stock. There are many grades of Dilecto, but only the better electrical grades are supplied with metal foil surfaces. Outstanding is C-D-F grade XXXP-26, a hot punching grade with high insulation resistance, low and stable dielectric losses and excellent moisture resistance. Green color. New C-D-F Catalog GF-53 gives complete data on Dilecto grades. Write for your copy today.

Teflon* METAL CLADS

Glass fiber cloth is first coated with Teflon resin and laminated into C-D-F GB-112T sheet stock. This base withstands high heat (200°C. maximum operating temperature) with the dissipation factor and dielectric constant extremely low over a wide frequency range. No adhesive film is needed to bond metal to the Teflon laminate, thus the inherently good electrical properties of the core material are maintained. GB-112T has practically zero water absorption, so a METAL CLAD with this core offers consistent high insulation resistance with excellent stability of dielectric loss properties.

METAL CLAD Surfaces

Copper foil (usually .00135″ or .0027″ thick) is bonded on one or both faces of the sheet grade of Dilecto selected. The foil used is a special grade of electrolytic deposition copper particularly adaptable for cementing onto laminated materials. An adhesive film is placed between the metal and the Dilecto, and cemented during the pressing and curing cycle. When closer tolerances are required C-D-F sands the Dilecto to the required thickness before bonding. Aluminum, silver, or other alloys of various metals may be supplied.

Better Bond Strengths

One of the most important physical properties of a metal clad product is its peel strength, the pounds pull required to separate the foil surface from the core material. Working with years of laminating know-how, C-D-F has been successful in obtaining the following average test values for its METAL CLAD sheet stocks:

	Lbs. pull per 1″ width
XXXP-26 plus .00135″ copper	5 to 8
XXXP-26 plus .0027″ copper . . .	7 to 10
XXXP-26 plus .0015″ aluminum ..	9 to 12
GB-112 Teflon plus .00135″ copper ..	6 to 9

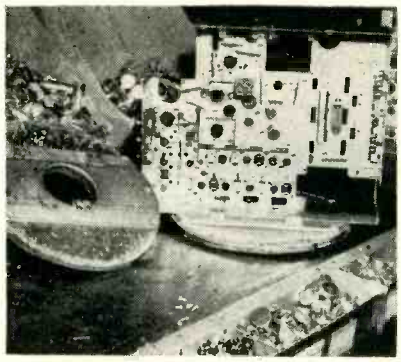
Sheet sizes: Dilecto grades — 38 x 38″, 38 x 42″
Teflon grades — 16 x 36″

THE NAME TO REMEMBER . . . FOR PRINTED CIRCUIT METAL CLAD STOCK

Continental-Diamond Fibre Company
NEWARK 16, DELAWARE

*DU PONT TRADE MARK

Write for new C-D-F General Catalog GF-53, new C-D-F Teflon folder T-52, and talk METAL CLADS with your C-D-F sales engineer.



DuMont-designed chassis-holding fixture

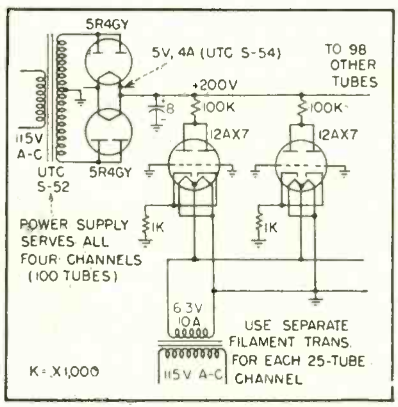
right angles, a chassis-gripping lip is welded to the bend and a metal stop is welded in position halfway down the slope. Once in position, the chassis cannot slide out unless it is first lifted up. Though simple and inexpensive, this fixture supports the chassis at the optimum angle for final wiring work.

A modified version of this chassis-holding technique is used on circular wood pallets employed on both pass-along and moving-conveyor lines in DuMont's East Paterson, N. J. television receiver plant. Here two different arrangements of the holding clips are used, to accommodate two different types of chassis. One set of clips serves as the back stop for the other set.

Tube Burn-in Setups

By Curtiss R. Schafer
The Liquidometer Corp.
Long Island City, N. Y.

RUGGEDIZED and Arinc tube types are not always available, even for military equipment. In the event that regular JAN types must be used, it is desirable to operate them for at least 50 hours under somewhat more severe conditions elec-

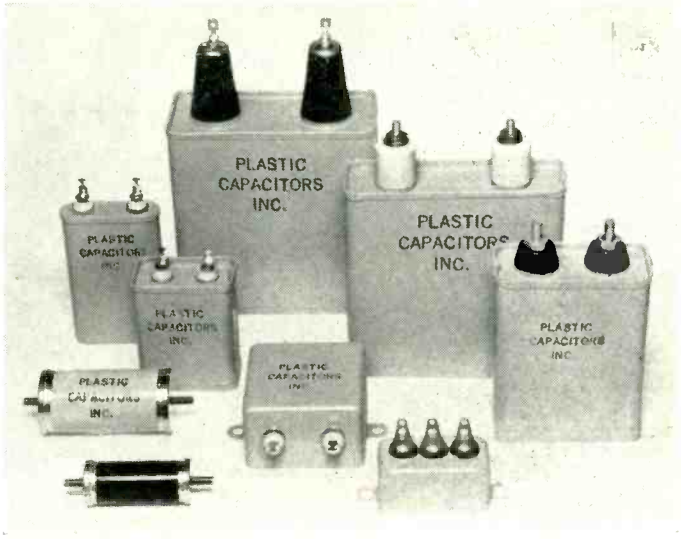


Circuit for aging 100 type 12AX7 tubes simultaneously

PC

Plastic Film Dielectric CAPACITORS*

—because the solid film is chemically stable, dielectrically strong, and non-porous—



GIVE YOU *these* IMPORTANT CHARACTERISTICS

- Smaller size and lighter weight for a given value.
- Operation up to 150° C and more without voltage derating.
- Series resistance exceeding 10^{12} megohms/mfd and as high as 10^{14} for small capacitance values.
- Dielectric absorption as low as 0.02%.
- Power factor at 60 cycles as low as 0.01%.
- Q factors exceeding 500 at 100 KC.
- Capacitance stability to within 0.5% for a period of one year.
- Voltage range 100 volts to 60 KV.
- High current (continuous or intermittent) service for r. f. or pulse circuits.

Get this FREE Catalog

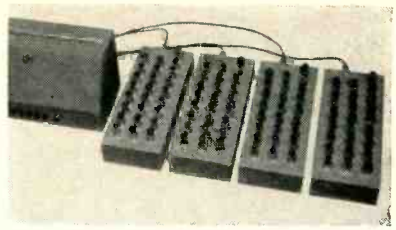
Contents: Temperature range; Capacitance tolerances; Capacitance stability; Temperature coefficient; Power and Q factors; Dielectric absorption; Permissible ripple; Life; Containers; Impregnant; Insulators and terminals; Mounting brackets; Vibration and shock; Salt spray and immersion; *plus* HIGH-VOLTAGE LOW-CURRENT POWER SUPPLIES and PULSE FORMING NETWORKS.

**Choice of solid dielectric film and impregnant accentuates the electrical characteristics and increases the effectiveness of the circuit.*

Plastic Capacitors, Inc.

PLASTIC FILM CAPACITORS • HIGH VOLTAGE POWER SUPPLIES • PULSE FORMING NETWORKS

2511 WEST MOFFAT STREET • CHICAGO 47, ILLINOIS



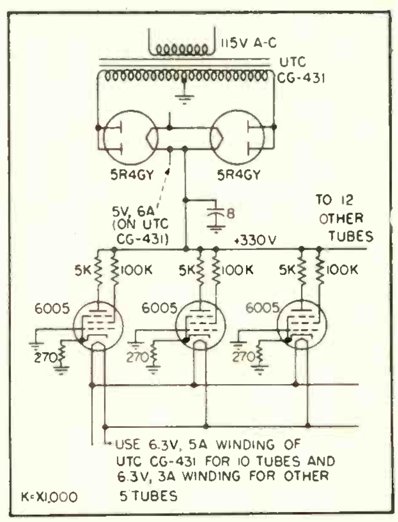
Burn-in setup for 100 type 12AX7 tubes

Burn-in setup for 15 type 6005 tubes

trically than they are subject to in normal use. The equipment shown is used to burn-in 12AT7 and 12AX7 tubes, 100 at a time and for a period of 100 hours. About 18 percent of all 12AT7 tubes received from the manufacturer showed one defect or another after the burn-in. These tubes checked OK on a standard tube checker when they were received, but they would undoubtedly have resulted in many equipment failures if they had been used.

The burn-in equipment consists of a power supply and four tube racks. Separate plate and cathode resistors are necessary to prevent oscillation.

A similar piece of equipment is



Circuit for aging 15 type 6005 tubes simultaneously

SYLVANIA PICTURE TUBES

Out-perform, out-last all others tested!

Fifty minutes *on* . . . ten minutes *off* . . . hour after hour for 500 consecutive hours, Sylvania Picture Tubes were tested side by side with the tubes of other leading manufacturers.

These intensive tests, made under punishing, accelerated voltages were conducted under supervision of an outside, independent laboratory. Checks were also taken over a 3-month period for emission, leakage, color, light out-put, grid control, and other characteristics.

Read the remarkable record.

The chart at right tells the story. Note that *only* Sylvania Picture Tubes showed no failures. And, in over-all point quality, *Sylvania won over all other brands by a wide margin.*

These important conclusions definitely place Sylvania Picture Tubes in the highest rank. They also mean the highest in trouble-free operation . . . better business . . . more satisfied customers for every set manufacturer who uses Sylvania Picture Tubes. For full details about these important tests write today to: Sylvania Electric Products Inc., Dept. R-1411, 1740 Broadway, New York 19, N. Y.

United States Testing Co.
1415 Park Ave., Hoboken, N. J.

Test No. E-5095
August 8, 1952

Manufacturer	Number of Tubes Tested	Number of Failures	Overall Point Quality
A	8	1	81
B	8	1	78
C	8	6	62
D	8	1	83
E	8	4	67
F	8	5	42
G	8	4	52
H	8	5	30
SYLVANIA	8	NONE	92

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS used for burning in 6AQ5 tubes. In this case the power requirements are so great that only 15 tubes are handled by each unit. Both aging setups are being used for tubes required in capacitance-type aircraft fuel gages made by The Liquidometer Corp.

Strand Twister

A MOTOR-DRIVEN wire twister rolls loose strands together on stripped wire at high speed in Crosley's Cincinnati plant. A cone-shaped hole in the end of the twister guides

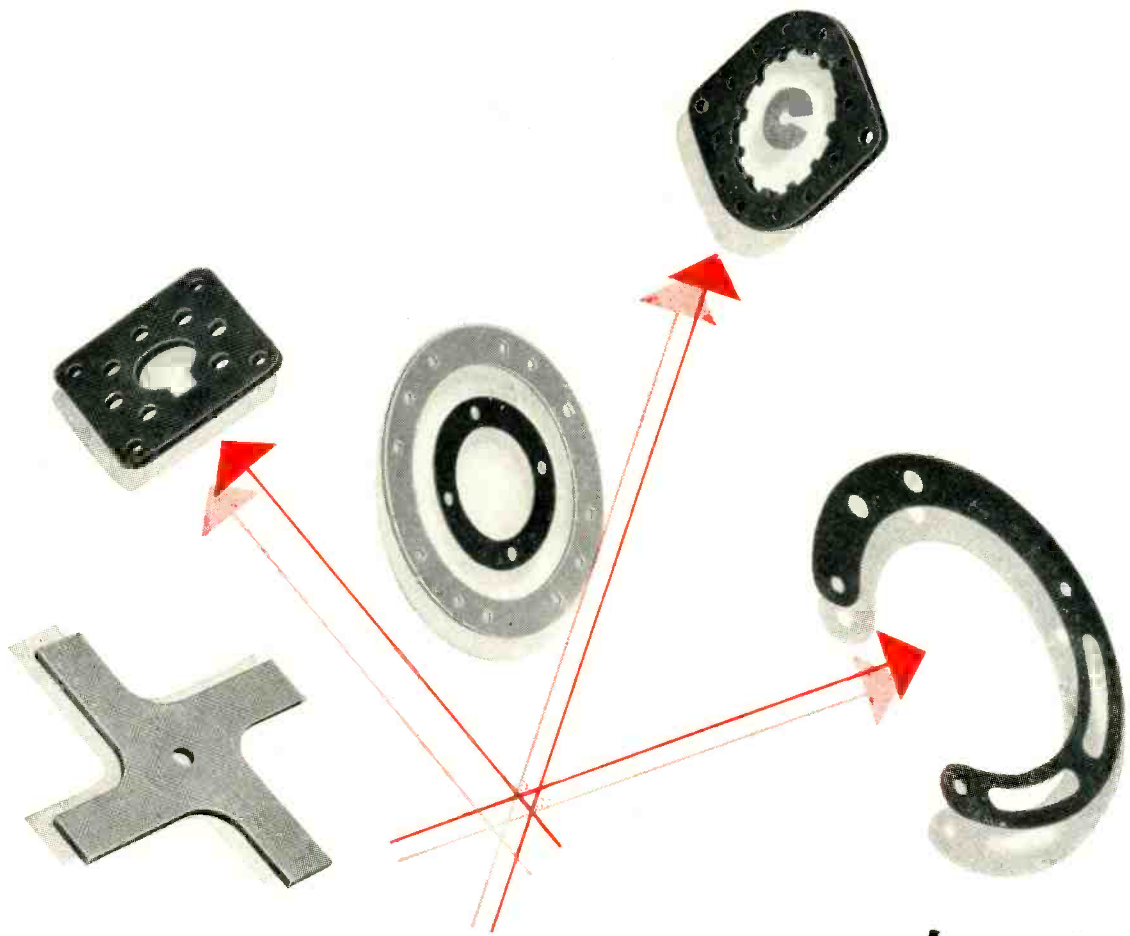
Twisting loose strands together on shielded cable after stripping. Next operation is tin-dipping. Operator picks up handful of conductors, twists them individually, then lines up ends and dips entire handful into solder pot

the strands between a rotating pair of flat jaws as the conductors are inserted one by one. The twister is made by The Wire Stripper Co., Cleveland, Ohio.

Slide-in Subassemblies Simplify Wiring and Soldering

BY WILLIAM F. WEBER
Project Supervisor
Ford Instrument Company
Division of the Sperry Corporation

A NEW packaging system for electronic components of a Navy aircraft computer features standardized miniature units, readily producible, extremely flexible, compact and light in weight. Equally important is the ease of assembly and disassembly, making for fast, uncluttered maintenance in the field by personnel with limited training. This equipment was evolved under



the properties <u>you</u> want are "built-into" Lamicoid®

High Dielectric Strength
Low Power Factor
Heat Resistance
Low Moisture Absorption
High Impact Resistance
Dimensional Stability
Light Weight
Tensile Strength
Abrasion Resistance
Good Machinability
Punchability

Many specific properties and combinations of properties—to suit the exact requirements of *your* product—are built into LAMICOID. This thermosetting laminated plastic (made with such fillers as glass, nylon, fabric, paper, etc., with a variety of synthetic resins) has solved the problem of material shortages in many fields.

LAMICOID may be the answer to the mechanical, structural and insulating needs of *your* application. Here are just a few of its many uses: dials, antenna parts, coil forms, tube socket supports, panels, motor and transformer parts, switch gear and relay parts.

Take advantage of the versatility of LAMICOID; put it to work for you. LAMICOID is supplied in standard sheets, rods and tubes, or fabricated into parts to your specifications. Whatever your electrical insulation problem may be, let us put our 58 years of experience at your disposal. For a prompt quotation, send blueprints or specifications.

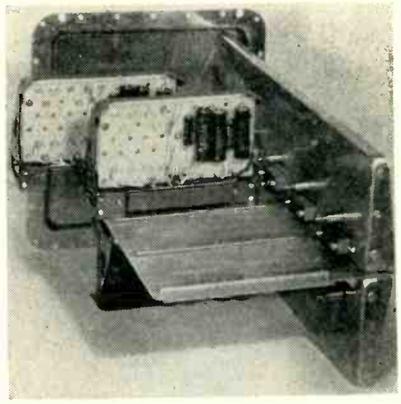
MICO ELECTRICAL INSULATION ®

MICA *Insulator* COMPANY

Schenectady 1, New York

Offices in Principal Cities

LAMICOID (Laminated Plastic) • MICANITE® (Built-up Mica) • EMPIRE® (Varnished Fabrics and Paper) • FABRICATED MICA

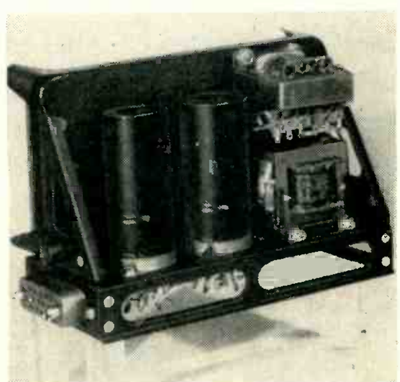


Type of T-shaped frame used to support subassemblies. This frame slides into a container which may be sealed for pressurizing

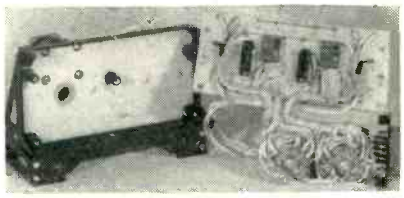
a development contract with the Navy Bureau of Aeronautics as part of a continuing program to equip Navy aircraft with reliable scientific instrumentation without further complicating the already highly complex chore of maintaining airborne equipment.

The development involves an electronic computing network, the basic packaging form of which may contain a dozen or more subassemblies. The mounting frame supporting the subassembly chassis is T-shaped. It mounts into a container that can be sealed, permitting pressurizing or the use of dry inert gas.

The subassemblies are built around standard chassis, terminal boards and plug-in connectors. Design of the chassis is such that resistors, capacitors, sockets and other components can be completely wired on a layout board before assembly onto the chassis. This expedient simplifies wiring and soldering operations, making for



Example of amplifier subassembly. Its chassis slides on rails and is locked in position on the main frame with the jack-screw at the left, which also serves to mate plug-in members



New packaging technique permits wiring resistors, capacitors and other parts on a convenient layout board before assembly onto the chassis

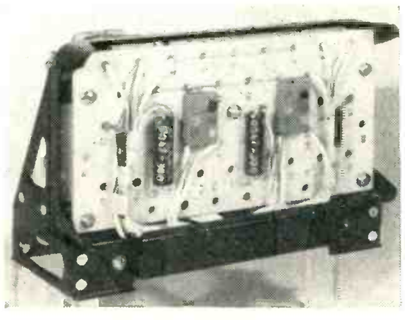
clean, well-soldered connections and uniform cable layout. This feature enhances miniature design, allowing for more compact construction through the elimination of inaccessible areas.

Assembly after wiring merely involves securing the terminal board, sockets and plug-in connector to the chassis and tightening several screws.

Interlocking rails and guards are used for mounting subassemblies on the T-shaped frame. A subassembly is installed by aligning the rails and guards, sliding the unit in place and tightening a jack screw. Electrical connections are made by plug-in connectors whose male and female members mate when the subassembly is secured. The T-shaped frame provides rigidity with a minimum of material and allows for even distribution of weight.

The flexibility of this type of construction makes it possible to build a complete computer to any degree of complexity by combining readily assembled, integral units. Modifications can be performed by simply exchanging one or more units and/or subassemblies.

The assembly of units in convenient rack-type structures with small intervening air spaces presents

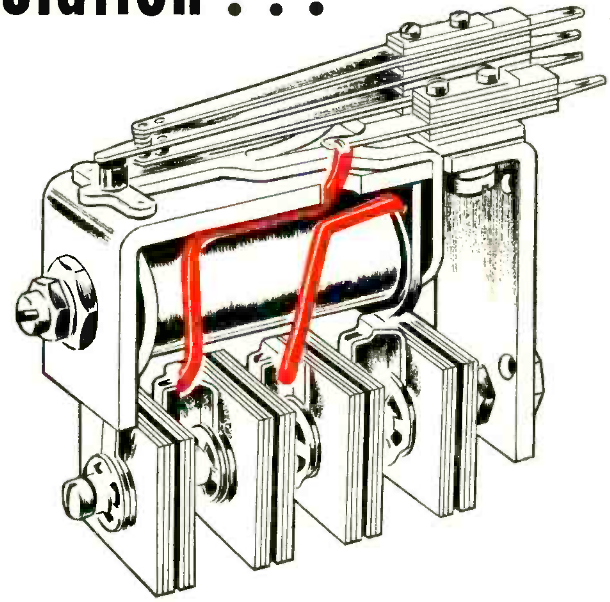


After wiring is completed, the layout board, sockets and plug-in connector are fastened to the chassis with bolts. Further speed-up in production could be achieved by use of dip-soldering if quantities warranted use of such high-speed fixtures

Where Application Requires Really Flexible Class H Electrical Insulation . . .

BH "1151"

SILICONE RUBBER COATED FIBERGLAS TUBING



BH "1151" Silicone Rubber coated Fiberglas tubing is flexible when manufactured and *stays* flexible through all applicable NEMA Class H tests. This long-lasting union of two great inorganic materials assures maximum product protection.

BH "1151" withstands bending, required in normal assembly, without loss of dielectric strength—will not craze or crack. It remains unchanged through continuous product operation in a temperature range of −90° F. to 400° F. . . takes 600° F. for 15 minutes without physical or dielectric failure.

Are you looking for a product with high dielectric, chemical and fungus resistance? . . . Use BH "1151".

Available in colors; in economical coils, 36 inch lengths, or cut without wastage to your specifications. Send for samples and data sheets today.

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Bentley, Harris Manufacturing Co.
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BH *Fiberglas SLEEVINGS**

*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

relatively large heat-dissipating areas, adapting the instrument to convectional cooling systems.

Grouping of accessible units simplifies maintenance. In the event of failure, units or subassemblies rather than isolated components can be checked and the fault remedied by the insertion of a new unit or subassembly. The testing of units rather than components allows for simplification of maintenance test equipment, making feasible the adaptation of built-in fault-locating systems.

Unit maintenance minimizes field servicing time and does not require the ability of highly trained personnel.

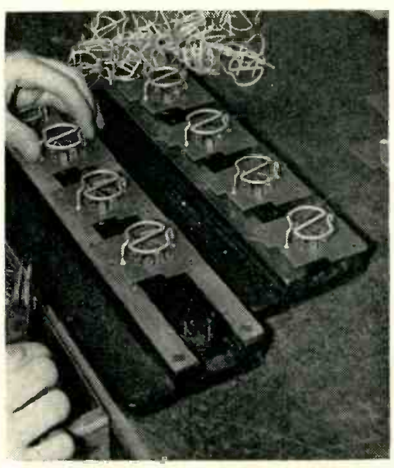
Structural parts are designed for simplicity and ruggedness. All parts can be readily produced by punching and die-forming operations, resulting in maximum production rates with a minimum of man effort.

Structural assemblies are of riveted construction. Rivets appearing at the surface of a unit are solder-sealed to prevent gas or pressure leakage.

The above-described packaging system has made possible great saving in weight and space, while still providing a frame rigid enough to withstand all stress in military aircraft and enough room for heat dissipation and clearance between electronic parts.

Socket-Holding Fixtures

ASSEMBLY of four corona shield and socket assemblies simultaneously is made possible by use of a simple



Socket subassemblies plug into up-ended tube bases on these holding fixtures

ON THE "FRONT LINE" IN COMMUNICATIONS

The rich experience and vast facilities of Delco Radio are again at the service of the nation!

Delco Radio has a major part in the current rearmament program . . . is currently producing advance-type radio equipment for many branches of the military. Delco Radio products serve equally well in civilian communications . . . in millions of passenger cars and trucks . . . in untold numbers of homes. Yes, in peace as in war, Delco Radio is on the front line in communications with on-time production of *superior* products. See for yourself!

DELCO RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

LEADER...

IN PRODUCTION

Delco Radio is the world's largest builder of automobile radios . . . the leader in production and assembly of component parts.

LEADER...

IN ENGINEERING

Delco Radio developed many of the most important advances in automotive radio . . . has unsurpassed experience in this field.

LEADER...

IN QUALITY

Every step in the manufacture of Delco Radio products is closely supervised to maintain high, uniform product quality.

LEADER...

IN MANUFACTURING

Completely integrated for efficient production, from raw material to finished product, Delco Radio meets any customer need.

wood fixture in Crosley's Cincinnati television receiver plant. Each socket is held upside down on the fixture by a tube base that has been bolted to the base of the fixture. Metal-covered wood rails alongside the tube bases serve as supports for the socket flanges, to protect socket terminal clips while pressure is applied during soldering of the heavy-wire corona shields.

On most fixtures of this type, all but two of the tube base pins have been clipped off to make insertion and removal of the socket easier. Octal tube bases are used. The aligning key is also removed since sockets can be oriented visually by glancing at the irregular-shaped socket mounting plate.

The metal plates on top of the rails serve to chill any solder running through the tubular rivets in which the corona shields are set and soldered. These same rivets also serve to fasten the socket to its plate.

Vise On Powrarm

A SIMPLE arrangement welded onto the stud of a Powrarm Junior work-positioning tool gives a universal holding fixture for assembly work on almost any type and size of small chassis or subassembly. As used at the Poughkeepsie, N. Y. plant of International Business Machine Corp., the vise jaws are tightened by an ordinary machine nut to

Vise-type holding fixture grips wide variety of subassemblies

ENGINEERING

PLUS

CRAFTSMANSHIP

SOLVED

THIS UNUSUAL

REQUIREMENT

THE PROBLEM:

The problem was to develop a crystal unit for AM broadcast (550-1600 kc) which would maintain frequency tolerance per FCC requirement (±20 cycles) *without temperature control.*

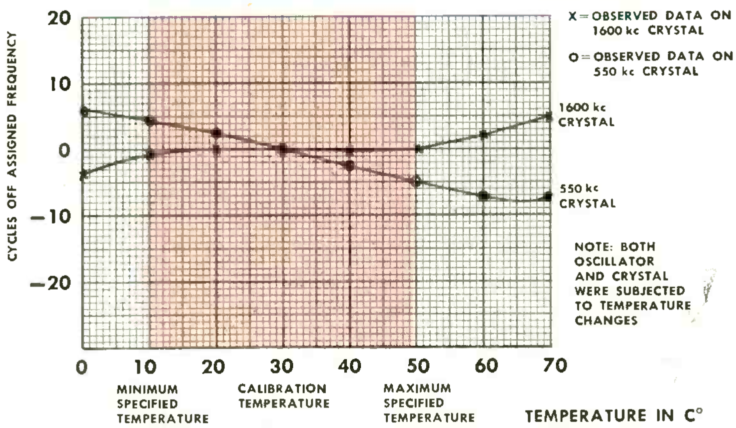
THE SOLUTION:

When designing the crystal oscillator, the transmitter manufacturer gave primary consideration to voltage stability and low r.f. current. The resultant design provided an ideal environment for realization of the inherent stability of the crystal unit employed.

Bliley designed a plated crystal utilizing precision orientation to achieve the low drift characteristic needed. Contrary to ordinary practice in this frequency range, the crystal was soldered between rigid supports to prevent frequency deviation due to physical displacement. The assembly was then hermetically sealed in a dry nitrogen atmosphere to prevent contamination and minimize aging.

The resultant production units,type BH8, are calibrated at 30°C with maximum deviation not exceeding ±10 cycles thru the temperature range from +10°C to + 50°C.

TYPICAL STABILITY DATA



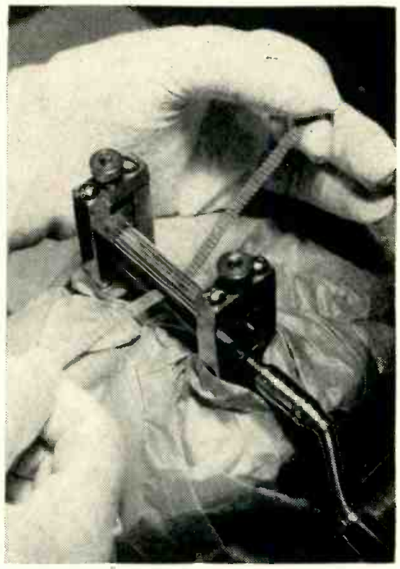
Bliley CRYSTALS

BLILEY ELECTRIC COMPANY • UNION STATION BUILDING • ERIE, PA.

which has been welded a rod that serves as a handle, eliminating need for a wrench. A spring between the jaws keeps them separated for ease in loading a new part.

Mesh-Crimping Machine

A VARIATION of the old hand-cranked clothes wringer is used to crimp nickel mesh ribbon in the Newark, N. J. plant of Chatham Electronics Corp. Both rollers have longitudinal ridges machined out of the solid metal. Spacing between rollers is such that the ridges mesh



Gloved hands and paper under crimping machine insure cleanliness of crimped mesh ribbon

like gear teeth, with only enough clearance to equal the thickness of the nickel ribbon. A crank arm is attached to one roller. Knurled lock nuts permit raising or lowering the upper roller to adjust for different thicknesses of materials.

The crimped ribbon serves as the hydride coil for the type 1907 hydrogen thyratron tube made by this firm for pulsing high-power radar magnetrons.

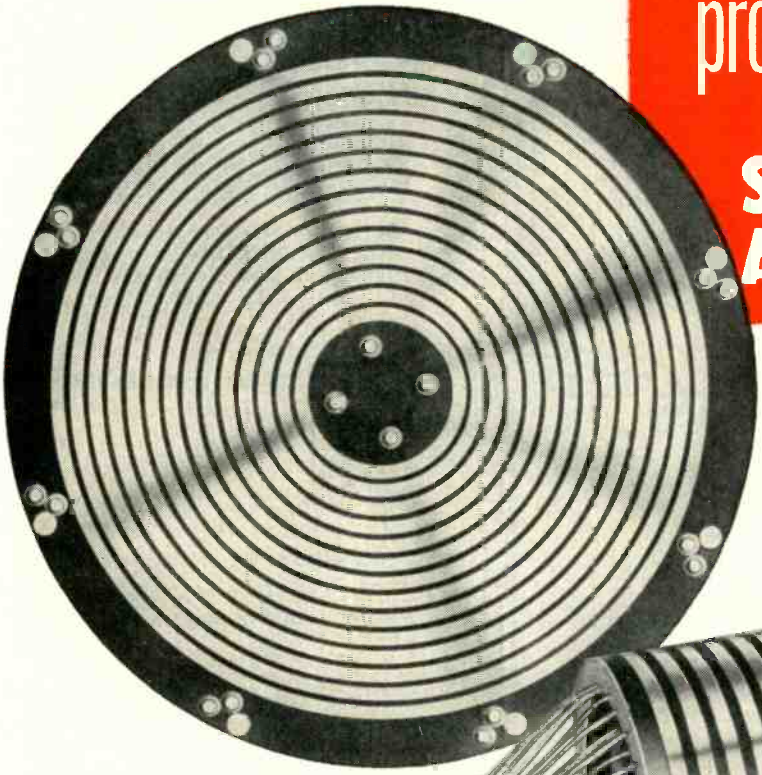
Rack for Line Cords

TOTE rods mounted on casters facilitate transporting of line cord assemblies to the next operating position on the television receiver assembly line in Crosley's Cincinnati plant. The tote rods are nailed at one end to a wood framework, and are spaced just far enough apart so that line cords go between them easily. The metal mounting

Now available the revolutionary ELECTRO TEC process* for your LARGE SLIP RING ASSEMBLIES

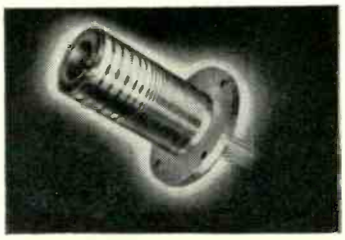
featuring

- LOWER COST • CLOSER TOLERANCES • ONE-PIECE CONSTRUCTION • JEWEL-LIKE FINISH • UNIFORM RING HARDNESS • REDUCED WEIGHT



An assembly with 14 concentric, hard silver rings electro deposited into machined plastic blank. Dovetail locks rings in place. Machined blank insures accuracy. Diameter approx. 11", thickness approx. 5/16".

Cylindrical assembly with 25 rings. Three wide rings accommodate large contact area brushes for high current capacity. Length 14", O.D. approx. 5⅜".



An assembly with 30 rings of various widths to accommodate various current requirements. Unit is approx. 4-5/16" long, designed for flange mounting.

Cylinder type assembly approx. 3¾" long with 24 hard silver rings. 1⅝" O.D. with wall thickness less than ¼".

*PATENTS PENDING

Now a Complete Service in all sizes of Slip Ring Assemblies

ELECTRO TEC is now tooled up, with new expanded facilities for production of large Slip Ring Assemblies to exact customer specification. Sizes range up to 24" in diameter, either cylindrical or disc type.

The exclusive ELECTRO TEC PROCESS*—the electro-deposition of hard silver rings into an accurately machined plastic blank—consistently yields a high degree of dimensional accuracy, excellent concentricity, and a jewel-like ring finish. This process also eliminates expensive tooling and mold charges, frequently lowers costs to 30% of other methods of manufacture. The silver rings are uniformly hard for long life—75-90 Brinell.

ELECTRO TEC one-piece construction precludes dimensional variation due to accumulated errors. The plastic base is fully cured before rings are plated into it, thus preventing separation of base material from the rings.

ELECTRO TEC LARGE SLIP RING Assemblies are widely used in Radar Equipment, Fire Control Systems, Test Tables and many other critical applications. Light weight combined with rugged durability recommends their use in airborne applications.

Every user knows the ELECTRO TEC reputation for quality and superiority in miniature and sub-miniature slip ring assemblies.

Our Engineering Department is available for consultation on any of your slip ring problems without obligation.

ELECTRO TEC CORPORATION
SOUTH HACKENSACK • NEW JERSEY

Rolling rack for television receiver line cords. Operator places cords on it after stapling the metal back-cover plate to the female end of the cord

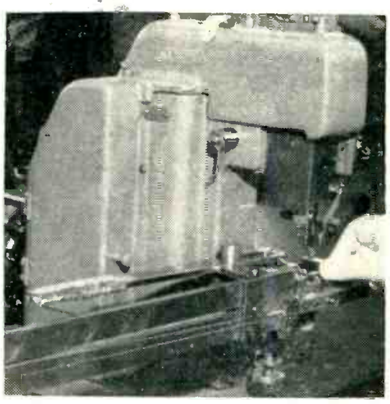
plate assemblies stay on top of the rods, and the coil cords hang down below. The construction reduces tangling of cords.

With 17 slots and a capacity of 10 cords per slot, the total capacity of the rack is 170 cords. The rack is called a xylophone by plant workers because of its resemblance when empty to this instrument.

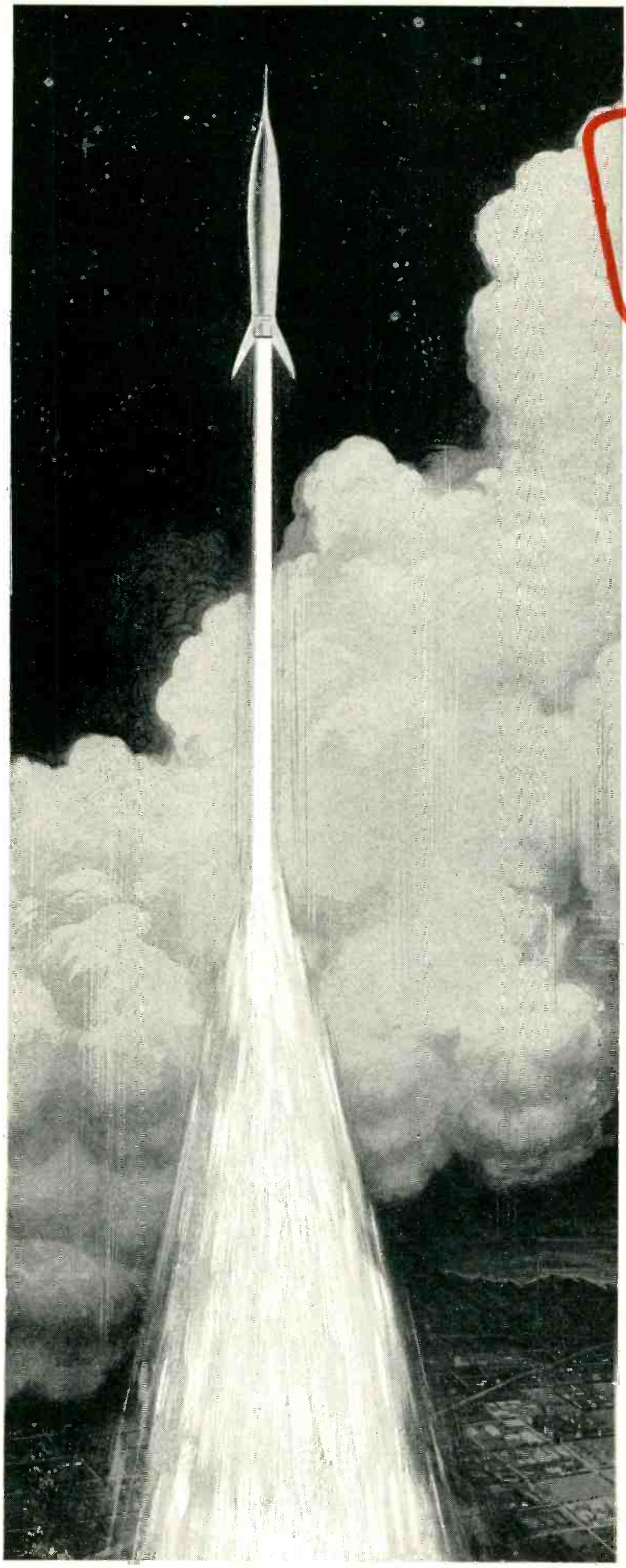
Assembling Dial Drive Cords

A RIVETING-MACHINE setup in Crosley's Cincinnati plant automatically produces finished dial drive cords cut to correct length and having securely riveted end loops. The operator needs only to unload and rethread the machine. Two loops are formed at each operation, one for the end of a finished cord and one for the start of a new cord.

As the first step, the operator hooks the loop (formed on the end of the cord coming from the spool during the previous operation) over



Riveting machine setup used for forming loops in drive cords for radio and television dial tuning



IMPORTANT ANNOUNCEMENT

...to Engineers and Scientists

You can now fill vital positions in our guided missile projects

Chance Vought Aircraft, a supplier of high performance Navy aircraft for 35 years, is presently engaged in highly classified work on guided missiles under Navy contract. These missiles are in restricted production for intensive experimental use. They are flying and their performance has been excellent.

Engineering and scientific personnel with backgrounds in Aerodynamics or Electronics will find exceptional opportunities for employment on these interesting projects. Openings are available to personnel with Ph.D. and M.S. degrees, or B.S. degrees with related missile experience.

For further information write Engineering Personnel Section, Chance Vought Aircraft, P. O. Box 5907, Dallas, Texas.

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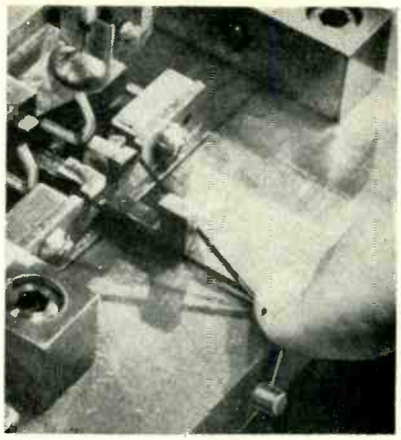
Division of United Aircraft Corporation

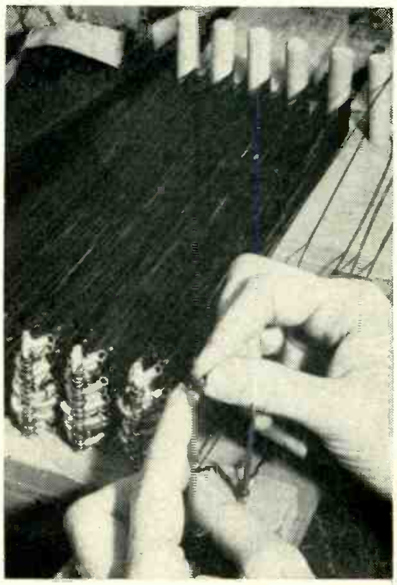
DALLAS, TEXAS



Closeup of riveting machine after cord has been strung. Retractable metal peg is just under finger. Cutter bar is just in front of finger, and moves away from finger when hand lever is operated

a spring that is clamped to the machine. She then brings the cord around a pulley mounted on an outrigger at the left end of the machine; the position of this pulley is adjustable for changing the total length of a cord.

From the pulley, the cord is brought back around a metal peg in front of the operator, brought around one loop-forming hook, run across a gap through which the cutting tool later passes, then brought around the other loop-forming hook and back toward the operator. She holds her finger on this end of the cord to maintain tension, then operates the foot pedal of the press. This applies the rivet

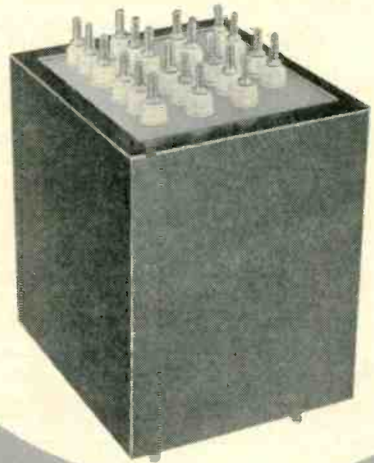


Rack for storing and transporting finished drive cords

"DOUBLE-TEAMED"

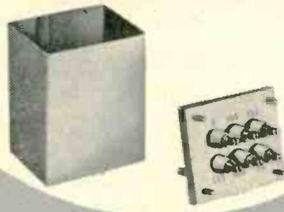
for quality

GENERAL TRANSFORMERS



manufactured with

Heldor CANS & TERMINALS



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MIL-T-27 SPECIFICATIONS

General Transformer Company uses Heldor transformer cans and compression-type, hermetic seal bushings as a practical solution to many assembly problems. From design through every step of production, they know that their finished transformers will meet MIL-T-27 specifications.

Take advantage of HELDOR's new "PACKAGE"—transformer cans with hermetic seal bushings ASSEMBLED in can covers, all ready for final assembly operations—to save time, money and inventory problems. Don't buy merely cans and terminals—buy this new Heldor "PACKAGE". Mail specifications of your present can and terminal assemblies for a money-saving quotation.

☐ Enclosed are specifications.
Quote on . . . . Heldor "PACKAGES"
(Quantity)
☐ Send new Heldor Bushing Catalog.
Name . . . .
Title . . . .
Company . . . .
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State . . . .

WRITE FOR DATA

HELDOR MANUFACTURING COMPANY

Division of HELDOR BUSHING & TERMINAL CO., INC.

225 Belleville Avenue, Bloomfield, New Jersey

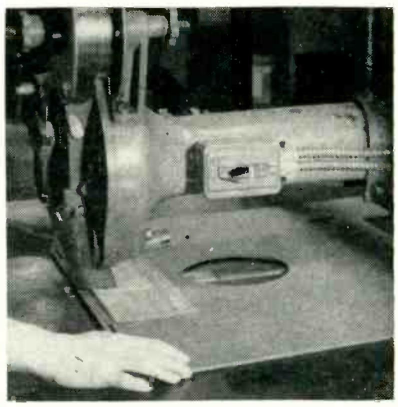
over the final loop to complete the cord.

With her left hand, the operator then moves the hand lever on the machine enough to bring the starting loop for the new cord under the riveting head, and operates the foot pedal again to apply the second rivet. Moving the hand lever still farther now pulls the cutting blade back through the cord, shearing it. A final movement of the lever retracts the metal peg on the front of the machine, releasing the tension so that the finished loops can be unhooked easily.

At another work position, a spring is hooked on to each end of the finished cord. The cords are then stored on an adjustable tote board. This has headless nails at one end over which the spring eyes are placed. Each cord is hooked over one of the wooden pegs on a sliding board at the other end. The peg board is positioned correctly for a particular length of cord, then locked in position with a thumb screw.

Ventilating-Screen Stapler

PROTECTIVE wire screens are stapled over ventilating openings in the composition backs of television receivers at a production rate of less than one minute per set, in Crosley's Cincinnati plant. This is made possible through use of a heavy-duty Bostitch power stapler controlled by a foot pedal. The machine uses spools of wire rather than staples, thereby reducing material costs for the operation.



Stapling protective screen to back cover for television receiver

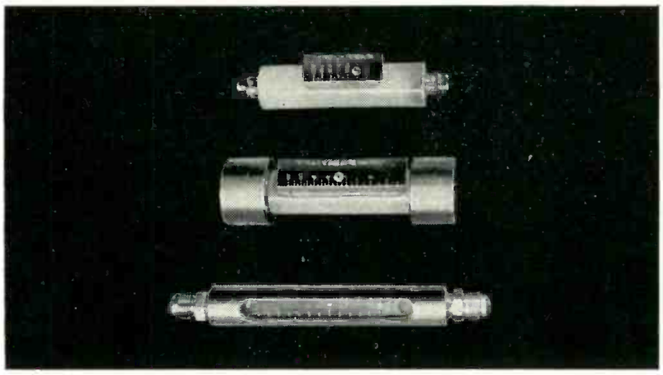
KEL-F

*Reg. U. S. Pat. Off.

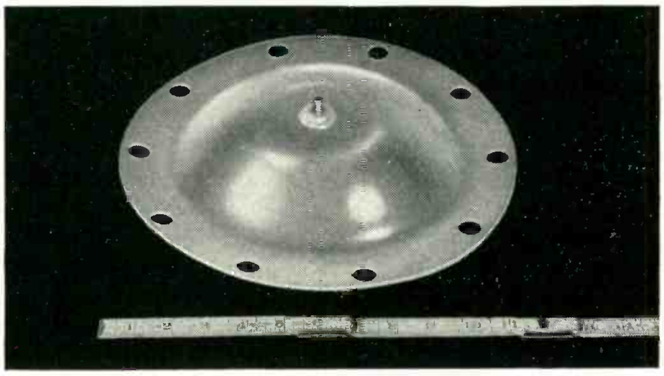
ONLY COMMERCIAL FLUORO-CHLORO-CARBON THERMOPLASTIC

Application Report #4

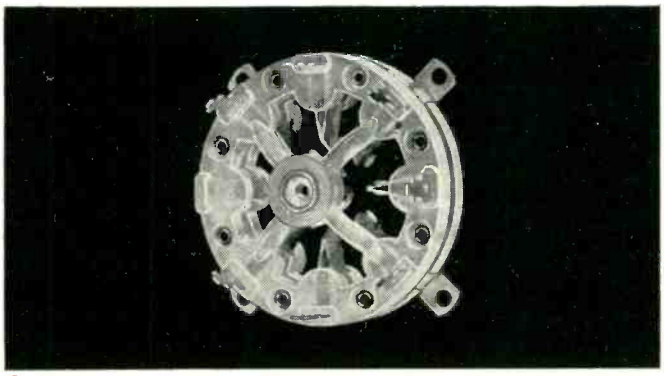
. . . how the unique thermoplastic — TRIFLUORO-CHLORO-ETHYLENE — has been used to solve tough design problems



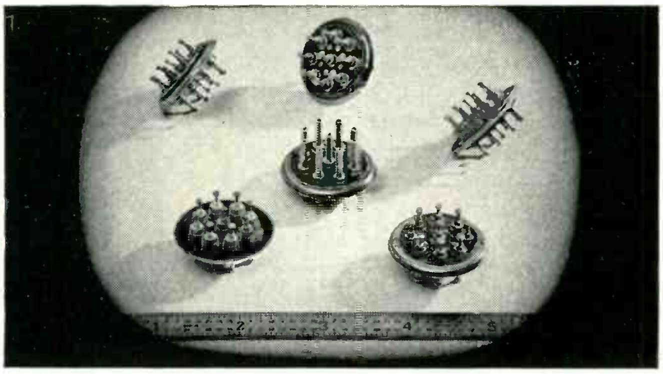
1. Glass won't do in these gauges which measure the rate of flow of hydrofluoric acid. Chemical inertness . . . transparency to permit reading liquid levels . . . shatter-resistance . . . and easy machinability of both rod and tube are the reasons for specification of Kel-F.



2. Superior flexibility over a wide temperature range, combined with chemical inertness, make Kel-F the natural specification for this large valve diaphragm to be used for corrosive service. Measuring *twelve* inches in diameter, the diaphragms are compression molded around metal inserts.



3. Mass production is possible with Kel-F because of its ready moldability. Electronic parts, like this tube base, may be injection molded in short cycles. No finishing, aside from sprue-removal, is required to assure close tolerance fits with metal parts.



4. A hermetical seal between insulation and contacts is required in these multi-lead terminals. Other major "specs" include superior electrical and heat resistance. Today, Kel-F is specified for such applications—because the seal is easily achieved through compression molding about metal contacts.

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) ★Strip
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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KELLOGG

THE M. W. KELLOGG COMPANY
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SUBSIDIARY OF PULLMAN INCORPORATED

NEW PRODUCTS

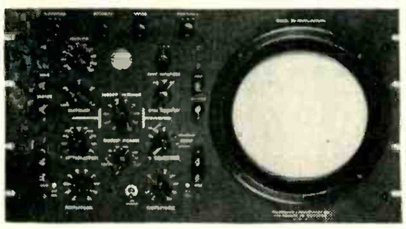
Edited by WILLIAM P. O'BRIEN

Recently Developed Test Instruments, New Materials and Components and Several of the Latest Tubes Are Included . . . Twenty-four Trade Bulletins Reviewed Under *Literature* (p 381)

OTHER DEPARTMENTS featured in this issue:

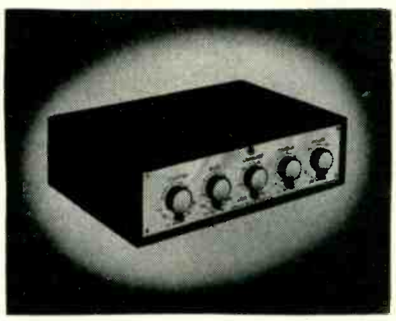
Half-Wave Vacuum Rectifier

RADIO CORP. OF AMERICA, Harrison, N. J., has announced the 6AX4-GT, a half-wave vacuum rectifier tube of the heater-cathode type. It is intended chiefly for use as a damper tube in horizontal deflection circuits of tv receivers. Designed to withstand negative peak pulses between heater and cathode of as much as 4,000 volts with a d-c component up to 900 volts, the tube provides flexibility in choice of deflection circuits.



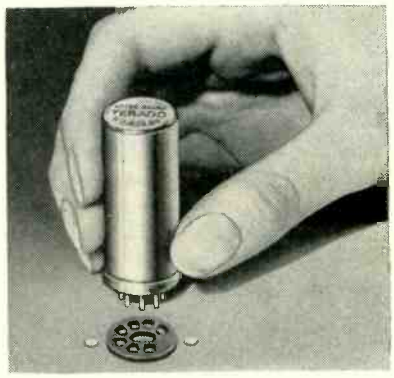
General-Purpose Oscilloscope

TELETRONIC LABORATORIES, INC., 1835 W. Rosecrans Ave., Gardena, Calif. Model 101 general-purpose rack-mounted oscilloscope features a 7-in. viewing screen. The vertical amplifier provides 5 stages of push-pull amplification, giving sensitivity of 10 mv peak-to-peak per in. The sinusoidal frequency response of the amplifier from 0 to 200,000 cps is within 10 percent down; from 0 to 500,000 cps, within 6 db down from maximum response. The horizontal amplifier provides 3 stages of push-pull amplification, giving sensitivity to 100 mv rms per in. Sinusoidal frequency response of the amplifier from 0 to 100,000 cps is within 10 percent down; and from 0 to 300,000 cps, within 6 db down from maximum response. Test signals are provided for in the form of a 0.5-v rms sine wave at the line frequency and 3.5 v peak-to-peak sawtooth wave at the horizontal sweep frequency.



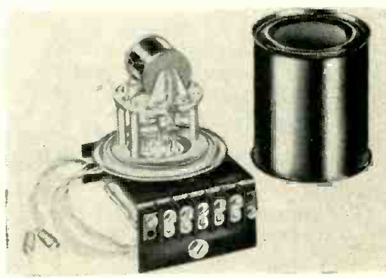
Equalizer Preamplifier

THE RADIO CRAFTSMEN, INC., 4401 N. Ravenswood Ave., Chicago 40, Ill. Model C300 equalizer preamplifier features five-position low-and-high record equalization, five-position low-and-high sharp-frequency-cut-off filters for reduction of rumble and record scratch respectively, choice of loudness or straight volume-control action, continuously variable bass and treble controls and five different audio inputs. Other features include a self-contained shielded power supply, tube filaments powered by d-c to reduce hum to a minimum, tubes mounted on a shock-mounted subchassis, and an all-triode circuit with cathode-follower output.



Miniature Relay

TERADO CO., 1068 Raymond Ave., St. Paul 8, Minn., has announced a miniature relay that is hermetically sealed and has an extreme sensitivity because of its high-efficiency coil. It will operate on 75 mw or less. The switch is spdt. Contacts are of solid coined silver. Other features include: maximum coil resistance, 10,000 ohms; insulation, 500 volts any terminal to ground; and base, the standard 7-pin miniature.



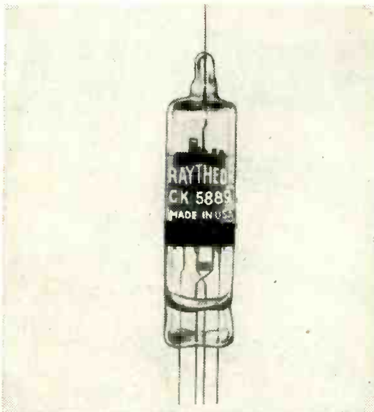
Synchronous Inverter

THE BRISTOL CO., P. O. Box 1790, Waterbury 20, Conn., has developed a synchronous inverter having a

sensitivity of 0.05 μv and a dissymmetry of less than 0.5 percent. It is capable of converting low-power d-c signals to alternating voltages that can be amplified and applied to electronic, electrical and servo systems. The Syncroverter Switch will operate at any frequency from 0 to 3,500 cycles. It is designed for precision use in electronic computers, instruments, gun directors, null detectors and many other similar uses. Instantaneous operation and length of life are not affected by vibration or shock. Errors due to thermal emf are eliminated by the use of two spdt contacts.

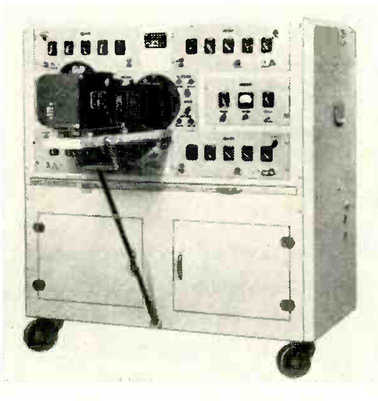
Voltmeter

THE DAVEN CO., 191 Central Ave., Newark 4, N. J., announces its improved electronic voltmeter, type 170-A, for general laboratory and production use. Amplifier and power supply sections are separate subassemblies. The amplifier is completely shockmounted, reducing microphonic effects to a minimum. Both amplifier and power supply are electrostatically and magnetically shielded from each other and from external fields. This eliminates pickup and reduces hum in the amplifier and also prevents disturbance of nearby equipment due to radiation. Another new feature of the unit is the fact that selected tubes are not necessary for replacement. Any standard vacuum tube may be substituted without affecting the characteristics of the voltmeter. The improved instrument measures accurately a-c sinusoidal voltages over a frequency range from 10 to 250,000 cycles, and a voltage range from 0.001 to 100 v. Accuracy is ± 2 percent over the entire frequency range.



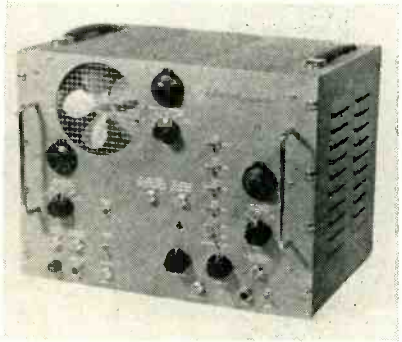
Electrometer Pentode

RAYTHEON MFG. CO., 55 Chapel St., Newton 58, Mass. Type CK5889 is a subminiature pentode electrometer tube with a control-grid current rating of 3×10^{-15} ampere maximum. A minimum of filament power is required by the 1.25-v, 0.0075 ampere filament. The conducting ring around the bulb may be grounded through a connecting clip to provide complete isolation of the grid lead, which is at the top of the tube. Full technical information is given in a data sheet now available.



Four-Channel Oscilloscope

ELECTRONIC TUBE CORP., 1200 E. Mermaid Lane, Philadelphia 18, Pa., has available a new high-gain, four-channel oscilloscope for measuring the minute potentials from brain waves, heart waves and other neuromuscular reactions studied in encephalography, biophysics and allied fields of medical research. Model E4GAM has a high input impedance and a maximum gain of 1.8 million. Signals from all four channels are displayed on the face of a single 7-in. crt that may be readily photographed with an oscillo-record camera. The sweep generator is common to all channels and has a continuously variable range from 1 sweep per minute to 50,000 sweeps per second plus provisions for blanking, external synchronization and either common or individual positioning.



Pulse Generator

RUTHERFORD ELECTRONICS CO., 3707 South Robertson B'lvd., Culver City, Calif. Model B-2 pulse generator is an instrument for the generation of pulses of variable width, amplitude, delay and repetition rate, with very accurate control of all factors by means of helical potentiometers. It features duty factors as high as 25 percent, and repetition rates as high as 100 kc. It has an internal oscillator giving rates from 10 cps to 100 kc in four decade ranges. It may be externally triggered or used in single pulse operation. The main pulse may be delayed from 0 to 10,000 μsec from the synchronizing pulse in five decade ranges. The main pulse is variable in width from 0.2 μsec to 1,000 μsec in four decade ranges, has a rise time of 0.02 μsec, a fall time of 0.05 to 0.1 μsec (depending on width), and maximum amplitude of 100 v into an open circuit. The internal impedance of the main pulse output is 100 ohms. Amplitude of the outputs is adjusted by a constant-impedance 100-ohm step attenuator,

NEW 7″ REELS OF audiotape* give you EXTRA VALUE

at no extra cost!

GUARANTEED SPLICE-FREE

SPLIT-SECOND TIMING
with New 2¾″ Hub
Timing errors are virtually eliminated by this improved reel design which minimizes tension and speed changes throughout the winding cycle. Ratio of O.D. to hub diameter is the same as on the standard NAB aluminum reel.

PERFECTED ANTI-FRICTION PROCESS. Reduces head wear—eliminates annoying tape "squeal" – prevents "tackiness" even under extreme temperature and humidity conditions.

MAXIMUM UNIFORMITY OF OUTPUT. All 7″ and 10″ reels of plastic-base Audiotape are guaranteed to have an output uniformity *within* ± ¼db – and reel-to-reel-variation of less than ± ½db. What's more, there's an actual *output curve* in every 5-reel package to prove it.

With Audiotape, all of these extra-value features are *standard.* There's no extra cost – no problem of separate inventories or variations in tape quality.

For there's *only one* Audiotape – the finest obtainable anywhere. Test it – compare it – let Audiotape speak for itself.

The new 7-inch plastic reel with large diameter hub for greater timing accuracy is now being supplied on all orders unless otherwise specified. Because of increased hub diameter, maximum reel capacity is slightly over 1200 feet. Older style Audiotape reels with 1¾″ hub and 1250 feet of tape will continue to be furnished on request at the same price.

***Trade Mark*

AUDIO DEVICES, Inc.
444 Madison Ave., New York 22, N. Y.
Export Department, 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

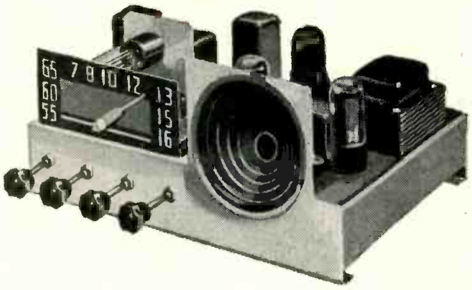
audiodiscs • audiotape • audiofilm • audiopoints having a 60-db range, together with a 10-db fill-in attenuator.

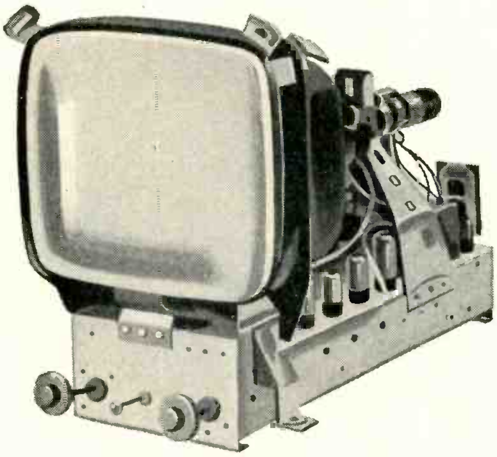
Hydrogen Thyratron

RADIO CORP. OF AMERICA, Harrison, N. J. The 3C45 is a hot-cathode, three-electrode hydrogen thyratron designed for pulsing service involving high repetition rates, high peak currents and low average currents in low-impedance circuits. It is especially useful for pulsing magnetron oscillators and other oscillators having a power input up to 50 kw. Features include short deionization time, low voltage drop, high peak anode current capability, ambient-temperature operating range of −50 to +90C, and positive-control characteristic which permits zero-bias operation utilizing positive triggering pulses.

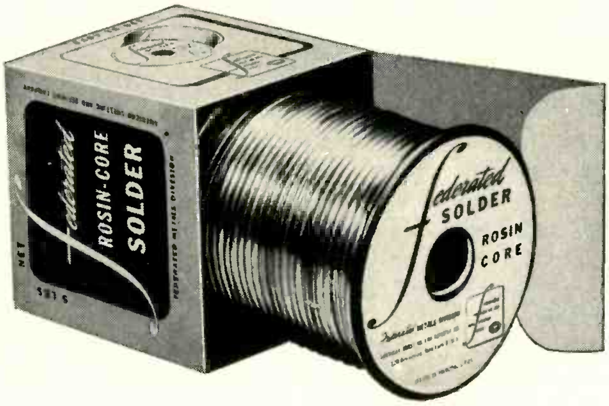
Radiation Measurement Instrument

RADIATION COUNTER LABORATORIES, INC., 5122 W. Grove St., Skokie, Ill. The Omniometer is a new, single, all-purpose instrument for the measurement of radiation. It may be employed with all types of sensing elements such as Geiger,

FOR RADIO  AND

TV  SOLDERING THAT LASTS...

USE...



For any soldering job that demands freedom from corrosion and conductive flux residue . . . for ease of working and unequalled consistency . . . there is nothing better than Federated Rosin Core Solder.

Each Rosin Core Solder composition . . . there is a variety for different purposes . . . is a tin and lead alloy with a rosin flux that is effective but not corrosive. Because the rosin residue is chemically inactive, current leakage at radio and television frequencies is prevented.

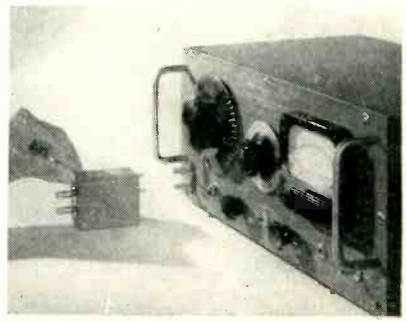
Federated Rosin Core Solder is a quality product that is unsurpassed for the permanence of the bond it produces . . . for the consistently easier soldering job it does! Look for it in 1, 5, 20, 25, and 50-pound sizes on the familiar orange and black metal spool. Listed by Underwriters' Laboratories Inc.

Federated Metals Division

Federated first in the non ferrous field FMD

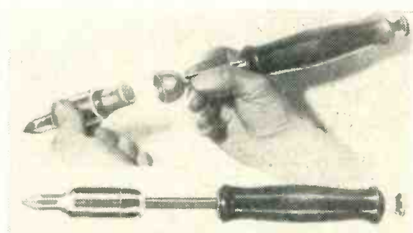
AMERICAN SMELTING AND REFINING COMPANY • 120 BROADWAY, NEW YORK 5, N. Y.

proportional and scintillation counters. The meter incorporates two h-v supplies which provide overlapping voltage ranges from 500 to 5,000 v. Changeover can be accomplished by a simple switch. If the sensing element delivers ¼ volt pulses or higher, then access is direct to the scaling circuit. For counting apparatus delivering voltage pulses of smaller magnitude, the pulses are fed into the amplifier input, and then to the scaler.



Line-Bridging Transformer

SIERRA ELECTRONIC CORP., 810 Brittan Ave., San Carlos, Calif. Converting an unbalanced to a balanced input, the model 122 line-bridging transformer is arranged for direct plug-in attachment to such measuring instruments as carrier-frequency voltmeters, vacuum-tube voltmeters and similar instruments having standard input terminals on ¾-in centers. Flat within 0.5 db from 15 to 500 kc, the new unit is capable of handling a maximum voltage of 100 v. Three styles are supplied for input impedances of 135, 500 and 600 ohms.



Compact Soldering Iron

KEMODE MFG. CO. INC., 161 W. 18th St., New York 11, N. Y. Requiring no electric current or external heat of any kind, the Quik-Shot soldering iron utilizes a chemical cartridge that heats the iron to working

The Standard of Quality

HICKOK

Model 292X

SIGNAL GENERATOR

Frequency Coverage:
125 KC to 220 MC

Calibrated Output:
Less than 1 microvolt, up to 100,000 microvolts.

Professional engineers and technicians everywhere constantly rely on the accuracy of calibration and long dependability of HICKOK instruments.

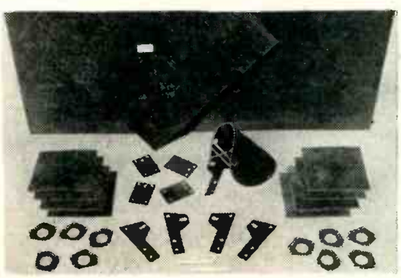
In electronic instruments, HICKOK pioneering leadership has been acknowledged for over 42 years.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
10514 Dupont Avenue • Cleveland 8, Ohio

temperatures in 10 seconds and maintains the iron at an average soldering temperature of 800 F for seven minutes. The cartridge is ignited by the impact of a spring rod that is pulled out and released at the back of the handle. The iron is adaptable to all kinds of soldering work where line power is neither available or convenient. Five interchangeable tip sizes from $\frac{3}{8}$ to 1 in. are featured.

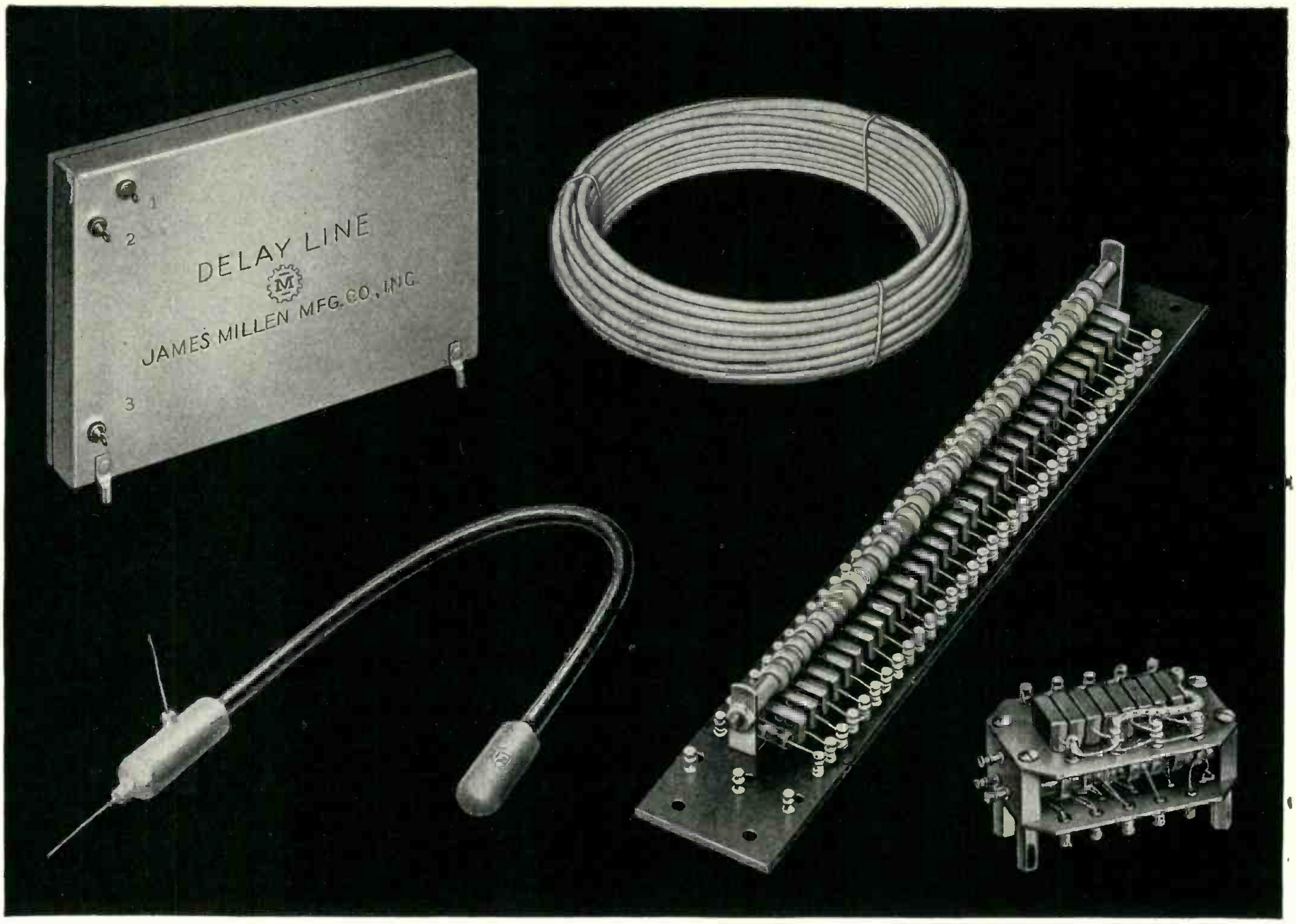
Magnetrons

MICROWAVE ASSOCIATES INC. 22 Cummington St., Boston 15, Mass., has available two 3-cm magnetrons, the 2J42 and its similar but higher powered sequel, the 2J42A (RTMA type 6027). Type 2J42 is a low-powered, 17-w average, packaged magnetron, with a coaxial-to-waveguide output that is stabilized by a cavity integral to the assembly. The anode is of the double-ring type and is fabricated from a new vacuum-cast copper. The 2J42A is identical physically to the 2J42 but is supplied with an additional magnet permitting an increase of average power to 21 watts.



Insulating Material

THE GLASTIC CORP., 1823 E. 40th St., Cleveland 3, Ohio. A new thin-gage insulating material made from glass fiber reinforced polyester, Glastic-940, is resistant to elevated



"Designed for Application"

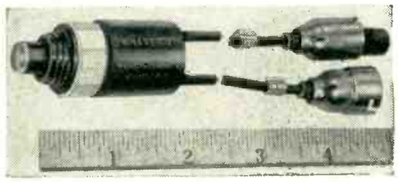
Delay Lines and Networks

The James Millen Mfg. Co., Inc. has been producing continuous delay lines and lump constant delay networks since the origination of the demand for these components in pulse formation and other circuits requiring time delay. The most modern of these is the distributed constant delay line designed to comply with the most stringent electrical and mechanical requirements for military, commercial and laboratory equipment.

Millen distributed constant line is available as bulk line for laboratory use and in either flexible or metallic hermetically sealed units adjusted to exact time delay for use in production equipment. Lump constant delay networks may be preferred for some specialized applications and can be furnished in open or hermetically sealed construction. The above illustrates several typical lines of both types. Our engineers are available to assist you in your delay line problems.

JAMES MILLEN MFG. CO., INC.
MAIN OFFICE AND FACTORY
MALDEN, MASSACHUSETTS, U. S. A.

temperatures in electrical apparatus. It has good arc-tracking resistance and dimensional stability. It is available in standard sheet sizes of 24 in. x 36 in. The material may be obtained in $\frac{1}{32}$-in. thickness as required for special insulating applications such as relay build-ups, resistance welding transformer barrier insulation, top-stick material in d-c motors, transformer end wrapping and various tv parts. It is also well suited to applications requiring dimensional stability and heat resistance encountered in aircraft generators, class B motor insulation and small electrical unit manufacturing. Technical data and samples are available.



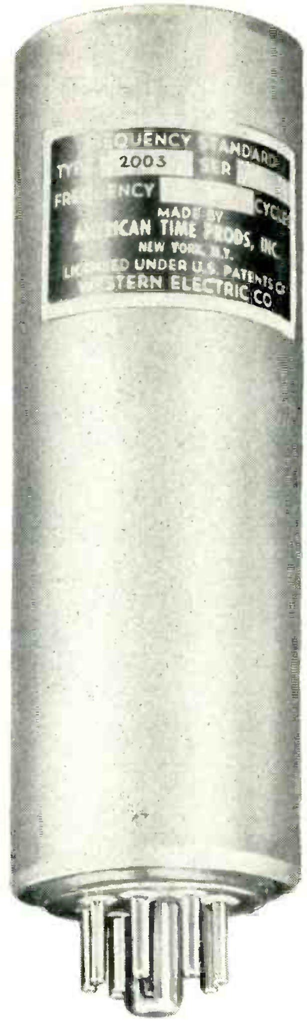
Pushbutton Switch

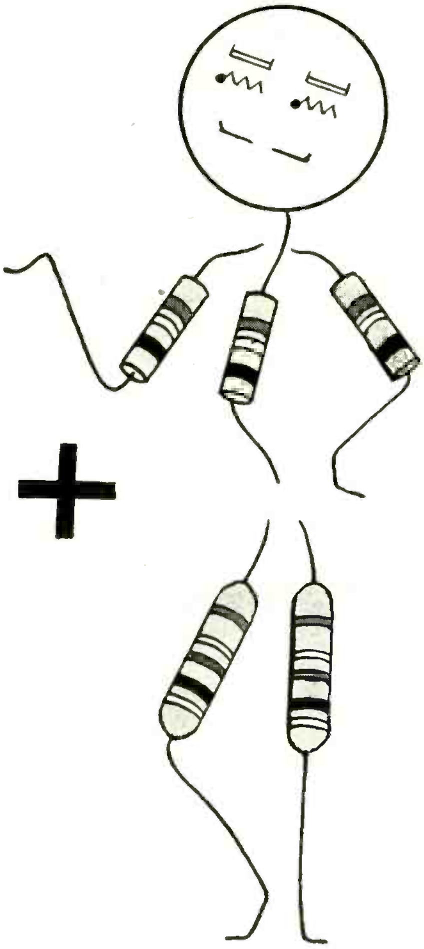
RIVERSIDE MFG. AND ELECTRICAL SUPPLY CO., 10228 Michigan Ave., Dearborn, Mich., has developed a pushbutton switch, to meet military specifications, that opens and closes electrical circuits underwater, functions from 65 F below zero to 165 F above, and withstands salt spray, shock and vibration. The switch has a continuous rating of 10 amperes at 15 v d-c, 30 v d-c, or 125 v a-c. It is a single throw, one circuit switch, furnished either normally open or normally closed. The company has available complete information on this pushbutton switch and on waterproofed toggle switches up to 200-ampere rating.

Portable Broadcast Amplifier

GENERAL ELECTRIC CO., Syracuse, N. Y., has announced the type BA-

The PERFECT *Wedding*





TYPE 2003 FREQUENCY STANDARD

The Type 2003 contains, in addition to the tuning fork, all circuit components which are selected or critical.—The tube and remaining components — three resistors and two .01 capacitors — are external and can be laid out and integrated with your equipment.

TUNING FORK STANDARD, hermetically sealed.
SIZE — 4½ inches long. 1½ inches diameter.
SIMPLE EXTERNAL CIRCUIT, 1 tube, 3 resistors, 2 capacitors.
TUBE — Choice of 12AT7, 6201, 5751, 6BF7, 6BG7 or 6021.
POWER REQUIRED, 75 to 300 V at 1 to 5 m.a. — 6.3 V at 300 or 350 m.a.
AVAILABLE — in 400 or 500 cycles
ACCURACY guaranteed to .002%, 15° to 35° C.

Write for descriptive literature, specifying Type 2003.

Also TYPE 2007
(4½" x 1½")
COMPLETELY SELF-CONTAINED INCLUDING VACUUM TUBE

Manufacturer of high precision frequency and timing instruments controlled by tuning fork oscillators.

American Time Products, Inc.

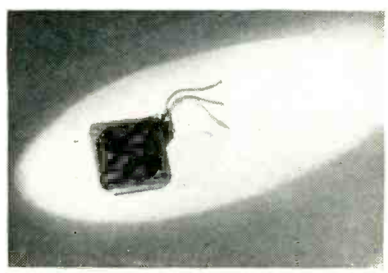
580 Fifth Avenue ***New York 36, N. Y.***

OPERATING UNDER PATENTS OF THE WESTERN ELECTRIC COMPANY

6-B portable broadcast amplifier for use in a studio as well as on remotes. Flexibility for both types of operation is provided by four built-in preamplifiers and a master mixer. The unit has a built-in a-c power supply, in addition to battery provisions, and it uses low-noise miniature tubes. A built-in 400-cycle tone oscillator permits easy level setting. A new cue amplifier gain control facilitates operation in noisy locations. The entire amplifier is enclosed in a steel case and weighs only 35 lb, including batteries.

Two-Set TV Coupler

RADIO MERCHANDISE SALES, INC., 1165 Southern Blvd., New York 59, N. Y. The AC-2 two-set coupler is a newly designed unit that permits operation of two sets from a single antenna. The unit equally distributes the signal to both receivers, and there is no limitation as to its location or length of lines between the coupler and either set. It also operates with coaxial cable.

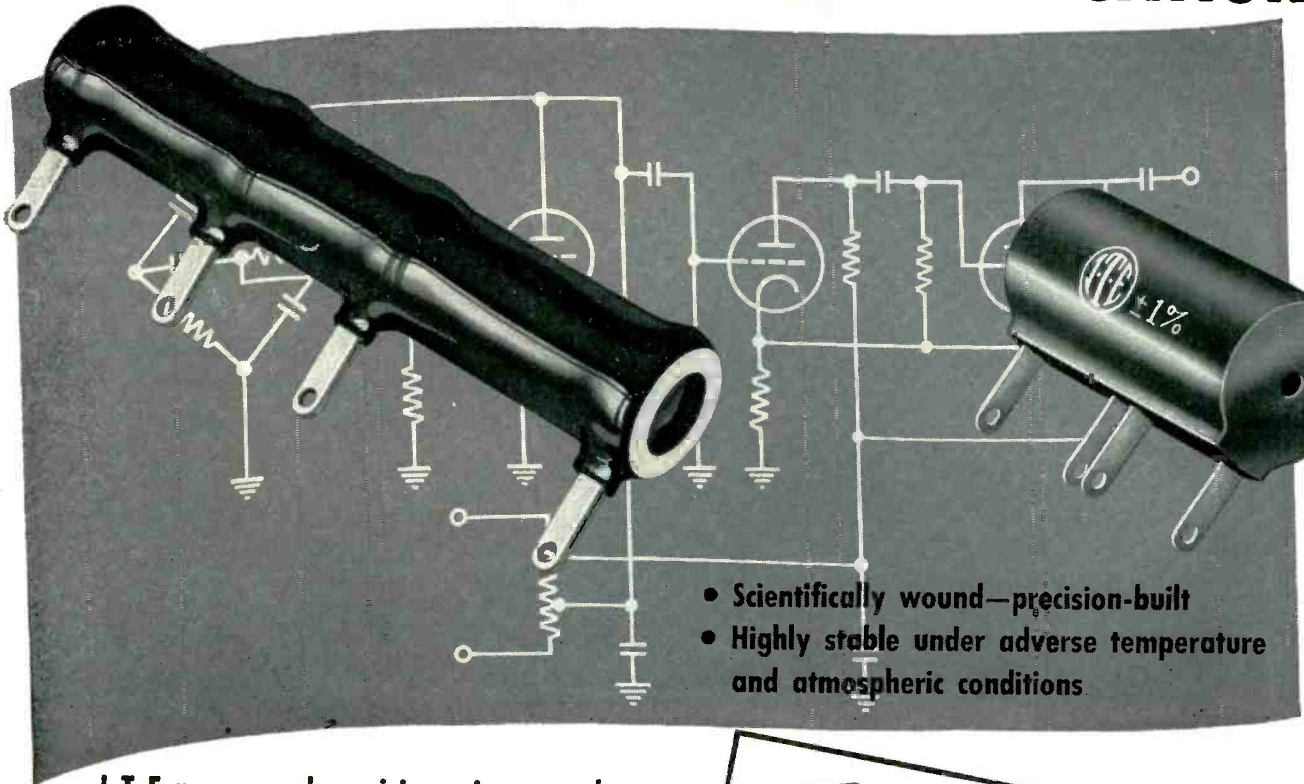


Reversible Motor

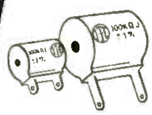
THE GENERAL INDUSTRIES CO., Elyria, Ohio, is producing a reversible 2-pole, four-coil motor for both remote control tv tuner and

HIGH STABILITY I-T-E RESISTORS

FOR CRITICAL ELECTRONIC APPLICATIONS



I-T-E power and precision wire-wound resistors give you maximum stability in critical electronic applications. Here's why:



PRECISION RESISTORS

High quality wire alloys are used—free from internal stresses and strains. Automatic precision winding assures even tension—eliminates hot spots. Hermetic sealing protects against destructive effects of salts, moisture, and atmospheric conditions. Accelerated aging process prior to calibration assures accuracy. Critical quality control eliminates all resistors which do not come up to high I-T-E standards.

Lightweight—for precision operation up to 125 C.
Surpass JAN R-93 and MIL R-93A specs.
Ratings from 0.01 ohms - 10 megohms, 0.125-5 watts.

Standard tolerance: ±1%. Available in specified tolerances down to ±0.05%.

POWER RESISTORS

Non-hygroscopic ceramic foundations are highly resistant to heat, shock, and vibration. Purest resistance wires are uniformly wound and mechanically tied to prevent shorted turns and excessive hot spots. Vitreous enamel coating (organic, if required) provides a glazed moisture-repellent surface with fast heat-dissipation qualities. Advanced production methods assure high stability, long life.

Standard fixed resistors: 5-200 watts
Adjustable resistors: 10-200 watts
Oval resistors: 30-75 watts
Ferrule resistors: 12-200 watts
Special resistors: built to specifications

Standard tolerance: ±10%. ±5% and less made to order.

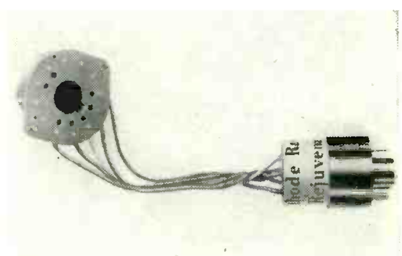
For detailed information—get in touch with your nearest I-T-E representative. Or, write direct to:

I-T-E Resistor Division
1924 Hamilton Street
Philadelphia 30, Penna.

specify I-T-E **RESISTORS**

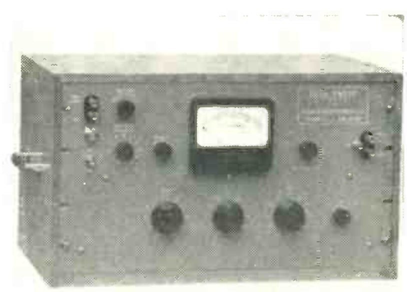
I-T-E CIRCUIT BREAKER COMPANY • RESISTOR DIVISION • PHILADELPHIA 30, PA.

rotating antenna applications, as well as other small motor applications in which accurate reversing action is required. Designated the model O, it can be furnished either as split-phase capacitor type or split-phase resistance type, depending upon application requirements. It is designed for 24-v a-c or less, 6 cycles, and may be used either horizontally or vertically without affecting performance characteristics. The model illustrated with 3 leads is designed for use with spdt switch. Adaptation with 4 leads for use with dpdt switch is available where increased output is desired.



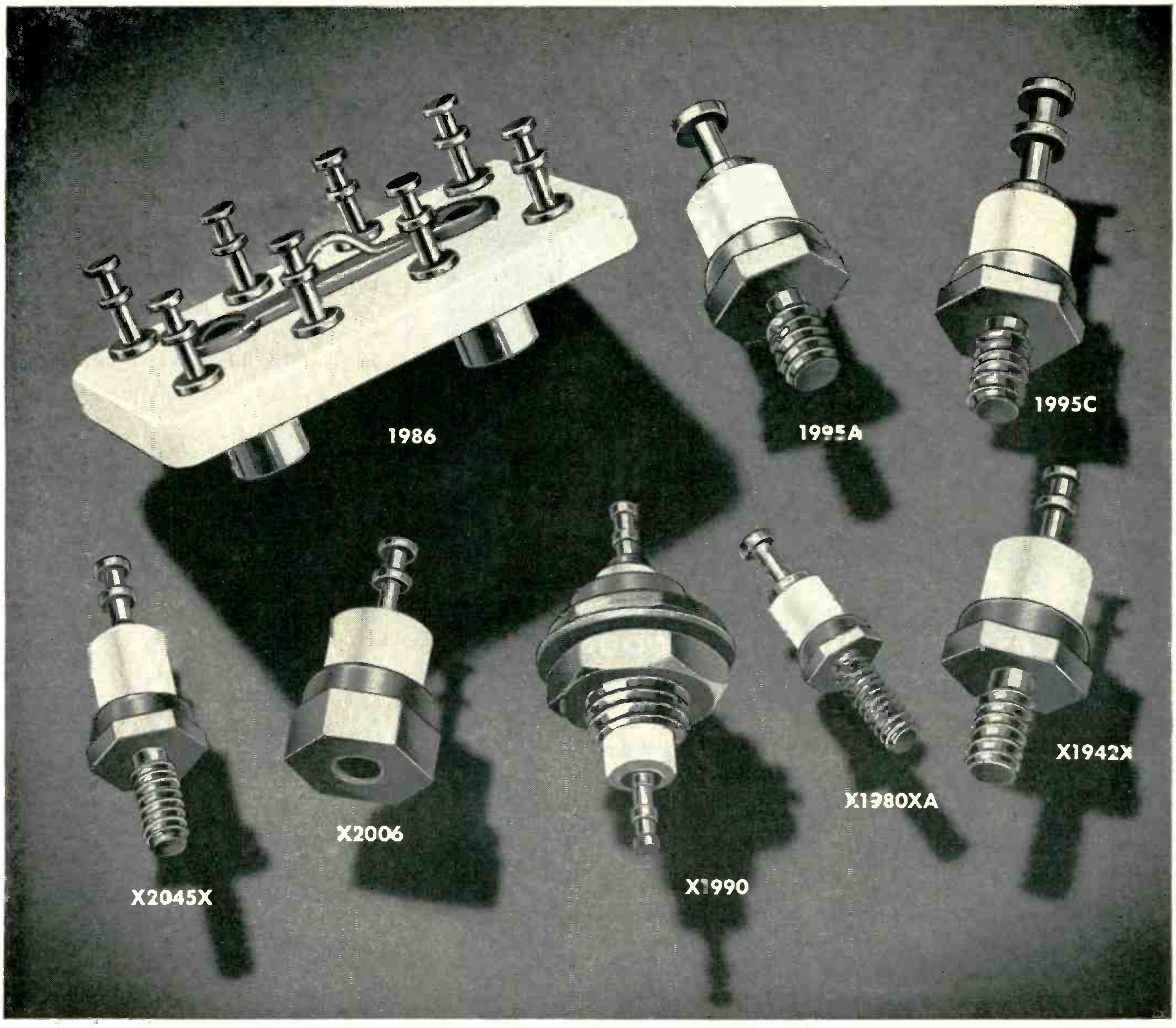
Picture Tube Rejuvenator

CREST LABORATORIES, INC., Whitehall Building, Far Rockaway, N. Y., has introduced the model C picture tube rejuvenator that can be used on all standard cathode-ray tubes regardless of size. It is a simple plug-in unit that can serve a dual purpose: it can be used either as a flasher type reactivator or as a permanently installed rejuvenator.



Sweeping Oscillator and Signal Generator

DECADE INSTRUMENT CO., Caldwell, N. J., has announced a precision combined h-f decade-switched sweeping oscillator and signal generator. The Deca-Sweep eliminates



Units shown magnified approximately 2½ times

Make *sure* of meeting government "specs" . . . see C.T.C. for ceramic insulated components

You have to be 100% on-the-beam if your equipment is to withstand the conditions it must undergo in military service.

That's why manufacturers using electrical and electronic components turn to C.T.C. for their ceramic insulated units. Our long experience and constant dealing with government requirements have gained us a wide acceptance as an outstanding supplier to those working on U. S. contracts . . . especially for the armed forces.

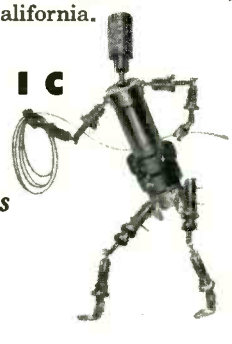
Whatever your needs in ceramic insulated terminals, feed-throughs or terminal boards you can depend on C.T.C. We meet the most exacting government standards for materials, tolerances, finishes, moisture prevention and anti-fungus treatment. Finishes on metal surfaces for instance, can be hot tinned, electro-tinned, cadmium plated, silver plated or gold plated to your requirements. All ceramic units in our standard line are grade L-5, silicone impregnated.

C.T.C. offers a consulting service at no extra charge to help solve your special problems. For all specifications and prices, write to Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Mass. West Coast Manufacturers contact: E. V. Roberts, 5068 West Washington Boulevard, Los Angeles 16 and 988 Market Street, San Francisco, California.

CAMBRIDGE THERMIONIC CORPORATION

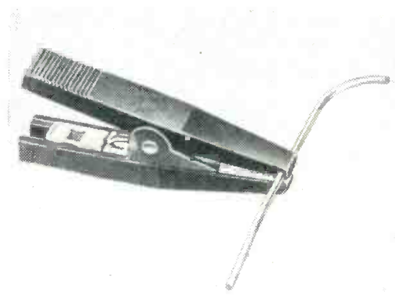
CTC

custom or standard . . . the guaranteed components



For our complete listing of C.T.C. electronic and electrical components, see Electronics Buyers Guide.

point-by-point measurements of high frequencies. It is equipped with a precision attenuator and output meter. A maximum output of 3 volts is available at 600 ohms. A variable output impedance down to a few ohms (for low output levels) is provided on a second jack, permitting any load impedance. The output level is constant within 1 db for all output frequencies. Full-scale meter ranges are provided for 10, 3, 1, 0.3, 0.1, 0.03 and 0.01 volts.



Non-Short Test Clip

GRAYHILL, 4524 West Madison St., Chicago 24, Ill. Completely insulated, the series No. 16 alligator-type test clip can be freely used side by side without danger of shorting out. The new clip also offers such features as silver contacts for low-contact resistance, brass current-carrying members silver soldered for easy soldering of the lead and positive spring action for good contact. The finger grips are of general purpose thermosetting phenolic.

UHF Attenuators

EMPIRE DEVICES, INC., 38-25 Bell Blvd., Bayside 61, N. Y., present

it's a magic world for homemakers!

—thanks to the accuracy, dependability and long life of Telechron® motors

Pressure cookers speed cooking—but timing must be accurate.

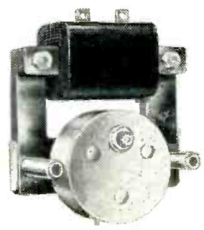
To be dependable, automatic timers on washing machines must start instantly.

Refrigerators last a long time. So should the automatic defrost timer.

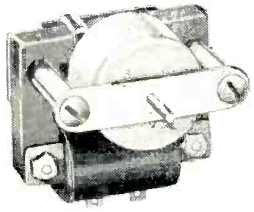
Accurate timing by Telechron motors has helped take much of the drudgery out of household chores.

Telechron timing motors are true synchronous motors. Rotors make one complete rotation for each cycle of the alternating current source—and are instantly self-starting (reach full speed in 1/20th of a second). This is especially advantageous for such uses as home appliances where many applications require intermittent operation of the timing motor, and demand instant, dependable starting. Similarly, because Telechron synchronous motors do not need close clearances between rotor and stator, they will remain quiet throughout their long life.

Get complete facts on the broad line of Telechron synchronous timing motors. Application engineering service assures proper selection. Write for catalog IS-120. Telechron Department, General Electric Company, 411 Homer Ave., Ashland, Mass.



Type H3 Motor—Used for the range timer and refrigerator defrost timer. Also recommended for such light-duty applications as timing and switching.

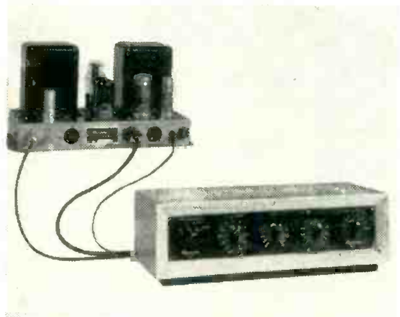


Type B3 Motor—A medium-duty motor that's ideal for washing machine timers, and other switching applications. Also recording and controlling mechanisms.

Telechron®

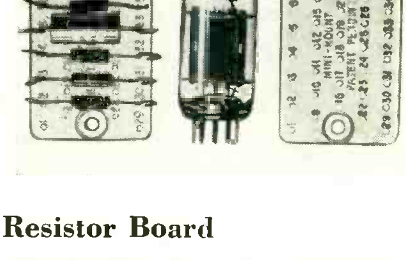
MARK OF TIMING LEADERSHIP

their new laboratory standard uhf attenuator, model AT-50. This is a resistive T-network of concentric line construction, with a frequency range from d-c to 4,000 mc. Vswr is better than 1.1 to 1.0 at all frequencies within said range; attenuation-standard: 3, 6, 10, 20, 40, 60 db, with an accuracy to ± 0.5 db. Rated power is 250 mw continuous, 500 w peak dissipation. The company also has available model AT-60 uhf power attenuator, which has a power dissipation of 2 w continuous, 2 kw peak.



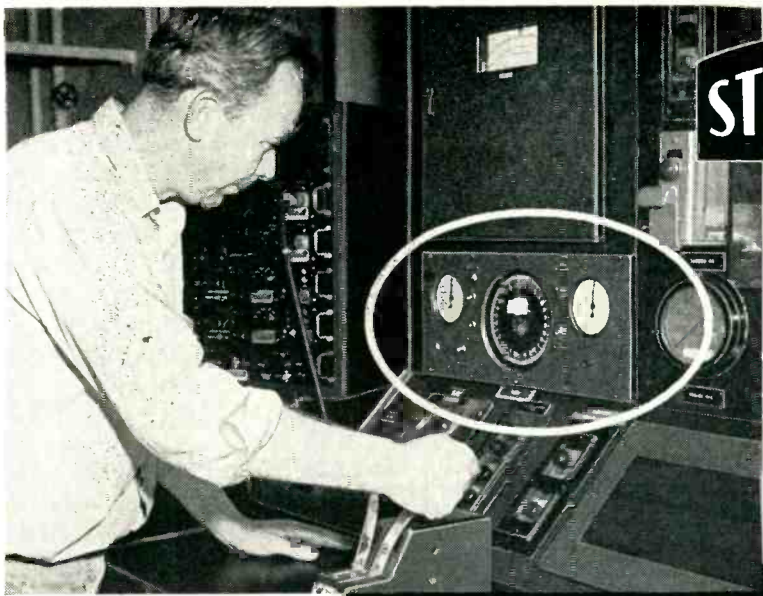
High-Fidelity Amplifier

WAVEFORMS, INC., 333 Sixth Ave., New York 14, N. Y., offers a new model of its high-fidelity amplifier system. The A-20-6 amplifier features a continuously-variable electronic filter for sharp treble cutoff of high-frequency noise and distortion, with a cut off range of 2,500 cycles to full 20,000-cycle response. A 20-db boost or cut bass and treble controls, a loudness control, and a four-channel input selector with independent level adjusts for each input channel are also included. An output is provided for a tape recorder.



Resistor Board

MINI-MOUNT CO., 773 Driggs Ave., Brooklyn 11, N. Y., has developed



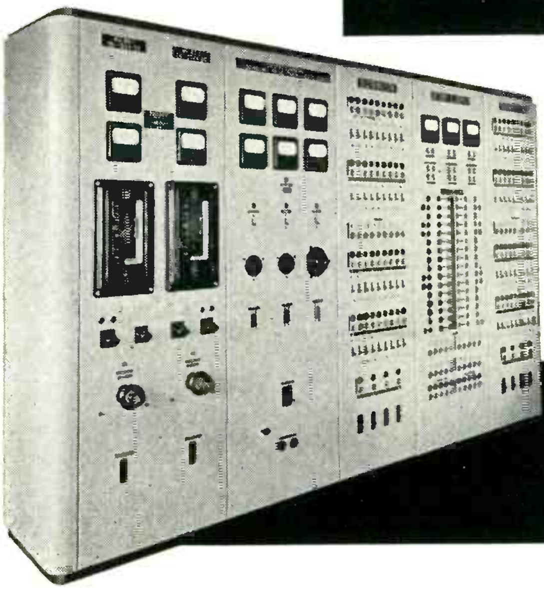
STANDARD

SINCE 1884

WRIGHT AERONAUTICAL DIVISION
CURTISS-WRIGHT CORPORATION

This photograph, taken in one of the experimental cells of the Wright Aeronautical plant at Woodridge, N. J., shows a STANDARD Chronotachometer installed in their test panel.

Not Only Chronotachometers . . .



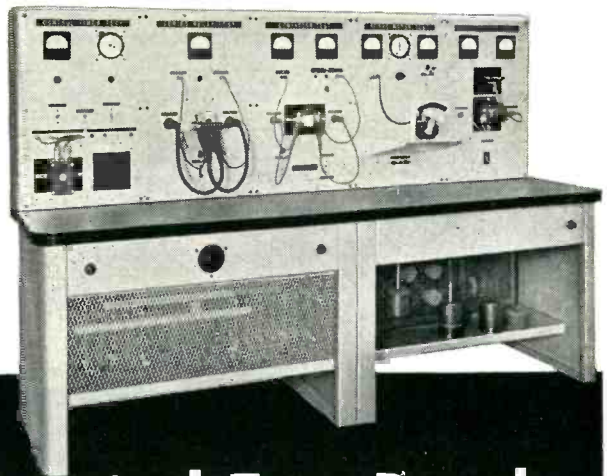
WILSON DAM (T. V. A.)

This experimental control and distribution switchboard handles various power supplies for their Chemical Laboratory Building.

plus "flexlab" Control and Distribution Switchboards

WESTINGHOUSE ELECTRIC COMPANY

This specially designed unit is for the control and test of aircraft timers, series relays, contactors, servo motors, and booster coils. It is typical of the wide range of custom-built equipment by STANDARD.

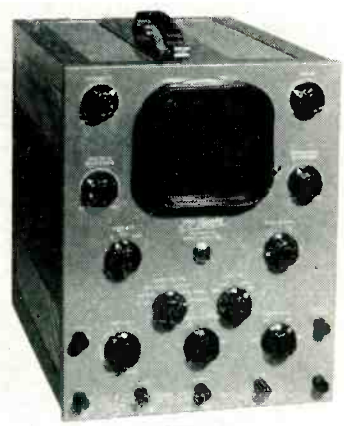


. . . but all kinds of Custom-built Electrical Test Panels

THE STANDARD ELECTRIC TIME COMPANY

97 LOGAN STREET • SPRINGFIELD 2, MASSACHUSETTS

a new type of molded resistor board, a method of mounting electronic components in a very small space. The board measures 1¼ in. × 2 in. × ⅓ in. with two standoffs provided for mounting. The standoffs have holes provided for No. 5 screws and can be stacked in tiers. The 36 holes are numbered to provide a convenient means for both initial layout and servicing. There are no metal lugs required—the pigtails on the electrode components provide the soldering terminal points. Once it is inserted and looped over, the electronic component is rigidly mounted to the board and can be conveniently soldered to. Ten to fifteen components can easily be mounted on each board and preassembled into subassemblies.



Precision Oscilloscope

EL-TRONICS, INC., 2665 N. Howard St., Philadelphia 33, Pa. A recent low-priced laboratory precision oscilloscope combines flexibility and accuracy in a new design; a vertical amplifier of 5-mc bandwidth with 4 in. of vertical deflection without overload; and a sweep oscillator variable from 10 cycles to 150 kc. The vertical amplifier has a sensitivity of 20 mv rms per inch of deflection; a frequency response (sine wave) of 20 cycles to 5 mc that is down 3 db at 5 mc; a square-wave response that is an excellent duplication of all square waves between 50 cycles and 1 mc with a maximum tilt of 5 percent for 50 cycle square wave; and a maximum input potential of 1,000 v peak-to-peak. The horizontal amplifier has a sensitivity of 0.3 v rms


$?
KOLLSMAN INSTRUMENTS

per inch of deflection, and a frequency response that is flat to 300 kc. The recurrent sweep oscillator has a frequency range from 10 cycles to 150 kc in 6 steps.

Small TV Camera Tube

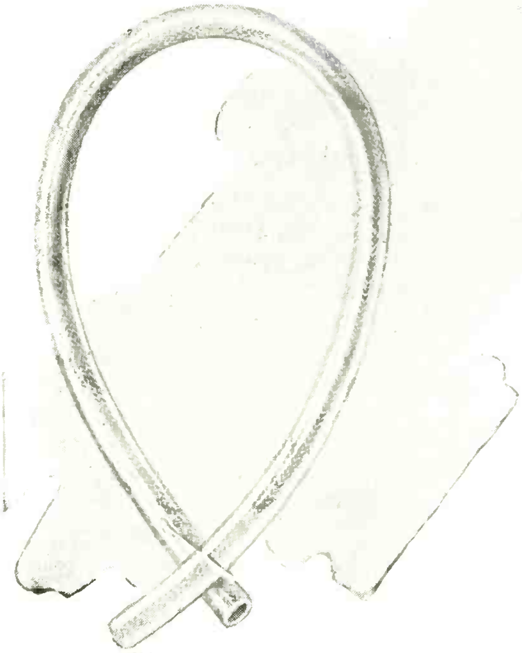
RADIO CORP. OF AMERICA, Harrison, N. J., has announced a small tv camera tube for industrial television applications. Utilizing a photoconductive layer as its light-sensitive element, the type 6198 Vidicon has a sensitivity which permits televising scenes with 100 to 200 foot-candles of incident illumination on the scene. The new tube provides 400-line resolution, employs magnetic focus and magnetic deflection, and operates with relatively low d-c voltages. It measures about 1 in. in diameter and 6¼ in. in length.

Snap-Action Switch

MICRO SWITCH, a division of Minneapolis-Honeywell Regulator Co., Freeport, Ill., has announced a waterproof, snap-action switch incorporating potted, waterproof

Flexible

Improved New
VARGLAS SILICONE
Tubing and Sleeving



Now Varglas Silicone has been made more flexible. Sharp turns and 90° bends cause no cracking or peeling — no loss of dielectric strength.

As pioneers in the manufacture of silicone sleeving and tubing, we know this is the greatest improvement made during the past ten years. Unexcelled where high temperatures must be withstood for several hours — not just for 15 minutes. You need not sacrifice abrasion resistance and toughness to get flexibility. The new Varglas Silicone sleeving and tubing will pass cold bend tests at 35° to 40° LOWER temperature than formerly.

The only Class H insulation with all these features:

Efficient from 500° F. to — 85° F.

Moisture and Fungus Resistant

Flame Resistant — Self extinguishing

Abrasion Resistant

Dielectrically Strong with average readings up to 7,000 volts.

Available in 10 colors — at no extra cost.

Samples of Varglas Silicone products as well as samples of our complete line of tubing and sleeving are available in a convenient sample folder. Just drop us a line telling us your problem and its peculiarities.

Varflex
CORPORATION

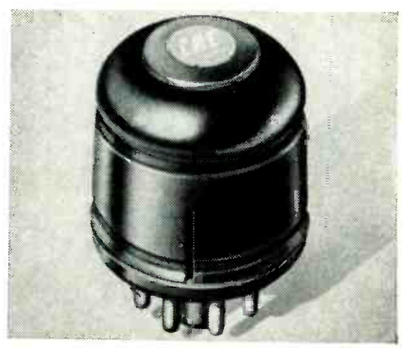
Makers of Electrical Insulating Tubing and Sleeving

VARFLEX *Sales Co., Inc.*
308 N. Jay St., Rome, N. Y.

terminal leads and a hermetically sealed contact chamber. Electrical rating of the type 4HS switch is as follows: 10 amperes inductive load, or 25 amperes resistive load, 28 volts d-c; 1 ampere inductive or resistive load, 125 volts a-c. The switch can be had with single-pole, single-throw or double-throw contact arrangement.

Decade-Inductor Units

HYCOR CO., INC., 11423 Vanowen St., North Hollywood, Calif. The 700 series decade-inductor units are necessary for design and experimental work on audio filters, equalizers and tuned circuits at frequencies between 150 and 20,000 cycles. Four units are available in ranges from 10 × 0.001 henry to 10 × 1.0 henry. When all four units are connecting in series, 11,110 steps from 0.001 henry to 11.11 henrys are obtained. Dimensions are 5¼ in. long × 3 in. wide × 2¼ in. high.



Ferro-Resonant Flip Flop

COMPUTER RESEARCH CORP., 3348 W. El Segundo Blvd., Hawthorne,

NEW COMPACT, LIGHTWEIGHT HIGH-VOLTAGE RECTIFIERS

One-third the size of existing tubes.

These exclusive new Westinghouse heavy-duty, high-voltage rectifiers permit more efficient design of mobile equipment where reduced weight and space are desired.

They are one-third the size of existing tubes with comparable ratings!

This advanced design permits the tubes to carry peak currents of 900 ma. (average currents of 150 ma.) without overloading. The high-wattage thoriated tungsten filaments require only three seconds' heating. Filament terminals may be operated either up or down.

Designers should evaluate these and other unique advantages of the Westinghouse WL-6102 and WL-6103 rectifiers. For further information write Westinghouse Electric Corporation, Electronic Tube Division, Dept. A-111, Elmira, N. Y.

Maximum Ratings

	WL-6102 Oil Immersed	WL-6103 Air Cooled
Peak Inverse Voltage	40 KV.	20 KV.
Peak Current	900 MA.	900 MA.
Average Current	150 MA.	150 MA.
Filament Voltage	5.25 V. (5.0 V. Center)	5.25 V. (5.0 V. Center)
Filament Current	7.6 AMP (7.2 AMP. Center)	7.6 AMP. (7.2 AMP. Center)
Height	2-13/16 IN.	2-15/15 IN.
Diameter	2-1/16 IN.	2-1/16 IN.
Weight	3½ OZ.	8½ OZ.

Typical Operation

Single Phase, Full-Wave

	WL-6102	WL-6103
Full Transformer Secondary Voltage (RMS)	28,300 V.	14,100 V.
DC Output Voltage to Filter	12,700 V.	6,300 V.
DC Output Current	.300 AMP.	.300 AMP.

3-Phase, Half-Wave

	WL-6102	WL-6103
Transformer Secondary Voltage (RMS)	16,400 V.	8,200 V.
DC Output Voltage to Filter	19,100 V.	9,500 V.
DC Output Current	.450 AMP.	.300 AMP.

Westinghouse WL-6102
Oil Immersed 40 KV Rectifier:
Only 2¾" high,
Weighs only 3½ ounces

Westinghouse WL-6103
Air-Cooled 20 KV Rectifier:
Weighs only 8½ ounces
Tubes pictured in actual size

RELIATRON™ TUBES

ELECTRONIC TUBE DIVISION

Westinghouse Electric Corporation
Box 284, Elmira, N. Y.

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

ET-95005

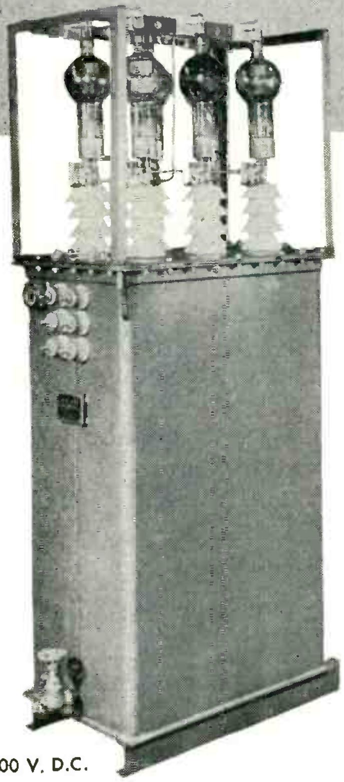
Calif. A new model MC, 100 kc ferro-resonant flip-flop has been developed as an efficient replacement for the vacuum tube in certain counting, amplifying and control applications. by using non-dissipating reactive elements the problem of heat dissipation is virtually eliminated. The new unit will not wear or burn out, and can be mounted in any circuit. It is also immune to high acceleration and shock. Specifications include: a-c requirements—1.6 mc, 1 watt at 12 v rms; trigger input impedance—5 mh in series with 25 ohms d-c resistance; trigger power requirements—pulse, 8 to 16 v and 1 to 5 μsec duration; outputs may swing between − 3 and + 21 v or between − 3 and − 21 v (by reversing output rectifier diode). The two outputs, opposite in phase, are capable of delivering 30 ma at 21 v each. Rated pulse frequency is 100,000 pps.

Toggle Switch

MICRO SWITCH, Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill., has developed a hermetically sealed precision toggle switch whose performance and operating characteristics are unaffected by environmental conditions. Although designed especially for aircraft, it can be used in a wide variety of installations for which other switches are unsuitable. Mechanical life tests indicate the switch has a life expectancy far greater than the 25,000 operations normally anticipated for hand-operated switches. The basic switch has a spdt contact arrangement. Tentative ratings are: 5 amperes motor

NEW COMPACT . . . DEPENDABLE

MAGNATRAN



34 kw 17,000 V. D.C.

UNITIZED RECTIFIERS

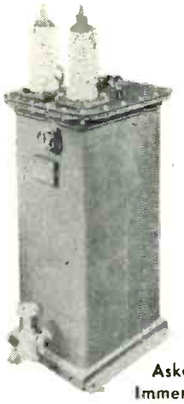
For high voltage D.C. sources . . . lower initial cost . . . minimum upkeep . . . convenient – ready to connect to A.C. line and D.C. load . . . compact – requires minimum floor space.

Dependability and long life factors are:

- Filament and plate transformers immersed in Askarel provide increased cooling and insulation.
- Special winding and insulation arrangements to withstand impulse surges.
- Vacuum filling removes all moisture
- Connected for out of phase filament operation to prolong tube life.

Independent bushing for plate and filament A.C. source.

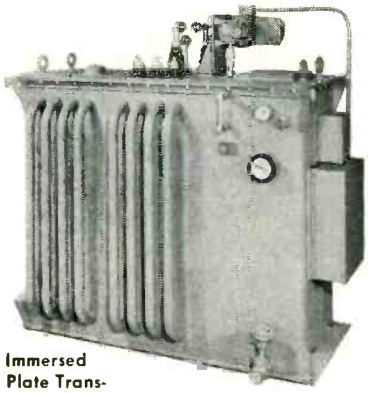
Fireproof vaults are not required with Askarel . . . Output voltages available to 20 K.V.D.C. . . . Companion filter chokes obtainable in suitable ranges.



Askarel Immersed Filter Reactor 50,000 Volt Test

–all your large or high voltage magnetic equipment can now be supplied and co-ordinated by *ONE DEPENDABLE SOURCE*

Magnatran is operated by personnel having unusual and outstanding knowledge in the transformer engineering and manufacturing field. Thus Magnatran, a new name, is backed by reputation and experience requiring little further introduction to the industry. A partial list of Magnatran quality products is shown below. Submit your requirements for our informational details.



Askarel Immersed 3-Phase Plate Transformer. Motor Driven Tap Changer 50,000 Volt Test

AIR . . . OIL . . . ASKAREL

MAGNATRAN PRODUCTS

Plate Transformers . Filament Transformers
Filter Reactors . Modulation Transformers
Distribution Transformers
Pulse Transformers . Testing Transformers
Precipitation Transformers
General Purpose Transformers
Hi-Voltage Power Rectifiers

Oil Immersed Modulation Transformer

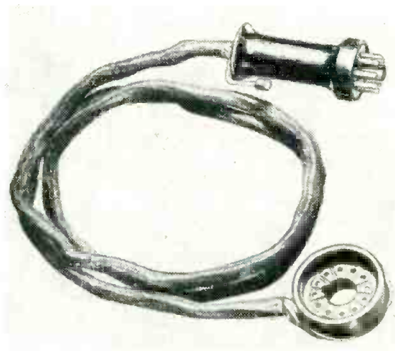
A NAME SYNONYMOUS WITH EXPERIENCE

MAGNATRAN INCORPORATED

TRANSFORMERS AND ELECTRICAL EQUIPMENT
WALTER GARLICK, JR., PRESIDENT
246 SCHUYLER AVE., KEARNY, NEW JERSEY

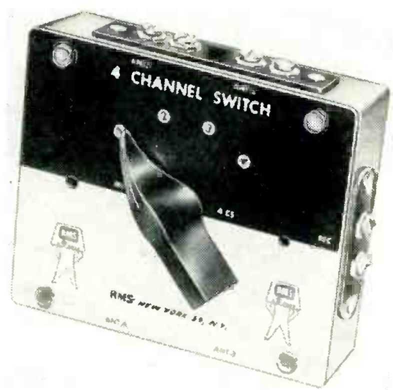
MAGNATRAN Trade Mark Pending

load 30 v d-c; 10 amperes inductive load 30 v d-c; 25 amperes resistive load 30 v d-c; 1.0 ampere a-c for any type of load, 125 v a-c.



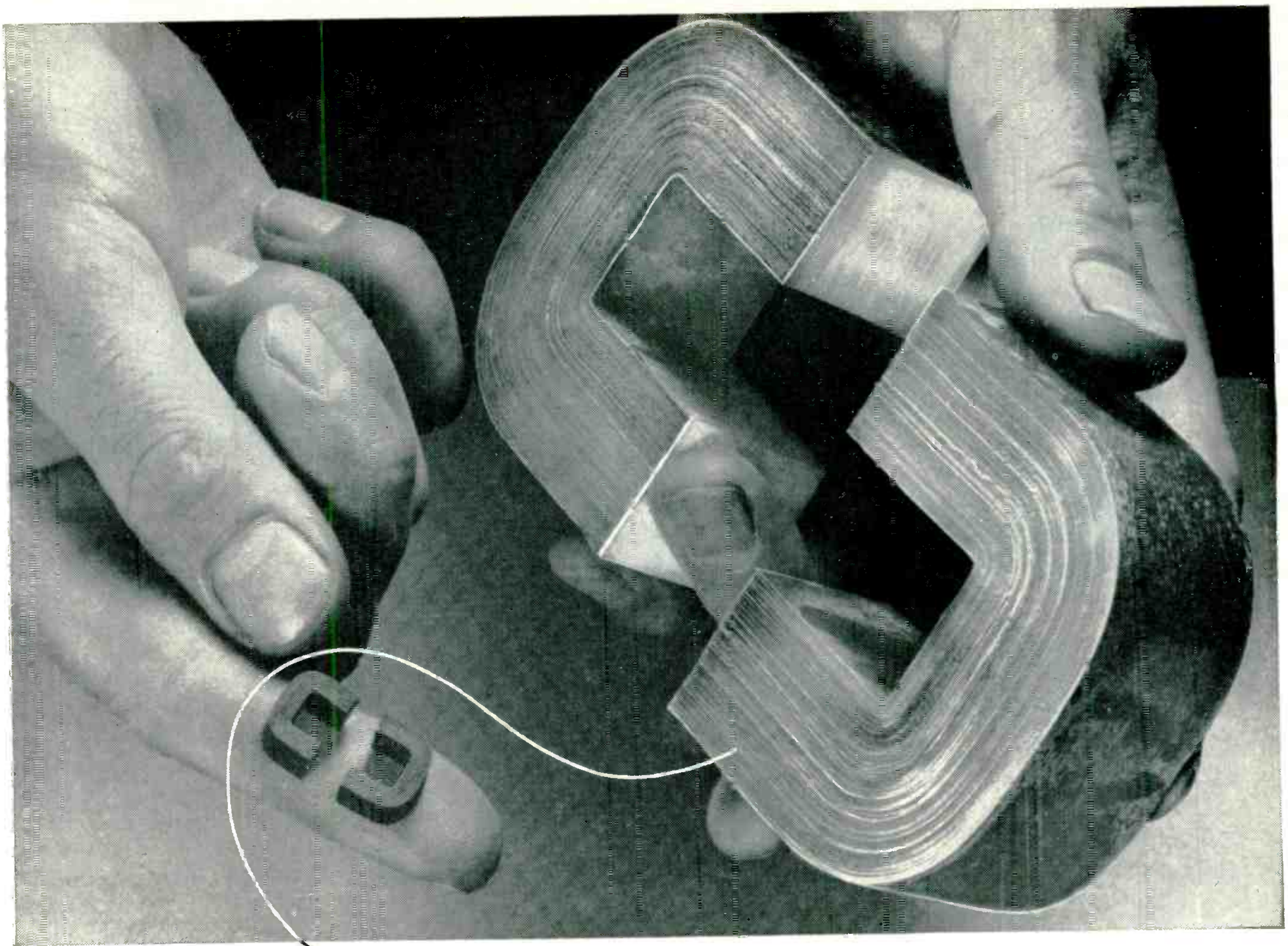
TV Picture-Tube Test Adapter

Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, N. Y., has released the new model CRA television picture-tube test adapter. Carefully designed for accuracy and safety, it gives a quantitative measurement of cathode emission, and tests for filament continuity and interelement shorts. It comes complete with standard 12-pin tv tube socket, octal plug-in connector and features an extra long 4-ft cable that enables the picture tube to remain in the set while testing.



Four-Channel Switch

Radio Merchandise Sales, Inc., 1165 Southern Blvd., New York 59, N. Y. Model 4CS four-channel switch will switch four antennas into one receiver, or will operate any one of four receivers from a single antenna. The unit is engineered to reduce the coupling effect between the antenna in use and those that are idle—an effect that



SILECTRON C-CORES... BIG or LITTLE

...any quantity and any size

For users operating on government schedules, Arnold is now producing C-Cores wound from ¼, ½, 1, 2, 4 and **12-mil** Silectron strip. The ultra-thin oriented silicon steel strip is rolled to exacting tolerances in our own plant on precision cold-reducing equipment of the most modern type. Winding of cores, processing of butt joints, etc. are carefully controlled, assuring the lowest possible core losses, and freedom from short-circuiting of the laminations.

We can offer prompt delivery in production quantities—*and size is no object, from a fraction of an ounce to C-Cores of 200 pounds or more.* Rigid standard tests—and special electrical tests where required—give you assurance of the highest quality in all gauges. ● *Your inquiries are invited.*

Wound from precision rolled oriented silicon steel strip as thin as .00025"

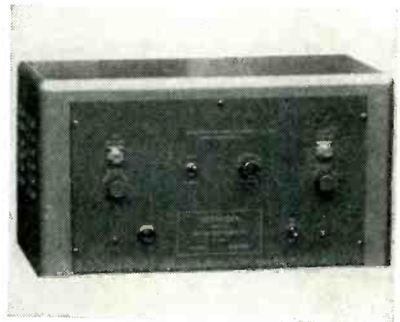
THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

W&D 4363

generally has been considered one of the drawbacks in the use of conventional types of switches.



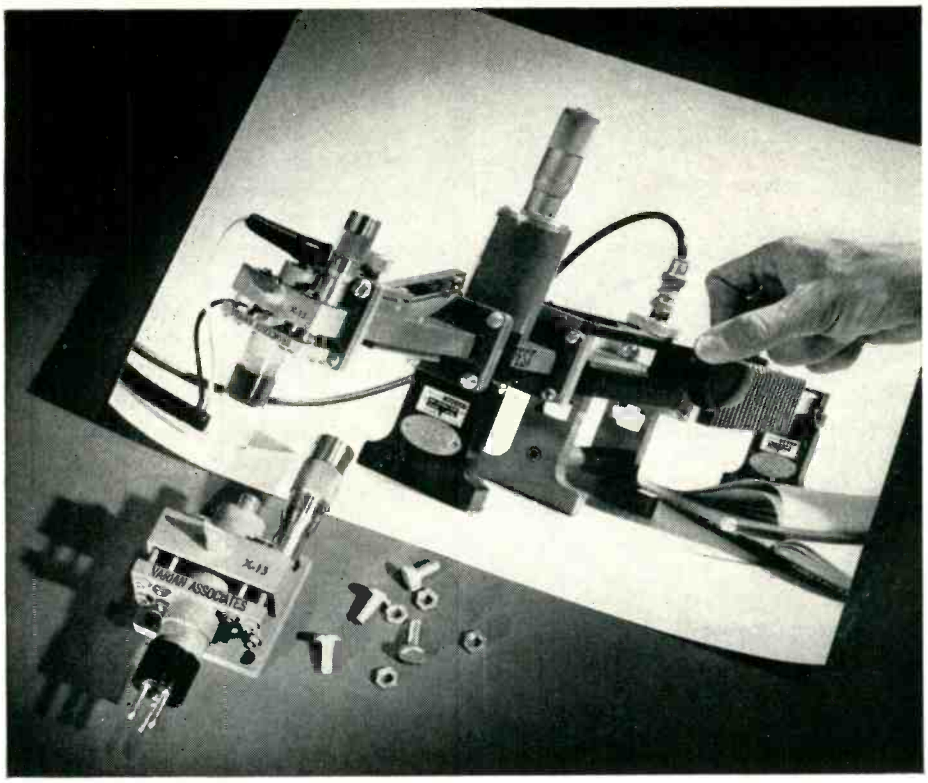
High-Frequency Counters

DECADE INSTRUMENT CO., Caldwell, N. J. Frequency counting in higher ranges, with equal precision, is now possible with Decaviders. No additional signal level is required and there is no loss of accuracy. Decaviders are connected in series with the input of standard frequency counters. Standard counter ranges of up to 10 mc, up to 1 mc and up to 100 kc can be extended by several Decavider models respectively to: 10 to 20 mc, 10 mc to 100 mc, 1 mc to 10 mc and 100 kc to 1 mc. The last three have 9 ranges. Decaviders also respond to transient waveforms, providing the spectrum is within the pass band of the Decavider amplifier and within the ranges listed above.

Toroidal Power Transformer

MILLIVAC INSTRUMENT CORP., 444 Second St., Schenectady 6, N. Y. has introduced a new toroidal power transformer that eliminates hum pickup in audio amplifiers. Transformer MT-1001 replaces ordinary

VARIAN associates



VERSATILE X-BAND SIGNAL SOURCE

Varian X-13 reflex klystron

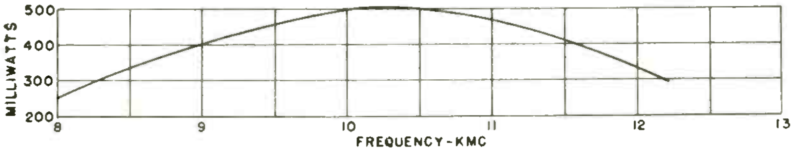
. . . 8.2-12.4 kmc

. . . 150-500 mw

IN LABORATORIES throughout the electronic field, the Varian X-13 Klystron is widely used as a general-purpose x-band signal source. In the typical setup above (checking load reflection), note the compactness, the convenience of connection, and the way the tube bolts directly to the waveguide.

OUTPUT POWER typically reaches half a watt at center frequency and exceeds 150 milliwatts over the full frequency range 8.2 to 12.4 kmc. The X-13 exhibits extremely low microphonic levels and operates directly into matched waveguide. Tuning is done with a single control. The tube is air cooled and has clearance dimensions of 4½ by 2½ by 2½ in., weight of only 6 oz.

Typical Power Output - Varian X-13 Klystron
(Beam Voltage, 500 v)



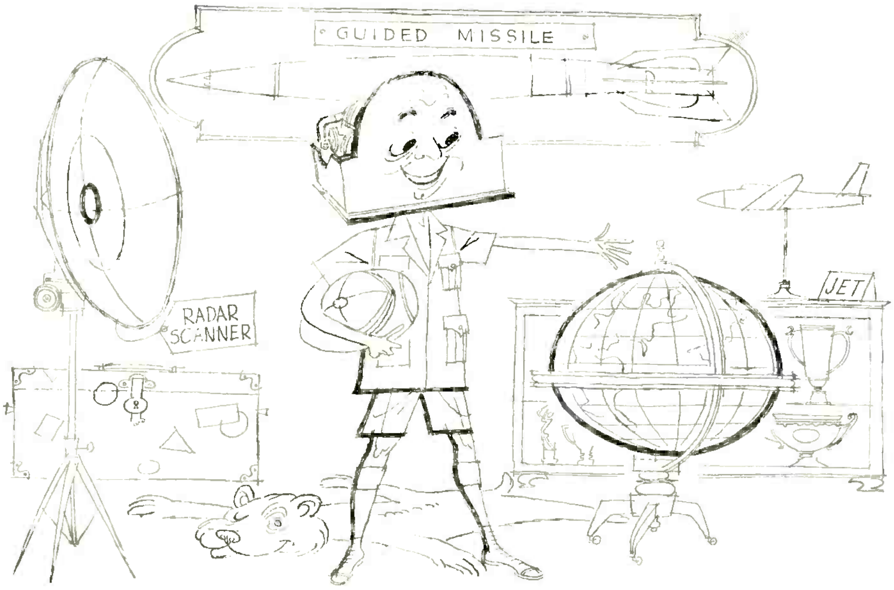
OTHER VARIAN KLYSTRONS extend and expand the functions of the X-13. An extensive line of tubes with designs based on that of the X-13 offers a wide selection of output powers, types of tuning devices and terminations, as well as capabilities for withstanding vibration and shock ranging far beyond 30 times gravity.

SEND FOR DATA on these or other klystrons from the extensive Varian line, many of which are necessarily unpublicized. You are invited to submit your microwave problems to the Varian application-engineering group for recommendations.

* TRADE MARK

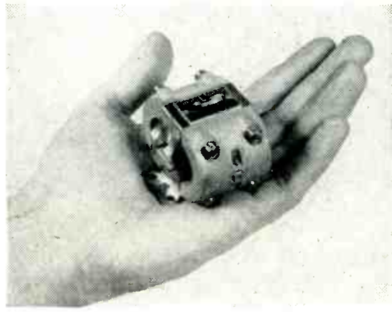
VARIAN associates
990 VARIAN STREET · SAN CARLOS 1, CALIFORNIA

FIELD ENGINEERING REPRESENTATIVES IN PRINCIPAL CITIES



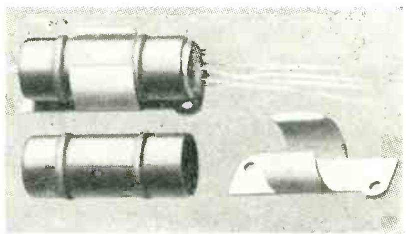
NEW PRODUCTS (continued)

power transformers in high gain amplifiers where an absolute minimum of hum pickup through magnetic field radiation is desired. It is precision wound on a ring core without air gaps and radiates less than 0.01 gauss at 5 in. from its surface. By parallel or series connection and doubler or tripler circuits the following d-c voltages for plate supply may be obtained: 350, 700, 1,200 and 1,800. The transformer has 2 separate heater windings which are rated 6.3 v and 1.5 amperes.



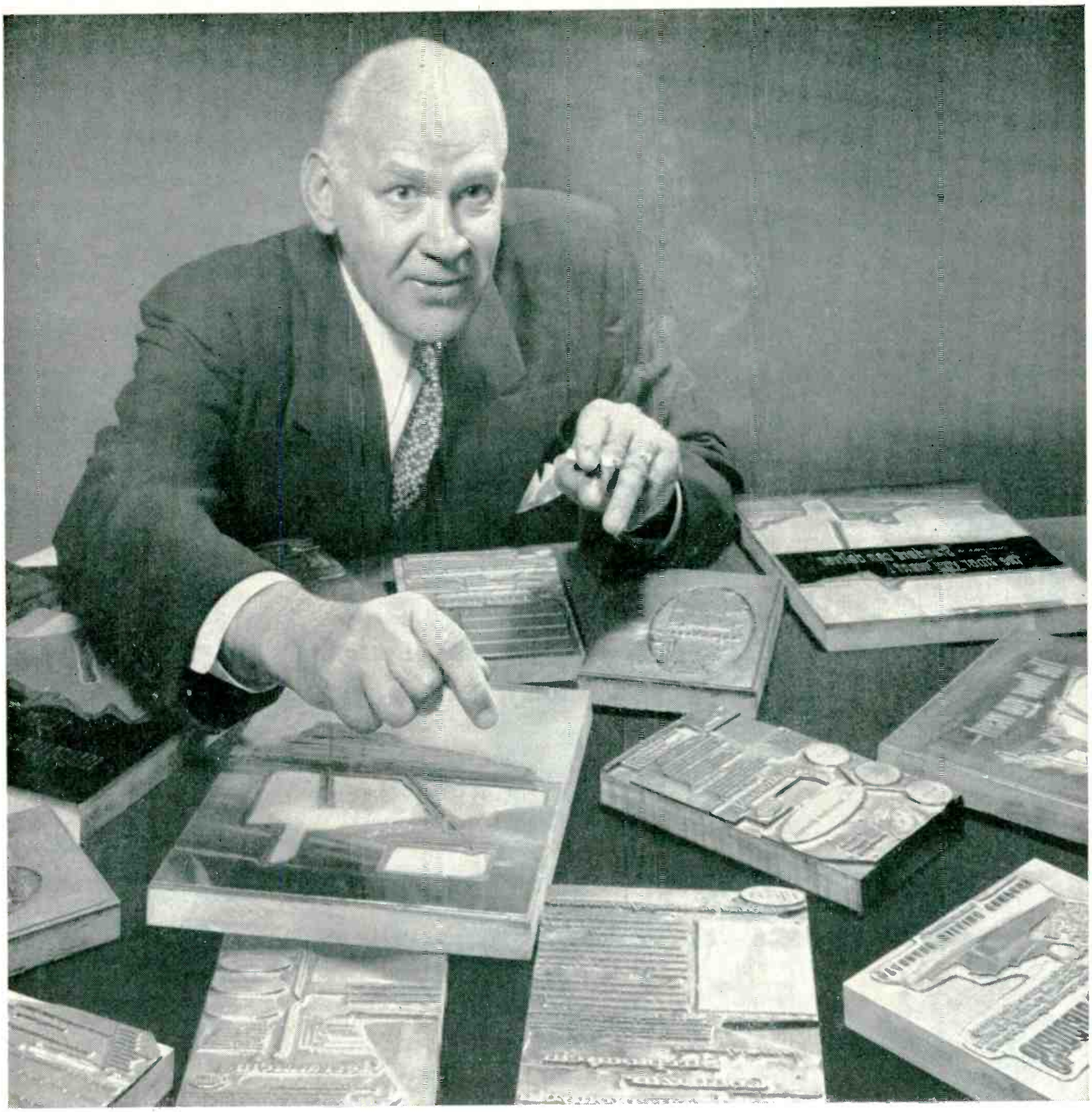
Small Torque Motor

MIDWESTERN GEOPHYSICAL LABORATORY, Tulsa, Oklahoma. The model 9, a small and powerful torque motor, is a precision linear actuator primarily designed to stroke pistons in hydraulic servovalves. However, it is being utilized in many engineering fields as a basic transducer to convert a few watts of power from an electronic amplifier to a linear mechanical motion with considerable force. Specifications are: midposition force, 9.5 lb; stroke, ± 0.015 in.; weight, 19 oz; no-load natural frequency, 425 cps; coil resistance, 3,400 ohms each; and balance current, 20 ma.



Subminiature Shield

THE STAVER CO., INC., Bay Shore, Long Island, N. Y., has introduced



"We want speed at any price ...yet we use the <u>cheapest</u> air service!"

—Richard E. Crowe, President, Globe Electrotype Company

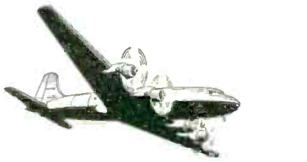
"We ship electrotypes to publications all over the country—from 30 to 300 in a single day. That's a lot of deadlines!

"We've made it a rule to specify Air Express.

"When Air Express started in 1927, we were among its first customers. We've used it ever since. And, in all that time, we've NEVER HAD ONE SINGLE KICK on an Air Express shipment! That's quite a record, and I've checked it with our people here.

"We've tested other air services. Air Express is consistently faster and more dependable. AND COSTS LESS! On most of our shipments, Air Express rates are the *lowest*, by a few cents to several dollars. Those differences add up to thousands of dollars in a year's shipping.

"I would advise anyone who is confused about shipping claims to test Air Express and keep a record of results. It convinced us."

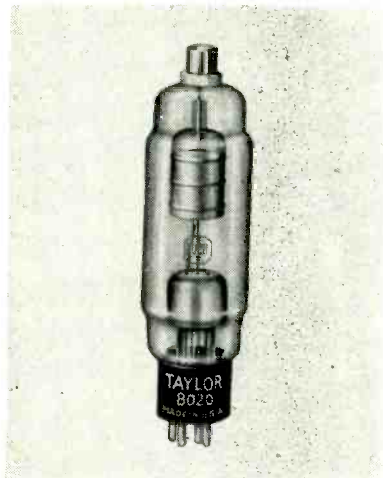


AIR EXPRESS

GETS THERE FIRST

Division of Railway Express Agency
1952 — our 25th year of service

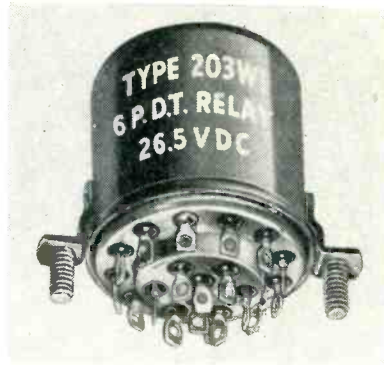
the Sub-Mini-Shield, a combination shield, clip and mount. Heat is effectively dissipated through an aluminum wrap-around shield. Tube diameters from a minimum 0.366-in. diameter to a maximum 0.400-in. diameter are held securely since the shield is of the overlap type, thus allowing for close contact between tube and shield. The shield mount, made of spring brass or phosphor bronze as an alternate material, serves to clamp the shield firmly to insure good contact between tube and socket under severe conditions of vibration. Minimum mounting center distances between mounts is $\frac{9}{16}$ in. Shield lengths are obtainable for tube types T3-1, T3-2, T3-3 and T3-4.



H-V Rectifier

TAYLOR TUBES, INC., 2312 West Wabansia Ave., Chicago 47, Ill., has introduced the type 8020 high-voltage rectifier tube. It is rated at 40 kvp inverse or forward in air, 60 kvp in oil, an average current of 100 ma, with instantaneous peak-current capacity of 2 amperes. The tube construction of Nonex glass with standard four-prong base uses special oil-resisting silicone basing compound to eliminate loose bases caused by oil immersed operation. The construction also features a treated tantalum anode for stability and long life and a filament of the thoriated tungsten type to operate at 5 volts, 6 amperes. Life expectancy of the tube is over 5,000 hours if operated within ratings. Its maximum physical dimensions are

8 in. in length and 2 5/6 in. in diameter.



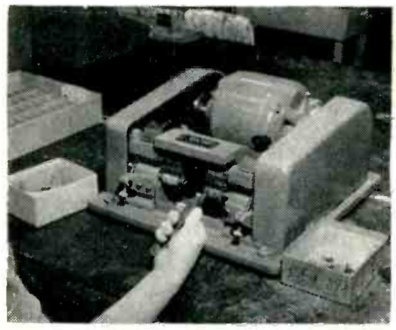
Small D-C Relay

RADIO CORP. OF AMERICA, Harrison, N. J. Type 203W1 hermetically-sealed miniaturized d-c relay was designed for use throughout the electrical systems of military aircraft. It is designed to meet the requirements of MIL-R-5757. Weight is only 3 oz and the relay can be operated in any position. Its 6-pole, double-throw construction features palladium contacts rated to handle 2 amperes with a resistive load at 26.5 volts d-c and 1 ampere with an inductive load at the same voltage. Contacts are arranged in a break-before-make sequence.

Voltage Booster

I.D.E.A., INC., Regency Division, 7900 Pendleton Pike, Indianapolis 26, Ind. To solve the problem of annoying fluctuations in tv picture size due to drops in line voltage, the company has designed a new voltage booster which maintains a 117-v power supply regardless of

line voltage variations from 90 to 130 v. The VB-1 booster can also be used to get peak performance from any electrical device drawing 350 w or less. Since it is an automatic transformer with tapped primary, it can be used with equal efficiency in high-voltage areas to decrease line voltage.



Twin-Headed Wire Stripper

THE ERASER CO., INC., 110 S. State St., Syracuse 2, N. Y. Model D-8 twin-head stripper uses proper wheel grades and settings for high-production stripping of leads of two different gages. The space regulator screw (at front of head) adjusts the minimum spacing to the bare diameter of the wire and prevents damage to the wire. A pressure regulator (on top of head) permits stripping all the wires in the lead with one pass. The stripper shown is equipped with a single wheel and stripper blade for stripping close to the coil. Two-wheel heads are also available. The wheels are specially engineered for the exact type and gage of wire being stripped.

Crystal Calibrated Standard

THE HICKOK ELECTRICAL INSTRUMENT CO., 10514 Dupont Ave., Cleveland 8, Ohio. Model 680 r-f marker and crystal calibrator is designed for use in the shop, labora-

WORKSHOP...

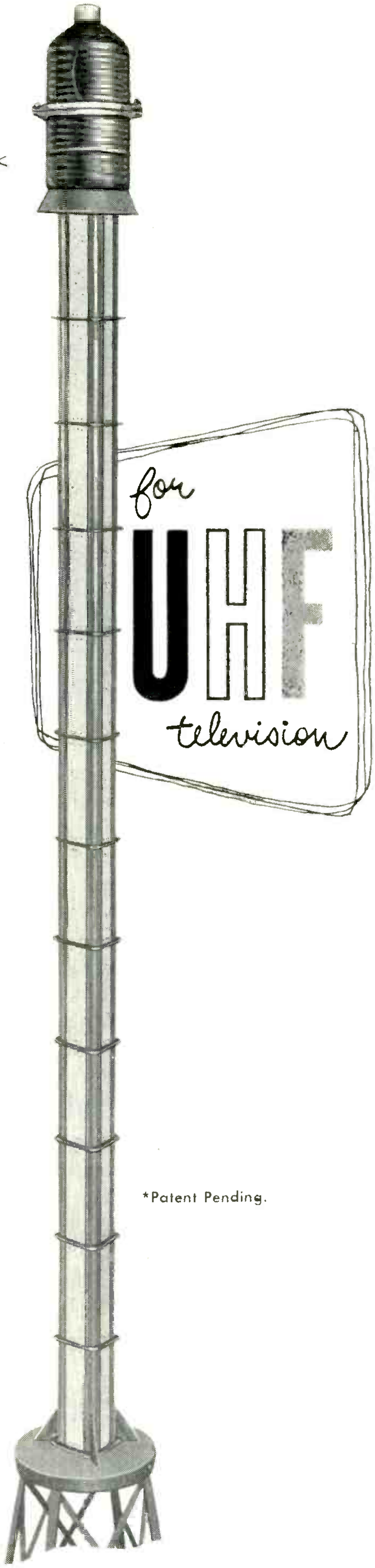
*is proud to announce its new UHF antenna**

the ultimate in–

SIMPLICITY

RUGGEDNESS

RELIABILITY



Simplicity—because the radiating and structural portions are coincidental. Cross sectional view at lower left clearly illustrates its clean cut revolutionary design.

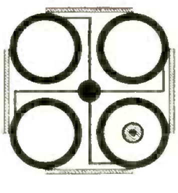
Ruggedness & Reliability—come from complete elimination of small, delicate connectors and breakable insulators. Antenna breakdowns are virtually impossible.

High Gain of 11 db over a tuned dipole for the 12 wavelength model. Power gain of 14.

Perfect Circularity—maximum variations of less than 0.5 db from mean value in horizontal pattern.

Vertical Pattern . . . 4.2° . . . VSWR less than 1.1 to 1 with best match at video carrier frequency . . . will handle 50 KW power . . . and a host of other features.

This is only part of the story on this new development. Specifications indicate its unusually high performance and operating dependability. Write or call for complete information.

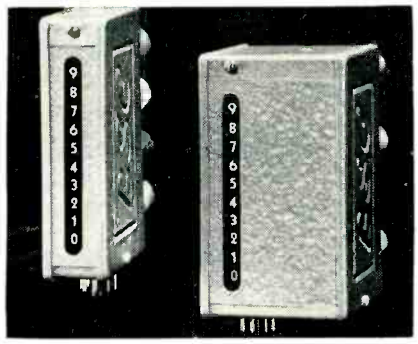


Cross-sectional view showing the four vertical tubes that form the radiating system. These tubes are actually slots and are further subdivided into resonant sections. They are fed by a single vertical inner conductor.

*Patent Pending.

WORKSHOP ASSOCIATES DIVISION
THE GABRIEL COMPANY
Endicott Street • Norwood, Mass.
DESIGNERS AND MANUFACTURERS OF A COMPLETE LINE OF MICROWAVE ANTENNAS

tory and factory, to check oscillators, generators and front-end or overall response curve of a tv receiver. The heterodyne detector and magic eye tube, which is a built-in feature, gives a visual zero-beat indicator to be used for calibration. A phone jack is provided at the back for an audible zero-beat. The 2.5-mc crystal, when beat with the vfo, gives an r-f generator calibrated to ±0.05 percent at 2.5-mc intervals over the range 53 to 89 mc and 174-217 mc on fundamentals, and to 868 mc on harmonics.

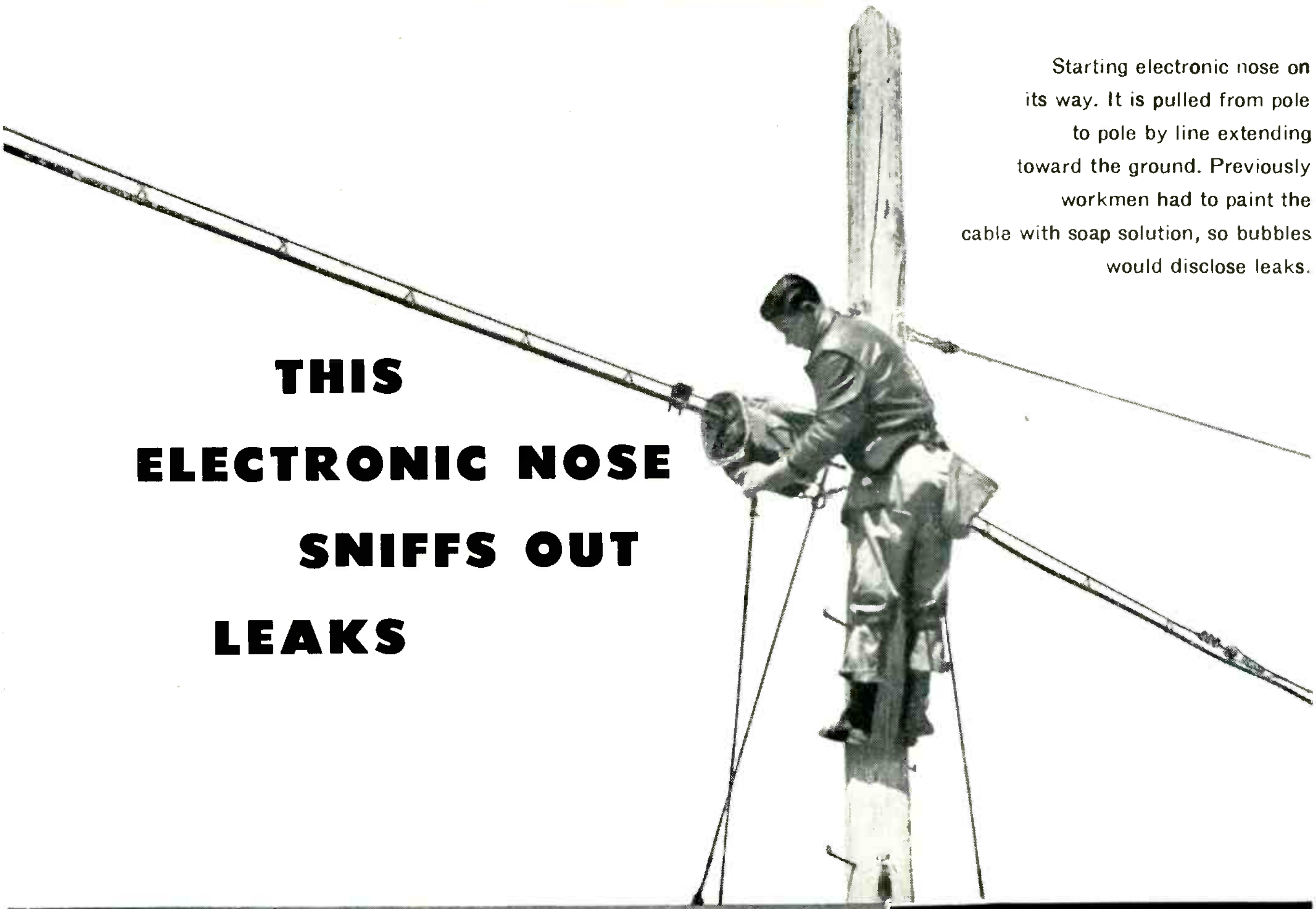


Decimal Counting Units

BERKELEY SCIENTIFIC CORP., 2200 Wright Ave., Richmond, Calif., has available a line of decimal counting units that are plug-in type, direct-reading, electronic counters capable of operating at speeds up to 1,000,000 counts per second and resolving paired pulses separated by as little as 0.8 μsec. The decimal counting unit counts from 0 to 9 and presents an illuminated numerical reading on the front panel. No interpolation is necessary. The tenth pulse resets the counter to 0 and simultaneously generates one pulse, which may be applied to the input of a following counter or other device. Reset to 0 of one or more units is accomplished by momentarily opening the grid return circuit. The units may be connected in cascade indefinitely to create an electronic counter or scaler having any desired number of decimal places.

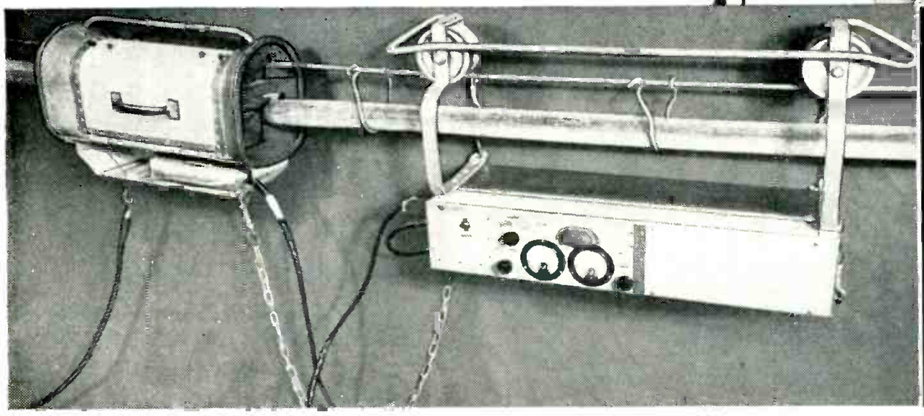
Record Measurements

TELECOMPUTING CORP., Burbank, Calif. Faster, more accurate meas-



Starting electronic nose on its way. It is pulled from pole to pole by line extending toward the ground. Previously workmen had to paint the cable with soap solution, so bubbles would disclose leaks.

THIS ELECTRONIC NOSE SNIFFS OUT LEAKS



For test, the cable is cleared of protective nitrogen or air, and filled with Freon gas. Case at left collects escaping gas which operates Freon-sensitive detector underneath. At points where Freon escapes through sheath cracks, the box at right—a combined control unit and power supply—rings a bell. Workmen mark the point of leak for later repair.

After years of buffeting by the wind, even tough telephone cable sometimes shows its age. Here and there the lead sheath may crack from fatigue or wear through at support points. Before moisture can enter to damage vital insulation, leaks must be located and sealed.

To speed detection, Bell Laboratories scientists constructed an electronic nose which *sniffs* out the leaks. Using an electrically operated element developed by the General Electric Company, the device detects leaks of as little as 1/100 cubic foot per day. Sheath inspection can be stepped up to 120 feet per minute.

Thus Bell scientists add findings in other fields to their own original research in ways to make your telephone system serve you better. On the other hand their discoveries are often used by other industries. Sharing of scientific information adds greatly to the over-all scientific and technological strength of America.

BELL TELEPHONE LABORATORIES

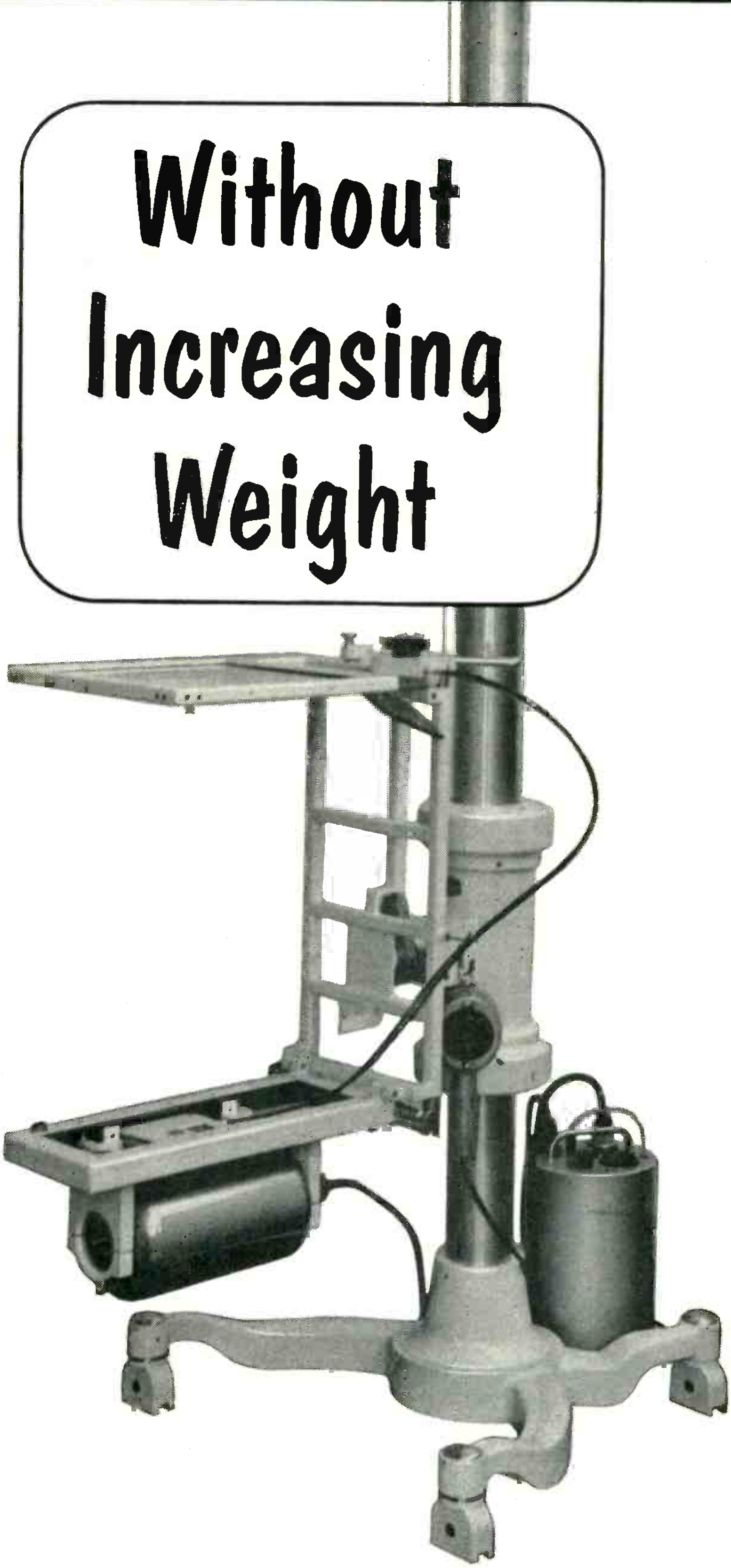
Improving telephone service for America provides careers for creative men in scientific and technical fields

urements of film and oscillograph records are now possible with the development of the Universal Telereader. The unit measures records ranging from 16 and 35-mm film to 12-in. oscillograph paper up to 100 ft in length. It can handle either translucent or opaque records. Three interchangeable projection lenses are provided with the Telereader to permit record magnification of 2X, 4X and 11X, depending on the need. When used with companion instruments such as the Telecordex and a summary punch, the Telereader can print its measurements in decimal form on a typewriter supplied with the Telecordex, as well as recording such information into punched cards.

Magnetic Tape Recorder

ECTRO, INC., Delaware, Ohio. The Parlo-Tape is a completely portable, two-speed tape recorder operating from self-contained batteries. Recordings can be started instantly by turning the knob to RECORD position, or played back by turning the knob to LISTEN position. Its automatic volume control feature provides for a stable recording level at various distances from the microphone. The $3\frac{3}{4}$-in.-per-second tape speed is for general use, and at this speed the recording time on 5-in. 600-ft reel will be 30 minutes. By reversing the reels on the reel spindles an additional 30 minutes of recording time can be added to the same tape, a total of one hour recording on one 5-in. reel of tape. The $7\frac{1}{2}$-in. speed allows a total of $\frac{1}{2}$ hr recording on the 5-in. reel at maximum fidelity and full frequency range. All or part of the

TRAN-COR 3X-0 doubles transformer capacity



In Delft, Holland, an x-ray machine manufacturer recently increased the rating of this portable x-ray unit 100 per cent without increasing its weight. He did it by changing transformer core material from the equivalent of AISI Hot-Rolled Type M-14 to Armco TRAN-COR 3X-0. Machine rating increased from 600 volt-amperes to 1200 volt-amperes.

CAPACITY LIMITED BY WEIGHT

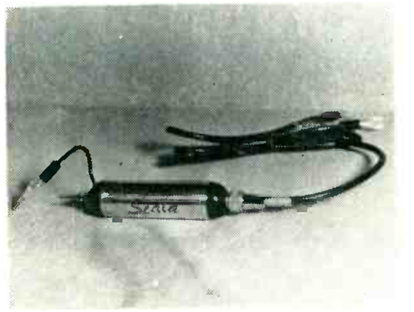
As long as this manufacturer was limited to the old magnetic material there was no way to raise machine capacity without increasing transformer weight. A heavier transformer would mean a heavier unit—too difficult for women operators to push around. Armco TRAN-COR 3X-0 with its advanced magnetic properties solved the problem.

Perhaps you would like to decrease transformer weight, increase capacity, or maybe design for a combination of these benefits. If so, write for the booklet, "Armco Oriented Electrical Steels." It has complete design data on the 14 mil thick Armco TRAN-COR 3X-0 and 2X-0, suitable for wound or stamped laminations. For wound cores only, ask about Armco TRAN-COR 4W-0 and 3W-0 in 12 mil thickness.

ARMCO

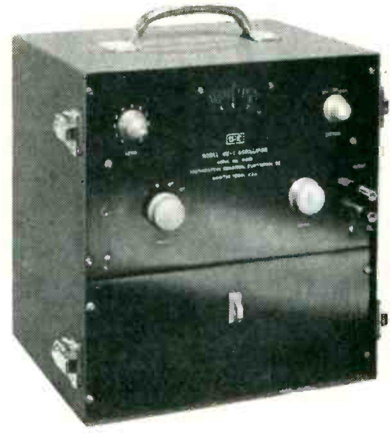
ARMCO STEEL CORPORATION

4512 CURTIS STREET, MIDDLETOWN, OHIO • PLANTS AND SALES OFFICES FROM COAST TO COAST • EXPORT: THE ARMCO INTERNATIONAL CORPORATION tape can be erased right on the machine and reused again and again.



Oscillograph Probes

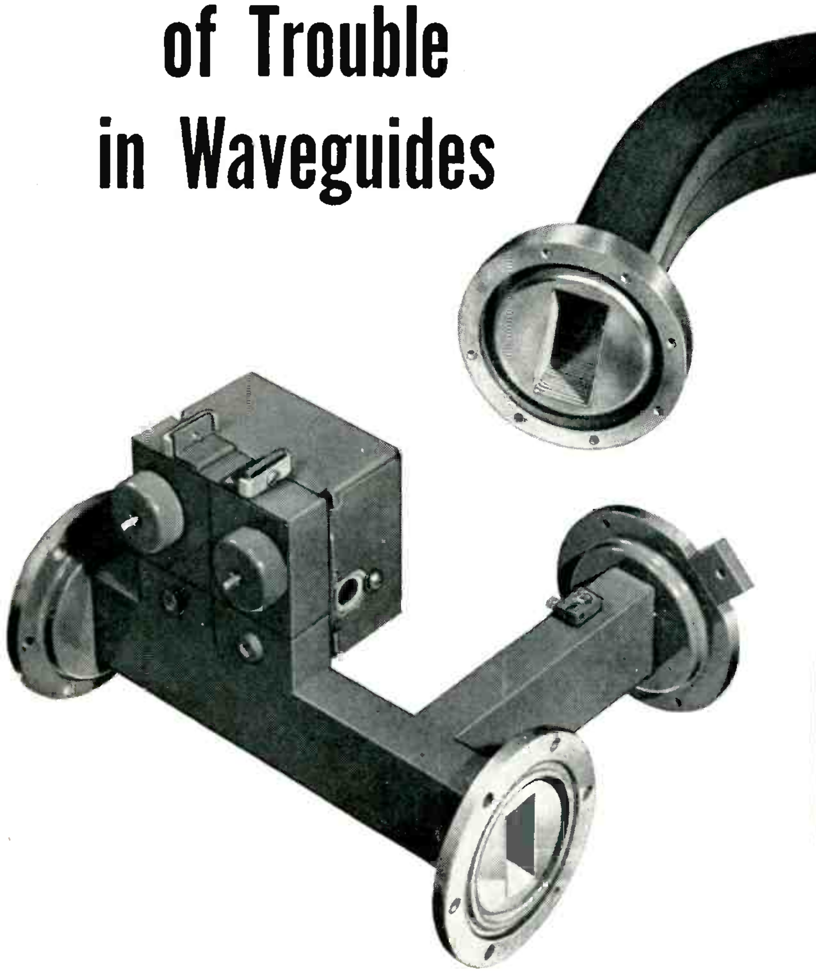
SCALA RADIO CO., 2814—19th St., San Francisco 10, Calif. The B.Z.1 signal-tracing probe can be used to locate dead i-f stages, mark ratio-detector curve, calibrate marker generator, adjust video amplifiers, check output of a sweep generator, view response of single i-f stage and trace buzz pulse in sound i-f strip. It can also be used with vtvm. The unit contains a demodulator of low-capacitance, high-impedance design, useful to 225 mc. Other models are the B.Z.2 low-capacitance probe, and the B.Z.3, a 100-to-1 voltage-divider probe.



Portable Oscillator

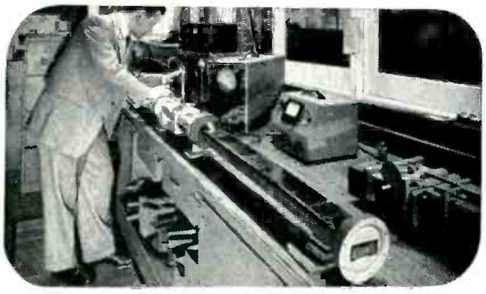
SOUTHWESTERN INDUSTRIAL ELECTRONICS CO., 2831 Post Oak Road, Houston 19, Texas, has available a new portable oscillator designed as a source of signal power for field use. Model MB-1 oscillator derives its operating power entirely from self-contained batteries and covers a frequency range of 2 to 20,000

A Molehill of Difference Can Make a Mountain of Trouble in Waveguides



Remember this traffic-stopper at the 1952 IRE Show in Grand Central Palace? It's a torture test. Flexed well over 1,000,000 times, Waveflex flexible Waveguides gave no evidence of failure or loss of physical or electrical properties.

Fabricated to precision methods, Titeflex flexible and rigid Waveguides are produced to the closest tolerances and to exacting specifications. Titeflex maintains strict quality control and inspection from raw materials to finished products.



No Waveguide gets by this department without a thorough electrical check-up. Every single Titeflex Waveguide is tagged before shipment with its test score on JAN-W-287 specifications for flexible Waveguides or JAN-W-85A for rigid Waveguides.

. . . A little difference in waveguides—imperceptible to the eye—can jeopardize a costly investment.

If you want to be sure of your electronic equipment, if you want to reduce operational failures, insist upon Titeflex microwave components.

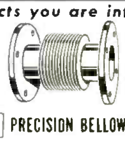
Send for free catalog of uses, properties, and specifications.

Let Our Family of Products Help Yours

Titeflex

✓ Check products you are interested in.

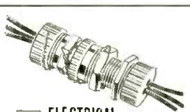
☐ SEAMED AND SEAMLESS METAL HOSE



☐ PRECISION BELLOWS

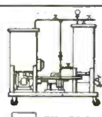
☐ IGNITION HARNESS

☐ IGNITION SHIELDING

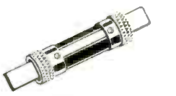


☐ ELECTRICAL CONNECTORS

☐ RIGID AND FLEXIBLE WAVE GUIDES



☐ FILTERS



☐ FUSES

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524 Frelinghuysen Ave.
Newark 5, N.J.

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Please send me without cost information about the products checked at the left.

NAME ____________

TITLE ____________

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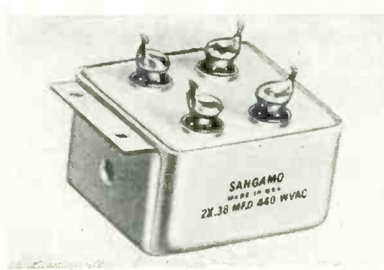
CITY ____________ ZONE ______ STATE ______ cps in 4 decade ranges. An output voltage of 5.5 v is delivered to a 2,000-ohm load and the instrument has an internal impedance of approximately 400 ohms. Distortion is less than 1 percent in the audio spectrum and the dial is accurate to within 2 percent of its indication. The unit is equipped with a switch that decreases the battery gain when the full output is not required, and thereby increases battery life to 100 hours or more for intermittent service.

Power Pentode

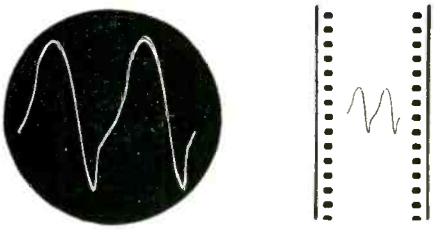
RADIO CORP. OF AMERICA, Harrison, N. J., has introduced a power pentode of the 9-pin miniature type for use in the final video-amplifier stage of tv receivers. The type 6CL6 has very high transconductance, low interelectrode capacitances and high output-current capability. These features make possible the design of wide-band video circuits having a voltage gain of 40 to 45. Providing high plate current at low plate voltages, it can supply sufficient peak-to-peak output voltage to drive large picture tubes with high efficiency and low amplitude distortion.



Capacitive Network

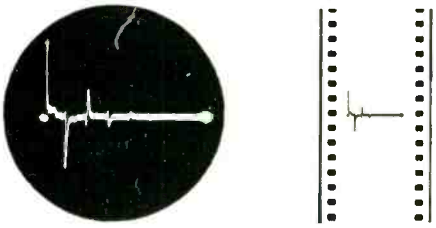
SANGAMO ELECTRIC CO., Marion, Ill., has developed type BTN capacitor

Want an oscilloscope camera NOW?



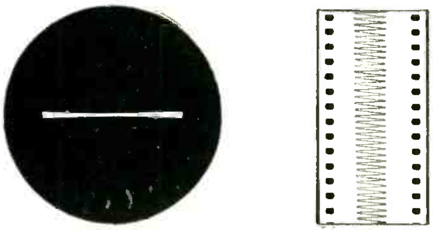
Scope Image — Film Recording

1. Single-frame photography of stationary patterns using a continuously running sweep.



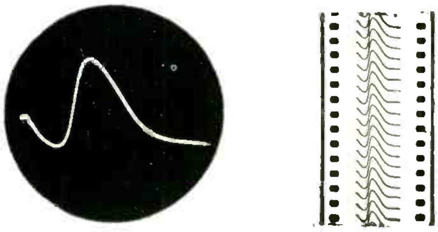
Scope Image — Film Recording

2. Single-frame photography of single transients using a single sweep.



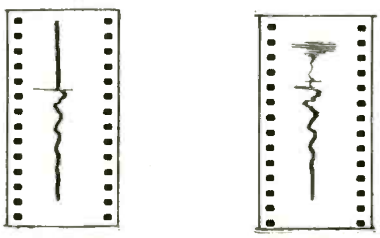
Scope Image — Film Recording

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

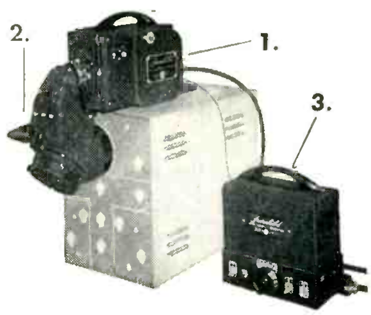
5. Continuous-motion photography employing combination of film motion and oscilloscope sweep as a time base.

Fairchild Oscillo-Record Cameras are now available *from stock* for immediate shipment. With these units you can make *permanent* photographic records of oscilloscope traces, thereby eliminating possible errors in making hand sketches from memory. In time-saving and convenience alone, these cameras will pay for themselves many times over.

FAIRCHILD OSCILLO-RECORD CAMERA IS UNUSUALLY VERSATILE

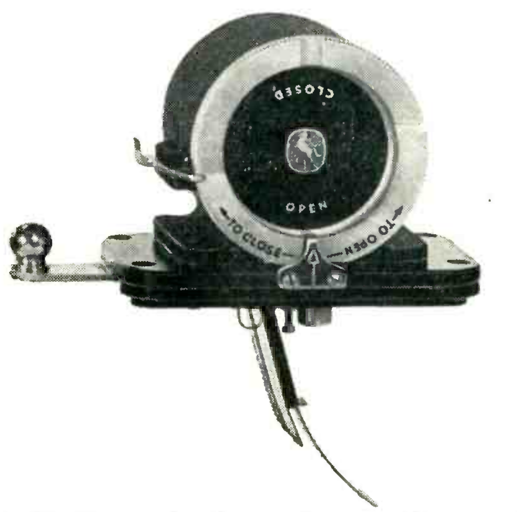
Users of the Fairchild Oscillo-Record Camera like its versatility. Designed for both still and continuous-motion photography on 35-mm film, it records non-recurring phenomena that are too rapid for visual study, others that are so slow that continuity is lost, and the occasions where very high-speed 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 TAKE-UP CASSETTE FOR SHORT RUNS



Where only a few pictures are required for quick development and study, a small Take-up Cassette is available as an accessory. The convenience afforded by this unit results in the saving of considerable time in handling short runs and reduces film wastage to a minimum. It is easily attached to the top of the camera by means of an adapter. A built-in knife permits short lengths of exposed film (up to 10 feet) to be cut off and removed with the cassette for developing.

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 120-18A3.*

FAIRCHILD
OSCILLOSCOPE RECORDING CAMERAS

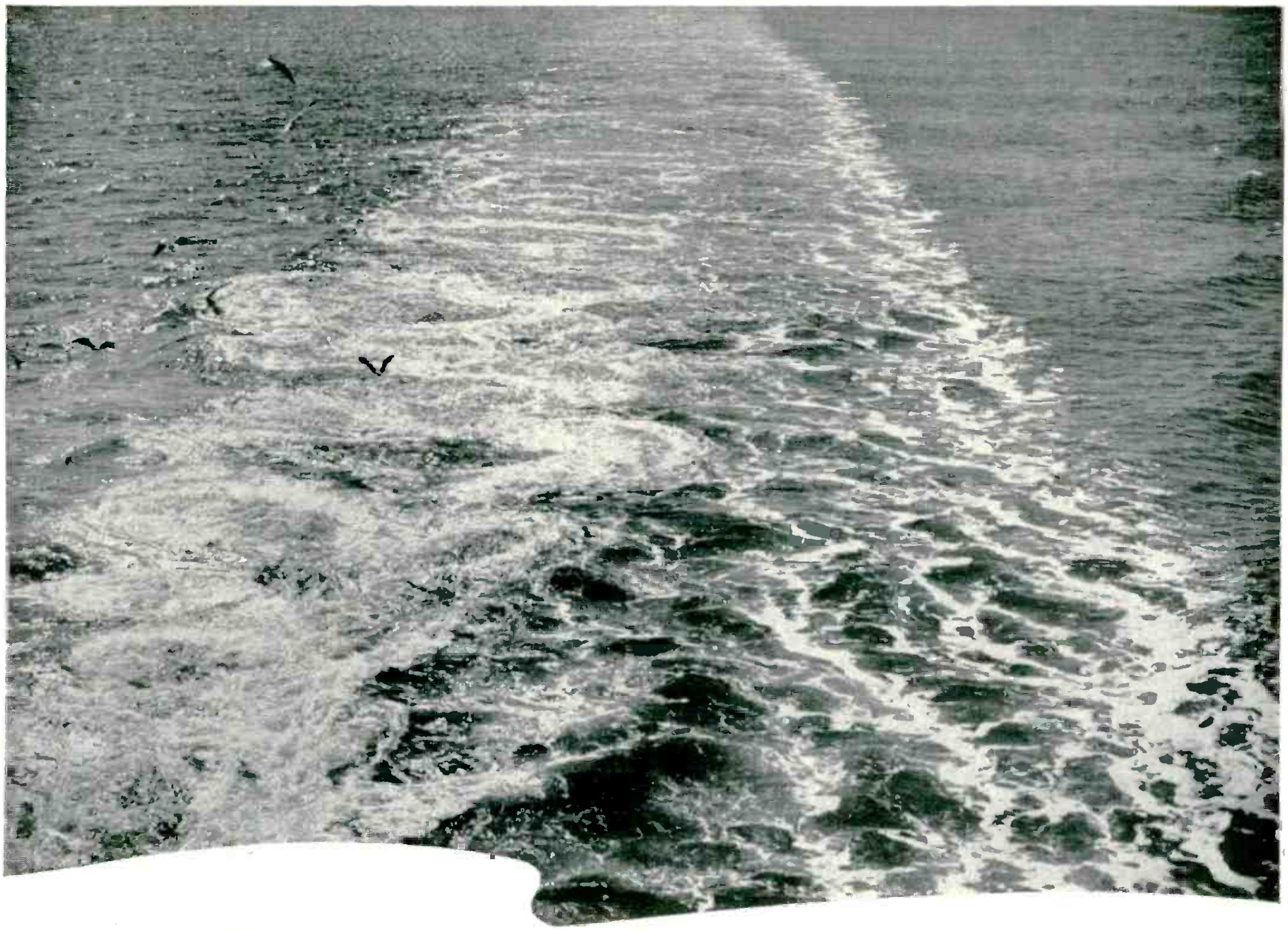
network, a multisection, metal encased, hermetically sealed paper dielectric unit. Its multiple sections can be internally connected to provide a selection of either capacitive pi, Y or delta networks. Type BTN can be provided with mineral oil, pentachlordiphenyl, or electrical grade waxes as impregnants. It is claimed to be advantageous for use in airborne equipment power frequency circuits where the compact single-unit construction offers space and weight saving advantages.

Secondary Standards of Low Capacitance

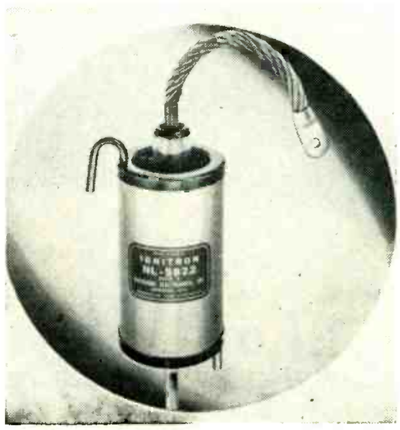
MACLEOD AND HANOPOL, INC., 10 Roland St., Charlestown 29, Mass. Convenient means for calibrating instruments used for measuring low values of capacitance are now available in the model 388 set of secondary standards of low capacitance. The set comprises two T networks, three auxiliaries and a set of cables for connecting the standard to various instruments. The nominal values of the networks are 0.075 and 7.5 $\mu\mu$f; the auxiliaries modify the networks so that values of 0.001, 0.0075 and 0.75 $\mu\mu$f can be obtained. All elements have Q of 200 or better and temperature coefficient of less than 0.05 percent per deg C.

High Temperature Coils

DOUGLAS-RANDALL, INC., 102 High St., Westerly, R. I. Capable of continuous operation in the 450 to



650 F range, yet occupying little more space than conventional windings, the high-temperature coils now available satisfy many needs in the construction of electrical and electronic apparatus for use in jet aircraft and guided missiles. They are particularly suited to solution of miniaturization problems since their ability to operate at high temperatures allows increased self-heat in magnet coils and in field coils of induction or synchronous motors. These coils, wound, with wire sizes 30 through 44, can be furnished on round or rectangular bobbins or as interleaved windings, with lug terminals or flexible leads, and for a-c or d-c service. They will withstand accelerations of 10 to 20 g.



Ignitron

NATIONAL ELECTRONICS, INC., Geneva, Ill., recently announced an addition to its line of industrial tubes. Model NL-5822 ignitron is a metal, water-cooled mercury pool tube designed especially for frequency-changer resistance welders. It utilizes an all-copper cooling system that provides exceptional cooling efficiency. The mercury-pool cathode permits the tube to handle extremely high currents on an intermittent basis. The baffle construction reduces deionization time and permits satisfactory operation under severe conditions of commutation. A technical data sheet is available.

Labeling Machines

POPPER & SONS, INC., 300 Fourth Ave., New York 10, N. Y., are now

"HIPERSIL® CORES

helped us design 99$\frac{96}{100}$% Perfect Amplification!"

McIntosh Engineering Laboratory, whose new output circuit is the first major advancement in years of audio amplifier design, credits Hipersil Cores with a vital contribution to its development.

"Hipersil Cores reduced the weight of our driver and output transformers by 30 pounds; enabled us to cut the height of our assembly from 20 to 7 inches. Further, by holding losses to a minimum, these cores eliminated the high distortion which is characteristic of larger cores at low output levels."

You can cut size, weight and assembly costs in all types of electrical and electronic transformers with Hipersil Cores. They combine highest permeability with lowest losses in a wide range of sizes, all frequencies (1 through 12 mil cores). Greater flux-carrying capacity and increased mechanical strength help to make them the best cores on the market. For specific information on how to apply them to your product, write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70630

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

HIPERSIL CORES

distributing in the U. S. the Rejafix marking and printing machines. The machine will, by use of metal types or cuts, mark, print or decorate any material such as glass, plastics, ceramics, rubber, metal or paper. The impressions may be indelible or washable as desired. Standard machines range from small hand operated ones to large fully automatic units. Rejafix machines are in operation in many places and are successfully marking and printing on products such as capacitors, resistors, tubes and cable.

Diode Tester

COMPUTER RESEARCH CORP., 3348 W. El Segundo Blvd., Hawthorne, Calif., has developed an instrument for testing the dynamic as well as static characteristics of crystal diodes. The new instrument tests both forward and back characteristics under static and dynamic conditions, telling how the diode will perform before one mounts it in the circuit. The diode tester occupies a space less than one-half cu ft, and will accommodate diodes with forward currents of 0 to 100 ma and back currents of 0 to 1,000 μa. Forward voltage is measured to an accuracy of 2 percent and back current to 3 percent. The tester is adaptable to high speed, volume testing and operates on 115-v, 60-cycle current, using 100 w or less.

Digital Computer Tube

GENERAL ELECTRIC CO., Syracuse, N. Y. Type GL-5965 miniature twin triode is designed for use in several of the different circuits used in digital computers. It incorporates a special heater-cathode construction designed for depend-

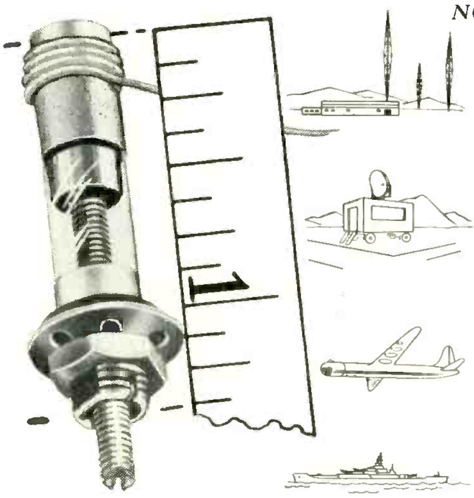
JFD MFG. CO.
BROOKLYN 4, N.Y.
BENSONHURST 6-9200

world's largest manufacturer of tv antennas & accessories

leading manufacturers use

JFD PISTON TYPE VARIABLE TRIMMER CAPACITORS

in both civil and military equipment



NO OTHER LIKE IT!

- Spring loaded piston made of special invar alloy having extremely low temperature coefficient of expansion.
- Silver band fused to exterior of precision drawn quartz or glass tube serves as stationary electrode.
- Piston dimensional accuracy is held to close tolerance maintaining minimum air gap between piston and cylinder wall.
- Approximately zero temperature coefficient for quartz and ± 50 P.P.M. per degree C. for glass units.
- "Q" rating of over 1000 at 1 mc.
- Dielectric strength equals 1000 volts DC at sea level pressure and 500 volts at 3.4 inches of mercury.
- 10,000 megohms insulation resistance minimum.
- Operating temperatures, −55 C. to +125 C. with glass dielectric. And −55 C. to +200 C. with quartz dielectric.
- Over 100 megohms moisture resistance after 24 hours exposure to 95% humidity at room temperature.

Write for Form No. 199

HIGH CAPACITY (300 Liters Per Minute) assured with this New WELCH TWO-STAGE DUO-SEAL® VACUUM PUMP

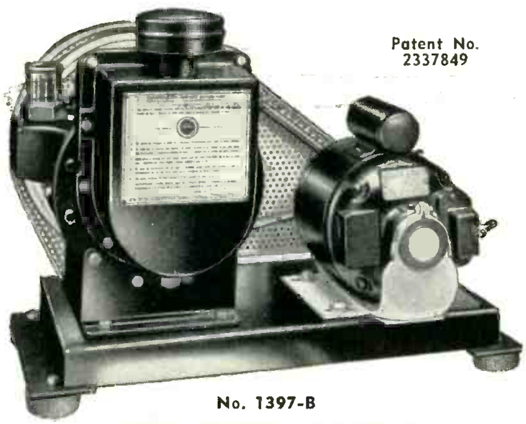
GUARANTEED VACUUM—.0001 mm (0.1 Micron)
FASTER PUMPING AT ALL PRESSURES

Exceptionally Quiet Operation

Built-in Trap prevents oil from backing up into system.

Indicator window shows oil level at all times.

Convenient oil drain permits oil change without dismantling system.



Patent No. 2337849

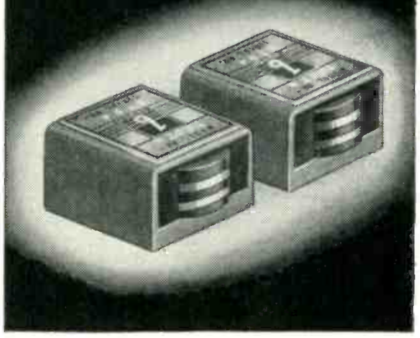
No. 1397-B

COMPACT
Size 26 x 14½ x 18½ inches

COMPLETE $515.00

W. M. WELCH SCIENTIFIC COMPANY
DIVISION OF W. M. WELCH MANUFACTURING COMPANY
ESTABLISHED 1880
1515 SEDGWICK STREET, DEPT. H   CHICAGO 10, ILLINOIS, U.S.A.

4 Channel Recording on ¼" Tape



The Brush Models BK-1502N Magnetic Record/Reproduce Heads are precision aligned, dual channel units. They are designed so that they may be step-mounted side-by-side to provide 4 channels of ¼" tape.

- Individual channels are cast into one integral block of especially selected synthetic resin
- All gaps in precise alignment
- Mu metal shields between individual channels
- Individual channel width, 0.044"
- Center to center spacing between channels .... 0.125"
- Gap width .... 0.0004"
- Total inductance, 75 millihenrys
- Total resistance .... 85 ohms
- Special design features can be supplied to meet your requirements

Model BK-1502N Record/Reproduce Heads, like all other Brush Magnetic Recording Components, are the products of Brush engineering leadership and Brush skills in precision production.

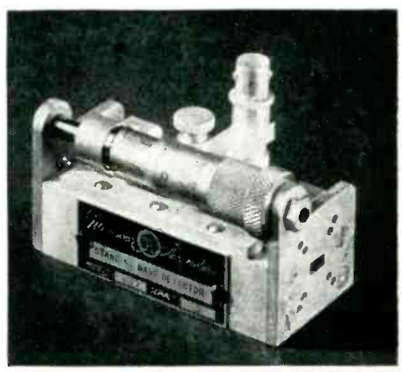
Write us for help on your magnetic recording problems. Your inquiries will receive the attention of capable engineers.

THE Brush DEVELOPMENT COMPANY
3405 Perkins Ave. • Cleveland 14, Ohio
Piezoelectric Crystals and Ceramics
Magnetic Recording Equipment
Acoustic Devices • Ultrasonics
Industrial & Research Instruments

ability under frequent "on-off" switching conditions. When used in "on-off" control applications it will maintain its emission capabilities after long periods of operation under cutoff conditions. Average characteristics with 150 v on the plate are: cathode bias resistor, 220 ohms; amplification factor, 47; approximate plate resistance, 7,250 ohms; transconductance, 6,500 microhms; and plate current, 8.2 ma.

Picture Tube Tester

VIDAIRE ELECTRONICS MFG. CO., Lynbrook, N. Y. The Kine-Test quickly and accurately determines any defects in a tv picture tube. It is also designed to check simultaneously filament voltage, first-anode voltage, bias voltage and the video signal. With a Kine-Lite, which is about the size of a radio tube, it is intended that the tv picture tube be checked without removing it or the chassis from the cabinet. It is meant to let the serviceman merely plug his pocket-sized Kine-Lite into the picture tube socket and have all the necessary information revealed in a matter of seconds.



Standing Wave Detector

MICROWAVE ASSOCIATES INC., 22 Cummington St., Boston 15, Mass. Type 1022 standing-wave detector is designed for precision low-level impedance measurements in the millimeter region when used with a suitable source and amplifier. Vswr's as low as 1.01 can be read accurately in the region from 34 to 36 kmc. The unit consists of a slotted section of RG-96/U waveguide milled from a solid piece of brass and silver plated. A movable carriage is provided carrying a spring-loaded adjustable coupling probe, a silicon diode detector socket, and coaxial output fitting that will mate with a UG-88/U or equivalent BNC cable connector. A total longitudinal probe displacement of 0.750 in. is available. Probe position can be read accurately to 0.001 in. Total insertion length of the unit is 3.25 in.

Equalizer Preamplifier

McINTOSH LABORATORIES, Binghamton, N. Y., has introduced a new equalizer preamplifier, model C-104 and C-104A. It is similar to the previous model, AE-2A, but incorporates greater simplicity of control and an additional turnover frequency. The unit can be used as the control center for any sound reproducing system. Five input channels are provided: for tv audio, f-m/a-m tuner, low-level microphone, high-level magnetic cartridge and low-level magnetic cartridge. There are separate, continuously variable bass and treble controls, providing 20-db bass attenuation and 20-db accentuation, independent of treble control; 15-db treble accentuation, 20-db attenuation, independent of bass control.

Miniature Microphone

THE ASTATIC CORP., Conneaut, Ohio. Model 54M3 miniature microphone employing crystal element is a high-

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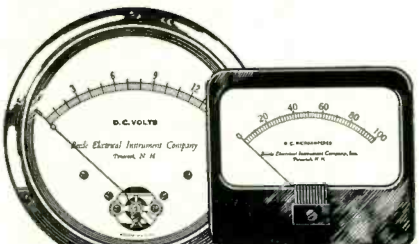

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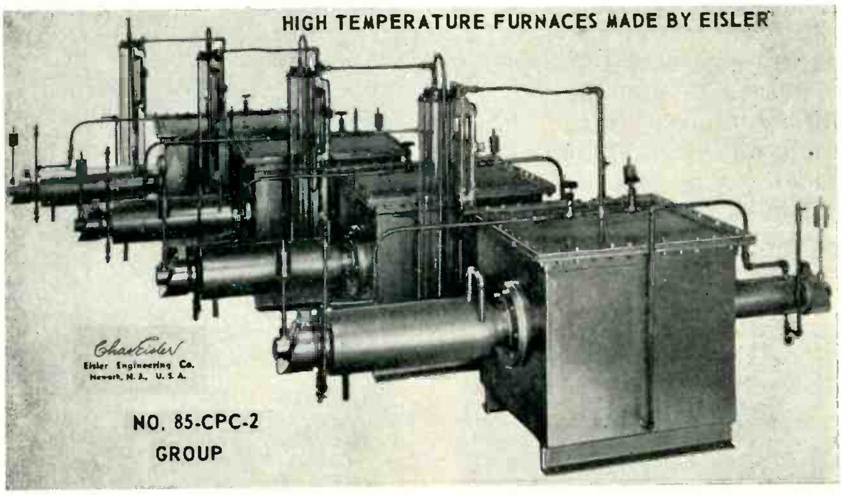

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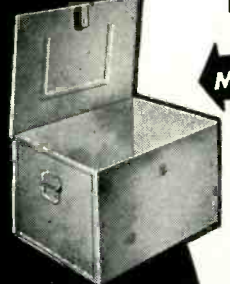

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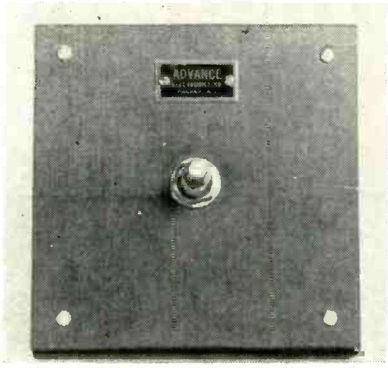
output unit (−51 db below 1 v per microbar). The top grille is a circular metal stamping, 1¾ in. diameter and ½ in. deep. Housing and handle are combined in a single die cast unit. The microphone is nondirectional when mounted in its base. Recommended for recorder, p-a, conference and other uses, its response (30 to 10,000 cps) is flat to 1,000, gradually rising to 6,000 cps. It is furnished with 5 ft of rubber covered, single-conductor shielded cable and protector sleeve at the microphone.

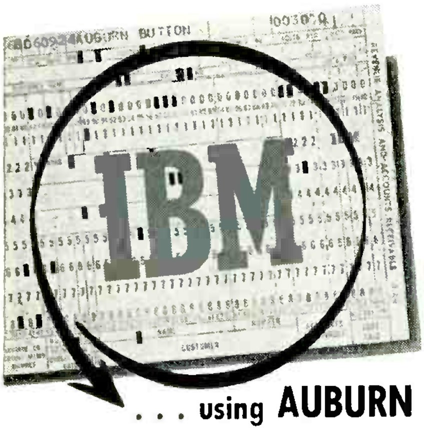


Miniature Delay Line

ADVANCE ELECTRONICS CO., P. O. Box 394, Passaic, N. J. Type 506 miniature continuously variable delay line is essentially a condensed r-f cable with one conductor changed into a long thin coil and the other conductor spaced closely to the first, thus producing a large amount of time delay yet maintaining low attenuation at high frequencies. It provides continuously variable time delay from zero to several hundreds of millimicroseconds. It features small size and weight, fast rise time, excellent stability, hairline accuracy and complete freedom of time jitter.

Radar Range Computer

GENERAL ELECTRIC CO., Syracuse, N. Y., has available a new circular



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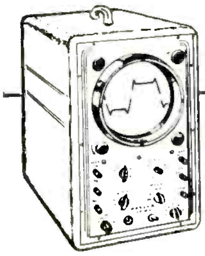

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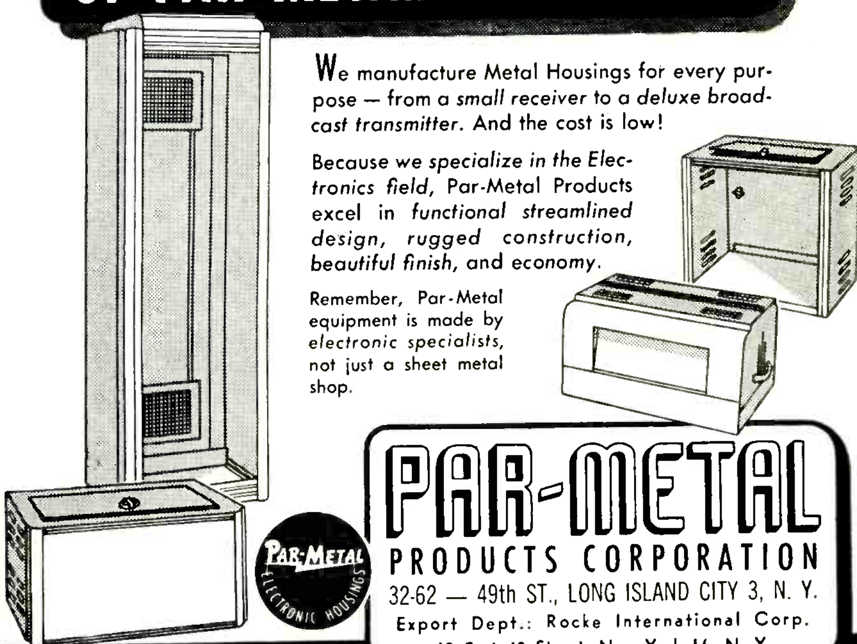

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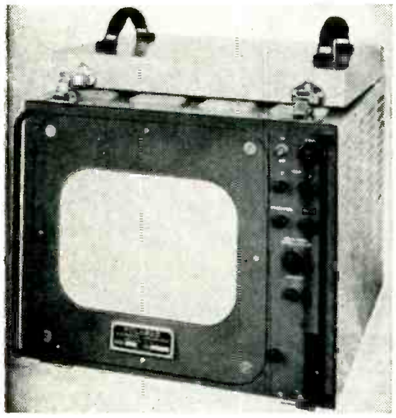
type slide computing rule, which solves quickly the equation for determining the maximum detection range of radar. The device, about 8 in. in diameter, is for calculating the free-space maximum range when the equipment design characteristics are known. On the reverse side of the circular calculator are provisions for determining antenna gains, power ratios and vertical coverage. The numerical calculation of the performance of a pulsed radar involves seven variables, all raised to exponential powers between one and three, a tedious and time-consuming task. The new slide rule provides a means for drastically reducing the time necessary to perform the same calculations many times, with varied quantities.



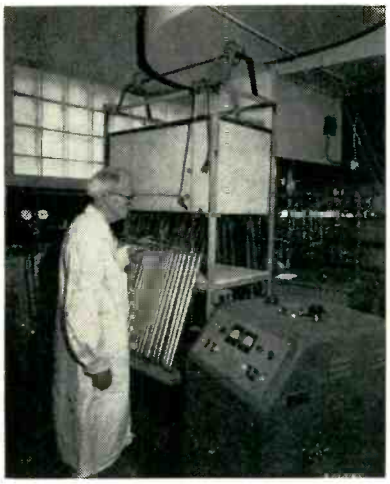
Studio Picture Monitor

POLARAD ELECTRONICS CORP., 100 Metropolitan Ave., Brooklyn 11, N. Y., announces a studio picture monitor, model M-104C, using a 12-in. kinescope. The unit consists of a prelined screen kinescope removable from the front. It is ideal for studio use or remote monitoring of telecasts. It is completely self-contained and presents a tv picture of black and white or color signals in black and white at the turn of a switch. The input signal is 1 volt peak-to-peak and the input impedance is 470,000 ohms. Resolution is in excess of 450 lines.

Combustion Analyzer

VICTORY ENGINEERING CORP., Springfield Road, Union, N. J. Model 140-A combustion tester com-

bines the accuracy of a laboratory Orsat-type tester with ease of operation. All three important factors in furnace operation—CO_2 content of flue gas, temperature of flue gas and draft over fire—are measured by this improved two-probe instrument. Features include: a glass-coated electronic thermistor; a gas analysis cell with built-in temperature compensator; and a filter drier requiring only 6 to 8 squeezes of a hand aspirator. The unit is vibration and shock proof.



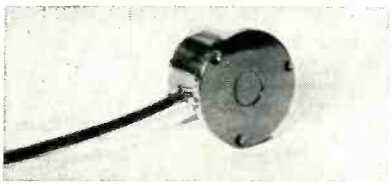
Boron Trifluoride Counters

RADIATION COUNTER LABORATORIES, INC., 5122 West Grove St., Skokie, Ill., has available a new boron trifluoride neutron counter. This two atmosphere (150 cm Hg) enriched BF_3 counter is of all aluminum construction (except for the anode, Kovar seal and connector), which insures minimum neutron capture in the counter shell. The end sections of the counter are "heli-arc" aluminum-welded, and the whole counter is helium leak-tested before filling. It is baked at 100 C for 12 hours while being evacuated. A guard ring type construction is utilized. Three counters are available in pressures of 150 and 12 cm Hg., and in three standard sizes: 1 in. x 6 in.; 1 in. x 12 in.; and 1 in. x 20 in. active length.

Small Triode-Pentode

SYLVANIA ELECTRIC PRODUCTS INC., 1740 Broadway, New York 19, N. Y., is producing a miniature

9-pin medium-mu triode and sharp cutoff pentode contained in one envelope, designated 6 X 8. The tube is designed as a combined mixer and oscillator in tv receivers using an i-f of approximately 40 mc. The pentode mixer section of the 6 X 8 provides low grid No. 1 to plate capacitance as compared with a triode mixer. This reduces feedback problems often encountered in mixers when using an i-f in the vicinity of 40 mc. The low output capacitance enables the tube to work into a high impedance plate circuit resulting in higher mixed gain. The type 6 X 8 is also well suited for use as a mixer in a-m/f-m receivers.



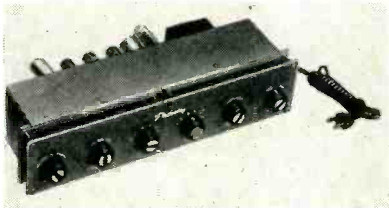
Pressure Transducer

THE BETA CORP., P.O. Box 8625, Richmond 26, Va. The type 3 electrokinetic transducer makes use of the streaming potential developed by a polar liquid flowing through a porous plug to provide a high-sensitivity means of measuring fluctuating or transient pressures over extended ranges of both amplitude and frequency. In the configuration shown the case may be baffle mounted for measuring air blasts and shock waves up to 100 psi or adapted to measure pressures in pipes or tubing. The unit provides a sensitivity of 250 mv per psi at a resistive output impedance of less than 100,000 ohms. The frequency response at the diaphragm extends from 0.25 cps to above 30 kc.

Audio Oscillator

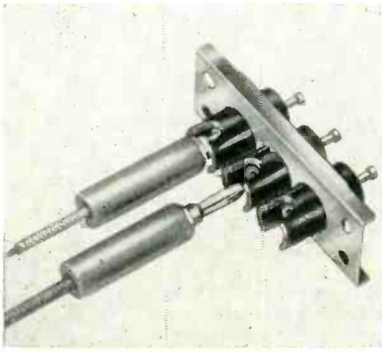
WAVEFORMS, INC., 333 Sixth Ave., New York 14, N. Y., announces a new model 510-B wide-range audio oscillator, featuring improvements in stability and precision. Frequency changes less than 0.5 percent with line-voltage variations from 95 to 130 v and less than 1.0 percent with temperature variations of 0 to 150 F. Standard calibration accuracy is 2.0 percent, but

accuracy of 1.0 percent is available on special order. Other features include miniature size, only 6 in. high, 4¼ in. wide, and 5 in. deep; unusually wide frequency range of 18 cycles to 1.2 mc; distortion under 0.2 percent over most of the useful range; and constant output within ± 0.5 db. A 600/150 ohm line matching transformer is available. Total weight is 6 lb and the instrument operates on any power-line frequency from 50 to 400 cycles.



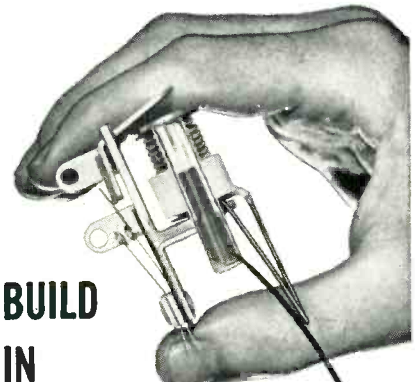
Audio Input System

PICKERING AND CO., INC., Oceanside, L. I., N. Y. Type 410 audio input system (equalizer-preamplifier) is designed to serve as an audio control center. Three input channels are provided; two are for high-level audio signals, and one for magnetic-type pickups. The pickup channel provides 40-db gain at 1,000 cycles and 6 db per octave of bass boost below the low-frequency turnover. Used with a high quality power amplifier the controls provide complete flexibility for volume and tone balance. It is self-powered and operates from a 115-v a-c line. Three a-c outlets on the rear of the chassis are controlled by the a-c switch on the panel, permitting this unit to be used as a master power control for the other components of the system.



Terminal Block

CURTIS DEVELOPMENT AND MFG. CO., 3266 North 33rd St., Milwau-



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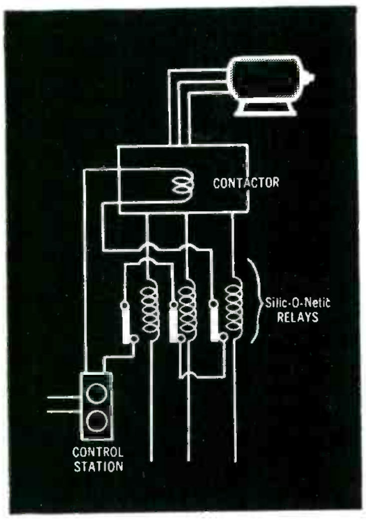

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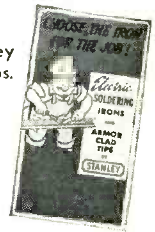

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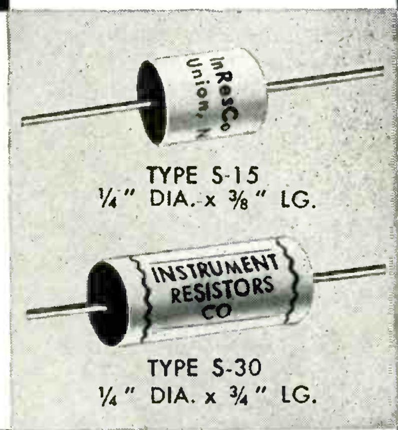

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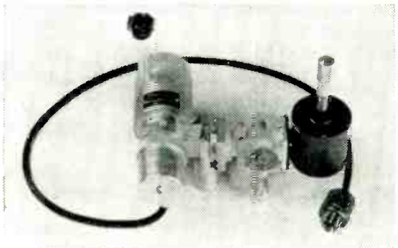
Thermal Switch

RADIO MERCHANDISE SALES, INC., 1165 Southern Blvd., New York 59, N. Y. Introduced primarily as a televiewing convenience device, the model TH-SW thermal switch permits automatic operation of lamps, rotor, booster and similar devices through operation of the tv receiver. In addition to this convenience, neatness of wiring arrangement and protection against operating electrical units overnight are other advantages claimed for the unit. The switch is compact and mounts easily to the wall. A spare outlet is provided for independent operation of other electrical devices.



Spectrum Analyzer Adapter

MICROWAVE ASSOCIATES INC., 22 Cummington St., Boston 15, Mass. Type P-530 spectrum analyzer

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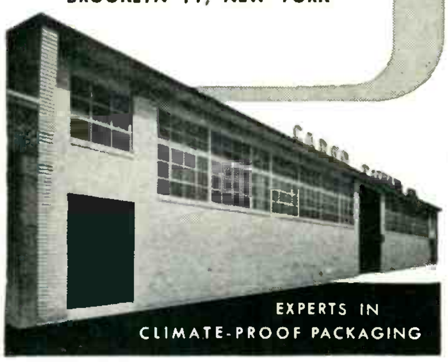

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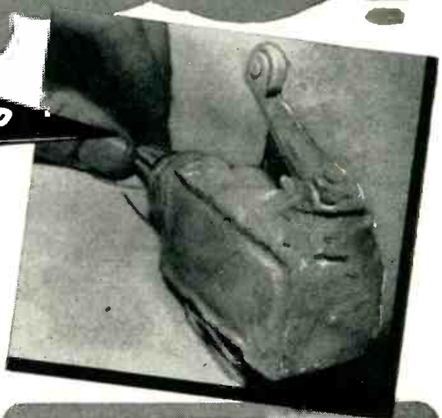

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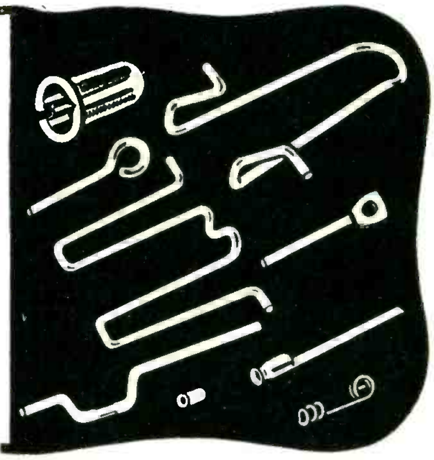

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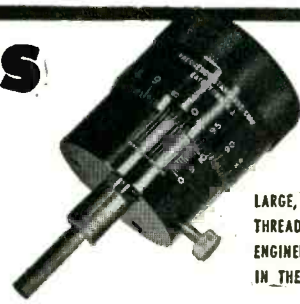

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for the Electronics Industry

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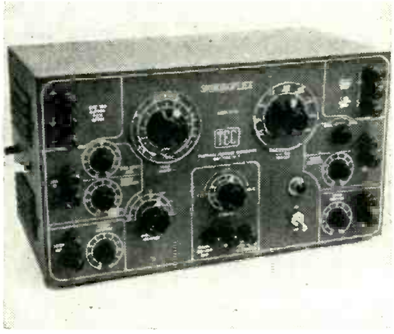
3

adapter consists of a complete set of r-f plumbing to convert any existing S or X band spectrum analyzer to the frequency range centered at 35,000 mc. Input sensitivity will vary with the noise figure of the spectrum analyzer receiver with which it is used, but threshold sensitivities of 70 db below 1 mw are to be expected. The unit is composed of a 2K25 klystron operating at X-band and powered from the spectrum analyzer power supply. Oscillator output is fed through a variable attenuator to a mixer where its fourth harmonic is mixed with the incoming millimeter signal. Signal input enters through a UG-381/U connector and RG-96/U waveguide. The i-f output of the mixer is a type N connector.



Versatile Test Instrument

TELEVISION EQUIPMENT CORP., 238 William St., New York 38, N. Y., announces a new type of test instrument, the Syncroplex, a multiwaveform generator and pulse synchronization unit. At repetition rates of 1 cps to 100 kc it provides: (1) sawtooth waves; (2) square waves or square pulses, 1 μsec to 1 second duration with rise time of 0.15 μsec; and (3) integrated or differentiated versions of the square waves and pulses. Other applications of the unit include: oscilloscope sweep phaser, delayed pulse generator, oscilloscope trace expander, frequency divider, and pulse-time or pulse-width modulator.

Square-Wave Generator

NEW LONDON INSTRUMENT CO., P.O. Box 189, New London, Conn. The compact type 150-A square-wave

ATR

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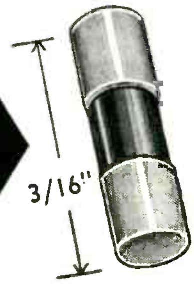
MICROWAVE RESISTORS TELEWAVE TYPE R

SMALLEST RESISTOR AVAILABLE

(Ideal for Miniaturization)



TYPICAL APPLICATIONS

- Power measurement at any frequency
- Matched terminations for waveguides or coaxial lines
- Resistive power pickup loops
- RF pads or attenuators
- Dummy loads
- Temperature measurements
- Impedance matching

TYPE R RESISTORS employ noble metal film deposits on specially selected heat resistant glass.

FILM THICKNESS offers negligible skin effect, at microwave frequencies.

POWER CAPACITY of 1/4 watt provides high power handling ability.

PHYSICAL STRUCTURE is ideally suited to impedance matching in standard coaxial line and waveguides.

FINISH. Coated with a special silicone varnish to protect the film.

SPECIFICATIONS

Resistance: 50 ohms standard, other values on request.
Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 25°C
Size: 1/16 inch diam. x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 — 1/16 inch
Type R-093 — 3/32 inch
Temperature Coefficient: approx. 0.0019 ohms/ohm/°C.
Power Sensitivity: Approx. 10 ohms/watt

AVAILABLE FOR IMMEDIATE DELIVERY

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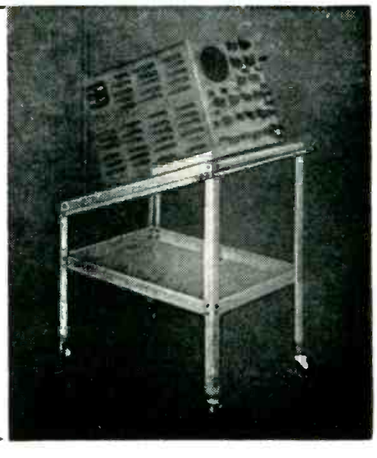

generator provides square waves at frequencies from 50 cps to 1 mc with a maximum rise time of 0.05 microsecond on all frequencies. Fixed frequencies are 50, 1,000, 10,000, 100,000 and 1,000,000 cps. Other frequencies are obtainable through the use of an external frequency-control capacitor for which terminals are provided. A pulse for oscilloscope synchronization is available. Output is controllable from 0 to 20 v peak-to-peak and is constant at all frequency settings. Tilt and overshoot are negligible.

Multiplier Phototube

RADIO CORP. OF AMERICA, Harrison, N. J. Model 6199 is a small, 10-stage multiplier phototube of the head-on type, intended for use in scintillation counters and in other applications involving low-level, large-area light sources. Spectral response covers the range from about 3,000 to 6,200 angstroms with a peak value at approximately 4,000 angstroms. Design features include a semitransparent cathode having a diameter of 1¼ in. on the inner surface of the face end of the bulb; a face with a flat surface 1 in. in diameter to facilitate the mounting of flat phosphor crystals in direct contact with the surface; and 10 electrostatically focused multiplying stages.

Literature

Electrical Computer. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif. Bulletin 1802A describes the model 30-103 electrical computer that is designed for rapid solution of as many as 12 simultaneous

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The modern styling and dependability and superior performance of the TELEX Monoset have made old fashioned headphones obsolete. Magnetic.

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New dynamic under-chin TELEX Dynaset, with more highs and lows of both music and speech, is the delight of radio and TV monitors. Weighs only 1.25 oz.

Modern, lightweight, durable . . . Easily adjustable and built for hard usage, TELEX Headsets give top quality reception without the punishment of extra weight and pressure.

***TWINSET**
This lightweight 1.6 oz. TELEX Twinset pipes signal directly into the ear, blocking out background noises and banishing listening fatigue. Magnetic.

***EARSET**
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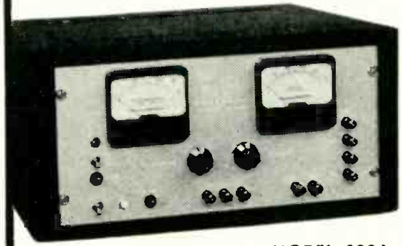

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- HV hum level within 2MV
- 0 to -150V bias, stabilized, 5MA max.
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Also available: general purpose units for industrial or laboratory use.

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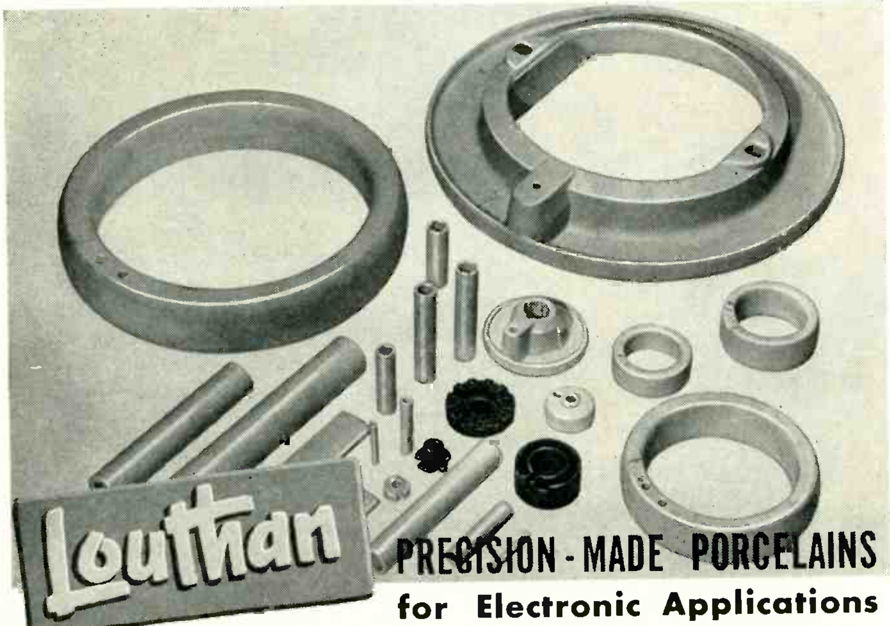

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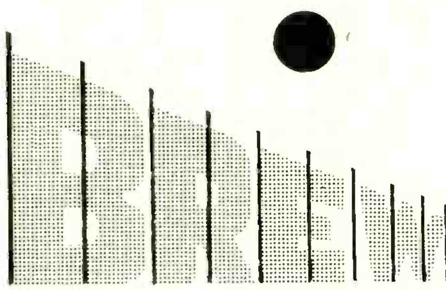

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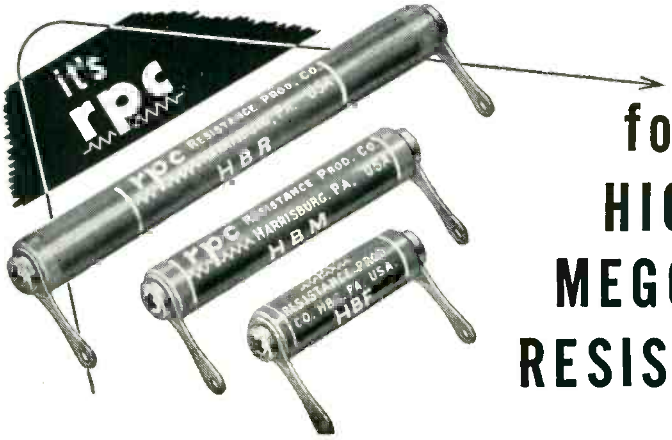
linear equations. The computer described, applicable to many fields such as electrical circuit study, aircraft flutter analysis, and statistics, is fast and accurate, yet priced within the budget of the average laboratory. It has been used widely for rapid reduction of mass spectrometer and infrared spectrophotometer data.

Laminated Plastics. The Formica Co., 4614 Spring Grove Ave., Cincinnati 32, Ohio, has issued a new general catalog describing 50 standard grades of Formica laminated plastics for industrial usage. Printed in colors, the 16-page illustrated publication features a new edition of the Formica comparator chart. In this chart the major characteristics of each grade are described and a quantitative grading system permits easy choice of the material best suited to special requirements. The catalog also shows typical uses of Formica in sheets, tubes, rods, molded and postformed shapes for electrical, chemical and mechanical applications.

Microwave Equipment. Radio Corp. of America, Camden 2, N. J. A new 20-page informational booklet provides a semitechnical description of microwave radio systems. It is fully illustrated with photographs, diagrams, charts, graphs and maps. Seventeen chapter headings include terse descriptions of microwave radio, how it works, propagation characteristics, operational advantages, economic factors influencing choice of frequencies and desirable design characteristics. Other chapters deal with multiplexing, telemetering and remote control features of microwave systems, while in other categories practical information as to who can use microwave, how to plan a microwave system, selecting station sites and other valuable information is presented.

Subminiature Tubes. Raytheon Mfg. Co., 55 Chapel St., Newton 58, Mass., has announced six new reliable subminiature tube types in a booklet just off the press. Included are a dual diode, three dual triodes of amplification factors of 20, 35 and 70, a voltage regulator tube,



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Precision drilling made easy!

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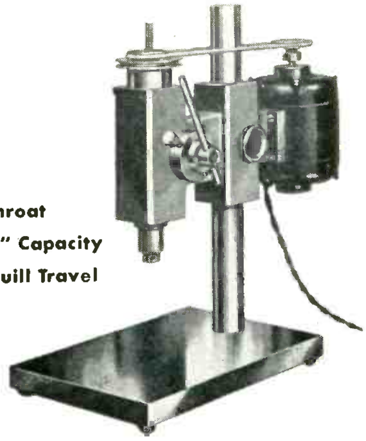

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0-1/8" Capacity
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Sensitive Speed Control: Foot-operated, leaves both hands free

High Precision: Selected Chuck and Bearings. Spindle true within .0004". Table square .0006" in 5" circle. Permanent accuracy, castings annealed and ground.

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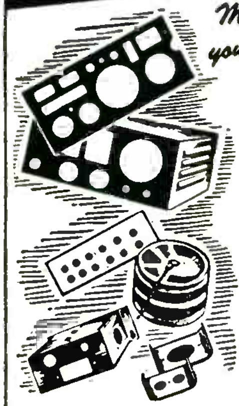

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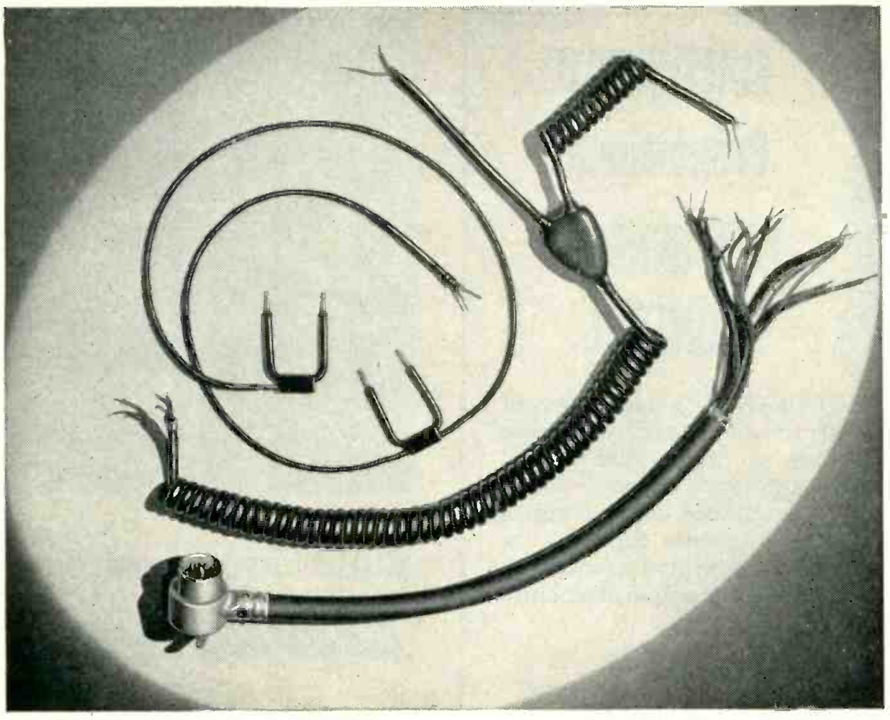


and a voltage reference tube. With the five reliable subminiature types previously announced the booklet describes a total of eleven types, all of which are available for prompt delivery.

Instrumentation Bulletin. The Gulton Mfg. Corp., 200 Durham Ave., Metuchen, N. J., has available technical bulletin KA-1, dealing with instrumentation for shock and vibration testing of electron tubes. Also described is a new test set, which includes accelerometers, amplifiers and filters. The instrument discussed can be used directly with galvanometers, oscilloscopes, or electronic voltmeters, for direct evaluation of shape and magnitude of accelerations.

Industrial Television. Diamond Power Specialty Corp., Lancaster, Ohio. Bulletin 1025-A covers the new model 300-B Utiliscope (wired television), the complete installation of which consists of a camera, a small power unit and the monitor or viewing unit. The bulletin is fully illustrated and includes the Utiliscope's advantages, typical uses, circuit design and general information.

Tubular Trimmers. JFD Mfg. Co., Inc., 6101 Sixteenth Ave., Brooklyn 4, N. Y. Form No. 199 is a single-page bulletin dealing with a line of piston-type variable trimmer capacitors. Approximately one inch in length, the tubular trimmers described deliver uniform change of capacitance in relation to rotation with excellent resettability. The literature includes illustrations and outstanding features of the units.

Motor Speed Controls. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass., has issued an 8-page bulletin illustrating and describing in detail all of its Variac motor-speed controls. Technical information including speed-torque curves and typical applications are given on all models. Prices are included.

Direct-Writing Recorders. Sanborn Co., 39 Osborne St., Cambridge 39, Mass., has issued a 16-page booklet covering the seven

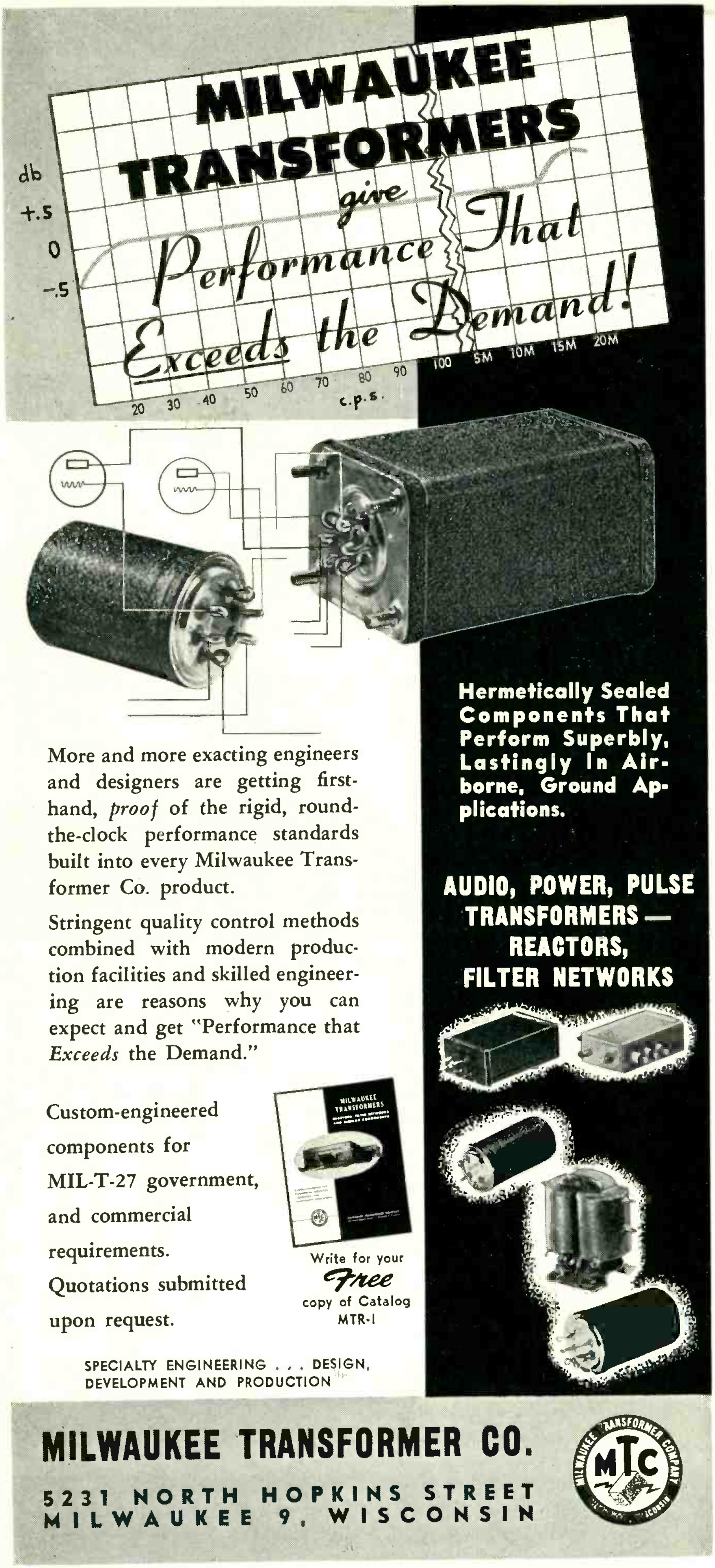
advantages of its direct-writing recorders for industrial users. The recording equipment described and illustrated is available in completely assembled systems that are ready for use in the laboratory or on the job, or as separate instruments fitted with proper connectors for use or integration with other equipment already owned. Typical users are listed, and chief applications and technical data are included.

Acoustical Lens. James B. Lansing Sound, Inc., 2439 Fletcher Drive, Los Angeles 39, Calif. Distributing a uniform sound wave over the entire audio spectrum, the new acoustical lens described in a single-sheet bulletin smooths out the high frequencies. An illustration, dimensional diagram and specifications are included. Also shown are polar diagrams of the directional characteristics of an acoustic lens and a multicellular horn.

Graphic Recorder. Francis L. Moseley, 1136 No. Las Palmas Ave., Los Angeles 38, Calif. A single data sheet presents an instrument that combines in convenient form all facilities needed for the graphic recording of test measurements. In seconds the Autograf illustrated and described in the bulletin will plot curves showing the relationship between a dependent and an independent variable—no reading of meters, no columns of data, no French curves. Complete specifications are given.

TV Studio Lighting. Kliegl Bros., 321 W. 50th St., New York 19, N. Y. A new tv studio lighting and associated facilities planning manual is now available. The manual, in folder form, is complete with tested sample studio plans and informative pictures of actual studios showing lighting facilities in use.

Coating Thickness Gage. Branson Instruments, Inc., 430 Fairfield Ave., Stamford, Conn., has released a 6-page folder describing the theory and operation of the model 600 Coatingage, a portable instrument that is used to measure the thickness of nonmagnetic coatings on magnetic bases and to detect pin-



holes in nonconductive coatings on conductive bases. One of the most important applications for the versatile instrument described has been the examination of corrosion-protective coatings for thickness and film continuity. Detailed information on the operation of the equipment is included.

Metal Fasteners. Prestole Corp., 1345 Miami St., Toledo, Ohio, has released a series of engineering application bulletins on patented metal fasteners. Both latching and non-latching types of the "C" and "J" clip fasteners are described, with engineering type of illustrations showing complete details of assembly. Engineering application data including dimensions, minimum panel hole sizes, material weights and screw sizes have been tabulated for easy reference.

Electrical Contact Rivets. Gibson Electric Co., Pittsburgh 21, Pa. Catalog C-521, just published describes the company's line of electrical contact rivets. Discussed in the 6-page folder are contact rivets made from fine silver, coil silver, silver alloys, palladium and powdered metal compositions designated as Ductile Gibsiloys. Standard sizes of flat, crowned and pointed contact rivets are also listed.

Medium-Mu Triode. Lewis and Kaufman, Inc., 50 El Rancho Ave., Los Gatos, Calif. A recent data sheet describes the type 254 medium-mu triode. The tube is illustrated, given outline dimensions and general electrical characteristics. Operating curves are provided for average static charactertistics while maximum ratings and typical operation parameters are supplied over three modes of operation: (1) class-B a-f power amplifier; (2) class-C r-f power amplifier, plate unmodulated; and (3) class-C r-f power amplifier, plate modulated.

Transformers and Reactors. Southwestern Industrial Electronics Co., Inc., 2831 Post Oak Road, Houston 19, Texas. An 8-page folder technically describes a line of precision engineered transformers and reactors that feature high induc-

RANGE RATE CALIBRATOR

MODEL 312

PROVIDES RAPID CALIBRATION OF BOTH RANGE, AND RANGE RATE OF RADAR RANGING SYSTEMS

RANGE:
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Accuracy .25%

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"E-Series terminals are applicable on MIL requirements and will withstand thermal shock, vibrations, mechanical strains, and excessive pressures with no impairment of the seal or other functional characteristics. E-3LW terminals are now being used at 1000 psi static oil pressure and undergo 5000 psi tests."

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

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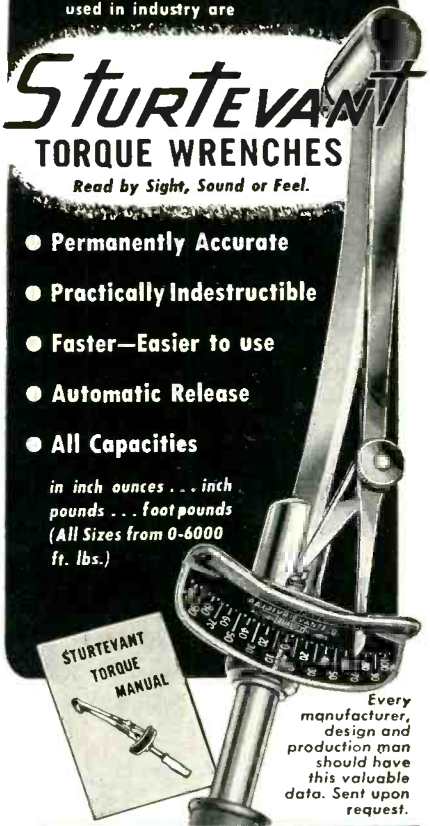

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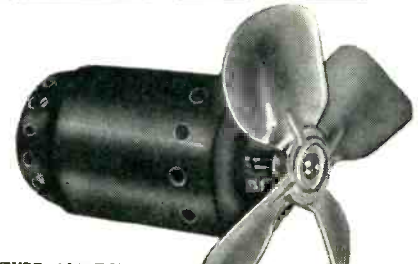

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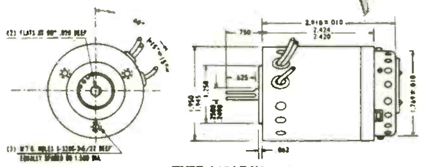

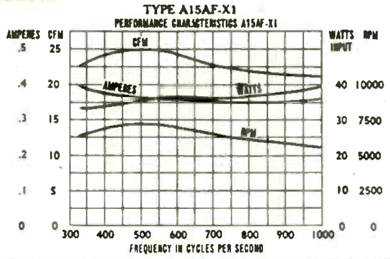

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Axial fan blower, 3 phase self-cooled motor is designed to start at a —55° C and feature maximum possible H P per unit weight and volume. The temperature will rise 45° C when fully loaded with 4" 4 blade, 29 degree pitch fan; Silicone wire and impregnation. At full load the input is 94 watts, the line current .54 amperes and the efficiency is 60%.

SPECIFICATIONS

Conform to NEMA Standards and other Gov't specifications.
Continuous duty

WEIGHT	22 oz.
C F M	22 Average
R P M	6250 Average
VOLTS	115
CYCLES	320-1000

can be supplied CW and CCW suitable for 50 to 60 CPS

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tances, small size, low frequency response, precisely matched characteristics, hermetic sealing, vacuum impregnation, dual coil (hum-bucking) construction, high-permeability cores and drawn mu-metal shields. The catalog also gives information on the company's special transformers and reactors with detailed specifications of some recent designs.

Pulse Transformers. Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn. Chief features and characteristics of the type 130A1 three-winding pulse transformer are shown in a single-sheet bulletin. The transformer described is intended for use in triggering and counting circuits, as a blocking oscillator transformer, and for d-c isolation, inversion, pulse-shaping and pulse-transmission circuits.

Snap-Action Switches. Micro Switch, a division of Minneapolis-Honeywell Regulator Co., Freeport, Ill., has published a 24-page, two-color, catalog No. 82 of precision snap-action switches. It covers safety, limit and interlock switches designed especially for switching a-c circuits in industrial and commercial applications. The publication gives complete information on each switch including description, dimensions, mechanical characteristics, electrical characteristics and electrical capacities. Also included are technical data and application ideas.

Soldering Iron. The Kemode Mfg. Co., Inc., 161 W. 18th St., New York 11, N. Y. A single-sheet bulletin covers the new Quik-Shot soldering iron, listing many of its emergency uses. The unit described reaches working temperature in 10 seconds, maintains soldering temperature for 6 to 8 minutes, has a peak wattage rating exceeding 250 watts and accepts $\frac{3}{8}$-in., $\frac{5}{8}$-in. or 1-in. tips.

Attenuators. The Daven Co., 191 Central ve., Newark 2, N. J., announces availability of its latest brochure on attenuators. A wide variety of controls is shown, in-

cluding r-f attenuators, special units for precision measuring equipment, tone-compensating attenuators, stereophonic controls and "T", balanced-"H", ladder and potentiometer type audio attenuators. Each unit is discussed separately with photographs of the unit, complete descriptions, charts and diagrams.

TV Broadcast Equipment. Allen B. DuMont Laboratories, Inc., 1500 Main Ave., Clifton, N. J. A new 20-page booklet on the universal image orthicon tv camera chain model TA-124-E is now available to tv station personnel, prospective tv broadcasters and others in the tv and radio industry. The booklet, profusely illustrated with photos and drawings of the camera and its associated equipment, explains how a single triple-duty chain can be used in studios, in the field and for film pickup. A clearly written specifications section of the booklet gives pertinent facts and figures on power supplies, monitors, generators and similar associated equipment together with the camera unit itself.

Toroidal Inductors. Lenkurt Electric Sales Co., 1113 County Road, San Carlos, Calif. Precision-wound high-Q toroidal inductors are listed in the new 4-page bulletin TL-P4. Five different types of coils are available with or without hermetically sealed cases. Included in the bulletins are Q curves and other design data for representative standard values of the varied coil types. The coils listed make available a wide range of inductance values between 1 mh and 80 henrys. Information is also included about the effect of direct current on the inductance values of each type of coil.

Identification Markers. Westline Products Division of Western Lithograph Co., 600 E. Second St., Los Angeles 54, Calif. The use of pressure-sensitive self-adhering printed identification for cable, conduit and pipe is described in a recent folder. Method of application and chief features are outlined. A stock list and order form are included.

PLANTS AND PEOPLE

Edited by WILLIAM P. O'BRIEN

OTHER DEPARTMENTS

featured in this issue:

West Coast Firm Changes Hands

KAAR ENGINEERING CORP. of Palo Alto, Calif., manufacturer of radiotelephone equipment, has been purchased by Pacific Associates, Inc., San Francisco, Calif.

John M. Kaar, who founded the firm 16 years ago, will retain one-sixth interest and will be vice-president, chief engineer and a director.

Pacific Associates plans to supply additional capital for expansion through public offering of its prior preference stock. Sales of some \$500,000 are expected in 1952 of which about 90 percent will be two-way mobile radio equipment, with the balance in marine depth sounders, direction finders and accessories.

Jensen Honored

AXEL G. JENSEN, director of television research at Bell Telephone Laboratories, has been named winner of the David Sarnoff Gold Medal. The award is presented each year by the Society of Motion Picture and Television Engineers "in recognition of recent technical contributions to the art of television."

In July Mr. Jensen was honored for his work in tv research when the Royal Technical University of Denmark awarded him the George A. Hagemann Gold Medal.

He celebrated his 30th anniversary with Bell Labs this year. Joining the Labs in 1922, he spent about four years in radio work. For the next five years he was in charge of a London test station operated in connection with the development of transatlantic short-wave telephone service. In 1930 he returned to the U.S. to work on coaxial cable projects. He has been engaged in tv research since 1935.

A. G. Jensen, winner of SMPTE award

Companies in Northwest Pool Facilities

THE Northwest Association of Electronic Manufacturers was formed recently in Portland, Ore., with membership open to firms operating in Oregon, Washington and Idaho. Purpose of the organization is trade promotion, attraction of new electronic industry to the area and mutual assistance.

The 17 manufacturing firms now included in the group are planning to pool their facilities for large contracts, pool orders for common supply items, establish industry job classifications and act as a clearing house for available surplus inventory facilities.

Electric Regulator Completes Plant

CONSTRUCTION of the new 15,600-sq ft plant and administrative building of the Electric Regulator Corp. in Norwalk, Conn., has been completed. The modern plant houses extensive laboratory, toolroom and assembly facilities for the production of the Regohm, an electric circuit controller that has found wide application in power equipment for government and industrial use. Other products will be developed here in addition to the basic Regohm unit, including associated control equipment and regulating and control systems.

The plant is currently employing more than 110 people. It is expected that this number will be substantially increased under the impact of defense production demands and a rapidly expanding civilian business.

Electric Regulator's new plant

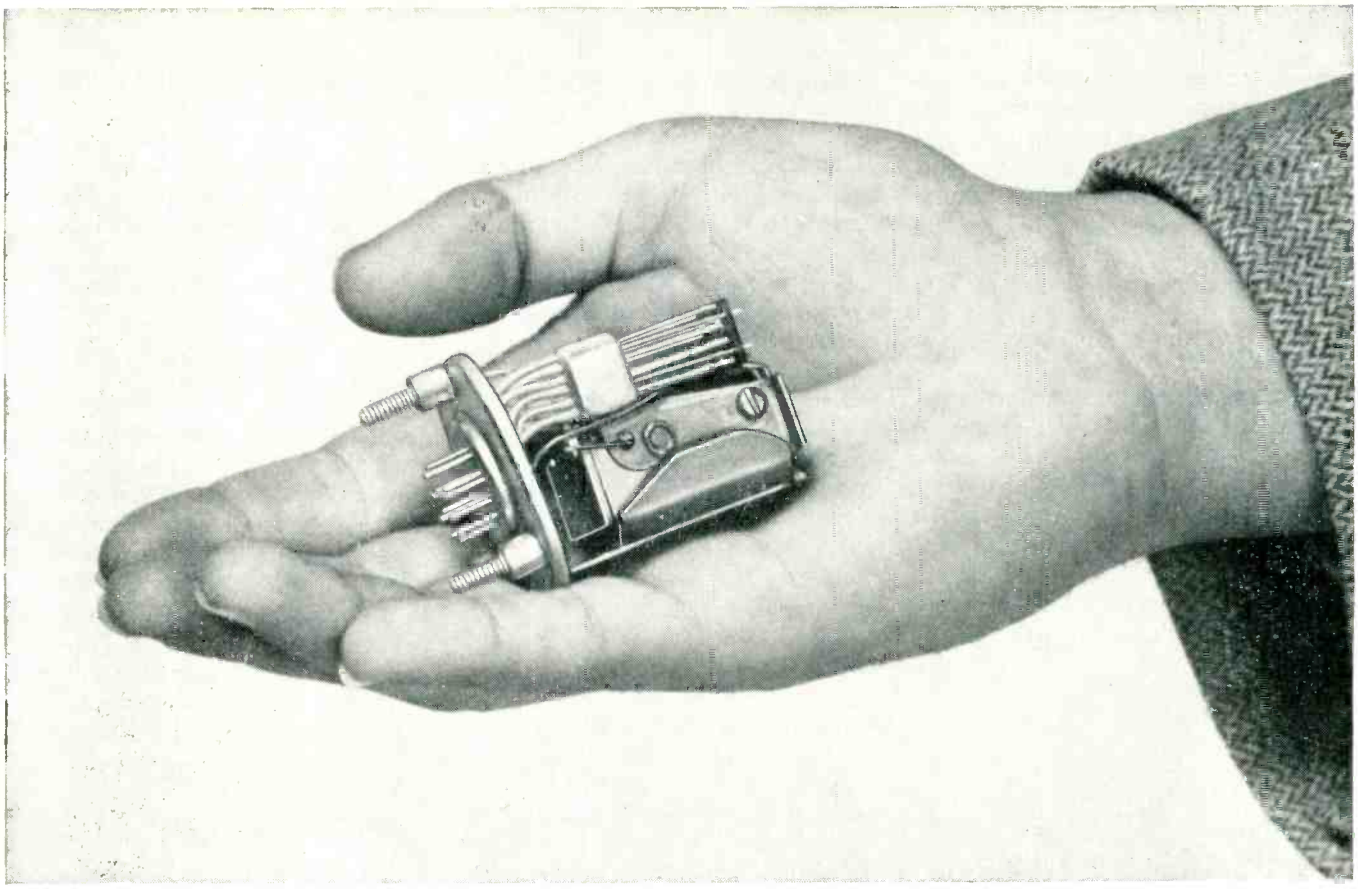
Williams Joins Telecomputing Corp.

JAMES V. WILLIAMS has been named project engineer for the Telecomputing Corp., Burbank, Calif., manufacturer of electronic data analysis equipment. He was former senior development engineer with International Business Machines Corp., and will be working with Telecomputing's development agreement between that company and IBM.

CEC's New Plant in Operation

CONTROL ENGINEERING CORP., formerly of Canton, Mass., is now in operation at its new enlarged headquarters located on a seven-acre tract in Norwood, Mass.

The new building provides space for the development of a new line



New G-E Relay Doubles Tip Pressure

Hermetically-sealed unit has larger magnet, no extra weight

Double the average tip pressure, 40-55 grams, is delivered by the larger magnet structure of the new G-E relay without exceeding Air Force-Navy specifications for size and weight.

The new relay, the first specifically designed for hermetic sealing, will withstand 50g operational shocks and instantaneous voltage surges up to 1500 volts rms *without failure.*

LONGER RELAY LIFE

The large magnet, polyester stack insulation, and silver-tipped contacts assure reliable, long-lived operation in aircraft, shipboard, portable land-based equipment and other systems which must meet Air Force-Navy specifications.

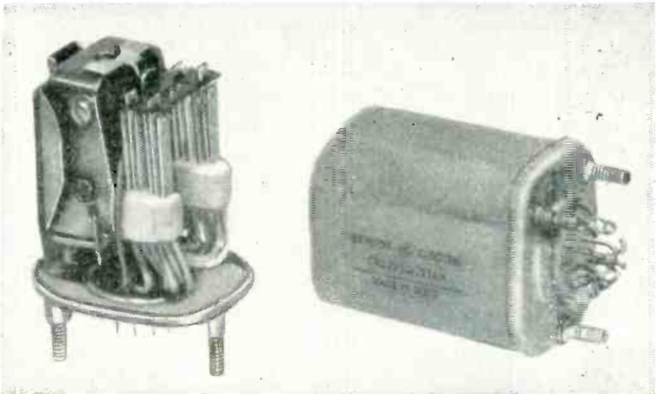
In every way, this new G-E relay is in a world of its own—sealed in a standard size enclosure against dirt, salt spray, high humidity, and widely varying air pressures.

RELIABLE SHIPMENT

This new device is now in full production and shipment can be made to meet your schedules.

Ask your nearest G-E office for more information, and send the attached coupon today. *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC



THE LARGER MAGNET is made possible by an exclusive G-E design which utilizes the relay housing for structural support, thus eliminating much of the weight of internal bracing.

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I would like __ copies of Bulletin GEA-5729 on hermetically-sealed relays for:

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Company ....

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City .... State ....

of instrumentation for the commercial market to supplement the company's current industrial instrument line and its electronic equipment manufactured under government contract for use in radar installations, guided missiles and gunfire control systems.

Giannini & Co. Adds to Staff

Two appointments were recently announced by the G. M. Giannini & Co., Inc. of Pasadena, Calif., manufacturers of precision instruments and controls for aircraft, missile and industrial measuring applications.

B. J. Garnett was named assistant chief engineer, airborne equipment. For the past ten years he had been in charge of design of aircraft and missile components for Vard Inc. of Pasadena.

B. J. Garnett, assistant chief engineer

John Bodnar is now manager of potentiometer sales. He was formerly an engineer with Radio Corp. of America, and also served as sales engineer for the Brush Development Co.

J. Bodnar, manager of potentiometer sales

Transducer Corp. Made AMF Division

MERGER of Transducer Corp. of Boston, Mass., with its parent company, American Machine & Foundry Co., has been announced. Transducer, formerly AMF's electronic subsidiary, now becomes the company's electronic division.

A leading manufacturer of electronic and ultrasonic trainers for the Air Force, Transducer was purchased by AMF as its electronic subsidiary in 1948. Its products are employed for instruction of radar gunners and navigational bombardiers. It also makes radar systems and precision computers adaptable to radar work on a sub-contract basis.

Currently the new AMF electronic division is working on more than $17,000,000 worth of government contracts in 315,000 sq ft of floor space at 1085 Commonwealth Ave., Boston, Mass., with a labor force of more than 1,400 employees.

Consulting Office Opened

LEONARD R. KAHN announces the opening of an electronics and communications consulting office at 22 Pine St., Freeport, L. I., N. Y.

Before opening his office Mr. Kahn was associated with Crosby Laboratories where he specialized in communication studies. While with Crosby Labs he worked on diversity receiving systems, single-sideband reception, the design of phase - modulation transmitting equipment, frequency modulation anaylsis and classified Armed Forces projects.

Westinghouse Engineer Receives Award

PHILIP E. VOLZ, section engineer for the Westinghouse Electronic Tube Division, has been named a winner of the $200 award in a continuous contest for the best patent disclosure out of each 50 submitted by engineers of the Division. Mr. Volz's disclosure concerned an improved method of increasing the power and efficiency of high-frequency generating tubes salient to the operation of radar.

He has been with the company's Electronic Tube Division since 1951, and is currently an engineer in the microwave generators section of the division.

Philco Inaugurates Radio Division

IN RECOGNITION of the size and importance of its radio business, Philco Corp. is establishing a separate Radio Division so that even greater emphasis can be put on all phases of the company's activities in the home and auto radio field.

William H. Chaffee has been appointed vice-president of the newly-formed division, which is under the direction of Frederick D. Ogilby.

Engineer Becomes Sales Exec

TO HEAD UP a newly created national sales engineering organization, Bendix Aviation Corp. has named Lawrence J. Straw as Mobile Sales Manager.

Straw joined Bendix in February 1952, having previously been associated with Capehart-Farnsworth. Prior to this he had been associated with Raymond Rosen Engineering Products in Philadelphia as an electronic engineer responsible for equipment and system design of telemetry projects for the U. S. Air Force and the AEC, and as an electronic engineer at the Philadelphia

L. J. Straw, new Mobile Sales Manager for Bendix Radio

for "Bridgeport" Service

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OFFICES AND WAREHOUSES IN PRINCIPAL CITIES

Brass with a higher "I. Q."

Are you using metal with a sufficiently high "I.Q." (Inner Quality) to give your product

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- **...higher strength, toughness and resistance to wear and corrosion?**

BRING YOUR METAL PROBLEMS TO BRIDGEPORT BRASS

Bridgeport metals have the high "I.Q." you need. They are specially made to meet your particular requirements in alloy composition . . . width and gauge tolerances . . . temper . . . grain size . . . surface . . . ductility . . . machinability . . . and other physical, mechanical and electrical properties.

Bridgeport mill products are made under strict laboratory control to meet customer specifications *exactly*.

The Bridgeport laboratory will gladly work with you to help solve your metal problems.

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BRIDGEPORT BRASS COMPANY

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Naval Base where he was responsible for vhf, uhf and radar systems design on the Aircraft Carrier Conversion Program.

Pettit Wins Achievement Award

ANNOUNCEMENT of the new Western Electronic Achievement Award to Dr. J. M. Pettit of Stanford U. was the culmination of the recent Pacific Region IRE conclave at the Long Beach, Calif., Municipal Auditorium.

The award, first to be made by the 7th Region of IRE, honored Dr. Pettit for major contributions to electronics. Selection was made from among 5,000 IRE members in the Pacific Region.

In 1949 Dr. Pettit was awarded the Presidential Certificate of Merit for his outstanding work during World War II and since in the field of electronics. His war work at Radio Research Laboratories involved detailed supervision of the development of the AN/APR-1 and AN/APR-4 radar search receivers. He also assisted in getting them into production.

Skiatron Gets Research Director

HENRY F. IVEY, formerly associated with the Westinghouse Electric Corp., was recently appointed director of research and development of the Skiatron Electronics and Television Corp.

In his new post he will coordinate Skiatron's activities in the field of subscription television, where the company has developed a pay-as-you-see system, and will also jointly develop, with Wayne B. Nottingham, the company's dark-trace tube for use in the military and industrial fields.

Raytheon to Lease New Plant

NEGOTIATIONS are being completed by Raytheon Mfg. Co., of Waltham, Mass., for a lease of the South Lowell Ordnance Plant previously occupied by Davis Aircraft Co. on Woburn St. in South Lowell, Mass.

Engineering and production work

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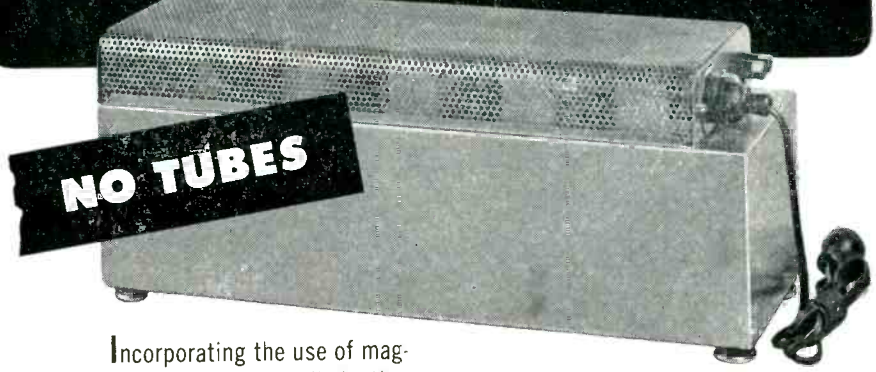

Incorporating the use of magnetic amplifier techniques — eliminating all vacuum tubes — this new Acme Regulated Power Supply provides an extremely dependable, trouble-free precision unit for both industrial and laboratory use. Because of the absence of all tubes, the equipment will give a **minimum** of 20,000 hours continuous service. It is available in a variety of voltages and frequencies.

Write for complete information.

Acme **Model S-715** 60-cycle Regulated Power Supply. 300 volt D.C. output with $\pm 1\%$ regulation from 0 to 200 MA, with less than .1% ripple.

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ELECTRONICS, INC.

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Applications engineer capable of analyzing large-scale customer requirements and making engineering decisions concerning filters, transformers, and associated components. Familiarity with toroidal inductors using powder-iron cores desirable.

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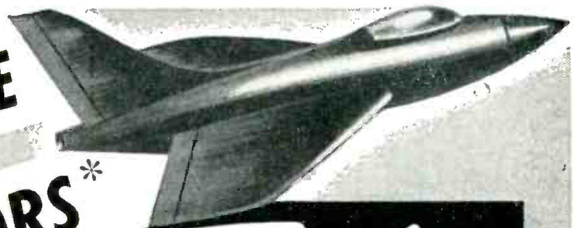

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Featuring

Tensolon HI-TEMP HOOK-UP WIRE

- **EXTRA FLEXIBILITY**
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- **HIGH DIELECTRIC**
- **RATING -55 TO +250°C**

***Black, brown, red, orange, yellow, green, blue, violet (purple), grey (slate), white, tan, pink (flesh), light green, light blue.**

Built to meet rigid government requirements, Tensolon Hook-up Wires are available in sizes from AWG30 through 20 with stranded silver-plated copper conductors and the patented **Tensulated** Teflon® covering which eliminates pin holes and other irregularities.

SPECIAL KIT FOR LABORATORY REQUIREMENTS —
Twelve 100 ft. rolls of AWG 22, in assorted colors in convenient compact container **$124.00**

TENSOLITE INSULATED WIRE CO., INC., TARRYTOWN, N. Y.

of an undisclosed nature for the U. S. government will be carried out there initially, with about 700 employees, but it is expected that operations will be enlarged on a gradually increasing scale as new employees are added and trained.

Weathers Opens New Plant

WEATHERS INDUSTRIES, manufacturers of f-m phonograph pickups, announce the opening of a new one-story modern factory at 66 E. Gloucester Pike at Barrington, N. J. The plant was formerly located in West Collingswood, N. J.

One of the new plant's many features is the series of sound laboratories and listening rooms devoted to the perfection of sound reproducing equipment.

Motorola Promotes Samuelson

ROBERT E. SAMUELSON has been promoted to chief engineer, Motorola Research Laboratory, Phoenix, Arizona.

R. E. Samuelson, new chief engineer

Immediately prior to this recent appointment Dr. Samuelson was head of the Communications Research Section.

Culver Joins Trinity U.

CHARLES A. CULVER, senior physicist for Southwest Research Institute and dean of professional development at the Essar Research Center, has been appointed chairman of the department of physics at Trinity University, San Antonio, Texas.

He was chief high-frequency

engineer for Canadian Radio Corp. from 1920 to 1923, professor of physics at Carlton College from 1923 to 1946, and professor at Park College from 1947 to 1951. Dr. Culver holds various U. S. and foreign patents relating to communications engineering.

Melpar Staff Additions

RALPH I. COLE, formerly technical director of the Rome Air Development Center, and Vernon C. Weihe, formerly systems engineer for the Air Transport Association, have joined the engineering staff of Melpar, Inc., Alexandria, Va.

Mr. Cole is chairman of the IRE Professional Group on Engineering Management and a member of the Research and Development Boards Radar Panel.

R. I. Cole

Vernon Weihe was formerly chief engineer of the Communications and Navigation Laboratory at the

V. C. Weihe

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PRODUCTS

Carbine Clip Bag — Padded Instrument Bag

BG BAGS—CW BAGS
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Ordnance Equipment
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—with the new HEXACON FEATHERWEIGHT MODEL 30H

So light its weight is hardly noticeable, but more powerful than its wattage rating indicates. Hatchet design makes it more comfortable and practical to use than a soldering pencil. No transformer required.

WEIGHT—5½ OUNCES (LESS CORD); WATTS—40 OR 60; TIP DIA.—BOTH ⅛" AND ¼" TIPS FURNISHED WITH EACH IRON; PRICE— **$5.50**

Write today for catalog describing the complete line of screw tip, plug tip and hatchet irons.

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Check the performance of this

HERMETICALLY SEALED TERMINAL*

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See why over 1,000,000 are now in use by the biggest names in industry!

- 2000 volts, RMS-Corona Free
- Flashover . . . 7500 volts RMS Min.
- Insulation Resistance . . . 1,000,000 Megohms
- 60 Cycle test . . . 5000 volts (RMS)
- Current rating . . . 15 Amperes
- Air, helium, oil pressure tests . . . 20 lbs per sq. inch
- Temp. . . −100°C. to +150° C. cont.

Custom problem? Write today!

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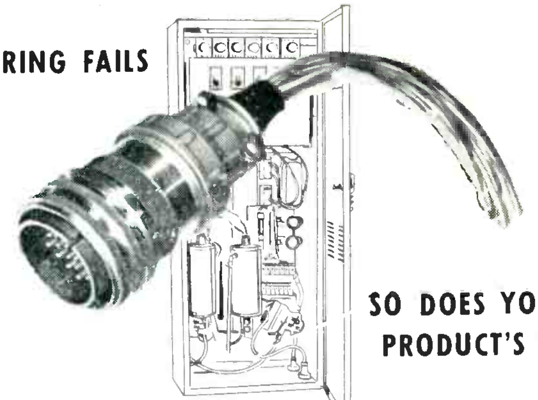
MINEOLA, L. I., N. Y.

IF THE WIRING FAILS



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Wright Air Development Center. He was a member of the American delegation to the Civil Aviation Organization, and technical advisor to the American Government at several international conferences.

RTMA Continues to Grow

SEVEN new members, five active and two associate, were submitted to RTMA membership by the board of directors at a recent meeting in New York City. The new members are:

Daystrom Electric Corp. of Poughkeepsie, N. Y.; Delco Radio Div. of General Motors Corp., Kokomo, Ind.; Eldico of New York, Inc., of Douglaston, N. Y., Investors Diversified Services, Inc., of Minneapolis, Minn.; Johnson Electronics of Orlando, Fla.; Lyman Electronic Corp. of Springfield, Mass.; and Rockbar Corp. of New York, N. Y.

IRE Announces 1953 Fellow Awards

FORTY-NINE leading radio engineers and scientists were named Fellows of the Institute of Radio Engineers by the board of directors at a meeting held in September in New York City. The Institute annually bestows the award of Fellow, its highest membership grade, on those who have made outstanding contributions to radio engineering or allied fields.

Presentation of the awards with citations will be made by the president of the Institute at the annual banquet on March 25, 1953 at the Waldorf-Astoria Hotel in New York during the 1953 IRE National Convention.

Recipients of the Fellow Award, which takes effect Jan. 1, 1953, are as follows:

Edward W. Allen, Jr., of the FCC; Jean P. Arnaud of Direccion General Fabricaciones Militaros (Argentina); Benjamin B. Bauer of Shure Brothers, Inc.; J. W. Bell of Smith & Stone, Ltd., Canada; Leonard J. Black of the U. of California; H. G. Booker of Cornell University; William E. Bradley of Philco Corp.; John L. Callahan of

RCA; K. A. Chittick of RCA; Arthur A. Collins of Collins Radio Co.; Edward U. Condon of Corning Glass Works; W. W. Eitel of Eitel-McCullough, Inc.; Harry Faulkner of the British Post Office, London, England; Enoch B. Ferrell of Bell Labs; Warren R. Ferris of Naval Research Laboratory; Lyman R. Fink of General Electric Co.; Lawrence R. Hafstad of the Atomic Energy Commission; F. Hamburger, Jr., of Johns Hopkins U.; Lewis B. Headrick of RCA; Philip J. Herbst of RCA; John Hessel of Signal Corps Engineering Labs; Hans E. Hollmann of U. S. Naval Air Missile Test Center, Point Mugu, Calif.; T. A. Hunter of Hunter Mfg. Co.; Eric J. Isbister of Sperry Gyroscope Co., Div. of Sperry Corp.; Edward C. Jordon of the U. of Illinois; Frank G. Kear of Kear and Kennedy, Washington, D. C.; Ronold W. P. King of Cruft Laboratory, Harvard U.; Royce G. Kloeffler of Kansas State College; Edmund A. LaPort of RCA; Russell R. Law of RCA; William A. MacDonald of Hazeltine Electronics Corp.; Jack A. McCullough of Eitel-McCullough, Inc.; J. A. Morton of Bell Labs; Allen B. Oxley of RCA Victor Co., Ltd., Canada; Albert Preisman of Capitol Radio Engineering Institute, Washington, D. C.; John C. R. Punchard of Northern Electric Co., Ltd., Canada; Jan A. Rajchman of RCA; J. A. Ratcliffe of Cambridge U., England; Stephen O. Rice of Bell Labs; Walther Richter, consulting engineer of Milwaukee, Wisc.; A. A. Roetken of Bell Labs; William M. Rust, Jr., of Humble Oil & Refining Co.; Jorgen Rybner of the Royal Technical U. of Denmark; Daniel Silverman of Stanolind Oil & Gas Co., Tulsa, Okla.; Archie W. Straiton of the U. of Texas; Irven Travis of Burroughs Adding Machine Co., Philadelphia, Pa.; Bertram Trevor of RCA Labs; Harry W. Wells of Carnegie Institution of Washington, D. C.; and Charles J. Young of RCA.

Board Reorganizes RTMA

SINCE his election as chairman of the RTMA board of directors at the June convention, A.D. Plamondon, Jr., has assumed the additional

duties of president of the association under a reorganization plan adopted in September.

Upon recommendation of the special Organization Committee, headed by former board chairman Robert C. Sprague, the board of directors also elected Glen McDaniel, who had resigned as RTMA president, to be RTMA general counsel, and promoted general manager James D. Secrest to executive vice-president.

The board of directors also voted to expand the special Organization Committee to include representatives of the Technical Products and Amplifier and Sound Equipment Division, after which president Plamondon appointed director Fred R. Lack as a member of the committee for the Technical Products Division, and director Arie Liberman as a member for the Amplifier and Sound Equipment Division. Other members of the Organization Committee, all past RTMA presidents, are: directors Max F. Balcom, Paul V. Galvin, Leslie F. Muter and chairman Robert C. Sprague.

High Award Winners Named by IRE

WINNERS of three high awards to be presented during the IRE National Convention in March 1953 in New York were recently announced by the Institute.

John M. Miller, superintendent of Radio Division 1 of the Naval Research Laboratory, Washington, D. C., has been named the recipient of the Medal of Honor for 1953, the highest award of the radio engineering profession. The Institute gave the award "in recognition of his pioneering contributions to our basic knowledge of electron tube theory, of radio instruments and measurements, and of crystal oscillators."

The 1953 Morris Liebmann Memorial Prize, given annually by the Institute for a recent important contribution to the radio art, went to John A. Pierce, senior research Fellow at Harvard U. He is noted for his contributions to the development of the loran system of long range radio navigation which

was widely used by the armed services during World War II, and more recently for his conception of the RADUX system of long range navigation now under development for the government.

Frank Gray, research engineer of Bell Telephone Laboratories, was awarded the Vladimir K. Zworykin Television Prize Award for 1953, given annually by the Institute for an outstanding contribution to television. A pioneer in the tv field, Mr. Gray early in the 1930's developed principles, the importance of which has only recently been recognized, and which are embodied in the color television system currently under development by the industry-sponsored National Television System Committee.

RTMA Names Thirteen to TV Committee

THE BOARD chairman of the RTMA, A. D. Plamondon, Jr., has appointed a 13-man television committee and renamed Dr. W. R. G. Baker as chairman of the group for the ensuing year. The top-level committee directs the tv activities of the RTMA.

Following is the membership of the committee:

W. R. G. Baker (chairman) of General Electric Co.; Benjamin Abrams of Emerson Radio & Phonograph Corp.; Robert S. Alexander of Wells-Gardner & Co.; Max F. Balcom of Sylvania Electric Products Inc.; H. C. Bonfig of Zenith Radio Corp.; John W. Craig of Crosley Div., Avco Mfg. Corp.; Allen B. Du Mont of Allen B. Du Mont Laboratories, Inc.; J. B. Elliott of RCA Victor Division of RCA; E. K. Foster of Bendix Radio Division; Paul V. Galvin of Motorola Inc.; W. J. Halligan of The Hallicrafters Co.; L. F. Hardy of Philco Corp.; and W. A. MacDonald of Hazeltine Electronics Corp.

Telecommunication Services Made Available

FORMATION of Microwave Services, Inc., New York City, was recently announced. It will provide consulting and construction services in the field of telecommunication.

NEW BOOKS

Primer of Electronics and Radiant Energy

BY DON CAVERLY. *Second edition, 1952. McGraw-Hill Book Co., New York*, 343 *pages*, $5.50.

THIS is indeed a primer and one of the easiest to read. It is aimed at the people who, having no fundamental business with electrons, protons, neutrons and their varied and magnificent manifestations, yet have a basic curiosity as to what it is all about. The author makes a serious and honest effort to remove the complexities and technicalities that surround the subject and, while he often forgets that his readers are supposed to be abysmally ignorant although anxious to learn and dives off the deep end, in general he succeeds in writing material that virtually anyone can read.

The subjects treated sound technical—electricity, magnetism, radiant energy of all kinds, electron tubes—yet he describes them in terms of one's daily life—sunburn, cooking with infrared, flash lamps, plant growth. At the same time he gives the reader a chance to understand such modern devices as the TR tube, loran, nuclear reactors, the image orthicon or the hydrophone. Even the engineer can find out some things he should know but probably doesn't.—K.H.

Electrical Engineering Theory and Practice

BY WILLIAM D. ERICKSON AND NELSON H. BRYANT, *Cornell Uuiversity. John Wiley & Sons, Inc., New York*, 523 *pages*, $6.00, 1952.

BASED on courses at Cornell for mechanical, civil and chemical engineering students, it is essentially nonmathematical, the stress being on physical analysis. Appendices contain sufficient explanation of the methods of complex notation to the solution of a-c problems to equip the student with this tool.

Aside from straight d-c and a-c theory and the effects of the basic *R*, *L* and *C* components on circuits, there are chapters on d-c machines, electrical instruments and measurements, a-c motors and transformers, a nice chapter on control (synchro

systems) and about one-third of the book on electronics aimed to equip the student with an approach to industrial circuit engineering. These chapters are divided essentially into the several kinds of tubes and their functions.

Final chapters cover communications and electronic control systems as used with motors, power supplies and welding machinery.—K. H.

Radio Astronomy

BY BERNARD LOVELL AND J. A. CLEGG, *University of Manchester. John Wiley & Sons, Inc., New York, 1952, 237 pages, $4.00.*

AN extraordinarily interesting book for any radio engineer possessed with man's natural awe of the universe in which he lives, plus his own interest in the field of radio techniques. It deals with the application of radio measurements to universe exploration.

The first two chapters constitute a brief introduction to astronomy which can be read by anyone, followed by two chapters on the basic radio techniques employed in astronomical research. Then come some 18 chapters on comets and meteors and what has been found out about them by radio, solar disturbances, radio emissions from sunspots and from various parts of the heavens, radio and the aurora borealis, lunar investigation by radio, etc.

Man's use of radio to look further into space has only begun, and as his thirst for more knowledge of what surrounds him is very great, it would be strange indeed if radio-astronomers did not come up with much new and fascinating knowledge.

This book is not for the high-powered experts; rather, it is for the average individual who, perhaps, knows more about radio than astronomy, and is not averse to learning something more about each subject.—K.H.

An Introduction To Acoustics

BY ROBERT H. RANDALL. *Addison-Wesley Press, Inc.,* 1951, 340 *pages,* $6.00.

WHILE intended primarily as an intermediate college-level physics text, this book provides useful supplemental reference and study material for the engineer. It does

much to help fill the need for texts at this level. Most of the recent works in the field of acoustics have been directed at more advanced specialists or largely at applied or engineering fields.

Easy informal style and good illustrations make is easy reading. Most of the material on applications, which comprise about half of the book, and much of the material on theory can be followed by the practicing engineer who has neglected his math. The usefulness of the book for self study or review is considerably enhanced by the large number of problems on important topics and by the answers which are given to half of them.

Objective Acoustics

The choice of topics seems well balanced and this is important since a 28-page chapter on Speech and Hearing leaves 312 pages for the entire field of objective acoustics. The topics and their treatment in the chapters on theory are conventional. Somewhat less space than usual is devoted to systems with more than one degree of freedom, and somewhat more space is given to interference and diffraction. Here the author draws heavily on the field of optics for analogies.

There is a brief introduction to the velocity potential which is amplified in the appendix. Lumped parameter approximations in acoustic circuits are treated briefly in connection with the Helmholtz resonator, the phase-inverting loudspeaker enclosure and acoustic filters.

Horns

The section on horns treats the conical and the exponential but fails to treat the "hyperbolic" family reported by Salmon. Since the conical and exponential are special cases of this family and Salmon's work provides a powerful tool for studying the effect of boundary shapes on performance, it would be desirable to refer to this work.

References

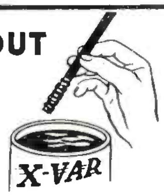
More references than are frequently given in texts at this level are included. Some of the references are to recent books of the survey type, so that unfortunately credit to the original workers has been left out. For example, Ballantine's

INSULATION
FORMVAR • FORMEX • ENAMEL
STRIPPED CLEAN IN SECONDS
with X-VAR

IN

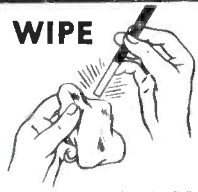
1. DIP WIRE in X-VAR for 3 seconds.

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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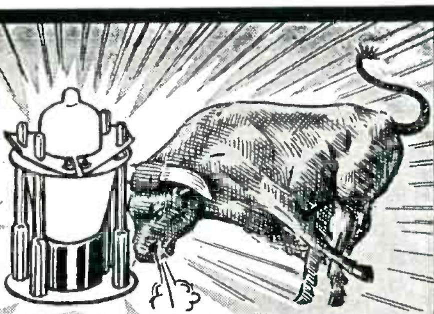
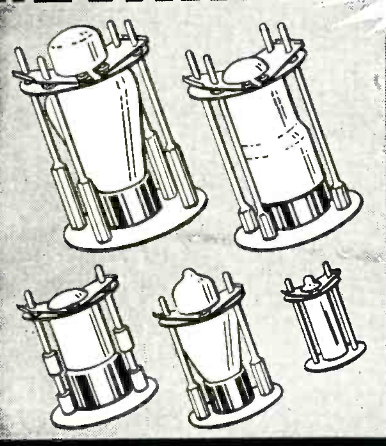
SHOCKPROOF VACUUM TUBE RETAINERS





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.

Available for envelope types T7, T8, MT8, T9, T12, ST12, T12ZDI, ST14, S14, ST16, T5½, T6½, MT-IC, ST19, T14, ST128CT-9.

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Solid Colors or Spiral Markings

AIRCRAFT WIRE-NYLON JACKET
MIL-W-5086 (Supersedes AN-J-C-48a)

105° C. U.L. APPROVED
Thermoplastic Hookup Wire

JAN-C-76 WL GLASS BRAID
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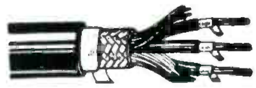

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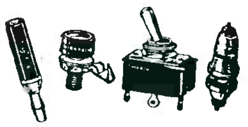

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important contributions to precise microphone measurements, namely the recognition and computation of the pressure rise due to diffraction and his corrections which made the thermophone a precision device, go unrecognized.

Errors

Only minor obscurities and errors which are to be expected in any first edition were observed. Under the discussion of pressure gradient microphones, the orientations of the diaphragm for no and for maximum response are reversed. Although the decibel is a very useful unit in describing hearing, it was historically the sequel to the TU or transmission unit introduced by the Bell Telephone Laboratories in 1923 which in turn superceded the transmission loss of a standard mile of cable.

Conclusions

The author points out the value of training in acoustics as a background for more advanced study in nearly all branches of physics and engineering. Brief references to the relation of acoustics to other branches of physics, other branches of science and to industry are made but these might well be expanded if the student and many faculty members are to be convinced that progress in theoretical acoustics did not die with Rayleigh.

The book is not only recommended as a text but as a reference work for the engineer with acoustical interests and the physicists with other specialized interests.—HUGH S. KNOWLES, *Director of Research, Industrial Research Products, Inc., Franklin Park, Illinois.*

Imperfections in Nearly Perfect Crystals

BY W. SHOCKLEY, J. H. HOLLOMON, R. MAURER, F. SEITZ. *John Wiley & Sons, Inc., New York*, 1952, 490 *pages*, $7.50.

IN October, 1950, a symposium was held at Pocono Manor, Pa., on the subject of imperfect crystals. The symposium was sponsored by the National Research Council and was organized by W. Shockley of the Bell Telephone Laboratories with the help of J. H. Hollomon of the General Electric Research Laboratories, and R. Maurer and F. Seitz

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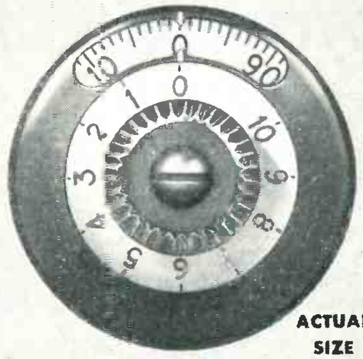

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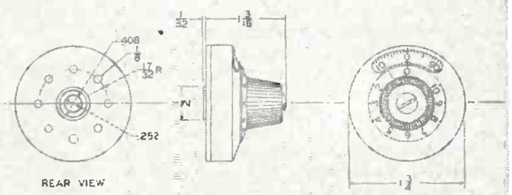

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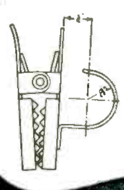

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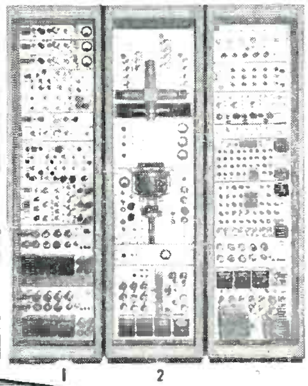

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of the University of Illinois. The important parts of the papers and discussions presented at Pocono Manor are summarized in this book. The list of titles and authors follows:

I. On the Nature of Imperfections in Nearly Perfect Crystals

1. Imperfections in Nearly Perfect Crystals: A Synthesis, Frederick Seitz

2. On the Geometry of Dislocations, W. T. Read, Jr., and W. Shockley

II. The Role of Imperfections in Deformation

3. Imperfections from Transformation and Deformation, C. S. Barrett

4. Experimental Information on Slip Lines, W. T. Read, Jr.

5. X-Ray Diffraction Studies of Cold Work in Metals, B. E. Warren and B. L. Averbach

6. Mechanical Strength and Creep in Metals, N. F. Mott

7. The influence of Dislocations and Impurities on the Damping and the Elastic Constants of Metal Single Crystals, J. S. Koehler

III. Diffusion and Related Phenomena

8. Relaxation Effects in Ionic Crystals, R. G. Breckenridge

9. Studies of Alkali Halides by Photoelectric Methods, L. Apker and E. Taft

10. Diffusion in Alloys and the Kirkendall Effect, J. Bardeen & C. Herring

11. Theory of Diffusion, Clarence Zener

IV. On the Properties and Effects of External and Internal Surfaces of Crystals

12. Surface and Interfacial Tensions of Single-Phase Solids, J. C. Fisher and C. G. Dunn

13. Dislocation Models of Grain Boundaries, W. T. Read, Jr., and W. Shockley

14. Interphase Interfaces, Cyril Stanley Smith

15. Substructures in Crystals, A. Guinier

16. The Properties and Effects of Grain Boundaries, Bruce Chalmers

17. Movement and Diffusion Phenomena in Grain Boundaries, R. Smoluchowski

This book was prepared mainly for specialists in metallurgy and

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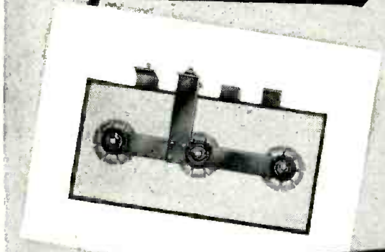

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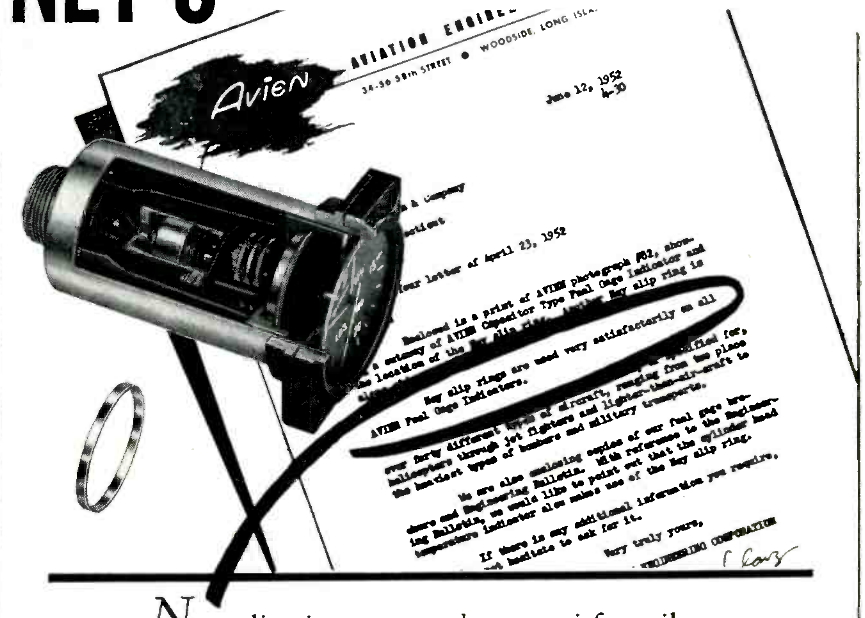

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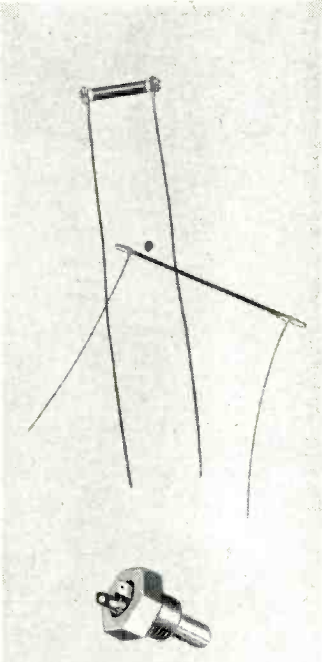

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solid-state physics. The contributors are among the outstanding leaders in their fields.

The work of compiling and editing the manuscripts has been an important and worthwhile task; the result is a valuable contribution to physics and physical metallurgy.—EDWARD N. CLARKE, *Physics Laboratories, Sylvania Electric Products Inc., Bayside, New York.*

The Nature Of Number

BY ROY DUBISCH, *Fresno State College, California. The Ronald Press Company, Inc., New York, 1952, 159 pages, $4.00.*

THIS book encompasses a well-written and precisely-stated account of the gradual development of the concept of number through the ages and of its rapid flowering in the last century to yield the bases of the modern linear associative algebras of today. Although couched in semi-textbook style, it can yet be read with interest by that large non-classroom audience whose eagerness for mathematical exposition is evidenced by the substantial sales of several editions of books such as Tobias Dantzig's "Number, the Language of Science: A Critical Survey Written for the Cultured Non-Mathematician," Eric T. Bell's "The Magic of Numbers" and Levi L. Conant's "The Number Concept: Its Origin and Development." The present text—less pedestrian in style than Conant's book, somewhat soberer in language and expression than Bell's, and not as concerned with points of philosophical interest as Dantzig's—reads easily; develops its theme fluently, chronologically, and accurately; and offers, *in toto*, an easily-grasped, well-delineated précis of the evolution of a branch of mathematics of prime usefulness to all mankind.

The book has twelve chapters. The semi-popular approach is indicated in the titles: Thus, Chapter 8: "The Great i Solves All" and Chapter 9: "A Shot in the Arm for Complacent Algebraists of the Nineteenth Century." However, despite the nature of these titles, the writing is not facetious nor is the author an amateur of mathematics. Rather, it is that a somewhat

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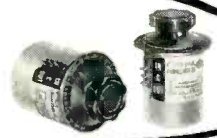

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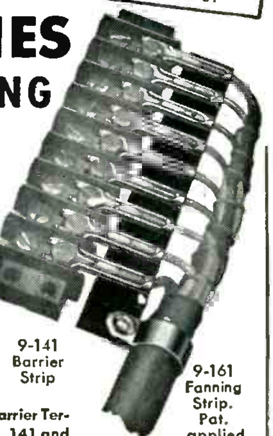

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THUMBNAIL REVIEWS

DIRECT CURRENT MACHINES. By Charles S. Siskind, Assistant Professor, Electrical Engineering, Purdue University. McGraw-Hill Book Co., 306 pages, $6.00. 1952. Fundamental, up-to-date clearly-presented material for a one-semester course. Mathematical derivations are rigid and widely used.

1952 MODERN PLASTICS ENCYCLOPEDIA AND ENGINEER'S HANDBOOK. Breskin Publications, New York, 1952, 848 pages, $6.00. Designed as a working guide to all phases of plastics production and material selection for companies using or contemplating the use of plastics products or components. Chapters covering molding, extruding, casting, fabricating, finishing and assembling operations and the machines and equipment presently available for plastics processing.

FERNSEHTECHNIK. By F. Kirschstein and G. Krawinkel, S. Hirzerl, Stuttgart, Germany. 288 pages, DM 25, 1952. In German. What appears to be a thorough-going text on all aspects of television from the photoelectric effect to the color processes much in recent public discussion. Latest reference is to the literature of January 1950, so it seems to be up to date.

ECONOMICS OF AMERICAN MANUFACTURING. By Edward L. Allen. Henry Holt and Co., New York, 1952, 566 pages, $6.95. Penetrating cross-section view of American industry. Examines nineteen representative industries within five general categories: basic metal, basic nonmetallic, metal-working, textile and allied, and consumer specialty. Topics discussed include export-import, corporate ownership and control, location and capacity of plants, pricing policy, profits, and future outlook. Concludes with extensive bibliography.

CONTROLLERS FOR ELECTRIC MOTORS. 2nd ed. By H. D. James and L. E. Markle. McGraw-Hill Book Co., New York, 1952, 418 pages, $7.00. Retains first edition information about the design, ap-

plication, operation, and maintenance of industrial controllers. In addition, it includes chapters on such recent developments as the magnetic amplifier, the dynamo electric amplifier, magnetic clutches, a-c and d-c crane control, and remote and supervisory control.

TELEVISION TECHNOTES. By Martin Clifford, Gernsback Library Book Number 46. Radcraft Publications, Inc., New York, N. Y. 128 pages, $1.50, 1952. For the technicians who have to fix TV sets that get out of whack. Notes on individual models of all manufacturers from Admiral to Westinghouse (in alphabetical order) and literally thousands of models.

THE MEASUREMENT AND CONTROL OF TEMPERATURES IN INDUSTRY. R. Royds. Chemical Publishing Co., Inc., New York, N. Y. 260 pages, $5.00, 1952. Revision of older volume of somewhat different title. Chapters on temperature scales, expansion and electrical thermometers, pyrometers, galvanometers and other indicators and the measurement of rapidly fluctuating temperatures.

AUTOMATIC RECORD CHANGER SERVICE MANUAL. Vol. 4 (1951-1952). Howard W. Sams & Co., Inc., Indianapolis, Ind., $3.00. Comprehensive service information, with increased emphasis on new models of wire and tape recorders.

INDUSTRIELLE ELEKTRONIK. By R. Kretzmann, Elektro Spezial, G.m.b.H., Hamburg, Germany. Verlag fuer Radio-Foto-Kinotechnik, Berlin. Describes, in German, electronic apparatus employed in industrial process control, especially switching methods.

MANAGEMENT CONTROLS IN INDUSTRIAL RESEARCH ORGANIZATIONS. By Robert N. Anthony, Associate Professor, Business Administration, Harvard Business School. 538 pages, $6.75, 1952, Harvard Business School, Boston 63, Mass. How to find "the proper balance between freedom at the laboratory level and direction from the top" for research administrators.

PROCEEDINGS, NATIONAL ELECTRONICS CONFERENCE, 1951, Vol. 7, National Electronics Conference, 852 E. 83rd Street, Chicago 19, Illinois. 736 pages, charts, diagrams, tables, 9¼ by 6¼ inches, cloth, $5.00. Papers—or digests—presented at the 1951 conference. The seventy-nine papers cover electronic research, audio systems, components, computers, high-frequency measurement, information theory, magnetic amplifiers, medical and industrial applications, microwave propagation, servo theory, signal detection, television and tubes.

SURVEY, R-F TRANSMISSION LINES AND WAVEGUIDES. E. S. Winlund. Radio Club of America, 11 West 42 St, New York 18, N. Y., 88 pages, 1951, $1.00. Historical survey, technical data and bibliography through 1951.

THE MANUAL OF CORPORATE GIVING. Edited by Beardsley Ruml in collaboration with Theodore Geiger. National Planning Association, 800-21st Street, N.W., Washington, D. C., 1952, 416 pages, $6.75. Contains sections by 26 experienced donors and recognized experts. Primarily concerned with explaining the specific ways in which gifts can be made to yield the maximum benefits both to the recipient and to the donor.

ULTRAVIOLET RADIATION. By Lewis R. Koller. John Wiley & Sons, Inc., New York, 1952, 270 pages, $6.50. Written for nonspecialists in radiation, to describe available sources of ultraviolet, discuss application techniques, and give pertinent data on filters, mirrors and other accessories used. Many tables and graphs increase the reference value of the book.

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Improved direct-reading instrument simplifies measurements of wow and flutter in speed of phonograph turntables, wire recorders, motion picture projectors and similar recording or reproducing mechanisms. It is the only meter in existence giving direct steady indication of meter pointer on scale.

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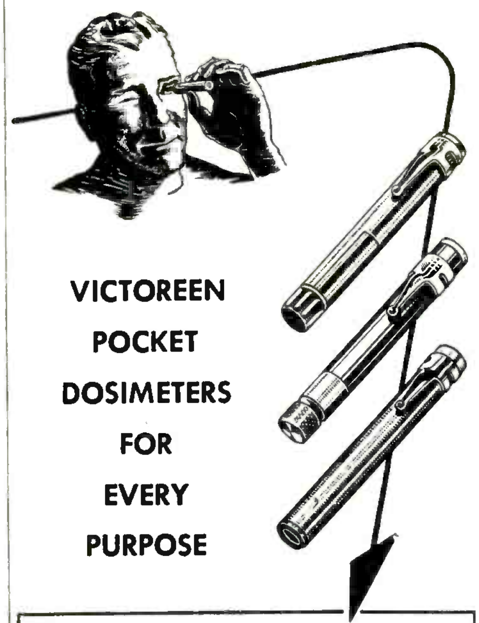

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541	Direct	0.2 r	At or above daily Tolerance Rate
547	Direct	5. r	Emergency
548	Direct	50. r	Trained personnel —Emergency
534	Direct	5. and 50. r	Civil defense, etc.
506	Indirect	100. r	Untrained personnel —Emergency
507	Indirect	200. r	Untrained personnel —Emergency

Write for Bulletin 3012 B

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BACKTALK

Tube Testers

DEAR SIRS:

I NOTE an article on page 139 of the June issue of ELECTRONICS entitled "Vacuum-Tube Testers". This article mentions "proposed classification (of tube testers) by RTMA" and lists "RTMA Tube Tester Classifications". I wish to point out that this list of classifications does not in any way constitute a proposal by RTMA. The list was formulated by a committee in an effort to see if agreement among tube tester manufacturers could be reached on such a classification. An agreement was not reached accepting this list and, therefore, this material has been set aside. At the moment there is no proposal under consideration.

VIRGIL M. GRAHAM
Associate Director
RTMA Engineering Department

New Diotron

DEAR SIRS:

A RECENT article by Rosenthal and Badoyannis (ELECTRONICS, Sept. 1952, p 128) mentions the Diotron mean-square voltmeter and points out two objectionable properties of the original instrument: zero drift and indeterminate behavior after overload. Later design has successfully dealt with both of these problems and we feel these criticisms do not apply to our instruments now on the market.

In addition, we have offered to rebuild instruments already in the field or to provide copies of the revised circuit diagram to users of the instrument who prefer to do the modifications themselves.

R. D. CAMPBELL
Electro-Physics Dept.
Reed Research
Washington, D. C.

Delete Five Words

DEAR SIRS:

THE ARTICLE "Nonsynchronous Pulse Multiplex System" in the August 1952 issue of ELECTRONICS is based on a paper presented at the March IRE Convention by Dr. J. R. Pierce and the writer. Quite extensive condensation was required

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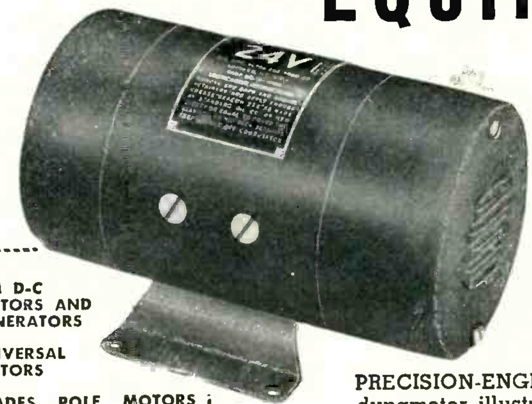

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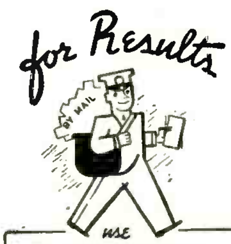

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to prepare this paper for publication and, in general, the editors of ELECTRONICS are to be complimented on this work. Unfortunately, however, a serious error appears in the published article.

On page 120, in the sentence just before the "Conclusion" heading, delete the last four words—"with a synchronous system". In the preceding sentence delete the word "outstanding". It is the nonsynchronous system which has the very large number of distinct and always available separate channel assignments. This tends to offset the lack of economy in the simultaneous use of channel capacity (bandwidth) so that this is not an "outstanding" disadvantage.

The difference between the two types of systems may be clarified by the following example. In an assumed synchronous system, there are exactly 50 separate channel assignments, any or all of which may be used simultaneously. In an assumed nonsynchronous system, there may be upwards of 500 separate channel assignments but only about 10 may be used simultaneously.

Thus the nonsynchronous system is attractive for relatively light traffic use where many stations must have continuous access to the common medium.

ANDREW L. HOPPER
Bell Telephone Laboratories
Murray Hill, New Jersey

Aftermath

DEAR SIRS:

I WOULD LIKE to offer a comment on L. E. Garner's description of the improvement in the transient performance of amplifiers by the addition of positive capacitive feedback in his article, "Improving Amplifier Response" (ELECTRONICS, p 213, Sept. 1952).

While the positive feedback usually has to be taken around two stages, suppose, for simplicity, at first, that only one stage is involved. Let the following symbols be used:

$g_m r_L$ = low-frequency gain of one stage
C_s = strong capacitance shunting the load resistance
C_f = capacitance in series with the feedback loop
r_f = resistance in series with the feedback loop
r_g = grid resistance, across which the

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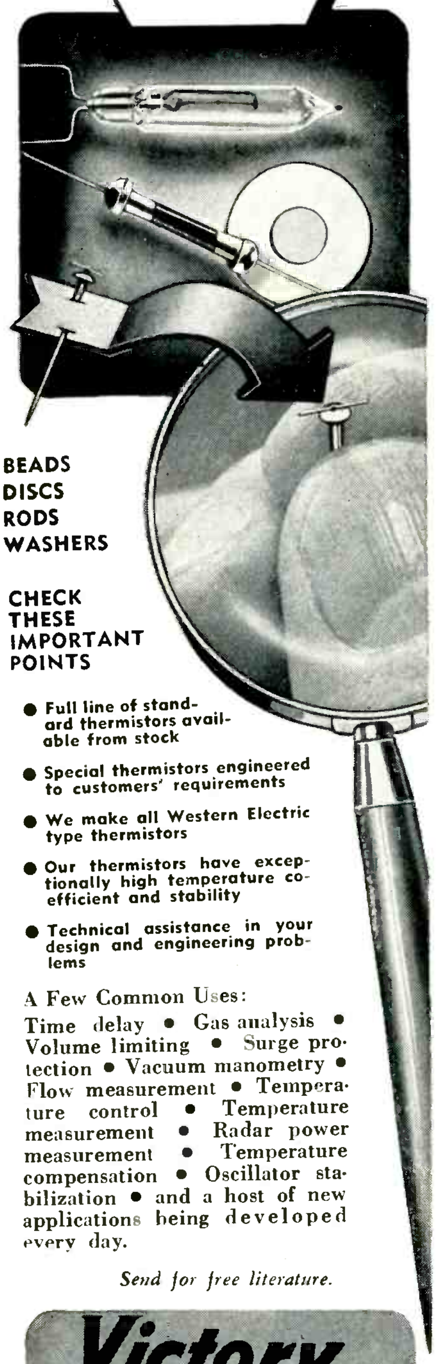

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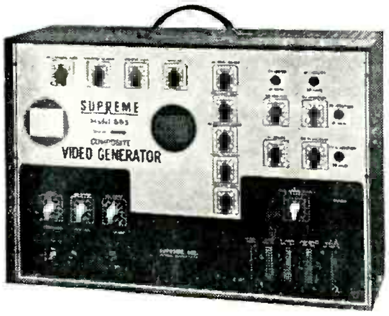

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feedback and signal are applied
L_p = peaking inductance, if used
p = complex angular frequency
G = gain

With neither inductive peaking nor feedback, the gain of one stage is given by

$$G = \frac{g_m r_L}{1 + C_s r_L p} \tag{1}$$

If peaking is provided by an inductance L_p in series with the load resistance, the gain becomes

$$G = \frac{g_m (r_L + p L_p)}{1 + C_s p (r_L + p L_p)} \tag{2}$$

Instead of inductive peaking, now let positive feedback be applied through the resistance r_f and the capacitor C_f in series. The gain is then given by the feedback formula* as

$$G = \frac{\dfrac{g_m r_L}{1 + C_s r_L p}}{1 - \dfrac{g_m r_L}{1 + C_s r_L p} \cdot \dfrac{r_g C_F p}{1 + (r_g + r_F) C_F p}} \tag{3}$$

$$= \frac{g_m r_L + g_m r_L (r_g + r_F) C_F p}{1 + [C_F(r_g + r_F) + C_s r_L - g_m C_F r_L r_g] p + C_s r_L C_F (r_g + r_F) p^2}$$

Comparison shows that Eq. 3 is identical with Eq. 2 provided

$$C_F = \frac{Lp}{r_L^2 r_g g_m} \tag{4}$$

$$r_F = r_g (r_L g_m - 1) \tag{5}$$

Thus the effect of any amount of inductive peaking (maximally flat or overcompensated) can be simulated by the feedback.

When the feedback is taken around two stages, as would usually be done, one has

$$G = \frac{\left(\dfrac{g_m r_L}{1 + C_s r_L p}\right)^2}{1 - \left(\dfrac{g_m r_L}{1 + C_s r_L p}\right)\left(\dfrac{C_F r_g p}{1 + C_F (r_F + r_g) p}\right)}$$

$$= \frac{(\text{Linear Function of } p)}{(\text{Cubic Function of } p)} \tag{6}$$

On the other hand, the gain for two stages with inductive peaking is given by the square of Eq. 2. Since the denominator of Eq. 6 is a cubic in p, while that of the square of Eq. 2 is a quartic, it will not, in general, be possible to simulate exactly the effect of inductive peaking. However, it is possible to choose the constants of Eq. 6 to obtain a desired behavior of G with frequency (maximally flat, or equal ripple). It is impossible, however, to deal with the selection of optimum gain vs frequency characteristics in this letter, the purpose of which is merely to point out the relation of the technique of extending the pass band by feedback to other techniques for accomplishing that purpose.

---

*This is, of course, the expression $A/(1 - A\beta)$, A being given by Eq. 1 and β by $r_g\ C_F\ p/\ [1 + (r_g + r_F)\ C_F\ p]$

H. L. ARMSTRONG
National Research Council
Ottowa, Canada

Omitted

DEAR SIRS:

WITH RESPECT to our article "Bridge Oscillator has Linear Tuning", which appears on page 134 in the August 1952 issue of ELECTRONICS, an error crept in during the editorial process.

The (1) in column 2 of page 134 should refer to two equations which were deleted, *i.e.*:

$$\omega_o = R/L;\ R_2/R_1 = 1/2$$

and should not appear after the equation with which it is now connected.

Unfortunately this change may make the derivation somewhat more difficult to follow.

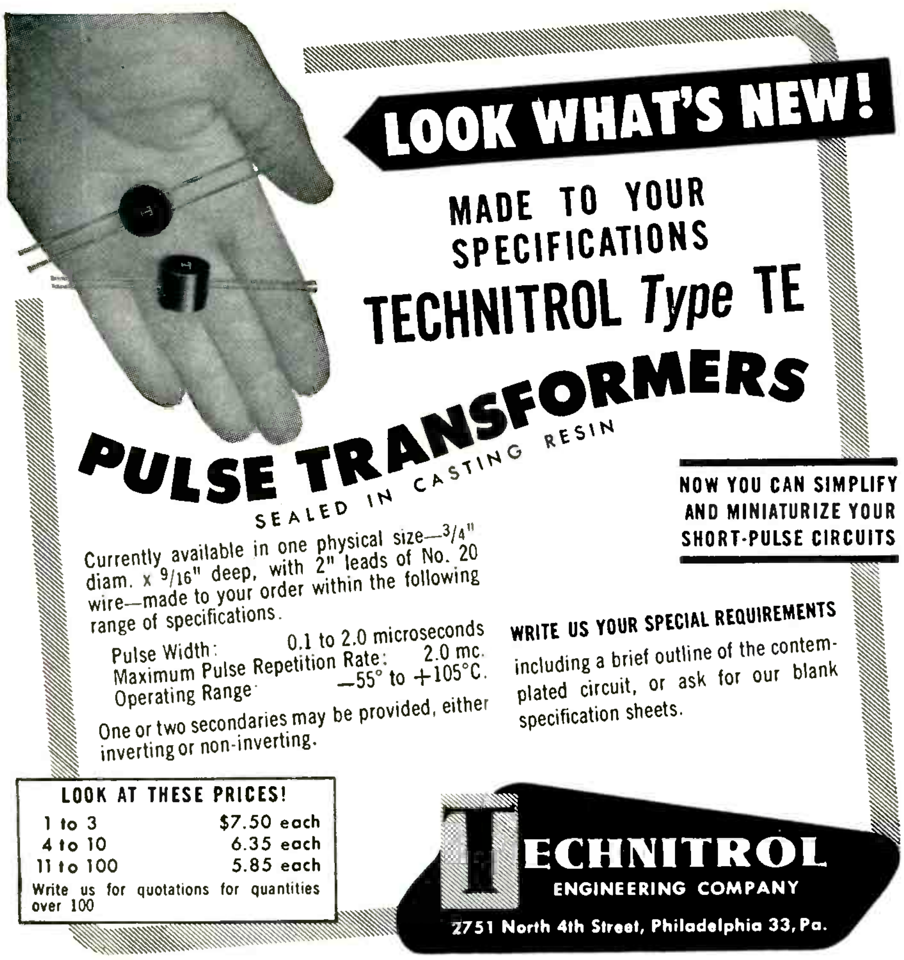
BENSON CARLIN
ABE HERSHLER
Electro-Marine Mfg. Corp.,
New York, N. Y.

Math Available

DEAR SIRS:

I AM writing in reference to the article entiled "Improving Amplifier Response" by L. E. Garner, Jr., which appeared in the *Electrons at Work* department of ELECTRONICS on page 213 of the September 1952 issue.

Mr. Garner stated that he had made no mathematical investigation of why greater bandwidth is afforded by the capacitive coupling feature described in his article. I should like to refer your readers to my article in the DuMont *Oscillographer* where the math ap-



pears in connection with the description of a new instrument. The article is somewhat commercial, but I believe that the portion concerning circuit investigation may be of interest.

WILLIAM J. O'MEARA
Technical Sales Engineer
Allen B. DuMont Labs. Inc.
Clifton, New Jersey

Another 'Tron

DEAR SIRS:

MR. BOCCIARELLI'S low-deflection-power cathode-ray tube (ELECTRONICS, Sept. 1952) brings back memories of an experimental tube produced at General Electric Company in 1940. We were even then conscious of a future demand for big-picture, inexpensive picture tubes short enough for table-model television sets.

An experimental tube was built having a ¾-inch diameter stem attached to a standard 12-inch bulb. By use of a simple triode gun and miniaturized focusing and deflection coils, a stem length of only about 3 inches was required. Simplified manufacture, reduced deflection power and short overall length were achieved at some cost in spot fineness.

The tube was nicknamed the Tittron and was not produced commercially to my knowledge.

FRANK G. WILLEY
Head, Electronics Engr. Dept.
Servo Corp. of America
New Hyde Park, N. Y.

Touche'

DEAR SIRS:

I AM SURPRISED at your being taken in on so simple a thing as appeared in the item "Rosin-Fume Fan" on page 256 of the August issue of ELECTRONICS.

You can no more reverse the action of a fan "by putting the fan on the motor shaft backward" than you can make a left-hand threaded bolt out of one with a right-hand thread by putting the slot at the other end. The change can, of course, be made by bending the blades as you suggest. Wouldn't it be simpler, though, to simply face a standard fan away from the operator

J. CREIGHTON DOUGLAS
Town of Mount Royal, Quebec

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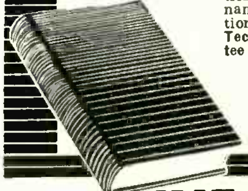

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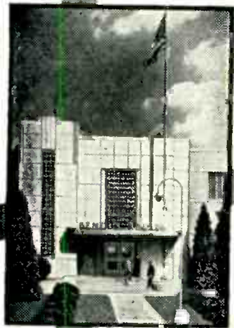

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The man who has this ability has a position and a future awaiting him with a 40 year old company that is large enough to offer a secure position, yet small enough for personal contact and recognition.

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P-5647, Electronics
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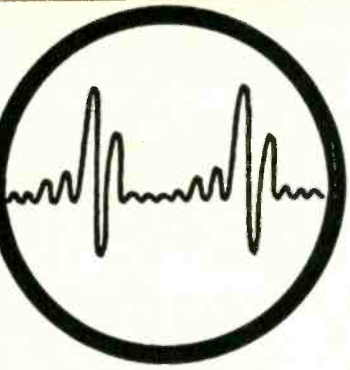

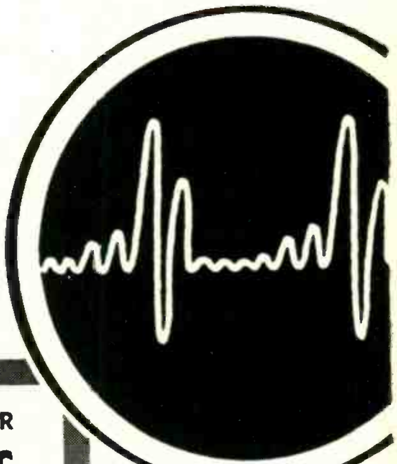

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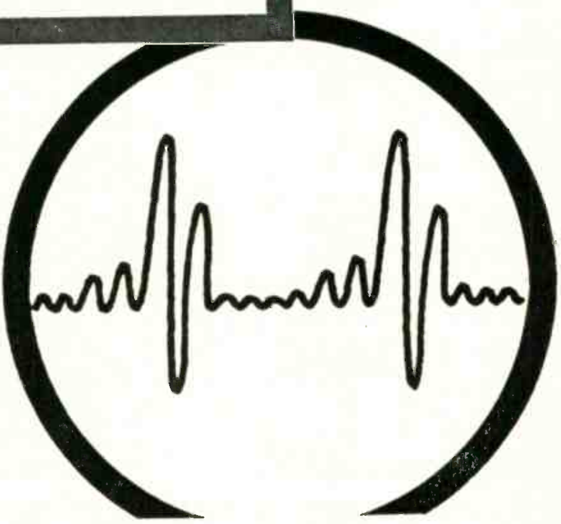

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1	600	.55	3	1500	2.50	.1-.1	7000	5.95	.025	50KV	42.50
2	600	.69	4	1500	2.95	.1	7500	2.85	.2	50KV	85.00
2	600 R'd	.69	.1-.5	2000	.95	1-1	7500	22.50	.25	50KV	95.00
2-2	600 R'd	1.65	.25	2000	1.50	.075-.075	8KV	6.50	7.5	220VAC	1.95
3	600	.95	.3	2000	1.30	.5	10	16.50	1-3	330VAC	1.95
4	600	1.65	1	2000	1.95	1	10KV	29.50	10	330VAC	3.95
4	600 R'd	1.65	3	2000	3.75	.1	12KV	8.95	12.75	330VAC	4.10
5	600	1.75	12	2000	8.95	1	15KV	45.00	15	330VAC	4.50
6	600	1.85	1	2500	2.75	.045	16KV	4.70	5	440VAC	3.10
8	600 R'd	1.85	1-1	2500	3.85	.05	16KV	4.95	2.9	660VAC	3.50
8-8	600	1.95	32	2500	15.80	.075	16KV	8.95	7	660VAC	4.25
4-4-4	600	2.50	.5	3000	2.40	.25	20KV	19.95	8	660VAC	4.50
4 x 3	600	2.50	1	3000	3.40	1	20KV	54.00			
10	600	3.25	2	3000	4.50						
1	1000	.65	.03	4000	1.25						
2	1000	.90	3 x .2	4000	2.95						
2	1000 R'd	.95	2	4000	6.95						
3.5-.5	1000	1.85	.1	5000	1.60						
4	1000	1.95	.2	5000	2.50						
6	1000	2.50	1	5000	4.88						
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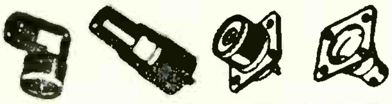

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83-1F	1.20	83-1SPN	.56	83-22T	1.95
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83-1HP	.25	83-2AP	1.95	83-185	.15
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UG-18/U	1.25	UG-23C/U	1.90	UG-58A/U	1.15	UG-106/U	.15	UG-191/AP	.80	UG-262/U	1.20
UG-18B/U	1.60	UG-21/U	1.30	UG-59A/U	2.25	UG-108 U	2.60	MX-195/U	.75	UG-273/U	2.25
UG-19/U	1.80	UG-25/U	1.35	UG-83/U	2.25	UG-109/U	2.60	UG-197/U	2.80	UG-274 U	2.75
UG-20B/U	1.80	UG-27/U	1.30	UG-85/U	1.75	UG-146/U	2.55	UG-201/U	2.25	UG-275 U	5.50
UG-21/U	.95	UG-27A/U	2.95	UG-86/U	2.50	CW-159/U	.60	UG-203/U	.85	UG-276/U	2.75
UG-21A/U	$1.50	UG-28A/U	3.75	UG-87/U	1.60	UG-166/U	32.50	UG-206/U	1.80	UG-290/U	1.20
UG-21B/U	1.35	UG-29/U	1.55	UG-88/U	1.10	UG-167/U	5.85	UG-224/U	1.20	UG-291/U	1.35
UG-21C/U	1.45	UG-30/U	2.30	UG-89/U	1.35	UG-171/U	2.80	UG-236/U	3.85	UG-306/U	2.95
UG-22/U	1.35	UG-34/U	16.50	UG-90/U	1.60	UG-173 U	.40	UG-245/U	2.30	UG-414/U	3.25
UG-22B/U	1.65	UG-36/U	17.50	UG-98/U	1.85	UG-175/U	.15	UG-254/U	2.75	UG-625/U	1.35

QUOTATIONS UPON REQUEST ON ANY CONNECTORS NOT LISTED HERE

M-358	MC-277	PL-259A	PL-325	93-C	49120	D-163950	ES-685696-5
M-359	MC-320	PL-274	SO-239	93-M	49121A	D-166132	ES-689172-1
M-359A	PL-258	PL-284	SO-264				
M-360	PL-259	PL-293	TM-201				

COAXIAL CABLE

Type	Price Per M Ft.	Type	Price Per M Ft.	Type	Price Per M Ft.	Type	Price Per M Ft.
RG-5/U	$140.00	RG-13/U	$216.00	RG-26/U	$475.00	RG-57/U	$325.00
RG-6/U	180.00	RG-17/U	650.00	RG-29/U	50.00	RG-58/U	60.00
RG-7/U	85.00	RG-18/U	900.00	RG-34/U	300.00	RG-58A/U	70.00
RG-8/U	100.00	RG-19/U	1250.00	RG-35/U	900.00	RG-59/U	60.00
RG-9/U	250.00	RG-20/U	1450.00	RG-54A/U	97.00	RG-62/U	75.00
RG-9A/U	275.00	RG-21/U	220.00	RG-55/U	110.00	RG-77/U	100.00
RG-10/U	240.00	RG-22/U	150.00				
RG-11/U	100.00	RG-22A/U	285.00				
RG-12/U	240.00	RG-24/U	675.00				

ADD 25% TO PRICES SHOWN FOR QUANTITIES UNDER 500 FT.

2 φ LOW INERTIA SERVO MOTORS

KOLLSMAN—45 Volt 60 cycle 4 watts 1500 RPM—new $22.50
PIONEER—10047-2-A 26 volt 400 cycle with 40:1 reduction gear $10.50
PIONEER—CK-14 115 volt 400 cycle—includes damping signal generator (autosyn)....$47.50

HIGH VOLTAGE TRANSFORMERS

G.E.—Pri. 115V 60 cy. Sec. 6250V 80 MA—12.5 KV Insulation $18.50
G.E.—Pri. 115V 60 cy. Sec. 6250/3850/2600V 56 MA 12.5 KV Insulation $18.50

ANTENNAS

AT-4/ARN-1 .... $8.25
AT-38A/APT (70 to 400MC) 13.70
AT-49/APR-4 (300 to 3300MC) 13.70
AN-65A (P/O SCR-521) 1.50
AN-66A (P/O SCR-521) 1.75
AIA-3CM conical scan 125.00
ASB Yagi—5 element 450 to 560MC.... 9.00
ASB Yagi—Double stacked 6 element.... 14.70
ASA Yagi—Double stacked 370 to 430MC.... 29.40

RELAYS

Sigma type 4AH—2000Ω 4 ma DC coil—SPDT contacts—hermetically sealed 5 pin plug-in base $3.30
Sigma type 4R—8000Ω 1 ma DC coil—SPDT contacts—enclosed type 5 pin plug-in base....$4.25
Stevens Arnold type 171 Millisec relay—900 ohm coil SPST NO contacts $5.50
Cutler-Hammer and Square D type B-7A contactor—24 VDC coil—SPST NO 200 Amp contacts...$4.75
Price Bros. type 161-M—220 VAC contactor—SPST NO double bk 30A contacts....$3.25
G.E. CR5181-1A6—115 V 60 cy. AC contactor—4PST 30 Amp contacts plus two auxiliary SPDT contacts $14.50
RBM—115 V 60 cy. AC coil—DPDT 3 amp Contacts $3.20

METERS

1 MA DC 3½" R Dejur Mod 310 (0-4KV scale).$5.75
500 Microamps. DC—2½" round—Sun.... 4.30
1ma. DC Fan type—4" scale (rem. from equipt). 3.95
500 ma. DC 2½" R.—General Electric.... 2.95
2 amp. RF 2½" Sq.—Simpson.... 3.15
5 amp. AC 4" R.—JBT 4.11
30 V DC 2½" R.—General Electric.... 3.95
3 amp. RF 3½" R.—Weston.... 6.00

CRYSTAL DIODES

1N21	$1.19	1N27	$1.79	1N41	$11.25
1N21A	1.69	1N31	3.10	1N42	18.75
1N21B	3.50	1N34	.66	1N43	1.55
1N22	1.09	1N34A	.95	1N45	.94
1N23	1.95	1N38	1.70	1N52	1.05
1N23A	3.25	1N39	6.25	1N55	3.15
1N23B	4.25	1N40	10.60	1N60	.55

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"	[illegible]	3/8"
500	5/8"	20K	SS	500K	SS
650	1/2"	25K	SS	500K	1/4"
1K	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"		

$1.25 each

DUAL "JJ" POTS.—$2.95 ea.

50 SS	330 SS	2500 SS	2.5 meg SS
100 SS	500 SS	10K SS	5 meg SS
250 SS	1K SS	1 meg SS	1K 25K ⅜"

TRIPLE "JJJ" POTS.—$3.95 ea.

100K/100K/100K ⅜" 20K/150K/15K ⅜"

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 $9.25

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
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 12121-1A 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-72K Signal Generator $48.50
- C-D Quietone Filter Type IF-16 110/220 V AC/DC 20 Amps. *$9.00
- TS-143/CPN Oscilloscope *$95.00
- Dumont 175A Oscilloscope *$225.00
- Gen. Radio 757-PI Power Supply....*$27.00
- 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
- CWI-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....*$125 00
- CW—60ABM Frequency Meter—10 CM....$97.50
- 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
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 DP-14 Direction Finder complete.... 385.00
CU-24/ART-13 Antenna Loading Cond.... 4.95
T-85/APT-5 300-1600 MC Transmitter.... 175 00
Sola #30807 Constant Volt. Transf. 250 VA.. 49.00
PP-101/APT-5 Rectifier Unit for above.... 42.50
BC-1016 Tape Recorder.... 350 00
AN/APA-30 .... 375.00
BC-910A Oscilloscope 147.50
BC-1068 Receiver 57.50
ATJ and ATK TV Block Equip.... Quote
BC-348 Receiver .... Quote
RTA-1B Transceiver .... Quote
T-47/ART-13 Transmitter .... Quote
Sperti 1S21 vacuum relay switch (P/O AN/ART-13) 9.50

PULSE TRANSFORMERS

UTAH 9262 9278 9280	UTAH 9318 9340 9350
G.E. K54J318	Westinghouse 187AW2F
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-2468B	Philco 352-7150
G.E. K-2469A	Philco 352-7071
G.E. K-2744B	Philco 352-7178
AN/APN-9 (901756-501)	Raytheon UX-7350
AN/APN-9 (901756-502)	Raytheon UX-10066
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 166AW2F	W.E. KS-9563
Westinghouse 176AW2F	

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 sinewave 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....$37.50
15-A-1-400-50P, 15 KV, "A" Circuit, 1 microsec. 400 PPS, 50 ohms imped....$32.50

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST. PHILA. 6, PA.

Telephones - MARKET 7-6771-2-3

"CABLE ADDRESS—LECTRONIC PHILADELPHIA"

GUARANTEED BRAND NEW

TUBE SPECIALS

STANDARD BRANDS ONLY

Receiving Tubes	
OOA	$1.50
O1A	.67
OZ4	.74
OZ4A	.90
1A3	.71
1A5GT	.72
1A6	.72
1A7GT	.91
1AB5	.89
1B3GT	.99
1B4P	1.17
1C5GT	.85
1C6	.69
1C7G	.69
1D5GP	.69
1D7G	.69
1D8GT	.71
1E5GP	.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
1LE3	.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
2E5	.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	.99
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
7E6	.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
1273	.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
1.55B	.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
3FP1	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
1B24A	39.50
1B26	3.73
1B27	19.50
1B29	2.90
1B32	3.95
1B35	12.50
1B36	12.50
1B38	32.50
1B40	4.95
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	21.50
2C44	1.50
2C46	29.50
2C51	5.75
2C53	12.00
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	49.50
2J49	65.00
2J50	39.50
2JB51	2.50
2J54	47.50
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
3B28	7.75
3C24	1.85
3C27	6.95
3C37	32.50
3D21	1.98
3D21A	4.75
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	52.50
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	4.79
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
701A	6.95
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	10.75
715A	6.75
715B	12.75
715C	26.50
717A	1.47
718AY	45.00
718BY	45.00
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	14.50
726B	45.00
726C	65.00
730A	25.00
731A	2.45
WL-787	9.80
788Y	1.40
800	1.89
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
833A	45.00
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
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

IMMEDIATE

DELIVERY FROM STOCK

GENERAL ELECTRIC — ARMA
CONTROL INSTRUMENT — BENDIX
FORD INSTRUMENT — KETAY
HENSCHEL — DIEHL

SYNCHROS

ARMY ORDNANCE—NAVY ORDNANCE—COMMERCIAL

AY-101D	5D	6DG	X	2JD5E1	C-78248
1CT	5DG	6G	2J1F1	C-44968-6	C-78249
1F	5F	7DG	2J1G1	C-56701	C-78254
1G	5G	7G	2J1H1	C-56776-1	C-78410
1HG	5N	A	2J1M1	C-69405-2	C-78411
1SF	5SF	B	2J5A2	C-69406	C-78414
5B	5SG	M	2J5D1	C-69406-1	C-78415
5CT	6CT	N	2J5HA1	C-77610	C-78670
					C-79331

SYNCHRO CAPACITORS — SYNCHRO BLOWN FUSE INDICATORS

SYNCHRO BLOWN FUSE INDICATORS

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.

"CABLE ADDRESS - LECTRONIC PHILADELPHIA"

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST. PHILA. 6, PA.

Telephones - MARKET 7-6771-2-3

Reliance Specials

GEAR ASSORTMENT

100 small assorted gears. Most are stainless steel or brass. Experimenter's dream! ....Only $6.50

HAYDON TIMING MOTOR

1 R.P.M., 115 V., 60 Cycle..........$1.95

SOUND POWER HANDSET

BRAND NEW

Includes 5 ft. cord.—Uses no batteries or external power source. $18.50 pr

AC LINE CORDS 6 ft. long with molded plug.......16c

BALL BEARINGS

Mfg. No.	ID	OD	Thick.	Price
MRC5028-1	5 1/2	6 1/2	1	$3.75
MRC7026-1	5 5/64	6 15/64	9/16	3.50
MRC7021-200	4 1/8	5 9/32	23/64	2.95
MRC106M2	1 17/64	2 7/16	25/64	1.75
MRC106M1	1 13/64	2 7/16	25/64	1.60
Federal LS11	1 1/8	2 1/2	5/8	1.75
Norma S11R	1 1/8	2 1/8	5/8	1.70
Federal AS41	1 1/16	1 1/2	9/32	1.50
Schatz	3/4	1 3/4	9/16	1.00
Norma 203S	5/8	1 9/16	7/16	.90
ND5202-C13M	1/2	1 3/8	1 3/8	1.00
ND 3200	25/64	15/32	11/32	.60
ND R6	3/8	7/8	7/32	.40
MRC39R1	11/32	1 1/32	5/16	.45
MRC38R3	8/16	55/64	13/32	.45

NEEDLE BEARINGS

TORRINGTON B108 ½" wide 5/8" 13'6".......30¢

Brand New Meters—Guaranteed

0-10 ma. D.C. 3½"..$3.95 0-80 Amp. D.C. 2½"..$2.50
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

TIMING MOTOR

8 RPM 115V 60 cyc
E. Ingraham Co.
$1.79

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

Amp.	Per 100	Amp.	Per 100	Amp.	Per 100
1/8......	$4.00	3/4......	$4.00	8.......	$3.00
3/8......	4.00	1........	3.00	10.......	3.00
1/2......	4.00	4........	3.00	15.......	3.00
		5........	3.00		

3 AG FUSE HOLDERS (Finger) 25¢

DELAY NETWORK—ALL 1400Ω

T 114—Approx. 2.2 micro sec. delay............. 95¢ each
T 115 Similar to T 114 with tap brought out

Sound Powered Chest Set RCA—With 24 Ft. Cord
Per Pair
USED $17.60
NEW $26.40

POSTAGE STAMP MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd
10	40	70	125	240	400	680	.0016	.004
20	47	75	135	250	430	800	.002	.0044
22	50	80	150	270	470	820	.0027	.005
23	51	82	160	300	500	910	.0033	.006
24	56	90	175	330	510	.001	.0036	.0065
25	60	100	180	360	580	.0012		.0068
33	62	110	200	370	600	.0013		.0082
39		120	220	390	650	.0015		.01

Price Schedules

10 mmf to 820 mmf...................................5¢
.001 mmf to .0016...................................8¢
.002 mfd to .0082 mfd...............................15¢
.01 mfd...28¢

SILVER MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
10	50	100	170	360	510	.001	.0024	.0047
18	51	110	180	370	525	.0011	.0025	.005
22	56	115	208	390	560	.0013	.0027	.0051
23	60	120	225	400	570	.0015	.0028	.0056
24	62	125	240	410	680	.0016	.003	.006
25	66	130	250	430	700	.0018	.0033	.0068
27	68	135	255	470	800	.0022	.0039	.004
30	75	150	260	488	900	.0023	.004	
40	82	155	270	500				

Price Schedule

10 mmf to 700 mfd...................................10¢
.0011 mfd to .002 mfd...............................20¢
.0022 mfd to .0082 mfd..............................50¢

PULSE TRANSFORMERS

UTAH—9262 9278 9280 9340
WESTERN ELECTRIC—D166173 D161310
KS8696, KS9565, KS9800, KS9862, KS13161
GENERAL ELECTRIC—80-G-5
JEFFERSON ELECTRIC—C-12A-1318
DINION COIL—TR 1048 TR1049
also 352-7250-2A; 352-7251-2A; T-1229621-60

COAXIAL CABLE CONNECTORS

15¢	$1.20	30¢	75¢	40¢	12¢
UG175/U	83-1F	83-1AP	83-1J	SO-239	HO OD

83-1AC	$0.42	UG-23/U	1.20	UG-175/U	.15
83-1AP	.30	UG-23B/U	1.90	UG-176/U	.15
83-1F	1.20	UG-23C/U	1.90	UG-185/U	1.20
83-1H	.12	UG-24/U	1.30	UG-224/U	1.35
83-1HP	.25	UG-25/U	1.35	UG-255/U	2.45
83-1J	.75	UG-27/U	1.30	UG-260/U	1.20
83-1R	.40	UG-27B/U	3.45	UG-261/U	1.20
83-1RTY	.65	UG-28A/U	3.75	UG-262/U	1.20
83-1SP	.50	UG-30/U	2.30	UG-274/U	2.75
83-1SPN	.55	UG-57B/U	2.30	UG-290/U	1.20
83-1T	1.30	UG-58/U	.80	UG-291/U	1.25
83-2AP	1.95	UG-58A/U	1.15	UG-306/U	2.95
83-2J	2.10	UG-59A/U	2.25	UG-499/U	1.25
83-2R	1.70	UG-83/U	1.95	UG-625/U	1.35
83-22AP	1.40	UG-85/U	1.75	CW-123A/U	.50
83-22R	.68	UG-87/U	1.60	M-358	1.30
83-22SP	.90	UG-88/U	1.10	M-359	.30
83-168	.15	UG-89/U	1.35	PL-258	.75
83-185	.15	UG-102/U	.90	PL-259	.50
UG-13/U	1.70	UG-103/U	.68	PL-259A	.55
UG-21/U	.95	UG-104/U	1.40	PL-274	1.20
UG-21B/U	1.35	UG-106/U	.12	SO-239	.40
UG-22/U	1.30	UG-146/U	2.55		
UG-22A/U	1.60	UG-167/U	5.70		

NEW COAXIAL CABLES

	Price per 1000 Ft.		Price per 1000 Ft.
RG 5/U*......	$140.00	RG 22/U*.....	150.00
RG 6/U.......	180.00	RG 22A/U.....	$285.00
RG 7*........	85.00	RG 24........	675.00
RG 8*/U......	100.00	RG 26/U......	475.00
RG 9*/U......	250.00	RG 29*.......	50.00
RG 9A/U......	275.00	RG 34/U......	300.00
RG 10........	240.00	RG 35........	900.00
RG 11*/U.....	100.00	RG 41*/U.....	295.00
RG 11A/U*....	150.00	RG 54A/U.....	97.00
RG 12........	240.00	RG 55*.......	110.00
RG 13*/U.....	216.00	RG 57*/U.....	325.00
RG 17........	650.00	RG 58*.......	60.00
RG 18/U......	900.00	RG 58A/U*....	65.00
RG 19........	1250.00	RG 59*.......	55.00
RG 20/U......	1450.00	RG 62*.......	75.00
RG 21........	220.00	RG 77*.......	100.00

Add 25% for orders less than 500 feet.
* No minimum order—others 250' minimum.

UNIVERSAL JOINT ALUMINUM

¼" hole x ½" O.D.
1⅛" long 85¢

SPAGHETTI SLEEVING—assortment—90 feet.....$1.00

TYPE "J" POTENTIOMETERS

100 S.S.*	1,500 1/4S.S.	15K 1/4	200K S.S.*
150 S.S.	2,000 1/4	25K S.S.	250K 5/8
300 S.S.*	2,500 S.S.	70K S.S.	250K S.S.*
400 S.S.	3,000 3/8	80K S.S.	500K S.S.*
500 S.S.	4,000 3/8	100K 7/16	1Meg S.S.
1,000 3/8	5.000 3/4*	100K S.S.*	
1,000 S.S.	10K 5/8	200K 5/8	

*Split Locking Bushing **$1.50 EACH**

TYPE "JJ" POTENTIOMETERS

Ohms	Shaft	Ohms	Shaft	Ohms	Shaft
1000	S.S.	30K-10K	3/8"†	1 Meg.	1/2"
10K	5/16"	3K-90K	1/4"	1 Meg.	S.S.
15K	S.S.			1 Meg.	S.S.

SD—Screw Driver
*—Split Locking Bushing
†—With Switch

PRICE—$2.00 EACH

JONES BARRIER STRIPS

2—140Y	$.17	3—141W	.27	9—141Y	.71
3—140¾W	.21	4—141W	.33	12—141	.64
6—140	.28	5—141	.29	3—142	.24
10—140W	.59	5—141¾W	.41	2—150	.43
10—140¾W	.59	7—141¾W	.56	3—150	.60
3—141¾W	.27	8—141¾W	.64		

TIME DELAY RELAY

Raytheon CPX 24166
1 Min. Delay. 115 V., 60 Cycle

2½ second recycling time spring return • Microswitch contact, 10A • Holds ON as long as power is applied • Fully Cased • ONLY $6.50

AN CONNECTORS

IMMEDIATE SERVICE
PHONE! WIRE! WRITE! YOUR NEEDS

OIL FILLED CONDENSERS

MFD	V.D.C.	Price	MFD	V.D.C.	Price
5.2	50	$0.35	.25	3,000	2.25
6	400	.85	1	3,600	3.95
3 x 3	400	1.00	3 x .2	4,000	2.50
4	500	.85	2	4,000	6.95
4-4	500	1.30	3	4,000	7.95
8	500	1.35	.01	5,000	.95
1	600	.45	.01-.03	6,000	1.40
.5-.5	600	.40	.03-.03	6,000	1.50
2	600	.80	1	6,000	9.95
4	600	1.63	.02-.02	7,000	1.55
8	600	2.05	.02-.03	7,000	1.60
10	600	2.95	.1	7,000	1.95
4 x 3	600	1.75	.1-.1	7,000	2.25
8-8	600	1.79	.1	7,500	2.25
1	800	.60	.3-.3	7,500	4.50
1	1,000	.75	.075-.075	8,000	1.85
2	1,000	.95	.15-.15	8,000	2.95
3	1,000	1.70	.25	20,000	19.95
6	1,000	2.75			
8	1,000	3.25			
1	1,500	1.45			
.02	2,000	.65			
.1-.1	2,000	1.30			
.1-.5	2,000	1.65			
3	2,000	3.75			
8	2,000	7.95			

1 mfd
6,000
V.D.C.
G.E.
$9.95

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	75	400	6,500	16,000	36,000
.334	13.15	87	723.1	7,000	16,700	37,000
.444	13.3	97.8	855	7,300	17,000	45,000
.502	15	125	970	7,500	19,860	47,000
.557	25	178	1,500	8,000	20,150	50,000
.627	44.73	179.5	2,500	8,500	21,300	56,000
.76	45	180	2,850	8,800	25,000	59,000
1.00	46	200	3,995	10,000	26,667	59,905
1.01	52	210	4,000	12,000	30,000	68,000
1.53	55.1	235	4,285	14,825	32,700	79,012
2.04	61	260	4,451	15,000	32,888	100,000
3.25	65	270	5,714	15,750	33,000	180,000
5.26	66.6	290	5,900	15,755	33,300	
5.89	69	298.3		15,810	35,888	

PRECISION RESISTORS—1 WATT—45¢

.1	2.55	15	60	425	7,000	55,000
.11	2.58	18	80	1,530	8,250	56,000
.2	2.6	28	125	2,215	9,000	65,000
.31	2.66	30	250	2,250	10,000	68,000
.861	3.1	38	270	2,550	12,000	70,000
1.01	3.39	45.5	312	3,300	50,000	84,000
1.166	5.21	54.25	420	5,221		95,000

PRECISION RESISTORS—1 WATT—60¢

100,000	149,500	270,000	348,000	590,000
105,000	150,000	296,000	399,000	600,000
120,000	240,000	310,000	413,000	645,000
128,000	260,000	320,000	520,000	650,000
130,000			522,000	700,000
132,000				800,000

MEGOHM 1 WATT 1%—$1.50; 5%—60¢

PRECISION RESISTORS—2 WATT—75¢

4,385 5,000 6,000 10,000 19,917

DIFFERENTIAL Used $4.95

115 V., 60 Cycle
#C78249
New $9.95

3⅜" dia. x 5⅜" long
Used between two C7824's as a dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted)..........$5.50
Mounting Brackets — Bakelite for selsyns, and differentials shown above....................35¢ pair

OIL FILLED A.C. CONDENSERS

MFD	V.A.C.	Price	MFD	V.A.C.	Price
.2	750	$0.69	15	440	6.25
8	660	7.50	4.4	375	2.15
6	660	5.95	25	330	7.50
5	660	5.45	20	330	6.75
4	660	4.95	4	330	2.25
3	660	4.45	3	330	1.45
2.9	660	4.35	1.75	330	.85
2	660	3 95	20	220	4.95
1	660	2.95	7.5	220	2.00

1N34 Crystal Diode..............................79c

300 Twin Lead...............02½ per ft. $18.95 per M

Dynamotor DM 33A..........................$3.75 ea.

Chokes: 30 Hy. 80MA @...$1.29: 6HY, 80 MA @...79c

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 $5.50

BC 221 FREQUENCY METER.....................$80.00

Mike Connector Amphenol 80-81 Interchangeable with Amphenol 80-M cad plated..........................25c

2J1G1 SELSYNS $8.95

400 CYCLE BRAND NEW

Minimum Orders $3 All orders f.o.b. PHILA, PA.

RELIANCE MERCHANDIZING CO.

Arch St. Cor. Croskey Phila. 3, Pa. Telephone Rittenhouse 6-4927

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..$295.00
2 KVA O'Keefe and Merritt. 115DC to 120AC, 50 cy., 1 Ph. Export Crated. New..........$195.00
MOTOR GENERATOR, TYPE CGU-2
Unit of U. S. Navy TCK-7 Transmitter
Motor: 2 H.P., 230 V.D.C., 10 amps.
Generator: 1800V. D.C., 0.4 A, 500V. D.C., 0.35A. 115 V. D.C., 1.5A, 12 V. D.C., 2A. 3480 R.P.M. Self excited. Brand new including spare armature $365.00

INVERTERS

Onan M-G.-215H. Navy type PU/13. Input 115/230, 60 cy., 1 Ph. Output: 115, 480 cy., 1 Ph., 1.2Kw and 26V DC at 4 amps. New..........$295.00
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. 5AS131551IA. Model 218J. Input: 28DC. Output: 115, 400 cy., 1 Ph., 1.5KVA. Regulated. New $89.50
Holtzer-Cabot M.G. 164. Input: 440, 3 Ph., 60 cy.. Output: 70V, 146 cy. 3 Ph., 0.140KVA. New $67.50
Eicor. 32DC to 110AC, 60 cy., 1 Ph. at 2.4 Amps. New $39.50

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Type PE94CM. For SCR-522. Brand new in overseas cases $19.50

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Oster E-7-5. 27.5DC. 1/20HP, 3600RPM. Shunt Wound. New $9.50
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E.A.D. Type J50-CW—60 cycle—NEW..........$15.50

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Ford Inst. Co. Synchro Differential Generator. Mod. 3 Type 5SDG. 90/90V. 400 cy., Ord. Dr. 173020. New $22.50
Armor. Synchro Differential Generator. Type 6DG. New $60.00
Hobart Mfg. Co. Synchro Differential Synchro Type XIX 115V. 60 cy. New..........$9.50

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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 $12.50

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U. S. Instrument Co. No. A-260 Combination headset and chest microphone. Brand new, including 20 ft. of rubber covered cable..........$17.50 each
W.E. Laboratory Headsets—Type 316 B, 600 ohms at 1000 C.P.S.
Brand new—Price per set..........$6.50

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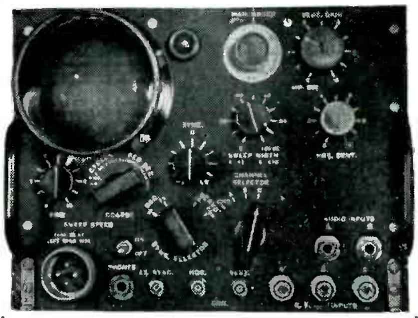
Leach type 1054, BSN 20-28V D.C..........$2.35
Clare Plug-in base No. 30FMX 115 A.C.....$3.50
G.E. Plug-in base Sensitive K27J853..........$4.50
Western Electric D-163781 Plug-in..........$10.00
Guardian Time Delay type B-9-SPDT..........$2.95
Haydon Time Delay 17717 110V/60..........$4.75

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
50 KV Capacitors also available various sizes. Write for list.

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

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TS-47APR Test Osc. 40-500MC.
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AN/APR-1 Receiving sets.
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AN/APR-4 Tuning Units TN-19 (950-2200 MC).
TU-58 Range "A" Tuning Units (110-370 MC).
AN/APA-10 Panoramic Adapters 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.

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Western Electric—type CR-1A/AR in holders. ½" pin spacing. Ideal for net frequency operation. Available in quantities, 5910-6350-6370-6470-6510-6610-6670-6690-6940-7270-7350-7380-7390-7480-7580-9720. All fundamentals in KC. Good multipliers to higher frequencies ....$1.25 each

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Antenna-Trans-Rec. Unit ASG-1.
Radar Set SQ complete with spares.
Modulator type SO-11.
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Radar Crystal Units 98.35kc, Raytheon.
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Repeater Adapters CRM-50 AFO.
SO Series Accessory Control Panels.
SO Series Transmitter-Receiver unit.
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Type SO-1 (10CM) assembly with reflector, waveguide nozzle, drive motor, etc. New $279.50
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Mallory APS-20—In: 115/230/60/3. Out: 12/42V-65-130A.
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Complete specs. on request.

TERMS: Rated Concerns Net 30, FOB Bronxville, New York. All Merchandise Guaranteed. Prices Subject to Change

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Constant Output Line RC-730C
Synchro Amplifiers for Radar
Intercommunication type BC-605

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TDY RADAR JAMMER HORNS
PARABOLOIDS, MAGNESIUM DISHES 17½" dia.
SCR-623-A (part of RC-153-B Antenna)
CU 64/APT Antenna matching unit 50 ohm unbal. to 100 bal.

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W.E. KS-15138 Linear Sawtooth
W.E. KS-8732 for SCR547 Radar
W.E. KS-8801 Motor Driven

LINEAR SAWTOOTH POTENTIOMETER W.E. KS-15138

Has continuous resistance winding to which 24 volts D.C. is fed to two fixed taps 180° apart. Two rotating brushes 180° apart take off linear sawtooth wave voltage at output. Brand New...$5.50

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Cathode Ray Shields for 3" tube..........$3.75
Variac type Motor Controls 600 watt..........$13.50
10 CM Waveguide 90° elbow..........$20.00
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Shock Mounts U. S. Rubber #5150C..........$.30
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ID-60/APA-10 Panoramic Adapter converted for 60 cycle operation—complete with tubes and 80 page Tech. Manual $245.00

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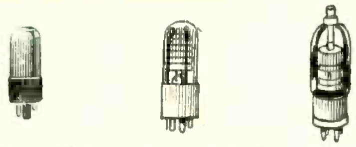
NEW YORK'S RADIO TUBE EXCHANGE



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OB2	1.75
OC3	1.25
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C1B	6.95
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1N21A	1.75
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1N23	2.00
1N23A	3.75
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2B26	3.75
2C34	.35
2C40	20.00
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2E22	3.75
2E30	2.75
2J21	17.95
2J22	17.95
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TYPE	PRICE
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2J38	17.95
2J40	35.00
2J42	189.00
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4J26	199.00
4J27	199.00
4J31	199.00
4J32	199.00
4J33	199.00
4J37	199.00
4J38	89.00
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249C	4.95
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274A	3.00
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304TL	14.50
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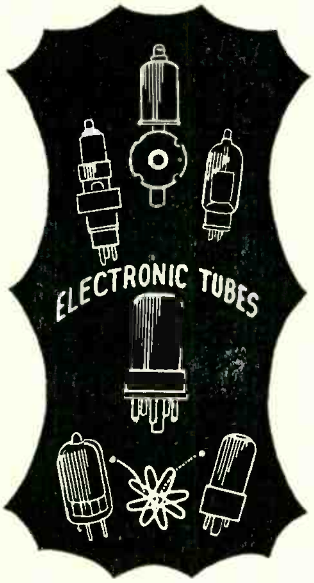

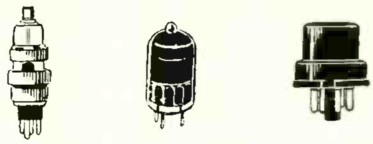

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803	7.95
804	13.50
805	5.95
806	25.00
807	1.69
808	3.50
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811A	3.15
813	9.95
814	3.95
815	3.50
816	1.45
829	12.95
829A	13.95
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830B	3.50
832	7.95
832A	9.95
833A	49.95
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954	.35
955	.55
956	.69
957	.29
958A	.69
991	.65
E1148	.35
1280	1.95
1611	1.95
1613	1.38
1616	2.95
1619	.89
1622	2.75
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1625	.45
851	1.85
2050	1.85
2051	1.80
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8013	2.95
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SPECTRUM ANALYZER

Field type X Band Spectrum Analyzer, Band 8430-9580 Megacycles.

Will check Frequency and Operation of various X Band equipment such as Radar Magnetrons, Klystrons, TR Boxes. It will also measure pulse width, c-w spectrum width and Q of resonant cavities. Will also check frequency of signal generators in the X band. Can also be used as frequency modulated Signal Generator etc. Available new complete with all accessories, in carrying case.

Also available of new production TS239A Synchroscope and TS147/UP X Band Signal Generator.

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TS10/APN Altimeter Test Set
TS12/AP VSWR Test Set for X Band
TS13/AP X Band Signal Generator
TS15/AP Flux Meter
TS16/AP Altimeter Test Set
TS33/AP X Band Power and Frequency Meter
TS34/AP Western El. Synchroscope
TS34A/AP Western El. Synchroscope
TS35/AP X Band Signal Generator

TS36/AP X Band Power Meter
TS47/APR 40-400 MC Signal Generator
TS69/AP Frequency Meter 400-1000 MC
TS100 Scope
TS102A/AP Range Calibrator
TS108 Power Load
TS110/AP S Band Echo Box
TS125/AP X Band Power Meter
TS126/AP Synchroscope
TS174/AP Signal Generator
TS175 Signal Generator
TS226 Power Meter

TS251 Range Calibrator APN9
TS270 S Band Echo Box
TS147 X Band Signal Generator
TS239A Synchroscope

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APA10 Oscilloscope and panoramic receiver
APA38 Panoramic Receiver
APS 3 and APS 4 Radar
APR5A Microwave Receiver
APT2 Radar Jamming Transmitter
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25 Dollars

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Wide Band S Band Signal Generator 2700/3400MC Using 2K41 or PD 8365 Klystron, Internal Cavity Attenuator, Precision individually calibrated Frequency measuring Cavity. CW or Pulse Modulated, externally or internally.

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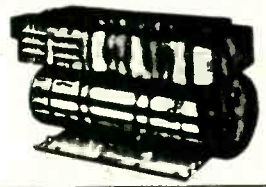
PHONE WORTH 4-8262

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.**

PIONEER 12130-3-B
Output: 122.5 VAC; 1.15 amps, 400 cycle single phase, 141 VA. **Input:** 20-30 VDC, 18-12 amps. Voltage and frequency regulated .... **$89.50 ea.**

10563 LELAND ELECTRIC
Output: 115 VAC; 400 cycle; 3-phase; 115 VA; 75 PF. **Input:** 28.5 VDC; 12 amp. .... **$80.00 ea.**

MG 165 HOLTZER-CABOT
2000 VA; 27.5 Volt; 100 amps. OUTPUT: 115 volt; 400 cycle; 3 phase; 90% PF **$249.50**

12116-2-A PIONEER
Output: 115 VAC; 400 cyc; single phase; 45 amp. **Input:** 24 VDC 5 amp. . **$90.00 ea.**

10285 LELAND ELECTRIC
Output: 115 Volts AC, 750 V.A., 3 phase, 400 cycle, .90 PF, and 26 volts, 50 amps, single phase, 400 cycle, .40 PF. **Input:** 27.5 VDC, 60 amps, cont. duty, 6000 RPM, Voltage and Frequency regulated . **$195.00**

94-32270-A LELAND ELECTRIC
OUTPUT: 115 Volts, 190 V.A., Single Phase: 400 cyc.; .90 PF. and 26 Volts, 60 V.A., 400 cyc., .40 PF. **INPUT:** 27.5 Volts DC, 18 amps; Cont. Duty, Voltage and frequency regulated **$95.00**

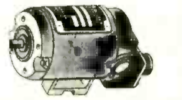
5 RPM GEAR HEAD MOTOR

Mfg. RAE., Type 7519, 115 Volts AD, DC. Fractional HP, Overall dimension: 5½" .... **$12.95 ea.**
Lots of 10 ...... **$11.95 ea.**

METERS
AMMETER: DC; 2" 100-100, complete with external shunt .... **$5.95 ea.**
AC Volt, Westinghouse, Type NA-35—3-inch round. F.S.-10 MA .... **$6.95 ea.**

ELAPSED TIME METER, Aero Instrument Co.—Model 1001. Records operating time of AC electrical and electronic equipment. Registers up to 9,999.9 hours in 1/10th hour increment . . . then automatically resets. Diameter 3½" with glass covered face. 120 VAC; 60 cycle. NEW . **$14.95**

MICROPOSITIONER
Barber Colman AYLZ 2133-I Polarized D.C. Relay: Double Coil Differential sensitive; Alnico P. M. Polarized field. 24V contacts; .5 amps; 28 V. Used for remote positioning, synchronizing, control, etc .... **$12.50 ea.**

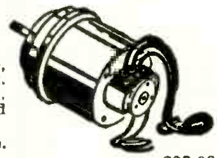


BLACK & DECKER MOTOR AN 94-32159-A; Volts 24; 1 amp; series wound; 12,000 RPM; 1/75 H.P.; Cont. duty; overall size 5-⅜" x 3" dia... **$9.95 ea.**

SYNCHROS
IF Special Repeater (115V-400 Cycle) **$15.00 ea.**
2JIF3 Generator (115V-400 cyc.) . **$10.00 ea.**
5CT Control Transformer; 90-50 Volt; 60 Cyc. .... **$50.00 ea.**
5F Motor (115/90 volt—60 cyc.) . **$60.00 ea.**
5G Generator (115/90 volt—60 cyc.) **$50.00 ea.**
5SDG Differential Generator (90/90 volts —400 cyc.) .... **$30.00 ea.**
TRANSMITTER, BENDIX C-78248; 115 Volt, 60 Cycle .... **$25.00 ea.**
REPEATER, BENDIX C-78410: 115 Volt, 60 Cycle .... **$37.50 ea.**
REPEATER, AC synchronous 115 V., 60 cycle, C-78863 .... **$15.00 ea.**

7G Synchro Generator (115/90 volt; 60 cycle) **$75.00**
6G Synchro Generator (115/90 volt; 60 cycle) **$60.00**
6DG Synchro Differential Generator (90/90 volt; 60 cycle) **$60.00**
1DG Synchro Differential Generator (90/90 volt; 60 cycles) **$50.00**
1CT Control Transformer (90/55 volt; 60 cycle) **$50.00**
1F Synchro Motor (115 volt; 60 cycle) **$50.00**

SYNCHRONOUS SELSYNS



110 volt, 60 cycle, brass cased, approx. 4" dia. x 6" long. Mfg. by Diehl and Bendix.
Quantities Available.
REPEATERS **$20.00**
TRANSMITTERS **$20.00**

G. E. ALTERNATOR
208 Volts, 400 Cycle, 3 Phase Mod. 2CM97B1 55.5 Amps., PF .75, Speed 8000 KW 15, Cont. Duty, Limited Quantity . . . $320.00

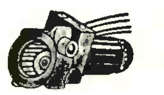
SERVO MOTOR 10047-2-A; 2 Phase; 400 Cycle; with 40-1 Reduction Gear $10.00 ea.

PIONEER TORQUE UNITS
TYPE 12604-3-A: Contain CK5 Motor coupled to output shaft through 125:1 gear reduction train. Output shaft coupled to autosyn. follow-up (AY43). Ratio of output shaft to follow-up Autosyn is 15:1 **$70.00 ea.**
TYPE 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.**

400 CYCLE MOTORS
AIRESEARCH: 115V; 40 CPS; Single phase; 6500 RPM; 1.4 amp; Torque 4.6 in. oz.; HP .03 .... **$10.00 ea.**
EASTERN AIR DEVICES TYPE JM6B: 200 VAC; 1 amp; 3 phase; 400 cycles, 6000 RPM .... **$12.50 ea.**
EASTERN AIR DEVICES, TYPE J31B: 115 V, 400-1200 Cycle, Single Phase **$12.50 ea.**
AIRESEARCH: AC Induction, 200 V; 3 Phase, 400 Cycle, 2 H.P.; 11,000 RPM; 8 amps .... **$79.50 ea.**
AIRESEARCH: AC Induction, 200 V; 3 Phase, 400 Cycle, .12 H.P., 6500 RPM; 1.5 amps **$25.00**
Electric Motor: PNT—1400—A1—1A Serial No. 207. 208 V., 400 cycles, 3 phase, Kearfott Co., Inc. .... **$17.50 ea.**

BLOWER ASSEMBLY
115 Volt, 400 Cycle. Westinghouse Type FL. 17CFM, complete with capacitor. New .... **$12.50 ea**

BLOWER



Eastern Air Devices, Type J31B: 115 volt; 400-1200 cycle; single phase; variable frequency; continuous duty; L & R #2 blower; approx. 22 cu. ft./min. **$15.00**

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.**

MOTOR GENERATORS
G.E. Model 5LY77AB1, Input: 115 volts D.C.; 1½ H.P. motor; 13 amp; 3600 RPM; shunt contact regulated. Output: 115 Volts A.C. 60 cycles; KVA .06; shunt self excited .... **$129.00 ea.**
MG-183, Input: 70 Volts DC, 5.4 amps., 1/3 H.P., 3500 RPM. Output: 50 Volts AC, 2.6 amps., 175 cycles, 3 phase, .225 KVA. **$79.00 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.

SMALL DC MOTORS
(Approx. size....4" long x 1¼" dial.)
General Electric Type 5AB10AJ37; 27 volts, DC; .5 amps, 8 oz inches torque; 250 RPM; shunt wound; 4 leads; reversible. . **$12.50 ea.**
General Electric. Mod. 5BA10FJ33; 12 oz. inches torque, 12 V DC, 56 RPM, 1.02 amp. **$15.00 ea.**
General Electric-Type 5BA10AJ52C; 27 volts, DC; .5 amps, 8 oz. inches torque; 145 RPM; shunt wound; 4 leads; reversible **$12.50 ea.**
General Electric Type 5BA10AJ18D; (27 volts DC; 1 oz. foot 110 r.p.m.; 0.7 amp. **$19.95**

ALNICO FIELD MOTORS

(Approx. size overall) . . . 3¾" x 1¼" diameter)
Delco-Type 5069230: 27.5 volts; DC; 145RPM **$19.95 ea.**
PM Motor, Delco Type #5069370: 27.5 volt; DC Alnico Field; 10,000 r.p.m.; dimensions 1" x 1" x 2" long; shaft extension ½", diameter 0.125" **$12.50**
PM Motor, Diehl Mfg. SS. FD6-21: 27.5 volt; DC Alnico Field; 10,000 r.p.m.; dimensions 1" x 1" x 2" long; shaft extension ½", diameter 0.125" **$12.50**

AC CONTROL MOTOR
Diehl Mfg. Co., FPE-25-7, 20 Volts, 2 ph 1600 RPM, .85 amps **$15.00**
Diehl Mfg. Co., FPE-25-11: 75 to 115 volts; 11 amps, 60 cycle, 2 phase 2 pole. Low inertia motor, 5 watts output **$25.00**

SENSITIVE ALTIMETERS

Pioneer Sensitive altimeters, 0-35,000 ft. range . . . calibrated in 100's of feet. Barometric setting adjustment. No hook-up required . . **$12.95 ea.**

PIONEER GYRO FLUX GATE AMPLIFIER
Type 12076-1-A, complete with tubes **$27.50 ea.**

SINE-COSINE GENERATORS
(Resolvers)
Diehl Type FJE43-9 (Single Phase Rotor). Two stator windings 90° apart, provides two outputs equal to the sine and cosine of the angular rotor displacement. Input voltage 115 volts, 400 cycle .... **$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.**
Arma Resolver Type 213044: equal in size to size 5 synchro; 55-60 cycle; single phase primary, 2 phase secondary **$79.50**

SYNCHRONOUS MOTOR
Reuland Electric; 3 phase; 220/440 volt; 1/3rd HP; 60 cycle; 1800 r.p.m.; frame #203; cont. duty; 40° C rise. Star connected; ball bearing; mounted in 1 HP frame **$49.50**

Immediate Delivery

ALL EQUIPMENT FULLY GUARANTEED

All prices net FOB Pasadena, Calif.

C and H Sales Company

BOX 356-X EAST PASADENA STATION • PASADENA 8, CALIFORNIA

IMMEDIATE DELIVERY • LOW PRICES • FULLY GUARANTEED

Aircraft Generator Eclipse NEA-3

Output 115 VAC; 10.4 amps 800 cycles at 2400 rpm. Also 30 VDC at 6 amps. Stock #SA-306. Price $39.50 each.

Radio Compass Indicator

I-82F. Compass Indicator. 0-360°-5 in. dial, 26 v. 400 cy. 8-12 v. 60 cy. Ideal position indicator. Stock #SA-284.

Price $6.50 each

JA1 MOTOR (D-C)

Electric Specialty, ¼ hp. 24 v. D-C. (Wing flap motor.) Stock #SA-325. **Price $19.50 ea.**

OSTER PM MOTOR

Alinco Field

27.5 v. d-c. Can also be used as rate generator. #SA-281. **$8.75 each**

DIEHL PM MOTOR

Type **FD6-31-1.** 27.5 V. D.C. 10,000 rpm. Dual Shaft. Shaft ext. ⅝" ea. end. Diam. 0.120, Motor 1" Sq. x 2" Lg. Stock #SA-355. **Price $13.25 each.**

400 CYCLE 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

OSTER MOTOR

John Oster Type B-9-1 motor with dual output shaft gear reduction. Cam operated linear motion translation. Motor 27.5 v. DC at 0.7 Amps. 6600 rpm. Stock #SA-335. **Price $9.75 each.**

DELCO CONSTANT SPEED MOTOR A-7155

1/30 hp. 27.5v d-c 3600 rpm. Cont. duty, 2½" diam. x 5½" lg. ⅞" shaft extension. 5/32" diam. 4 hole base mounting. Stock #SA-34. **Price $19.50 each.**

BLOWER ASSEMBLY

Delco 27 v. DC motor, 5400 rpm. 3" Sirroco impeller. Shunt motor. 4 in./oz. torque. Base Mtg. Stock #SA-352. **Price $9.75 each.**

PRECISION AUTOSYN

Pioneer Type AY-150 Control Autosyn. Precision type. 26 v. 400 cycle. Stock #SA-297. **Special low price $14.50 each.**

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 each.**

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.**

BLOWER ASSEMBLY

WESTINGHOUSE FL BLOWER

115 v. 400 cy. 17 c.f.m. Includes capacitor. Stock #SA-144. Price **$14.50 ea.**

KOLLSMAN SERVO MOTOR

Type 776-06. 115 v. 400 cy., 2 phase. 5600 rpm. Drag Cup type. 10 Tooth 96 P.D. shaft. Stall torque 0.5 in/oz. **Stock #SA-358. Price $29.50 each.**

SELSYN SPECIALS

General Electric 2J1F1 & 2J1F3

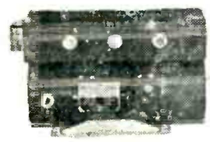
115 v. 400 cycle Selsyn Generator. Large quantity.

Prices on request

INVERTERS

Wincharger PU-7/AP Input 28 VDC at 160 amps. Output 115 v. 400 cy 1 ϕ at 2500 VA. Voltage and frequency, regulated. Cont. duty. Stock #SA-164. **Price $119.50 each.**

G.E. 5AS131NJ3 (PE-118) Input 26 VDC at 100 amps. Output 115 v. 400 cy. 1 ϕ at 1500 VA. PF 0.8 W.E. Spec. Ks-5601L1 Stock #SA-286. **Price $39.50 each**



PE-218E Inverters Russell Electric and Leland. Input 28 VDC at 92 amp. Output 115 v. 400 cycles at 1500 VA. PF 0.9. Stock #SA-112A. **Price $69.50 each.**

Pioneer 12130-4-B Input 28 VDC at 14 amps. Output 120 v. 400 cy. single phase at 1.15 amps. (140 VA.) Voltage and frequency regulated. Made 1949. Stock #SA-304. **Price $99.50 each.**

DC SERVO MOTORS

Elinco B-64 DC Servo Unit — armature voltage, 80 v d-c max. 27.5 v. field 1/165 hp 3100 rpm. Field current 200 ma. Armature current 200 ma. at normal torque. Stock #SA-211. **Price $16.50 each.**

DIEHL DC MOTOR

Type **FDE-83-2.** 24v @ 9.5 Amps. 1/6 hp. 6350 rpm. Cont. duty. Motor 4¼" diam. x 5" Lg. with 1" shaft ext. x ⅜" dia. front mtg. flange 4¼" Sq. Stock #SA-354. **Price $19.50 ea.**

Aircraft Turret Motor—G.E. 5BA50I J22. ½ hp. Amplidyne controlled motor. Armature voltage 60 max. Field 27 v. Max. arm. current 8.3 amps. Field 2.9 amps. 10 minute rating. Stock #SA-345.

Quantity prices on request.

AUTOSYN MOTOR

Bendix-Marine 851

32 v. 60 cycle excitation. Use as either generator or repeater. Stock #SA-158.

Price $24.50 each.

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 extensions. Speed 1725 rpm. **Large Quantity.**

Special $19.50 each

LEAR POSITIONING MOTOR

Model 156A. 115 watt 24 v. DC motor. 10,000 rpm. Int. duty. Reversible. Dual rt. angle output shaft. Release clutch. 7:1 reduction to output. 250:1 reduction to limit switches. **Stock #SA-343.**

Prices on request

AC Motor Special Eastern Air Devices J-33

115 V. 400 cy. 3 phase synchronous. 8000 RPM. Stock #SA-69.

Price $19.50 each

SYNCHROS AND SELSYNS

Navy Types

A; M; 1SF; 5G; 5F; 5SDG; 6SG; 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.

SERIES MOTOR

John Oster Type A-21D-7A

24 v. DC. 0.005 hp. .6 Amps. 11,000 rpm. Cont. duty. 1-½" diam. x 2-½" lg. Front flange mtg. Shaft 3/16 dia. x ⅝" ext. Stock #SA-353. **Price $8.75 each.**

WRITE FOR LISTING
Prices F.O.B. Paterson
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4 Godwin Ave. Paterson, N. J.

SPECIALISTS IN FRACTIONAL HORSE POWER MOTOR SPEED CONTROL

COMMUNICATIONS EQUIPMENT CO.

24 VOLT TRANSFORMERS

For operating surplus gear, toy trains, gadgets, etc. Operates from 115V, 60 cy., supplies 24 VAC at 1.2 Amp., herm. sealed and cased..........A Great Buy at Only **$1.49**

UNIVERSAL SUPPLY KIT

Delivers 230V @ 40MA DC. From 110/220VAC 60 Cy. Kit Consists of 1-PWR Transformer, 5 HY @ 40MA Choke, 2-8MFD @ 450V Filter Cond. 1-6x5 Tube. A great buy at only............ **3.95**

Interphone Transformer Set

Rig your own interphone. Kit consists of 1-Input Transformer (Matches 4 or 6 OHM SPKR to Grid) and 1-Output Transformer (Matches 50L6, 35L6, 25L6, etc. to 4 or 6 OHM Speaker Set of 2 XFMRS. ONLY........................ **1.00**

12-14V SUPPLY KIT

Delivers 12-14VDC at 3.5A from 115V, 60 cy., Kit contains 1—Transformer Rated 18.5V, 4A, 1—Selenium Rectifier, F. W. Bridge...... **$6.95**

OSCILLOSCOPE SUPPLY KIT

Ideal for 3" Scope or Panadapter. Delivers 850V Negative, 300 VDC @ 65MA, 6.3V @ 4A, 6.3V @ 0.6A, 2.5V @ 1.75A. You get 1—Herm. Sealed Transformer 1—25H Choke, 1—2x2 Tube, 1—3x5 Rect. 3—Filter Cond., 1—Filter Resister, 1—Bleeder For Only.............................. **$12.95**

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps Input

CT75B	600-0-600V/.6A, 2X5VCT/6.2A, 6.3VCT/3A, 6.3V/.3A			$12.95
CTJ5-2-600VCT/.2A, 5V/6A				5.95
CT-15A	550VCT .085A 6.3V/.6A, 6.3V/1.8A			2.85
CT-164	4200V.002A/12KV Test, 5VCT/3A/12KV Test, 6.3V/0.6A/5400V Test			12.95
CT-341	1050 10 MA,—625V @ 5 MA, 26V @ 4.5A 2x2.5V/3A, 6.3V @ 3A			16.95
CR-825	360VCT	.340A	6.3VCT/3.6, 6.3VCT/3A	3.95
CT-626	1500V	.160A	2.5/12, 30/.100	9.95
CT-071	110V	.200A	33/.200, 5V/10, 2.5/10	4.95
CT-367	580VCT	.050 A	5VCT/3A	2.25
CT-99A	2x110VCT	.010 A	6.3/1A, 2.5VCT/7A	3.25
CT-403	350VCT	.026 A	5V/3A	2.75
CT-931	585VCT	.086 A	5V/3A, 6.3V/6A	4.25
CT-610	1250	.002 A	2.5V/2.1A, 2.5V/1.75A	4.95
CT-456	390VCT	30 MA	6.3V/1.3A, 5V/3A	3.45
CT-160	800VCT	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
CT-720	550-0-550V/250 MA, 6.3V/1.8A			8.95
CT-43A	600-0-600V/.08A, 2.5VCT/6A, 6.3VCT/1A			6.49
CT7-501	650VCT/200 MA, 6.3V/8A, 6.3V/5A			6.49
CT-444	230-0-230V/.085A, 5V/3A, 6V/2.5A			3.49

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	14.95
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	8.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V/3A.	8.95
FT-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-608	6.3V/3A/750V Test	1.79
FT-873	4.5V/.5A, 7V/7A	2.19
FT-899	2x5V @ 5A, 29KV Test	24.50

Plate Trans.—115V, 60 cps

Item	Rating	Price
PT-699	300/150V/.05A, 300/150V/.05A	$2.79
PT-302	120-0-120V/350 MA	4.69
PT-108	17,600V/144 MA	120.00
PT-671	62V/3.5A	7.95

Special Fil. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STF-370	220/440	3x2.5V/5A, 3KV Test 2.5V/15A	$6.95
STF-11A	220V	2x40V/.05A, 2x5V/6A 12.6V/1A	4.49
STF-608	220V	24V/0.6A, 5V/3A, 6.3V/1A, 6.3V/1A	3.45
STF-968	230V	2.5V/6.5A	3.50
STF-631	230V	2x5V/27A, 2x5V/9A	17.59

Special Plate Transformers—60 cps

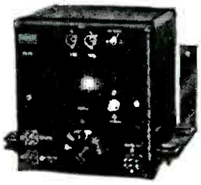
Item	Pri. Volts	Secondaries	Price
STP-613	230V	230/.05A, 230V/.05A	$1.79
STP-409	220/440V	136VCT/3.5A	5.69
STP-815	240/440, 3ph	1310V/.67A, 6KV Test	27.50
STP-129	230V	3850V/3.12KVA	42.59
STP-823	137V	222VCT/.3A	2.35
STP-08B	50V	2x750V/.001A	1.79
STP-622	210/220/230	5000V/1A	59.75
STP-945	210/220/230	550-0-550V/.3A	5.95

Special Comb. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STC-16A	220V	260V/.03A, 100V/1A, 6.3V/4.2A	$4.69
STC-609	220V	220V/3A	6.95

TWO-WAY COMMUNICATION EQUIPMENT

SONAR MOBILE MB-26 Xmtr



Like SR-9 Rcvr, this crystal-controlled 6-tube Xmtr goes everywhere, fits anywhere, employs latest v.h.f. techniques! Lets you send clear signal, no matter how grueling the going. Output: 6 watts., Power consumption: equivalent to car bright lights. Just 6½" high, 7" wide, 5⅞" deep. Built-in antenna relay system, power filter network. Low maintenance — standard tubes. Power and antenna coax connectors on front panel.

FOR . . .
- 2 MTRS
- 6 MTRS
- 10-11 MTRS

$72.45

SONAR MOBILE SR-9 Rcvr

Indispensable when you must hear what's coming through, in mobile or fixed operation, CD, CAP or emergency activity. More than a monitor, more than a converter—it's a 9-tube superhet receiver with overall sensitivity better than 1.0 micro-volt. Tiny — only 4-9/16" high, 5-3/16" wide, and 5-11/16" deep. Yet SR-9 gives you built-in automatic noise limiter, voltage regulated oscillator, precision slide rule dial.

MODEL SR-9
- 2 MTRS
- 6 MTRS
- 10-11 MTRS

$72.45

Model MR-3 5 Bands • 8 Tubes

Ideally suited for mobile with its compact size, lightweight, the MR-3 is excellent for CD, CAP, or any emergency operations. The MR-3 is a COMPLETE 5 BAND RECEIVER—NOT a converter—for 80-75, 20, 10-11 mtr bands, with less than 1 micro-volt of sensitivity—comes complete with 8 tubes, one of the best automatic noise limiters yet designed, voltage regulated oscillator, accurate slide-rule, dial and mounting brackets ....Net **$89.95**

FOR MORE DETAILED INFORMATION ON THE MODELS SHOWN, AND THE NEW MODEL AC-109 AIRCRAFT RECEIVER, SEND FOR BULLETIN "S".

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 11
			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-H: Input: 25 28 vdc, 92 amp. Output: 115 v. 350 500 cy 1500 volt-amperes. New..................$44.50

PE-206: Input: 28 vdc, 38 amps. Output: 80 v 800-cy. 500 volt-amps. Dim: 13"x5⅓"x10⅓". New..............$22.50

LELAND No. 10536: IN: 28 VDC. 12A. OUT: 115V, 115VA. 400 CY 3 PHASE. EXC. COND..................$70.00

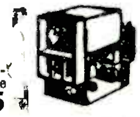
THERMISTORS

D167018	$1.50
D167332	1.50
D167613	1.50
D166228	1.50
D164699	2.50
D166792	2.15

VARISTORS

D171812	$1.50
D172155	1.50
D167176	1.50
D168687	1.50
D167208E, D171858	1.50
308A, 3A, 27-B	1.50
D168403	2.15

INTERPHONE AMPLIFIER



Easily converted to an ideal Inter-Communications set for office, home or factory. Original. New w/conversion diagram..... **$4.75**

*SELENIUM RECTIFIERS

F. W. BRIDGE

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
5A	10.00
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

NON-POLAR CAPACITORS

A.C. ELECTROLYTICS

CAP.	VAC.	PRICE
13-15	220-	$1.20
20-24	110-	1.00
26-30	220-	1.35
43-65	110-	1.25
43-48	110-	1.25
50-75	110-	1.25
53-60	220-	1.50
61-69	320-	1.60
64-72	110-	1.25
72-87	110-	1.25
75-84	110-	1.25
88-106	110-	1.50
107-129	110-	1.65
130-157	110-	1.75
130-150	70-	1.50
130-180	110-	1.85
158-191	110-	1.85
161-180	110-	1.75
189-210	110-	1.95
200-220	110-	1.95
270-300	110-	2.10
324-360	110-	2.40
378-420	175-	3.00
432-480	110-	2.75
485-540	110-	2.85

FILTER CHOKES

Stock	Description	Price
CH-366	20H/.3A	6.95
CH-322	.35H/350 MA—10 Ohms DCR	2.75
CH-141	Dual 7H/75 MA, 11H/60 MA 5KV DC Test	4.69
CH-119	8.5H/125 MA	2.79
CH-69-1	Dual; 120H/17 MA	2.35
CH-8-28	2 x .5H/380 MA/25 Ohms	1.79
CH-776	1.28H/130 MA/75 ohms	2.25
CH-344	1.5H/145MA/1200V Test	2.35
CH-43A	10HY/15MA—850 ohms DCR	1.75
CH-917	10H, 450MA, 10KV TEST	12.95
CH-366	20H/300MA	6.955
CH-999	15HY/15MA—400 ohms DCR	1.95
CH-511	6H/80MA—310 ohms DCR	2.45
CH3-501	2x5H/400MA	2.79
CH-188M	5HY 200MA	1.79
CH 303	300H/.02A, 2500V Test	1.69
CH 932	SWING 9-60H/.4-.05A, 10KV	7.95

This Month's Special

OSCILLOGRAPH RECORDING, PHOTO PAPER, 35 MM, 250 FT. Roll	$1.00
SA4A/APA-1 Motor Driven Coaxial Ant. Switch DPDT, Continuous Operation from 24VDC. Completely Enclosed	$24.50
MP-22 MAST BASE Mobile Antenna Mount.	4.95
SA1A/APN-1 Altitude Limit Switch for APN-1 Altimeter	7.95
ALTITUDE INDICATOR for APN-1	12.50
C-387-D Final P.A. Coil for BC610 2-3.5 MC, Variable Link	4.89
RA-74 Power Supply for Super Pro	69.50
J-17/ARC-5 Junction Box for ARC-5	7.95
J-22/ARC-5 Junction Box	3.49
SUPERSONIC CRYSTALS, Rochelle salt	$.50 ea.
MOTOR, 24 vdc, 3 HP 3800 rpm, New	$75.00
TV LEAD-IN WIRE, 300 ohms, HI-Q, Lo-Loss	$17.50/M FT Roll
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 Antenna	8.50
2 Meter Choke, 1000 MA, 20-144 ....8/	1.00
Supersonic Crystal Head, M-I, 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 ....per M	3.50
AN/ARC-4 VHF Trans-Rcvr	75.00
PE 36 Test Set, New	37.50
SCR 274 Test Set, 1-104	12.25
ART-13 Driver Trans. 6V6 to P-P 811's	1.29
Klixon Breaker: Thermal, 35A	.69
T-30 Carbon Mikes, New	.89
Tel. Tape, ⅝"x8½" Rolls ....23¢ ea. 5/	1.00
Tel. Tape, 4" Rolls ....12¢ ea. 10/	1.00
BC366 Interphone Jack Box	.79 ea.
AN/109-A Antenna	1.98 ea.
C-30/ARC-5 Control Box	2.35 ea.
EE-89A Telephone Repeater	12.50 ea.
EE-65A Telephone Test Set	50.00 ea.
ID24/ARN-9 Cross Point Indicator	6.95 ea.
TU-8 Tuning Unit 6.2-7.7mc	4.95 ea.
BC-496-A Dual Rcvr. Con't box, 3-6 & 6-9, 1mc	1.75 ea.
AN/104-A Antenna, 150mc	1.49 ea.
BC704 Indicator, 5" CR Tube, New	22.50 ea.
BC929 Indicator, 3BPI, all tubes, New	29.50 ea.
Noise Filters, 100 AMP, G.E.	1.39 ea.
MC211 Right Angle Drives	.19 ea.
IF Transformers, 112 KC Double Slug Tune.	.69 ea.
IF Transformers, 1600 KC Double Slug	.79 ea.

MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P.O. ALL MDSE. SUBJECT TO PRIOR SALE, AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE. PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK & RAILEX.

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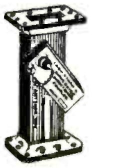
COMMUNICATIONS EQUIPMENT CO.

MICROWAVE COMPONENTS

S BAND—3" x 1 1/2" W.G. 10 CM.



DIRECTIONAL COUPLER, Broadband, 20 db. Coupling, Type "N" Takeoff. Complete with all Hardware. Navy # CABV-47AAN-2. As shown..$37.50
WAVEMETER, 2700-3400 MC. Reaction Type with counter Dial—Mfg., W.E. $92.50
REACTION WAVEMETER, Mfg. G.E. 3000-3700 MC. Mic. Head....$125.00
LHTR LIGHTHOUSE ASSEMBLY. Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG To Recvr. Uses 2C40, 2C43, 1B27. Tunable APX 2400-2700 MCS. Silver Plated $49.50
BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice, each $47.50
MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated....$45.00
RT-39/APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr.-TR cavity, compl. recvr. & 30 MC IF strip using 6AK5 (2040, 2C43 1B27 lineup) w/Tubes.
721A TR BOX complete with tube and tuning plungers $12.50
McNALLY KLYSTRON CAVITIES for 707B or 2K28 ....$4.00
F 29/SPR-2 FILTERS, type "N" input and output Hi-Pass Over 1000 MC....$12.50
WAVEGUIDE TO 7/8" RIGID COAX "DOORKNOB" ADAPTER CHOKE FLANGE, SILVER PLATED BROAD BAND $32.50
AS14A/AP-10 CM Pick up Dipole with "N" Cables $4.50
OAJ ECHO BOX, 10 CM TUNABLE....$22.50
HOMEDELL-TO-TYPE "N" Male Adapters, W.E. #D167284 ....$2.75
I. F. AMP STRIP: 30 MC. 120 d.b. gain, 2 MC Bandwidth, uses 6AC7's—with video detector. Less tubes $24.50
POLYROD ANTENNA, AS31/APN-7 in Lucite Ball. Type "N" feed $22.50
ANTENNA, AT49A/APR: Broadband Conical, 300-3300 MC Type "N" Feed $12.50
"E" or "H" PLANE BENDS, 90 Deg. less flanges $7.50

7/8" RIGID COAX—3/8" I. C.

RIGHT ANGLE BEND, with flexible coax output pick-up 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
7/8" RIGID COAX. BULKHEAD FEED-THRU..$14.00

X BAND—1" x 1/2" W.G. 3 CM.

1" x 1/2" 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
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, Mount. (Back to back) with crystal mount. tunable termination attenuating slugs.$18.50
Directional Coupler, UG-40/U Take off 20 db...$17.50
TR-ATR Duplexor section for above....$8.50
723AB Mixer—Beacon dual Osc. Mnt. w/xtal holder $12.00
Waveguide Section 12" long choke to cover 45 deg. twist & 2 1/2" radius, 90 deg. bend....$4.50
Twist 90 deg. 5" choke to cover w/pres nipple...$6.50
Waveguide Sections 2 1/2 ft. long silver plated with choke flange $5.75
Rotary joint choke to choke with deck mounting.$17.50
3 cm. mitered elbow "E" plane....$12.00
UG 39 Flanges ....$ .65
90 degree elbows, "E" or "H" plane 2 1/2" radius.$12.50
45 degree twist $8.00
APS-4 Under Belly Assembly, less tubes....$375.00

1 1/4" x 5/8" WAVEGUIDE

CG 98B/APQ 13 12" Flex. Sect. 1 1/4" x 5/8" OD..$10.00
X Band Wave GD. 1 1/4" x 5/8" 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

K BAND—1/2" x 1/4" W.G. 1.25 CM.

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

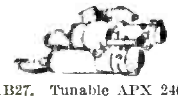
WANTED

RADAR SETS AND PARTS
.... ANY AND ALL TYPES.
Also SURPLUS ELECTRONIC PARTS
.... WHAT HAVE YOU TO SELL

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	734VCT/.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, 5V3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300VCT, 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	2.95
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	6.4/7.5A, 6.4V/3.8A, 6.4V/2.5A	4.79
	ALL CT	
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95
95-G-45	2000V/.002A, 465V/.6A, 44V/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



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

TS-13/AP TEST SET

SIGNAL GENERATOR (PULSE AND CW) COMPLETE WITH BUILT-IN WAVEMETER AND POWER MONITOR. FOR CHECKING RECEIVER SENSITIVITY AND BANDWIDTH. ALSO POWER OUTPUT FROM RADAR TRANSMITTER. FREQ. RANGE: 9305-9445 MC/SEC. OUTPUT: 0-50 MICROWATT. POWER REQUIREMENTS: 105-120 VAC. 60-800 CY, 150W. COMPLETE WITH ALL PROBES AND ACCESSORIES. WRITE FOR PRICE.

TS 34/AP SYNCHROSCOPE

PORTABLE UNIT FOR OBSERVING VIDEO PULSES AND TRIGGERS. MEASURES PULSES FROM 0.25 USEC. TO 30,000 USEC. FREQ. RESPONSE: 30 CPS-1,000,000 CPS. TRIGGER SWEEP: 5, 50, 250 USEC. SAWTOOTH: 10-50,000 CPS POWER INPUT: 105-125 VAC, 50-1200 CPS, 90W. INQUIRIES INVITED.

● Signal Gen.	RCA 710A, 370-560 MC	350.00
● Signal Gen.	20A Microvolter	175.00
● TS 10A	Altim ter Test Set	32.50
● TS 16/AP	Altimeter Test Set	
● TS 36	Power Meter, 3 CM	
● TS 47/APR	Test Osc. 50-3000 MC	325.00
● TS 56/AP	Slotted Line, 500 MC	325.00
● TS 127/UP	Wavemeter, 300-700 MC	72.50
● TS 69/AP	Wavemeter, 340-1000 MC	72.50
● TS-70/AP	Pwr. Meter, 200-800 MC	
● TS 110/AP	Echo Box, 2400-2700 MC	

1 PER CENT PRECISION W. W. RESISTORS

ALL VALUES IN OHMS

5	82	150	800	7,500	20,000
5.0511	120	250	920	10,000	30,000
10.1	125	430	1100	12,000	35,000
18	128	468	4300	17,000	84,000

30c EACH ....10 FOR $2.50
100K 120K 150K 220K
40c EACH ....10 FOR $3.50
1 MEGOHM ....EACH 75c

STEP-DOWN TRANSFORMERS

210-250V PRI—110/120V SEC

Watts	Price
300	7.49
500	10.95
1000	19.95
1500	24.95

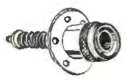
PULSE NETWORKS

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 (as shown) $6.50
G.E. #3E (3-84-810) (8-2.24-405) 50P4T; 3 KV "E" CKT Dual Unit; Unit 1, 3 sections. 0.84 Microsec. 810 PPS, 50 ohms imp; Unit 2, 8 sections, 2.24 microsec. 405 PPS, 50 ohms imp....$6.50
7.5E3-1-200-67P. 7.5 KV. "E" Circuit, 1 microsec 200 PPS. 67 ohms impedance 3 sections......$7.50
7.5E4-16-60, 67P. 7.5 KV. "E" Circuit, 4 sections 16 Microsec. 60 PPS. 67 ohms impedance........$15.00
7.5E3-3-200-6FT, 7.5 KV, "E" Circuit, 3 microsec. 200 PPS. 6 ohms imp. 3 sections....$12.50
#755: 10KV, 2.2usec., 375 PPS, 50 ohms imp..$27.50
#754: 10KV, 0.85usec., 750 PPS, 50 ohms imp..$27.50

PULSE TRANSFORMERS

U-10198 Pri: 4-5KV. 97A Pk Sec; 18KV, 26A. PRR-350-500 Cy. Duration 1.3 usec....$42.50
D-166173: Video, Ratio = 50:900 Ohms 10KC—2MC $12.50
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. 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 100 KW 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 ....$5.00
PHILCO 352-7250, 352-7251, 352-7287
UTAH 9332, 9278, 9341.
RAYTHEON: UX8693, UX5986 ....$5 ea.
W. E.: D-166310, D-16638, KS 9800, KS9948

PULSE EQUIPMENT



H/I-Volt Pulse Bulkhead. Feed thru. Fits UG-36 Connector—as shown $15.00
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 KV (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

DELAY LINES

D-168184: 5 microsec. up to 2000 PPS 1800 ohm term. $4.00
D-170499: 25/.50/.75 microsec. 8 KV 50 ohms imp. $16.50
D-65997: 1 1/4 microsec. $7.50
RCA 255686-502, 2.2u sec. 1400 ohms....$2.00

MAGNETRONS

Tube	Tube	Tube
2J27	2J49	720BY
2J31	2J61	725-A
2J21	700	730-A
2J22	706	QK 62
2J26	2J62	QK 61
2J32	3J31	QK 60
2J37	5J30	2J56
2J38	718DY	2J32
2J39		

MICROWAVE ANTENNA EQUIPMENT

AS-31/APN-7: 10 cm Polyrod in Lucite Ball. Type N Fitting Coax Feed....$22.50
Relay System Parabolic reflectors approx. range 2000 to 6000 Mc. Dimensions 4 1/2" x 3'. New....$100.00
Dipole for above $12.00
TDY "JAM" Radar rotating antenna, 10 cm. 30 deg. beam, 115 V AC drive. New....$150.00
Cone Antenna. AS 125 APR. 1000-3200 mc. Stub supported with type "N" connector....$14.50
AT49A/APR—Broadband Conical, 300-3300 MC. Type N Feed $12.50

10 CM GUN-SIGHT ANTENNA

SPHERICAL RADOME HOUSES DRIVE MOTOR, DISH, FEED AND GUNMOUNT. TOTAL DIAMETER: APPROX. 15 INCHES. DISH: 13" DIAM. FEED: DIPOLE AND DISK VERTEX. SCAN: CONICAL AT 2400 RPM. BEAMWIDTH: 25°-30°. ENTIRE UNIT MAY BE PRESSURIZED UP TO 15 LBS/IN., AND ENERGY MAY BE FED BY ANY FLEXIBLE COAX CABLE. COMPLETE UNIT WITH DRIVE-MOTOR AND RADOME $325.00

MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P.O. ALL MDSE. SUBJECT TO PRIOR SALE, AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE. PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK OR RAILEX.

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RAYTHEON
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25¢ Each 100 Lots — 35¢ each 3 for $1.00

BUTTERFLY CONDENSERS

FIG. 1

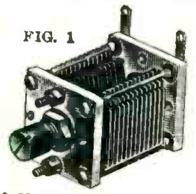
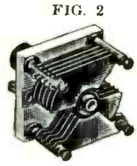


FIG. 2



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¢**

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.

SMALL MOTORS

OSTER B9-2. 5600 RPM. 12 VDC @ 1.2 Amps. .... $7.00 Ea.
OSTER C-2H-1A 7000 RPM. 27.5 VDC 1/100 HP. .... $7.50 Ea.
KOLLSMAN Type 775-01 Mo-26. $2.50 Ea.
WESTINGHOUSE 115 volt 400 C. Blower. Type Fl. 6700 RPM .... $6.95 Ea.

OIL FILLED CONDENSERS

Stock No.	Capacity MFD.	D. C. WKG. Voltage	Dimensions	Price Each
6057A	2	600	1" x 1-3/4" x 2-3/4"	$0.59
5994A	4	600	1-1/4" x 2-1/2" x 3-1/4"	1.75
5865A	4	1000	1-1/4" x 2-1/2" x 4-3/4"	1.95
6102A	8	1000	1-1/4" x 3-3/4" x 4-3/4"	2.50
6101A	4	1500	1-1/4" x 3-3/4" x 4-1/2"	2.75
6103A	0.5	5000	2-1/4" x 4" x 4-1/8"	2.95
6104A	1	5000	3-5/8" x 4-1/2" x 4-1/8"	4.25
5399A	0.045	16000	1-3/4" x 3-1/2" x 4-3/4"	4.95
6052A	2 X .15	8000	1-3/4" x 3-1/2" x 4-3/4"	4.95

All have ceramic insulated terminals except No. 5865A which has bakelite insulated terminals. All are NEW, standard name brands.

SIGNAL CORPS TRANSFORMERS— CHOKES & FILTERS

2C6191/K1	2Z9619-00	2Z9638.44	3C317-43
2C6191/T3	2Z9621.43	2Z9643.42	3C317-44
2C6191A/3	9Z9621-112	2Z9647.11	3C323-6C
2C619F/T2	2Z9625-1	2Z9655	3C323-14A
2C6230/123	2Z9625-8	2Z9662	3C323-54B
2C6230.3/124	2Z9626	2Z9702-2	3C323-122B
2C6307/AK1	2Z9627-35	2Z9760	3C323-145B
2C6386A/T14	2Z9628-2	2Z9805	3C324-4
2C6494A/C11	2Z9631.7	2Z9808	3C324-40
2C6530-653A/C10	2Z9631.187	2Z9828	3C343-2
2C6530-653A/T5	2Z9632.8	2Z9851	3C344
2Z3625-66	2Z9632.14	2Z9853	3C344-9
2Z5731-337	2Z9632.39	2Z9854	3C362-8
2Z9600.3	2Z9632.170	2Z9855	3C375-15
2Z9604.16	2Z9632.171	2Z9876-2	3C549
2Z9608.36	2Z9632.248	2Z9878-11	3C573
2Z9611.115	2Z9632.362	2Z9878-13	3C575G-1
2Z9611-289	2Z9632.365	2Z9879	3C362-23
2Z9612.52	2Z9632.366	2Z9879-2	3C362-24
2Z9613.14	2Z9634.4	2Z9879-3	3C1987.20
2Z9613.304	2Z9634.35	2Z9900-5	3C1987-29
2Z9614-94	2Z9634.39	2Z9944	3C4075
2Z9617-22	2Z9634.46	2Z9984	3F4061B/C1
2Z9618-9	2Z9634.49	3C106B	6C8/F1
2Z9618-42	2Z9636.16	3C307-1	
2Z9619.42	2Z9638.14	3C307-46	
2Z9619.63	2Z9638.16	3C317-33	

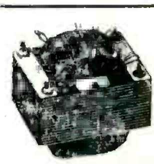
MORE INFORMATION AND PRICES UPON REQUEST

6.3 VOLT FILAMENT TRANSFORMERS

Primary 115 Volt 60 Cycle 1600 Insulation Three 6.4 Volt Secondaries

6.3 Volts @ 4.9 Amps.
6.3 Volts @ 4.5 Amps.
6.3 Volts @ 1.1 Amps.

Horizontal Half Shell Mounting. 2¼" x 2 13/16" Mounting Centers. 2 13/16" x 3⅜" Core Size. 2½" above Chassis. Solder Lug Terminals—All Terminals Marked.



Stock No. 5254A — Price EACH **$2.65**

MICROPHONE CONNECTORS

Single Contact Female Cable Connector. Same as Amphenol 75-MC1F. ....
$15.00 per 100
Stock No. 6131 — Price Each **18¢**

Single Contact Male Cable Connector. Same as Amphenol 75-MC1M. ....
$12.50 per 100
Stock No. 6132 — Price Each **15¢**

H & H ROTARY SWITCH

S.P.S.T. Rotary Switch. Screw Terminals. ¼" Shaft x ½" Long. 3 Amp. @ 250 Volts. Hardware included.
$15.00 per 100
Stock No. 6105 — Price Each **18¢**

MISCELLANEOUS ITEMS

HEAVY DUTY 10 ft. SJ-7/16 Dia. BUNA CORD, 2 ins. #14 strd Conductors w/heavy duty plug .... $.60 each
J-5 Flameproof keys .... $.95
J-38 Keys .... $.95
Fenwal #S1080 Therman Switches .. $3.95
Guardian BK-17A Relay $2.95
MS-52-53 Mast Sections .... $.95
TS-13 Handset $7.95
TS-9 Handset $7.95
T-46 Chestset $1.95

2 VOLT BATTERY

Signal Corps Type BB-54A 2 Volt 27 Ampere Hour Storage Battery. Non-Spillable Transparent Acid Proof Plastic Case has Built-in Ball Type Hydrometer. 3" x 4" x 5" High. Shipped Dry with Acid in Separate Container. Made by Willard.
Carton of 12 @ $1.60 Each
Stock No. 5458A — Price Each **$1.95**

10 MFD.—600 VDC

Sprague No. R2-157. 10 Mfd. 220 VAC 600 VDC Capacitor with Universal Mounting Ring. 2-7/16" Diameter, 3¾" high. Bakelite insulated terminals.
Stock No. 5958A — Price Each **95¢**

TRANSMITTING MICAS

Stock No.	Cap.	Test Volts	Type No.	Price Each
5493A*	.01	1000	1445	.35¢
5494A	.02	1000	144T	.40¢
5495A	.006	1200	A2	.40¢
5496A	.0001	1500	BE 15	.20¢
5493A	.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	F21	1.00
5606A	.000025	10,000	PL-34L	1.95
5607A**	.00015	10,000	PL-315	7.95

*Supplied with Meter Bracket
**D.C. Working Voltage
OTHER TYPES AND SIZES AVAILABLE

TERMS:

Open Account to rated or Acceptable reference accounts. Others Pre-payment of 25% deposit with order, balance C.O.D. Price F.O.B. Chicago and subject to change without notice. Merchandise subject to prior sale.

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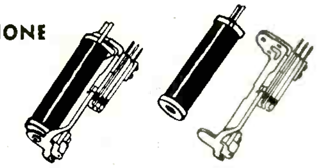
SEE OUR PREVIOUS ELECTRONICS ADS FOR LISTINGS OR WRITE FOR CIRCULARS

SHORT TELEPHONE RELAYS

A11996 CLARE (H77519-1) 24VDC, 3PST n.o. (3As), 2000 ohm, #R94	$ 1.75
6385 ARC 12VDC, SPST n.o. (1A), 10A contact, 200 ohm, Part of ARC5 or SCR 274N, #R13	1.50
C58180 BENDIX, 12VDC, DPDT & SPST n.c. (2C, 1B) 150 ohm, Part of SCR522, #R58	2.00
A22268 CLARE, 12VDC, SPST n.o. (1A), 200 ohm, #R411	1.50
5586 W.E., 12-24VDC, SPST n.o. (1A), 425 ohm, #R414	1.25
D170788 W.E., 4850 ohm, 8maDC, SPDT, #R92	2.50
CLARE 24V DC, SPDT(1C), 500 ohm #R278	2.75
CLARE K102, 6ma DC, 3500 ohm #R30	3.49
CLARE 110V, 50-60 cyc, 3PST n.c. (3Bs) Quick acting, Octal Plug Base, #R279	3.25
AUTOMATIC, 1.5V DC, DPST n.c. (2Bs), 5 ohm, #R280	3.00

TELEPHONE TYPE RELAYS



These relays have been standardized so that coils and frames of most manufacturers can be interchanged without affecting adjustments. A wide variety of applicable combinations are thus possible from a comparatively small number of relays.

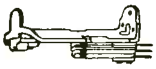
Listed below are frames and coils from our stock. They may be purchased separately. However, a complete relay consists of coil and frame.

Representative completed relays are also listed with voltage and current ratings. Values are indicative of sensitivity that may be expected from similar combinations.

107 COOK, 3-6VDC, 6 make, 1 break (5As, 1C), 12 ohm. Part of BC654, #R407	$ 3.95
CLARE, 6500 ohm, 8maDC, 3 makes (3As), R276	4.25
5035A7 AUTOMATIC, 1300 ohm, 8maDC, SPST n.o., (1A), #R103	1.75
A18258 BENDIX (Cook 102) 8-12 VDC, Copper Slug, Slow Release, SPDT, 200 ohm, Part of SCR 522, #R365	2.49
R5229A1 AUTOMATIC 6VDC, 3PST n.o. (3As), 75 ohms, Slow Release, #R412	2.50
R5021A1 AUTOMATIC 1300 ohm, 20maDC, SPST n.c. (1B), #R413	2.95

FRAMES

(For Cost of Relay Add Price of Frame to Price of Coil)



Stock No.	Contacts	Price each	Stock No.	Contacts	Price each
F101	1A	1.25	F106	1B, 1A	1.50
F102	2A	1.50	F111	1B, 2A	1.75
F103	3A	1.75	F114	1B, 3A	2.00
F104	4A	2.00	F108	1B, 1A, 1C	2.00
F105	5A	2.25	F119	1B, 7A	3.00
F106	1A, 1B	1.50	F107	2B, 1A	1.75
F107	1A, 2B	1.75	F112	2B, 2A, 2C	3.00
F108	1A, 1B, 1C	2.00	F118	2B, 5A, 1C	3.25
F109	1A, 1C	1.75	F113	5B, 2A	2.75
F110	1A, 2C	2.25	F121	5B, 1C	2.75
F111	2A, 1B	1.75	F122	1C	1.50
F112	2A, 2B, 2C	3.00	F123	2C	2.00
F113	2A, 5B	2.75	F124	4C	3.00
F114	3A, 1B	2.00	F109	1C, 1A	1.75
F115	3A, 2C	2.75	F116	1C, 4A	2.50
F116	4A, 1C	2.50	F117	1C, 5A	2.75
F117	5A, 1C	2.75	F121	1C, 5B	2.75
F118	5A, 2B, 1C	3.25	F110	2C, 1A	2.25
F119	7A, 1B	3.00	F115	2C, 3A	2.75
F120	1B	1.25	F108	1C, 1A, 1B	2.00
			F118	1C, 5A, 2B	3.25
			F112	2C, 2A, 2B	3.00

FRAMES WITH MICROSWITCH

F125	1A, 1C (Microsw.)	1.75
F126	1A, 1A (Microsw.)	1.75

COILS

(For Cost of Relay Add Price of Coil to Price of Frame)

Stock No.	Ohms	Price each	Stock No.	Ohms	Price each
K101	0.75	1.25	K106	1100/500 Dual	2.00
K102	12	1.25	K111	1300	1.75
K103	250	1.25	K112	2000	2.25
K104	450	1.50	K113	3000	2.50
K105	500	1.50	K114	3600	2.50
K106	500/1100 Dual	2.00	K115	4600	2.75
K107	750	1.50	K116	6500	2.75
K108	900	1.75	K117	10,000	3.00
K109	1000	1.75	K118	40,000	3.25
K110	1100	1.75			

A-C COILS

Stock No.	Voltage	Price each
K119	6V AC	1.75
K120	24V AC	1.75
K121	110V AC	2.50

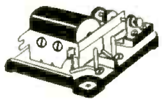
SLOW ACTION COILS

Stock No.	Ohms	Slow Action	Price each
K122	33	Make	1.50
K123	75	Release	1.50
K124	200	Release	1.50
K125	300	Make	1.75
K126	2000	Make	2.00
K127	2500	Release	2.00

No. 0150734
S.C. stock No. 2C6996-1053A/C2
Western Electric
PHASE SHIFT CAPACITOR

As Used in BC1053A, SCR545 and other Radar Equipment. New, in original boxes. 10 for 150.00, 100 for 1250.00.
17.50 each

ULTRA SENSITIVE RELAY



Nominal Operating Characteristics, 11,000 ohms, 0.4 Ma, 4V DC SPDT Kurman BK35 Adjustable Contacts & Armature, #R277. 10 for 55.00, 100 for 475.00.
5.95 each

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
HAYDON 1600A; 1 RPM	2.25
HAYDON: 1 RPM, 24V AC	1.95

SHOCKMOUNTS

Large Quantities of Lord, Barry, U. S. Rubber and Other Makes of Shockmounts in Stock. Most Sizes Available. Prices Below Manufacturer's Cost. Send Us Your Requirements.

APC TRIMMERS

We Have Production Quantities of 13, 15, 25, 35, 50, 75, 100 and 140 Mmf Air Trimmers Available at Low Prices.

MU-METAL LAMINATIONS

Es, Fs, Is, Ls. Ten Sizes. Quantities Available.
Sample Kit, 6 lbs, Sufficient Quantity of Each Size for One Unit—Postpaid in U. S. A.
$19.75

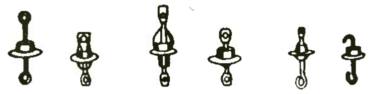
H-F TIE POST

Low-Loss Melamine Insulation, pictured actual size (4-40 Thread) ..$7.50/C
$67.50/M

SEALED RELAYS

Clare 5001; 24vdc; DPDT; 300 ohm; Octal Plug Base; #R678	$5.95
Struthers-Dunn 181CXC100: 12 vdc; 3As, 3Bs; #R679	$5.95
Sigma 73351; 16vdc; SPDT; 2000 ohm; 8 ma; #R682	$6.95
Allied SKHX, 24VDC; 3A, 3B; 425 ohm; #R913	$5.95
SIGMA Type 4AH; 2000 ohm; SPDT, 4 ma, pull in, 2.5 ma, hold, 5 prong plug-in	$3.95
SIGMA 71257; 6 voc, SPDT, 500 ohms	$4.95
SIGMA 949; 115V AC, SPST N.C.	$4.95

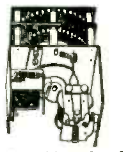
KOVAR GLASS TO METAL SEALS HIGH-VOLTAGE FEED THRU



Many types and sizes. Send us your blueprint or sample for our quote. Our prices are a fraction of original factory costs.

SAMPLE KIT 96 Seals (8 ea. 12 types)	5.00	postpaid in USA
LAB KIT 300 Seals (20 types)	15.00	postpaid in USA

STEPPING RELAYS GUARDIAN SERIES R



Three basic types for 24V AC operation:

1. Continuous rotation: In this type the contact finger advances one step each time the circuit is made and broken.
2. Electrical reset. Resets when a second coil is energized.
3. Add and subtract. Steps back one or more contacts at a time instead of resetting completely.

10 Pulses per second. Contacts are rated at 1 ampere at 110 volts, 60 cycles, non-inductive AC. The electrical reset type has up to 36 active contacts while the continuous rotation types each have 40 contacts. SEND US YOUR REQUIREMENTS.

* A=Normally Open; B=Normally Closed; C=Double Throw.

WE ALSO HAVE PRODUCTION QUANTITIES IN STOCK OF

APC Air Trimmers	Coils	Knobs	Spaghetti
Binding Posts	Controls	Sine-Cosine Potentiometers	Micro Switches
Cable	Crystals	Pulse Transformers	Toggle Switches
Capacitors	Filters	Relays	Transformers
Ceramicons	Fuses	Resistors	Tubes
Ceramics	Kovar Glass Seals	Servo Transformers	And Other Radio & Electronics Parts
Adel & Tinnerman Clamps	Rubber Grommets	Shockmounts	
Chokes	Hardware	Sockets	
	Iron Core Slugs		

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.)

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Universal general corp.

WE SPECIALIZE IN RELAYS

TREMENDOUS QUANTITIES IN STOCK!

CONDENSERS

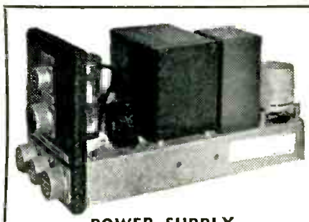
MICRO & TOG. SWS. – RELAYS – "J" POTS

GUARANTEED—OIL CONDENSER SPECIALS—GUARANTEED

1 mfd.—1500 .... $1.05
GE #26F537-G2
3.75 mfd.—1000 V ... $1.25
C-D KGB 6037-1
6 mfd.—330 VAC $1.15
Dims. 4⅛"x3¾"x1¼"
2 mfd.—600 V .... $.69
C-D 2¾"x1¾"x1"
.5 mfd.—400 V .... $.21
CP63 B1AE504 KK
Avox 416 MCT. Disc.
100 10%, 500 25%

10 mfd.—600 V ...... $.98
Three term, bal. mtg. channel type. Dims. 3¾" x 3½" x 2". Two 5 mfd. sections rated 400 V at 72 deg. "C". 1800 V test. Meets commercial specs. for 600 V. operation up to 40 degs. "C". Ideal for filter or power factor application. Repeat sales prove this rugged high quality condenser to be of outstanding value. Carton of 24, weight 42 lbs. Large qua. available... **$.89**

4 mfd.—600 V $1.15
Tobe TRS-604
5 mfd.—300 VAC $1.05
3⅞"x2½"x1-3/16"
8 mfd.—600 V $1.69
4½" H. x 2" Dia. Bkt.
1—1 mfd.—600 V .... $.85
3 ST. Bathtub. Lots of 100 10% Disc. Same Type but with 2 Terms. Case common. $.70
Lots of 100 10% Disc.



POWER SUPPLY
#CJP-20ABX for ASB 7/7A/7B equip. 800 cy. 115V. imp. 2.5/56.5/880/2000V. out. Contains 6AC7, 5T4 & 2X2, plus oil conds; chokes, resistors, connectors & Switches. Brand new and individually boxed. Measures 7"H x 5¾"W x 13"-L. Cover not shown.......$6.75
Lots of 10, 10% disc.; 25, 15%; 50 & over, 25%.

— TRANSTAT —

115V. 1 phase, 100 amps., Kva. 11.5, Range 0-115 V. Amertran #29145. Specially priced.

JAN APPROVED

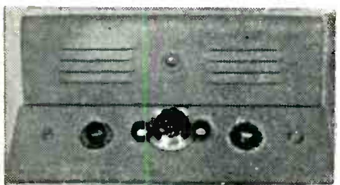
10mfd—1000V 4.55 8mfd—600V 2.25
8mfd—1500V 4.25 6mfd—600V 1.55
8mfd—1000V 3.25 4mfd—600V 1.75

Mfd	Volts	Price	Mfd	Volts	Price
.005-			2	1500V	1.65
.005-.01	10KV	3.75	2	2000V	2.80
.01	10KV	4.25	2	2500V	3.39
.012	25KV	19.50	2	3000V	4.69
.02	20KV	15.90	2	4000V	5.69
.03	16KV	Quote	2	5000V	10.95
.075-			2	12,500V	Quote
.075	7.5KV	3.95	2-2	600V	1.25
.08	12.5KV	15.95	3	600V	.59
.1	1500V	.59	3	4000V	7.95
.1	2000V	.49	3	13.5KV	Quote
.1	2500V	1.29	3-3	150V	.35
.1	3000V	1.75	3-3-3	400V	.75
.1	7500V	1.75	3.75	1000V	1.59
.1	7500V	4.24	4	400V	.85
.1-.1	7500V	6.25	4	600V	1.25
.1	10KV	8.95	4	1000V	1.95
.1	15KV	15.95	4	1500V	2.79
.1-	20KV	19.50	4	2000V	4.25
.15-.1	8000V	1.95	4	3000V	7.95
.2	10KV	10.95	4-4-4	600V	2.40
.25	2000V	1.25	5	330VAC	1.75
.25	3000V	2.15	5	600	1.35
.25	6000V	1.75	5	600V	2.49
.25	18KV	15.95	5	1500V	2.89
.25	20KV	19.95	5-1	400V	.89
.4	10KV	12.95	6	600V	1.45
.5	1500V	1.02	6	330VAC	2.49
.5	2000V	1.39	6	1000V	2.49
.5	3000V	2.69	6	1500V	3.25
.5	25KV	Quote	6	2000V	3.95
.5-.1	2000V	.89	7	600V	1.45
.5-.5	600V	.69	7	800V	1.90
1	400V	.45	7	1000V	2.49
1	500V	.59	8	500V	1.35
1	1000V	.69	8	600V	1.75-2.15
1	1500V	1.35	8	660VAC	4.25
1	2000V	1.95	8	1000V	3.20
1	2500V	2.25	8	1500V	4.25
1	3000V	3.50	8	2000V	4.95
1	6KV	7.50	8-8	600V	1.75
1	5000V	4.99	10	600V	2.50
1	10KV	Quote	10	1000V	4.55
1	15KV	Quote	10	6000V	Quote
1	16KV	Quote	12	600V	2.40
1	25KV	Quote	12	1000V	4.95
1 1	7500V	Quote	14	1000V	5.25
2	600V	.59-.79	15	1000V	5.25
2 TLAD	600V	.80	17	25V	.69
2	100V	.85	17		
2 TLA	1000V	1.29	24	1500V	3.50

COAX. CONNECTORS

83-1R........... $.45 83-1SPN...... $.39
83-1AP........... .25 PL-177........ .50

ELECTRONIC 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....................$59.50
2 10% Disc.

TRANS. MICA CONDS.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.000024	2500	.19	.0024	5000	2.35
.00003	2000	.75	.0025	1200	.42
.000047	2500	.21	.003	6000	5.95
.00005	2500	.29	.0035	2500	.55
.00008	1200	.21	.004	2500	.65
.00009	3000	.75	.0043	2500	.79
.0001	600	.22	.0045	600	.24
.0001	1200	.32	.005	1200	.43
.0001	3000	.85	.006	600	.29
.0001	5000	1.95	.006	1200	.45
.00015	5000	1.95	.01	600	.40
.0002	15KV	Quote	.01	1200	.69
.00025	1200	.35	.01	15KV	Quoted
.00025	5000	2.05			
.00027	2500	.35	.015	2500	.95
.001	600	.23	.0125	6000	Quote
.001	1200	.32	.02	600	.27
.001	2500	.48			
.001	4500	1.45	.02	600	.39
.001	8000	3.95	.02	1200	.85
.0015	5000	2.25	.02	2000	1.25
.002	1200	.40	.03	600	.49
.002	2500	.50	.033	600	.59

MICA CONDENSERS

5, 6, 8, 10, 15, 25, 30, 34, 39, 50, 70, 75, 100, 140, 150, 185, 200, 230, 240, 250, 300, 350, 390, 400, 470, 500, 510, 600, 650, 700, 750, 1000, 1200, 1250, 1400, 1500, 2000, 2200, 2400, 3000, 3300, 3700, 3900, 4000, 4700, 5000, 5100, 6000, 6200, 6500, 7900, 7950, 7960, 8000, 9100 & 10,000 MMfd.

PRICE SCHEDULE

5 to 750 mmfd....................4¢
1000 to 1500 mmfd....................6¢
2000 to 5100 mmfd....................10¢
9100 to 10000 mmfd....................26¢

Special Mica Kit 100 @ $3.50

SILVER MICA CONDENSERS

7, 24, 25, 33, 50, 60, 75, 95, 100, 120, 150, 170, 200, 270, 300, 330, 390, 400, 450, 500, 750, 800, 1000, 1400, 1450, 1700, & 2500 mmfd.

7 to 95 mmfd....................8¢
1000 to 1700 mmfd....................14¢
100 to 800 mmfd....................9¢
2500mmfd....................16¢

Special S.Mica Kit—100 @ $6.50

CHOKES

5 Hen 2 amps	14 Hen .13 amps
2.6 Hen .80 amps	15 Hen .50 amps
7 Hen .57 amps	Thord'n T60650
8 Hen .52 amps	Thord'n T19C45
12 Hen .10 amps	Specially Priced

CERAMICON CONDS.

10, 56 & 100 mmfd @....................05
1000 to 5000 mmfd @....................06
01 400 V

AIRCRAFT TOG. SWS.

Aircraft type-20A @ 24VDC-10A @ 125VAC-C-H

CH#	Govt. Spec.	Circuit
8201K4	B-5A	SPST On-Off
8211K5	B-6B	SPST Off-Mom. On
8208K4	B-7A	SPST On-Off-Mom. On
8210K5	B-1B	SPST On-On
8200K8	AN3022-1B	SPDT On-Off-On

Plush Mounted-Luminous Tip—Bat. Handle—Price—$.22 ea.; $20/100; $170/1000.
To get 1000 qus. disc. you may combine types.

OTHER AIRCRAFT TYPES

CHn	Circuit	Cur. @ 125VAC	Price
8871K-1	SPST	15A Push but.—Type A2—On-Mom. Off	$.59 P.T.
8905K-514	SP-4Pos.	35A @ 24VDC On-Off-Mom. On-Mom. On	.79 L.T.
8905K-526	SPST	5A B-5A-1¼" Bat.	.32 L.T.
8905K-722	3PST	10A Off-Mom. On	.79 L.T.
8911K-524	DPST	15A Push But.-Off-Mom. On	.59 P.T.
8202K-7	SPST	10A 2 Gang B-5A	.32 L.T.

10% Dis. in quas. of 100 or more per Type.

TOGGLE SWITCHES

CH#	Circuit	Price	AH & H	Circuit	Price
8800K4	SPDT	$.60	6A, 125V	DPST	$.42
8824K4	DPDT	.75	6A, 125V	DPDT	.50

RELAYS & CONTACTORS

Type	Volt	Ohms	Current	Action	Price
1027	12 Leach	67	8	DPDT	1.25
1077-BFW	24 Leach	160	¼ Cont.	DPDT	1.50
1220-DE	24 Leach	95	20	SPST-Double Break	1.25
1222-BF	24 Leach	160	10	SPST-Double Break	1.25
1227-B2A	24 Leach	140	25	SPST	1.25
1254M	24 Leach	160	10	2-SPST N.O.	1.25
7055	12 Leach	100	50	SPST N.O.	3.50
2791-B100-C3	24 GE	150		DPDT	.95
2791-B100-G3	24 GE			3PST N.O.	.95
9350-B7A	24 Sq. D	132	250	SPST N.O.	4.75
6041-H81A	24 CH	65	100	SPST N.O.	2.95
6046-H1A-C1	24 CH	70	50	DPDT	9.95
6046-H1B-C1	24 CH	70	50	DPDT	9.95
6046-H2B-C2	24 CH	49	100	DPDT	11.95
B-9 Time Delay Guard		500		SPDT	.95
106-612	115 WL		6	DPST	1.50
9340-975 Latching Relay	24 Sq. D	500		4 Pole	8.95

TYPE "AB" POTS $.95

OHMS	Shaft	OHMS	Shaft
50	1/8 S	20000	1 1/4 & 1/8 LS
60	1/8 LS	25000	3/8 & 1/8 S
150	1/4 S	3000	1/8 S
300	3/8 S	40000	1/8 LS
500	3/8 & 1/8 S	50000	1/4 & 1/8 S
1000	1/8 S	50000	1/8 LS
1500	1/4 S	100000	1/2"
2000	1/8 LS & 3/8 S	150000	2 1/8
2500	1/8 S	200000	1/8 LS
3000	1/8 LS	250000	1/8 LS, 9/16 & 1/8 S
6000	1/4	300000	1/8 S (2 terms.)
5000	1/8 LS & 3/8	5 Meg.	1/8 LS
10000	3/8 & 1 1/7	1 Meg.	1/8 S & 1/8 LS
10000	5/16		
15000	1/8 S		

DUAL "AB" POTS $2.00

OHMS	SHAFT	OHMS	SHAFT
1500	5/16"	20K	7/16"
1-5 meg	1/2"	1 meg	1/2"
		2 meg	1/8 S

WANTED
Condensers of all types in any quantity. Also other standard components. Top prices.

CHANNEL CONDS.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.025	600	$.19	.4	600	.30
.05	1000*	.22	.5	400*	.21
2x.05	600	.30			
.1	500	.28	.5	500*	.33
.1	600	.32	.5	600	.49
.1	2500	1.25	2x.5	600	.59
2x.1	400	.34	.5-.1	600	.39
2x.1	600	.40	1	400	.50
3x.1	400	.40	1	500	.58
3x.1	1000	.52		500*	.58
.25	400V	.34	1	600	.63
.25	600V	.39	1		
2x.25	600	.48			

* Top Terms.

KITS

Bathtub cond. .... 15 @ $1.00
Potentiometer .... 15 @ 1.00
S. Mica cond. ....100 @ 6.50
Mica cond. ....100 @ 3.50
Rotary Sws. .... 10 @ 1.00
Filter, 2 4-600V conds.
2 SH. 165 Ma. Chokes ......@ 3.30

25 W. POWER RHEOS.

Ohms	Shaft	Price	Ohms	Shaft	Price
1.3-1.3	1/8S	$.98	200	1/2	.69
15	1/2	.69	225	1/8LS	.69
20	1/2	.69	225	1/4S	.69
25	1/2	.69	300	1/2	.69
37.5	1/2	.69	350	1/2	.69
50	1/8S	.69	375	1/2	.69
50-50	1/2	1.25	500	1/4S	.69
75	1	.69	2500	1/2	1.20
100	1/2	.69	5000	1/2 & 1/8S	1.20
125	1/2	.69			
150	1/2	.69			
175	1/2	.89			
185	1/2	.69			

100 ohm Lots of 100 .... $.54

METAL TUBULAR OIL CONDS.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.0025	400	$.10	.05	600V	.16
.005	600	.14	.05	1000V	.19
.01	300	.09	.1	400V	.17
.01	600	.15	.1	600V	.20
.01	2000	.19	.25	600V	.18
.02	400	.14	.5	600V	.19
.03	400V	.15			
.05	200V	.07			

Quas. of 100, 10% disc.

BATHTUB CONDS.

Mfd	Volts	Price	Mfd	Volts	Price
.01-.01	600	$.25	.25-.25	600	.49
.02-.02	600	.25	.25	1000	.48
.04-.04	600	.25	.3	400	.15
.05	600	.20	.5	400	.37
.05-.05	600	.25	.5	600	.47
.08-.08	600	.25	.5	1000	.52
.1	600	.39	2x.5	600	.59
.1	1000	.42	1	200	.25
.1	1200	.45	1	300	.30
.1-.1	400	.29	1	400	.45
.1-.1	600	.39	1	600	.59
.1-.1	1000	.51	1-1	600	.85
3x.1	600	.40	2	400	.60
.2	1000	.21	2	600	.91
			4	100	.40
.25	800	.19			
.25	400	.30			
.25	600	.41			

Sp. Bathtub Ki
15 @ 1.00

Write: **ART HANKINS,** *Owner*

MONMOUTH RADIO LABORATORIES

Box 159 Long Branch 6-5192 OAKHURST, N. J.

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Attn: Industrial Purchasing Agents . . .

Our new Radio Master Catalogue is available to you at no charge upon receipt of your request on your letterhead. We are National Distributors of General Electric, Sylvania, Ohmite, Amphenol, Sprague, Aerovox, Sangamo, Stancor, Merit A. H. & H., Simpson and many others. All telegrams, cablegrams, and inquiries acknoweldged and promptly answered.

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Portable Instruments

Molded Bakelite case 7" x 4½" x 3"

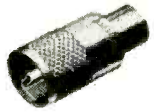
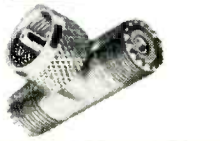
D.C. MICROAMMETERS
5..10..50 microamperes
THERMOCOUPLE MILLIAMMETERS
1, 5..5..10 milliamperes
THERMOCOUPLE VOLTMETERS
5 to 500 volts

Available in multiple range combinations

Precision Electrical Instrument Co.
146 Grand Street New York 13, N. Y.

YOUR MOST COMPLETE SOURCE OF UHF • UG • AN CONNECTORS

NO.	JAN NO.	DESCRIPTION	1–99	100 TO 999	1000 AND OVER
83-IR	SO 239	RECEPTACLE	$ .50	$ .45	$ .40
83-ISP	PL 259	PLUG	.55	.55	.50
83-168	UG 176/U	ADAPTER	.15	.12	.11
83-185	UG 175/U	ADAPTER	.15	.12	.11
83-ISPN	PL 259A	PLUG	.65	.60	.55
83-776	UG 203/U	PLUG	.65	.60	.55
83-IRTY	....	RECEPTACLE	.75	.65	.65
83-IH	UG 106/U	HOOD	.15	.14	.13
83-IHP	... .	HOOD	.27	.24	.22
83-765	UG 177/U	HOOD	.24	.24	.24
83-IAC	. ....	CAP & CHAIN	.55	.50	.45
83-IBC	....	CAP & CHAIN	.35	.31	.30
83-IT	M 358	T CONNECTOR	1.50	1.40	1.40
83-IAP	M 359	ADAPTER	.35	.30	.28
83-IAP	M 359A	ADAPTER	.80	.75	.70
83-IJ	PL 258	JUNCTION	.75	.70	.65
83-IF	PL 274	FEED THRU	1.25	1.20	1.10
83-22SP	UG 102/U	TWIN PLUG	.90	.80	.75
83-22R	UG 103/U	RECEPTACLE	.90	.80	.75
83-22AP	UG 104/U	ADAPTER	1.40	1.25	1.10
83-22J	UG 105/U	JUNCTION	1.50	1.40	1.40
83-22T	UG 196/U	T CONNECTOR	1.65	1.50	1.50
83-22F	PL 275	FEED THRU	2.00	1.80	1.75
83-2SP	PL 295	PLUG	2.25	2.15	2.00
83-2R	SO 265	RECEPTACLE	1.65	1.55	1.50

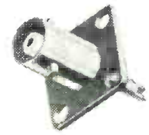
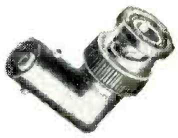

From stock

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
UG 9/U	$ 1.95	UG 57/U	$ 2.30	CW 155/U	$ .63	UG 254 A/U	$ 3.50	UG 496/U	$ 3.50
UG 10/U	2.75	UG 57 B/U	1.85	UG 155/U	9.50	UG 255/U	2.85	UG 499/U	1.50
UG 11/U	2.25	UG 58/U	.80	UG 156/U	8.50	UG 256/U	15.50	UG 503/U	50.00
UG 12/U	1.55	UG 58 A/U	1.25	UG 157/U	8.50	UG 257/U	15.50	MX 504	.45
UG 13/U	2.25	UG 59/U	2.45	UG 158/U	47.50	UG 259/U	6.50	UG 505/U	50.00
UG 14/U	1.80	UG 59 A/U	2.15	CW 159/U	1.95	UG 260/U	1.20	UG 506/U	50.00
UG 15/U	1.25	UG 59B/U	2.75	UG 159 A/U	2.20	UG 260 A/U	1.40	UG 507/U	50.00
UG 16/U	2.75	UG 60/U	2.40	UG 160 A/U	2.20	UG 261/U	1.20	UG 526/U	3.75
UG 17/U	2.75	UG 60 A/U	2.25	UG 160 B/U	2.50	UG 262/U	1.20	UG 530/U	4.50
UG 18/U	1.75	UG 61/U	2.55	UG 166/U	47.50	UG 266/U	4.50	UG 531/U	5.15
UG 18 A/U	1.75	UG 61 A/U	2.40	UG 167/U	5.75	UG 269/U	3.75	UG 532-U	6.95
UG 18 B/U	1.75	UG 83/U	1.95	UG 167 A/U	5.75	UG 270/U	10.00	UG 533/U	10.00
UG 19/U	2.25	UG 85/U	2.00	UG 173/U	.38	UG 271/U	10.00	UG 535/U	4.95
UG 19 A/U	2.25	UG 86/U	2.80	UG 174/U	20.00	UG 272/U	25.00	UG 536/U	2.45
UG 19 B/U	1.95	UG 87/U	1.60	UG 180 A/U	10.00	UG 273/U	2.55	UG 541/U	3.95
UG 20/U	1.95	UG 88/U	1.10	UG 181 A/U	10.00	UG 274/U	3.95	MX 554/U	2.25
UG 20 A/U	1.90	UG 88 B/U	1.95	UG 182 A/U	10.00	UG 275/U	7.50	UG 557/U	5.50
UG 20 B/U	1.90	UG 89/U	1.35	UG 185/U	1.35	UG 276/U	7.50	MX 564/U	.55
UG 21/U	1.25	UG 90/U	1.60	UG 188/U	1.30	UG 279/U	3.95	UG 564/U	3.95
UG 21 A/U	1.95	UG 91/U	1.95	MX 195/U	1.00	UG 286/U	4.95	UG 565/U	3.95
UG 21 B/U	1.45	UG 91 A/U	1.70	UG 197/U	4.95	UG 287/U	7.75	UG 566/U	7.95
UG 21 C/U	1.75	UG 92/U	1.80	UG 201/U	2.75	UG 290/U	1.20	UG 567/U	6.95
UG 21 D/U	1.95	UG 92 A/U	2.25	UG 202/U	3.95	UG 291/U	1.25	UG 568/U	4.95
UG 22/U	1.65	UG 93/U	1.95	UG 204 A/U	3.50	UG 294/U	2.20	UG 569/U	2.95
UG 22 A/U	1.60	UG 93 A/U	2.25	UG 206/U	2.00	UG 299/U	7.75	UG 570/U	2.95
UG 22 B/U	1.50	UG 94/U	2.25	UG 207/U	25.00	UG 306/U	2.95	UG 571/U	6.95
UG 22 C/U	1.95	UG 94 A/U	1.60	UG 208/U	22.50	UG 309/U	3.75	UG 572/U	5.95
UG 23/U	1.65	UG 95/U	1.95	UG 212 A/U	3.50	UG 332/U	3.50	UG 573/U	7.25
UG 23 A/U	1.95	UG 95 A/U	2.00	UG 213 A/U	4.10	UG 333/U	5.50	UG 602/U	3.00
UG 23 B/U	1.75	UG 96/U	2.10	UG 215/U	5.50	UG 334/U	6.50	UG 603/U	3.00
UG 23 C/U	1.95	UG 96 A/U	1.95	UG 216/U	14.00	UG 335/U	3.75	UG 625/U	1.70
UG 27 A/U	3.75	UG 97/U	4.25	UG 217/U	7.50	UG 347/U	2.50	UG 627/U	7.25
UG 27 B/U	3.75	UG 97 A/U	3.95	UG 218/U	10.00	UG 348/U	1.50	UG 628/U	7.25
UG 27C/U	4.50	UG 98/U	2.50	UG 219/U	7.50	UG 349/U	3.50	UG 634/U	4.95
UG 28/U	3.95	UG 98 A/U	2.70	UG 220/U	10.00	UG 352/U	7.50	MX 913/U	.65
UG 28 A/U	3.95	UG 100/U	2.95	UG 222/U	43.75	UG 352A/U	9.00	UG 931/U	3.00
UG 28 B/U	4.50	UG 100 A/U	3.75	UG 223/U	6.50	MT 412	.95	UG 932/U	3.00
UG 29/U	1.00	UG 101/U	4.45	UG 224/U	1.20	UG 414/U	2.95		
UG 29 A/U	1.90	UG 101 A/U	4.55	UG 231/U	2.70	UG 419/U	1.95		
UG 29 B/U	1.90	UG 107 A/U	4.50	UG 233/U	18.50	UG 421/U	3.25		
UG 30/U	2.50	UG 107 B/U	4.50	UG 234/U	18.50	UG 422/U	3.25		
UG 32/U	19.00	UG 108/U	2.90	UG 235/U	35.50	UG 423/U	5.80		
UG 33/U	19.00	UG 108 A/U	3.25	UG 236/U	12.00	UG 447/U	1.50		
UG 34/U	19.00	UG 109/U	2.30	UG 237/U	25.00	UG 478/U	50.00		
UG 35 A/U	19.00	UG 109 A/U	2.90	UG 241/U	3.45	UG 479/U	33.80		
UG 36/U	19.00	UG 110/U	15.00	UG 242/U	3.95	UG 482/U	33.80		
UG 37/U	19.00	UG 114/U	2.15	UG 243/U	4.50	UG 483/U	4.65		
UG 37 A/U	19.00	UG 115/U	2.25	UG 244/U	4.00	UG 484/U	5.80		
UG 38 A/U	22.00	UG 119 U/P	7.50	UG 245/U	2.50	UG 486/U	2.30		
UG 39/U	1.75	CW 123 A/U	.55	UG 246/U	3.10	UG 487/U	6.50		
UG 40/U	1.95	UG 131/U	10.00	UG 249/U	18.50	UG 491/U	2.25		
UG 45/U	5.00	UG 146/U	2.95	UG 250/U	18.50	UG 492/U	5.00		
UG 46/U	5.00	UG 148 A/U	7.85	UG 251/U	18.50	UG 493/U	7.25		
UG 49/U	20.00	UG 149 A/U	5.25	UG 252/U	7.50	UG 494/U	4.75		
UG 50/U	20.00	UG 154/U	9.50	UG 253/U	5.50	UG 495/U	7.50		

IPC Miniature Connector

MC 10	.36
MC 20	.46
MC 30	.82
MC 40	.86
MC 50	.36
MC 60	.46
MC 70	.82
MC 80	.86
MC 100	1.20
MC 110	1.12
MC 120	.36
MC 150	.75
MC 250	1.50



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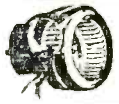

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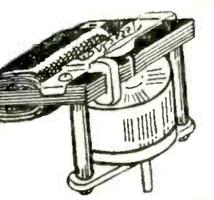

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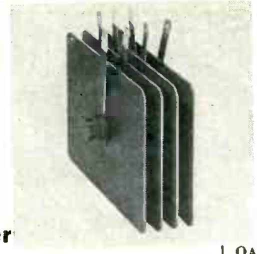

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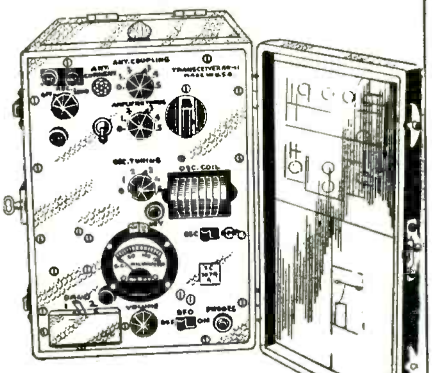

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6AB4	.75	35L6	.69	9003	1.10
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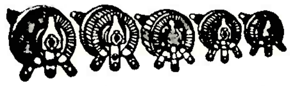

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.5	50	2.81	75	75	3.90	585	150	6.59
.5	150	5.93	80	50	2.53	750	25	2.23
1	50	2.81	80	500	12.46	750	150	5.46
2	50	2.81	100	25	1.98	1000	25	2.53
2	100	4.68	100	50	2.53	1000	50	2.66
2	300	8.42	100	100	4.39	1200	225	7.20
3	100	4.67	125	25	2.23	1200	300	8.40
3	225	6.58	150	50	2.53	1250	50	2.66
4	225	6.60	175	25	2.23	1250	150	6.10
5	25	1.97	185	25	2.23	1500	25	2.53
5	50	2.53	200	25	2.23	1500	50	2.66
5	100	4.68	200	100	4.40	1600	50	2.66
6	25	2.23	200	150	5.04	1800	150	6.19
6	50	2.53	225	50	2.53	2000	25	2.53
6	75	3.90	250	25	2.23	2000	50	2.66
7	25	1.98	250	50	2.53	2250	150	6.24
7.5	75	3.95	300	50	2.53	2500	50	2.66
8	50	2.53	300	75	3.90	2500	100	4.68
10	25	2.23	300	100	4.40	2500	150	6.24
10	50	2.53	300	150	5.04	3000	25	2.66
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12	25	2.23	350	100	4.40	5000	25	2.66
12	50	2.53	370	25	2.23	5000	50	2.90
15	25	1.98	378	150	6.59	7500	50	2.90
15	75	3.90	400	25	2.23	7500	100	5.32
15	100	4.38	400	75	3.90	10000	50	2.99
20	50	2.53	500	25	2.23	10000	100	5.32
22	50	2.53	500	50	2.53	10000	100	5.51
25	25	2.23	500	75	3.95	15000	25	3.25
50	25	1.98	500	100	4.50	20000	150	8.75
50	50	2.53	500	150	5.15			

Specify Type Shaft Required "S" or "Knob"
Special Prices to Quantity Users.

LARGEST VARIETIES OF NEW SURPLUS AT LOWEST PRICES

- **OIL CAPACITORS** LARGE RECTANGULARS, SMALL RECTANGULARS, BATHTUBS; TUBULAR
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- **OTHER** CARBON, WIRE-WOUND **POTS**
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- **AIRCRAFT** NOISE FILTERS
- **RESISTORS** GLASS FERRULE, PRECISION
- **FUSEHOLDERS-MOUNTS**
- **INSTRUMENT KNOBS**
- **MANY OTHER ITEMS**

HIGH POWER TRANS. MICA

G-1 Type		G-2 Type		G-3 Type		G-4 Type	
.0001	6kv	.0001	10kv	.001	20kv	.00025	30kv
.00015	5kv	.00015	10kv	.00015	20kv	.0006	35kv
.0002	6kv	.0002	10kv	.0004	20kv	.0025	25kv
.0008	6kv	.00025	12kv	.00045	15kv	.003	20kv
.01	4kv	.0003	10kv	.00047	20kv	.0039	20kv
.032	2kv	.000375	10kv	.0005	20kv	.0075	15kv
.04	1kv	.0004	5kv	.00095	5kv	.01	12kv
.051	1.5kv	.0005	10kv	.001	20kv	.03	8kv
.08	1.5kv	.00057	10kv	.0011	20kv	.056	5kv
.09	1.5kv	.00065	10kv	.00124	15kv		
		.001	10kv	.01	5kv		
				.015	3kv		
				.25	1.6kv		

C-D Type #56

.000155	30kv	.001	30kv
.0004	30kv	.03356	2.5kv
.000533	30kv	.007/15kv—70A/300kc	

Full ratings and prices upon request. Specify your needs.

A. MOGULL CO.

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WIRE-CABLE TUBES PARTS

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
2 conductor shielded AWG 10

AMOUR

DRIA-23 DHFA-100 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

OIL FILLED CONDENSERS

MFD	VDC	Each	Ten	MFD	VDC	Each	Ten
1	600	.85	.80	.5	2000	2.00	1.90
2	600	.95	.95	.25	3000	2.85	2.80
4	600	1.40	1.40	.5	3000	2.95	2.90
5	600	1.65	1.60	.2	5000	4.50	4.25
1–8	600	2.50	2.35	.1	7500	3.95	3.95
.01	1000	.85	.80	1	7500	12.50	12.00
.5	1000	.95	.90	.1	12000	7.95	7.95
2	1000	1.65	1.60	.0008	15000	12.50	11.75
1	1200	1.65	1.60	.2	15000	14.95	14.80
1	1500	1.75	1.65	.045	16000	12.95	12.50

SPECIALS

80-86 Crystal in Holder $2.50
Balloon with Hydrogen Generator $2.50
300 Feet Aerial Wire $2.00

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.

TUBES

2C34	$.45	803	3.60	CEQ 72	.85
2X2/879	.55	826	.65	CK 70	4.15
3B24	4.95	864	.25	CRP 72	.85
3C24	1.60	931A	4.45	E 1148	.30
7C4/1203A	.70	955	.30	HY 615	.20
10Y	.35	957	.35	RKR 72	.85
15R	.65	CK 1005	.45	RK 73	.45
30 Spec.	.40	CK 1007	.90	5BP4	4.25
39/44	.25	1626	.35	5FP7	1.75
45 Spec.	.35	1629	.25	1J6 G	.70
WE 203A	6.75	2051	1.10	1B3 GT	.80
316A	.60	7193	.50	3A4	.60
WL 531	4.95	8011	1.50	5U4G	.57
713A	.90	9006	.30	6K6GT	.60
801A	.25	C5	8.00		

HI VOLTAGE FILTER CHOKES

.4 HY 4.5 Amp DC 3 ohms 1230 RMS to ground. 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.

NAVY ENTERING TYPE INSULATOR

Porcelain flanged bowl with brass rod, fittings and aluminum shield. Dimensions 4⅞" high, 6-5/16" OD at base. Brand new $4.50.

10 CM ROTATING ANTENNA

24" Parabola in turret 360° spun at 12 RPM DC, motor control and reversing switch New.

TIME DELAY SWITCHES

1 Minute 115 VAC 60 cycle Enc. in Waterproof Metal Case New $5.25
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Thermo Switch 50° to 300° F 115 VAC @ 6A 230 VAC @ 5A
Breaks Contact with increase in 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 BJD36.....$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

ROLLER INDUCTANCE COIL 0-15 MH WITH VERNIER ADJUSTMENT

Coil is wound on ceramic form 3⅛" long. Right angle drive gear with ⅝" shaft. Three position switch for vernier operation New—Meissner—C-625

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

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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

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300A Harmonic Wave Analyzer (Hewlett-Packard)
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EE-65-F Test Set
188X Signal Generator (Hickok)
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BC-1016 Recorder
BC-1255-A Delco Het. Monitor
BC-906-D Frequency Meter
CW-60-ABM Wavemeter
CZH-50152 Audio Amplifier
EE-65-E Test Set
EE-85 Time Interval Apparatus
EE-99-T3 Telephone Repeater Equipment
Type 1 Officers' Intercept Kit
Type 7 Oscilloscope
TVFM Electronic Sweep Generator
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US-253 G.E. Square Wave Generator
155 R.C.A. Scopes
620A G.R. Test Set
720A G.R. Het. Freq. Meter
BC-221-J Frequency Meter (Mercury)
E-400 Sweep Signal Generator (Precision)
I-56-E Test Set, Weston Model 714, Type 4
I-95-A Field Strength Meter
I-102-A Indicator
I-135-E Galvin Test Set
I-198-A Signal Generator
I-222A Signal Generator
ID-6A/APN-4 Oscilloscope Indicator
ME-21A Maintenance Equipment
OAN (Fada) Test Oscillator
PRC Analyzer Test Set Recorder, by Leeds & Northrup
S-6 Browning Lab. Freq. Meter
SR-90A Het. Freq. Meter
TS-59/APN-1 Test Set
TS-323UR Freq. Meter
TG-10 Keyer
VM-27 Vac. Tube Voltmeter, (Barber)
19X Hickok Microvolt Generator
546B G.R. Microvolter
715 RCA Scope Console
726A G.R. Vac. Tube Voltmeter
BC-221J Freq. Meter (Howard)

(Details and Prices on application)

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1N22	1.25
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1N27	2.95
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2C40	17.50
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3B24	5.50
3C23	10.50
3C24/24G	1.95
3DP1	3.95
3D6/1299	.62
3EP1	4.95
3FP7	4.50
3GP1	4.75
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4B22/EL5B	9.75
4B25/EL6CF	8.95
4J36	175.00
4J37	175.00
5BP1	5.95
5D21	23.95
5FP7	2.50
5JP1	23.50

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6AC7	.95
6AG7	1.20
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6AJ6	2.10
6B6G	.75
6C6	.79
6C8G	.79
6H6	.69
6K7	.75
6SA7	.74
6SC7	.97
6SH7GT	.79
6SH7	.79
7C4/1203A	.75
7E5/1201	.95
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10Y	1.50
12A6	.85
12C8	.89
12H6	.69
12J5GT	.57
12SF7	.75
12SJ7GT	.65
14H7	.97
14J7	1.10
15R	1.00
23D4	.65
30	.48
45	.35
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815	3.40
816	1.45
826	1.39
830B	2.95
832	7.95
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838	3.50
838W	6.50
845	3.95
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959	1.50
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1625	2.00
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9004	1.75
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EL6CF	8.95
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QK-60	85.00
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1N23	1.25
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2E41	1.10
2J21	7.50
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2J22	6.95
2J26	14.95
2J27	14.95
2J31	39.50
2J32	39.50
2J33	39.50
2J34	39.50
2J36	110.00
2J37	12.70
2J40	27.50
2J48	27.50
2J50	Write
2J55	85.00
2J56	149.50
2J61	39.50
2J62	39.50
2K22	49.50
2K23	49.50
2K25	29.50
2K28	32.00
2K29	23.95
2K33	Write
2K41	110.00
2K45	110.00
2K48	Write
2K54	Write
2K55	Write
2X2	.59
3A4	.65
3A5	.85
3AP1	8.95
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3B23	4.95
3B24	4.95
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3B26	3.50
3B28	6.50
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3C31	3.15
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3C45	16.95
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3GP1	3.95
3HP7	3.95
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4C28	25.00
4C35	24.50
4E27	14.95
4J21	129.50
4J22	129.50
4J23	129.50

4J26	129.50
4J27	129.50
4J28	129.50
4J29	149.50
4J30	249.50
4J31	99.50
4J32	129.50
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5GP1	4.50
5HP1	6.95
5HP4	4.95
5JP1	19.95
5JP2	19.95
5JP4	19.95
5JP5	19.95
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5J26	259.50
5J29	11.95
5J30	39.50
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5T4	1.98
C6L/5528	12.50
6AC7W	2.75
6AJ5	1.95
6AK5	1.10
6AK5WE	1.50
6AL5W	2.00
6AN5	3.65
6AN6	2.75
6AR6	2.25
6AS6	2.30
6BL6	Write
6BM6	Write
6C21	19.50
6F4	4.50
6G6G	1.10
6J4	6.95
6K4	3.50
6SN7WGT	2.00
6ST7	1.19
6SU7GTY	Write
7C23	69.50
7V7	1.19
9LP7	4.95
10Y	.49
12AY7	4.50
12DP7	16.95
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5 FIGURE adds or subtracts 10 for each revolution of shaft

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Size ¾" wide x 1-5/16" long. Dovetail mounting—removable lever.

12HP7	13.50	204A	49.50
15E	1.25	205F	Write
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FG-17/5557	Write	217C	4.95
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RX-21	4.95	RX233A	3.50
24G/3C24	1.50	FG-235A	Write
FG-27A	4.95	250R	8.95

YOUR SURPLUS WANTED
We Pay Highest Prices!

FG-32	12.95	250TH	20.00
45 Spec.	.32	250TL	12.50
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RK60/1641	2.25	274B	3.25
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CRP-72	.75	282A	Write
RKR-72	.75	301A	Write
CRP-73	.75	304TH	8.95
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75TL	5.95	308A	Write
83V	1.10	310B	12.95
FG-95/5560	22.50	316A	.75
VT98-Br.	19.95	323A	19.95
98R	5.95	327A	4.50
J-100	Write	331A	10.95
100-L	Write	349A	8.50
100TH	8.50	350A	5.95
FG-104	29.95	350B	3.95
FG-105	19.00	355A	Write
VU-111	.95	371B	.75
114B	Write	374B	3.95
HF120	9.95	388A	1.49
F-123A	7.75	393A	8.95
VT-127A	3.75	394A	3.95
HF-140	Write	417A	8.50
FG-172	29.50	423A	Write
HF200	14.50	434A	19.95
201A	98.00	446A	1.19
201C	98.00	446B	3.50

450TH	35.00
451	3.95
464A	10.95
469	13.95
471	2.25
527	12.95
530	16.95
531	5.75
532	2.95
536	Write
551	Write
559	1.49
575	13.95
587	Write
605CX	Write
609	Write
615	Write
632	19.95
KU676	39.50
700A	16.50
700B	16.50
700C	16.50
700D	16.50
701A	4.50
702A	2.75
703A	4.95
704A	Write
705A	1.50
706AY	29.50
706BY	29.50
706CY	29.50
706FY	29.50
706GY	29.50
707A	7.95
707B	17.50
708A	3.95
713A	.95
714AY	5.50
715A	6.25
715B	8.95
715C	22.75
717A	.98
719A	24.50
720AY	Write
720BY	Write
721A	2.95
722A	1.95
723A/B	16.95
724B	2.75
725A	6.95
726A	Write
726C	59.50
730A	25.00
750TL	99.50
802	3.95
803	3.75
804	10.95
805	3.25
807	1.59
807W	9.95
808	2.95

809	2.95
810	10.95
811	3.50
812	2.75
813	11.95
814	2.95
815	2.90
826	1.95
828	9.95
829	9.95
829B	11.95
830B	2.75
832A	9.95
833A	34.95
836	3.45
837	1.45
841	.45
843	.45
845	8.50
852	19.95
860	3.75
861	19.95
861A	.45
864	.39
865	.98
866A	1.35
866JR	1.25
869B	53.00
872A	2.75
874	1.10
876	.59
881	1.50
884	1.60
885	Write
889R	139.50
905	3.25
923	1.25
927	1.25
931A	6.50
953B	Write
953D	Write
953E	Write
954	.33
955	.49
956	.49
957	.49
958	.69
959	2.95
977CX	Write
979	Write
980D	Write
991	.39
1005	.69
1006	2.75
1007	.89
1613	Write
1616	.90
1619	.39
1624	1.45
1625	.39
1626	.39

1629	.39
1630	.95
1631	1.50
1632	.69
1635	1.50
1636	2.75
1644	.89
1787	Write
2050	1.40
2051	1.10
5514	Write
5523	Write
5560/FG95	22.50
5586	249.50
5611	115.00
5635	8.95
5637	Write
5638	8.95
5645	8.95
5646	8.95
5651	2.75
5654	3.95
5670	4.30
5672	2.00
5676	3.35
5678	2.25
5686	4.25
5687	4.25
5694	2.60
5702	6.50
5704	4.50
5718	Write
5726	2.25
5744/619CX	5.95
5749	3.95
5751	3.25
5763	1.50
5783	6.00
5784	5.50
5787	6.00
5814	3.25
5823	3.95
5844	5.50
5915	1.00
6005	5.75
6026	Write
6653	3.95
8005	4.95
8012	1.95
8013	4.95
8014A	Write
8020	1.25
8025	4.95
9001	1.25
9002	.98
9003	1.50
9004	.69
9005	1.50
9006	.69

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12 mmfd., 20,000 v. $ 7.50
12 mmfd., 32,000 v. $10.00

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Special: VACUUM CAPACITORS
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50 mmfd., 32,000 v. $12.50
100 mmfd., 20,000 v. $14.50

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BINDING POSTS
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CABLE ASSEMBLIES
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Oil Filled, Bathtub, Hearing Aid, Transmitting Micas, Silver Micas, Ceramic, Variable, Trimmer
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FILTERS
FUSES & MOUNTINGS
GENERATORS
GROUND RODS
HEADSETS
IF COILS
JACKS
JACK BOXES
KEYS, *Telegraph*
KNOBS
LAMPS
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LUGS
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RECTIFIERS
Selenium, Copper Oxide, Meter, Diode
RESISTORS—*All Types*
SELSYNS
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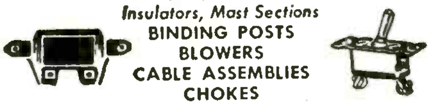
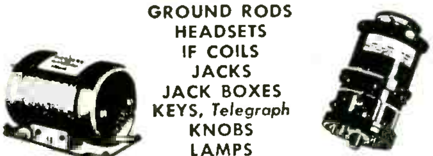
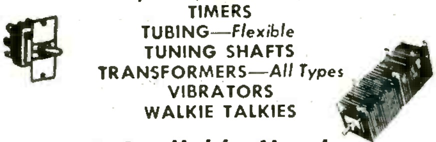
SWITCHES
Aircraft, Micro, Switchettes, Toggle
TIMERS
TUBING—*Flexible*
TUNING SHAFTS
TRANSFORMERS—*All Types*
VIBRATORS
WALKIE TALKIES







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A complete signal corps stock number listing of items in our stock. Write for listing No. SG-200. (For government agencies and contractors only.)

Manufacturers and distributors—write for Radio-Electronics Catalog No. H 501.

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***all phones:* SEeley 8-4143**

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BLOWERS:

115 Volt 60 cycle BLOWER (pictured), approx. 100 CFM Dis. 2¼" intake; 2" outlet. Quiet running. Motor size: 2½"x3¼". NEW — not Gov't surplus. Order No. E-520 **$7.99**

DUAL BLOWER—Same as RN-520 above, except has blower assembly on each side of motor. Order No. E-800 .... $12.95

COMPACT TYPE—108 CFM, motor built inside squirrel cage, 4-½" Intake: 3-⅜" x 3" Dis. Complete size: 4-¼" W x 9-⅜" H x 8-⅛" D. Order No. E-860 .... $13.50

FLANGE TYPE—140 CFM, 3-½" Intake: 2-½" Dis. Complete size: 7-½" W x 7-¼" H x 6-¾" D. Order No. E-865 .... $12.95

FLANGE TWIN—275 CFM, 4-½" Intake: 3-¼" x 3" Dis. Complete size: 11-¾" W x 8-⅝" H x 8-1/16" D. No. E-134 .... $20.95

CORDS—CABLES

C-501 Cord—f/GN-45 Generator	$2.50
CD-318 Cord w/PL-68 & SW-141 & JK-48F..	.89
CD-307 Cord—6.5 Ft. w/PL-55 & JK-26......	.89
CD-604 Cord w/C-410 Trans. & PL-54 Plug..	.89
CD-365 Cord for LP-21-Loop	1.75
MC-215 Tuning Shaft for 274N	2.00

JUST WHAT YOU NEED . . .

Standard Test Leads, 4" x 1-½" Prods. .... Pair: 39¢ — 3 for $1.00

Phone Plug—Nickel Plated, Screw Terminals...... Ea.: 39¢ — 3 for $1.00

Instrument Knobs—Bar, Octagon, Set Screw, Skirts, Asst. .... 10 for $1.00

Line Cord—Bro. Rubber 7 ft., Molded Rubber Plug .... Ea.: 29¢ — 4 for $1.00

Line Cord—Black Rubber 6 ft., Angle Molded Plug .... Ea.: 39¢ — 3 for $1.00

PLUGS AND CONNECTORS

PL-112 Plug for LP-21 Loop	$1.25
PL-P-103 Plug for BC-348	1.50
MC-211 Rightangle Adapter for Comm. Sets...	.50
M-359 Rightangle Coaxial Connector	.25

CONTROL BOXES:

	NEW:	USED:
C-87/ART-13—f/ART-13 Trans	$ 6.95	$4.95
BC-434 for ADF	5.95	3.95
BC-732 for Localizer	2.95	1.95

MOUNTINGS AND CLAMPS:

FT-154 for BC-348 Receiver	$2.50
FT-470 Mounting & Clamp	1.00
MC-476 Maple Ball for above—f/Fairlead....	1.00
MC-396 Wood Clamp for Fairlead	.75
M-235 Bobbin & 250 Ft. W-106 Antenna Wire..	3.50
WT-7 Weight for Trailing Antenna	1.50

AIRCRAFT CONTROL CABLE—3/32" 7 x 14 Strand, Weatherproofed, Galvanized, 920 lb. Test. Ideal for Television Guying and many other uses. Prices: 3-½¢ per Ft. 1000 Ft. or more @ 3¢ per Ft.

DYNAMOTORS:

DYNAMOTOR and BLOWER: 9 Volts DC input: output 450 Volts 60 MA. 4500 RPM. At 6 Volts DC input: output 260 Volts 65 MA. 3000 RPM...... $4.95

Input	Output	Stock No.	Price
14 V. DC	600 V. 300 MA.	BD-86	$9.95
12 V. DC	220 V. 70 MA.	DM-24	6.95
12 V. DC	220 V. 100 MA.	DM-18	4.95
12 or 24 V. DC	440 V. 200 MA. & 220 V. 100 MA.	D-104	14.95
14 V. DC	375 V. 150 MA.	DM-375	8.95
14 V. DC	330 V. 135 MA.	DM-330	7.95
14 V. DC	500 V. 500 MA.	PE-59	14.95
12 or 24 V. DC	275 V. 110 MA.	USA/0516	3.95
12 or 24 V. DC	500 V. 50 MA.	USA/0515	3.95

ALSO—PE-73; PE-86; DM-53; DM-33; 5055; DM-416; PE-101, etc.

ANTENNA EQUIPMENT

MAST BASES—INSULATED:

MP-132 BASE—(As illustrated at left) 1" heavy coil spring, 2" insulator. Overall length: 11-½". Weight: 2-¾ lbs. Price $3.95

MP-48 BASE—Insulated type with heavy coil spring. Requires 1-⅜" mounting hole. Weight: 11 lbs. $4.9

MP-57 BASE—Insulated type with heavy coil spring and 5" dia. insulator. Requires 1-⅜" hole for mtg. Weight: 9 lbs... $5.95

MAST SECTIONS For ABOVE BASES:

Tubular steel, copper coated, painted, in 3 ft. sections, screw-in type. MS-53 can be used to make any length with MS-52-51-50-49 for taper. Any section .... 50¢ Each

Larger Diameter Sections: MS-55-54.... $1.25 Each.

AN-104B Antenna—100-156 MC.—Copper	$5.95
AN-104B Antenna—100-156 MC.—Steel	3.95
AN-104A Antenna—100-156 MC.—Copper	3.00
AN-104A—Antenna—100-156 MC.—Steel	2.00
AN-117 Whip Steel—6 Ft. length	1.50
AN-109A Whip Steel, 5 Ft. w-Base	1.50
AS-27/ARN-5 Ram's Horn, 10 MC.—USED..	5.95
LP-20A Loop for ADF equip.—Used, tested....	9.95
AT-37/APT Stub—113-150 MC.	6.95
AT-42/APT-3 or APT-1 Stub—113-150 MC....	6.95
AS-97/ARQ-8 Spike with coaxial load in base..	4.95
AS-61/ARN-5-Half-Wave Dipole—335 MC.....	3.95
AT-2/APN-2	4.95

SELENIUM RECTIFIER UNITS

HEAVY DUTY—30 VOLT DC OUTPUT:

115/200 V. Three Phase 400 Cycle Input:

TYPE 143 w/Transformer & VR 100 Amp...... $69.50

TYPE 3FS-5 w/Trans., VR, & Blower—200 Amp. $69.50

TYPE 52A-11 Rectifier Only, Cased, 200 Amp.. $39.50

TYPE A-1 Rectifier Only, Cased, 300 Amp..... $49.50

AERIAL WIRE—Phosphorus Bronze #16 Stranded. 200 lb. test. Weatherproof. 150 ft. on Reel. RL-3 with Clips $1.50

TELEPHONE WIRE—3 Cond. copper & steel, 525 ft. $4.75

TRANSFORMERS—110 V. 60 Cycle Pri.

Sec. Two 12 V. 4 A. windings—gives 12 V. 8 A. or 24 V. 4 A.	$5.95
Sec. 24 Volt ½ Amp.	1.50
Sec. 24 Volt 1 Amp.	1.95
Sec. 24 Volt 6 Amp.	5.9
Sec. 6-24 or 30 Volts 8 Amp.	5.95

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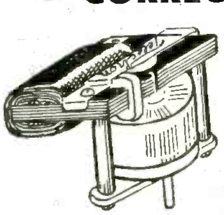
FAIR RADIO SALES 132 S. MAIN ST. LIMA, OHIO

• CORRECTION •



Due to Typographical error in Sept. ELECTRONICS the **TELECHRON 2 RPM MOTOR** was priced at $2.00. The Correct price is $2.90. For our other Listings see pg. 465

BLAN

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ERIE CERAMICONS

Large quantities in stock; immediate delivery.

All values and tolerances.

N.P.O. & TEMPERATURE COEFFICIENT
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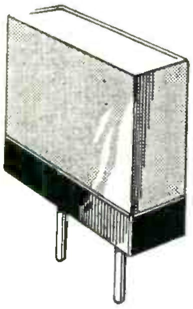

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MFG. BY WESTERN ELECTRIC AND FEDERAL TEL. & RADIO

ALL FT-241-A HOLDERS

Available As Follows For:

SCR 608-A and SCR 628-A
BC 684 ....120 per set

SCR 528 and SCR 538
BC 604 ....80 per set

200 KC Crystals	$2.95 ea.
500 KC Crystals	$1.95 ea.
1000 KC Crystals	$3.95 ea.

QUANTITIES AVAILABLE

Write For Price Quotation On Your Requirements.

C and H Sales Company

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Nation's Largest Wholesale Supplier Specializing *ONLY* in Buying and Selling

ELECTRONIC TUBES AND CRYSTALS

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TOP STANDARD BRANDS
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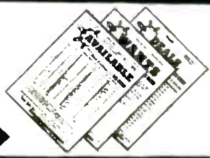

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WIRE: STATE LABS, WUX, N. Y.
TELETYPE: N. Y. 1-1807 CABLE: STATELABS

Telephone Equipment & Parts

TS 15 handsets with cord & PL68 and PL55 plug ....Each	$ 8.50
TS 13 handsets with cord & PL68 and PL55 plugs..........Each	8.50
New W.E. F1W handsets with cord & PL47 plug..............Each	6.95
New TS9 handsets with butterfly flip switch in handle.......Each	6.50
EE8 field telephones reconditioned Each	18.50
Like new Magneto Wall telephones (Like EE8) ....Each	13.00
Reconditioned like new W.E. solid handsets ....Each	4.95
Reconditioned like new TS9 handsets ....Each	4.95
Upright desk telephones reconditioned (for extensions, etc.).Each	2.95
Operators head & Chest sets HS19 reconditioned Double receiver Each	6.50
Single receiver ....Each	5.75
EE2C units less cord used. For BD7k & BD72 switchboards Each	1.00
New 4 ½ foot rubber cords with PL47 plug ....Each	0.75
Sound power field telephones like new ....Each	25.00

Terms:
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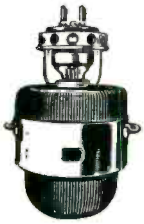

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COOKE, AUTOMATIC—ELECTRIC
ALL TYPES of COILS and PILE-UPS
Send Us Your Specs. for Our Quote

Clare Type G Half Size Sensitive Telephone Relays

	Coil	Contacts	Will Close at	Price
1)	6500 ohms	2A	5 MA	$2.50 ea.
2)	5800 ohms	3A	4 MA	2.50 ea.
3)	5800 ohms	2B-1C	5 MA	2.50 ea.
4)	4850 ohms	1C	4 MA	2.50 ea.
5)	3600 ohms	1C	6 MA	2.00 ea.
6)	4850 ohms	1A	5 MA	2.00 ea.
7)	3300 ohms	(None)	ACTUATOR	1.50 ea.

All above Relays may be used for continuous duty operation on 110V. D.C.

Other Type G Telephone Relays

1)	1300 ohms	1A-1C	24 or 48V.	2.50 ea.
2)	700 ohms	2A-1C	24V.	2.50 ea.
3)	400 ohms	1A	12 or 24V	1.65 ea.

Clare Type C Standard Size Telephone Relays

	Coil	Contacts	Voltage	Price
1)	2500 ohms	1A	24 or 48V	$2.25 ea.
2)	2500 ohms	1B-1C	24 or 48V	2.50 ea.
3)	2500 ohms	2A-1B	24 or 48V	2.50 ea.
4)	2500 ohms	3A-1B	24 or 48V	2.75 ea.
5)	2500 ohms	5A	48V	3.00 ea.
6)	2500 ohms	5A-1C	48V	3.00 ea.

CONTACT SYMBOLS

A=Norm. Open B=Norm. Closed C=S.P.D.T.

G.E. Relays #CR 2701-B109P36 Coil—10,000 ohms Contacts 1A, 1B Operates on 8 MA..**Price $1.65**

Signal Wheelock Relays #KS9665 Coil—2,000 ohms Contacts-1A, 1B, 1C Operates at 9 MA. **Price—$2.75 ea.**

Leach Relays Type 1025-SN-BF. Coil—24V. 425 ohms. Contacts—D.P.S.T. Norm. closed. Rated at 10 Amps ....**Price—$1.50 ea.**

Five Prong CR-2791 G.E. Plug In Relays.
1) C-103C25 2200 ohms SPDT 4.5 MA..$4.00 ea.
2) C-104B28 700 ohms SPDT 6 MA..$3.00 ea.

Slow Release (**For SCR-522-A**) Telephone Relays. Part No. A18258 ....**Price—$2.00 ea.**

Patch Cords—2½ Ft. long with a Phone Plug (Like PL-55) on each end............**Price—95¢**

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Famous 2" Sq. Weston Sangamo

PANEL METERS

0-20v DC
0-40v DC

0-.5 R.F. MA
0-5 MA

0-100 MA (0-300 SCALE)

LARGE QUANTITIES AVAILABLE

$2.69 Any Type were $3.95

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WE OWN & OFFER, QUANTITY LOTS OF BRAND NEW PANEL METERS!

Wholesale quantities only at special reduced lot prices. Some of these lots can be modified to your requirements. Write for complete details and special low prices.

Quan.	Type	Range	Make	Model
57	DC Milliammeter	0-30	Weston	301
59	DC Milliammeter	0-50	Gruen	522
130	DC Ammeter	0-100	Hoyt	
49	AC Ammeter	0-35	Roller Smith	
28	Microammeter	special	Weston 366	
77	DC Milliammeter	0-3	Gruen	5-87
124	DC Milliammeter	0-15	Simpson	26
23	DC Milliammeter	0-150	Gen. Elec.	DO-53
50	DC Milliammeter	0-200	Marion	
32	DC Milliammeter	0-200	Simpson	25
281	DC Milliammeter	0-400	Triplett	321-T
147	DC Milliammeter	0-500	Dejur	312
77	DC Voltmeter	0-5/125	Weston	506
57	DC Voltmeter	0-150	Hoyt	17-L
61	DC Voltmeter	0-300	Sun	2AU346
35	DC Voltmeter	0-300	Sun	3AP380
50	AC Ammeter	0-150(5)	Westinghouse	NA:35
210	RF Ammeter	0-2.5	Weston	425
40	RF Ammeter	0-2.5	Simpson	35
193	RF Ammeter	0-2.5	Westinghouse	NT-35
740	RF Ammeter	0-2.5	McClintock	
34	RF Ammeter	0-3	Weston	425
220	RF Ammeter	0-3	Westinghouse	NT-35
98	RF Ammeter	0-5	Gen. Elec.	DO-44
122	RF Ammeter	0-5	Gen. Elec.	DO-44
1200	RF Ammeter	0-6	Gen. Elec.	DW-44
1350	AC Voltmeter	0-15	Gen. Elec.	AW-41
288	AC Voltmeter	0-15	Westinghouse	NA-35
37	AC Voltmeter	0-40	Westinghouse	NA-33
53	AC Voltmeter	0-75	Weston	517
24	DC Ammeter	0-1	Gen. Elec.	DO-41
350	AC Milliammeter	0-1.3	Weston 545	

The following items are NAF type 1091 series and miscellaneous aircraft style instruments. All are made by Weston, Westinghouse, or General Electric. External shunts are available where required.

Quan.	Type	Range	
330	DC Amp	0-30	self contained
560	DC Amp	30-0-30	self-contained
3500	DC Amp	0-60	50 M.V.
490	DC Amp	60-0-60	50 M.V.
240	DC Amp	0-120	50 M.V.
270	DC Amp	120-0-120	50 M.V.
1340	DC Amp	0-240	50 M.V.
230	DC Amp	240-0-240	50 M.V.
2800	DC Volt-Amp	0-30v/30a]	50 M.V.
330	DC Volt-Amp	0-30v/60a	50 M.V.
50	DC Amp	0-50	50 M.V.
60	DC Amp	50-0-50	self-contained
140	DC Amp	20-0-100	50 M.V.
300	DC Amp	0-150	50 M.V.
250	DC Amp	0-300	50 M.V.
160	DC Volt	0-30	50 M.V.
280	AC Volt	0-40	50 M.V.

NOTE!
ONLY A PARTIAL LISTING!!

We have in stock a large variety of panel, switchboard, laboratory and recording instruments, too numerous to itemize.

We also stock a full line of shunts, current transformers and multipliers, as well as miscellaneous items, such as voltage regulators, meggers, voltage relays, tachometers, etc.

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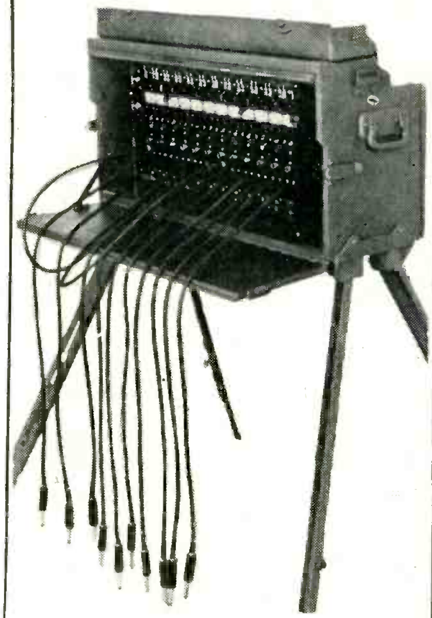
MARITIME SWITCHBOARD
INSTRUMENTS—ACCESSORIES

336 Canal Street — Wo 4-8217 — New York 13, New York

Switchboard BD-72 and BD-71



These Switchboards are portable, monocord, magneto-telephone switchboards for use primarily in field wire systems.

The capacity of the Switchboard BD-72 is 12 lines and of the BD-71 is 6 lines. Each switchboard contains all the equipment necessary for terminating and switching field telephone circuits, including a line terminal strip to which incoming lines may be connected directly.

These units are reconditioned and ready to set-up and operate. They are tested and in excellent operating condition.

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1C6	.69
1D5GP	.69
1E5G	.71
1G4GT	.69
1G6GT	.69
1H5GT	.69
1H6G	.75
1J6GT	.75
1L4	.83
1LA6	.95
1LB4	.98
1LC6	.91
1LH4	.87
1LN5	.75
1N5GT	.75
1N6G	.75
1P5GT	.69
1Q5	.68
1R4	.69
1R5	.65
1S4	.69
1S5	.64
1T4	.65
1T5GT	.68
1U4	.67
1U5	.65
1V	.65
1X2A	.90
1Z2	.75
2A3	1.10
2X2	.59
2X2A	1.55
3A4	.65
3A5	.85
3D6	.45
3Q4	.63
3Q5GT	.79
3S4	.70
5T4	1.35
5U4G	.65
5U4GW	2.35
5V4G	.89
5W4	.79
5Y3GT	.49
5Y4G	.65
5Z3	.75
5Z4	.85
6A3	.95
6A6	.82
6A7	.87
6A8	.85
6A8GT	.95
6AB4	.65
6AB5	.85
6AB7	.98
6AC5	1.08
6AC7	.93
6AD7	1.29
6AE5	.89
6AF4	1.45
6AF6	.88
6AG5	.80
6AG7	1.25
6AH6	1.29
6AJ5	1.98
6AK5	1.30
6AK6	1.09
6AL5	.59
6AL7GT	1.15
6AQ5	.57
6AQ6	.85
6AQ7GT	1.02
6AR6	3.35
6AS5	.75
6AS6	3.30
6AS7	4.50
6AT6	.60
6AU5GT	1.19
6AU6	.63
6AV5	.95
6AV5GT	.95
6AV6	.55
6AX5GT	
6BA6	.63
6BA7	1.25
6BC5	.73
6BE6	.63
6BF5	1.10
6BF6	.72
6BG6G	1.59
6BH6	.90
6BJ6	.85
6BK7	.95
6BL7GT	1.25
6BQ6GT	1.20
6B4G	1.25
6B7	.95
6B8	.75
6B8G	.75
6C4	.55
6C5	.60
6C5GT	.60
6C6	.59
6C8	.85
6CB6	.72
6CD6G	1.85
6D6	.72
6E5	.79
6F5	.62
6F5GT	.62
6F6	.85
6F6GT	.80
6F7	.85
6F8G	.87
6G6G	.95
6H6	.65
6H6GT	.65
6J5	.65
6J5GT	.55
6J6	.90
6J7	.89
6J7GT	.60
6J8G	1.30
6K5GT	1.00
6K6GT	.65
6K7	.79
6K7GT	.79
6K8	.85
6K8GT	.85
6L5G	.75
6L6	2.25
6L6G	1.45
6L6GA	1.45
6L7	.85
6L7G	.85
6N5	
6N7	.95
6N7GT	.85
6Q7	.79
6Q7GT	.85
6R7G	.85
6S4	.62
6S7	.85
6SA7	.65
6SA7GT	.65
6SB7Y	.90
6SC7	.85
6SC7GT	.85
6SD7GT	.85
6SF5	.75
6SF7	.75
6SG7	.75
6SH7	.75
6SH7GT	.75
6SJ7	.65
6SJ7GT	.70
6SJ7Y	.80
6SK7	.70
6SK7GT	.72
6SL7GT	.75
6SN7GT	.75
6SN7GTA	.80
6SN7GTW	2.25
6SQ7	.60
6SQ7GT	.62
6SR7	.65
6SR7GT	.67
6SS7	.80
6ST7	.98
6SU7GTY	2.70
6SV7	1.05
6T8	1.00
6U4	.75
6U5	.87
6U6GT	.85
6V6	1.30
6V6GT	.67
6W4GT	.65
6W6GT	.75
6X4	.60
6X5	.60
6X5GT	.60
6Y6G	.95
6Z4	.60
6Z5G	.60
7A4	.75
7A5	.75
7A6	.75
7A8	.75
7AF7	1.05
7B4	.75
7B7	.75
7C4	.75
7C5	.75
7C6	.80
7C7	.75
7E7	.75
7E5	.75
7F7	.75
7F8	1.65
7H7	.75
7L7	.85
7N7	.85
7S4	.95
7V7	.89
7W7	.95
12A6	.65
12A6GT	.65
12A7	.90
12AL5	.85
12AT6	.55
12AT7	.95
12AU6	.70
12AU7	.85
12AV6	.60
12AW6	1.20
12AX7	.90
12BA6	.69
12BE6	.69
12BH7	.90
12BN6	1.05
12C8	.69
12H6	.69
12J5	.50
12J5GT	.50
12K7GT	.75
12K8	.72
12K8Y	.90
12SA7	.78
12SA7GT	.79
12SC7	.89
12SF5	.75
12SF7	.81
12SG7	.85
12SH7	.68
12SJ7	.65
12SK7	.75
12SK7GT	.75
12SL7	.75
12SL7GT	.92
12SN7GT	.77
12SQ7	.70
12SQ7GT	.72
12Z3	.75
14F7	.85
14H7	.85
14J7	.85
19BG6G	1.83
19T8	1.05
24A	.85
25AV5GT	1.05
25BQ6GT	1.45
25C6G	1.47
25L6GT	.67
25W4GT	.68
25Z5	.65
25Z6GT	.65
27	.30
28D7	2.35
30	.30
31	.50
32	.47
35A5	.68
35B5	.67
35C5	.67
35L6GT	.67
35W4	.49
35Z3	.69
35Z4	.60
35Z5	.50
36	.64
37	.59
39/44	.25
40	.69
41	.69
42	.65
43	.65
45	.75
50B5	.75
50C5	.75
50L6GT	.65
50Z7G	.75
53	.68
54	1.35
56	.55
70L7	1.35
71A	.55
75	.82
76	.55
77	.55
78	.75
79	.75
80	.60
81	.75
83	1.10
84	.75
85	.69
89	.25
101A	.50
102A	.50
117Z3	.65
300B	3.75

TRANSMITTING

OA2	1.10
OA3	1.10
OA4G	1.10
OB2	1.30
OB3	1.15
OC3	1.05
OD3	.95
OZ3	.95
KC1	350.00
VG1A	8.75
1B21A	2.75
1B22	2.10
1B23	8.45
1B24	9.95
1B26	2.95
1B27	18.75
1B29	2.45
1B32	1.95
1B35A	17.50
1B36	16.75
1B37	19.95
1B38	39.95
1B41	45.80
1B42	10.00
1B44	37.50
1B50	27.50
1B51	12.50
1B54	27.50
1B56	37.50
1B63A	85.00
C1J	9.00
1D21	3.25
1L21	18.00
1L22	30.00
1L23	30.00
1L24	48.00
1L25	16.00
1L31	16.00
1L32	15.00
1L33	34.50
1L36	15.00
1L38	25.00
1N21	1.25
1N21A	1.95
1N21B	3.65
1N21C	17.50
1N23	1.00
1N23A	2.50
1N23B	3.50
1N25	4.50
1N26	6.95
1N34	.65
1N34A	.95
1N36	.55
1N43	1.65
1N47	8.50
1N58A	1.00
1P21	53.95
1P29	2.75
1P37	2.70
1P39	1.60
1P40	1.75
1Q26	100.00
2AP1	6.50
2AP1A	10.50
2B22	2.75
2C21	.69
2C22	.39
2C26	.59
2C26A	.59
2C33	3.65
2C36	27.50
2C39	24.50
2C39A	33.75
2C40	15.95
2C42	20.00
2C43	18.50
2C44	1.45
2C50	3.95
2C51	7.50
2C52	6.25
2D21	1.75
2E22	1.95
2E24	4.50
2E26	3.75
2E30	2.00
2E31	2.35
2E32	1.60
2E36	4.25
2E41	3.35
2E42	2.75
2G21	2.45
2G22	2.45
2H21	125.00
2J21A	7.50
2J22	10.50
2J26	17.50
2J27	17.50
2J30	69.50
2J31	27.50
2J32	27.50
2J34	27.50
2J37A	32.50
2K25	27.50
2RA3	1.95
2X2A	1.95
3AP1A	14.00
3BP1	5.25
3BP4	8.25
3B24	5.25
3B24W	7.50
3B26	3.75
3B27	3.95
3B29	14.95
3CP1	4.75
3C23	9.95
3C24	1.95
3C31	3.45
3C33	14.00
3C45	17.50
3D23	2.35
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3FP7	2.95
3FP7A	12.95
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3MP1	15.00
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4B24	6.50
4B26	7.75
4C35	33.50
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4J33	145.00
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C5B	3.95
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5BP4	4.95
5CP1	3.95
5CP7	12.50
5C22	50.00
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7BP7	10.50
10Y	.49
12DP7	17.50
12GP7	17.50
12HP7	17.50
CA13	.60
15E	1.75
15R	.79
FG17	5.25
RK20A	9.95
24G	1.85
FG27A	15.00
RK28A	14.75
FG32	15.00
FG33	23.00
RK34	.85
35TIG	4.25
35TG	4.25
35T	7.50
RK39	14.50
RK48A	9.50
EF50	1.30
53A	5.95
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FG67	22.50
CEQ72	.75
CRP72	.75
RKR72	.85
RKR73	.65
RK75	4.25
FG81A	9.25
FG95	27.50
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FG98A	27.00
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100TH	10.95
100TS	1.95
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FG105	24.95
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FG172	29.95
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203D	3.25
204A	59.50
211	1.25
CE213	2.50
217C	9.95
GL218	225.00
RX233A	3.95
FG235A	79.50
249B	6.50
250TH	21.50
250TL	18.95
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264C	3.25
270A	99.50
FG271	57.50
FG280	59.50
FP285	22.50
GL393A	13.25
304TH	13.95
304TL	13.95
307A	4.95
308A	55.00
CE309	5.25
310A	7.50
313C	4.15
316A	.75
327A	4.75
331A	3.50
8340	2.65
349A	1.35
350A	7.95
368AS	6.95
371B	1.25
393A	8.95
394A	4.95
417A	17.50
GL441	4.50
446A	4.95
446B	17.50
450TH	55.00
464A	8.95
471A	2.75
GL473	165.00
GL502A	1.80
WL530	17.25
WL532A	2.50
WL549	34.50
WL559	1.25
GL575A	18.50
GL592A	33.00
HY615	.29
GL627	22.00
WL651	65.00
F660	37.90
WL672	27.50
GL673	21.95
705A	2.35
706DY	59.50
708A	4.65
709A	3.75
713A	1.75
714AY	12.50
715	5.00
715A	6.25
715B	8.50
715C	22.50
717A	1.35
718BY	59.50
719A	24.50
721A	2.25
723A/B	18.95
724A	2.25
724B	3.15
725A	7.50
726A	14.50
726B	42.50
726C	52.50
8N729	3.45
730A	28.95
801A	.75
802	4.25
803	4.95
803A	11.50
805	3.95
807	1.69
807W	3.75
808	2.25
809	1.95
810	15.00
811	2.85
811A	4.50
812	2.75
812A	4.50
813	13.50
814	3.25
815	2.95
816	2.00
826	1.75
828	8.75
829	7.50
829A	9.95
829B	13.95
830B	2.95
832	6.95
832A	9.95
833A	50.00
835	19.00
836	4.45
837	1.65
838	2.65
841	.55
842	3.75
843	.75
845	13.50
849	39.95
851	59.95
852	27.50
857B	225.00
860	3.25
861	37.95
864	.39
866A	1.42
868	2.25
869B	145.00
872A	4.25
874	1.35
884	1.75
885	2.00
886	1.70
889A	225.00
891	250.00
892	250.00
905	3.95
926	2.35
927	1.45
929	1.50
930	1.50
931A	5.25
932	4.25
935	7.45
954	.49
955	.49
956	.49
957	.50
959	3.95
991	.39
CK1005	.95
CK1006	3.45
CK1089	1.25
CK1090	.75
R1111	3.50
R1131C	7.50
E1148	.35
1201	1.20
1203A	.79
1206	.85
1612	2.25
1613	1.60
1614	2.00
1616	1.25
1619	1.25
1620	6.26
1621	2.00
1622	2.15
1623	4.00
1624	4.00
1625	.49
1626	.49
1629	.49
1630	.95
1632	.85
1633	.85
1634	.85
1641	2.65
1642	.85
1851	1.65
2050	1.85
2051	1.15
4120	3.25
R4330	12.00
R4410	15.00
5516	5.00
5518	450.00
5528	12.75
5544	27.00
5545	34.00
5550	54.00
5551	75.00
5552	125.00
5553	250.00
5554	225.00
5555	325.00
5556	13.50
5557	7.25
5558	15.00
5559	17.50
5560	27.00
5561	39.00
5581	2.10
5588	125.00
5593	105.00
5610	.85
5620	13.20
5621	13.50
5622	13.25
5623	13.50
5624	13.50
5625	250.00
5626	22.00
5627	27.00
5628	27.00
5629	21.00
5632	12.75
5654	4.00
5662	1.35
5663	2.00
5670	7.00
5674	105.00
5680	250.00
5686	5.25
5691	7.45
5692	7.45
5693	5.95
5718	8.00
5720	23.00
5725	5.00
5726	2.25
5727	4.00
5728	27.00
5739	49.95
5740	89.50
5742	14.50
5743	14.35
5749	2.95
5750	3.10
5751	3.75
5763	1.65
5779	90.00
5797	12.75
5798	16.50
5803	5.75
5814	3.95
5824	3.35
5830	210.00
5840	12.00
5844	2.25
5855	89.95
5896	7.50
5902	10.75
5931	4.95
5963	1.25
5965	2.25
5973	375.00
5978	350.00
6005	5.25
6011	12.75
6044	42.00
6046	1.50
6072	5.00
6089	1.75
6135	3.00
6136	3.25
6137	3.75
6201	5.25
6653	.75
8000	14.95
8005	7.45
8008	7.60
8013	3.35
8013A	6.70
8020	2.35
8025	5.45
8025A	10.00
9001	1.65
9002	1.15
9003	1.65
9004	.95
9005	1.95
9006	.65

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INDEX SEARCHLIGHT

November, 1952

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ADVERTISERS INDEX

TO THE ADVERTISERS

November, 1952

SEARCHLIGHT SECTION
(Classified Advertising)
H. E. Hilty, Mgr.

WANTED! WANTED!

Needed for Government Defense Projects—all types of military electronic gear with the prefix TS, BC, SCR, APR, APS, etc. Highest prices paid or will exchange for your needs. No offer too small or too large.

WRITE! WIRE! CALL!

TEST EQUIPMENT

TS-34/AP SYNCROSCOPE AND OSCILLOSCOPE.

Used to test and service airborne and ground radars. Complete in portable carrying case with all probes, cables and accessories. Input 110v 60-2600 cyc.

TS-3/AP—S-Band Power Frequency Meter
TS-10/AP—APN-1 Test Set
TS-12/AP—X-Band V.S.W.R. Test Set
TS-13/AP—X-Band Signal Generator
TS-14/AP—S-Band Signal Generator
TS-15/AP—Flux Meter
TS-16/AP—APN-1 Test Set
TS-18/AP—Capacity Divider
TS-23/APN—SCR-718 Test Set
TS-33/AP—X-Band Frequency Meter
TS-35/AP—X-Band Test Set
TS-36/AP—X-Band Power Meter
TS-45/APM-3—X-Band Signal Generator
TS-59/APN—APN-1 Test Set
TS-61/AP—S-Band Echo Box
TS-62/AP—X-Band Echo Box
TS-69/AP—300-1000 MC Frequency Meter
TS-89/AP—Pulse Voltage Divider
TS-98/AP—Pulse Voltage Divider
TS-102/AP—Range Calibrator
TS-111/AP—S-Band Wavemeter
TS-118/AP—Power Meter
TS-125/AP—S-Band Power Meter
TS-155/UP—S-Band Signal Generator
TS-164/AP—Frequency Meter
TS-170/ARN-5—I.L.S. Test Set
TS-184/AP—Test Set
2S-226/AP—300-1000 MC Power Meter
TS-268/UP—Crystal Test Set
TS-278/AP—APS-13 Test Set
IE-19—SCR-522 Test Set
IE-36—SCR-522 Test Set
BC-221—Frequency Meter
BC-1277—S-Band Signal Generator
TBN/3EV—Thermistor Bridge
CW/60/ABM—S-Band Frequency Meter

FLUXMETER

Portable Gauss Meter with range of 500-4000 Gauss. Used to test Magnatron and other magnets. Probe has a gap of 1¼". Complete. Brand New $32.50

RECEIVING TUBES

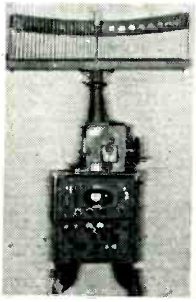
OA2	$0.95	6AK5	$0.88	6ST7	$0.9
OA4G	1.05	6AK6	1.09	6SU7GTY	2.7
OB2	1.05	6AL5	.52	6SV7	.9
OZ4	.59	6AQ5	.57	6V6	1.55
1A3	.70	6AQ6	.85	6V6GT	.6
1A7GT	.80	6AR5	1.25	6W4	.6
1B3/8016	.82	6AT6	.65	6X4	.6
1C5GT	.75	6AU5	1.19	6X5GT	.65
1D8GT	.65	6AU6	.59	6Y6G	.9
1G6GT	.65	6AV6	.55	6Y7G	.7
1L4	.67	6B4G	1.25	7A6	.7
1LA4	.85	6B7	.95	7B7	.7
1LA6	.95	6B8G	.75	7C5	.7
1LB4	.98	6BA6	.65	7C7	.7
1LC5	.75	6BC5	.75	7F7	.7
1LC6	.91	6BE6	.65	7N7	.8
1LN5	.75	6BF6	.72	7Y4	.5
1N5GT	.75	6BG6G	1.89	12A6	.6
1P5GT	.69	6GH6	.95	12A7	.9
1R4	.69	6BJ6	.95	12AH7GT	1.1
1R5	.65	6BQ6	1.25	12AT6	.5
1S4	.69	6C4	.55	12AT7	1.10
1S5	.65	6C5	.60	12AU6	.7
1T4	.65	6C6	.59	12AU7	.8
1U4	.67	6C8G	.85	12BA6	.6
1V	.65	6D6	.72	12C8	.6
1X2	.96	6D8	.85	12H6	.6
2A3	1.10	6E5	.79	12K8	.72
2X2	.50	6F6	.85	12SA7GT	.7
2X2A	1.55	6F7	.85	12SC7	.85
3A4	.65	6H6	.65	12SG7	.85
3A5	.85	6H6GT	.65	12SJ7GT	.65
3B7/1291	.42	6J5	.75	12SK7GT	.80
3D6/1299	.43	6J5GT	.55	12SL7GT	.75
3Q4	.63	6J6	.95	12SN7GT	.85
3Q5GT	.79	6J7	.95	12SQ7GT	.72
3S4	.74	6J7G	.60	12SR7	.72
3V4	.74	6K6GT	.65	14B6	.75
5R4GY	1.65	6K7	.79	14H7	.85
5T4	1.32	6K8GT	1.15	25L6GT	.65
5U4G	.69	6L6	2.25	25Z5	.65
5V4G	.98	6L6G	1.50	25/6GT	.68
5W4	.79	6L6GA	1.50	41	.69
5Y3GT	.45	6L7	.85	43	.65
5Y4G	.67	6N7GT	.85	45	.75
5Z3	.85	6R7	.79	50A5	.89
5Z4G	.95	6SA7GT	.65	50B5	.75
6A3	.95	6SC7	.95	50C5	.67
6A6	.82	6SF7	.75	50L6GT	.65
6A7	.89	6SG7	.75	50Y6	.72
6A8GT	.95	6SH7	.65	53	.68
6AB7	.98	5SJ7	.75	75	.82
6AC5GT	1.05	6SK7GT	.72	80	.65
6AC7	.95	6SL7GT	.75	83	.95
6AG5	.75	6SN7GT	.75	83V	.92
6AG7	1.45	6SQ7	.65	84/6Z4	.75
6AH6	1.29	6SR7GT	.68		
6AJ5	1.95	66SS7	.80		

R·H·S

RELIABILITY! HONESTY! SERVICE!

RADAR

APA-10—Panoramic Adaptor
APA-17—Automatic Direction Finder 250-1000 MC
APQ-5—Low Altitude Tracking & Bombing Equip.
APR-1—Radar Search Receiver 40-3400 MC
APR-2—Radar Search Receiver 85-1000 MC
APR-4—Radar Search Receiver 38-4000 MC
APR-5—Radar Search Receiver 1000-3100 MC
APR-6—Radar Search Receiver 3000-6000 MC
APS-2—S-Band Search Radar
APS-3—X-Band Search Radar
APS-4—X-Band Search & Homing Radar
APS-6—X-Band Search & Gun Laying Radar
APS-15A—X-Band Blind Bombing Radar
APR-4—Radar Jamming Xmitter 165-780 MC
APT-5—Radar Jamming Xmitter 350-1400 MC
SO-13—S-Band Marine Radar, Lightweight
SQ—10 CM Portable Radar
TPS-1—Portable Search Radar
TPS-3—L-Band Search Radar
UPN-1 & 2—S-Band Portable Beacon Battery or 110v AC



SQ 10 CM PORTABLE RADAR

This set is a very compact search radar. Complete installation available. New in carrying cases. Tech. data as follows: power input: 90-130v cy cyc.; pulse rate: 800 cyc.; range: 3, 15, 45 miles; pulse width: 1 microsec.: 300 yds. min. range, all ranges; I.F.F. synch. output available: accuracy ± 5°; power output 1 KW; beam width: 8° horiz. 15° vert.; presentation: A, B, P.P.I.

MOBILE POWER PLANT

(GAS DRIVEN)

Output: 220v — 3KW — 60 cyc. One phase. Excellent condition, checked out.

RA-34—Power Supply for BC-375E
RA-62—Power Supply for SCR-522
BC-1016—Ink Tape Recorder
PE-103—Dynamotor Power Supply
PE-104—Vibrator Power Supply
GN-58—Hand Cranked Generator W/Legs & Seat
SCR-578—Gibson Girl (Emergency Xmitter)
CRT-3—Victory Girl Dual Freq. Emergency Xmitter Sound Powered Chest & Headsets MI-2454-B; Type O, Mfg. RCA.
AS-32/APX-1—Antenna
ANICRC-7—V.H.F. Handi-Talkies 112MC Xtal Controlled.
MN/26-Y—Compass Receiver
BC-733D—Receiver with Tubes
C-3—Navy Snooperscope in Carrying Case
BC-1284—Lighthouse Tube Preamplifier
BC-996—Interphone Amplifier
RL-42—Motor Antenna Reel
30 MC—I.F. Strips Using 6AK5
RD-7/APA-23—Recorder for APR
AS-27/ARN-5—Antenna
ARA—Receiver—500-1500 KC
ID/80-APA-17—Indicator
R-28/ARC-5—Receiver—100-156 MC
RM-29—Remote Control
BC-455—Receiver—6-9 MC
BC-454—Receiver—3-6 MC
BC-800—Transmitter/Receiver
BC-950—Transmitter—100-156 MC
RA-300—FM Exciter (Mfg. Tempco)
FL-8—Filter
FL-5—Filter, Less Cables
3C-16-D GSAP—Gun Camera Computers with All Accessories: in Carrying Case
AT-2A/APN-2—Antenna

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ALL EQUIPMENT SOLD IS CAREFULLY RECONDITIONED AND CHECKED OUT TO ORIGINAL SPECIFICATIONS IN OUR OWN SHOPS USING FINEST LAB TYPE TEST EQUIPMENT

THESE COMPLETELY EQUIPPED SHOPS AND OUR EXPERIENCED TECHNICAL STAFF ARE AVAILABLE FOR GOVERNMENT PRIME OR SUB-CONTRACT WORK OR PRIVATE COMMERCIAL ORDERS ON ANY TYPE OF COMMUNICATIONS OR RADAR APPARATUS.

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2" SQUARE WESTON—SANGAMO

0-20 Volts D.C.	$2.95	0-5 Ma	$2.95
0-40 Volts D.C.	2.95	0-500 Microamp.	4.95
0.5 Amp. R.F.	2.95	0-100 Ma (0-300 scale)	2.95

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Provides Radio-Telephone Communication between Aircraft or Aircraft and Ground. Complete with Shock Mount and Control Box. Input: 28V DC. Excellent condition. Available in either 10 or 20 Crystal Controlled Channels 100-156 MCS.

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ARC-4—VHF Transceiver 140-150 MC
ARN-5—Glide Path Receiver
ARN-7—Airborne Directional Finder
ARR-2—Homing & Receiving Equipment
ART-13—Collins Autotune Transmitter
BC-223—30-Watt Transmitter 2-5.2 MC
BC-342—Receiver—1.5 to 18 MC 110v AC
BC-348—Receiver—1.5 to 18 MC 28v DC
BC-375E—Radio Transmitter
BC-639—VHF Receiver 100-156 MC
BC-640—VHF Transmitter 100-156 MC
BC-1206—Beacon Receiver 200-400 KC
RC-103—Airborne Localizer Receiver
SCR-269—Radio Compass
SCR-274N—Command Equipment
SCR-284—Field Radio Station
SCR-291—Semi-Portable Direction Finder
SCR-300—Field Transmitter and Receiver
SCR-522—VHF Transmitter and Receiver
SCR-536—Handi-Talkie
SCR-555—Semi-Portable Direction Finder
SCR-694—Portable Field Transceiver
SCR-625—Mine Detector
SCR-718A-AM-C—High Altitude Altimeter
T-50—Radio Telegraph Transmitter
TCS—Marine Telephone Transceiver

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OB3/VR90	1.19	28D7	11.95	866JR	1.2
OC3/VR105	1.19	30 Spec	.45	869B	65.0
OD3/VR150	.95	35T	3.25	872A	2.9
1B23	9.75	45 Spec	.32	874	1.1
1B24	9.75	100TH	7.95	878	1.5
1B27	14.95	211	.65	885	1.3
1B29	2.45	250TH	19.95	902A	9.9
1N21B	3.25	250TL	17.95	918	1.1
1N23	1.25	262B	3.95	922	1.2
1N23A	2.39	274B	2.95	923	.9
1N23B	3.69	304TH	8.95	927	1.0
1N34	.76	304TL	8.95	930	.9
1N34A	.97	307A/RK75	3.95	931A	4.4
2AP1	10.95	316A	.65	954	.25
2C40	7.50	328A	8.95	955	.3
2C43	14.95	350A	6.45	956	.3
2C44	1.19	350B	3.95	957	.39
2C46	7.95	368AS	7.50	959	.45
2C51	6.25	371A	.95	959	3.95
2D21	1.35	371B	.69	991/NE16	.35
2E22	1.75	393A	7.95	1603	7.99
2E24	4.65	394A	3.95	1613	.39
2E26	3.15	417A	8.75	1616	.69
2K25/723AB	28.75	434A	27.50	1619	.24
		446A	1.15	1622	2.45
2K28	32.50	446B	3.75	1624	1.45
2K33A	310.00	575A	15.75	1625	.35
3AP1	9.95	701A	5.75	1626	.25
3B24	5.25	703A	5.25	1629	.25
3B24W	7.95	705A	1.65	1630	.75
3B26	3.59	707B	13.95	1632	.72
3BP1	5.95	714AY	7.95	1638	.45
3C22	115.00	715A	6.39	1851	1.55
3C24/24G	1.75	715B	8.75	2051	1.18
3C45	15.95	715C	19.95	5670	6.95
3CP1	1.95	717A	.98	8008	5.95
3CP1S1	1.95	721A	2.45	8011	.90
3DP1	4.45	723A	9.50	8012	2.65
3DP1A	6.95	723A/B	19.95	8013	2.59
3DP1-S2A	8.95	724B	3.25	8020	.98
3D21A	3.25	725A	6.75	9001	1.50
3E29	13.95	726A	18.95	9002	.98
3FP7	1.65	730A	29.50	9003	1.65
3GP1	4.39	800	1.75	9004	.35
4-125A	27.50	802	3.95	9005	1.45
4-250A	37.50	803	3.25	9006	.27
4AP10	4.45	804	11.75	C1JA	9.95
4C35	27.50	805	3.75	C6A	7.95
4E27	14.95	806	24.95	C6J	6.39
5AP1	3.45	807	1.59	CK1005	.48
5AP4	3.45	808	2.69	F123A	7.75
5BP1	4.45	810	9.50	F127A	27.50
5BP4	4.45	811	2.85	F128A	89.50
5CP1	4.59	812	2.75	FG17	4.89
5CP7	11.75	813	11.75	FG27A	4.95
5D21	19.95	814	2.69	FG32	8.95
5FP7	1.85	815	2.35	FG57	14.95
5GP1	4.85	816	1.05	FG81A	3.49
5JP1	24.45	826	.69	FG105	17.95
5JP2	22.50	828	9.95	FG172	33.50
5LP1	22.50	829	10.95	GL434A	29.95
5NP1	5.50	829B	12.95	GL502A	1.79
6AN5	3.30	830B	2.75	HF100	8.95
6AS6	2.50	832	6.75	HF300	22.45
6AS7	4.45	832A	8.50	HY114B	.69
6C21	21.00	836A	3.49	HY115	.69
6J4	6.75	837	1.45	ML101	47.50
7BP7	6.55	838	2.25	REL21	1.95
7DP4	14.50	845W	4.25	RK60/1641	2.25
9LP7	4.95	849C	27.50	RK65	26.50
10BP4	17.45	851	47.50	RK72	.48
10Y	.39	860	3.95	VT127A	2.45
12DP7	14.75	861	22.50	WL616	34.50
15E	1.35	865	.98		

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RADIO HAM SHACK Inc.

191 GREENWICH STREET . NEW YORK, N. Y.

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All 115 V 60 Cyc Input TV & CR Pwr Xfmr up to 20" Tubes. Hi VOLTS to 20 KV (w/quadrupler ckt.) ALL Tubes. PL & FIL wndgs & 300 VDC/275Ma Full-Wave. 6.4V/10.3A. 5.4V/8A. 2.5V/3A Hypersil Core. Oil Impreg. **$6.49**: Two for........**$12.49**
2500V for CRT, 6.3V/.6A. 2.5V/1.75A CSD Kenyon Hvins, 4/BC412........**$7.98**
1320V & 375VCT/110MA, 5V/3A. 2.5V/3.25A; 6.3V/2.75A HSLD HVINS........**$8.98**
1000VCT 200MA, 18V/.55A, 6.3V/5A, 5V/6A........**$6.98**, Two for........**$12.98**
1000VCT/45MA, 795VCT/80MA, 360VCT/55MA. 3X5V/3A, 6.3VCT/1A, 6.3VCT/.3A CSD HVINS CAN BE USED 2X RATING RAYTHEON HIPERSIL CORE........**$4.98**
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900V/3MA, 6.3V/2A, 2.5V/3A........**$2.98**
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720V/85MA, 5V/3.5A, 6.3V/3.5A........**$2.98**
700VCT/120MA, 2X6.3V/3A, 6.3V/1A Price........**$3.98**: Two for........**$7.25**
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650VCT/150MA, 5V/3A, 6.3V/2.1A........**$2.98**
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420VCT/90MA, 6.3V/1.9A W/INPUTS 6, 12, 24, 115VDC & 115 230VAC @........**$1.98**
550VCT/150MA, 5V/3A, 6.3V/5A........**$3.49**
220V/50MA, 6.3V/2A, 6.3V/1A, 5V/6.5A **JEFFERSON H'SLD**........**$1.89**

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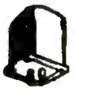

Dual 30 Hy/60ma Csd........$ .98
15Hy/40ma AC/DC sets. 3 for .98
12Hy/80ma/3KVins........2.25
10Hy/75ma........1.25
10Hy/125ma/UTC/Csd/H'Sld/1KVins........1.69
50Hy/125ma/Csd/H'Sld........2.89
12Hy/300ma/5KVins........4.95
20Hy/300ma or 15Hy/400ma/12KVins........8.95
13.5Hy 1A/17KVins/Raytheon........45.00
10Hy 200ma Hmsld Jefferson........2.95
8 HY 225ma Thordason........3.50
Dual 2Hy/300ma USN..$1.25; 2 for........1.98
8Hy/400ma 12KVins........3.49

FILAMENT TRANS.

2.5V/2A @ 79c, 2 for $1.49, 10 for........$6.49
2.5VCT/10A 5KVINS........3.59
2.5VCT/20A/12KV INSUL CSD HSLD........7.98
5VCT/10A, 4KV INSUL CSD HSLD........5.95
5VCT/10A/12KV INSUL G.E........8.25
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5V/115A CSD KENYON HVINS........16.95
6.3VCT/.6A 1KV INS CSD HVINS........1.98
6.3VCT/.7A NAVY HSLD HVINS........1.98
6.3VCT/1A HVINS CSD........1.98
6.3VCT/4A USN USABLE 6.5A CSD........2.69
6VCT/5A, 6V/5A, 5VCT/5A........6.95
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12.6VCT/1.25A CSD HMSLD........1.98
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15VCT/2A PRI 110V or 220V........3.95
24V/6A CSD @ **$4.98** Two for........9.49
42.5V/2A SEL RECT TRANS........4.85
INPT 110 & 220 V., OUTPT 12.6 VCT/3.5A, 16.6V/1.25A........6.98
6.3V/.6A, 2X2.5V/1.75A HSLD........3.49
2X2.5VCT/6A, 2.5VCT/12A/12KVINS BRIDG. RECT UTC CSD........8.49
2X6.3V/.3A, 5V/3A, 5V/6A, 7V/14A GE CSD........**$5.98**; Two for........**$11.49**

PLATE TRANSFORMER

2X330VCT/25MA or 660VCT CSD........5.98
1100VCT/212MA; PRI 115 CASED........6.50
3000V/10MA CSD WE D161913........8.95
5500VCT/650MA USN WSTGHS CSD........69.95
15000V AS V'DBLR WE. SIG 3H5629/7500V/35MA........19.95

400 CYCLE XFMRS

G-E M7472401P1 3140, 3030, 2920, 2810V/35 Ma........$4.98
WE KS9608 1233vct/350Ma, 1140vct/70Ma 5.98
G-E M7472443P1 788V/200Ma, 210V/15Ma, 5V/2A........4.95
G-E M7472469 6.3V/7A, 6.7V/.9A, 6.3V/.3A........3.98
WE KS9604 6.3V/4.65A, 6.3V/.3A........3.49
WE KS9603 6.3V/3A, 5V/2A........2.98
WE D163412 6.3V/1A........1.95
LANGEVIN 702556 6.3V/.6A........1.49
FREED 11686 5V/10A........4.95
WE KS9602 5V/4A........2.98
FREED 11685 2.5vct/10A CSD........4.95
LANGEVIN 702720 5V/6A, 13 KVINS........4.98
WED164533 6.3V/1.25A, 6.3V/1.25A........1.98

RHEOSTATS

2 ohm 50W Model J........$2.59
6 ohm 25W Model LH........1.98
15 ohm 25W w/knob........1.98
15 ohm 75W Model G........3.74
20 ohm 50W Model J........2.35
60 ohm 50W w/knob........2.69
100 ohm 50W Model K........2.25
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, 25 watt........**79c; 3 for** 2.00
1000 ohm 25W Model J........2.19
7500 ohm 50W Model J........2.59
Write For Special Price on (5) or More

ALIGNMENT TOOLS

Ideal NO-LOSS Alignment Screwdriver TL150, Long Insulated Shaft. Sure-Grip Knurled Knob. Only........**49c**
RELAY Spring Adjuster & Switch-Bd Tool Slot takes up to .022". WEC No. 293..**98c**
Feeler Gauge for Relay, Telephone & Teletype contact, 8 Detachable sizes........**98c**

MODEL HF-1 OSCILLOSCOPE

Laboratory Features. 5 M C Bandwidth, 10MV Sens. PP Horiz & Vert Amp. Cathode Coupled Multi Vib Swp. Int Retrace. Cathode F'lwr Inpt Vert & Horiz Amp. Non-Freq Discrim Gain Cntrl. Cal Compensated Attenuators. Sync Pos or Neg. Intrnl or Extrnl. Inbuilt Cathode F'lwr for Sig Tracing with Phones. Tech. Manual. 13 Tube. Line up. 3—6C4, 4—6AG5, 2—6AG7, 2—6X5, 1—6J6, 1—3BP1 C'Ray Tube. **All Data Diagrams.**

A "TAB" SPECIAL only $99.50

"TAB" THAT'S A BUY

UHF ANTENNA

UHF ANTENNA 12"/30CM AT5/ARR1 Usable Citzn & Ham Band Ins. Coax Term Silv Pl Cont Gask & H'ware Mobile Mtg....**39c; 4 for $1.00**
PL259 for above.........65
TV CONICAL ANTENNA All Channel Sturdy Prefab Const. Inclds 8 elements & 100 ft. Copper Twinex Cross Bar & Hdware. Brand New........$6.25
MICROWAVE ANT AS125/APR. 1000 to 3400Mc w/UG58U Term InBuilt HiPass Fltr Flange Mtg Incl. H'ware........$5.98

SECTIONAL ANTENNAS

MS49-52, 12½ ft........$1.69
MS49-53, 16 ft........2.49
BASES: MP22..3.98: **MP48**..3.98: **MP47**..3.75

Test Equipment Buys

EE65 Telephone Test Set Good Cond........$24.98
I-198 Sig Gen Good Cond., Less Tubes Range 7–15MC........14.95
BC906 Freq. Mtr. Less Tubes........29.95
BC221 Sig Gen. Exc. Cond........125.00
I-222A Sig Gen. 115V/60cy........129.50
I-222A Sig Gen. As Is........59.95
General Electric Television Test Equip. Nothing Finer to Open Your Service Clinic with. 3 Units Like New. Marker Generator, ST-5A. Sweep Generator ST-4A, 5" Oscilloscope ST-2A. One Complete Set, First Order Takes This "TAB" Special........$895.00
GE Sig Generator, 9 to 11 Cm. Direct Reading Pulse/CW........Write

PULSE TRANSFORMERS

7.5 KV Pulse, Pri 4KV, 50–1000 ohm Imped. Permalloy Core, WEco........$14.98
Pulse Blocking Osc. 3 wndgs. Video Interstate, 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 windgs, 1:1:1 ratio, 4.3 mh windgs, GE, H'Sld, HiVins, 1, Micro Second rise time........$2.98
PULSE SHAPING Xfmr Raytheon UX12819, 1 MU Sec. 2000 CY........$6.95
UTAH 9340 P/O CP-5A/APS15........$9.00
Write for Details on Pulse Units

MICROWAVE

Klystron Mtg Assy (723 AB) & Coupling to 2 Type "N" Co-Ax Fittings..**$9.98**....Two for **$18.00**
1 Microsecond Delay Line....**$2.95**
Microwave Lighthouse Assy—P/O RT39 Apg & 15, osc and Tr Cavities, Type N Coupling. Uses 2C43, 2C40, 1B27. Tunes 24–2700 MC Less Tubes **$22.00; 2 for $40.**
3cm T-Sect. Waveguide & Atten. Output. Thermal Comp & Pwr Meas Thermistors Xtal Diode Detector Mtg. & C'ling $18.95........**2 for $35.00**
Less Xtal Mtg. & Thermistor........**$13.95**
3MC X-Band Wave Meter 9285-9465MC $29.95

SELSYNS

2J1H1 GE Selsyns........2 for $6.98
2J1F3 GE Brand New 115V/400 cy. ea........9.75
C78248 Sync. Trans. 115/60 cy **$39.95**: 2 for **75.00**
C78249 Sync. Diff. 115V/60 cy **12.95**..2 for **25.00**
Sync Trans. C-69405–2 Type I-I........2 for 90.00
Sync Repeater 115/60 cy Type 11–4 New **$52.00**........2 for 99.00
Bendix Autosyns AY1 & AY5........2 for 4.95
Bendix AY20 New Orig Crtns........12.98

DYNAMOTORS

INPT 6VDC. Output 200V/100ma, or 12/24V Output 500V/50ma P' Magnt. As Illustrated.. 6.95
Inpt 28VDC/1.4A out 250V/60ma........3.69
DM412&24V out **225V/100ma**, 440V/200ma. 11.98
DM53A 28V/1.45A out 220V/80ma........4.25
DA3A 28V/10.5A out 300VDC/260ma 150VDC/10ma, 14.5vdc/.5A........6.75
PE94 Plate Supp., Uses DA3A (SCR522)........8.98
PE97 Plate Supp., Less Tubes........9.98
INPT 6VDC/27.5A Oupt 590VDC/150MA Carter Mag Motor........29.95

OIL CAPACITORS

Mfd.	Each
50 wvdc	
4	.49
150 wvdc	
1-1-3-5	.98
250 wvdc	
2x.25	.35
300 wvdc	
1.2	.39
400wvdc	
.1	.49
.5	.59
1	.69
4	1.69
6	2.29
8	2.49
10	2.89
2x.1	.75
2x.5	.94
3x.1	.91
3x.25	.99
600wvdc	
.034	3.69
.1	.52
.25	.61
.5	.65
1	.75
2	.92
3	1.08
5	1.98
6	2.69
7	2.89
10	3.29
2x.1	.79
2x.25	.85
2x.5	.98
2x1	1.19
2x2	1.39
2x8	3.49
3x.05	.89
3x.22	.98
3x.25	1.09
700wvdc	
4	1.98
800wvdc	
.1	.69

Mfd.	Each
1000wvdc	
.45	.79
1	1.09
2	1.69
5	2.98
15	4.98
1400wvdc	
.25	1.29
.5	1.39
1500wvdc	
.5	1.49
.75	1.69
1	1.79
5	3.49
6	3.98
2000wvdc	
.1	1.49
2x.1	1.75
1	1.89
2	2.98
3	3.69
8	9.49
2500wvdc	
.25	2.29
3000wvdc	
.1	2.49
.5	2.98
2	4.49
3	6.98
4	7.98
4000wvdc	
2	8.98
5000wvdc	
.2	4.49
2	10.98
4	19.98
7000wvdc	
.002	1.69
.0075	1.98
.1	4.98
7500wvdc	
.03	2.98
.05	3.49
10000wvdc	
.03	3.49

Mfd.	Each
12500wvdc	
2	95.00
15000wvdc	
.0016	9.98
25000wvdc	
.00025	7.49
1	95.00
AC RATED	
220vac/600dc	
2	.69
4	.89
5	1.29
225vac/630dc	
3.3	.79
230vac/630dc	
5	1.29
330vac/1000dc	
1.25	.79
1.5	.89
1.75	.98
2	.33
2.5	1.09
2.8	1.15
3	1.19
4	1.29
5	1.49
15	3.98
25	6.49
405vac/1200dc	
15	1.29
600vac/1800dc	
16	6.98
660vac/2000dc	
5	4.49
6	4.98
10	6.98
16	7.98

2MFD/330VAC/1000VDC CD" Rd. Can........**3 for $1; 12 for $3.50; 100 for $25.**
9MFD/220VAC/600VDC Each $1.00 12 for $10.
QUANTITY USERS. WRITE FOR SPECIAL PRICES

PRECISION RESISTORS

Over 2½ Million in Stock

"TAB"—Specialists in Precision Resistors
No Mfrs Choice—We Ship Types in Stock

0.116	271	1225	3333	16500	110000
0.42	275	1250	3384	16800	115000
0.425	290	1260	3500	17000	116667
0.607	296	1300	3509	17500	120000
0.7	289	1350	3600	17977	130000
1.03	299	1355	3700	18000	135000
1.3	300	1400	3730	18300	140000
1.75	310	1488	3760	18380	141000
2.5	311.5	1495	3900	18500	145000
3	320	1500	4000	18800	147000
3.83	325	1510	4030	19000	150000
4	330	1518	4200	19500	155000
4.35	340	1600	4220	20000	160000
5	350	1640	4280	20441	165000
5.025	360	1646	4300	20500	166750
6.25	366.6	1650	4314	21000	167000
6.5	370	1670	4440	21500	169200
7	375	1680	4444	22000	175000
7.8	380	1710	4500	22500	180000
7.9	389	1712	4700	22990	180600
8	390	1740	4720	23000	185000
10.38	400	1770	4750	23150	186600
11.25	410	1800	4850	23325	190000
12	414.3	1818	4885	23400	198000
13.52	418.8	1830	4900	23500	200000
14.2	425	1850	5000	24000	201000
14.25	426.9	1865	5100	24600	205000
14.5	427	1892	5210	25000	210000
15	430	1894	5235	25200	215000
16	440	1895	5270	25400	220000
17	450	1896	5300	25833	225000
19	452	1897	5500	26000	229000
19.2	460	1898	5600	26500	230000
20	470	1899	5730	26600	235500
22	475	1900	5770	27000	238000
23	478	1901	5910	27500	240000
24	480	1902	6000	28000	245000
25	487	1903	6100	28430	250000
26	500	1904	6125	28500	265000
28	510	1905	6140	29000	268000
30	520	1906	6200	29500	270000
31.5	525	1907	6300	29990	275000
37	540	1908	6495	30000	294000
48	550	1909	6500	31000	300000
49	560	1910	6800	31500	307500
50	575	1911	6840	32000	311000
51.78	580	1912	6990	33000	314000
55	588	1913	7000	35000	316000
56.7	600	1914	7320	36000	325000
60	612	1915	7500	37000	330000
63	620	1916	7700	38140	333500
68	625	1917	7717	38500	350000
74	633	1918	7900	39000	353500
75	640	1919	7930	39500	375000
80	641	1922	7950	40000	380000
81.4	645	1924	8000	41400	390000
88	649	1926	8094	42000	400000
89.8	650	1960	8200	43000	402000
95	657	1980	8250	45000	420000
100	665	2000	8500	47000	422000
101	670	2045	8700	47500	425000
103.2	673	2080	8770	48000	430000
105	675	2095	9000	48660	450000
105.7	680	2141	9100	49000	458000
107	681	2142	9445	50000	470000
110	684	2145	9500	51000	472000
120	689	2150	9710	52000	478000
121.2	697	2160	9800	55000	500000
125	699	2180	9900	56000	510000
130	700	2187	9902	57065	520000
135	711	2195	10000	58333	521000
147.5	733	2200	10430	60000	525000
150	740	2250	10500	61430	543000
160	750	2300	10600	62000	550000
165	800	2400	10900	64000	560000
170	806	2450	10936	65000	570000
175	820	2463	11000	66600	575000
179	850	2485	11400	66650	600000
180	854	2490	11500	67500	620000
182	899	2500	11690	68000	650000
182.4	900	2525	12000	70000	654000
200	910	2600	12500	72000	660000
209.4	917	2625	12800	73500	680000
210	946	2635	13000	75000	690000
216	978	2700	13100	80000	700000
220	1000	2750	13500	82000	750000
220.4	1030	2850	13550	84000	761300
225	1056	2860	13600	85000	800000
230	1059	2870	14000	85750	813000
235	1067	2900	14250	88000	820000
240	1100	3000	14400	90000	850000
245	1110	3100	14500	91000	860000
245.4	1150	3163	14550	93000	900000
250	1155	3259	14600	93300	910000
260	1162	3290	15000	95000	930000
270	1200	3300	16000	100000	950000

Any Size Above. Each 35c; Ten for $3.29

MEGOHMS

1.	1.579	2.7	4	6.7	10
1.1	1.65	2.75	4.23	7	11.55
1.2	1.75	2.8	4.25	7.5	12
1.25	1.8	2.855	4.5	7.62	12.83
1.3	1.9	3	5	7.74	13
1.35	2	3.3	5.1	8	13.85
1.39	2.11	3.5	5.5	8.02	30
1.4	2.2	3.673	6	8.5	51
1.5	2.25	3.75	6.5	9.05	
1.57	2.5	3.9	6.6	9.5	

Any Size Above. Each 70c: Ten for $6.49

POTENTIOMETERS—Type J

5 ohm Type J ¾" shaft. $.93
200 ohm Type J ½" Slotted shaft......**93c: 12 for $10.00**
1000 ohm Type J ¾" shaft......**93c: 12 for $10.00**
3500 ohm Type J ¾" shaft......**93c: 12 for $10.00**
7K ohm Type J ½" Slotted shaft......**93c: 12 for $10.00**
25K ohm Type J ½" Slotted shaft......**93c: 12 for $10.00**
50K ohm Type J ¾" shaft......**93c: 12 for $10.00**
100K ohm Type J ¾" shaft......**93c: 12 for $10.00**
1 meg Type J ½" Slotted shaft......**93c: 12 for $10.00**
1 meg Type JJJ (Triple) 1¾" shaft......3.69

HIGH CURRENT MICA CNDRS CYLINDRICAL SIMILAR TYPE "G"

MFD	KV	AMPS	MC	EACH
.01	10	30	3	49.50
.0025	20	22	3	45.00
.0025	12	20	3	28.95
.001	30	30	3	110.00
.0012	20	16	3	35.00
.002	20	22	3	40.00
.005	10	30	3	32.50
.004	12	20	3	34.00

METER SPECIALS

0-30VDC "AN Type 1.95......**10 for 17.50**
0-1Ma 3" Round........$7.50
0-25Ma. Weston 3" sq........6.98
0-100Ma 2½" Rnd........5.98
0-50 Micro Ammeter 3" sq. Weston. 16.98
-20 +3 VU. Weston Vol. Level Indict 16.98
0-150V A.C. 3" sq. Weston Rect. Type 8.98
57-63 Cycles Freq. Mtr. 3" RND........4.98
0-120MA RF 3½" Rnd Weston........14.98
0-800Volt DC Weston 3" Sq........12.98

NEW THRIFT-LITE LIFETIME PHOTO-FLASH

Not a kit. Incl. Pwr pak, Life gtd Lamp, Rflctr & 15' cord flash every 7 sec. True daylight color. Usable all cameras oper 115VAC w/lite Gun Type AC40, Dlvd U.S.A..**$38.00**
Complete Outfit for AC & Battery opr. Incl. AC40 & BP25 portopak & all accesrs for KODAK & COMPUR shutters. Dlvd U.S.A........**$56.00**
AD15 Intensifier, Doubles Light Output of Basic Unit. Dlvd U. S. A........**$15.85**
AC-45F 115V/60cy Flash Unit. Features Selective Time Delay. Up to 30 Millisecond. Complete W/Lifetime Flash-Bulb. Dlvd U. S. A....**$49.00**

TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W-Sec. Max.	Each
U10	GE FT114	100	$7.25
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT 210	200	9.98
53GT	GE FT 403	500	13.50
VA	SYLV. 4330	200	9.98
23MT	FT 214	250	9.98
22ST	FT 110	200	9.98
353GTQ	FT 503	5000	49.98
V4X4	X400	200	10.98
DX	SPRGFA100	150	9.00
U5W	GE-FT105	100	5.98

Write for Complete "THRIFTLITE" Data Boosterpacks, Ext lites, Units for Focal plane shutters & accessories. We Buy Sell & Swap.

PHOTO FLASH PWR SUPP KIT

1800VDC/35MA. Using Doubler Crkt. Transformer. Rectifier Socket. Condensers. Resistors Diagram. W/Flash Tube V4X4/X400. Rated 200–300 Watt Sec 115V/60cy oper........**$29.98**

PHOTOFLASH CAPACITORS

2x.36MFD Total .72MFD Per Unit. 30 Units 21.6MFD 1800VDC/38 8 W. Sec... **$4.98**
30 Units 21.6MFD/3000VDC 64 8 W. Sec.. **6.98**
Save on Replacements, Write for Details
15MFD/330VAC/1500VDC Intermittent....**$3.98**
25MFD/330VAC/1500VDC Intermittent.... **6.49**
16MFD/600VAC/2800VDC Intermittent.... **6.95**
16MFD/660VAC/3000VDC Intermittent.... **7.95**
32MFD/1.2KVDC/23W. Sec........**7.49**
27MFD/460VAC/2KV Int. 54W. Sec.........**8.95**
4.5MFD/660VAC/3KVDC Int. 20W. Sec.... **4.25**
26MFD/330VAC/1.5KVDC Int. 29W. Sec... **6.98**
2X.44MFD, Total 88MFD Per Unit. 25 Units Equals **22MFD/660VAC/3KVDC Intermittent, 99W. Sec.**........**7.49**

TUBE CLAMPS

926B-5, 926B-16, 926B, 929-1, 930-19, 926B-19, 926A-10........**5 for $1.00**

"TABS" TUBE SPECIALS

BROKEN KEYS—ELECTRICALLY PERFECT

1B3GT, 6H6, 6K6GT, 6SN7GT 12SN7GT........**Each 50c; 5 for $2.00**
6BG6G, 6BQ6GT, 12SG7, 19BG6, 6L6G, 6L6GA........**Each 79c; 3 for $2.00**

VARIABLE CONDENSERS

150mmf/300VGap HF........$1.39
BUD Dual 75mf ea. Sect 1000V Gap. HF...$1.29
JOHNSON 70H30 70 mmf/3000V Gap......$1.29
Cardwell Neut ZT/12 mmf 500 Volt Gap......98c
Vernier Drive 10 to 369mmf, each......69c
Midget 3 to 15 mmf. Midline, each......39c
2½ Meter Butterfly Cndsr 30mmf w/RF Tank & Choke........**59c; 2 for 98c**

LINE FILTERS

10 Amp/130vacdc Cad USN 0.1 to 1000 Mc's........$1.29
30 Amp/250vacdc Cad USN 0.1 to 1000 Mc's........$3.98 ; **2 for $6.00**
50 Amp/600vac/250vac. Fltrs both sides of line. SOLAR "Elim-O-Stat" New........$9.98
100 Amp/usable 110 vacdc GE........**2 for $1.98**

MICA CAPACITORS

Brand NEW Made to Rigid Gov't Specs.

Fig. B. .001 mf. **10c**; .006 mf. **23c**; .01 mfd. **35c.**

Fig. C. Solder Lug Terminals & Mtg Holes

Mfd.	Each
600 WV	
.0001	$0.29
.001	.42
.002	.45
.004	.53
.005	.55
.006	.59
.008	.63
.01	.66
.02	$0.76

Mfd.	Each
600 WV	
.03	1.19
1200 WV	
.002	.66
.004	.68
.005	.71
.01	.78
2500 WV	
.00047	.59

Fig. D. Screw Term & Mtg.

Mfd.	Each
600 WV	
.0001	$0.29
.00055	.37
.00085	.42
.0012	.44
.003	.49
.005	.54
.015	.71
.02	.78
.03	1.19
.033	1.29
.039	1.98
.04	2.09
.05	2.39
1200 WV	
.001	.61
.002	.66
.0051	.71
.0068	.75

Mfd.	Each
1200 WV	
.01	$0.78
.013	.89
.03	1.89
.033	2.39
2500 WV	
.0004	.59
.002	1.09
.0022	1.09
.0024	1.13
.0035	1.19
.0036	1.19
.0043	1.29
.005	1.45
.006	1.55
.01	1.89
.015	2.19
3000 WV	
.005	1.65

Fig. E. Upright Xmtg Micas

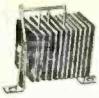
Mfd.	Each
250 VDC	
.05	$0.47
.2	2.59
1500 VDC	
.04	.89
.05	1.08
2000 VDC	
.003	1.08
.005	1.19
.006	1.25
.01	1.39
.015	1.68
.02	1.98
.03	2.35
2500 VDC	
.0025	1.08
.006	1.65
3000 VDC	
.00005	.78

Mfd.	Each
.0001	$1.08
.0003	1.15
.0007	1.19
.0055	1.39
3000 VDC	
.0055	1.35
.008	1.79
3500 VDC	
.000033	.78
5000 VDC	
.000082	1.65
.0001	1.79
.00015	2.29
.00018	2.39
.0003	2.75
.00043	2.85
.0006	3.59
.001	3.89
.01	4.79

THAT'S A BUY **"TAB"** THAT'S A BUY

Dept. 11E 111 Liberty Street New York 6, N. Y., U. S. A. STORE: 111 LIBERTY STREET

Money Back Guarantee (Cost of Mdse Only) $5 Min. Order FOB NYC. Add Shpg. Charges & 25% Dep. Tubes Gtd via R-Exp. only. Prices Subject to Change Without Notice. Phone RECTOR 2-6245.



SELENIUM RECTIFIERS

We specialize in Rectifiers and Power supplies to your specifications. Immediate delivery.

Current (cont.)	18/14 Volts	26/18 Volts	36/28 Volts	54/40 Volts	130/100 Volts
2AMP	2.20		3.60	6.50	10.50
4AMP	3.75		6.75	8.75	
5AMP	4.95		7.95	18.00	27.00
10AMP	6.75	9.98	12.00	20.00	40.00
12AMP	8.50		16.00	25.50	50.00
20AMP	13.25	16.20	24.00	36.00	90.00
24AMP	16.00		31.00	39.50	98.00
30AMP	18.50	24.30	36.00		
36AMP	25.50		45.00		

Full Wave Selen Rect & Trans. in Kit Form.
All 115V/60cy inputs. V
up to 14VDC at 12 amps 23.98
up to 28VDC at 12 amps 31.98
up to 28VDC at 48 amps 149.50
up to *20VDC at 6 amps 12.98

RECTIFIER XFMRS

18.8—19.2—20.4—21.4 Volts/12 Amp $14.98
31—32—34—36 Volts/12 Amp 2 Kvins ... 16.98
18—12—9—CT—9—12—18V/4 Amp 8.75
18—12—9—CT—9—12—18V/12 Amp 16.75
36VCT—24V—18V/24 Amp 35.75

BATTERY CHARGER RECTIFIER

10-0-10 Volt Ct. 120 Amp (Fan Cooled) Selenium Rectifier. Replaces Old Inefficient Sulphur Oxide Types. "TAB" Special $13.75
WRITE FOR QUALITY PRICES

SELENIUM POWER SUPPLY

0 to 12VDC/2 Amp. Variable DC supply, uncased and completely built—inpt. 115v/60 cy. Usable LAB supply, filament D.C. plating, battery charging, model railroad, includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives $10.95
2 for $20.0 0

"TAB" THAT'S A BUY

FUSES & HOLDERS

3AG: 1/8, 1/4, 1/2 Amp. Ea 5c
3AG: 1, 1 1/2, 2, 3, 4, 15, 20 Amp. Ea. 3c: .... 100 for 2.49
3AG: Slo-Blo; 10, 20 Amp... 20 for 1.50
4AB: BUSS 10 Amp. 7c; ... 100 for 5.98
4AG: 1/4, 1/2 Amp. 7c; .... 100 for 5.98
4AG: 3, 5, 10, 15 Amp. Ea. 5c; ..... 100 for 3.98
4AG: Slo-Blo: 3, 10, 15, 20 Amp. Ea. 9c: 100/7.98
5AB: BUSS, Littelfuse, 5 Amp. Ea. 4c; 100/3.00
5AG: 35, 80 Amp. Ea. 5c; .... 100 for 3.98
7AG: 0.2 Amp. Littelfuse, Ea. 9c; ... 100 for 7.98
8AG: 1/32, 2/10, 1/2 Amp. Ea. 8c; ... 100 for 6.98
HOLDER 1075 Littelfuse 20c; .... 10 for 1.75

ONE YEAR GTD TV PICTURE TUBES

10 inch Round	$14.95
12 inch Round	17.95
12 inch Metal	21.98
14 inch Rectangular	20.95
16 inch Glass	22.95
16 inch Metal	23.98
17 inch Rectangular	23.49
19 inch Round	27.98
20 inch Rectangular	29.95
21 inch Rectangular	30.98

Your old pict. tube is worth money, write for trade-in-allowance toward RMA coded and dated tubes with one year guarantee. Ship your defective picture tubes prepaid only.
When ordering metal tube, defective metal tube is required.

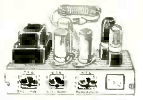
866A KIT AND XFORMER

2 Tubes, Sckts, xfmr 115v 60cyc Inpt, outpt. 2.5vct. 10A/Hvinsul $6.98

DIODE PROBE TUBE

Unexcelled for No-Loss VHF testing. Ultra-sensitive subminiature-envelope. New, w/data VR92 .... 25c; 5 for $1.

Audio Amplifiers



Model 600AA 10 Watt Hi-Fidelity Ampl. in the Low Price Range. Features Mike & Phono Inpts, w/ Separate Gain Cntrls. Uses Inverse Feedback for Base Boost. W/Tone Cntrl. Chassis is Finished in Hammered Bronze Enamel. Complete W/6 Tubes $24.98
Model 305MP 5 Watt Ampl, as Pictured Above Features Mike & Phono Inpts. W/Sep. Gain Cntrls. Latest Compensated Tone Cntrl Design. Complete W/3 Tubes $14.98

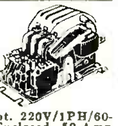
PARTS CABINET

50 Draw Hvy Steel 34½"H/18"W/9"L/65 lbs Draws 3"W/2½"H/8"L $38
100 Draws as above .... $63.
27 Draw Hvy Steel 37"H/30¾"W/14¼"L/120 lbs. Draws 3"H/9"W/12"L $39.95
Write for Quality Price "EXTEND DO"

STORAGE BATTERIES

36 Volt WILLARD Mini-BRAND NEW; 5 oz Designed Portable Equip. Models.. 98c; 4 for $3
(4) 36V BATTERIES W/Acid 3.35
2V/20AH Willard PLUS 2V. Vibrator 2.98
2V/20AH Batt. W/Acid 3.59
6V/6AH Willd NT6/BB214U 1.98
6V/6AH Batt. W/Acid 2.45
6V/40AH Willard 6.98
6V/40AH Batt. W/Acid 9.25
Hydrometer 1.06 to 1.24 Sp Grav 1.98
Spec Grav Ind & Merc. Thermom .... .98
Acid is Shipped in Bottles, R'Exp only

CONTACTOR



G. E. CR2811C22AQ. Heavy Duty Electric Starter. Transmitter or Motor Starter Switch. For Single or 2 or 3 Phase Appl. Rated 1 Phase 3HP/110V, 7½ HP/220V, 10 HP/600V. Rated 2 or 3 Phase 7½ HP/110V, 15 HP/220V, 25 HP/600V. Control Inpt. 220V/1PH/60-Cy. Contacts rated 45 Amp Enclosed, 50 Amp Open. Delivered U.S.A.... $39.95; 2 for $75.00.

Infrared Snooperscope

Image-Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—Resolution up to 350 line/in. Complete data & tube. ea .... $4.98; 2 for $9.49

SNOOPERSCOPE PWR SUPPLY

1800VDC/35MA, Using Doubler Crkt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram 115V/60cy Oper $6.98

MERCURY THERMO REGULATOR

DUAL CKT, 105°F & 32°F. Extremely sensitive & accurate for most exacting requirements—Research, Fire Prev., Freeze, Pt Control, or Max-Min Temp Control. Brand New, Individ. Boxed w-data & ckt. Excellent Safety Device for Thermo Control of Air Cooled Selenium Rectifiers
SPECIAL Ea. 98c; .... 12 for $10.00

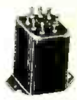
CIRCUIT BREAKER FUSES

PUSH TO RESET

Amps 3-5-7-10-15-20 Ea. 20c
4 for $1.; 25 for $5.; 100 for $18.
Circuit Breaker Fuse W/2 Mounting Clips 39c; 3 for.... $1.00; 20 for.... $5.98; 100 for.... $25. Fuse is 3AG Size. Operates up to 24 Volts

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, Amps; 5, 10, 15, 20, 25 98c .... 10 for $8.98
Klixon Thermal Push Button Brkrs Amps: 5, 10, 15, 20, 25, 30 89c ... 10 for $7.98

VARISTOR



WE D-97966. High Quality, Full Frequency Response. Designed for A-C Operation in Transmission Crkts. $2.49; .... 5 for $10.
3 wdg. 600 Ohm Ct & 400 tapped 250 & 150 Ohm can be used Mike to Grid, Line to Grid & Line to Line Csd & Hmt Sld
SPECIAL 49c; Ten for $4.49; 100 for $25

TUBES

"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

OA2	.95	2E24	4.69	6A4	1.89
OA3/VR75	1.04	2E25/HY65	5.15	6A5G	2.39
OA4G	1.05	2E26	2.88	6A6	.89
OB2	1.37	2E30	1.95	6A7	1.32
OB3/VR90	1.09	2E31	1.49	6A8GT	1.09
OC3/VR105	1.19	2E36	2.19	6AB1	.79
OD3/VR150	.90	2E41	2.39	6AB5/6N5	1.33
OY4	2.53	2E43	1.39	6AB7/1853	1.39
OZ4	.60	2G21	2.39	6AC5GT	1.09
C1A/ELC1A	9.75	2J21	8.75	6AC6G	1.49
O1A	.69	2J21A	8.90	6A67	.99
VS-1	12.49	2J22	7.69	6AD6G	.98
1A3	1.10	2J30	87.25	6AD7G	1.49
1A4P	.79	2J31	27.25	6AF6G	1.33
1A5GT	.79	2J31A	79.95	6AG5	.79
1A6	1.49	2J32	27.45	6AG7	1.99
1A7GT	1.32	2J33	27.25	6AH5G	1.49
1AD4	2.95	2J34	27.25	6AH6	1.89
1AE4	1.80	2J36	120.00	6AJ5	1.40
ELC1B/3C31	3.45	2J37	12.70	6AK5	.74
1B3/8016	.81	2J38	11.75	6AK5W	2.98
1B4P	.89	2J39	44.00	6AK6	1.05
1B5/25S	.99	2J42	250.00	6AL5	.54
1B7GT	.99	2J48	24.25	6AL7GT	1.29
1B21/471A	2.85	2J49	34.00	6AN5	2.90
1B22	2.20	2J50	21.25	6AQ5	.55
1B23	9.90	2J52	249.50	6AQ5W	3.98
1B24	9.45	2J55	85.00	6AQ6	.81
1B26	2.45	2J56	149.00	6AQ7GT	1.29
1B27	12.75	2J61	49.95	6AR5	.79
1B32/532A	3.90	2J62	49.45	6AR6	2.98
1B35	10.98	2K22	49.95	6AS5	.79
1B37	16.98	2K23	29.00	6AS6	2.43
1B38	29.95	2K25	31.59	6AS6W	3.20
1B40	4.95	2K25/723AB	39.00	6AS7G	4.14
1B41	49.95	2K28	32.00	6AT6	.63
1B42	18.00	2K29	23.95	6AU5GT	1.49
1B46	1.98	2K33	300.00	6AU6	.59
1B53	49.95	2K35	398.00	6AV5GT	1.29
1B56	38.50	2K41	145.00	6AV6	.59
1B58	1.75	2K42	145.00	6AW6	1.89
1B59		2K43	135.00	6AX4/6U4	.79
1B60	69.75	2K46	360.00	6AX5GT	.79
1B63	50.00	2K47	460.00	6B4G	1.23
1B63A	75.00	2K48	118.00	6B5	1.19
EL1C	2.70	2V3G	.98	6B6G	.89
1C5GT	.89	2W3GT	.98	6B7	1.19
1C6	.79	2X2	.49	6B8G	1.09
1C7G	.89	2X2A	1.53	6BA6	.63
1D5GP	.99	3A4	.99	6BA7	1.27
1D7G	.89	3A5	.81	6BC5	.63
1D8GT	.89	3A8GT	1.59	6BC7	1.23
1D21/631P1	3.89	3B4	2.69	6BD5GT	1.65
1E5	.99	3B5	.98	6BD6	.83
1E7G	.99	3B7/1291	.69	6BE6	.59
1F4	.69	3B22	2.70	6BF5	.98
1F5G	.79	3B23/RK22	4.95	6BF6	1.49
1F6	.89	3B24	5.40	6BF7	2.55
1F7G	.89	3B25	4.50	6BG6G	1.39
1G4GT	.89	3B26	3.70	6BG7	1.98
1G5G	.89	3B28	7.90	6BH6	.63
1G6GT	.79	3C6/XXB	1.49	6BJ6	.69
1H4G	.89	3C22	77.00	6BK7	2.15
1H5GT	.89	3C23	9.90	6BL7GT	1.45
1H6GT	.79	3C31/C1B	3.45	6BN6	1.49
1J5G	1.20	3C33	14.98	6BN7	1.69
1J6GT	.79	3C34/HK24	5.49	6BO6GT	1.20
1L4	.69	3C45	15.48	6BQ7	2.15
1L6	.98	3D6/1299	.69	6BY5G	1.45
1LA4	1.19	3D21A	4.98	EL6C/6C	16.98
1LA6	.99	3D22	13.95	6C4	.60
1LB4	1.29	3D23	4.90	6C5GT	.79
1LC5	.79	3E29	14.95	6C6	.79
1LC6	1.39	3K22	275.00	6C7	1.26
3K30	300.00	3K23	405.00	6C8G	.89
1LD5	.99	3K30	300.00	6C21	29.45
1LE3	.99	3LF4	1.29	6CB6	.69
1LH4	.89	3Q4	.79	6CD6G	1.69
1LN5	.79	3Q5GT	1.29	6D4	2.70
1N5GT	.99	3S4	.85	6D6	.89
1P5GT	.79	3V4	.79	6D7G	.89
1P42	5.60	4-125A	29.95	6D8G	.89
1Q5GT	.89	4-250A	40.95	6E5	1.24
1Q26	69.00	4-1000A	108.50	6E6	2.65
1R4/1294	1.29	4B23	16.98	6E7	1.39
1R5	.79	4B27	4.98	6F4	6.35
1S4	1.19	4C25/HK54	5.98	6F5	.95
1S5	.79	4C33	59.00	6F6	.99
1S21	7.90	4C35	27.25	6F6GT	.79
1T4	.79	4C36	15.98	6F7	1.39
1T5GT	.99	4E27/257	14.50	6F7G	1.29
1U4/5910	.73	4J22	148.50	6G6G	1.39
1U5	.79	4J31	95.00	6H6	.89
1V	.79	4J34	194.00	C6J/5C21	6.95
1V2	.70	4J42/700	27.00	6J4	6.66
1X2	.95	4J47	260.00	6J5GT	.59
1Y2	6.98	4J47CY	198.00	6J6	.63
1Z2	3.98	4J52	350.00	6J7	1.09
2A3	1.78	4T4/2	5.95	6J8G	1.19
2A4G	1.19	4X-150A	45.00	6K4	5.15
2A5	.69	4X-500F	85.00	6K4A	6.45
2A6	.69	5AX4GT	.54	6K5GT	1.09
2A7	.69	5AZ4	1.35	6K6GT	.79
2AC15	4.98	C5B/5C30	3.95	6K7	.85
2AS15	4.98	EL5BHD	16.98	6K8	1.08
2B7	.89	5C21/C6J	6.95	6L5G	.79
2B22	3.90	5C22	49.95	6L6	2.09
2C21/1642	.67	5C30/C5B	3.95	6L6G	1.69
2C22/7193	.33	5D21	27.45	6L6GA	1.69
2C26	.19	5D23/RK65	36.50	6L6GAY	2.29
2C26A	.47	5J29	12.40	6L7	1.19
23C33/RX233A	3.49	5R4GY	1.35	6N4	2.39
2C34/RK34	.69	5R4WGY	1.75	6N6G	1.69
2C39	33.98	5T4	2.49	6N7GT	1.29
2C40	7.29	5U4G	.55	6P5GT	.89
2C43	26.75	5V4G	1.10	6Q7	.89
2C43/464A	9.49	5W4	.89	6R7	.99
2C44	1.20	5X4G	.79	6R8	1.39
2C50	3.69	5Y3GT	.43	6S4	.98
2C51	6.45	5Y4G	.79	6S7G	.89
2C52	5.98	5Z3	.99	6S8GT	.99
2D21	1.26	5Z4	1.49	6SA7GT	.89
2E5	1.19	C6A	6.75	6SA7GTY	3.37
2E22	1.95	6A3	1.59	6SB7Y	1.19

6SC7	1.39	12AX4GT	1.20	32L7GT	1.49	117N7GT	1.79	CK534AX	.89
6SD7GT	.99	12AX7	.79	33	.59	117P7GT	1.39	CK536AX	.89
6SF5	.89	12AY7	2.95	34	.69	117Z3	.59		
6SF7	.89	12AZ7	1.49	33/51	.89	117Z4GT	1.39	CK537AX	4.98
6SG7	1.39	12BA6	.79	35A5	.79	117Z6GT	1.19	CK538DX	.89
6SH7	.99	12BA7	.79	35B5	.79	117Z7GT	1.49	CK539DX	1.98
6SJ7	.89	12BD6	1.23	35C5	.69	F123A	7.90	CK541DX	1.98
6SK7GT	.89	12BE6	.63	35L6GT	.79	T125	12.49	CK542DX	.98
6SL7GT	.89	12BF6	.85	35T	6.95	F127A	19.98	CK543DX	.98
6SN7GT	.79	12BH7	1.29	35TG	5.45	VT127A	3.90	CK544DX	.98
6SN7WGT	2.25	12BY7	1.35	35W4	.59	CV148	4.98	CK546DX	1.98
6SQ7GT	.79	12BZ7	1.25	35Y4	.69	150T	14.50	CK547DX	1.98
6SR7	.69	12C8	1.39	35Z3	.79	FG166	49.00	550P1	19.95
6SS7	1.12	12F5GT	.79	35Z4GT	.69	FG172	29.00	CK571AX/	
6ST7	1.33	12H6	.89	35Z5GT	.59	182B	1.20	5886	4.98
6SU7GTY	3.37	12J5GT	.69	REL36/6J4	.49	FG190	12.80	CK573AX/	
6SZ7	1.05	12J7GT	.99	36	.65	T200	22.98	6029	4.45
6T7G	.89	12K7GT	.89	37	.69	201A/CX301A	.98	575A/975	13.75
6T8	1.09	12K8	.99	38	.59	203A	5.98	WL579	10.49
6U5/6G5	.99	12Q7GT	.79	RK39	2.89	205B/VT2	1.69	WL579B	12.98
6U6GT	1.09	12S8GT	.98	39/44	.59	CE206	3.15	601B	.19
6U7G	.69	12SA7GT	.89	CRC40	.59	211/VT4C	.45	HY615	.25
6V3	1.89	12SC7	1.39	T40	4.29	CE215	8.98	616	37.00
6V6	2.25	12SF5GT	.79	TZ40	3.98	RX215	9.95	KU627	18.00
6V6GT	.57	12SF7GT	.69	40	1.09	WE215A	.18	WL652	65.00
6V8	1.99	12SG7	1.05	HY40Z	3.75	217C	8.75	WL670A	11.98
6W4GT	.57	12SH7	1.10	41	.79	227A	4.98	WL676	39.95
6W6GT	.89	12SJ7GT	.79	42	.69	231	1.20	WL686	35.00
6W7G	1.33	12SK7	.89	43	.85	242C	3.95	701A	5.89
6X4	.69	12SL7GT	.79	45	.69	244A	4.15	702A	3.29
6X5GT	.75	12SN7GT	.89	45S/VT52	.65	247A	9.95	702B	5.98
6Y6G	1.27	12SQ7GT	.79	45Z3	.69	250R	9.90	703A	4.75
6Y7G	.89	12SR7	.98	45Z5GT	.89	250TH	22.25		
6Z7G	.89	12X3	.90	46	.89	250TL	17.75	704A	.98
6ZY5G	.89	12Z3	.89	47	.99	HK254	14.49	705A/8021	1.98
7A4/XXL	.89	14A4	1.09	48	1.17	262B	3.98	707A	7.90

Use Your Priority for SPEEDY DELIVERY—Extend Your DO & Contract Nos.

7A5	.99	14A7/12B7	.99	RK48A	6.85	B	3.45	707B	13.50
7A6	.79	14AF7/XXD	1.19	RK49	7.50	276A	9.89	710A/8011	.95
7A7	.99	14B6	.99	49	.83	T300	26.98	713A	.98
7A8	.89	14B8	.89	50	1.19	300B	11.50	NL714	5.95
7AD7	1.49	14C5	1.09	50A5	1.19	304TH	8.90	714AY	5.90
7AF7	.89	14C7	1.09	50B5	.79	304TL	8.90	715A	6.00
7AG7	1.99	14E6	.99	50C5	.69	307A/RK75	4.25	715B	8.40
7AH7	1.19	14E7	1.09	50C6	1.49	310A	6.25	715C	19.80
7B4	.79	14F7	1.09	50L6GT	.69	311CH	10.95	717A	.90
7B5	.79	14F8	1.29	50X6	.89	311CT	10.50	718BY	48.45
7B6	.79	14H7	.99	50Y6GT	.79	311T	10.50	718CY	48.45
7B7	.89	14J7	1.19	50Z7G	.98	313C	2.98	719A	28.50
7B8	.89	14N7	1.49	52	.99	316A	1.49	721A	2.49
7C4/1203A	.79	14Q7	1.09	53	.69	323A	24.25	722A/287	2.45
7C5	.98	14R7	1.19	T55	8.79	327A	4.95	723A	11.95
7C6	.99	14S7	1.09	55	1.06	S340	2.98	723A/B	25.00
7C7	.69	14W7	1.09	56	.85	350A	6.50	724A	3.95
7C23	72.00	14X7	1.23	57	.79	350B	4.95	724B	3.45
7C29	69.95	15E	1.98	58	.79	353A	4.65	725A	8.90
7E5/1201	1.25	15R	.89	RK59	1.45	HK354	24.98	726A	14.25
7E6	.89	FG17	3.95	RK61	3.05	355A	14.15	726B	45.00
7E7	.89	18	.98	RK60/1641	1.95	368AS	7.49	726C	52.00
7F7	1.25	19	.69	T60	10.49	371B	.90	800	1.85
7F8	2.19	19BG6G	1.79	HY69	4.98	380A	.79	801A	.45
7G7/1232	1.29	19T8	1.09	70A7	1.59	388A	1.49	803	3.89
7H7	.89	19V8	1.62	70L7GT	1.59	393A	8.90	804	11.50
7J7	1.09	T20/1623	3.79	71A	.79	394A	4.90	805	3.90
7K7	1.29	TUF20	5.19	CRP72	1.20	FP400	15.98		
7L7	1.19	TZ20	3.79	CRP73	1.49	WE417/5842	18.50	807	1.65
7N7	1.19	20	1.17	73	1.67	WL417A	8.95	808	2.59
7Q7	.79	RK20A	8.95	NR74	.29	GL434A	18.45	809	2.43

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7R7	.99	RX21	3.75	HY75	4.59	446A	1.05	810	9.95
7S7	1.09	22	.99	75	.99	446B	3.89	811	2.90
7T7	1.03	24	.85	76	.79	450TH	45.00	811A	3.79
7V7	1.39	24A	1.10	77	.69	450TL	52.00	812	2.70
7W7	1.19	24G/3C24	1.90	78	1.05	460/HF200	15.95	813	12.49
7X7/XXFM	1.19	25A6	1.09	79	.89	WL468	13.95	814	2.75
7Y4	.69	25A7	2.98	80	.69			815	2.98
7Z4	.69	25AC5GT	1.59	81	1.69	GL471A	2.69	816/866Jr.	1.07
8DC-15	4.98	25AV5GT	1.29	FG81A	3.90	CK501X	1.26	826	.95
10Y	.43	25EQ6GT	1.19	82	1.19	CK501AX	1.26	828	11.29
CV11	5.25	25C6	1.18	82V	1.39	CK502AX	1.79	SD828	.98
12A	.89	25L6GT	.69	83	1.45	CK505AX	1.79	829	11.49
12A5	1.39	25W4GT	.89	83V	1.79	CK506AX	1.79	829B	12.45
12A6	.89	25Y5	.79	84/6Z4	.99	RH507	9.98	830B	3.49
12A7	1.29	25Z5	.79	85	.79	CK509AX	1.26	832	7.65
12A8GT	.79	25Z6GT	.99	89	.75	CK512AX	3.15	832A	9.65
12AC7	1.45	26	.79	VR92	.25	CK522AX	2.49	833A	39.45
12AH7GT	1.45	27	.69	FG95/5560	24.85	CK525AX	3.15	834	5.95
12AK5	1.98	FG27A	8.70	FG98	19.95	CK526AX	3.95	836	4.75
12AK5W	2.98	HV27	10.95	100TH	8.89	CK527AX	3.49	837	1.45
12AL5	.83	RK28A	4.89	102D	2.98	CK528AX	2.39	838	3.98
12AT6	.53	28D7	1.95	102G	2.98	CK529AX	2.98	843	.39
12AT7	.72	30	.70	FG104	37.98	GL530	22.00	845	5.95
12AU6	.72	31	.59	FG105	17.64	CK531DX	1.98	849	29.45
12AU7	.57	HY31Z	2.75	VU111	1.45	531	6.98		
12AV6	.53			HY114B	.75	CK532DX	1.98	852	19.98
12AV7	.98	32	.49	HY115/145	.79	WL532	3.98	860	4.90
12AW6	1.79	FG32/5558	13.85	117L/M7GT	1.59	CK533AX	1.39	861	23.95

864	.39
865	1.29
866A	1.50
868/CE1C	3.49
869	36.95
872A	3.29
874	1.39
878	1.95
884/6Q5G	1.80
885	1.45
893A	250.00
917	2.59
919	2.75
925	1.69
922	1.85
923	1.00
927/CE25	1.49
930	1.20
931A	5.00
954	.25
955	.39
956	.36
957	.45
958A	.67
967/FG17	3.95
SD969	.98
973	16.95
991	.45
FM1000	1.50
CK1005	.85
CK1006	3.49
CK1007	.89
CK1027	3.35
CK1028	9.98
CK1089	2.98
CK1090	2.98
R1100	5.00
R1130	12.00
E1148	1.35
HY1231Z	5.39
1612	1.90
1613	.89
1616	.74
1619	.25
1620	4.70
1622	2.69
1624	1.90
1625	.39
1626	.39
1629	.29
1630	.97
1631	.74
1632	.77
1633	.73
1634	.73
1635	1.89
1636	3.19
1644	.95
2000T	149.50
2050	1.47
2051	1.19
5516	5.98
5517	3.39
5594	6.65
5608A	5.95
5637	7.15
5638	12.70
5651	3.05
5654	2.79
5656	6.90
5663	1.85
5670	5.31
CK5672	2.29
CK5676	2.29
CK5678	2.45
5684	14.98
5686	3.90
5687	5.75
5692	7.69
5693	7.69
5694	3.65
CK5697	5.98
CK5702	7.45
CK5703	.98
CK5704	4.39
5718	10.15
5719	12.75
5726	4.39
GL5727	4.49
5744/CK619CX	6.49
5749	3.39
5751	5.45
5763	1.70
CK5783	6.69
CK5784	7.40
5812	2.99
5814	5.49
CK5829	4.49
5840	12.75
CK5851	4.98
CK5875	1.98
5881	2.89
X6030	4.49
8002R	99.50
8005	7.25
8008	6.49
8012	2.89
8013	2.75
8013A	6.45
8014A	28.95
8020	1.25
8025A	4.75

9001	1.55
9002	.95
9003	1.50
9004	.42
9006	.39

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2AP1	9.70
3AP1	9.75
3AP5	18.00
3AP1A	14.25
3BP1	5.75
3BP1A	14.98
3BP5	18.00
3CP1	1.90
3DP1	4.75
3EP1/1806P1	4.85
5FP7	.98
3FP7A	14.98
3GP1	4.20
3GP4	16.50
3GP5	18.00
3GP7	18.00
3HP7	3.40
3HP14	14.98
3JP7	12.50
3JP12	19.95
3JP14	16.95
4AP10	4.40
5AP1	3.45
5BP1	4.25
5BP4	4.25
5CP1	4.50
5CP5	30.00
5CP7	11.95
5FP7	1.49
5HP1	5.70
5HP4	5.70
5JP2	19.25
5JP4	26.75
5JP5	35.00
5JP7A	39.00
5LP1	22.25
5LP2	27.50
5LP4A	33.00
5LP7	19.95
5MP1	10.50
5RP7A	89.50
7BP1	8.65
7BP7	6.50
7EP4	17.98
7JP4	18.39
9GP7	12.75
9LP7	2.98
12DP7	16.89
12DP7A	49.50
12GP1	49.98
12GP7	14.75
12HP7	14.75
12JP4	27.00
12KP4	47.00
12LP4	21.25
912	89.98
913	9.98

Xtal Diodes

1N21A	1.55
1N21B	3.00
1N21C	21.50
1N22	1.25
1N23	1.35
1N23A	2.35
1N23B	3.49
1N25	4.98
1N26	8.75
1N27	1.55
1N29	3.50
1N32	23.75
1N34	.64
1N34A	.90
1N35	1.65
1N38	1.43
1N39	4.15
1N40	7.95
1N41	9.98
1N42	17.50
1N43	1.69
1N44	1.21
1N45	1.39
1N46	.69
1N47	5.49
1N48	.59
1N51	.45
1N52	1.85
1N54	.89
1N55	2.35
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

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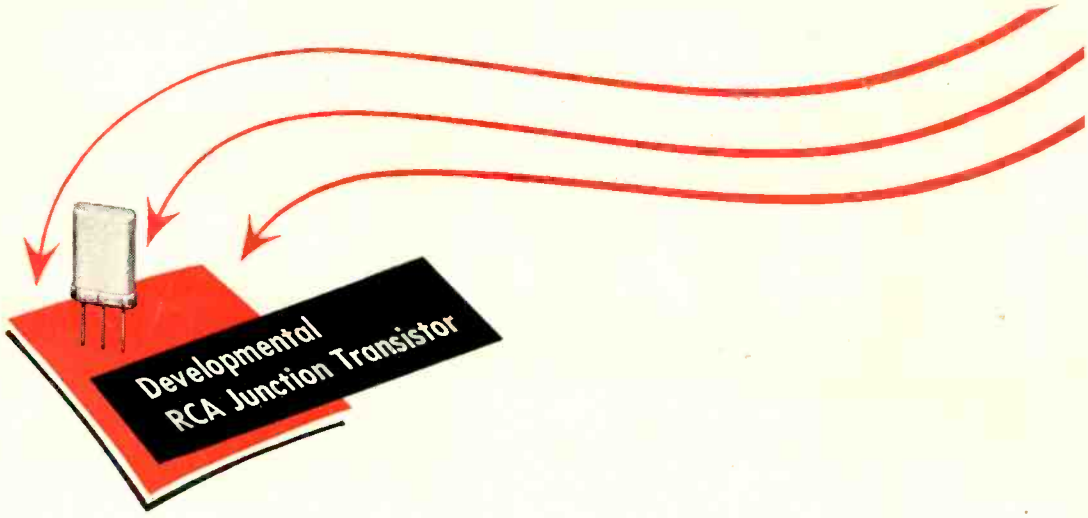
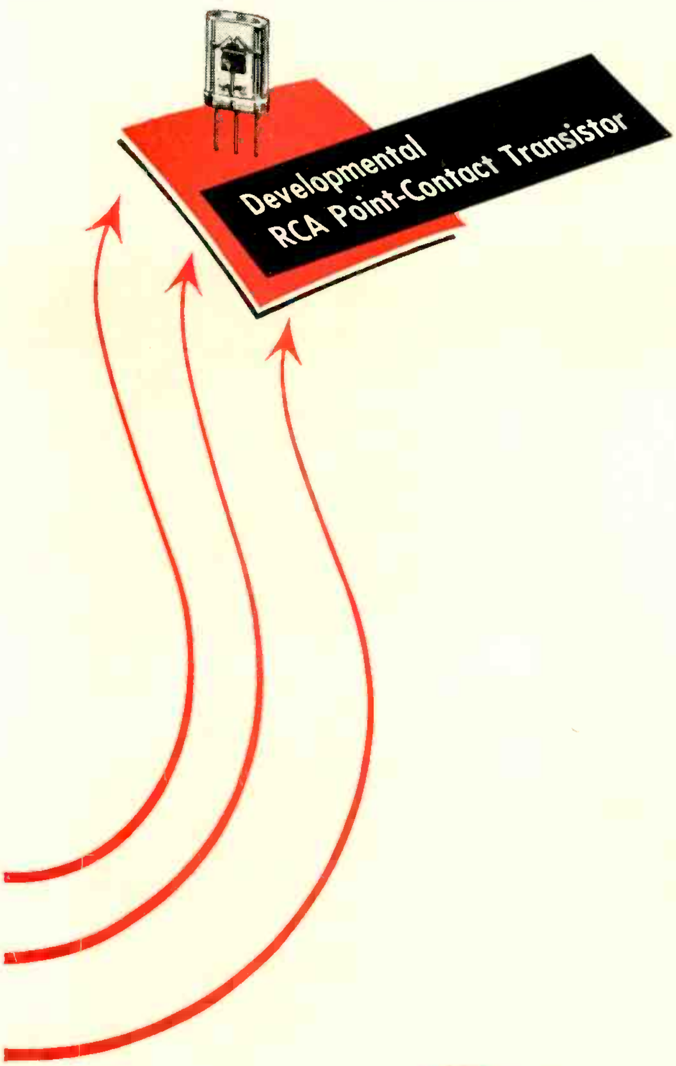


An RCA progress report

...*on Transistors*



MORE THAN FOUR YEARS AGO, RCA embarked on a research and development program to determine the practicability of transistors in the field of electronics. The early work was concerned with the principles, designs, and applications of point-contact transistors; and later was expanded to include junction transistors and other similar semiconductive devices.

As an important recent result of the studies on point-contact transistors, RCA Tube Department engineers have made in the laboratory experimental point-contact transistors which oscillate at frequencies above 200 megacycles, one of which exceeded 300 megacycles. This achievement opens the way to the use of transistors in FM radio and in VHF television, in addition to their previous potentialities for low-frequency applications including audio and switching uses.

This work has also led to considerable success in developing junction transistors for audio and radio amplifier applications. A point of particular significance is that much progress has been made in the development of practical assembly techniques.

Point-contact types are now being sampled to equipment manufacturers and government agencies as a part of our development program. It is anticipated that junction transistors will be available for similar sampling in the near future.

Although much remains to be done, promising results have been attained in controlling the characteristics of both types of transistors; pilot production runs are being made.

Meanwhile RCA is pushing forward its development program to assure its customers that the commercial transistors of the future will be made to the same high standards of quality and dependability as the RCA electron tubes of today.

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