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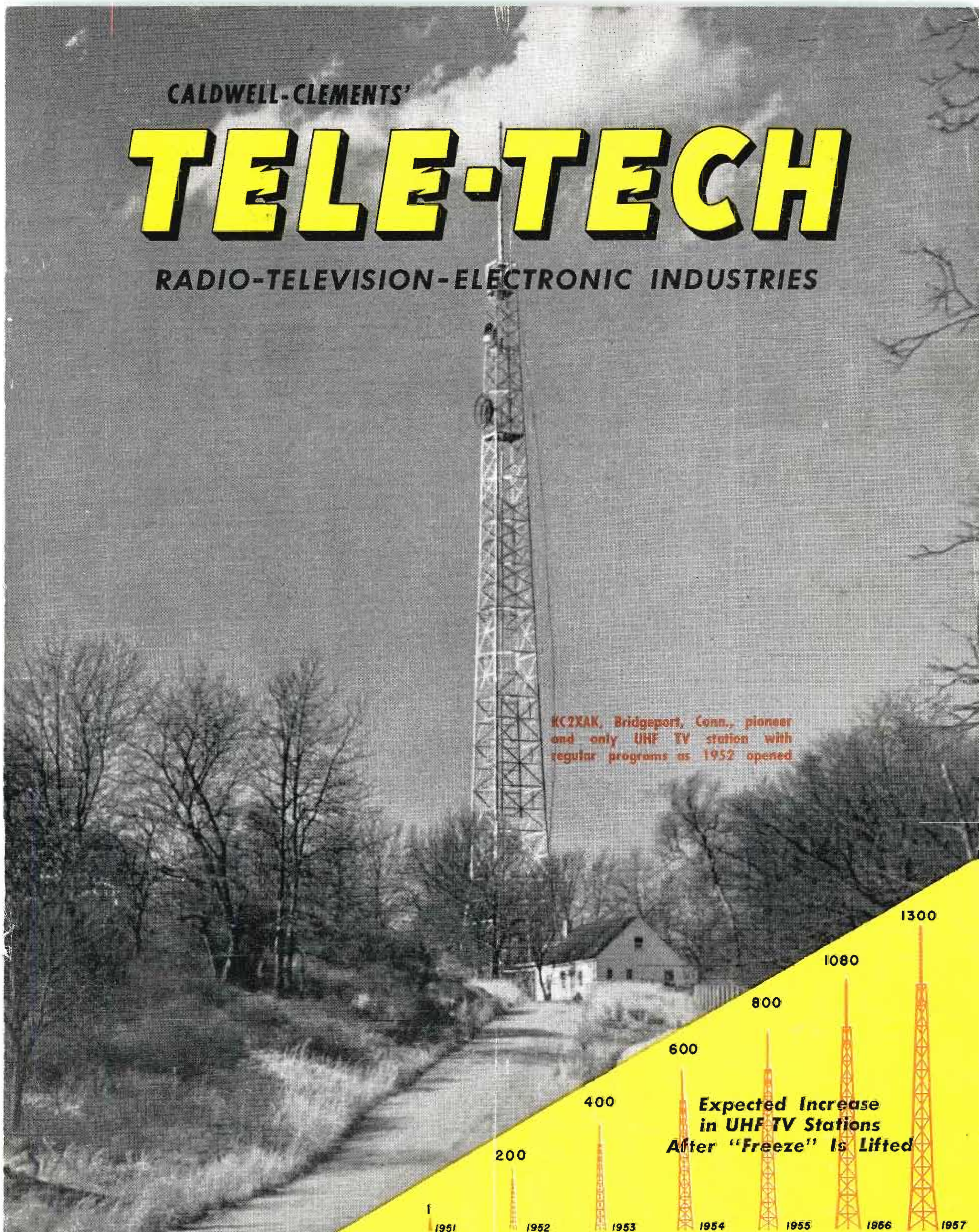
RADIO-TELEVISION-ELECTRONIC INDUSTRIES



KC2XAK, Bridgeport, Conn., pioneer and only UHF TV station with regular programs as 1952 opened

Vacuum Tube Reliability

UHF TV Sweep Generator Design

February • 1952

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- High Working Voltages
- Low Power Factor
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Designed to Replace Tubular Ceramic and Mica Condensers at LOWER COST!

RMC Type C temperature compensating and general purpose DISCAPS conform to the electrical specifications of the RTMA standard for Class 1 ceramic capacitors and Army-Navy JAN-C-20A. Their capacity will not change under voltage. Ideally suited to coupling and tuned circuit applications, RMC DISCAPS are available in a wide range of capacities and temperature coefficients. If you are interested in improving quality and uniformity on your production lines, now is the time to check on the advantages of using RMC DISCAPS.

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Edited for the 18,000 top influential engineers in the Tele-communications and Electronic Industries, TELE-TECH each month brings clearly written, compact, and authoritative articles and summaries of the latest technological developments to the busy executive. Aside from its engineering articles dealing with manufacture and operation of new communications equipment, TELE-TECH is widely recognized for comprehensive analyses and statistical surveys of trends in the industry. Its timely reports and interpretations of governmental activity with regard to regulation, purchasing, research, and development are sought by the leaders in the many engineering fields listed below.

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FEBRUARY, 1952

FRONT COVER: PIONEER UHF TV TRANSMITTER KC2XAK—This NBC experimental transmitter near Bridgeport, Conn., has been making UHF history on 530 and 850 MC for many months. Started up in 1949, "Operation Bridgeport" has been a recent Mecca for both transmitter and receiver engineers designing equipment for the 470-890 MC region of the spectrum. Regular TV programs have facilitated daily tests of UHF antennas, receivers, tuners and converters, participated in by 60 manufacturers and by several hundred home viewers who volunteered as laymen guinea-pigs to report comparative UHF and VHF reception.

* *ELECTRONIC INDUSTRIES for DEFENSE . . . See articles marked with asterisks*

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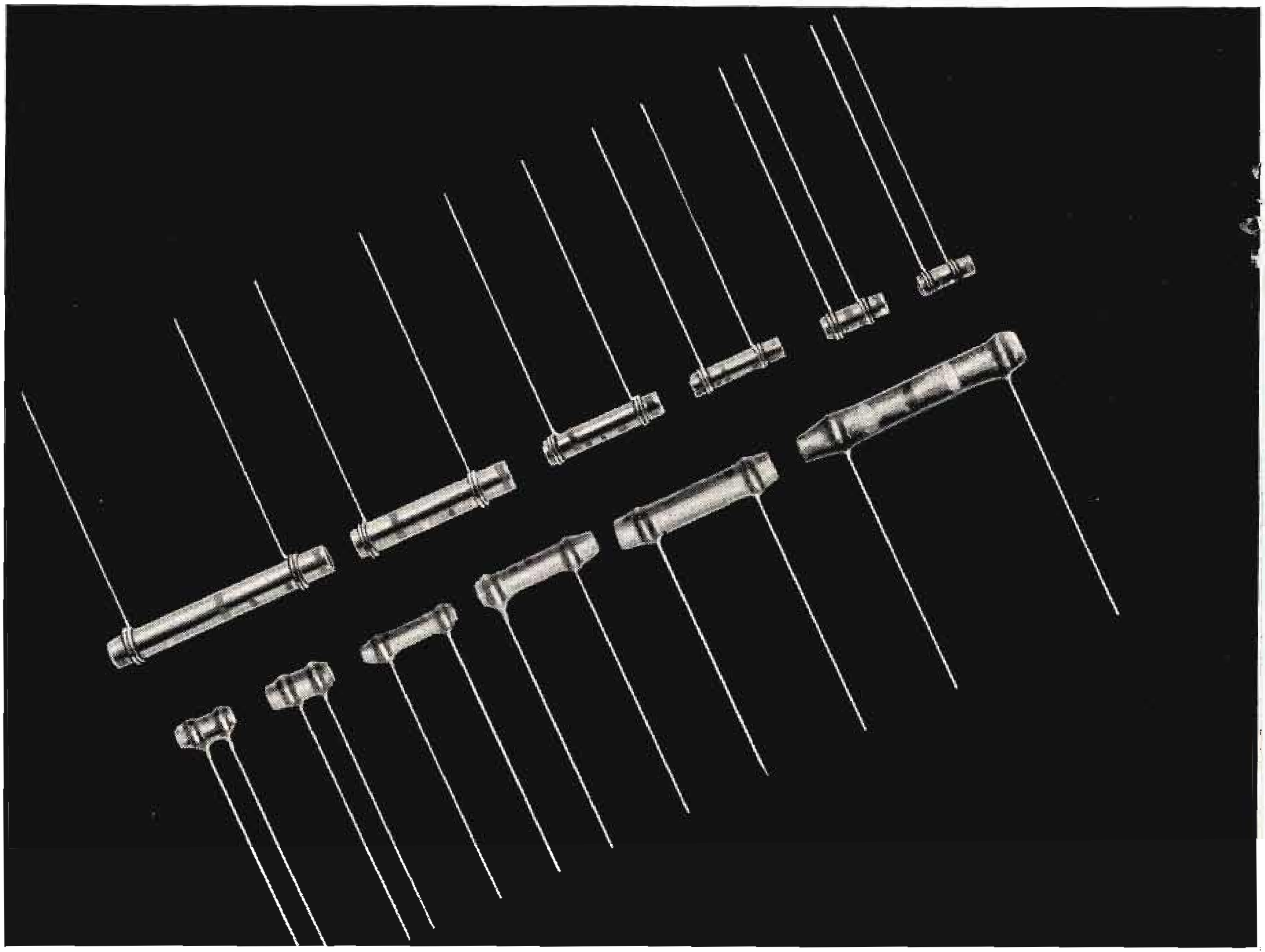
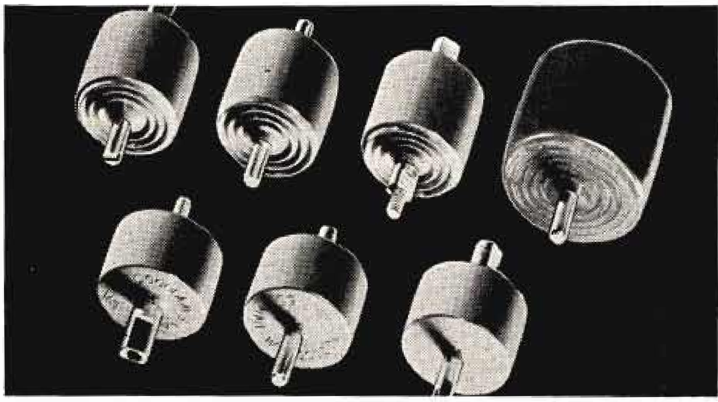
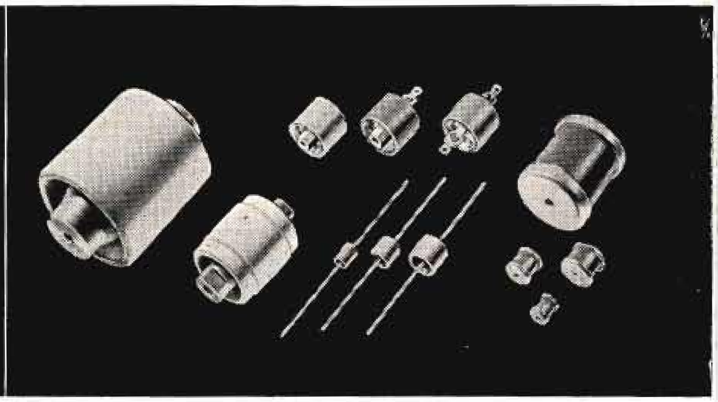
Centralab Ceramic



TEMPERATURE COMPENSATING TUBULAR CAPACITORS have extremely low power factor — very low inductance — more capacity per area — available non-insulated (top row above) or insulated (bottom row). Conform to JAN-C-20 electrical specifications. Offer full range of standard and extended temperature coefficients (NPO through N5250). Capacity, tolerance and nominal TC clearly identified by JAN-20 or RTMA color code. Recommended for VHF and UHF. Write for Bulletin 42-18.



TV HI-VO-KAPS are the standard high voltage capacitors for the TV industry. Capacitance: 500 mmf., 10 KV, 20 KV and 30 KV D.C. working. For more information, check Bulletin 42-10R in coupon at right.



HIGH VOLTAGE HEAVY CURRENT CAPACITORS. Capacitance: 5 to 500 mmf., 5 KV to 20 KV D.C. working. Ideal for portable or mobile equipment of high voltage and high frequency requirements. Check Bulletin No. 42-102 in coupon at the right.

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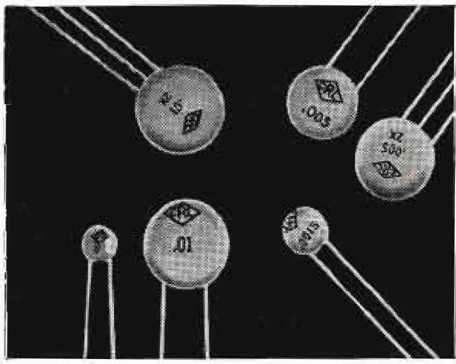
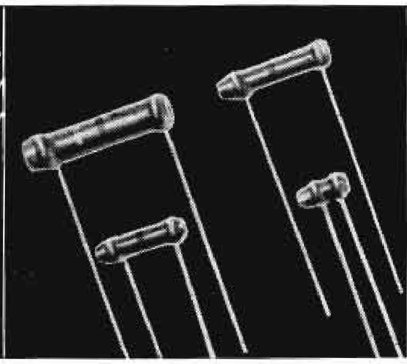
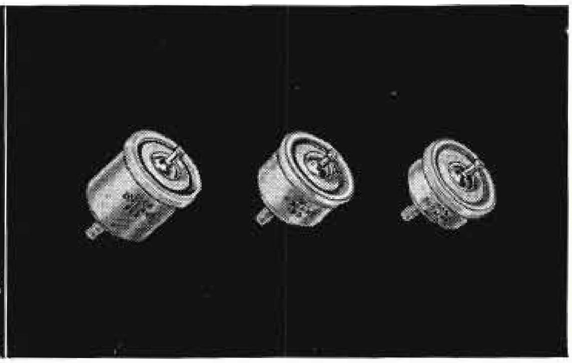
Compare with all others — and you'll standardize on Centralab for highest efficiency.



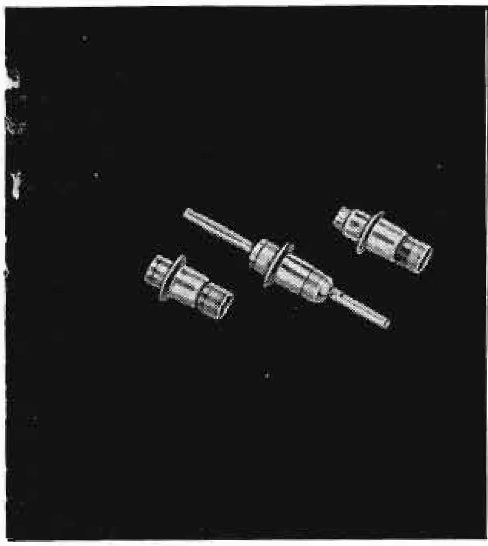
CERAMIC DISC HI-KAP CAPACITORS hold thickness to a minimum. Very high capacity in extremely small size. Used in r.f. by-pass and coupling. Send for Bulletin No. 42-4R.



BC HI-KAP TUBULAR CERAMIC CAPACITORS available in 48 preferred values. Ideal for use in r.f. by-pass and audio-coupling. Check Bulletin No. 42-3 on coupon below.



HIGH ACCURACY CERAMIC CAPACITORS for precision r.f. circuits. Especially suited to resonant application in oscillator circuits of primary and secondary frequency standards and meters. Check Bulletin 42-123 below.



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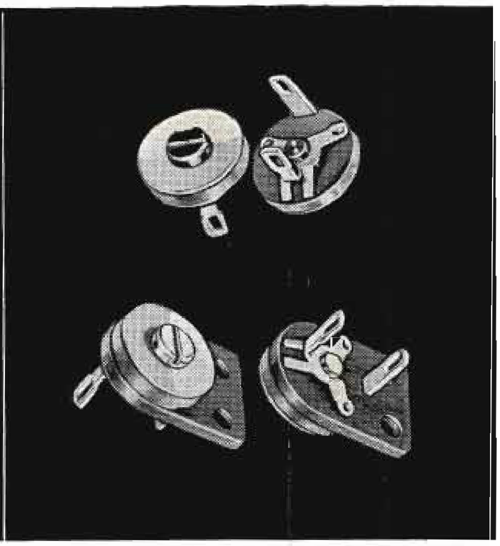

MINIATURE CERAMIC TRIMMERS can be mounted to chassis or terminal mounted to coil or terminal board. No. 821 (shown) has voltage rating of 500 V.D.C.W. Available in various trimming ranges. Check Bulletin No. EP-16 at the right.

For more information on the capacitors listed in this ad, fill out coupon below and check bulletins you want. For complete information on Centralab electronic components . . . switches, controls, ceramic capacitors and printed electronic circuits . . . see your Centralab representative or your local Centralab distributor. Ask for Catalog 27.

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Please send me the Technical Bulletins on Ceramic Capacitors as checked below:

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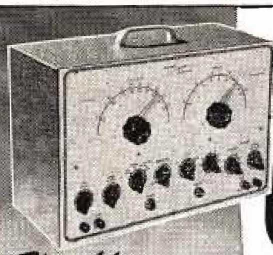
New 1952 HEATHKITS



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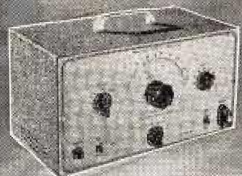

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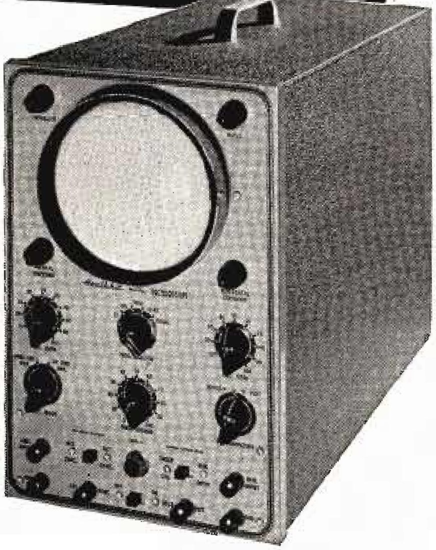


- New "spot shape" control for spot adjustment — to give really sharp focusing.
- A total of ten tubes including CR tube and five miniatures.
- Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.
- Greatly reduced retrace time.
- Step attenuated — frequency compensated — cathode follower vertical input.
- Low impedance vertical gain control for minimum distortion.
- New mounting of phase splitter and deflection amplifier tubes near
- CR tube base.
- Greatly simplified wiring layout.
- Increased frequency response — useful to 5 MC.
- Tremendous sensitivity .03 RMS per inch Vertical .6V RMS per inch Hor.
- Dual control in-vernier sweep frequency circuit — smoother acting.
- Positive or negative peak internal synchronization.
- Multivibrator type Wide Range Sweep Generator.

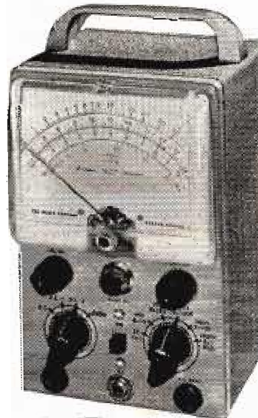
A brand new 1952 Heathkit Oscilloscope Kit with a multitude of outstanding features and really excellent performance. A scope you'll truly like and certainly want to own.

The kit is complete with all parts including all tubes, power transformer, punched and formed chassis, etc. Detailed instruction manual makes assembly simple and clear — contains step-by-step instructions, pictorials, diagrams, schematic, circuit description and uses of scope. A truly outstanding value.

MODEL 0-7
SHIPPING WT. 24 LBS.

$43.50

Heathkit VACUUM TUBE VOLTMETER KIT



- New styling — formd case for beauty.
- New truly compact size — Cabinet 4⅛" deep x 4-1/16" wide x 7⅜" high.
- Quality Simpson 200 microamp meter.
- New ohms battery holding clamp and spring clip — assurance of good electrical contact.
- Highest quality precision resistors in multiplier circuit.
- Calibrates on both AC and DC for maximum accuracy.
- Terrific coverage — Reads from ½V to 1000V AC, ½V to 1000V DC, and .1 to over 1 billion ohms resistance.
- Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.
- New styling presents attractive and professional appearance.

The 1952 Model Heathkit Vacuum Tube Voltmeter! Newly designed cabinet combines style and beauty with compactness. Greatly reduced size to occupy a minimum of space on your work-bench. Covers a tremendous range of measurements and is easy to use. Uses only quality components including 1% precision resistors in multiplier circuit for greatest accuracy, Simpson 200 microamp meter with easy to read scales for fast and sure readings.

All parts come right with kit, and complete instruction manual makes assembly a cinch.

MODEL V-5
SHIPPING WT. 5 LBS.

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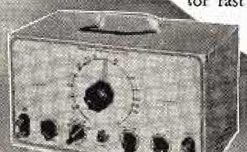

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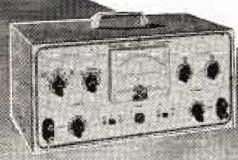

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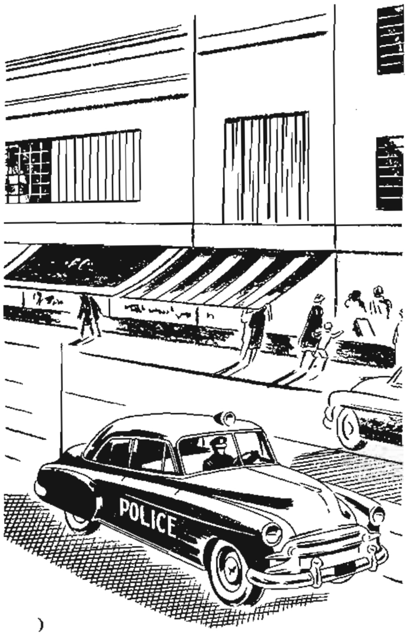

TOWERS THAT "TALK" TO THE STATE OR SQUAD CARS

Mobile Communications Systems naturally require no thousand-foot towers to cover their "beat." But isn't it good business to do business with a concern that makes both? There's no need to compromise on the antenna towers for your UHF system when you can be sure with a Blaw-Knox Tower *designed* especially for this important radio field. Scores of these self-supporting towers are now providing safe support for high-gain antennas that give maximum signal strength and soft-pedal the high noise level of metropolitan areas. The cost? No more than for "make-shift" structures.
For complete technical data just drop a note to

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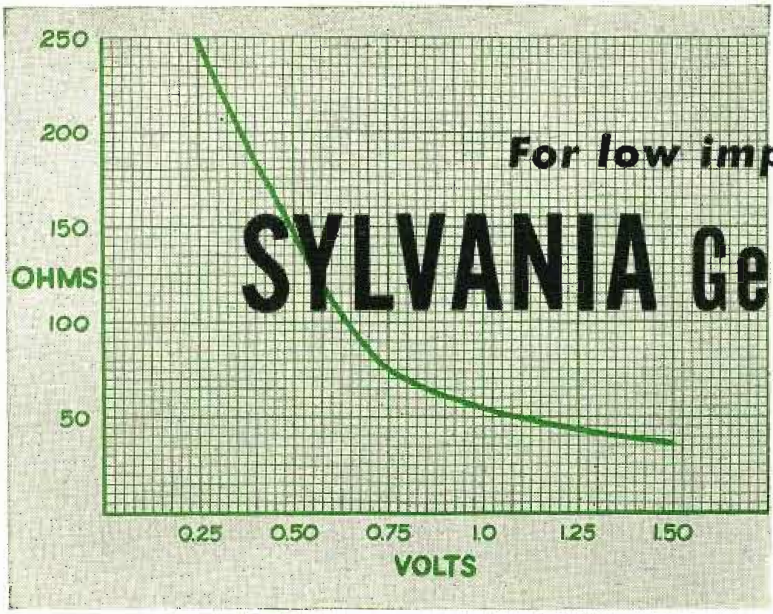
SYLVANIA Germanium Diodes



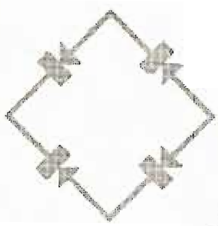
Typical 1N56 Resistance Characteristic

All Germanium Diodes are notable for their low forward impedance. But the 1N56 is specially engineered to make the most of this quality.

Use this diode for high efficiency circuits with low input and output impedances. Use it for relay activation, heavy current and surge applications with low impedance coils, transformers and condensers.

Try the 1N71 varistor in carrier telegraphy and telephony work. The low shunt capacitance insures high efficiency throughout the high frequency range. You will find this varistor equally efficient in low impedance modulator circuits of the carrier suppression or carrier transmission type.

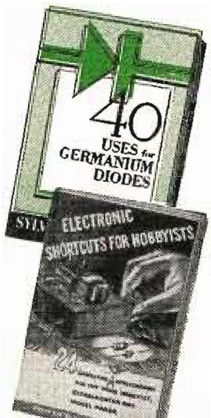
1N56 DIODE with a potential of +1 volt will pass a current of 15 ma. or more. With a potential of –30 volts, less than 300 μa. will flow.



For Carrier Communications

1N71 VARISTOR—The 1N71 consists of 4 matched low impedance diodes each of which, with +1 volt impressed, will pass a current within one ma. of the average current of the four.

Both the 1N56 Germanium Diode and 1N71 Varistor are available from your Sylvania Distributor. Ask him for copies of the two books shown below. Price of each is only 25¢, together they comprise the most complete collection of Germanium Diode applications yet published.



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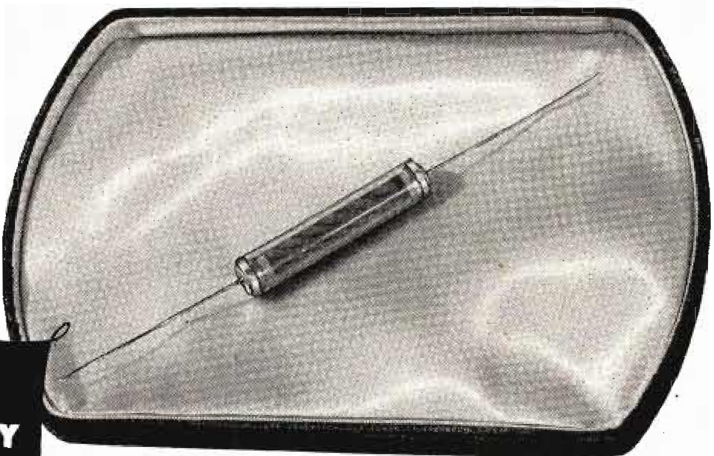

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NEW

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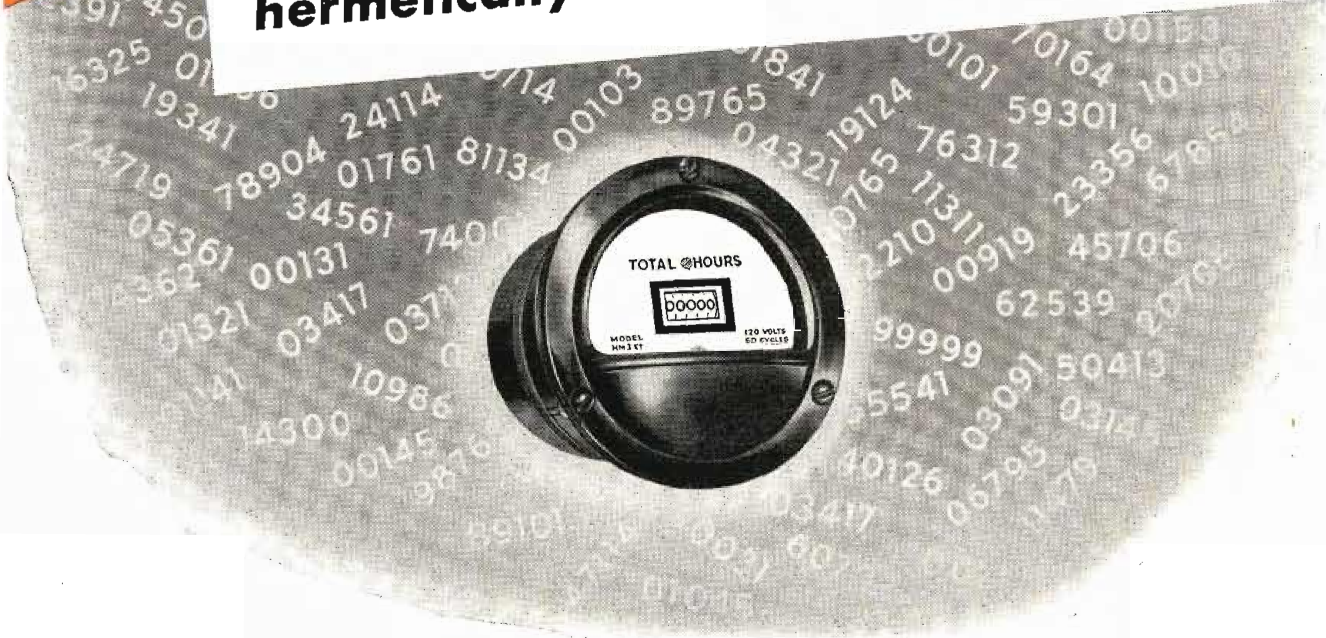
hermetically sealed running time meter



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SPECIFICATIONS

- Registers in 1/10 hour steps to 9999.9 or hour steps to 99999
- Hermetically sealed, glass to metal
- Moisture-proof, dust-proof
- Drawn steel case provides magnetic shielding
- Self-starting synchronous motor
- Moderately priced

Marion's new Running Time Meter is absolutely tamper-proof because it is sealed in a drawn steel case. Designed for a wide range of operating temperatures, it is also ideal for use in hazardous atmospheres. The easy-to-read dial is viewed through tempered glass crystal which is fused directly to the case.

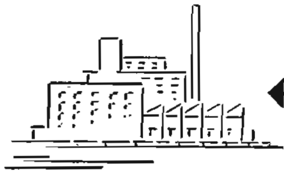
Powered by a durable self-starting synchronous motor, available for 110-125, 220-250 volts . . . 50 or 60 cycle A. C. . . . the Marion Running Time Meter occupies no more panel space than an ordinary 3½" meter.

Demands of our national mobilization program come first, of course, but we will gladly supply further information and serve you to the best of our ability.

MARION ELECTRICAL INSTRUMENT CO., 401 CANAL ST., MANCHESTER, N. H.

marion meters

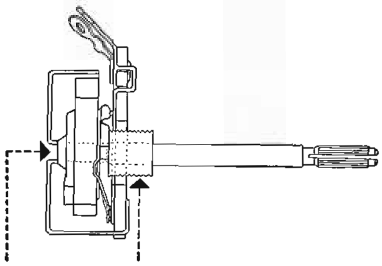
MANUFACTURERS OF MARION Ruggedized PANEL METERS



here and here

MALLORY Midgetrols®

do a trouble-free job for you



Two-Point Suspension

Only with Mallory Midgetrols do you get two-point suspension—the feature which gives more stable resistance values and longer control life. It also permits specification of longer shafts and makes it possible to use shorter shaft bushings.

When you use Mallory Midgetrols you take advantage of outstanding carbon control design, construction and performance features that pay off on your production line . . . and in the homes of your customers.

ON THE LINE—Exclusive two-point shaft suspension eliminates side play and makes possible use of heavy pressure to attach knobs without control damage.

Two-point suspension also results in a shorter shaft bushing and thus saves space in chassis arrangement.

Versatility of design permits Mallory to make quick delivery of standard units adapted to meet production emergencies . . . for short runs . . . for experimental work . . . or for service replacement stocks.

IN THE HOME—Two-point suspension eliminates shaft wobble—thus prevents damage to the carbon element.

Resistance drift is sharply limited because the phenolic base of the carbon element resists extremes of temperature and humidity.

Quiet operation and smooth tapers because of the fine molecular structure of the carbon and exclusive methods of application.

Long-lasting performance because of precision design and construction.

You can see that Mallory Midgetrols offer real advantages in production and in use—advantages that build satisfaction for your dealers and their customers because of the trouble-free performance of Mallory Midgetrols. Write or call Mallory today for additional information on the job Mallory Midgetrols can do for you.

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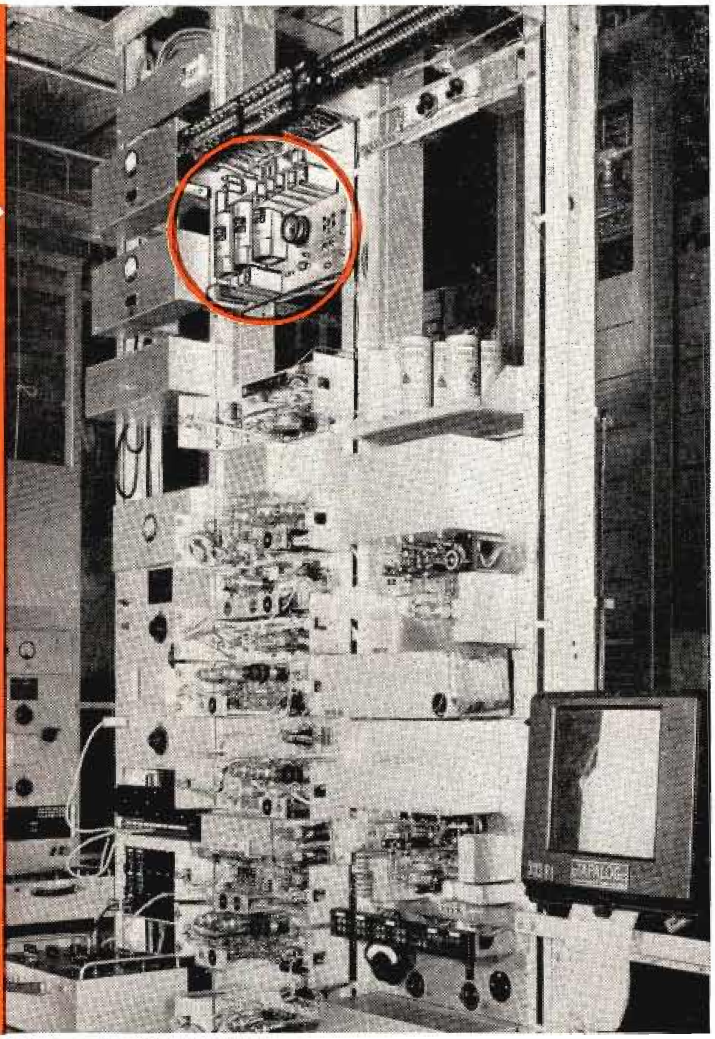
ADLAKE Relays play an important part in this American Telephone and Telegraph Company Toll System manufactured by the Western Electric Company. Shown are "K" Carrier Telephone, Pilot Channel Regulator, Terminal, Repeater, Alarm Equipment and Test Equipment.

ADLAKE relays in communication equipment



foolproof–maintenance free

Western Electric, one of America's leading electrical manufacturers, uses foolproof maintenance-free ADLAKE relays in its communication equipment.

ADLAKE Relays are designed and built to meet industry's most exacting requirements. Their mercury-to-mercury contact prevents burning, pitting and sticking, and their sturdy construction armors them against outside vibration or impact. And, most important of all, *they require no maintenance*, for they are hermetically sealed against dust, dirt, and moisture.

For the full story on the part ADLAKE Relays can play in your business just drop a card to the Adams & Westlake Company, 1130 No. Michigan, Elkhart, Indiana. No obligation of course.

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HERMETICALLY SEALED—dust, dirt, moisture, oxidation and temperature changes can't interfere with operation.

MERCURY-TO-MERCURY CONTACT—prevents burning, pitting and sticking.

SILENT AND CHATTERLESS • REQUIRES NO MAINTENANCE

ABSOLUTELY SAFE

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THE Adams & Westlake COMPANY

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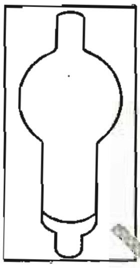
New York • Chicago

Manufacturers of ADLAKE Hermetically Sealed Relays



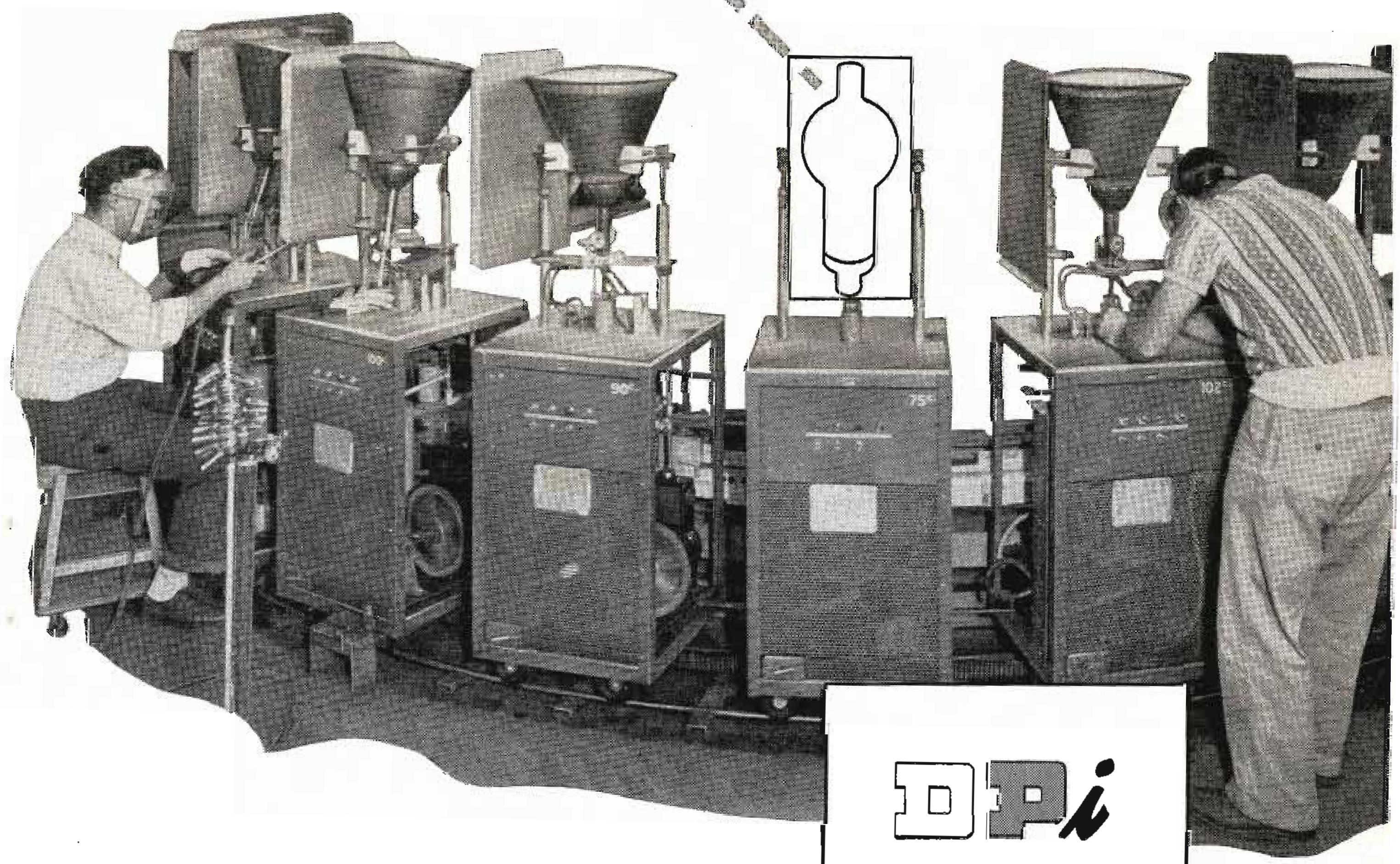
New rider

for a fast, familiar track

SINCE 1945, DPi has been supplying manufacturers of television picture tubes with inline exhaust systems. Even with the largest tubes, this fast-production race track has been giving the high vacuum that means sharper-focus beams, longer, more reliable life.

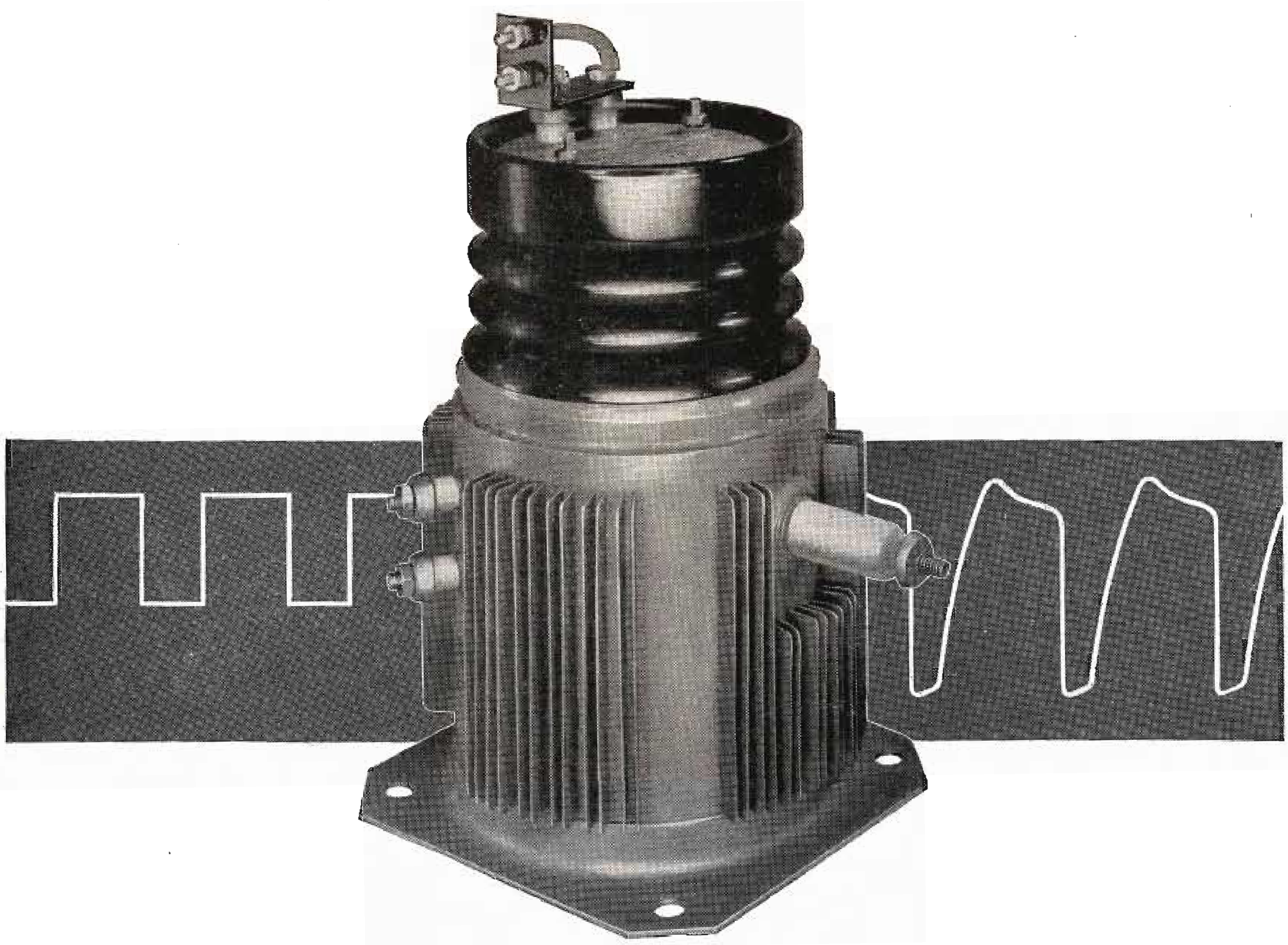
For the first time, DPi offers to makers of large power tubes, high-frequency oscillators, and x-ray tubes this system converted to their use. With the same trouble-free efficiency, capable of producing ultimate vacuums below 1 x 10^{-6} mm Hg, and affording the same fast production pace, it will evacuate your tubes on a continuous instead of a batch basis. And the system is adaptable to running a variety of tubes at once.

If you already have a DPi inline system and would like to consider conversion, or are interested in a new system, talk it over with our engineers. We're ready to help you meet your problem, whether it involves a single unit or the design of a complete exhaust system for a tube factory. Just write ***Distillation Products Industries***, Vacuum Equipment Department, 629 Ridge Road West, Rochester 3, N. Y. (Division of Eastman Kodak Company).



high vacuum research and engineering

Also...vitamins A and E...distilled monoglycerides...more than 3500 Eastman Organic Chemicals for science and industry



To tailor a wave more accurately...

It's a recognized principle that the smaller, more compact the pulse transformer, the more acceptable will be the shape of the output wave. That's where Westinghouse transformer engineering can offer greater advantages to the designer of electronic circuits.

In pulse transformers like the one above, for example, Westinghouse is able to produce a smaller, lighter, better performing transformer by using a two-piece HIPERSIL® type C core wound from one mil thick material. Insulation applied depends upon actual requirements . . . for instance, Fosterite® insulation on open-type transformers for adverse atmospheric conditions; silicone oil for high-temperature applications. But with an initial advantage on core size, and corresponding reduction in coils, the compactness of Westinghouse Pulse Transformers assures better wave shape, plus saving in both size and weight.

If size, weight, performance or quantity production have any bearing on your transformer problem call your Westinghouse representative. For many applications, standardized designs are available at substantial savings. Westinghouse Electric Corporation, Specialty Transformer Department, Sharon, Pa. J-70611

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Westinghouse

TRANSFORMERS

...WITH CONFIDENCE

Sylvania proudly presents 2 Zero Focus Voltage Picture Tubes

Paring anything off television set costs is a tough problem for today's designers. Sure, there are ways . . . and ways, but naturally you have a fine reputation to maintain. You want *confidence* as well as cost cutting.

And, that's just what Sylvania offers you. Now we proudly present 2 Zero Focus Voltage Electrostatic Picture Tubes . . . quality tested to assure finest possible performance, PLUS real design savings.

Types 17RP4 and 21FP4

These new Sylvania tubes are electrostatic focus, magnetic deflection, all-glass direct-view picture tubes.

Outstanding Savings result from the elimination not only of focus coils and fixed magnets, but also potentiometers and condensers to adjust focus voltage.

Special features of these new tubes include: (1) a neutral filter face plate which greatly improves picture contrast; (2) the ion trap gun which focuses at zero voltage; (3) an external conductive coating that acts as a filter condenser.

Critical Materials are Saved, too. The elimination of magnets and other components conserves your allotments of cobalt, nickel, and copper . . . prevents plant tie-ups and costly delays. Complete data sheets for both these tubes are now available. For your free copies address: Sylvania Electric Products Inc., Dept. R-3502, Emporium, Pa.

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

World Wide Acceptance!

GATES 5/10 KW Transmitters

Typical Gates Customers Around the Globe

Bangkok, Thailand	4 — 10KW
"YSS", San Salvador	1 — 10KW
"YSU", San Salvador	2 — 5KW
"CMCU", Havana, Cuba	1 — 10KW
Embassy of Pakistan	1 — 5KW
Johannesburg, South Africa	3 — 10KW
"CJON" St. Johns, Nfld..	6 — 5KW

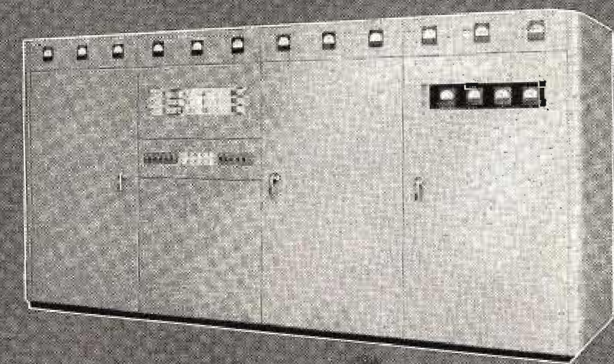
Domestic BC 5-10 KW Users

WOOF	Dothan, Ala.	KCNA	Tucson, Ariz.
KBIG	Avalon, Calif.	KPOL	Los Angeles, Calif.
KFXD	Nampa, Ida.	KSCJ	Sioux City, Ia.
KGNO	Dodge City, Kan.	WKNK	Muskegon, Mich.
WCOW	South St. Paul, Minn.	KRES	St. Joseph, Mo.
KTRM	Beaumont, Texas	WENE	Endicott, N. Y.
WIST	Charlotte, N. C.	WBSC	Bennettsville, S.C.
KUTA	Salt Lake City, Utah	WCHS	Charleston, W. Va.

In Bangkok and Sioux City, Johannesburg and Muskegon, broadcasters have discovered that, in any language, the name GATES stands for dependability — low cost operation!

Yes, acceptance of GATES 5/10 KW transmitters is world wide, and for many good reasons.

For example: Whether for standard broadcast or short wave telephone or telegraph service, there is a GATES 5/10 KW transmitter exactly suited for the job to be done. With twelve models to choose from, there is no necessity for making costly adaptations — no need for compromises that cost in efficiency as well as dollars.



GATES BC-5B 5KW TRANSMITTER With Phasor

5 R.F. stages with single 3X2500F3 power amplifier; 4 audio stages with pair 3X2500F3 Class B modulators. Inverse feedback employed but will meet full F.C.C. requirements when omitted. Three power supplies. Oil filled modulation transformer and reactor. Response 30 - 10,000 cycles 1.5 Db. Noise 60 Db. below 100% modulation unweighted; Distortion 3% at 50 and 7500 cycles, even better between. Power consumption at 100% modulation only 18.5 KW.

LOW INITIAL COST — LOW OPERATING COST

Another prime reason for GATES popularity, everywhere, is that while maintaining the highest standards of quality, GATES 5/10 KW transmitters always cost less to buy and install — and equally important, cost less to operate.

Because over 80% of GATES production is that of radio transmitting equipment, production efficiencies are possible that result in substantial savings of up to several thousands of dollars compared to competitive makes of equal caliber.

Savings, too, are provided by the use of the popular new 3X2500F3 tubes as both power amplifiers and modulators. This proved tube, an excellent performer at both medium and short waves, operates at lower plate voltage which means greater safety factor and better circuit constants.

Operating costs are lower since power consumption and tube replacement costs are less. One broadcaster reported actual savings of $100.00 monthly in power bill after installing new GATES 5 KW equipment. Because every GATES transmitter is straightforward design, maintenance is easier and replacement components standard throughout the world.

Wherever you are — whatever your transmitter requirements — why not write today for descriptive literature and engineering data on these modern GATES 5/10 KW transmitters? See for yourself why GATES transmitters are the first choice of so many — the world around!

GATES

GATES RADIO COMPANY, QUINCY, ILLINOIS, U.S.A.

MANUFACTURING ENGINEERS SINCE 1922

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Because... BUSS FUSES

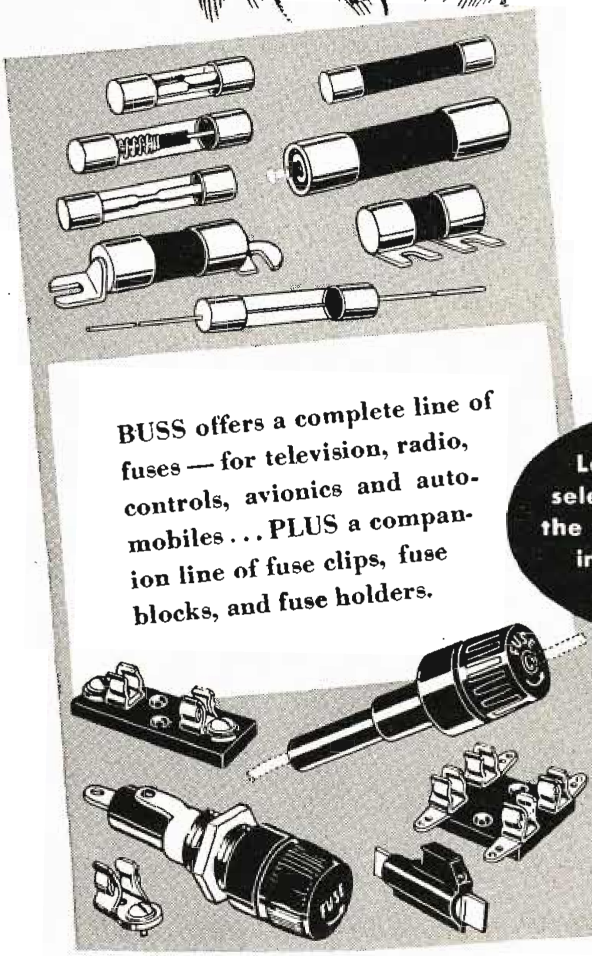
Are trouble-free—never any complaints about the operation of equipment due to faulty fuse blows.

First, each individual BUSS fuse is tested in a sensitive electronic device to make sure it will operate properly under all service conditions.

Second, the millions and millions of BUSS house fuses, industrial fuses, and fuses for the automotive and electronic industries have firmly established the unusual merits of BUSS fuses in the mind of the public.

The BUSS reputation for quality means that a distributor, dealer or consumer will know you have chosen the best fuses available.

With the cost of a fuse being so insignificant compared to the value of the equipment it protects—how can any manufacturer take a chance on any fuse except a BUSS fuse—the standard of dependable quality for more than 37 years?



Let us help you in selecting or designing the fuse or fuse mounting best suited to your needs.

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Division of McGraw Electric Company

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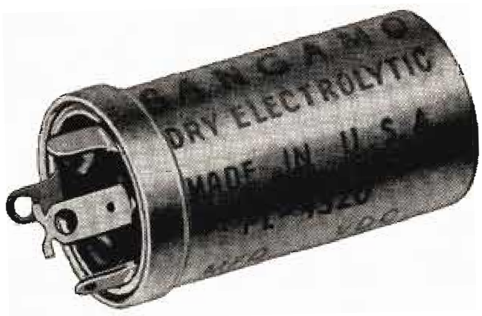
Sangamo "Twist-Tabs"*

never flinch in a hot seat!

High surge voltages and extreme ripple currents don't faze them...



***Type PL Electrolytic Capacitors**

Sangamo "Twist-Tab" (Type PL) Electrolytic Capacitors are designed particularly for all television and electronic applications that demand long life and dependable performance at 85° C under conditions involving extreme ripple currents and high surge voltages.

These quality components are sealed in round aluminum cans and have twist prong tabs for washer or direct chassis mounting. All connections from the capacitor are securely fastened to the terminal lugs, providing permanent low resistance connections. The aluminum cans are negative, and the mounting ring provides the negative connection.

Sangamo "Twist-Tabs" offer a selection from the largest listing of capacities and voltages available from any single source. Write for full information.

Your Assurance of Dependable Performance

SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

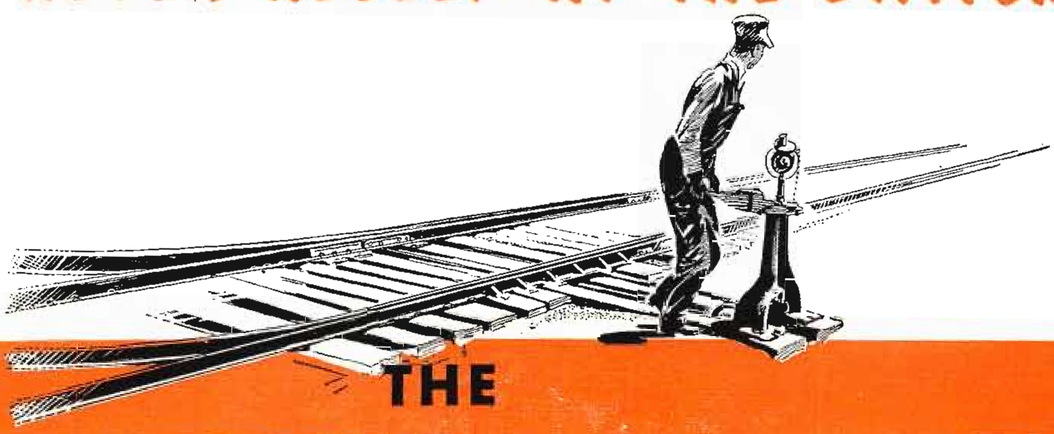
The SANGAMO Tribe
PAPER · MICA · SILVER · ELECTROLYTIC CAPACITORS

IN CANADA: SANGAMO COMPANY LIMITED, LEASIDE, ONTARIO

SC52-1

NEVER ASLEEP AT THE SWITCH

ACTUAL SIZE

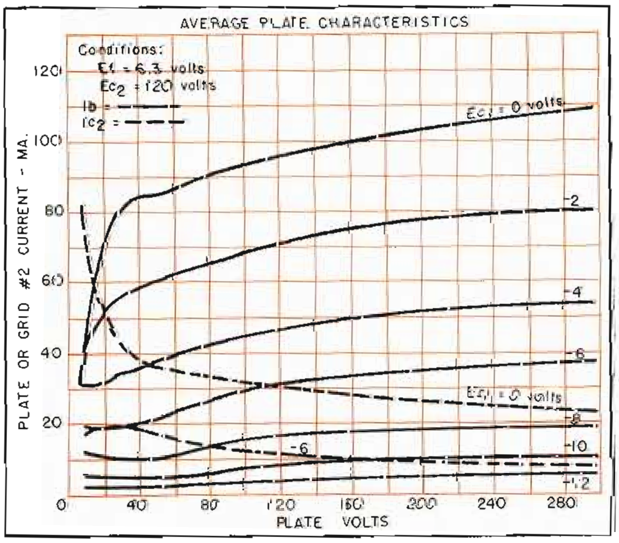


THE RAYTHEON 6AN5

MINIATURE PENTODE

For Computer Applications

The Raytheon 6AN5 was the first of its kind — the first with low interface resistance to avoid "*sleeping sickness*". It remains the first choice of designers of dependable, long lived computing devices.



The Raytheon 6AN5 has been in continuous production for over two years. This means maximum reliability, minimum failures.

Important characteristics of the 6AN5 drop less than 10% in 5000 hours *under on, off, or flip-flop conditions.*

The Raytheon 6AN5, providing high efficiency with low plate voltage is also recommended for such services as

Video Output Amplifier
Wide Band RF Amplifier
Wide Band IF Amplifier
RF Class C Amplifier
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Write for data sheets which contain complete information on this and many other Raytheon Special Purpose Miniature and Subminiature Tubes.

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RAYTHEON MANUFACTURING COMPANY
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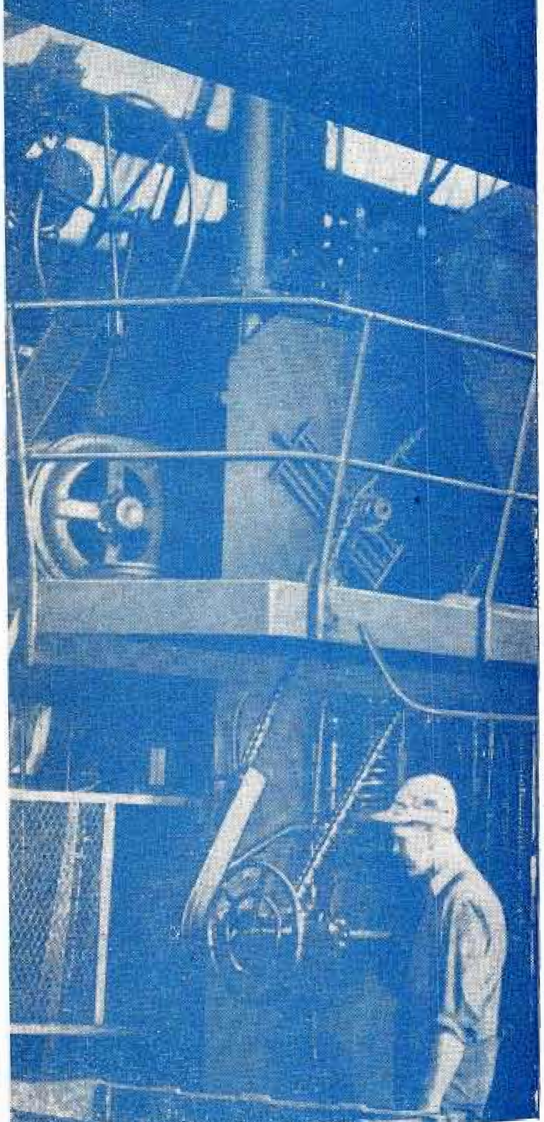
Excellence in Electronics

RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • RADIAC TUBES • RECEIVING AND PICTURE TUBES • MICROWAVE TUBES



TELE-TIPS

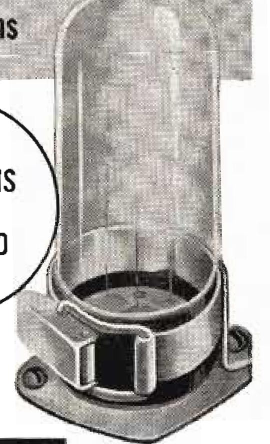
GO SOUTH, OLD MAN!—The Electro Tec Corp., South Hackensack, N. J., has opened a new development laboratory in Ormond Beach, Florida, having decided on the Florida location when a search for trained engineers, technicians and skilled mechanics disclosed an abundance of qualified individuals in retirement in the area, who were willing to resume limited activity in the engineering field. This new approach to the problem of the shortage of trained technicians also provides a measure of decentralization in accordance with governmental aims and removes pressure from an ever-tightening national manpower situation.

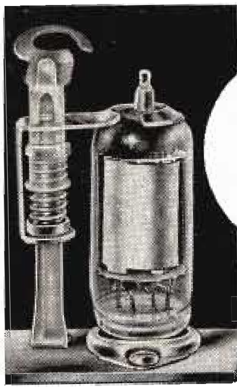
INJUNS—Nearing completion is a new addition to the Lac du Flambeau (Wisconsin) branch of the Simpson Electric Co., which will provide more assembly lines for Simpson test equipment and panel meters and will also give full employment to the remainder of the Chippewa Indians who live on the nearby reservation and are now 75% employed by Simpson. As this is the only large industry in the area, the Indians are dependent on this factory for their livelihood.

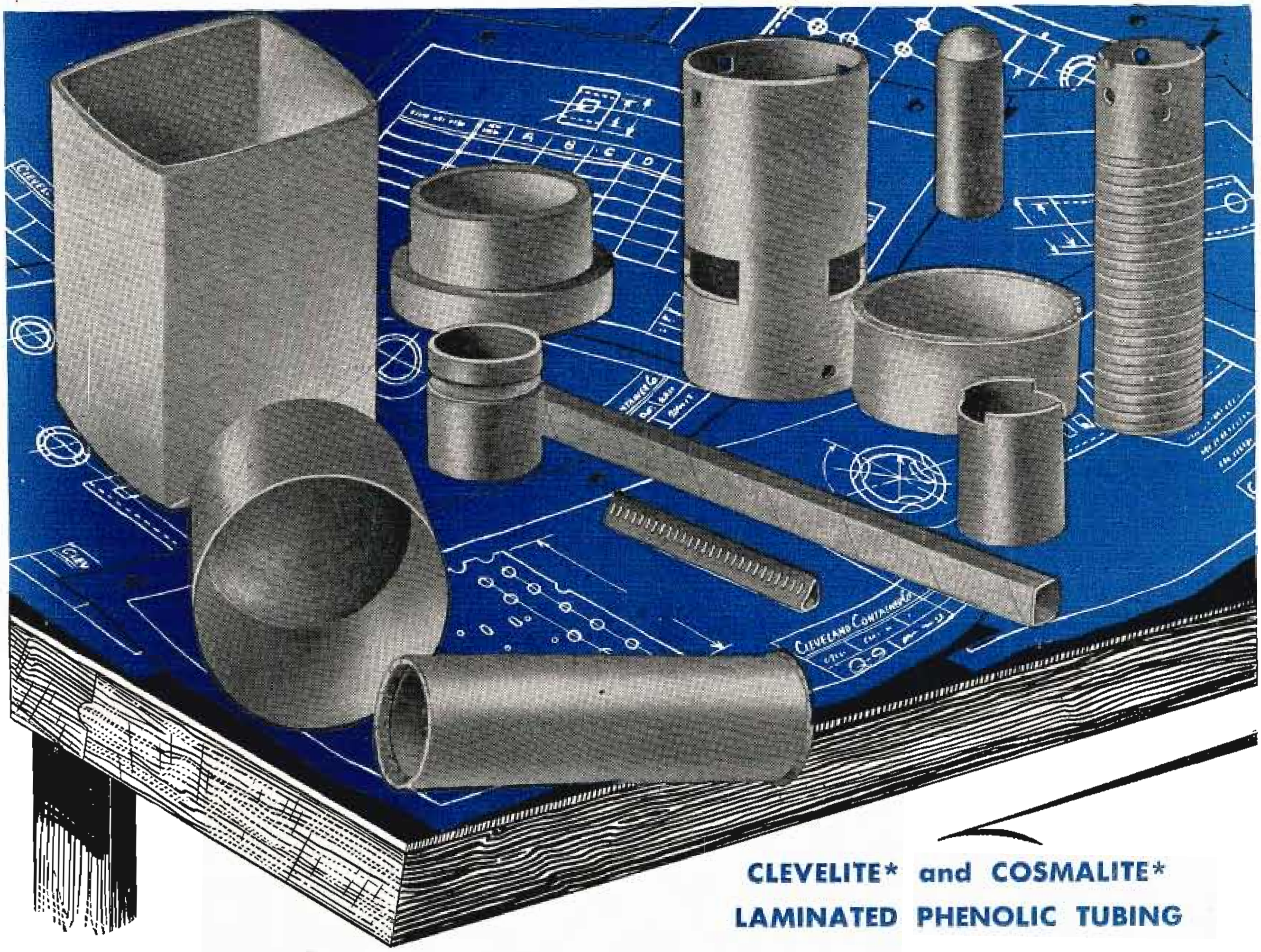
COUNTER MEASURES panel of the Research & Development Board is focusing attention on "passive detectors," reports Dr. Edwin A. Speakman, vice-chairman. The idea here is to have a radar receiver listen for an enemy signal which in turn can be used to betray the enemy's position. This is in contrast to our turning our radars in order to locate the enemy. Devices now being brought into being by this panel are concerned with rapid means of frequency scanning, determination of frequency, and direction of signal as well as the character of signal such as pulse rate and pulse widths. In other words, this amounts to tieing a communications receiver ahead of a computer and waiting at the output end for the answers.

"DON'T TELL ME it can't be done!" Pet expression of Comdr. E. F. McDonald, Jr., president of Zenith Radio Corp., to Zenith engineers.

(*Continued on page* 26)







CLEVELITE* and COSMALITE*
LAMINATED PHENOLIC TUBING

A GRADE FOR EVERY NEED!

Available in diameters, wall thicknesses and lengths to meet regular or special adaptations.

CLEVELITE

- Grade E. . . . . Improved post cure fabrication and stapling.
- Grade EX. . . . Special grade for TV deflection yoke sleeve.
- Grade EE. . . . Improved general purpose.
- Grade EEX. . . Superior electrical and moisture absorption properties.
- Grade EEE. . . Critical electrical and high voltage applications.
- Grade XAX. . Special grade for government phenolic specifications.

COSMALITE

- Grade SP. . . . Post cure fabrication and stapling.
- Grade SS. . . . General purpose.
- Grade SSP. . . General purpose—punching grade.
- Grade SLF. . . Thin wall tubing—high dielectric and compression strength.

Cleveland Container Co. is known for its EXCELLENT SERVICE and PROMPT DELIVERIES.

See our exhibit #207 at the Radio Engineering Show in New York City, March 3-6.

. . . meets the most exacting requirements of the electronic and electrical industries!

Whether to insulate the live electrical parts of a rectifier, a high voltage transformer, or any one of countless other applications . . . satisfaction is ensured.

For wherever physical strength, low moisture absorption, high dielectric strength, low loss and good machineability are of prime importance . . . the combined electrical and physical properties of CLEVELITE and COSMALITE are essential.

DEPENDABLE • ECONOMICAL • LONG LASTING

Why pay more? . . . for the best call CLEVELAND

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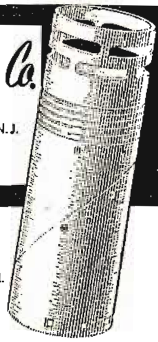
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario



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CHICAGO AREA PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO

TINNERMAN *Speed Nut* SAVINGS STORIES

Beseler "Throws Light" ON 50% TIME SAVINGS

How the Charles Beseler Company, Newark, New Jersey, eliminated 84 fasteners and cut assembly time and cost in half on new opaque projector assembly

It used to take 168 screws, nuts and washers to attach the cover panels to the base frame of the new Beseler opaque projector. That was before "U"-Type SPEED NUTS were tried. Now it takes only 84 screws and SPEED NUTS to do this job.

By making this switch, Beseler picked up a 5% material savings, reduced handling, stocking and ordering of parts and made a substantial 50% saving in assembly time.

"U"-Type self-retaining SPEED NUTS are pre-assembled on the base frames of projectors—ready for simple attaching of panels as frames come down assembly line. Time required for this step was cut from 13 minutes to 6, and the production rate was increased to a new high.

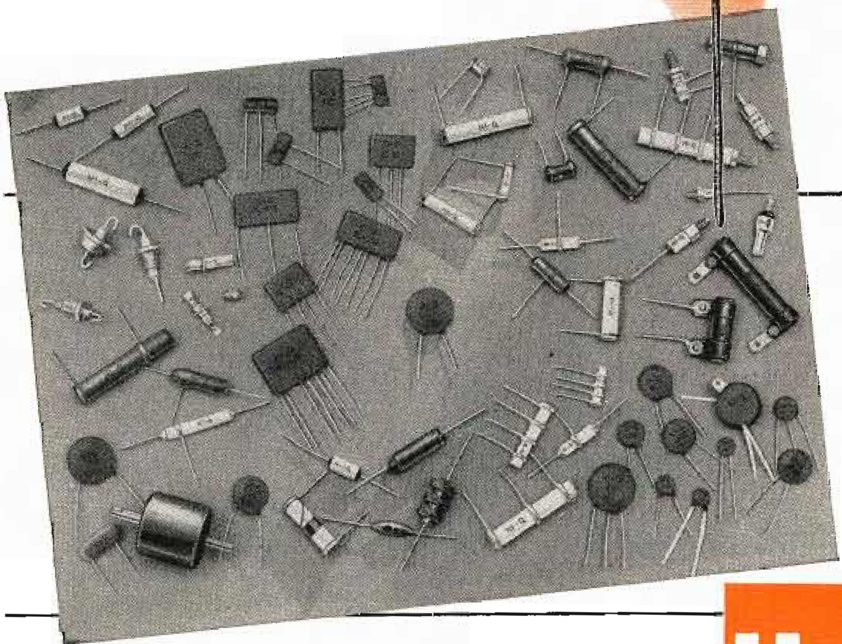
There is no better time than now to take a close look at *your* fastening costs. Savings here often balance rising costs elsewhere. Your Tinnerman representative will supply helpful details. Call him in—and write now for your copy of Savings Stories, Vol. III. TINNERMAN PRODUCTS, INC., Dept. 12, Box 6688, Cleveland 1, Ohio. In Canada: Dominion Fasteners, Limited, Hamilton. In Great Britain, Simmonds Aerocessories, Limited, Treforest, Wales.

HI-Q* SERVES NATIONAL DEFENSE

Wherever Electronics Guide Them Home

The amazing and intricate science of electronics has provided new eyes and ears to bring our airmen straight home from anywhere . . . to sight a target many horizons beyond the span of human vision. On land and sea, electronics likewise has become a vital keystone in national defense.

And wherever you find electronics, you'll find **Hi-Q** . . . Small Ceramic Disk Capacitors, for example, of both the by-pass and temperature compensating types. Tubulars, perhaps . . . Plates or the new High Voltage units. And wherever you find **Hi-Q** you'll find unerring dependability, rigid adherence to specifications and tolerances, and long life. Whether your needs are for standard or specially designed components, **Hi-Q** engineering and production keenness can meet your most exacting requirements.



Specializing in ceramic capacitors, **Hi-Q** has developed a complete line of Temperature Compensating Disk Capacitors with a capacity range from 475 mmf to .3 mmf and standard tolerances of ±5%, 10% or 20%. For applications requiring a large gradient of capacity vs. temperature **Hi-Q** Extended Temperature Compensating Disk Capacitors are available. These together with **Hi-Q** By-pass Disk Capacitors give you one source of supply for all ceramic Disk type capacitors. Write for New Engineering Bulletin on Disks.

**Trade Mark Reg. U.S. Pat. Office*

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TELE-TIPS

(*Continued from page 22*)

PDF!—That's the new alphabetical designation for Post-Deflection Focusing of the electron beam as employed in the Lawrence color-TV tube, according to Chromatic TV Labs' chief engineer Robert Dressler. Chromatic now has a new factory going at Stamford, Conn.

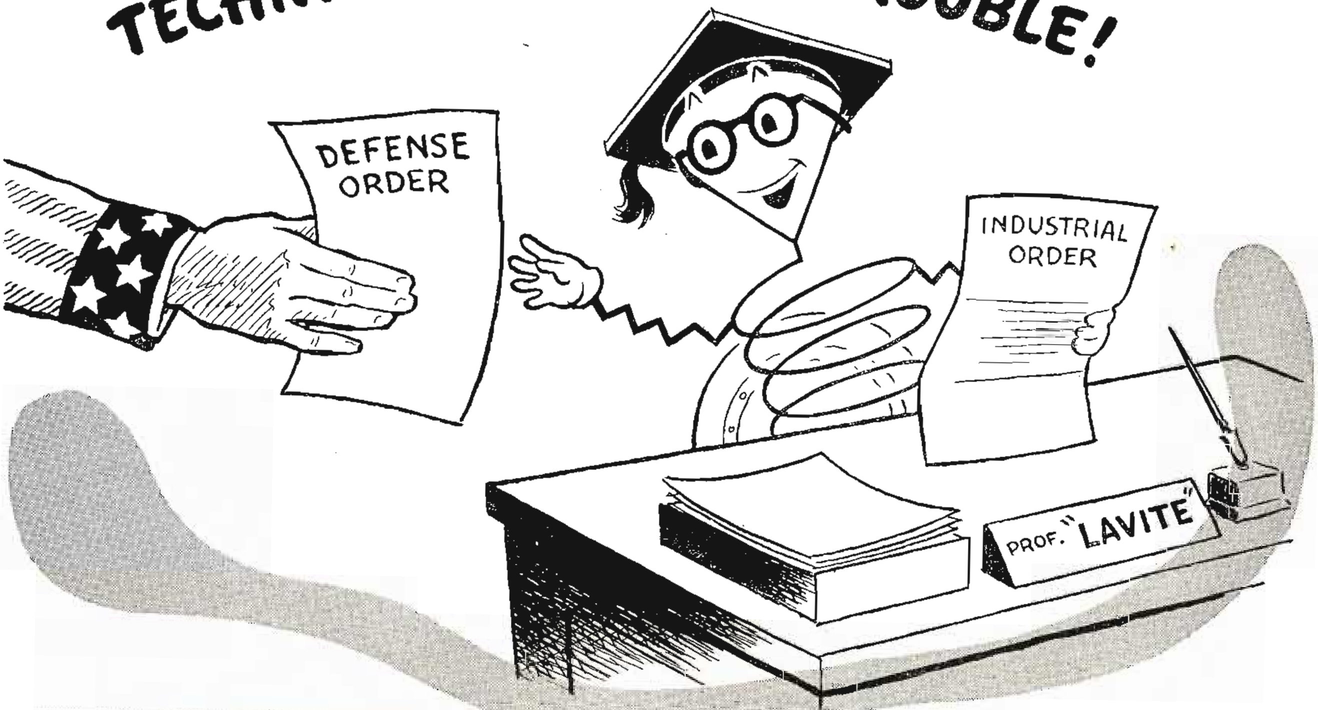
"QUALITY CONTROL" course of 15 weeks at the University of New Hampshire, featuring statistical methods was recently followed by a group of Clarostat engineers and production men headed by William Mucher. The two-hour weekly sessions were directed by Prof. William Keckline of the university's College of Technology. Main purpose of the course is to provide a sound training in the use of statistics in governing production processes. Tuition costs were borne by the management.

NEW SOUNDTRACKS—Reeves Soundcraft Laboratories has perfected a quick, inexpensive method of putting magnetic soundstripes on film enabling old sound tracks to be erased and new ones substituted. For manufacturers, this means that industrial, education, or advertising films can be kept up to date with the latest information without the costly expense of remaking the entire film.

SIGHTLESS PERSONS are finding new spheres of usefulness. The German radio NWDR has begun to use blind men as radio monitors in its main studios. The suggestion is entirely sensible since a blind man's sense of hearing is much more acute than a sighted person's and as a result he will be more critical of the audio signals reaching his ears. War veterans have been used in the German operation and its principle might well be adopted by those organizations which have need for large-scale audio monitoring in this country.

VP'S NOT VIP!—Dr. C. E. Kenneth Mees, vice-president in charge of research, Eastman Kodak Co., pointed out that only those who thoroughly understand a problem con plan it well. Best planner is research worker himself,—with his department head or group leader next best. Dr. Mees adds: "The research director may be wrong half the time; a committee of any kind will be wrong most of the time; and a committee of vice-presidents would probably be wrong all the time."

NO NEED FOR HAVING TECHNICAL CERAMIC TROUBLE!



DEFENSE or INDUSTRIAL
STANDARD or SPECIAL

Lavite CERAMICS
ARE AVAILABLE IN AN UNLIMITED RANGE OF CHARACTERISTICS

Send for tables of characteristics of standard "LAVITE" Ceramics. For special needs send your specifications to our engineers for recommendations.

Remember—
There are non-critical Ferrites for non-critical defense uses.

Although scarcity of materials are causing trouble, even in ceramics—you can be sure that your needs will be completely satisfied by Steward's increased capacity to produce "LAVITE" Ceramics—(LAVITE Steatites, LAVITE Ferrites, LAVITE Titanates), if those needs can be at all answered.

Standard Ceramic products, most of which are in production every day, are promptly available in large quantities.

Special requirements receive immediate and experienced attention by Steward engineers assuring scientifically developed solutions to your most exacting Technical Ceramic problems.

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HIGH-TEMPERATURE MAGNET WIRE

A most important aid in the miniaturization of small transformers, reactors, relays, and other copper-wound components of electronic equipment and aircraft! That's the rapidly spreading story about CEROC T, the new and important development in magnet wire.

The first and only magnet wire to operate safely at a continuous temperature of 250°C., Sprague CEROC T wire has considerably higher current ratings than conventional magnet wires of equivalent AWG size. Consequently, you can use smaller sizes of CEROC T to achieve a considerable saving in the physical dimensions and weight of small electric apparatus.

Or if it is necessary to "beef up" equipment already designed to fit a certain space, you can switch to CEROC **T** windings for a marked increase in electrical rating.

CEROC T Magnet Wire is made by an exclusive, patented Sprague process for applying its insulation of inorganic ceramic and Teflon. It has excellent solvent and abrasion resistance and high dielectric strength. Complete specifications are yours for the asking in Engineering Bulletin 402F.

UP TO 200°C.—CEROC 200 — This ceramic-silicon coated wire is your best choice for operating temperatures up to 200°C. Write for Bulletins 401 and 403B.

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TELE-TECH

RADIO-TELEVISION-ELECTRONIC INDUSTRIES

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

Lifting of "Freeze" Will Usher In

TV's UHF ERA

It now seems a matter of weeks only, before the TV "freeze" will be lifted. This move by the FCC will open the way for the long-delayed construction of hundreds of VHF and UHF stations which the public and the industry have impatiently awaited.

First relief, obviously, should come in bereft communities like Denver, the two Portlands, and Spokane, where great populations have found themselves inexplicably caught with no TV facilities. Dozens of such VHF applications should be processed without delay, filling up the many "wide open spaces" in channels 2 to 13.

But the greatest engineering challenge will come as the first UHF assignments are made. Evidently the New England region will be the first to get the benefit of this new TV realm, for already New England's VHF allocations are about exhausted and there the next step must be "up the spectrum"—above 470 MC.

"Operation Bridgeport," pictured on our front cover, has been making history in its UHF pioneering these last three years. Inspected by hundreds of TV engineers, NBC's 530- and 850-MC station has demonstrated that UHF-TV is stable and practical, and under some conditions even better than VHF, because of freedom from interference.

This pioneer UHF transmitter has thus started the procession of 200 or more commercial UHF stations expected to be built yearly at an annual outlay of around sixty million dollars, and aggregating within five years a new nationwide telecasting array representing the expenditure of a third of a billion.

With the early opening of the UHF channels, certainly a distinct New Television Era is on its way!

RADARSCOPE

Revealing Important Advances Throughout the Spectrum of Radio, TV and Tele Communications

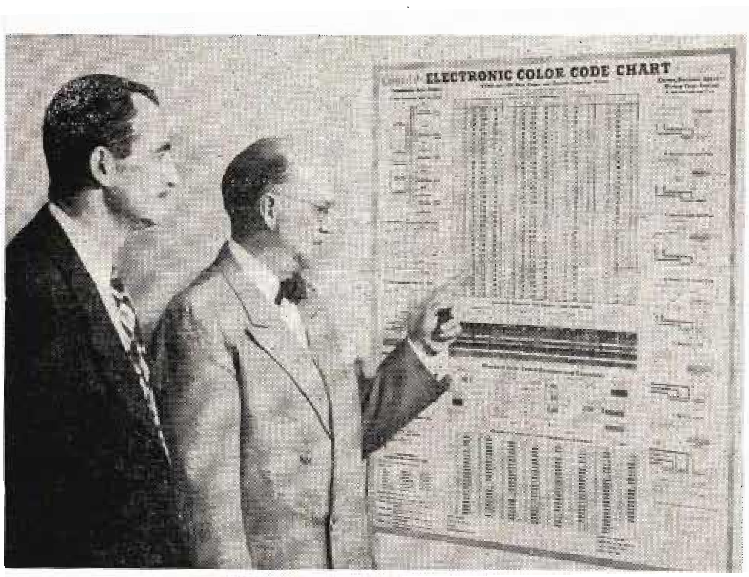
REARMAMENT

LEADERS in the electronic-radio manufacturing industry emphasized at the beginning of 1952 that the industry is ready, through its expanded plant production capacity, to meet the increasing requirements of the military services for the national defense mobilization. RCA's production potential, for example, is the greatest in the 32 years of its history, declares President Folsom, and Dr. W. R. G. Baker has declared General Electric will more than double its 1951 military production total. These assurances, together with an authoritative statement to Tele-Tech's Washington bureau from a leading Air Force electronics procurement official, refute press and magazine assertions that military aircraft operations have been delayed by lack of electronic and radio equipment.

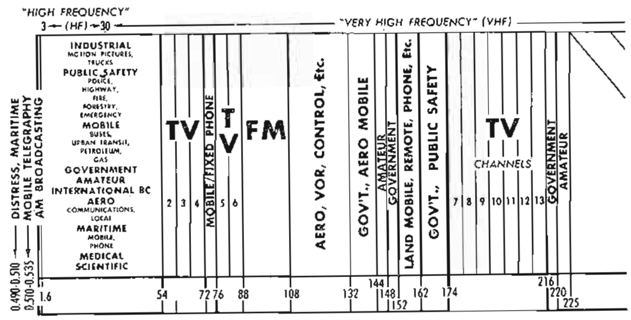
MOBILE

NPA MOBILE RADIO COMMITTEE—The National Production Authority's Electronics Division has established an industry advisory committee from the mobile radiocommunications field to aid in developing the programming of critical materials and metals and equipment for the mobile radio services. The mobile radio services have been accorded a high rating by the defense mobilization agencies for a continued supply of equipment and parts because mobile radio is regarded as highly important in the national defense effort.

STANDARDIZATION



All color coding requirements are shown in this 11-color chart with 3300 color dots, explains W. S. Parsons, Centralab vice-president. Coding covers transformers, antenna leads, RTMA and JAN mica, paper and ceramic capacitor values, resistors, speakers and receiver chassies.



MATERIALS

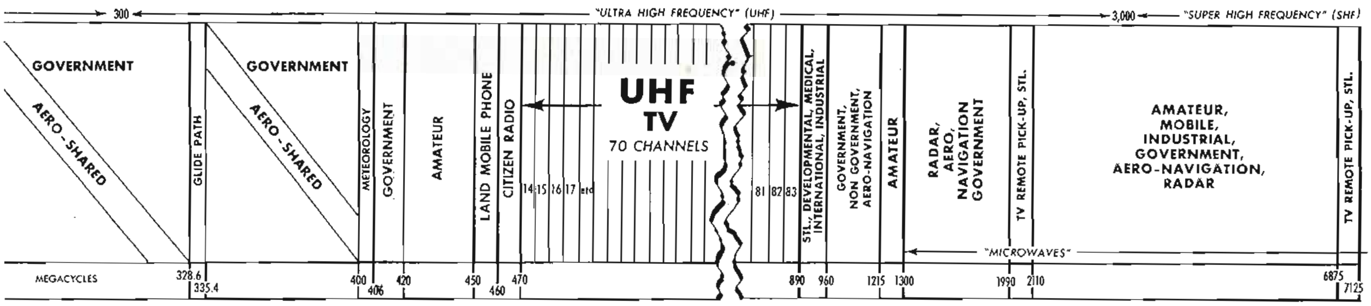
PLASTICS production as used in electronics has reached a point where the supply has about equalled the demand, with the notable exception of polyethylene. Even with increased plant expansion the output of polyethylene is not expected to catch up with potential uses for several years. Other plastics are still being used where possible in place of it. Phenolics and vinyls, tighter in the first half of the past year, have now eased, and there is today a buyers' market. One reason for the fact that plastics are not holding up defense production as are metals is that here a much smaller percentage of the industry's output goes into military supplies. For example, polyethylene is used in assault wire at the rate of 14 lbs. per mile, with nylon in the same manufacture at about 7 lbs. per mile of wire. But this comes out of a combined national production figure of over 50 million lbs. per year. Urea is in fairly good supply, and more fabricators may look to it as a molding medium than have in the past. Although still insufficient for essential production, supplies of most types of synthetic rubber are continuing to improve, except butyl.

AVIATION

AIRBORNE RADIO EQUIPMENT for privately-owned planes belonging both to individuals and corporations is steadily being installed and improved upon. Unlike the airlines which have to use more or less standardized equipments, these owners of one, or at the most, two, aircraft with perhaps only one pilot, can make their installations as individual and different as they like. In fact many of the newer safety devices and radio modifications which are later incorporated in the commercially available equipment originate here. The Corporation Aircraft Owners Association Inc. plays a large part in such development and continues pushing many of these devices which are often the result of a brain wave on the part of a radio engineer who is interested in airplanes.

AUDIO

LOOKING AHEAD, we see a steady increase in the quality and flexibility of high-fidelity systems. Many new applications of binaural sound recordings (now commercially available), should also be making their appearance. The new loudspeaker enclosure which seems to give considerably increased bass efficiency through the tight coupling of both sides of the speaker cone, may, if it bears up under comparison with other systems,



provide the biggest boost since LP in increasing audio interest and sales. Also, in connection with loudspeakers, there will be continued emphasis on the use of multiple-unit two- and three-way speaker installations. More of the top commercial instruments are expected to be using separate bass and treble controls. And employment of inverse feedback from the voice coil windings will be standard procedure in even the medium-priced consoles. New pickups for the high-fidelity field continue, with the latest, a light-weight (1 gram) unit, designed to vary the capacity of an FM oscillator. Most better combinations will be using low-output magnetic cartridges. Tape-recorder performance at the low and medium price levels will improve, thus adding to the volume of users. At the higher-price end of the scale, prices are expected to stay high and several new models may be added.

COMPONENTS

ADVANCES in component miniaturization continue. As a result, it is becoming increasingly difficult to identify the types of components involved in different circuits. For example, the physical appearance of some germanium diodes is little different from composition resistors or from certain ceramic capacitors. Also, with transistors coming into the picture, it will become increasingly difficult to distinguish between miniaturized pulse transformers, ceramic capacitors and transistors without first referring to a component identification diagram. It would appear desirable to start developing some new system for component identification soon. Perhaps the resistor-capacitor color coding system can be extended.

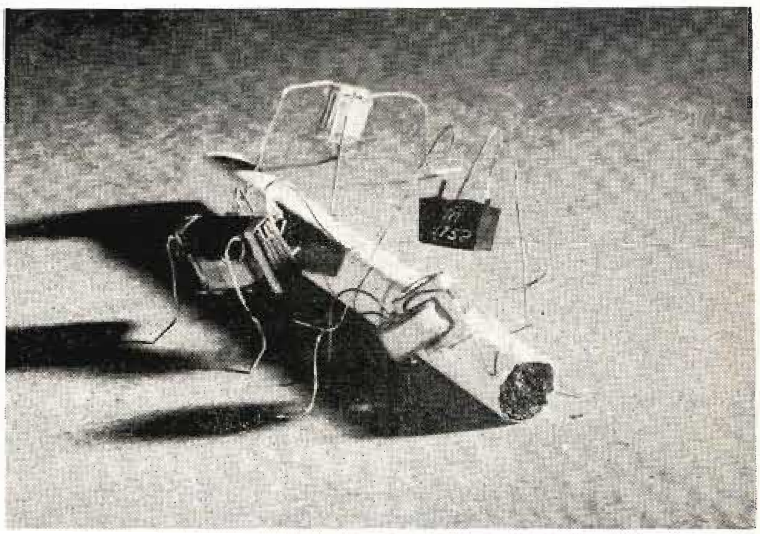
THEATRE TV

MANY SCHEMES have been announced for the presentation of theater television in areas where there are no television stations. So far a few of these plans have borne fruit, and some fights and sporting events have been shown via closed circuit TV in cities where the general TV public has not been able to receive such pictures on their home TV receivers. Now we have more ambitious plans for big-screen television in many of the Western cities where there are no TV stations. For example, Denver is expected to be one of the first TV-less western cities to put large-screen TV in its movies and theaters. Watch also for some Broadway plays to be televised from New York or Philadelphia during their tryouts via closed-circuit TV and fed to the screens of admission-charging houses in other circuits. There is no reason why this sort of operation should not be most satisfactory, provided there are adequate relay channels available. Of course, if the TV public suffers as a result of diverting TV network facilities to this purpose, the plan should be shelved until such time as more facilities are available.

FM & AM

"OLD FASHIONED" AUDIO in the form of AM and FM will continue to attract many a listener during the coming year, and, in some instances, to recover viewers who deserted to television, and after a surfeit of moronic programs have returned to a medium where the listeners' imagination can be used. AM stations will continue to add to their numbers, although at a slower rate. And there will probably be more failures for financial reasons. FM will plod along, struggling against FCC red tape to make enough money to support the medium. So-called "captive audiences" will be deleted by FCC or federal order, but the use of supersonic signals to enable FM transmissions to perform functions outside their normal operation will certainly be approved by the FCC. This will enable many stations to keep going. Most noteworthy development will be conservation activities to save scarce materials and components—notably tubes.

MINIATURIZATION



Advent of transistors, printed circuits, new materials, new potting techniques (such as plastic encasements) and smaller terminals, are all contributing to present miniaturization methods. Picture shows a junction transistor (at right) and three tiny transformers built by skilled Bell Labs technicians.

DEFENSE CONTRACTS

Selling to Uncle Sam in '52

Now that the "break-in" period is over, buyers and sellers will operate under modified procurement procedures reflecting switch from advertised to negotiated bidding. Here are some helpful hints

By MURRAY FIEBERT,
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(Former Gov't Procurement Officer)

IF you have been dealing with military buying agencies, you will know that doing business with Uncle Sam is somewhat complicated. The beginner hardly knows how and where to start in his efforts to get his first contract. The first impression of the small business man is that he is being pushed around. In an effort to clarify the status of small business in the defense picture, TELE-TECH published a series of articles in 1951 which analyzed the defense role which small business is playing.

The following information is designed to crystalize the military buying situation for 1952 as it applies to the TV-radio-electronic industry and to highlight what can or cannot be done when selling services to the government.

Military buying agencies are primarily organized as follows: (Clerical and administrative operations are not referred to here.)

At the peak of advertised bidding in 1951, bid requests went out by the thousands as shown in this Air Force photo. Bulk of military buying in 1952 will be by negotiated bidding from known suppliers

1. Engineering—Prepares specifications, invitations, and evaluates technical questions on equivalent bids.

2. Procurement—Makes purchases. The contracting officer or his representatives, usually designated as purchase officers, are responsible for issuing bids, screening and making the award, after recommendations have been received by the technical assistants, who evaluate technical exceptions to bids. The contracting officer is responsible for determining a contractor's technical and financial ability to perform before making the award and for contract modifications and terminations.

3. Inspection—Responsible for inspection and acceptance of manufactured material.

4. Industrial Mobilization—Overall planning for war emergencies. Conducts plant surveys, determines plant manufacturing capacity.

5. Engineering Laboratory—Designs specifications for new equipment. Tests pre-production models, and conducts research and development projects. In some agencies the laboratory engineers may be called upon to assist in an evaluation of bidder's equivalent quotation, as well as to determine a contractor's technical ability to produce a complicated piece of equipment.

Military and civilian personnel work in cooperation with one another. In most agencies the permanent civilian employee is the "operations" man. Officers generally receive rotating assignments and are not always as fully informed and familiar with the problems as the permanent civilian employee. In every case possible, it is recommended that an effort be made to meet the contracting officer, the purchasing officer and procurement engineers, both civilian and military.

Get On the Mailing List

Getting on the mailing list is academic to most business men by this time—procedure details were published in TELE-TECH during 1951.

It is well to remember, however, that the contracting officer is responsible for making the award. Wherever possible, a copy of your brochure should be given to the contracting officer, personally. Although many agencies delegate this responsibility, the contracting officer is the official who makes the final decision regarding the company to be solicited, both for negotiated and formally advertised bids.

The bible of military procurement is the Armed Service Procurement Regulations. The ASPR is issued by the Secretaries of the Army, Navy and Air Force, and establishes for these departments uniform policies relating to the procurement of supplies and services under the authority of the Armed Services Procurement Act of 1947, Public Law 413, 80th Congress, 41 U. S. Code 151-161, or under other statutory authorization. It is recommended that firms doing business with the Government acquire a complete set of the ASPR's. Copies of each Section can be purchased for ten cents from the Government Printing Office, Washington 25, D. C. These regulations are an invaluable aid in understanding and interpreting prerogatives of a bidder, as well as the responsibility of the buying agency. They contain answers to many questions regarding negotiation, contract forms, federal excise taxes, patents, patents and copyrights, labor regulations, clauses for fixed-price supply contracts, duty and customs, foreign purchases, interdepartmental procurements, advance payments, types of contracts, qualified products, openings of bids and award of contract, solicitation of bids, procurement by formal advertising, basic policies.

When selling to the government, the procurement and contracting officers and the engineer responsible for specifications on the equipment should be seen. It's still a matter of personal selling

Bid Preparation

Before completing any of the bid forms accompanying invitation, a qualified company official should thoroughly read all instructions, schedules and attached papers. Failure to do so can lead to serious error and possible financial loss. A bid should not be signed by a company official unless he understands all clauses and commitments being made.

Items which must be filled in before submission of the bid include unit and total bid price, discount (it is always advisable to offer the government a discount as it is considered in evaluating price and assists in obtaining prompt payment), acceptance date, f.o.b. point, and delivery information. (This paragraph on delivery is important and should be considered carefully) Many bidders assume that since the government requires the material within a specified schedule, anybody offering an alternate schedule would not be considered. This is not so. Bidders should quote realistic schedules. Unless the invitation states that delivery is a material factor in making an award, the delivery schedule quoted by the bidder will not be the determining factor in making an award.

When quoting on an "or equal," the bid papers should include the applicable drawings, schematics, photographs when available, commercial catalogs and whatever other information deemed necessary to properly describe the item.

Bids may be modified or withdrawn, at any time prior to the time fixed for opening, by written or telegraphic notice received by the buying agency prior to the time fixed for opening. After the opening of bids, no bid may be modified (except in the case of a minor irregularity or an obvious or apparent mistake of a clerical nature, as provided by regulations) or withdrawn unless such modifications or withdrawal is received before the award has been made and either (1) failure of the modification or withdrawal to arrive prior to the time fixed for opening was due solely to delay in the mails for which the bidder was not responsible or (2) modification is in the interest of the Government and not prejudicial to the other bidders.

Results of Bid Openings

Interested bidders are invited to attend bid openings. They may obtain results of the bid during the opening of bids. Those present are permitted to make a complete recording (or abstract) of the bids. If bidder is unable to attend opening, it becomes somewhat difficult to get immediate results of bid openings. Should a bidder not be present at the bid opening he can in most cases call the buying agency for the bid price information. However, certain agencies refuse to furnish this information. Companies manage to get such information by either having a company representative present at the opening, or hiring a reporting company to render the service.

Negotiated Bid Openings

Quotations received as a result of negotiation are not opened publicly. Most agencies do not permit bidders to attend bid openings on negotiated procurement. Bidders who are invited to submit a negotiated bid are entitled to information about their competitors' prices, but are not furnished with other details. Procedures on negotiated bids are separate and different from those governing formal advertising. In many cases industry has complained about the manner in which negotiated procurements are handled. Too many agencies appear to have adopted the policy that the right to negotiate implies elimination of competition. This is not intended by the law permitting negotiation.

The period of time which a bidder allows for acceptance of his bid is called the acceptance date. Government agencies are required by regulations to award a contract with reasonable promptness and by written notice to that responsible bidder

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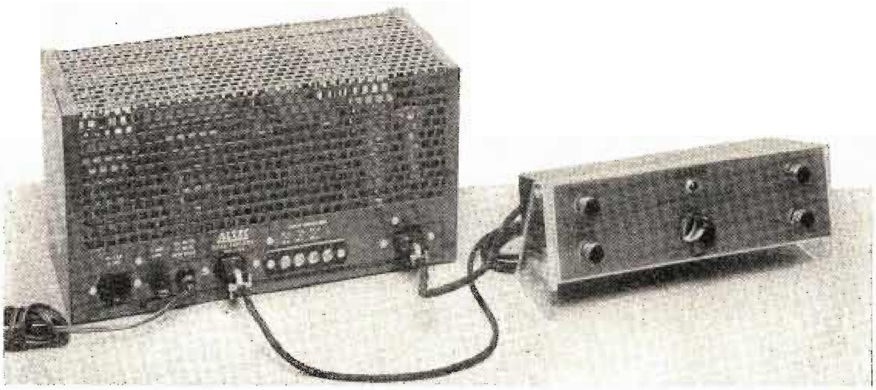

Amplifier and control panel which may be at considerable distance from each other

A High

Newly - designed
power with few-

By JAMES J. NOBLE and JOHN STORK
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A PHOTOGRAPH of the underside of the power amplifier with case and covers removed is shown in Fig. 8. The open construction of the chassis greatly facilitates wiring. Most of the resistors and capacitors are mounted on a terminal board below the line of tube sockets. In many cases, interconnections between the terminal board and other components of the amplifier can be made with uninsulated wire. Leads from the transformers can be seen projecting through holes in the chassis. Those of the output transformers are just below the terminal board, with the secondary leads connected directly to output terminals on the bottom flange.

To the right of the output transformer is the power transformer, oriented to induce the least hum currents in the output coil. The power-supply filter choke, which generates a prominent electric field—rich in harmonics, is placed to the right of the power transformer at the greatest distance from low level tubes and circuits.

The connector for input signal from the pre-amplifier and for plate voltage and ground leads to the pre-amplifier is mounted at the left end of the bottom flange. The connector for pre-amplifier filaments and master power switch is on the other side of the output terminals. Next, in order, to the right are the power cord, fuse and an outlet, controlled by the master switch, for phonograph or radio tuner power cord.

The external case is in two pieces—a cover completely enclosing the circuits and components on the under-side of the chassis, and a perforated metal box covering the tubes and transformers.

One of the most limiting restrictions on the design of a pre-amplifier to accompany a high-quality power-amplifier is that it should contribute little or nothing to output distortion over the full operating range of the system. The harmonic distortion produced by vacuum tubes in voltage amplifier circuits with very small signals is not often considered. Referring to grid voltage-plate current curves is of little help since the operating range is too small to obtain accuracy by graphical constructions, and small-signal distortion figures are not published for ordinary receiving tubes.

Distortion Figures

The most practical means for determining distortion figures, then, is by tests of circuits equivalent to the complete pre-amplifier circuit. An arbitrary criterion of performance is that the intermodulation distortion at the output of the power-amplifier, with full gain in the pre-amplifier and with tone controls set for flat response, be less than 1% at 12 watts output. From Fig. 6, this is seen to be very slightly more than the distortion of the power amplifier alone. About 0.4% intermodulation distortion from the pre-amplifier is the most that could be tolerated.

The lowest level input source contemplated for the pre-amplifier is a variable-reluctance type phonograph pickup. Assuming that the average output voltage of such a unit is .015 volts, a single pentode stage and single triode stage would be sufficient, including equalization but

Fig. 8: Under-side of power amplifier chassis

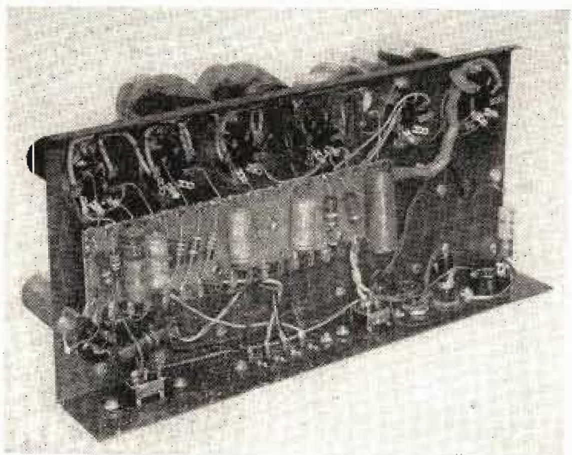
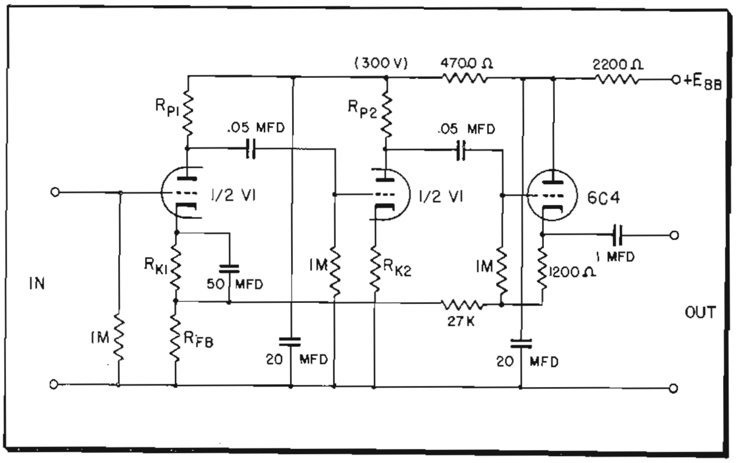


Fig. 9: Circuit to determine triode distortion. See Table I



Quality Audio Amplifier

Part Two of Two Parts

audio amplifier provides source of high-level, low-distortion er components and at lower cost together with remote control

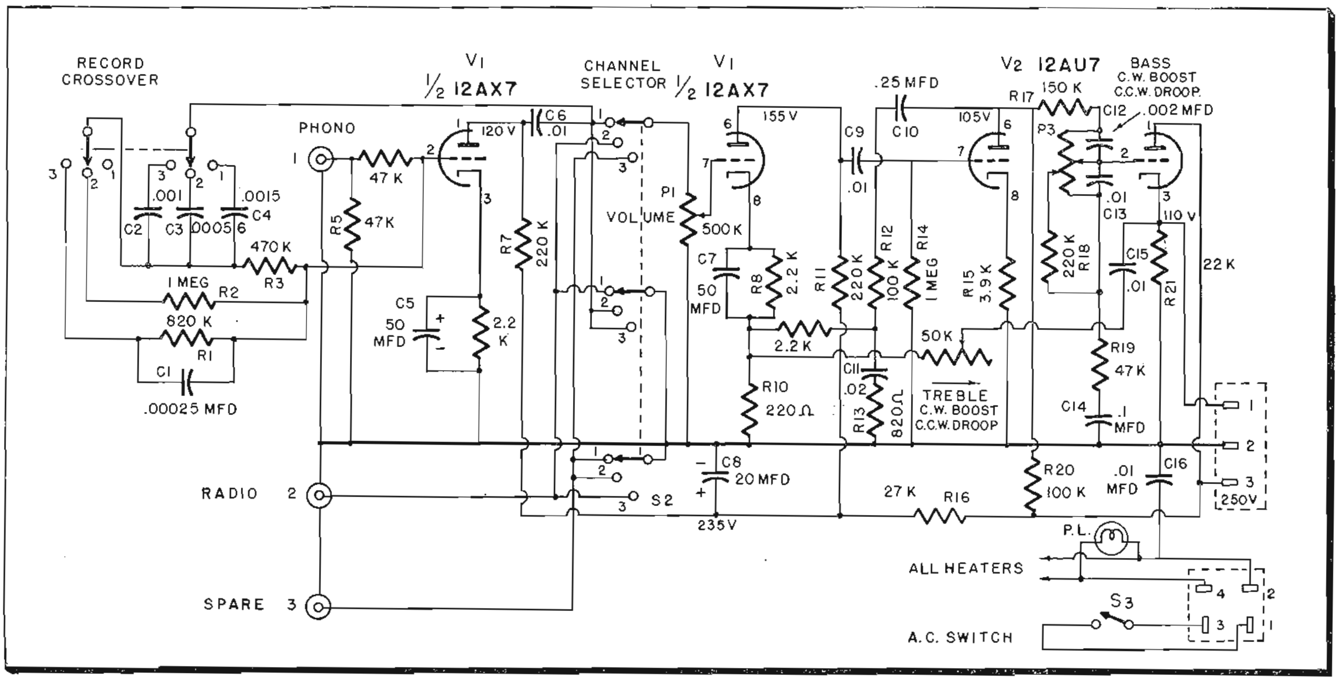


Fig. 10: Final circuit of pre-amplifier. Response and gain controls are in positions to minimize tube noise effects

without feedback, to drive the power amplifier. If appreciable feedback is used, more gain is required, and two high-mu triodes and one medium-mu triode are the best combination. Another reason for favoring a high-mu triode input stage is that high level signal sources connected to the pre-amplifier will normally be at a 30 to 35 db higher voltage level than the variable reluctance pickup. These can be connected to the second stage of the pre-amplifier and then about the same operating range of a single gain control will serve for all inputs. Since a low output impedance is necessary in order to use long lines between pre-amplifier and power amplifier, it is most practical to use a cathode-follower output stage. No unusual precautions regarding microphonics and other tube noise are needed, and with regard for reducing size of the completed unit, miniature double-triodes, such as the 12AX7 and 12AU7, are convenient.

A test circuit was constructed for determining distortion figures using various miniature double-triodes. The circuit, which is shown in Fig. 9, includes a cathode follower output. The output stage not only simulates the contemplated pre-amplifier design, but also offers a convenient low impedance output for measurement purposes and a source of feedback if it is necessary to determine the amount of feedback needed for specified performance.

Test Results

The results of tests for typical tubes are given in Table I. The plate loads and bias resistors are in each case near the recommended values in resistance coupled amplifier charts prepared by the tube manufacturers for the specified plate supply voltage. For harmonic distortion measurements, a 700 cps signal containing 0.32% second harmonic and .020% third harmonic was used. There were no higher order components measurable in either the signal source or the test circuit output. Intermodulation tests were made at 40 and 2,000 cps, 4 to 1 ratio, and .03% signal generator distortion. The equivalent source and load impedances were 300 ohms and 30,000 ohms, respectively.

For the 12AX7 tube, output voltage was maintained constant at 10 volts and input voltage was raised as increasing amounts of feedback were applied. An input voltage of .025 volts is comparable with the output of a magnetic pickup or the pickup with one amplifier stage and low-frequency equalization. With the feedback used for this input level, distortion is quite acceptable, and the output voltage is about three times that required at the input of the power amplifier for 20 watts output. It should be noted that as feedback is increased and input voltage raised, the distortion does not drop as low as it would for constant input voltage. Because of higher grid signal voltage at the second stage than at the first, the second stage is the principal source of distortion. Comparison between different input levels without feedback is shown in the results for the 12AU7 tube. With .004 volts input level, the signal output was too small to measure with the intermodulation test set-up used. However, by comparing the second-harmonic distortion with results obtained for the 12AX7, it is probable that intermodulation distortion is

HIGH QUALITY AUDIO AMPLIFIER (Continued)

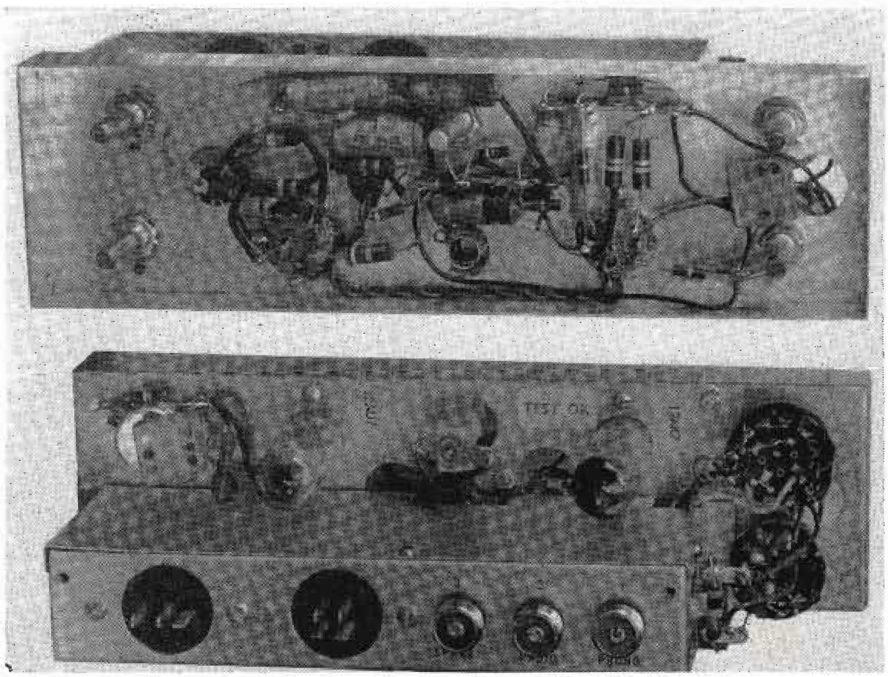


Fig. 11: Front and back of pre-amplifier with the case and control panel removed

about 0.2%. Apparently, appreciable feedback would be required to obtain sufficient output level to drive the power amplifier with very low distortion.

Tests on the 12AY7 and 12AT7 were conducted similarly to those above. Evidently the 12AU7 and 12AT7 were not intended to be used as low distortion voltage amplifiers without degenerative circuits. In this respect, they compare poorly with tubes such as the 6SN7 and 6SL7 whose grid-voltage plate-current curves show very uniform amplification characteristics.

On the basis of grid-voltage handling capabilities with 10 volts output for a single stage, the 12AY7 shows best characteristics. Its relatively high initial and replacement costs are a drawback and the amplification is insufficient for this application. In general, second order distortion is the most prominent, with almost negligible third and higher order components, as may be expected from non-uniform amplification.

The results of these tests point definitely to the need for negative feedback around all vacuum tube stages. Accordingly, at the expense of increased complication, the equalization described below is obtained through compensation in feedback networks.

Control Features

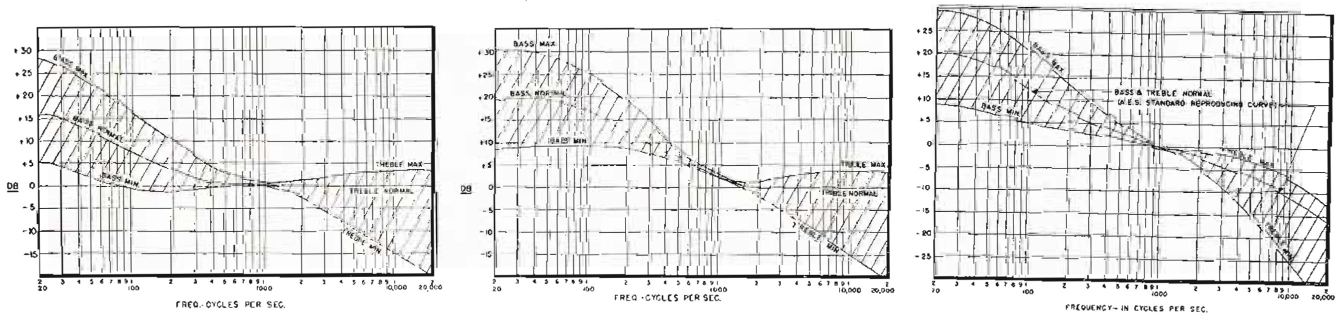
The control features which it was felt necessary to incorporate in the pre-amplifier are a selection of three input circuits — one for magnetic pickup and two for higher level sources, a range of three bass rise crossover frequencies active only on the low level input, variable bass and treble controls to obtain both rise and drop at high and low frequencies with fixed crossover points, gain control, and switch to control the a.c. power for the entire system.

Some consideration was given to the use of a loudness control, or gain control, with compensation for hearing-frequency characteristics at different volume levels. Several commercial types that are simple and have excellent characteristics are available. Unfortunately, use of such a control is not simple. For correct operation, the control must furnish approximately flat response when the sound output at the loudspeaker, or more accurately, the sound at the listener's ear, is the same level as that at the microphone, or some appropriate reference point, during recording.

Naturally, the sound level for different types of music and on different records will vary, and the listener must decide what is a realistic sound level for the program material at hand. A separate, ordinary gain control is required in addition to the loudness control to establish the same input level to the control from all signal sources. We feel that the certainty of misuse of a loudness control by most users of home reproducing equipment makes the control undesirable.

A great deal of experimenting and construction of samples took place before obtaining the final circuit of Fig. 10. Two of the most important considerations in design were reduction of distortion to the desired limits under all possible operating conditions, and positioning of the response and gain controls so that the effects of tube noise would not be noticeable. It is appropriate to regard a control which provides an increase in response at low frequencies as one which reduces amplification at higher frequencies and allows the system to return to its normal gain in the bass range. If such a control is placed between the signal source and the amplifier, the effect is to reduce the input signal to the amplifier. More amplification will be required and objectionable noise may intrude. It is usually best to place tone con-

Figs. 12-14: (L to R) Frequency response characteristics of pre-amplifier from inputs with 1st, 2nd and 3rd crossover points



VI	R_{P1} Ohms	R_{P2} Ohms	R_{K1} Ohms	R_{K2} Ohms	R_{FB} Ohms	Feed-back db	E_{in} Volts	E_{out} Volts	Voltage Gain db	HARMONIC DIST. % 2nd	HARMONIC DIST. % 3rd	I.M. Dist. %
12AX7	220K	220K	1,800	2,200	0	0	.004	10	67.9	.152	.020	0.8
					15	8	.01	10	59.9	.090	.020	0.43
					56	16	.025	10	51.9	.060	.021	0.22
					120	22.5	.054	10	45.4	.041	.020	0.12
					330	30.5	.13	10	37.4	.040	.025	0.09
12AU7	100K	100K	3,900	3,900	0	0	.105	10	39.6	.55	.015	2.05
					0	0	.015	1.4	39.6	.145	.025	......
					0	0	.004	.27	39.6	.05	......	......
					330	6.7	.226	10	32.9	.28	.027	1.02
12AY7	100K	100K	1,500	1,800	0	0	.016	10	55.9	.250	.027	0.75
					0	0	.004	2.2	55.9	.065	.020	......
					330	18	.127	10	37.9	.088	.027	0.20
12AT7	100K	100K	1,500	1,800	0	0	.014	10	57.0	.69	.023	2.60
					0	0	.004	2.5	57.0	.182	.020	......
					330	18.3	.115	10	38.7	.122	.023	0.45

Table I: Distortion with low-level signals for miniature double triodes. Test circuit is shown in Fig. 9

trols at as high-level a point in the system as is consistent with distortionless operation of the circuits, thereby obtaining the maximum input level and the lowest system noise.

The crossover-frequency function for record reproduction is obtained by feedback circuits around the first stage of the amplifier. Frequencies at which a 3 db rise occurs are 250, 450 and 800 cps. Complete bass compensation occurs in this network. Additional boost is attainable by means of the variable control following the final voltage-amplifier stage. Overall response characteristics of the various crossover positions are shown in Figs. 12-14.

Referring again to Fig. 10, capacitors C_2, C_3 and C_4 control the 3 db rise points in the crossover circuit. At high frequencies, the reactance of these elements is small and there is considerable feedback through R_3 around the first stage. Position 3 of S_1 is for the 450 cps crossover. It was decided that this position be used for long-playing record equalization; accordingly, a high-frequency attenuating network was added to the feedback loop with C_1 and R_1. The response curve obtained is that recommended in the now familiar Audio Engineering Society Standard Reproducing Curve. The variable frequency controls should be set to normal response for this function.

The components of the crossover network, as well as those in the other control circuits described below, may be easily changed. For those who wish to compensate for special recording characteristics or who feel that the operating points are not suited to their reproducing equipment, this should be a desirable feature. For instance, the 3 db rise frequency of 250 cps can be changed to 350 cps by decreasing C_4 from 0.0015 mfd. to 0.001 mfd., since the ratio of crossover frequencies is the inverse of the ratio of capacity values.

Variable Bass Control

The variable bass control consists of the network P_3, R_{17} and R_{19}, and C_{12} and C_{13}. With P_3 in the extreme clockwise position, R_{17}, C_{13} and R_{19} form a voltage divider which controls the signal voltage applied to the grid of the output stage. The reactance of C_{13} increases at lower frequencies and, by reduced divider action, allows a greater portion of the signal to appear at the grid. With P_3 in the farthest counter-clockwise position, the voltage divider consist of R_{17}, C_{12} and R_{19}. Greater reactance of C_{12} at lower frequencies increases the divider action and reduces the signal at the grid. At one point on the range of P_3, the time-constants of the R_{17}-C_{12} and R_{19}-C_{13} circuits will be approximately equal, and frequency response will be substantially flat. With this type of control, as with the high-frequency adjustment described below, there are small variations in response over the entire range of frequencies. The departure from uniformity are less than 1 db. We have not observed any effect on listening quality of the system from this source and did not include the small variations in the curves of Figs. 12-14.

Control of high-frequency response is obtained with negative feedback from the amplifier output to the cathode of the second stage. When P_2 is in the extreme counter-clockwise position, feedback through C_{15} and R_{10} reduces the gain of the amplifier. The amount of the feedback will be large when the reactance of C_{15} is small at high-frequencies. Below about 1,000 cps there is negligible feedback through this path. With P_2 in its extreme clockwise position, the principal feedback path is through R_{12} and R_9 to R_{10}. At frequencies above about 2,500 cps, the feedback is reduced by the shunting action of C_{11} and produces an increase in amplifier gain. The effect is limited by R_{13} and by the residual feedback through P_2. R_{13}, R_9 and R_{12} are adjusted to give the maximum high-frequency rise without overloading the third amplifier stage. The frequency at which the rise in gain begins to occur may be lowered or raised by a proportional increase or decrease, respectively, in the value of C_{11}. The amount of maximum treble drop at a given frequency is governed by C_{15}. With C_{15} = .01 mfd., as shown, the loss at 5,000 cps will be about 10 db maximum (15 db with no. 3 position of the record crossover switch).

It should be noted that both of the high-frequency control circuits have sufficient remaining feedback over their inoperative ranges to reduce distortion of the pre-amplifier. Overall performance of power and pre-amplifier is within the limit of

(*Continued on page 84*)

Sweep Frequency Generator

Newly-designed oscillator response measurements of

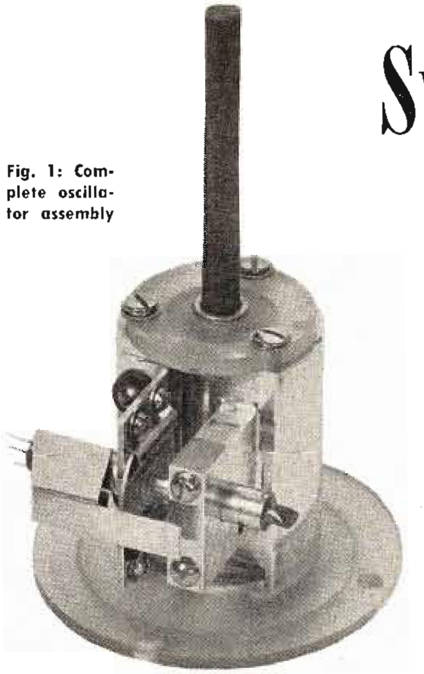


Fig. 1: Complete oscillator assembly

By J. A. CORNELL and J. F. STERNER

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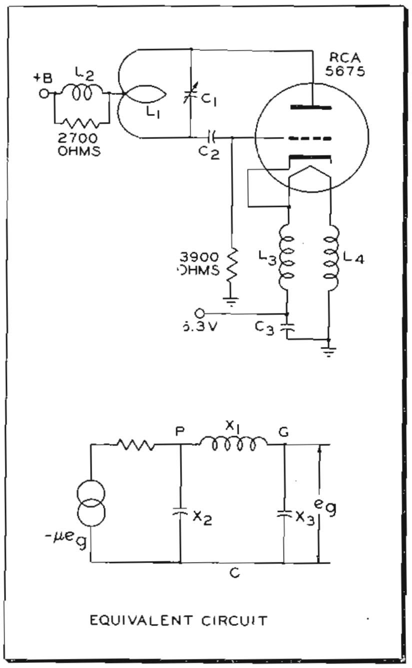
THE sweep frequency generator described in this article was designed for laboratory investigations of the characteristics of filters, tuners, and other components used in the 470-890 MC TV band. It comprises a sweep frequency oscillator modulated by a vibrating mechanical device, a variable frequency marker oscillator, a crystal calibrator providing 1 MC check points and an arrangement of mixers and adders which superimposes marker and calibration pips upon the response curves under observation.

Fig. 2: Schematic diagram of oscillator



One of the most favorable triode oscillator circuits for the 470-890 MC band is the familiar Colpitts circuit in which feedback is obtained by means of the tube interelectrode capacitances. In this type of oscillator circuit, the electron transit angle, if not too large, can be beneficial in obtaining the necessary phase shift for oscillation. The low frequency equivalent pi-network for a Colpitts oscillator is shown in Fig. 2. Although this equivalent circuit is valid only for signals small enough to keep the tube amplification factor essentially constant over the operating range, it can be used to define minimum criteria for oscillation. If it is assumed that the reactive elements are lossless, the circuit will oscillate when the reactances X_1, X_2, and X_3 are such as to produce a 180° phase shift, and when $X_3 = X_2/\mu$. The first condition occurs at a frequency at which the sum of th three reactances is equal to zero .Obviously if X_1 were capacitive and X_2 and X_3 both inductive, the simplified conditions for oscillation would still hold; in fact, Fig. 2 would then be an equivalent circuit for the Hartley oscillator. At UHF, however, phase shift due to circuit losses, power output loading, and grid loading can be partially overcome by an opposing phase shift within the tube due to transit angle when X_1 is inductive. When X_1 is capacitive, as in the Hartley oscillator circuit, then transit angle effects combine with the effects of circuit losses and grid loading in such a way that the necessary conditions for oscillation are more difficult to obtain; hence, the superiority of the Colpitts circuit in this application.

The simplified circuit of Fig. 2 is modified somewhat at UHF because of the necessity for considering lead inductance, transit time effects and losses. Anode and grid lead inductances can be considered as part of X_1, and if X_2 and X_3 are the plate-cathode and grid-cathode capacitances, respectively, then the cathode lead inductance is zero. Circuit losses and loading in the oscillator tank can be represented by a resistance in series with X_1; grid loading can be represented by a conductance in shunt with X_3. Transit angle may be represented by a shift in phase of $-\mu e_g$ of more than 180° with respect to e_g. Under these conditions the requirement that $X_3 = X_2/\mu$ no longer holds. It can be shown that for best operation at any particular frequency, X_2 and X_3 have optimum values. Practically, these values should be approximately equal, or at least of the same order of magnitude for a wide-range tunable UHF oscillator. Since the capacitances determining these reactances are tube interelectrode capacitances, the latter requirement must be met by choosing a tube with proper values of grid-cathode and anode-cathode capacitances, or by adding capacitance externally. The latter alternative, however, leads to difficulties because of the series inductance which is an inherent part of any added capacitance.

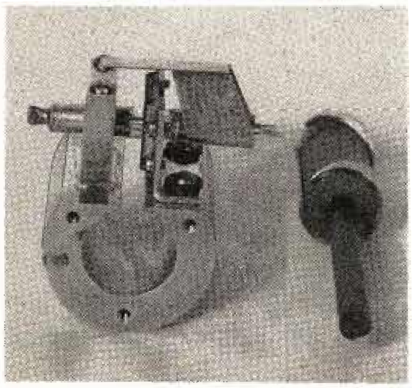


Fig. 3: Oscillator tank with rotor removed

Selecting Triode

Because there are not many triodes available for use in UHF oscillators, the tube choice involved a careful evaluation of a number of factors such as mechanical adaptability to the type of circuit used, thermal drift characteristics, size, power output, and uniformity of results when tubes are changed. The tube selected is an RCA-5675 pencil triode, which is a

for UHF Television Band

fulfills tests instrument needs for making rapid frequency tuners, filters and other equipment designed for 470-890 MC

medium-mu triode originally designed for grounded-grid amplifier service at frequencies up to 3000 MC. It has a grid cathode capacitance of 2.3 μμf and an anode-cathode capacitance of only 0.09 μμf. The 5675 consequently will not oscillate in the simple two-terminal circuit of Fig. 2 unless external andoe-cathode capacitance is added. A schematic diagram of the oscillator is shown in Fig. 2. The inductance L_1 and capacitance C_1 have an inductive reactance at the operating frequency which corresponds to X_1 of the equivalent circuit. The chokes L_2, L_4, and L_5 isolate the oscillator from the power supply so that the conditions shown in the equivalent circuit of Fig. 2 will not be appreciably modified. Since these chokes must have impedances which are high compared to X_2 and X_3 over the 470-890 MC band, their values are best determined experimentally. Because the choke design will vary with the physical arrangement of the circuit, the shield, and the stray capacitance to ground, no set rules were followed for their construction. Generally speaking, however, they were designed to be resonant at some frequency just below the lower edge of the band. The cathode chokes are located so as to offer a minimum of interference with the r-f field about the tank coil L_1.

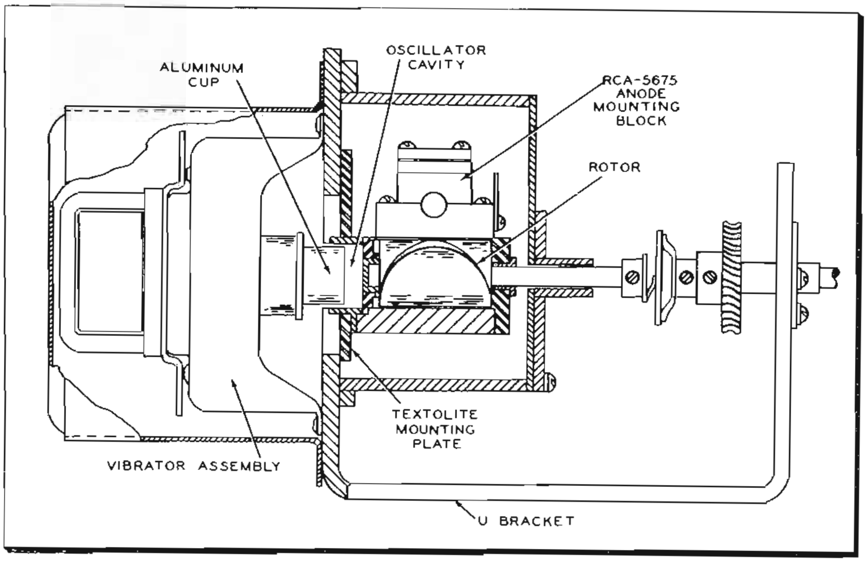


Fig. 4: Cross-section of oscillator showing support bracket, shield cans and vibrator mechanism

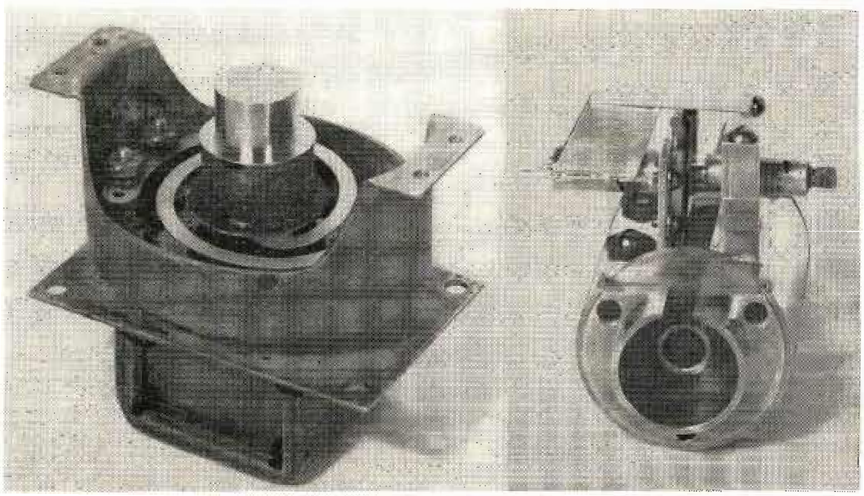
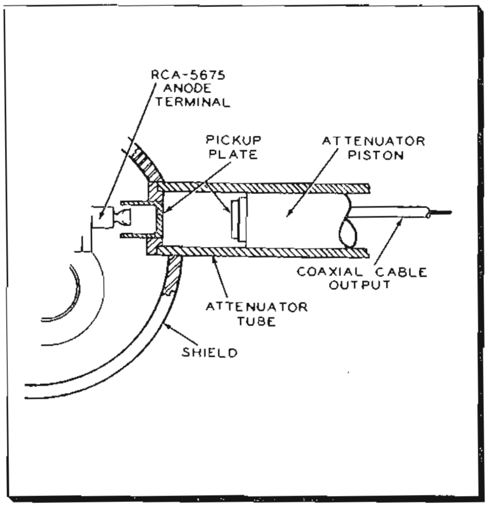


Fig. 5: (L) Vibrator mechanism for modulating oscillator. Fig. 6: (R) Bottom view of oscillator tank

Oscillator Construction

A photograph of the oscillator tank circuit, which consists of a slotted cylinder machined from brass and silver plated, and a specially shaped rotor, is shown in Fig. 3. Tuning is accomplished by varying the capacitance across the slot by means of the rotor. The rotor is made by pressing a Textolite (high temperature polystyrene) cylinder over a Micalex shaft, cutting the metallic part of the rotor from heavy sheet brass, rolling it, and pressing it over the Textolite cylinder. Finally, the rotor is finished to exact diameter in a lathe and given a light silver plate. With this rotor, the 470-890 MC coverage is obtained with rotation of about 240°. Clearance between the inside diameter of the cylinder and the rotor is about 0.005 in. The tube is mounted across the slot in the cyclinder by means of phosphor bronze spring clamps which grip the grid flange, and a pillory block which holds the anode. The external anode-cathode capacitance required is supplied by the cathode sleeve also shown in Fig. 3. This sleeve, which is designed to have a minimum of series inductance, is slipped over the cathode of the 5675 before the tube socket is installed. Fig. 1 shows the complete oscillator assembly, together with the Textolite plate by which it is mounted to its support bracket.

The complete mechanical assembly of the oscillator is shown in the cross-section view given in Fig. 4. The steel U-shaped bracket holds the complete assembly. The upper bearing hole and the large lower hole which holds the Textolite mounting plate are drilled in a jig so that good axial alignment is maintained. The surface on which the mounting plate rests is faced in



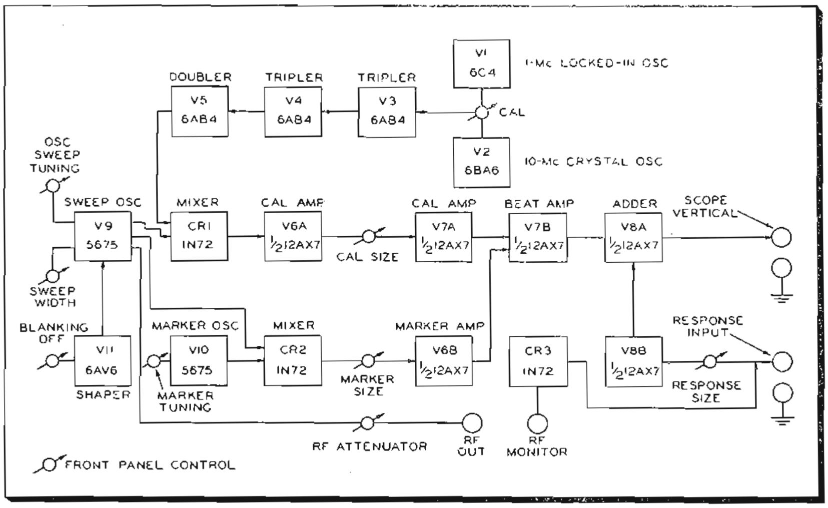


Fig. 7: (L) Oscillator output circuit and below-cutoff type piston attenuator. Fig. 8: (R) Block diagram of complete sweep generator

the same jig so that the center line of the cylinder will not be tilted with respect to the axis of the two holes. The rotor-bearing holders and the shoulders of the mounting plate are turned so that axial alignment is maintained to a high degree of accuracy. The bearing holders as well as the mounting plate are made of Textolite.

Mounted on the underside of the bracket is the vibrator mechanism which modulates the oscillator frequency. This mechanism, shown in Fig. 5, was originally designed for a VHF sweep generator in which it operates as a variable capacitor. With a few modifications, this mechanism was adapted to the UHF generator. The hollow aluminum cup, which acts as an eddy current shield, is vibrated within the oscillator cylinder to effect an incremental inductance change. A bottom view of the oscillator showing the part of the cylindrical cavity within which the aluminum cup vibrates is given in Fig. 6.

Two shield cans are provided; one fits over the cylinder, and the other fits over the vibrator motor. All heater leads from the oscillator are brought through the upper shield box into the lower shield box by means of feed-through capacitors in the bracket, and then out through the lower shield box by means of another set of feed-through capacitors. The upper shield is made as small as practicable, both to minimize radiation losses and to avoid cavity resonances within the band. Re-entrants and metallic brackets of any kind are avoided wherever possible to minimize the possibility of spurious resonances which might cause a "hole" in the oscillator output or a discontinuity in the tuning characteristic. By way of example, a "hole" caused by parasitic resonances was found in a developmental model of this oscillator. In this model, the cylinder and the vibrator assembly were in the same shield can. A "hole" at approximately 750 MC was caused by the vibrating-element suspension. Decreasing the coupling between the cylinder and the suspension by lengthening the paper tube between the aluminum cup and the metal spiders forming the suspension reduced the size of the "hole"; separating cylinder and the vibrator motor by means of two separate shield cans eliminated it.

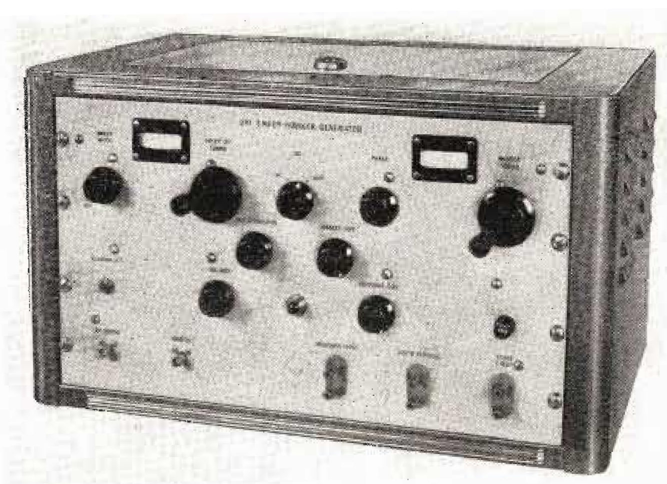


Fig. 9: Front panel view of developmental model UHF sweep generator. The instrument should prove a useful tool for obtaining rapid quantitative analyses of tuners, filters and associated units employed in UHF television equipment

Attenuator

Energy is brought out from the cavity through the attenuator shown in Fig. 7. The attenuator is a waveguide of the below-cutoff type operated in the TM_{01} mode. The small pickup plate, which is capacitively coupled to the anode of the 5675, propagates energy through the attenuator tube where it is intercepted by another pickup plate located on a sliding metal piston. The piston travel is such as to give a maximum attenuation of 110 db. A 50 ohm resistor is connected between the piston pickup plate and ground to make the internal impedance of the generator 50 ohms. The use of this resistor, by minimizing the round-trip reflection, reduces the vswr on the output cable when it is not properly terminated. Amplitude variations in the output of the sweep oscillator are less than 0.1 db/MC.

Applied to the grid of the oscillator tube is a 60 cycle square wave of such phase as to cut the oscillator off during the time it would normally be sweeping from its high-

(*Continued on page 86*)

TV Coverage Increase from Higher Powers

By *JOHN H. BATTISON*
Contributing Editor

ON August 20, 1951 the Federal Communications Commission revised its Rules and Regulations to permit television stations to operate with the full transmitter output power into the transmission lines. Until that date the power into the transmission line was limited by the gain of the antenna and its height above average terrain to produce a coverage area no larger than the equivalent of 50 kw radiated from an antenna with a height of 500 feet above average terrain.

The modification referred to above was not a blanket permit and individual stations had to make application to the Federal Communications Commission for permission to raise their powers to the maximum limits, or, as close to the maximum as local allocation conditions permitted. Generally speaking approval was forthcoming quite rapidly and by now most stations which are in a position to do so have raised their powers to the maximum. In order to be able to evaluate the results of the change and present its readers with some useful and pertinent information TELE-TECH has conducted a survey of the stations which have increased their power.

Results

Of course, local construction details and engineering play a large part in controlling the actual power reaching the antenna, and in many cases the transmission line run is such that as much as 20% of the power is dissipated in it. Out of all the stations queried only two reported that they were not using full transmitter power into the transmission lines. Of these one reply was so sketchy that it was of not much use, and the other was from WHAS-TV, Louisville and showed a transmitter power into the transmission line of 4.6 kw instead of the maximum of 5 kw permitted. However, in this case the effective radiated power on channel 9 was increased from 9.6 kw to 50 kw with an antenna height above average terrain of 495 ft. Here is a case where foresighted engineering paid off in providing the ability to increase power by "turning a knob" when the signal was given. An ERP such as this indicates an antenna gain of around 11 in order to compensate for line and diplexer losses.

Seven stations indicated that they were operating with the equivalent of the original FCC power limit of 50 kw at 500 ft. above average terrain. The majority of these were stations with unusually high antennas, whose height factor brought them up to the limiting figure rather than the use of high ERPs. In some cases where the transmission line run was considerable, even the use of maximum transmitter output power was not sufficient to overcome the line losses and the ERP was not the maximum permissible.

The questionnaire asked for comparative figures on distances to the 5 mv and 0.1 mv contours, the latter was used as being more in keeping with the more realistic trend of audience research used today than the old 0.5 mv contour. This section brought to light some rather astonishing facts about the methods used to estimate coverage and the lack, to date, of any really satisfactory method of locating contours, short of measuring them micro-volt by micro-volt! In one case an effective radiated power increase of five times produced a 12 mile expansion of the 0.1 mv contour. In another an increase of almost eight times the power produced an increased distance to the 0.1 mv contour of 13 miles. These two instances are reasonable and compare well but one or two appeared to be composed of a certain amount of optimism rather than scientific data.

Table below shows the old and new powers, old and new contours and area served for some representative stations.

Fringe Areas and Interference

The effect of increasing the effective radiated power of TV stations in some areas was much greater than in others. Quite obviously, in an area where the distance to adjacent, or co-channel stations is great the fringe area will extend out to a much greater distance in all directions and only attenuation and static will impair reception. However, in other areas, particularly in the east where the station concentration is high, one of the main results is to improve reception in existing areas of low signal strength where the signal to noise ratio is poor, and to improve reception generally all the way out to approximately the original location for limiting interference/ratio signals—if the interfering signals also increase power.

No reports of increased interference were received, nor were any unusual phenomena reported. In fact the whole project appears to have gone into operation with a minimum of disruption and trouble. When the proposed new high powers of 100 kw and 200 kw are used, service areas should be widened considerably and the *whole* area signal quality should be equalized. Thus the "fringe" areas will receive as good signals as the closer-in locations, since the interference ratios will remain the same, and stay in approximately the same locations with only the signal strengths comprising the ratios being higher.

Comparison of old and new—powers, contours, and areas for representative stations

TABLE I STATION	ORIG. POWER KW (ERP)	NEW POWER KW (ERP)	ORIG. 0.1 MV/M CONTOUR	NEW 0.1 MV/M CONTOUR	AREA SQ. MILES	ANT. HT. ABOVE A.T.
KFMB	20	27	50	60	2,500	710
WAVE-TV	7	24.1	48	62	9,800	510
WBKB	11	25.2	79	84	——	686
WCBS-TV	13.7	20.1	64.5	68	——	910
WCPO-TV	21	24	64	65	6,600	695
WGN-TV	11.2	29.2	46	50	4,174	585
WHAS-TV	9.6	50	65.5	78	15,903	495
WHBF-TV	11	23.5	60	70	——	370
WOI-TV	13	15.6	40	41	4,255	560
WOR-TV	9	22	50	57	9,950	925
WSAZ-TV	12	17	56	58	100,000	590
WTVJ	2.2	16.5	35	48	——	306
WXEL	21	25.6	56	57	7,100	725

Mechanical Considerations Affecting

Tubes manufactured mechanical fatigue,

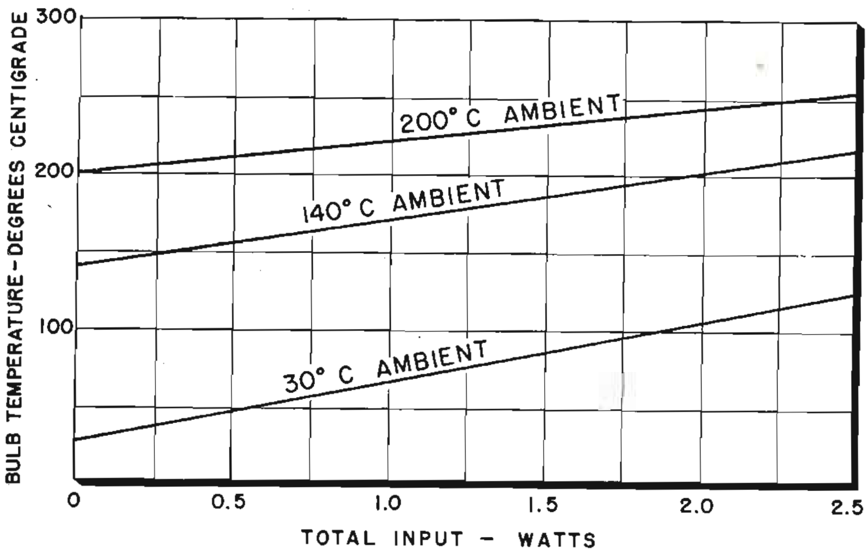


Fig. 1: Relationship of bulb temperature vs. input power for one tube family

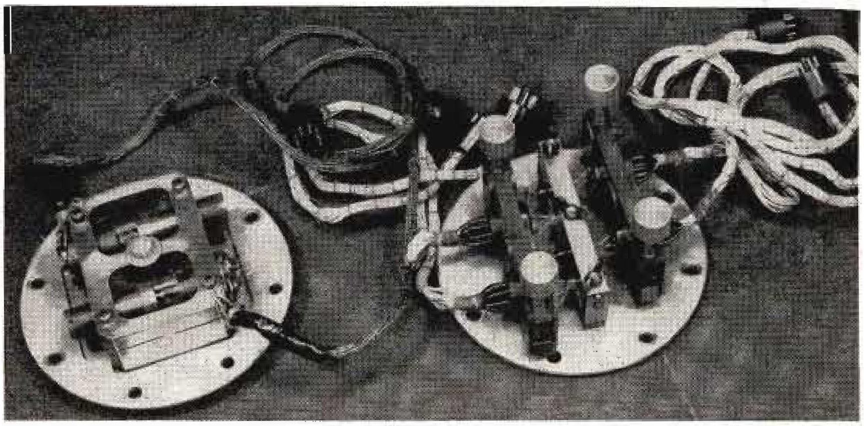


Fig. 2: Two different types of shock test clamps mounted on their adaptor plates

By R. J. E. WHITTIER
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THE following discussion of mechanical considerations affecting tube reliability attempts to reduce a several year development program into the high lights which are pertinent to Guided Missile equipment. Because of the meager experience the tube industry has had with Guided Missile application problems, this discussion is chiefly based on experience with other forms of electronic equipment which appear to parallel Guided Missile problems. This discussion is also confined to the application of miniature and subminiature tube types with occasional reference to GT tubes since these types constitute the vast majority of Guided Missile sockets. Other tube types differ so greatly in mechanical construction that special consideration would have to be given to each individual type.

Heat

The environmental temperature conditions and heat transfer problems facing the equipment designers of specialized military electronic gear are complicated by a background condition common to many of the other application problems of electronic tubes. Many of the logical tube types for such equipment designs have a history of development and ratings which were very closely associated with radio and television applications. These tubes usually have fairly complete ratings with respect to voltages and element dissipation factors but they have a very ragged pattern with respect to consistent safety factors in those ratings. On some types the safety factor is not very safe. All of these electrical ratings are frequently hiding behind unpublished ratings for ambient temperature.

The radio-television application situation, however, is not as confused as these factors might indicate, because typical radio and television service is confined to operation at room temperature. The highest ambient temperature, external to the equipment, is a non-air conditioned room in Arizona. In addition, there are very close contacts between the equipment designers and the commercial engineering groups of the various tube manufacturers.

In dealing with thermionic vacuum tubes, there is one fundamental and necessary temperature within the tube, namely the cathode temperature of 700°C to 800°C. The ideal tube design and application would maintain this cathode temperature and would maintain the temperature of all other parts at 30°C. This ideal tube, obviously, cannot exist. Even transistors, which do not have thermionic cathodes, have localized temperature problems as a result of heat dissipation within the units. In a typical tube type the order of magnitude of the external bulb temperature is from 140°C to 265°C. The temperature of the internal elements, with the possible exception of the heater and cathode, are dependent in varying degree upon the external environmental conditions. All of these internal temperatures, including the heater and cathode, are also related to each other in the form of conduction and radiation effects.

Assuming that the internal electrical ratings of the tube are not exceeded, the bulb temperature is a fairly reliable indication of appropriate temperature environmental conditions. One ultimate limitation of bulb temperature, rarely attained

Vacuum Tube Reliability

PART ONE OF TWO PARTS

for guided missile equipment require special attention to heat dissipation, vibration re. microphonism and noise factors. Designers should avoid "tube-critical" circuits

in practical designs, is the softening point of the glass which is 400°C to 500°C, much higher than the highest published bulb temperature rating for miniature and subminiature tube types. There are a few types with a maximum bulb temperature rating of 265°C.

A second limitation is the development of electrolysis, a common source of trouble. Electrolysis in glass is a function of local temperature and time when a voltage is present between two lead wires. The magnitude of voltage is not critical for this effect. Electrolysis is first evidenced by grey fibrous patterns appearing within the glass, usually starting with the negative wire in cases where the voltage gradient between the leads is dc. The grey fibers grow into heavy black areas and, subsequently, the dielectric characteristics of the glass deteriorate. A final tube failure is produced by the glass areas adjacent to the leads becoming porous or cracking so that the tube loses vacuum. This process is extremely critical as to temperature and as small a temperature difference as 10°C can make the difference between a long life tube and a short life failure.

All of the preceding troubles are very real hazards for which solutions can be obtained (within the limitations of the other equipment components) by the application of sufficient ingenuity and study of the environmental and mounting conditions. Many of the newer special purpose tube types that have been introduced by various tube manufacturers, in the 5500 series of RTMA or JETEC type numbers, have been given temperature ratings. These types, and certain older types, have acquired JAN life tests at various ambient temperature conditions. These tube types should be chosen for military or other critical designs. The existence of life test controls under these high temperature conditions at the tube manufacturer's plant acts as an insurance against undesirable variations in materials and processing.

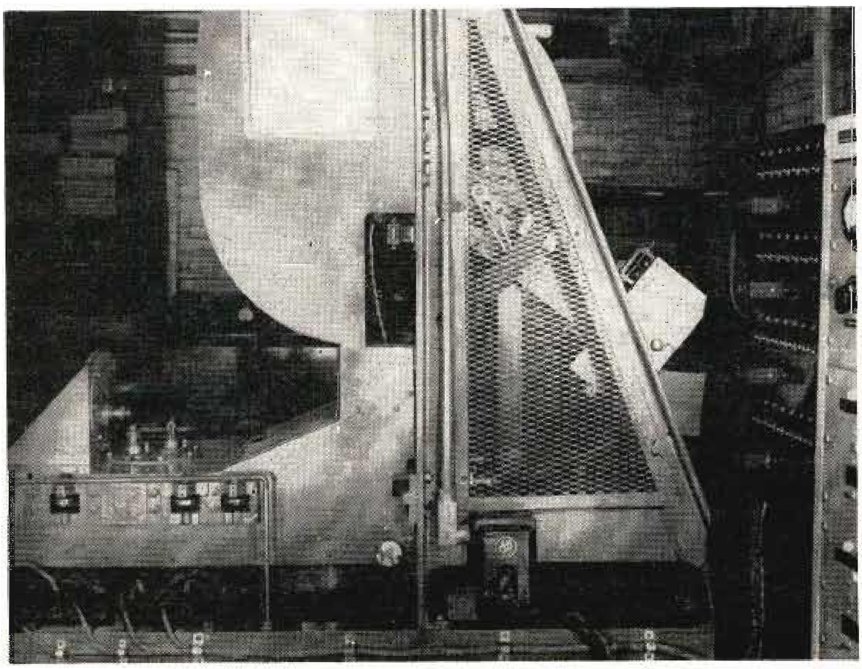
Another design consideration is to provide as much conduction, radiation and convection cooling to the tube as possible, always bearing in mind that the ideal application would provide room temperature conditions for all tube parts except the cathode. The use of heavy leads to the tube terminals, wherever mechanical or electrical conditions permit (with the connections located as close to the tube as practical in the case of flexible lead tubes) should be attempted in order to provide as much thermal conduction through the tube leads as possible, and so reduce the possibilities of electrolysis.

Cooling of Envelope

The cooling of the tube envelope is the most important mounting consideration. The standardized miniature tube shield (which is not close fitting) does not provide a good thermal contact to the bulb of the tube or to the chassis so that this device effectively constitutes a "storm window" which raises the bulb temperature. Black painting on the inside or outside of the shield does not help this situation appreciably. One solution is to omit the shield and permit the tube to radiate directly to surrounding parts which usually have good thermal contact to the chassis. Another solution is to use a tight fitting shield, and thus provide good thermal contact from the bulb to the shield, together with additional hardware to provide good thermal conduction between the shield and the chassis. A shield design with good thermal conduction in both directions is much more practical with subminiature tubes in which the flexible leads constitute a non-rigid socket, and the tube shield provides the rigid support.

When a particular mounting design has been determined, it should be evaluated by bulb temperature measurements under the exact tube and equipment operating conditions and by short term tube life tests at slightly accelerated conditions for about 200 hours. Obviously, if reliable temperature measurements indicate that the tube manufacturer's maximum temperature ratings are in no danger of being exceeded, a life test program is not necessary. However, the techniques of measurements are very devious and complicated, and it would be well to discuss temperature measurement techniques and results with the commercial

Fig. 3: Photo of Taft-Pierce shock test machine with hammer at a 48° angle



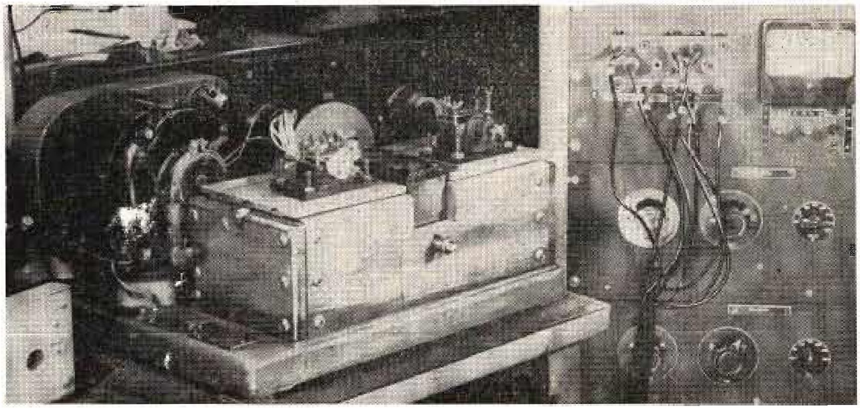


Fig. 4: BTL Leaf Spring Vibrator produces a fixed 25 cycle, 2.5 G vibration

engineering organization of the particular tube manufacturer before deciding that an equipment life test is not necessary. It should be kept in mind that a bulb temperature limit imposes an appreciable reduction in permissible internal wattage dissipation at elevated ambient temperatures. Fig. 1 indicates this relationship for one particular family of tubes.[1]

One other attractive tube mounting design philosophy should be avoided as being very dangerous. This is the idea of providing such extremely effective conduction cooling to the bulb that the bulb temperature is reduced below its nominal value for typical room temperature operation. This cooling is extremely helpful, but the next step in this program, to increase the internal electrical dissipations appreciably above the room temperature published values, is hazardous. Such a scheme of extra heat conduction and extra ratings is possible, but an entirely new set of internal heat transfer conditions are established within the tube. This puts an extreme burden upon the tube manufacturers, since the industry has not yet achieved complete temperature ratings on all of the tube types which are now necessary to your equipment designs.

To be successful, a program of tube ratings at higher dissipation with the super cooled operating conditions would involve new and additional life testing equipment at the tube manufacturer's plant in order to cover all of the possible variations in cooling conditions.

The present form of shock test evaluation of tubes was started during World War II as a result of difficulties in Navy equipments from the effects of gun fire. The same type of problems have been encountered in all the other branches of the military service. One report on the study of mechanical shock applied to equipment during transportation, indicated that when a typical radio chassis is dropped 4 ft. to hard earth, a shock of 600 G is produced. The same 4 ft. drop to concrete is reported to produce a shock of 1,000 G. The defects developing in tubes as a result of shock are not confined to glass breakage. With proper tube type selection and mounting techniques, however, there should be essentially no glass breakage from equipment shock.

Tube Failures

A list of types of tube failures produced by shock testing under the present conventional conditions may be of interest. The following list tabulates the types of defects which showed up on a sample of 10 commercial non-ruggedized tubes at the 48° shock test level which is equivalent to approximately 700 G.

Broken Bulbs	0
Open Weld (G2)	1
Tap Shorts (K-G1)	1
Tap Shorts (G2-G3)	1
High Vibration Output	4
Low Gm or Low Emission	0
Transient Short (H-G1)	1
Measurable Tubes	7
Acceptable Tubes	3
Officially Defective Tubes	7

The 70% defective tubes indicated by this list demonstrate the degree of equipment trouble that can be produced by improper tube types or improper tube mounting. These rejects also indicate a few problems of quality control and tube design. Even though there were no emission or transconductance rejects in the preceding list, this type of defect is quite common in high level shock tests. The shock forces against the mica cause it to flake and apparently release small amounts of latent gas from the newly exposed layers of mica. The gas then poisons the cathode.

In connection with evaluating tubes for shock test quality, there have been many problems of test procedure and test standardization. These problems were solved through development contracts issued to the tube manufacturers for different tube types, coordinated by the Armed Services. The standards and procedures are fairly well established now except for the problem of tube clamping, which is perhaps 50% standardized at this time. The problem of tube clamps for standardized shock testing requires a device which does not break the tube in an unfair manner, which holds the tubes rigidly so that the shock is transmitted to the tube without extra transient oscillations in the shock wave, and which provides for convenient installation of the tubes for the relatively large volume testing level which is now common in several tube manufacturers' plants. One alternate type of clamp which is permitted by certain JAN Specifications consists of potting the tube in Montan Wax which then constitutes a tube mounting very similar to the potting-in-plastic techniques used on certain equipments. Fig. 2 shows two different shock test clamps on their adaptor plates which, during shock test, are bolted on the machine.

The Standard Equipment for shock test is the Naval Research Laboratory High Impact Machine for Electronic Devices (the so-called Taft-Pierce Machine). The essential parts of this machine are a 110 pound steel table and mounting fixtures to which the tubes are clamped, and a 90 pound steel hammer plus supporting arm which swings as a pendulum on a two-foot arm and delivers a horizontal blow to the table at the bottom of its swing. The table is mounted on a horizontal track where it is accelerated by the hammer blow and gradually decelerated by hydraulic stops. The intensity of the blow is determined by the angular displacement of the hammer which is specified in the individual tube data sheets. The tubes are clamped to the table successively in four mounting positions. The condemned tubes are subjected to a total of 20 hammer blows, five blows for each of four mounting positions. During the test, rated heater voltage is applied and each tube is connected to a short-circuit indicator. Permanent "shorts" during shock test are considered

(*Continued on page* 62)

Suppressing Local Oscillator Radiation in TV Receivers

Proper shielding, grounding, and orientation of oscillator components; adequate rejection in coupling and power supply networks reduces chassis radiation

By JOHN P. VAN DUYNE
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DURING the last three years, there has been a mounting engineering interest in the suppression of incidental radiation capable of interfering with radio broadcasting and communication services. This interest stems from an engineering conference on oscillator radiation held by the FCC on Nov. 1, 1949. At this conference, attention was drawn by the FCC to the fact that during the period July 1, 1948 to June 30, 1949, 1,730 complaints of interference to broadcasting services were received.[1]

These complaints covered many sources of interference, but the most rapidly growing source was that from the LO (local oscillator) of TV receivers. As a result of this conference, the RTMA Committee on radio interference was reorganized and an active compaign was begun on Jan. 11, 1950 in New York City. At this time, the R15 Committee of RTMA was made aware of the magnitude of the problem and the FCC desire for an early solution.

The work of this committee and that of the IRE Committee on radio receiver test methods culminated in the adoption of two standards: (1) a standard of allowable radiation limits for TV and FM receivers by the RTMA, and (2) a standard on "Method of Measurement of Spurious Radiation of Frequency Modulation and Television Receivers" (50 IRE17 PSI) by the IRE Committee. Once the TV design engineer had a specific limit and method of measuring performance against that limit, it was possible for him to design economical TV receivers to meet the specified radiation limits with a reasonable safety factor.

There are several sources of incidental radiation in a TV receiver. These are, in order of importance: high frequency LO, horizontal deflection system and associated high voltage generator, video i-f amplifier, sound i-f amplifier, and video amplifier. By far the most serious of these has been the high frequency LO radiation. The remainder of this article will deal with methods and techniques useful in the design of a TV receiver and particularly its r-f tuner to meet the new RTMA radiation limits on LO radiation. Space does not permit a discussion of the other forms of interference here.

The LO radiation problem may again be subdivided into "antenna radiation" and "chassis and/or power line" radiation. The power line radiation situation will be considered a special case of so-called chassis radiation. This is due to the fact that excitation of the power line is a result of the same leakage of LO energy from the r-f tuner that excites the whole chassis. By antenna radiation, we mean that component of radiated interference which may be eliminated by the removal of the transmission line from the receiver and the substitution of a matched dummy load resistor. The remaining interfering radiation will be referred to as "chassis radiation."

Experience to date has indicated that when starting with an existing receiver design, by far the most serious component of radiation is the chassis radiation. See Table 1 for supporting data. This is not necessarily true once the design has been altered to minimize chassis radiation. The progress of a radiation reduction investigation is analogous to the problem of the archeologist. When

TABLE I: Radiation Data on Typical Untreated TV Receiver

Channel	Antenna Plus Chassis Field Strength µV/Meter*	Chassis Alone Field Strength µV/Meter*
4	52	34
5	100	90
6	168	113
7	426	464
8	450	487
9	474	592
10	900	972
11	1478	1296
12	1850	1924
13	1865	1872

* Measurements by standard IRE method. RTMA limits: low VHF band 50 µv/meter; high VHF band 150 µv/meter;

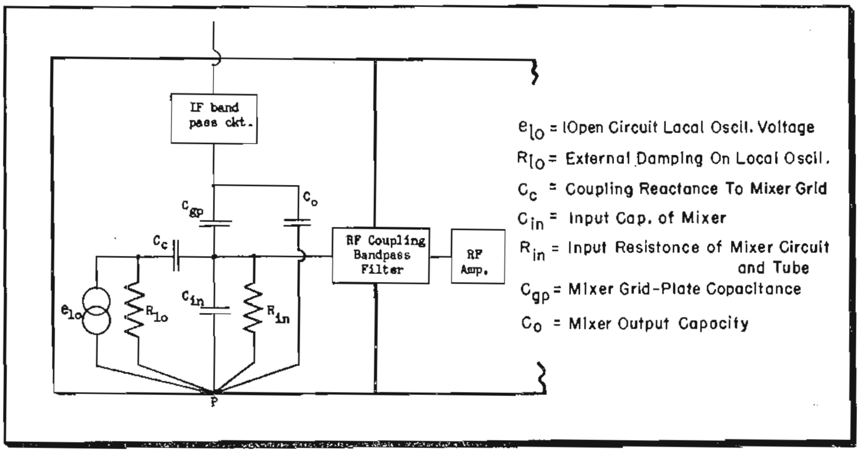


Fig. 1: Shielded local oscillator equivalent circuit. R-F and i-f bandpass filters introduce sufficient attenuation at local oscillator frequencies to make their ground returns relatively unimportant

LOCAL OSCILLATOR (Continued)

he uncovers one layer of interesting relics, has carefully dusted off and restored each one of his important finds, and is about to sit back and enjoy a well earned rest, he discovers that there is yet another layer peering through the dust to mock him. This results in a certain amount of jockeying to and fro from chassis to antenna radiation and the need for constant field testing of "improvements."

Unfortunately, as the engineer begins to peruse the available literature on these problems of radiation reduction, he soon finds that the bulk of the literature is concerned with antenna radiation and mentions little of the problems of chassis radiation. This is natural in view of the fact that prior to the wide sale of TV and FM receivers which operate in the VHF region, most receivers, both home and communication, operated in a frequency range such that the chassis was very small compared to a half wavelength, hence minimizing the importance of chassis radiation.

However, in the case of TV receivers, the chassis usually is big enough to approach half-wave resonance in the 174 to 216 MC TV band and therefore is an efficient radiator. Once this situation is realized, the next step is usually to pull the dust cover off the nearest available VHF standard signal generator and view, in awe, the elegant shielding employed by the manufacturer of the instrument. It would be nice if it were practical for the TV designer to construct the LO of his TV receiver in a manner similar to the signal generator. Unfortunately, however, the economics of the situation prevent this course of action. The buying public would not be favorably impressed with an increase in list price consistent with employment of signal generator techniques.

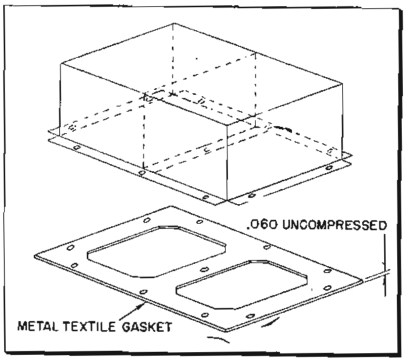


Fig. 2: Typical shield construction

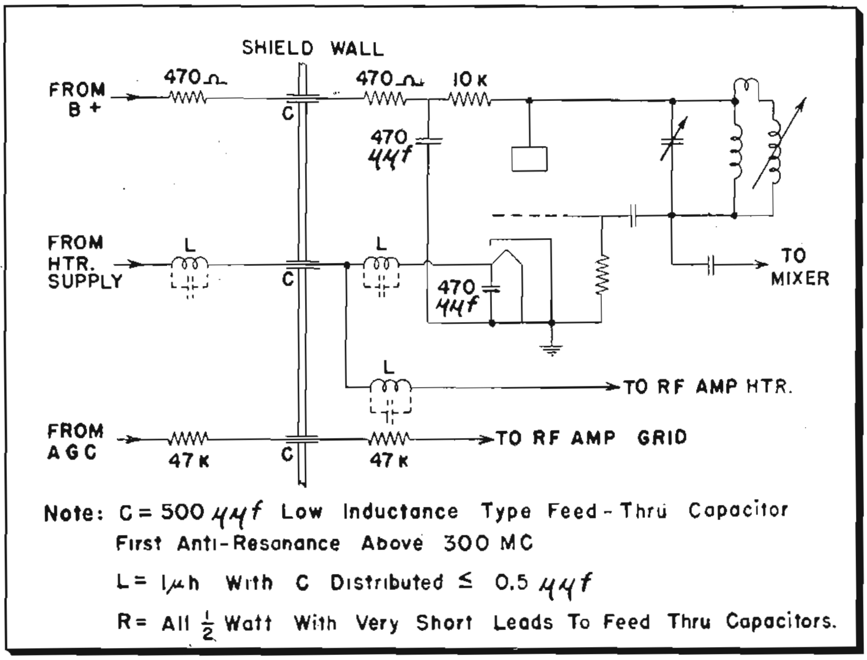
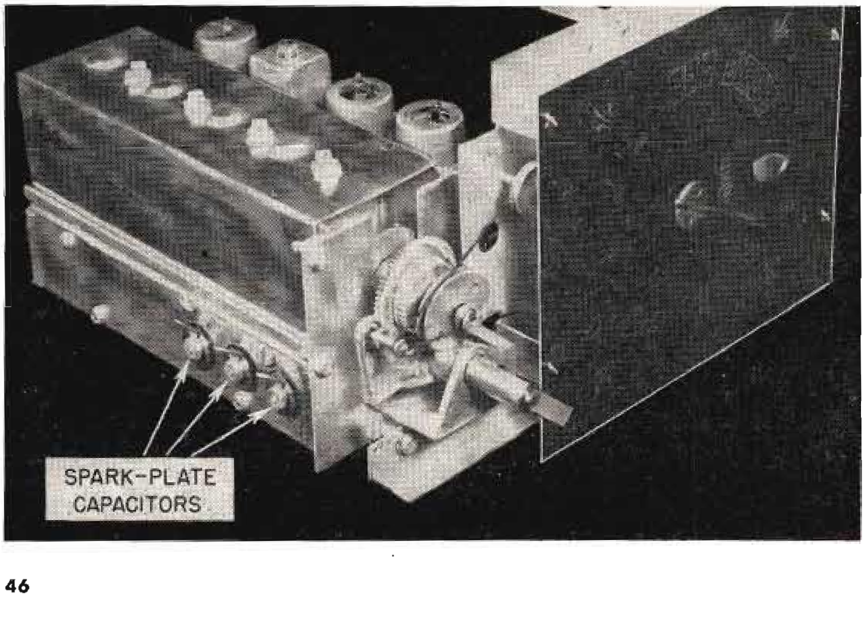


Fig. 3: Filter arrangement designed to prevent spurious resonances within oscillator tuning range

Fig. 4: Spark-plate capacitors employed to filter B+; heater and AGC leads passing through shield wall



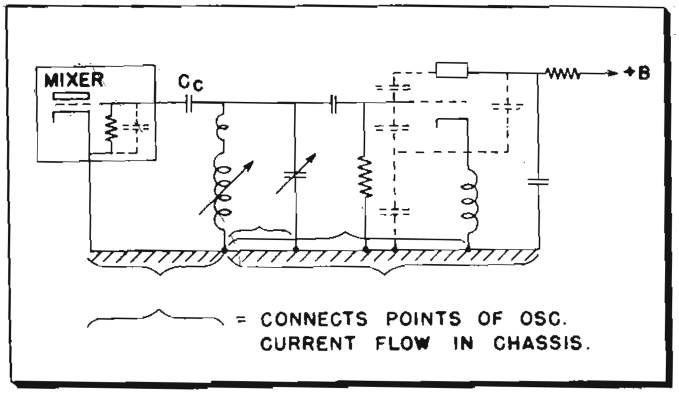
Signal Generator Techniques

However, it is possible for the TV design engineer to profit immensely by careful consideration of the techniques employed by the signal generator manufacturer. The principles exemplified by this construction may be applied in a much less expensive manner to a TV tuner. Following a further discussion of the basic problem, we shall discuss such techniques as applied to a TV receiver.

Reference to an elementary text on radiation discloses that we get a radiation component whenever an electromagnetic field is accelerated in a medium of finite velocity of propagation. If this radiated energy is not totally reflected, the original electromagnetic field experiences an energy loss. It is the job of the designer to provide either for the reflection or the absorption of this energy which would normally be lost to the LO and gained by the receiver in the next apartment.

In order to prevent the radiation of energy by the receiver chassis, it is obvious that we must prevent the excitation of that chassis by the LO energy or totally reflect the energy radiated by the chassis. Since it is wasteful of material to attempt to confine a field within such a large volume, the most economical approach is that of preventing the excitation of the chassis.

Thus we may state that the basic problem confronting us as design



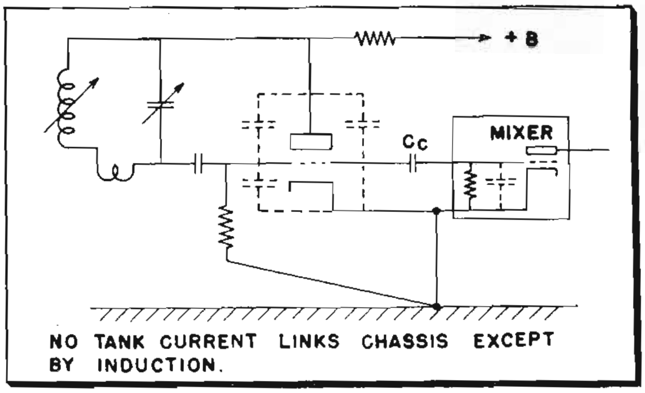


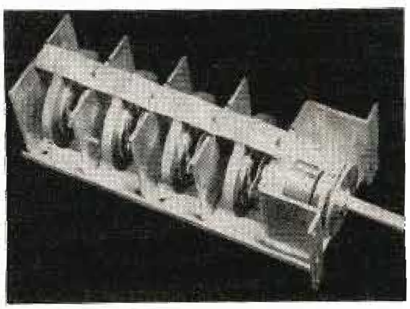
Fig. 5A: (L) Poor oscillator design causes conduction currents in chassis. Fig. 5B: (R) Good oscillator design reduces chassis currents

engineers is to confine the electromagnetic fields due to the LO to the immediate vicinity of the LO. The degree of this confinement is, of course, established by the limits that one is trying to reach. The RTMA limits on radiation have been established with the intent of protecting the maximum amount of service area without imposing an impossible economic burden on the buying public.

There are several characteristics peculiar to TV receivers which aid the program of LO radiation reduction. These are:

a. The oscillator is operated on the high frequency side of the desired signal, separated from the sound carrier by 21 or 41 MC in modern receivers. This separation permits relatively simple and inexpensive selective circuits greatly to attenuate the oscillator signal before it reaches the r-f amplifier plate circuit.
b. The i-f is removed by at least one octave from the oscillator frequency. This permits i-f band pass circuits of proper design to discriminate greatly against the oscillator signal.
c. A higher degree of r-f circuit shielding is required by a TV receiver for many reasons other than oscillator radiation suppression. It only remains to extend this shielding to include the problem of oscillator radiation.

Fig. 6: Continuous inductance tuning unit



There are also some problems in the TV receiver which complicate a low radiation design. These are:

a. The need for a high degree of economy and reproducibility in the design.
b. The circuits located within the shielded compartments must be available for quick servicing.
c. The chassis used in TV receivers are large enough to be rather efficient radiators, especially in the 174 to 216 MC band.
d. The use of metal cabinets may, under some circumstances, in-

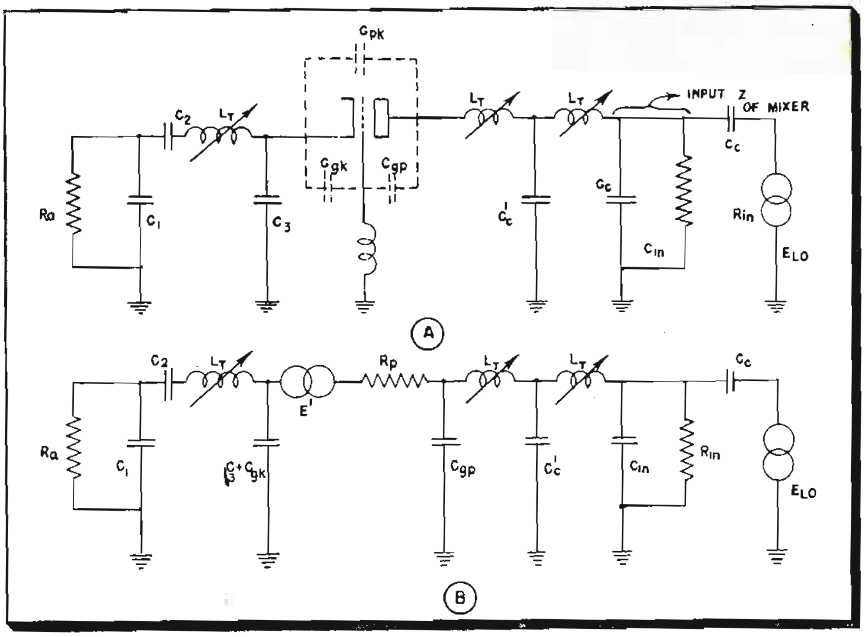
(*Continued on page* 95)

TABLE II: Local Oscillator Radiation Reduction Results

	Antenna Plus Chassis Radiation		Chassis Radiation Alone	
TV Channel	Before µV/Meter*	After µV/Meter*	Before µV/Meter*	After µV/Meter*
4	52	11	34	Less than five
5	100	11	90	Less than five
6	168	7.3	113	Less than five
7	426	32	464	7.2
8	450	28	487	7.0
9	474	52	592	7.2
10	900	27	972	5.6
11	1478	26	1296	6.2
12	1850	41	1924	13.
13	1865	29	1872	25.

* IRE Standard Method
RTMA Limits: low UHF Band 50 uv/meter; high VHF Band 150 uv/meter

Fig. 7: Grid-separation amplifier and equivalent circuit. Plate current in input has LO component



Improved Photo-Recordings

Superior military and commercial photo-recordings of TV pictures
sideration and control of film spectral response, dc insertion, and

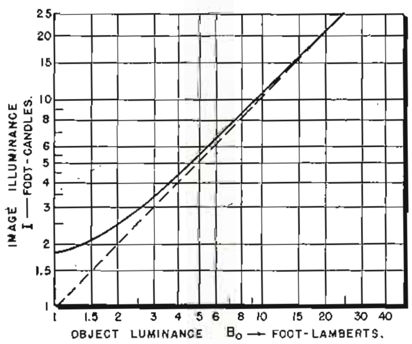
By LT. RUDOLPH L. KUEHN
Aircraft Radiation Lab.
Wright Field, Dayton, Ohio

THE TV system is essentially an extension of man's visual apparatus by means of optical photo-electric and radio techniques. As such, it suffers from the limitations inherent in all of its components, not the least of which is the transiency of the overall phenomena. Satisfactory photographic transcriptions of the TV image may be made by proper consideration of sensiometric evaluations, electronic gamma and gradient controls, and film processing standards.

No great difficulty is experienced in exposing film to a kinescope for approximately one frame interval or multiple thereof and obtaining a recognizable picture. This procedure, however, will probably yield a final print, with distorted tonal range and reduced resolution.

This article is primarily concerned with the TV system requirement which begins at the recording monitor. Briefly considering the picture processing up to that point, a lens system must first produce an image on some photo-sensitive surface. If for every scene element of luminance. B_0 there exists a corresponding optical image of illuminance, I, such that the relationship between logarithms of all such points is linear and of unity slope, then the image would be an exact luminance reproduction of the original. Such is not normally the case due to flare light reaching the image plane. The effect of such flare is most pronounced through the middle tones to the shadows, lowering the gradient as shown in Fig. 1. It is apparent that a relative flare of one per cent of the highlights in a 100:1 contrast range may be a change of 100% in the blacks, effectively reducing the contrast to about 50:1 in the image. Lens coating materially aids flare reduction due to multiple reflections and lens shades are necessary for the reduction of extraneous light.

Fig. 1: Luminance gradient (solid line) reduced in shadows by flare effect



At the photosensitive surface, the optical image is translated into electrical patterns which are ultimately scanned by a beam of electrons, creating a current variation which may be transmitted as a voltage change to a remote receiver. If the process which produces an electrical wave form corresponding to an optical image is linear and also of unity slope (in logarithmic coordinates), the exact tonality of the original scene is maintained. However, some departure from exact reproduction must be expected in the kinescope and iconoscope. If the reproduced illuminance, I, as represented by its electrical equivalent, is related to the scene luminance, B, by the expression $I = KB^\gamma$, where K is the constant of proportionality and γ (gamma) is the straight line gradient, then the exponent γ is a measure of the transducer gray scale range. Thus, a gamma less than unity reduces the original scene contrasts, whereas a gamma larger than one increases the contrast.

Video Signal Amplified

From the photo-sensitive device the electrical signal may proceed through a number of video amplifiers, conversion units, transmitter and finally to the kinescope. The problem now is to photograph the image on the kinescope such that the subjective effects of the final print and that of the original scene are as much the same as system limitations will permit.

Outdoor scenes may have a contrast ratio of 150:1 or higher, whereas the TV system can accommodate a range of only 30:1 without compression. This logarithmic range of 1.5 (log 30 = 1.5) can be readily accepted by negative materials and many printing papers. It is necessary, however, to determine the desired final gamma (product of intermediate gammas) of the photographic process relative to the initial scene, and the proper exposure to the kinescope.

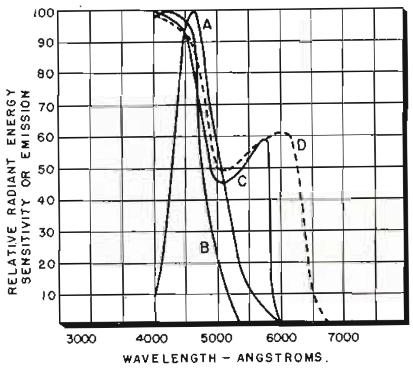


Fig. 2: Comparative spectral responses of (A) P11 phosphor, (B) ordinary

Film Response

At this point the spectral sensitivities of film materials and kinescope phosphors should be examined. The three basic black and white film emulsions are:

1. Panchromatic: sensitive from ultra-violet (4000 A°) through red (7000 A°); approximates visual response.
2. Orthochromatic: sensitivity from ultra-violet through green (5700 A°).
3. Ordinary: "non-color" sensitive, responding to ultra-violet, blue region; generally used for papers and positive films.

Of the many phosphors, P5, P11, and P15 are rich in ultra-violet and blue radiation. The high actinic efficiency, high radiant energy output, and short persistence of P11 suggest it as a likely candidate for film recording use. Fig. 2 shows the relative responses of the three basic film types and the spectral energy characteristic of the P11 phosphor. The following table illustrates the relative exposures to a zinc sulfide P11,

From Cathode-Ray TV Tubes

require special con-
relative frame rate.

with daylight of equal intensity being the unity reference.

Panchromatic — 1/6
Orthochromatic — 1/12
Ordinary — 1/16 to 1/32

It may be advantageous to use positive film stock which is cheaper than negative material, has greater resolution, is easier to handle, and in this case is most efficient.

In order to obtain consistent and predictable results, a means of determining film exposure is required. Since the luminous output of the kinescope is dependent upon the energy input to the screen, beam current is a convenient measure of phosphor radiation. If a series of exposures at different beam currents is made with a given film, and the resulting densities after normal development are plotted against log-beam current, a sensitometric characteristic will result. A normal negative exposed to a 30 db brightness range and developed to a gamma of 0.65 should have a density variation from 0.25 to about 1.4. Ordinarily, good results can be obtained with a gamma from 0.6 to 0.65 when the TV camera employs an image orthicon, and a gamma equal to 0.7 when an iconoscope is used. The change in beam current necessary to produce this density range can be read from the density-long beam current curve.

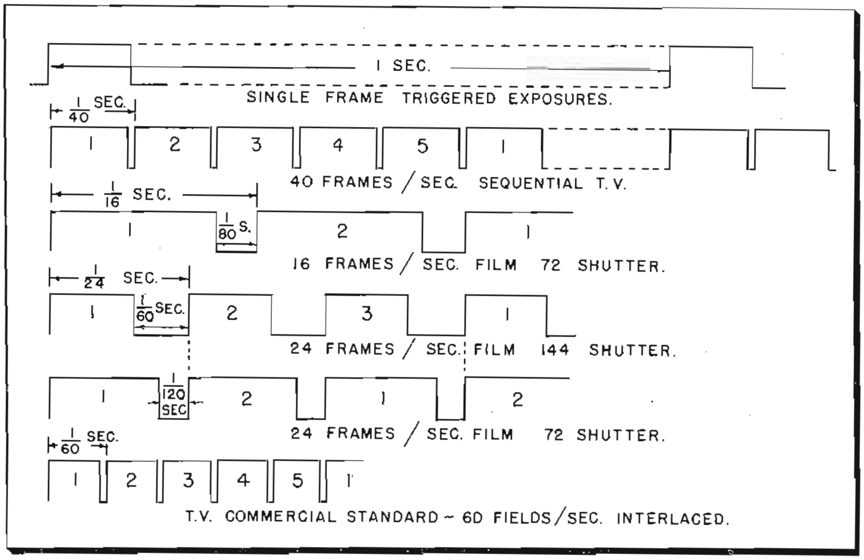


Fig. 5: Synchronizing methods for TV photography showing difference between film and TV frame rates

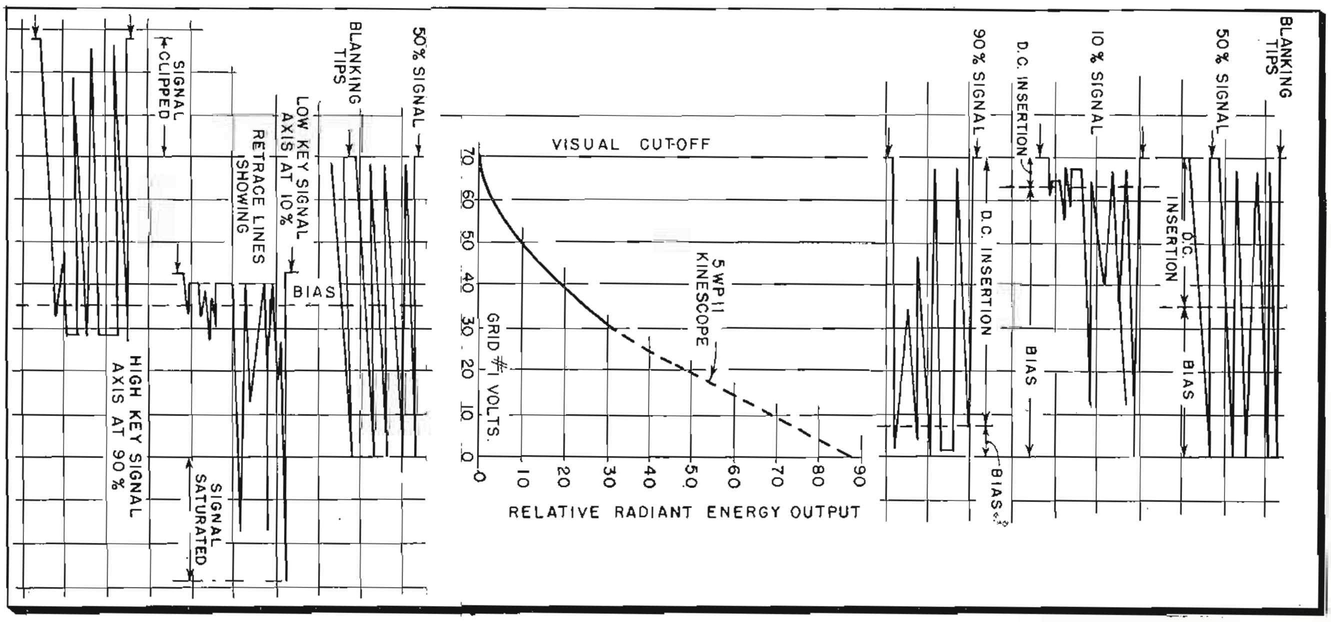
Exposure

In practice, the correct exposure would be that beam current which produces a density in the middle of the required range. A video signal whose ac axis is at approximately 50% and whose blanking level is set at the kinescope visual cut-off should be used in adjusting the exposure. Naturally, ordinary signals seldom exhibit such an ac axis, but this procedure is capable of producing adequate photographs.

An unfortunate condition exists in certain military television systems in so far as photography is concerned. This is the lack of a dc component in the video signal. Consider the effect of two signals, one with an ac axis at 90% (high key scene), and the other with a 10% axis (low key scene). Fig. 3 illustrates that with kinescope bias adjusted for a 50% picture, the black compression of the high key scene will be exten-

(*Continued on page* 64)

Fig. 3: (L) Effect of two signal extremes without dc component. Fig. 4: (R) Effect of two signal extremes with positive dc insertion.



CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

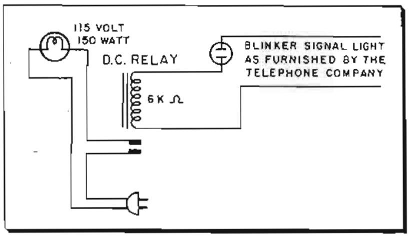
Edited by John H. Battison

Telephone Signal Light in Control Room

VERNON HUGHES, KICA, Clovis, New Mexico

MANY radio control rooms have a telephone close at hand. When the announcer operates a console and attends to other duties, the telephone signal becomes of great importance. A buzzer loud enough to be heard is too loud for the microphone and a blinker light, as furnished by the telephone company, is too dim to be seen unless directly under observation.

The system at KICA is located outside of the operating room with the exception of the signal light. The



DC relay improves 'phone blinker circuit

signal light may be any value of 115 volt lamp which can be accommodated by the contact rating of the relay points. We use a 150 watt bulb which lights to full brilliancy and is easily seen by the announcer even with his back turned. A dc relay of 6,000 ohms coil resistance is used in series with the blinker light as furnished by the telephone company and it works very well. No telephone calls are lost.

Emergency Pick-Up Head for Broadcast Stations

ANTONIO VACCARO, Chief Engineer, WHEB, Portsmouth, N. H.

AT many radio stations, the studios are located away from the transmitter and the engineers. At WHEB the announcers run the controls and turntables, which are located at the studios, and whenever trouble occurs with one of the pick-up heads, the announcing man has only one turntable to use until such time as an engineer can replace the broken pick-up head. Repairs may be delayed for hours or even days.

To overcome this, a pick-up arm was made from an old aluminum base transcription disc. The pattern was cut out with shears, scored and bent to the required shape. All necessary holes for mounting head, matching "ouncer" transformer, counter weight and phono-plug, were first drilled into arm layout. The arm shown was designed to fit around a spare RCA magnetic pick-up unit, although any other kind of head may be used.

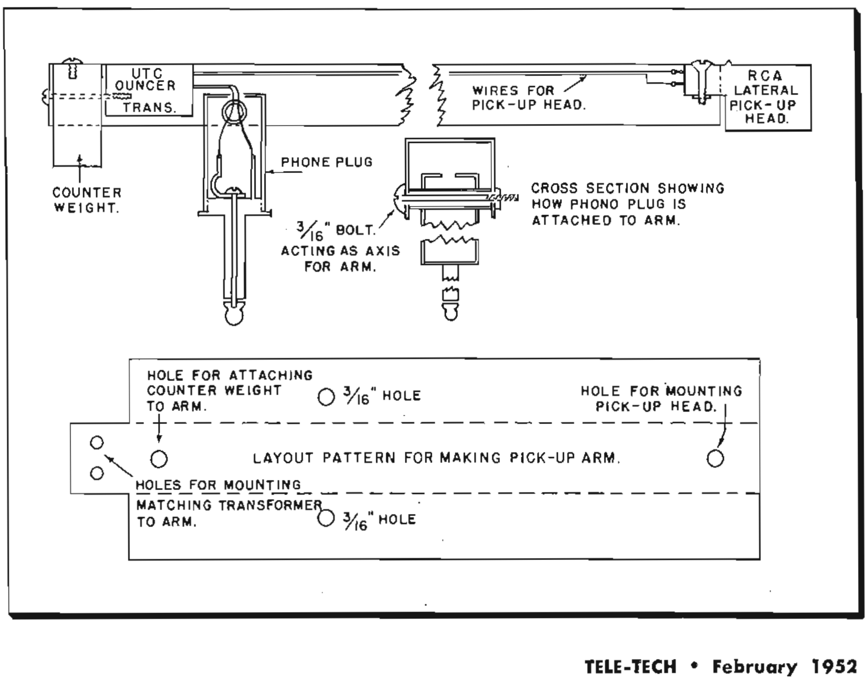
The only additional parts needed for construction are one UTC "ouncer" transformer, one phone plug and jack and some steel, lead or iron stock for the counter weight. The "ouncer" transformer serves the dual purpose of partial counterweight and matching unit for a pick-up head. If its head has same impedance as the source into which it is to work, its transformer may be left out and the space used for counter-weight. No dimensions are given, since builders can determine these themselves. The head is wired to the "ouncer" transformer primary, and the secondary is wired to tip and sleeve terminals of a phone plug.

Sufficient slack is left in the wire from secondary of transformer to plug, so that its finished arm may be raised and lowered onto the recording without binding. After its pick-up unit has been built, mount phone jacks of the type matching plug of new arm on each transcription playback table, making certain that jacks are mounted so that when its emergency pick-up is plugged into jack, the arm will ride parallel to the surface of its turntable. Whenever trouble occurs with one of the pick-up units, the announcer merely plugs the emergency pick-up unit into the jack on the turntable and is back to normal with two tables at his disposal.

At WHEB, a double-pole double-throw type of phone jack was used, so that when the emergency unit is plugged in, the jack contacts will automatically remove the defective permanent head from the input circuit connecting the emergency unit to the input of the filter network.

Some constructional details follow: About ⅜ in. down from top of bakelite sleeve of phone plug, a ¼ in. hole is drilled completely through both sides and then reamed out so

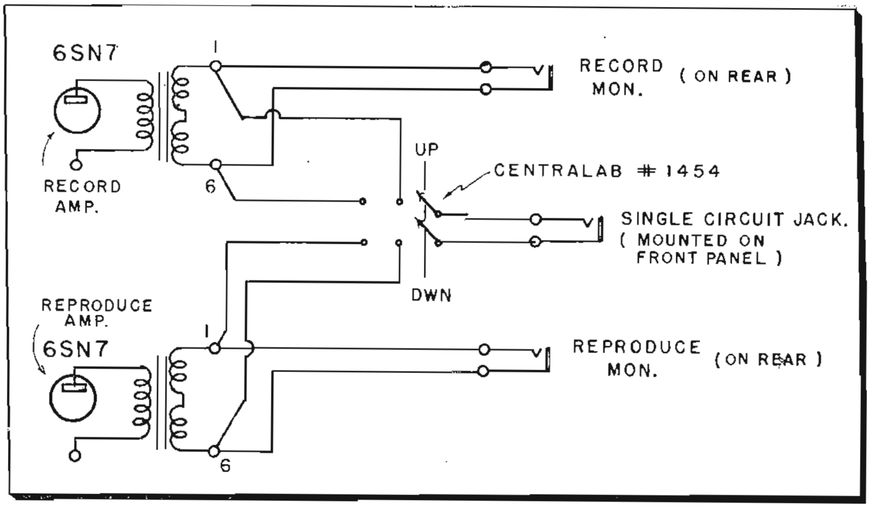
Construction details of an emergency pick-up arm made from discarded transcription



$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is preferred. Our usual rates will be paid for material used.

this hole is just slightly larger than ¼ in. A piece of copper tubing is cut off to a length which fits snugly between inside surfaces of the pick-up arm. The copper tubing is now pushed through the reamed out holes which were drilled horizontally through the bakelite sleeve on the phone plug. The tubing should fit loosely so that the arm can be raised or lowered with ease. Next the copper tubing is aligned with the 3/16 in. holes on side of pick-up arm, a bolt is passed through entire unit and a nut affixed to the bolt and taken up tight. If the pick-up head needle jumps the grooves, loosen the tension of the contact springs of the jack where they make contact with tip and sleeve of plug.



A and B circuit for comparing two programs rapidly on the Presto PT-900 amplifier

A-B Listening Jack and Switch

DON. V. R. DRENNER, KGGF, Coffeyville, Kansas

As supplied, the Presto PT-900 series tape amplifier has two phone jacks on the rear apron for monitoring; one for pre-recorded programs and the other from the tape. This arrangement, while economical, obviously does not permit rapid comparison of program material.

An inexpensive and simple A-B system may be added, as shown. The position of the jack and Centralab switch is important, as there isn't much space on the front panel. The leads should be short and shielded. No connections of the original amplifier are changed; and the switch leads are run to terminals 1 and 6 of the respective output transformers, as shown.

This simple switching system will permit easy cueing, and almost simultaneous monitoring of program source and tape, with less effort and fewer lost programs!

Bridgeport UHF Station's Two-Man Crew

At a recent gathering of broadcasters, Raymond F. Guy, NBC Manager of Radio and Allocations Engineering, discussed the present and future status of UHF television and highlighted the operations which have been in progress under his direction for nearly two years at the Bridgeport experimental station, pictured on the front cover of this issue.

Mr. Guy pointed out that RCA and NBC had in 1946-8 built and operated four UHF television stations and reported their findings to the industry and the FCC engineers. But these projects primarily sought information that engineers need with which to evolve technical standards and allocation plans. In the Bridgeport project the objectives were greatly broadened to include matters of commercial significance to non-engineers and to more completely provide the information sought by individuals and groups contemplating UHF TV operation.

Mr. Guy stated that the Bridgeport equipment is therefore not a laboratory toy nursed along by laboratory engineers but of commercial type and factory-built in strictly conventional manner.

The station was planned and built to be a prototype of a commercial station without any abnormal costs or problems, and for the entire period of its existence has been operated with a staff of only two technicians, from 9.00 A.M. to midnight, five days per week. As a re-

(Continued on page 68)

Station wagon (left) used for measuring field intensities of experimental UHF television station KC2XAK, Stratford, Conn. "Bow Tie" receiving antenna is mounted on roof of vehicle. Engineers (right) check control console and transmitter switchboard of the RCA-NBC station

Simplified Approach to

Toroidal coils offer many advantages over more conventional forms and

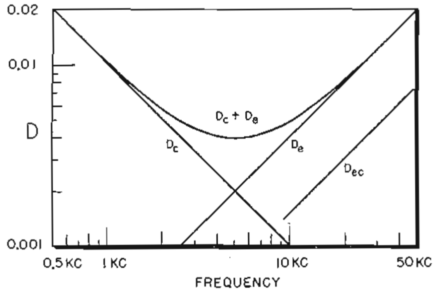


Fig. 7: Dissipation factor caused by proximity effect varies with frequency.

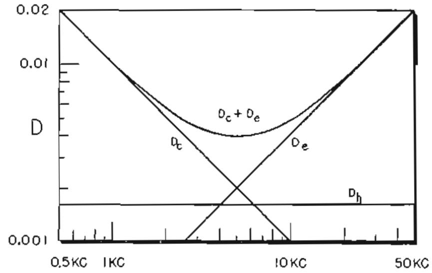


Fig. 8: Dissipation factor due to hysteresis loss is independent of frequency.

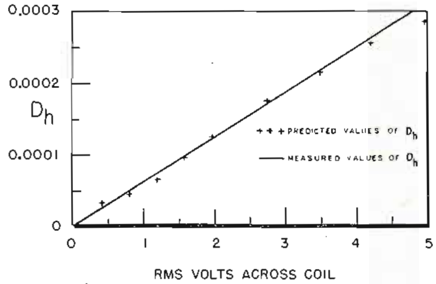


Fig. 9: Comparison of predicted and measured hysteresis dissipation factors.

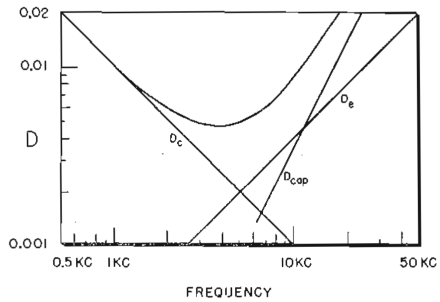


Fig. 10: Capacitance dissipation factor causes asymmetrical sum-loss curve.

By H. E. HARRIS, Apparatus Dept.*
General Electric Co., Schenectady 5, N. Y.

An examination of the relations of Table 1 will show that only two of the coil losses are affected by the stranding of the wire. The first losses are the copper eddy current losses due to internal flux in the wire.

Unfortunately, space does not permit a full discussion of this well-known skin effect loss. For the usual coil, however, this loss will be so much smaller than the copper eddy current losses due to the external flux of the coil that it can safely be neglected.

If it is desired to handle this loss quantitatively, the easiest way seems to be to derive a criterion for selection of strand diameter which will insure that this loss will always be negligible with respect to the dc copper loss (that is such that the skin effect ratio will be held to a predetermined value). Another straight line graph (on log-log paper) is the result, but, as mentioned above, in all practical cases the requirement is so much less severe than that resulting from a consideration of external flux losses that the plot has little utility.

Losses Due to External Flux

The second losses, eddy current losses in the copper due to external flux, are caused by currents induced in the copper wires of the winding by the total net leakage flux of the coil—that is the small fraction of the flux that exists in the space occupied by the winding rather than in the higher permeability core.

Equation 4, Table 1 shows that the dissipation factor due to this "proximity effect", as it is frequently called, is directly proportional to frequency, so a plot of it on log-log paper will look something like that in Fig. 7 where it has been superimposed upon a plot of the two main losses of the coil, D_c and D_e, and their sum.

This plot immediately suggests two possible methods of handling this loss. First, it will be noted that this dissipation factor follows exactly the same laws of variation as that for eddy current losses in the iron. (This, of course, would be expected, since both are eddy current phenomena, and the same general laws must be followed whether the eddy currents are in iron or copper.) Thus if the eddy current loss in the copper is made negligible with respect to that in the iron at any one frequency, it will be negligible with respect to it at all frequencies. Further, Equation 4 shows that the copper eddy current losses can be reduced to any degree desired by making the strand diameter small enough. Therefore, a criterion can be set up for the strand diameter to be used which will insure that the proximity effect loss will be negligible with respect to iron losses, and hence to total coil losses, over the entire frequency range of the coil. This line of attack is the one which should be used for the design of general purpose coils, or where coils must be used over a wide frequency range.

In some cases, however, this criterion would be unnecessarily severe. For instance, if a coil is to be used at a frequency appreciably below its point of minimum dissipation factor, there would be no point in insisting that proximity effect loss be negligible with respect to iron losses, for iron losses themselves are negligible at such a point. It is only necessary to use fine enough wire to make D_{ec} negligible with respect to the total dissipation factor. It is, therefore, also necessary to derive an expression which will give the diameter necessary to reduce the proximity effect to any predetermined value. This added flexibility will be well worthwhile if many coils are to be wound, for the finer strandings of wire are relatively expensive.

There is still one major difficulty

*This paper was prepared while the author was affiliated with the Research Laboratory of Electronics at the Massachusetts Institute of Technology.

Toroidal Inductor Design

Part Two
of Two Parts

by using molybdenum permalloy for cores, precise control can be obtained

to be resolved before such a criterion can be derived, however, and that is the evaluation of the factor (B_L/B_{mc}) in Equation 4—that is the ratio of leakage to useful core flux in the coil. One would expect intuitively that except for variation with core permeability, this ratio would remain approximately constant for all toroids, since the proportion of total flux-producing current outside of a radius extending to any given fractional depth in the winding will be approximately the same regardless of whether the winding has one layer or twenty. The assumptions necessary for calculation of this ratio are not, however, at all obvious.

Experimental Results

Without going into great detail it may be said that this ratio was here evaluated experimentally, from measurements made on a number of air core toroids. It was found that the factor did indeed remain essentially constant regardless of the shape or size of the toroid, and taking into account the effect of an iron core, the best approximation to the desired ratio seemed to be:

$$(B_L/B_{mc}) = (0.6/\mu_r).$$

Substituting this value into Equation 4 and solving for strand diameter, gives:

$$d_s^2 = 946\mu_r \frac{\gamma\, r_m\, A_c}{V_w} \frac{1}{f} D_{ec} \;\ldots\ldots\ (\text{in.})$$

This equation is now in a form suitable for predicting the strand diameter necessary to hold the proximity effect dissipation factor to any desired value.

There is also one fact apparent from this equation which is very significant if it is desired to specify in advance a critical strand diameter such that the proximity effect loss shall always be negligible with respect to iron loss. It will be noted that there is no term in this equation involving the inductance or any quantity related to it. Therefore once the critical strand diameter is determined to make D_{ec} negligible with respect to D_e (which itself is independent of inductance) at any arbitrary frequency, this critical diameter will hold for all coils wound on that core. In other words, it is possible to establish a critical strand diameter simply as a constant of the core, and it becomes as much a constant of the core as any of its dimensions.

For instance, for the cores considered earlier in this chapter, the critical strand diameters to keep the copper eddy current loss to 10% or less of the iron eddy current loss turn out to be as indicated in Table II.

For the particular 1.3 henry coil to work at 6 KC which has been used as an example, it is apparent that no stranding of the wire is necessary. Number 31 solid wire can be used without any decrease in the Q. In fact, the critical diameter for this core A is so large that it was not possible to make any measurements on this particular core to verify the theoretical calculations in this section.

The data in the Table III, however, shows a comparison of predicted and experimental data for a 0.5 millihenry coil wound upon core D (see Fig. 4 for dissipation factor plot of this coil).

The data for this table was obtained by winding four coils in succession on the same core, keeping the total diameter of the wire bundle the same (28 mils) but varying the stranding from number 41 to number 32 in the four steps shown.

"Stranding Factor"

The so-called "stranding factor" γ which has been used here perhaps deserves some special mention. It is obvious that for a given total outside diameter of the wire bundle, more of the effective winding area is actually going to be occupied by copper if the wire is solid than if it is stranded. From simple geometrical reasoning it is easily shown that this factor is equal to 1 for solid wire, and to about 0.57 for stranded wire. Probably the best way to handle this factor is to calculate the critical strand diameter first assuming that solid wire is to be used. If this diameter turns out to be smaller than the overall wire diameter obtained for requirement 3, so that Litz wire is necessary, the correct strand diameter can be obtained merely by multiplying the value already found by $\sqrt{0.57}$, or 0.76.

Hysteresis Losses

All of the essential information which must be determined before an actual coil can be wound is now known. There are, however, three further losses which have not been considered. These losses lead to limitations on the coil which must be taken into account if the performance is to be predicted accurately.

Consider first the hysteresis losses. Reference to equation 6, Table I, shows that the dissipation factor due to this loss is independent of frequency. A plot of this dissipation factor superimposed upon that for the two main losses of the coil, then, would look something like the one shown in Fig. 8.

Equation 6, however, shows that this dissipation factor is directly proportional to the flux density in the core. This fact immediately suggests that if the flux density is kept low enough, by restricting the voltage or current, the hysteresis loss can be made negligible with respect to the other losses of the coil so that it will not affect the overall Q.

It is also evident that if the flux density were used as a design variable, the hysteresis loss, like the eddy current loss in the iron, would be dependent only on the material from which the core is made and not at all upon any of the constants of the winding. Unfortunately, the flux density is seldom known in a practical case, so it is hardly a convenient design parameter. Instead, the terminal voltage of the coil will be used. This has the effect of reintroducing not only the constants of the winding but also the frequency as well, but nevertheless since high Q coils are most often used as resonant elements in interstage coupling networks, where the approximate voltage level is known, it is the most convenient parameter for design purposes.

The conversion is easily made by substitution into Equation 6. The

(Continued on page 70)

For MANUFACTURERS

New Methods, New Materials and New Machines

Edited By Bernard F. Osbahr

Testing Flybacks

THEODORE E. CANTOR, *3015 Riverdale Ave., New York 63, N. Y.*

In testing fly-back transformers, it is not essential to connect the one or two turn h-v filament loop to the 1B3 or 1X2 rectifier tube. Since the loop is exposed, it can be given a quick visual inspection. The h-v rectifier in the test set can be operated from a standard 1.5 volt, No. 6 dry-cell, and left on during the normal testing day. If disconnected at night the battery will provide the correct filament voltage and easily last two to three months. Compare the small cost of the battery with the time saved in not having to connect the two ends of the filament loop.

Be sure that the battery rests on an insulated block and that its terminals aren't exposed, since it is at the h-v potential. (See sketch below).

Ultrasonic Soldering Bath

The rapid tinning of small aluminum and aluminum alloy articles is made possible by an ultrasonic soldering bath recently introduced by the Equipment Division of Mullard Ltd., Shaftesbury Ave., London WC2, England. This unit has been developed specifically for the soldering of small and complex shaped parts composed of foils, wire and tubes. Extensive applications in making connections for condenser foils, tinning of aluminum galvanometer suspensions, and soldering small tubes and sections to anchorings or mountings are expected.

$$$ FOR YOUR IDEAS

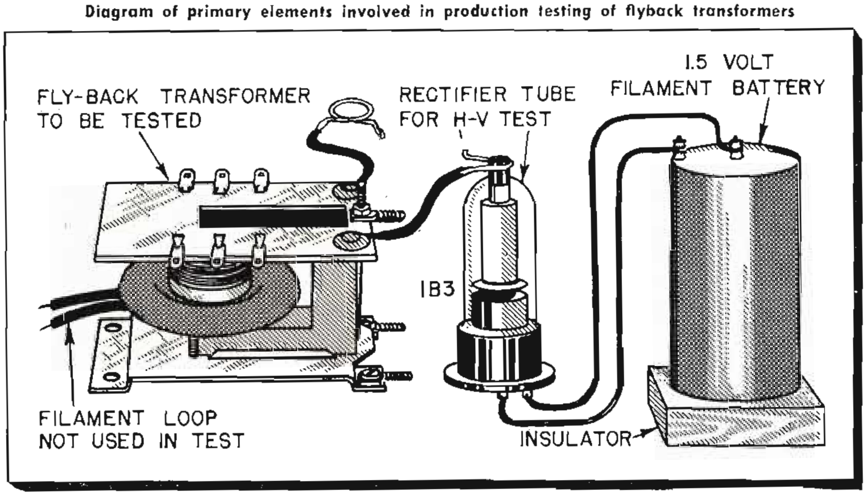
Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is preferred. Our usual rates will be paid for material used.

The new unit consists of a small soldering bath ⅞ in. diameter and ⅜ in. deep. It is heated by means of a conventional resistance winding, and the molten solder in the bath is agitated ultrasonically (appr. 20 KC) by means of a magnetostriction transducer composed of a stack of iron alloy laminations.

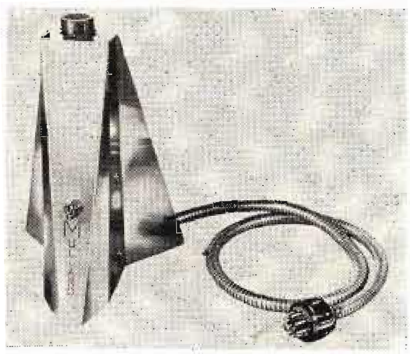
In operation, the rapid vibration of the bath, resulting from the magnetostriction effect produced in the transducer, is used to break up the highly refractory oxide films which normally form very easily on such metals as aluminum.

The bath is allowed to heat to its usual operating temperature. The transducer is then energized by closing the switch on the front of the unit, and articles can then be tinned simply by immersing them in the molten solder. An important advantage of this method is that no flux is required. Moreover, soft solders may be employed. To avoid electrolytic action when soldering aluminum and its alloys there may however be advantages in using a tin-zinc instead of the usual solder with a tin-lead base.

Diagram of primary elements involved in production testing of flyback transformers



The ultrasonic power necessary to drive the transducer is supplied by an electronic amplifier comprising the power supply unit. This unit is housed in a metal case with handles and may easily be carried around the factory. It is suitable for operation from a 100-250 volt, 40-60 cycle power source and has a total power consumption of about 200 watts. Connection with the soldering bath is by a simple multicore cable, which supplies both the heating winding and the transducer excitation and pick-up coils. The only control on the supply unit is the amplifier switch.



Ultrasonic soldering bath for rapid tinning of small aluminum and aluminum alloy parts

The dimensions and weights of the units comprising the equipment are as follows:

Soldering Bath	6"x 6"x9½"	4 lb.
Supply Unit	9"x10"x 12"	40 lb.

Metal-Surfaced Dielectric Sheets

"Chemelec Multi-Bond" is the trade name applied to a new series of metal surfaced dielectric materials offered by the Fluorocarbon Products Division of United States Gasket Company, Camden 1, N. J.

Dielectric materials include Teflon, Kel-F, etc., and mixtures of fluorocarbon resins with various other materials, such as Asbestos, Mica, Fiberglass, Glass, Ceramics, Quartz, etc. The metal surfaces available on

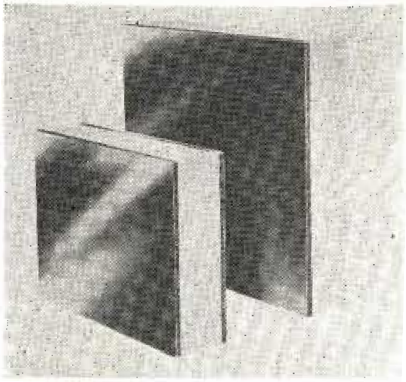


Photo of dielectric sheets metalized on both sides (left) and on one side only (right)

any of the dielectric materials include Aluminum, Boron Carbide, Copper, Alnico, Monel, Lead, Mu Metal, Solder, Tin, Magnesium, Iron, Steel, Molybdenum, Nickel, Nichrome, Zinc, Bronze, Brass and the precious metals.

Sheets may be metalized on one or both surfaces. Standard thicknesses of dielectric material range from 0.030 to 1.50 in., and of the conducting metal surface from 0.004 to 0.25 in. The thickness of the Multi-Bond area ranges from 0.008 in. to a homogeneous mass. The bond structure is micro-crystalline in nature and gradually changes from pure dielectric to pure metal. The surface metal finish is applied by electro deposition or other conventional means. Chemelec Multi-Bond is ideal for fabricating moisture proof printed circuits.

Faster Sub-Base Markings

Component identification markings on equipment sub-bases can be rapidly applied by paint spraying used in conjunction with precision stencils developed by Jas. H. Matthews & Co., 3890 Forbes Street, Pittsburgh 13, Pa. These stencils fit snugly over the part to be marked, regardless of its shape or size. Each code or symbol is precisely relieved from the contour-formed stencil, assuring accurate, perfectly legible reproduction. Stencil holders make it possible to spray both sides of the chassis in a single operation, and eliminate the necessity of handling a "wet" stencil. Precision stencils, however, are not stock items. Each stencil is engineered to fit a customer's specifications.

Stencil and stencil holder assembly used in fast spraying of component identification

Micro-Motion Movies

While micro-motion movies are not new to time and motion study engineers as an efficient means for determining how long it takes for any given operation on an assembly line, the more recent application in studying machine design and efficiency is significant. Here the idea is to study both the machine and the operator to determine whether a change in the operation or a change in machine design, or both, would be desirable to increase production efficiency.

The Industrial Division of Eastman Kodak Co., Rochester, N.Y., reports that on one job production was increased by 400% after improvements suggested by micro-motion movies had been effected; in another, using push button controls rather than toggle switches on a machine saved $10,000 a year, and in still another instance, an indicated machine design change upped production 75%.

An electric motor-driven 16 mm camera is used to make these pictures at a fixed rate of 1000 frames/minute. An ordinary home 16 mm camera can also be employed, but in such instances a clock that indicates thousandths of a minute is included in the picture while the operation is photographed.

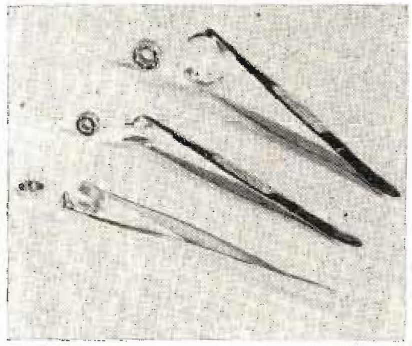
In analyzing the operation the pictures are projected and the process is charted on a standard chart form, thus enabling a breakdown of the operation into its component parts. A typical chart has two columns, one for the right hand of the operator and one for the left. What each hand does at all times during the operation, the type of movement that it is making, the length of time required for each movement, and whether or not the hands are engaged in productive activity are all noted.

When the chart is complete the engineer can tell whether or not the operation is efficient both from a mechanical and operative standpoint, whether a new or major machine redesign job is necessary, or whether a special jig or fixture is called for.

Ball Bearing Tools

The Baker Company of Maplewood, Maine announces the availability of new convenient tools for handling instrument ball bearings during inspection, cleaning and relubrication operations.

The new tools are essentially special tweezers for use on bearings having bores from 3/32 to 1/2 inch, and can be furnished in two models—one for gripping the bearing by the inside race and the other for the outer race. These tools are a useful addition to those used for assembling bearings into equipment, and will help avoid the corrosive effects of finger handling of bearings.

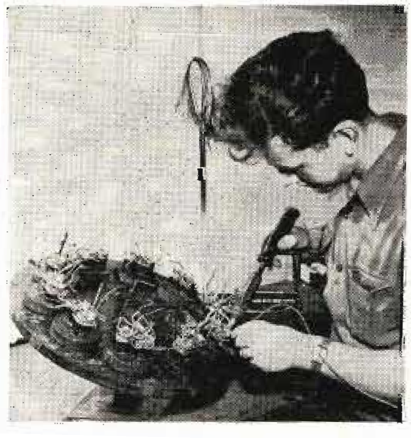


Special tweezers for miniature bearings

Turntable Assembly-Jig

Sub-assembly manufacture at the Mt. Vernon plant of North American Phillips Co., Inc., has been greatly facilitated by the introduction of a turntable to hold several units at one time. The operator, instead of completing each assembly separately, finds it less tedious and less subject to error if, for example, the same resistor is added to each unit as the table is turned. This ten-unit turntable was constructed to permit easier soldering of small resistors and capacitors to tube socket terminals. Many other variations are possible.

Operator using turntable jig to solder resistors and condensers to tube socket terminals



New Developments

Philadelphia's Mobile Civil Defense Communications Center

A unique eight-transmitter mobile communications center for civilian defense has been delivered to the city of Philadelphia by RCA. The self-contained unit, housed in a truck 23 ft. long and 8 ft. wide, supplements a main control center and four regional control centers which had been previously established at fixed locations.

Mobile civilian defense control center

Operational flexibility is indicated by the equipment which includes three 60 watt station transmitters with associated receivers, operating on the Fire Dept. base station frequency, Police Dept. frequency and Civilian Air Patrol frequency, respectively. In addition, two 30-watt transmitters and receivers are provided for operation on the Fire Dept. and Police Dept. mobile frequencies. Three amateur transmitters operate in the 2, 10 and 75 meter bands and are used for contacting 267 ham operators with stations in their automobiles, as well as many hams in fixed locations.

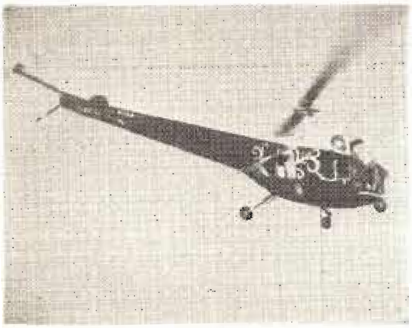
The operating room, occupying the forward end of the coach, provides space for the driver, the radio command officer, and six or more radio operators. Mounted in the extreme rear of the truck is the 10 kw single-phase generator which supplies all power required for the equipment at remote locations where no ac power line is available. Removable sections in the coach body afford easy access to the power plant for servicing. The mobile station carries 150 ft. of telephone cable, mounted on a reel at the rear of the coach. This 26-pair cable can be quickly tapped into any telephone trunk line to establish telephone service between the 16 phones in the truck and existing telephone facilities.

The various transmitter antennas on the roof of the truck are spring mounted, except for one collapsible 35 ft. unit to be used for the 75 meter transmitter. Also on the roof are a loudspeaker connected to a 75 watt public address system, flood lights, flashing red lights, and a siren.

TV Antenna Patterns Measured by Helicopter

The old and laborious method of installing field strength measuring equipment into station wagons and driving along radials for days, and weeks, of slow point-by-point measurement of field intensity may soon be superseded by the use of airborne methods. Recently the American Broadcasting Company made a survey of the radiation pattern around its TV antenna atop the Empire State Building in New York City in two hours by loading John G. Preston, Chief Allocations Engineer, together with a set of field intensity measuring equipment into a Bell Helicopter.

The party circled WJZ-TV's antenna



Helicopter used to make radiation pattern measurements. Esterline-Angus graphic recorder is mounted in baggage hatch to rear of engine compartment. Horizontal loop antenna projects below plane from opposite side. Doors have been removed to permit observation of ground reference points.

(1425 ft. altitude) at a radius of 1.4 miles, and recorded the field strength measurements. The average figure was 550 mv/m and is understood to be amazingly consistent with the theoretical figures. The particular distance of 1.4 miles was dictated by the need to have numerous easily distinguishable landmarks for the pilot to use in maintaining a constant course and to be reasonably accessible to emergency landing areas in case of power failure. Also, this distance was expected to produce a strong signal which would aid in giving consistent results. A horizontal circular loop antenna was used and calibrated to the Clarke measuring set. Use of this type of antenna eliminated the need for reorienting a dipole as the helicopter circled the tower, but its low gain (about 0.5) made it necessary to operate in a reasonably high field.

The results obtained appear to bear out the contentions of many broadcast engineers that the old methods of measuring field intensity on the ground, or just above it, and converting such figures to free space values, are inaccurate. The airborne system certainly provides information which is free from artificial effects produced by proximity to the ground, and other terrain effects.

A survey of the findings resulting from this flight, showed that the WJZ-TV signal, as described on a graph, looped out from the antenna in the form of a four-leaf clover. The clover design indicated that the areas between the leaves were of inferior strength, and locales receiving a TV signal from these radiation points were not getting a clear image.

The radiation pattern was changed to a circular one, thereby eliminating the weak signals between clover leaves, by driving all antenna elements in phase instead of phase quadrature as was done previously.

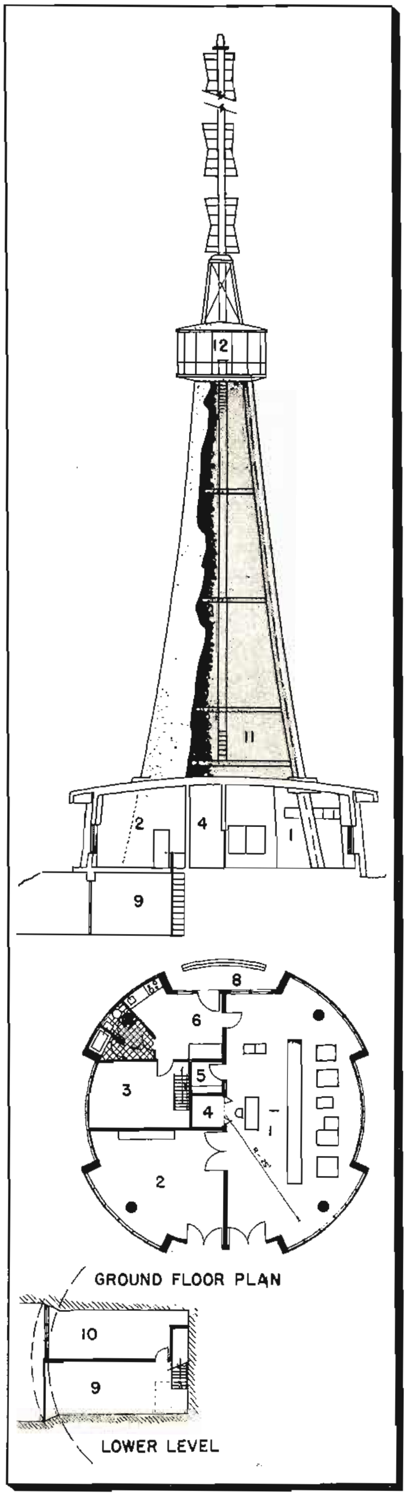
Viking-I Radiophone on West Indies Expedition

Before leaving on a five month expedition through the West Indies where he will chart all of the unmarked hunting terrain and fishing waters for sportsmen, former naval officer Edward Stevenson of Babylon, N. Y. checked his Viking-I marine radio-telephone with Joseph S. Henry, general sales manager of Hudson American Radio Div. of Claude Neon, Inc.

The 95 lb. Viking-I has a 50 watt output on six crystal controlled frequencies which may be set at any point within the operating range 2 to 12 MC. The output circuit can be matched to antenna impedances between 10 and 600 ohms. The crystal controlled superheterodyne receiver has a sensitivity of 0.5 µv/50 mw, over 60 db image rejection, three watts audio output, and audio response flat within 1 db from 100 to 5000 cps.

Joseph Henry (r) wishes Edward Stevenson good luck on his West Indies trip

in Telecommunications



Mountain-top station design withstands weather extremes; consists of conical tower and transmitter building of reinforced concrete. 1) Transmitter room; 2) Workshop; 3) Store room; 4) Stairwell; 5) Emergency studio; 6) Living quarters; 7) Lavatory; 8) Sheltered entrance; 9) Garage; 10) Power room; 11) Auxiliary equipment room; 12) Microwave relay dish housing

Japanese TV to Use U.S. Standards

AS a result of conferences with an independent mission of US consultants, the emerging TV industry of Japan is adopting the established 525 line, 60 field standard. This change was proposed last September by the mission during meetings in Tokyo with the sponsors of the new Japanese Television Network and with the country's Radio Regulatory Commission, Japan's counterpart to the FCC.

Sponsoring the Japanese TV Network are private individuals and companies representing the country's principal newspaper, motion picture, and radio interests. As major shareholders in the newly organized network, these originally issued the invitation to the American consultants. Members of the mission were William S. Halstead, consulting engineer; Dr. Walter J. Duschinsky, planner of numerous communications installations; and Henry F. Holthusen, attorney.

While in Japan, the mission prepared the network's application to the RRC for Japan's first TV license. Basic plans call for studios and a transmitter in Central Tokyo and a series of mountain-top microwave relay and transmitting links to reach as far as Osaka. Dr. Duschinsky and Mr. Halstead also prepared a longer-range plan to blanket the Japanese islands by approximately 18 transmitting and relay stations.

As envisaged in the application submitted to the RRC, the network's first stage of development will find programs originating solely from one live-talent studio and one film studio in Tokyo's Yumuri Building. These programs will, in turn, be relayed and transmitted by the mountain-top stations in a regional pattern over the most populous portion of Honshu, Japan's main island.

The accompanying sketches illustrate several features of Dr. Duschinsky's plan for the regional mountain-top stations in the network link-up.

Standard TV transmitter and microwave relay equipment is housed in each station unit, but the dishes are protected by enclosure in a special plastic gondola on top of the tower. In addition, space has been provided for multiplex equipment which is of importance to the network's newspaper shareholders.

It is expected that the license for the Tokyo originating station will be granted within a few months.

Coming Events

March 3-6—1952 IRE Convention, Waldorf Astoria Hotel and Grand Central Palace, New York, N. Y.

March 10-13—NEMA, Edgewater Beach Hotel, Winter Meeting, Chicago, Ill.

March 30—NARTB Broadcast Engineering Conference, Conrad Hilton Hotel, Chicago, Ill.

April 19—IRE Spring Technical Conference, Cincinnati Section, Cincinnati, Ohio.

April 21-24—National Committee of the International Scientific Radio Union and IRE Professional Group on Antennas and Propagation, Spring Technical Meeting, National Bureau of Standards, Washington, D. C.

April 21-25—SMPTE, 71st Convention, Drake Hotel, Chicago, Ill.

April 24-26—AFCA, National Convention, Philadelphia, Pa.

May 4-8—Electrochemical Society, 50th Anniversary Meeting, Benjamin Franklin Hotel, Philadelphia, Pa.

May 5-16—British Industries Fair, Earls Court and Olympia, London, England

May 5-7—IRE-AIEE-RTMA Symposium on Progress in Quality Electronic Components, Dept. of Interior Auditorium, Washington, D. C.

May 7-9—IRE National Conference on Airborne Electronics, Hotel Biltmore, Dayton, Ohio.

May 8-10—ASA, Semi-Annual Meeting, Hotel Statler, New York City.

May 16-17 Southwestern IRE Conference and Radio Show, Rice Hotel, Houston, Tex.

May 19-22—1952 Radio Parts and Electronic Equipment Show, Hotel Stevens, Chicago, Ill.

May 22-24—ASQC, Sixth Annual Convention, Syracuse, N. Y.

June 23-27—AIEE Summer General Meeting, Hotel Nicolet, Minneapolis, Minn.

August 27-28—WCEMA, Show and Convention.

September 8-12—ISA, 7th National Instrument Conference and Exhibition, Sherman Hotel, Chicago, Ill.

September 22-25—NEDA, 3rd National Convention, Ambassador Hotel, Atlantic City, N. J.

September 29-October 1—Eighth National Electronics Conference and Exhibition, Sherman Hotel, Chicago, Ill.

AFCA: Armed Forces Communications Assoc.
AIEE: American Institute of Electrical Engineers
ASA: Acoustical Society of America
ASQC: American Society for Quality Control
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
NARTB: Nat'l. Assoc. of Radio & TV Broadcasters
NEDA: Nat'l. Electronic Distr. Assoc.
NEMA: Nat'l. Electrical Manufacturers Association
RTMA: Radio-Television Mfrs. Assn.
SMPTE: Society of Motion Picture & TV Engineers
WCEMA: West Coast Electronic Mfrs. Assoc.

New Equipment and Components

Portable Mixer

Designed for high fidelity mixing, the 220A portable mixer incorporates the use of two 1410A dual preamplifiers with individual

volume controls for four microphone inputs, a 1440A line amplifier, a master volume control, a 30A power supply and a large 4-in. illuminated VU meter. It can be operated from ac power or external battery supply. Available input impedances are 30, 150/250, or 500/600 ohms, and a selection of output impedances of either 125 or 600 ohms is provided through a selector switch. The gain of the system is 80 db, with a maximum output level of + 18 dbm at less than 1% harmonic distortion. The frequency response is ± 1 db from 30 to 15,000 cps and the noise level is—64 db at 70 db gain when referred to peak output signal of ± 18 dbm.—**Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.**—TELE-TECH.

Pulse Generator

A fast-rise pulse generator has been designed for testing the transient response of wide-band systems, but can also be used for the generation of impulse of "continuous spectrum" noise for signal-to-noise ratio testing and for narrow-band receiver alignment. It produces a rectangular pulse having a rise time less than 10^{-9} seconds. The width of the pulse is controlled by the external "width" cable, and may be as short as 2×10^{-9} seconds. Pulse amplitudes from 0.1 to 100 v., of either polarity, may be selected. A single pulse, controlled by an external trigger, or internally controlled repetitive pulses, with repetition rates from 50 to 150 per second, may be produced.—**Spencer-Kennedy Laboratories, Inc., Dept. TT, 186 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH.

Octave-Band Noise Analyzer

Type 1550-A octave-band noise analyzer is particularly useful in applications where reasonably continuous spectrum noises are found and great detail in the analysis is not required. It has been used successfully for determination of loudness, speech-interference level, articulation index, airplane comfort level, and in other problems involving the reduction of noise to produce comfort or ear protection. The octave-band analyzer can also be used in the determination of the sound-transmission loss of building walls, partitions and floors; and is use-

ful as a selective bridge detector or filter. Eight pass bands are provided; the lowest is a low-pass filter and the highest a high-pass filter; the middle six, covering from 75-4800 cps, are each an octave in width. The initial rate of attenuation beyond cut-off of the band pass sections is about 50 db per octave. An amplifier, calibrated attenuator and indicating meter in the instrument make it possible to measure octave-band levels over a range of about 60 db.—**General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH.

Instrument Rectifiers

Minisel instrument rectifiers are believed to be the first instrument rectifiers made with selenium rectifier cells. This revolu-

tionary advance is made possible by a special plate stabilizing process, and by matching the characteristics of the individual cells so as to give excellent uniformity within and between units. These instrument rectifiers are more efficient than conventional type because they have higher blocking resistances and lower conducting resistances. These rectifiers are manufactured in all standard configurations: half-wave; center-tap; doubler; ¾ bridge; and bridge. The individual cells are rated at 10 v. ac input and 5 ma dc output, but can be had in input ratings up to 26 v. ac and output current ratings up to 10 ma dc for special applications.—**Electronic Devices, Inc., Precision Rectifier Div., 429 12th St., Brooklyn, N. Y.**—TELE-TECH.

Volume Level Indicator

Components in the series 911 volume level indicator are especially mounted to withstand shock and the rough usage given

portables. This unit is completely self-contained, requiring no batteries or external power supply. It is sensitive to low power levels, rugged and dependable. The indicating meter is a copper-oxide type instrument possessing ideal characteristics for monitoring purposes. The adjustment is such that the pointer will indicate 99% normal deflection at zero vu in approximately 0.3 seconds. Overswing is not more than 1 to 1½%. Two meter controls are provided; one a small decade with screw driver adjustment for zero level setting of the meter pointer; the other a constant impedance "T" type network for extending the range of the instrument in steps of 2 db. These controls make it possible for all vu meters in one installation to be adjusted to the same scale reading when desired.—**Daven Co., 191 Central Ave., Newark 4, N. J.**—TELE-TECH.

Coaxial Switch

A new, compact, DPDT coaxial r-f switch to replace the use of two SPDT switches and provide substantial saving in weight and

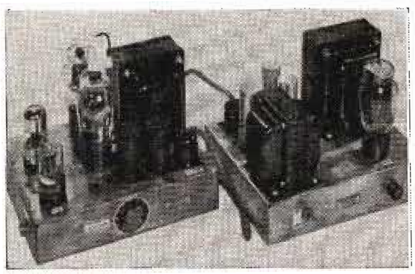
flexibility of installation. Switch is motor operated instead of solenoid. Straight end connections eliminate the use of lossy angle connectors, save time and space. Frequency ranges up to 11,000 MC and vswr is less than 1.3 to 1. Attenuation between unused connectors is 55 db average. Power handling capabilities are equal to improved type N connectors. Motor driven actuator rating 24-28 v. dc.—**Transco Products, Inc., 12210 Nebraska Ave., Los Angeles 25, Calif.**—TELE-TECH.

New Mercury Contactor

The Saxl Mercury Contactor is a variation of the familiar mercury type on-off switches. It consists essentially of a glass tube with the electrodes placed at opposite sides of the center of the tube, perpendicular to its axis. The tube is evacuated (or filled with the proper gas to avoid contact oxidation) and contains the mercury pool. Rotating the tube provides momentary contacts between the electrodes through the mercury, and both duration and rate of contacts are of course dependent on rotational speed. The device is finding an ever increasing number of applications in various equipments such as: numerical counters, watt-hour meters, relays, pulse generators, timers, speed governors, etc.—**Saxl Instrument Co., Harvard, Mass.**—TELE-TECH.

Amplifier Kit

Components for the Williamson amplifier, consisting of the output transformer, power transformer, and power supply choke, plus

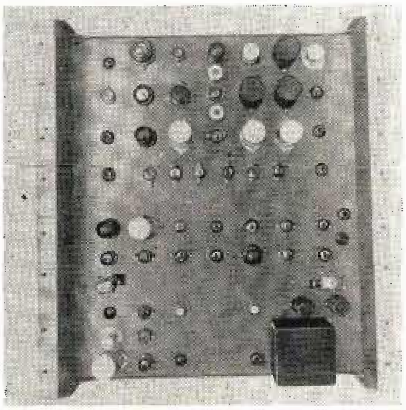


detailed schematic, small parts lists and chassis layout drawings, are now being supplied for the assembly of this high-quality audio amplifier. At 8 watts the intermodulation distortion is less than 3%, and the harmonic distortion negligible. Bulletin 382, giving the schematic, parts list, and layout, is free of charge. The firm also makes available a punched and finished chassis for use with this kit, and is sold under Stancor part No. WM-8. **Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill.**—TELE-TECH.

for Designers and Manufacturers

Special Effects Amplifier

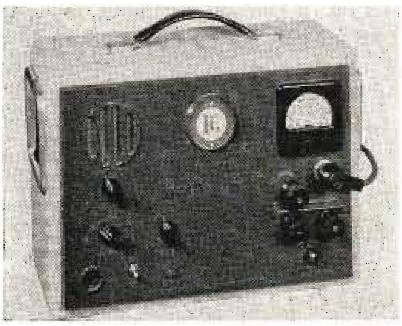
The TA-15A special effects amplifier is designed for use in the production of modern television programs where it is desirable



to combine two scenes into a single picture —or to remove a portion of one scene to replace it by a portion of another scene. The TA-15A produces composite television pictures, from two independent picture sources, in which one picture occupies a part of the scanned area, and the other picture occupies the remainder of the scanned area. The two pictures are not superposed, but occupy adjacent areas independently. The boundary line between these adjacent areas is determined by a masking signal from a third source of television signals. When a camera is used to produce the masking signal, motion of the boundary line may be accomplished by moving the black-and-white pattern, or by panning or tilting the camera across the scene. The masking signal is used to operate two electronic switching circuits which are in the channels carrying the two picture signals to be mixed. When the masking source scans black, one picture signal is transmitted, and when it scans white, the other signal is transmitted.—**Radio Corporation of America, Engineering Products Dept., Camden, N. J.**—TELE-TECH.

Insulation Tester

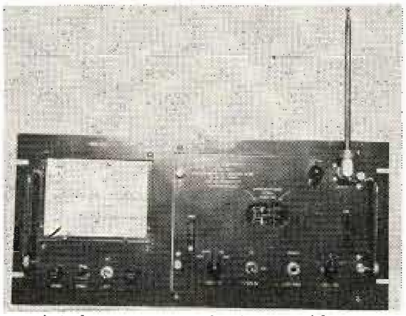
A new electronic high voltage insulation tester for measuring insulation resistance at any desired dc potential from 500 to 10.000 v. dc by stepless adjustment provides an aural indication of the ac components of leakage or ionization current through the test specimen. The instrument incorporates a selector switch which enables the operator to observe the applied potential on the external circuit in kilovolts and also the current leakage through specimen in microamperes by viewing the meter on the panel. The voltage reading in kilovolts divided by the current reading in micro-amperes gives the insulation resistance in thousands of megohms. On this basis, the resistance range covered, as calculated from current readings



at 10,000 v. dc is: 5,000 to 250,000 megohms; 500 to 25,000 megohms; 100 to 2,500 megohms. A chart is supplied with the instrument for rapid calculation of resistance values.—**Herman H. Sticht Co., Inc., 27 Park Place, New York 7, N. Y.**—TELE-TECH.

VHF Frequency Meter

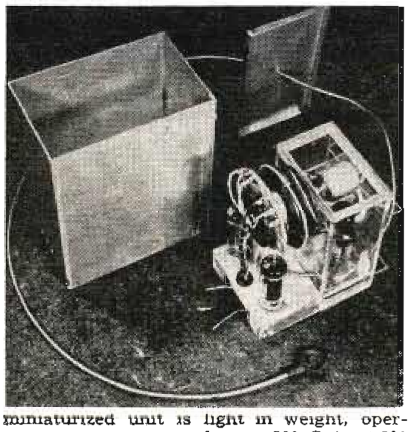
A new direct reading VHF frequency meter (FM-1A) has a frequency range 20-480 MC; and power supply is with PS-1/FM-1A



regulated power supply to provide proper voltage with line voltage variations from 105 to 125 volts. The new model meter was designed to provide a direct method of measuring or generating any frequency from 20 to 480 MC and frequency is read direct from dial reading, without the use of a calibration book. Provision is made to modulate the carrier frequency at a minimum of 30% at 1,000 cps. The FM-1A employs a unique and original circuit utilizing an extremely accurate 1.0 MC crystal, with variable capacity trimming to allow exact adjustment. All frequency measurements are referenced to the crystal, which has a temperature coefficient of 0.001% per C°.—**Gertsch Products, Inc., 11846 Mississippi St., Los Angeles 46, Calif.**—TELE-TECH.

Power Supply

A new Norelco low-cost regulated high-voltage dc power supply unit for use with cathode ray tubes has been developed. This



miniaturized unit is light in weight, operates at temperatures from −30° C to +80° C, and can be adapted for many applications particularly airborne and radar equipment. Input is 315 v. dc, 50 milliamperes. Output is 18 KV dc, 150 microamperes maximum. Taps may be provided at lower voltages to supply intermediate accellerating anodes. The ac ripple averages 1%. Unit is built to withstand 21 KV at 50% humidity. A Ferroxcube core is used in the high voltage transformer to obtain high efficiency and compactness. Dimensions of the power supply unit are 6 in. wide, 5¼ in. high, 3½ in. deep and weight is 2½ lbs. Volume is approximately 110 cu. in.—**Electronics Div., North American Philips Co., Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y.** —TELE-TECH.

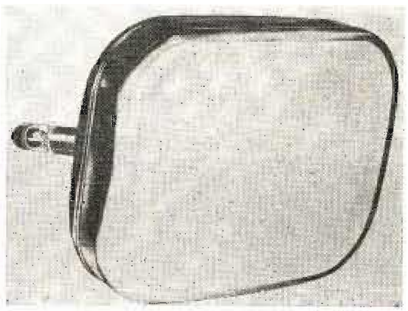
Double Pulse Generator

Model 903 double pulse generator produces either single or double pulses such that the amplitude and width of each pulse is continuously and individually variable. Spacing between pulses is controlled by means of a calibrated front panel knob. The unit is capable of producing either positive or negative pulses. Amplitude of negative pulses is individually and continuously variable from 200 v. maximum into a 1000 ohm load and 10 v. maximum into a 50 ohm load. The amplitude of positive pulses is continuously and individually variable from 50 v. maximum into a 1000 ohm load and 2.5 v. maximum into a 50 ohm load. Separation of the pulse pairs is continuously variable from 0 to 10 μsec and can be read directly on a calibrated knob on the front panel. The rise time of the pulses is 0.035 μsec and decay time less than 0.15 μsec. Pulse width is individually variable

from 0.1 to 1.8 μsec. The repetition rate of either single pulses or pulse pairs is internally controllable from 1 to 1000 pps. Single cycle pulses or pulse pairs may be obtained by means of a pushbutton. The unit can be driven from an external generator at any rate up to 1000 pps.—**Berkeley Scientific Corp., 2200 Wright Ave., Richmond, Calif.**—TELE-TECH.

Rectangular TV Tube

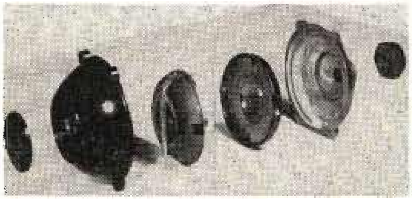
A new, all-glass, 21-in. rectangular, low voltage, electrostatic focus television picture tube has been developed with a revolution-



ary no-glare cylindrical face. Known as the 21FP4A, this tube is said to virtually eliminate reflections from surrounding objects and lights. This no-glare feature is accomplished by using a cylindrical area face plate rather than a spherical face, commonly employed in picture tubes. By using a cylindrical face, annoying reflections are thrown below the level of the viewers' eyes by tilting the tube to an almost unnoticeable degree. To do this with a sperical face tube, it would be necessary to tip it so far forward that it could not be viewed comfortably. The Sheldon 21FP4 no-glare picture tube with an overall length of 23 x ⅜ in. has a useful screen area of 19⅛ x 13⅞ in. Current production is presently at the rate of 1500 daily.—**Sheldon Electric Co., 76-86 Coit St., Irvington, N. J.**—TELE-TECH.

Driver Unit

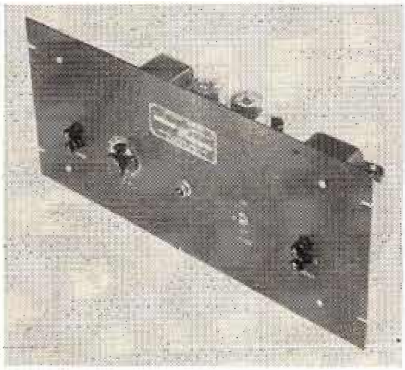
A complete diaphragm structure which can be snapped in place quickly and easily is the outstanding feature of a new 30-watt driver



unit. The "Self-Instal" diaphragm assembly is said to eliminate 40% of all conventional speaker breakdowns. Frequency response is rated from 75 cps to 15 KC and voice coil impedance is 16 ohms. Pressure-sealed neoprene gaskets make the unit submergance-proof and blast-proof.—**Audicraft, Inc., 77 South 5th St., Brooklyn 11, N.Y.**—TELE-TECH.

Relay Rack Amplifier

A new relay rack type 221-A amplifier features extended frequency response, high power output, and negligible hum and dis-



tortion. Specifications are: rated output, 20 watts; frequency response flat from 12,000 to 55,000 cps with extended controlled cutoff characteristics; first-order difference-tone intermodulation less than 0.1% and harmonic distortion less than 0.5% at rated peak output; hum level 90 db below full output; input for 20 watt output, 0.5 v. on low level input, 1.5 v. on high level input; input impedance 0.5 megohm for low level input, 1.5 megohms for high level input.—**Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.**—TELE-TECH.

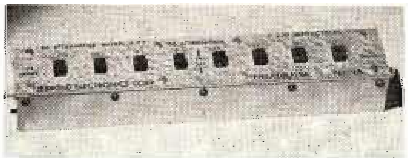
TV Camera Dolly

The Camart TV Camera Car is a medium weight four-wheel dolly with maneuverable boom arm that will support any heavy duty professional motion picture or television camera. Ideal for studio use or on location when confined to small areas, its 30 in. width will clear most standard doorways without requiring the set to be disassembled. Its total weight of 350 lbs. enables it to be

handled with a minimum of effort, and it can be lifted easily and transported in a station wagon. Lens angles are provided from 26 in. to a height of 7 ft. as illustrated. The dolly will carry the cameraman, and an assistant, and can be maneuvered easily by one man either on or off dolly tracks. The two front wheels are set in a fixed position, and the two rear wheels have an auto linkage steering mechanism for maneuverability. Two floor locks make the dolly rock steady for set shots, and the boom arm braces (not illustrated) prevent vibrations for extended dolly runs.—**Camera Mart, Inc., 1845 Broadway, New York 19, N. Y.**—TELE-TECH.

R-F Attenuator

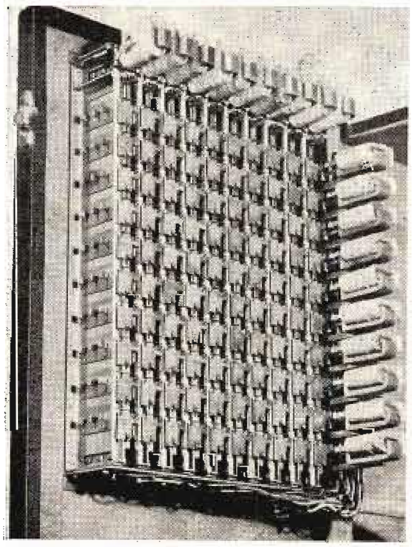
A versatile new r-f attenuator has been designed for 72-ohm input and output matching over the 0-250 MC range. It pro-



vides precise attenuation in any value from 0 to 82 db by a simple in and out switching arrangement. The attenuator is accurate within 1% at the maximum attenuation. The feed-through insertion loss is less than 0.5 db at 250 MC. Uses of this new Jerrold attenuator in TV-radio-electronic design and maintenance include its application as a standard to calibrate laboratory, bench and field test instruments. It is also useful to check the values of attenuator pads; to measure the gain of amplifiers, in conjunction with a signal generator and output meter; and to simulate line losses.—**Jerrold Electronics Corp., N.E. Cor. 26 & Dickinson Sts., Philadelphia, Pa.**—TELE-TECH.

Crossbar Switch

A new Crossbar switch features low cross-talk and low bridging capacitance allowing operation through the audio and video



ranges up to 10 MC. Ten three-wire horizontal circuits may be connected to ten vertical circuits in any combination by the operation of twenty magnets. The momentary operation of a horizontal magnet presets that horizontal level to make connection with any one or more vertical circuits until connection is made and held by the vertical magnets. Magnets operate on two watts at any required voltage up to 50 v. Contacts are twin palladium. Switch measures: 8 x 11 x 3½ in.—**A. W Vincent Co., 39 State St., Rochester 14, N. Y.**—TELE-TECH.

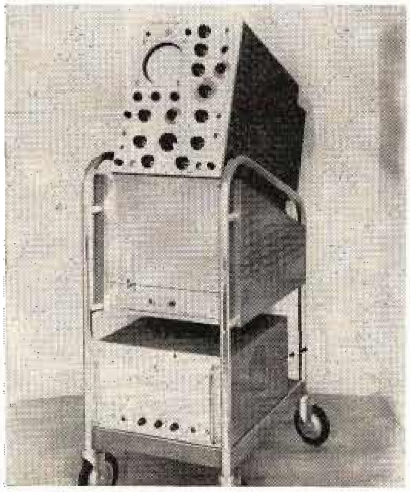
Capacitor

The "J-Cap" is a thin disk ceramic capacitor of unusual physical strength. Its dimensions are only 0.156 in. maximum thickness

and 0.594 in. maximum diameter. The combination of a completely fabricated high K ceramic body and the newly-developed coating material is claimed to impart great strength to the capacitor. The unit now in mass production is the 0.005 µf 500 v. unit. It will easily meet all requirements of the RTMA standards. It is rated as follows: Minimum capacity 0.005 µf working volts, 500 volts dc; test voltage, 1300 volts dc; leakage resistance, over 7500 megohms; power factor, less than 2.5%.—**Speer Carbon Co., Saint Marys, Pa.**—TELE-TECH.

Oscilloscope

Type 517 oscilloscope is a wide band high-voltage cathode-ray instrument designed primarily for the observation and photo-



graphic recording of very fast-rising waveforms having a low duty cycle. All critical voltages are electronically controlled to preserve the accuracy of the sweep and vertical amplitude calibrations. Fixed sweeps of 10 20. 50. 100 500 µsec/cm and 1, 2, 5, 10, 20 µsec/cm are provided, with a maximum displacement error of 2% for 8 cm sweep length. The amplitude calibrator provides continuously variable output voltages in six ranges, from 0.15v to 50v full scale, with an accuracy better than 4% of full scale. Distributed type vertical amplifiers provide a rise time of 0.007 µsec. with a maximum sensitivity of 0.1v/cm. Sufficient time delay is incorporated in the vertical amplifier to permit viewing the leading edge of the waveform that triggers the sweep. An accelerating potential of 24kv on a metallized cathode-ray tube permits photographic recording of single sweeps at the maximum writing-rate permitted by the vertical amplifier and sweep circuits. A continuously variable trigger-rate generator operating from 15 to 15,000 cps in three ranges, with an accuracy of 5% of full scale, is incorporated in the instrument.—**Tektronix, Inc., P. O. Box 831, Portland 7, Oregon.**—TELE-TECH.

WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

TV ALLOCATIONS COMPLETED—Nearly 500 new television-station applications will be readied for FCC authorization with the sanction in February by the Commission of its VHF-UHF allocations assignment plan which will give the green light to the "thawing" of the three-and-a-half-year-old television freeze. Approximately 350 of the TV station construction permit applications which await channel assignment through the allocations plan were in the original filings at the time that the FCC imposed its "freeze" in September, 1948, and there are only approximately 30 applications for UHF television assignments. After the allocation plan has been finally approved by the FCC during this month (February) which will mean the lifting of the "freeze," processing of the station applications will be commenced by the FCC staff after a period of probably 60 days has elapsed for the filing of new applications and revision of old applications already submitted to the Commission. FCC Chairman Wayne Coy has streamlined the processing methods down to the barest essentials.

NO PLANES DELAYED—An Air Force source told TELE-TECH that *no* U.S. Air Force airplanes are being deferred for acceptance from aircraft manufacturers for lack of electronic and radio apparatus and devices. Since electronic and radio devices are continually being improved, some combat planes may not have the latest equipments when they are delivered to the Air Force, it was agreed, but all completed planes, some 5,000 in 1951, had adequate electronic-radio installations. The backlog of electronic devices at aircraft manufacturing plants, now a three weeks to two months supply, is slated to be improved to the aircraft industry's desired backlog of from six to eight months during 1952's increased tempo of military electronic-radio production.

RADIO EMERGENCY PLAN—Broadcasting and television stations have long been recognized by the military and civil defense authorities as most important elements in advising and warning the civilian population in case of enemy bombing attacks and the Federal Civil Defense Administration in collaboration with the state and municipal civil defense agencies, but the U.S. Air Defense Continental Command as during World War II felt radiobroadcast stations and other radio transmitters had to be silenced in event of any enemy airplane attack to prevent their use for "homing" navigational aids, which resulted in the recent Congressional statute for such an emergency. Nevertheless the value of broadcasting and television is so important to the nation's governmental and military leadership that the executive order of President Truman on the machinery to put the stations under emergency operation blueprinted the Conelrad formula under which stations will notify their listeners to tune their receivers to two specified frequencies during an attack. The "payoff" recognition by the President and the governmental leadership was the requirement that stations will be allowed to resume normal operations after the emergency has ceased.

NEW MOTION PICTURE TV DIRECTOR—Theatre television will be the next "piece de resistance" of the FCC with the hearings' starting date of Feb. 25 likely to be postponed for a month later or even longer. The motion picture industry is striving to obtain exclusive frequencies for their TV service and not to share their spectrum space with the industrial mobile radio services because of the threat of interference. New figure in motion picture television, Edward Cooper, who has been since 1939 the communications-broadcasting-television staff expert with the Senate Interstate and Foreign Commerce Committee became at the beginning of this year Television Director of the Motion Picture Association. Mr. Cooper's views because of his lengthy experience in a major role in the formulation of Congressional aims and policies on television will carry weight with the FCC and other governmental agencies which are engaged in TV matters.

RADIO IN CIVIL DEFENSE—Valuable use of all mobile services and cities was blueprinted by the Federal Civil Defense Administration at a week-long conference at its staff college near Washington which was attended by more than 130 government and manufacturing and operating radio experts. A permanent advisory committee of approximately a dozen leading government and industry radio officials was formed to implement the program of usage of mobile radio services for civil defense emergencies. The radio services enrolled in the civil defense communications plan ranged from police and fire departments, power utilities, taxicabs, buses, telephone companies, highway departments and major radio manufacturing companies, including RCA, General Electric and Motorola.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington, Editor

Tube Reliability

(*Continued from page 44*)

failures. After shock, tubes are retested for "shorts," transconductance, vibration and heater-cathode leakage. The exact conditions and test procedure are described in the JAN-1A Specifications, paragraph F-6b (9e). Fig. 3 shows a picture of this machine with the hammer poised at a 48° angle[2].

The basic purpose of these shock tests, which are made on a lot sampling basis, is to provide insurance against mistakes or design deficiencies in different tube lots and to indicate variations in process such as poor quality welding. The shock intensities on typical specifications are rigid enough to constitute true destructive testing. It is unusual not to have several failures in a 100 tube sample. The JAN Specifications have suitable sampling tables which permit approximately 20% failures. For this reason, the maximum shock test ratings, such as 500 G, (this number is approximately 15 times the hammer angle under the shock test conditions) found at the top of the JAN Specifications, do not indicate that a reliable equipment can be designed to be subjected to repeated 500 G shocks without deterioration of tube characteristics. In addition, experience indicates it is almost impossible that any particular electronic equipment will have a tube mounting device such that the tube manufacturer's standardized shock test results will be exactly simulated.

One of the problems in the standardization of shock tests which is quite formidable is the apparently simple definition of short circuits. There were two basic questions; how low a resistance constitutes a short circuit, and how long should this low resistance exist during the application of the shock wave to constitute a short circuit? This was finally resolved into a definition that 50,000 ohms maximum and 100 microseconds minimum constitute a short circuit. One reason for the relatively long time constant was the necessity for the extensive cabling facilities to the short test indicating equipment. This results in shock test data which does not record an intermittent short, of a duration of a few microseconds, during the application of shock. In addition, so called "transient shorts" are not considered as official rejects on most JAN specifications although they are usually recorded on the shock test data. A "transient short" is defined as a short circuit during the application of shock which does not exist after the application of shock and cannot be made to indicate a short under subsequent tapping. Thus, the shock test specifications tolerate occasional short circuits which may exist for a few microseconds during shock. If there are any equipments which must function during the application of hundreds of G shock, and which would mal-function by the existence of a short circuit of a few microseconds, the problem will not be resolved by simply specifying tube types with JAN shock ratings. The existence of any equipments with this type of design requirement should be discussed with the cognizant Military Service Project Engineering Group, with the tube manufacturer, and with the Panel on Electron Tubes.

1. "Electron Tube Ratings at Very High Altitudes," R. J. Bibbero, TELE-TECH, May, 1951, p. 42.
2. "Shock Testing of Airborne Electronic Equipment"; Charles E. Crede, TELE-TECH, July, 1951, p. 36, August, 1951, p. 36.

Part Two will appear in March.

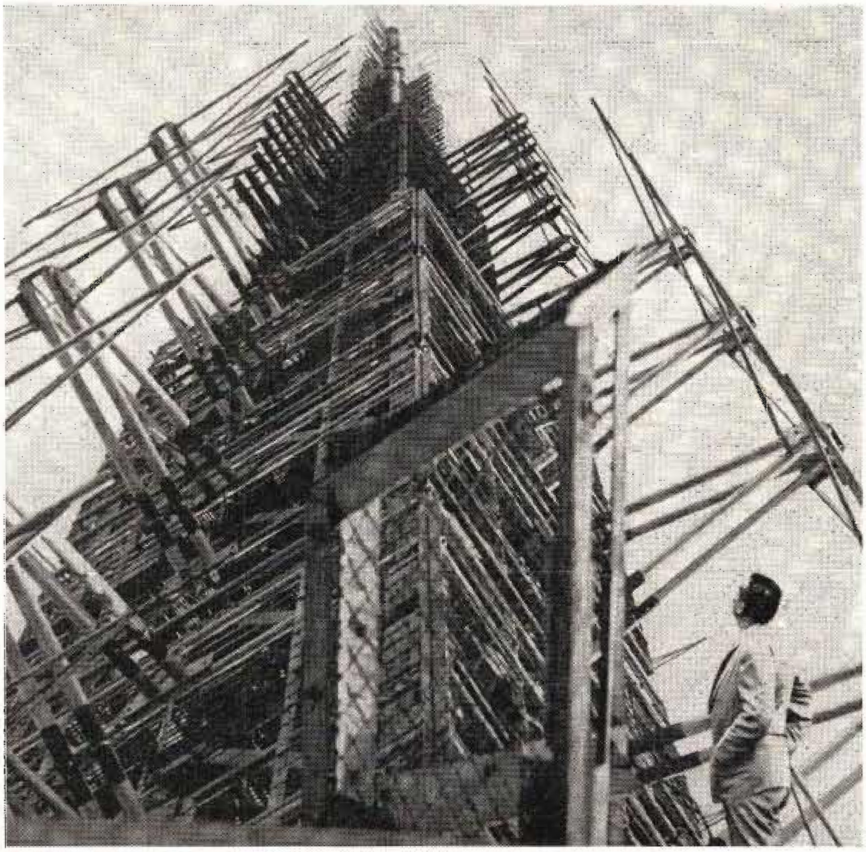
Enlarged Multi-Tron Facilities

Multi-Tron Laboratory, established four years ago, has moved to greatly enlarged quarters at 4624 W. Washington Blvd., Chicago, Ill., to fulfill the increased demand for research and manufacture of special purpose tubes, electron gun mounts, precision assemblies for vacuum tubes, and tool and die units. The company, headed by Mr. Nicholas D. Glyptis, is credited with the development of an ion filter using coaxial electric and magnetic fields and an ionization gauge of the continuous degassing type.

Thordarson Manual Lists 50,000 Transformer Designs

Over 50,000 transformer designs are included in the cross-indexed book being published by the Thordarson Mfg. Div. of Mt. Carmel, Ill. This reference work covers virtually the entire field of filters, chokes and transformers, and makes available to the engineer, the field-proven designs accumulated during 56 years of work. In addition to providing manufacturers with a wealth of practical transformer information, this material provides Thordarson's engineering department with an effective method of handling quotations by finding the existing design and specifications most nearly resembling the new job, and making the modifications required by the customer's particular needs.

13 TRANSMITTERS OPERATING ATOP EMPIRE STATE



Dr. Frank Kear inspects the Empire State TV antenna tower which was completed at a cost of $875,-000 and has 13 transmitters including five TV picture, five TV sound and three FM, simultaneously radiating signals from the 222 ft. structure. The 60 ton tapered tower is eight ft. square at the base, has 116 radiating elements, is fed by more than 60 pipes and coaxial lines, can withstand wind velocity of 150 mph, has an automatic de-icing system and intercom arrangement between stations. An estimated audience of 17 million people within a radius of 70 miles are serviced by the project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TV Photography

(*Continued from page* 49)

sive and the low key scene will exhibit a saturation of highlight gradations. It is possible to assume a reference level at blanking pulse tips, detect the departure of the ac axis therefrom, and inject a compensating bias. Positive dc insertion at the kinescope grid can accomplish this process and hold all signals with blanking at visual cut-off (or wherever else the bias may be set). Fig. 4 illustrates this condition for ideal operation. When it is desirable to photograph an electrically reversed image resulting in a direct film positive, the photomonitor should also cause the dc insertion polarity to be properly applied, and inject a reversed blanking to mask the retrace lines.

Two methods of photographic recording present themselves at this time. One is a series of single frame stills and the other is cinematography. Any integral inumber of television frames may provide the exposure for one film frame; however, a unity frame ratio minimizes action blurring. Thus, at the start of one frame the mechanical shutter is caused to open or a high kinescope bias is removed. The shutter is closed or the kinescope extinguished after one complete scan, and the film is advanced for subsequent exposures. By utilizing the actuating pulses of the TV system to control exposure time, guarantee is made of an exact integral TV-film frame ratio. Exposure may be started during any position of the scanning beam, as long as its duration is an integral multiple of scanning frame time. Pulsed operation of the kinescope presents the added complication of focus and beam current adjustment. The latter may be calibrated against degrees rotation of the bias and video gain controls for a 50% axis picture. Focus should be made before pulsed operation begins.

Cinematography of the kinescope image must resolve the difference in film and TV frame rates. The frame ratio between 40 sequential TV and 24 film is 5:3. If the exposure ratio is unity with 2/3 frame interval ($2/3 - 1/40 = 1/60$ sec) allowed for pulldown, then the 5:3 fraction is maintained (see Fig. 5). The pulldown interval calls for a 144° shutter, twice that of the commercial requirement. Thus it is a simple matter to utilize existing equipment with minor modification. A higher exposure duty cycle may be ob-

(*Continued on page* 66)

tained if the film travels at 16 frames per second. Now the frame ratio is 5:2, and two TV frames may be exposed to each film frame with a half-frame (1/80 sec) allowed for pulldown. The shutter here is 72° corresponding to that of available transcriber cameras. A simple gear modification can reduce the 24 frame standard to 16 frames.

A possible objection to the 16 frame rate may be the extent of action blur introduced by exposing two television frames to one film frame. Consider an airplane in level flight at 600 mph at an altitude of 1000 ft. It is equipped with an image orthicon camera provided with a 1 in. lens and scanning 350 lines/frame. If the aspect ratio is 3 x 4 on a 1.6 in. diagonal, then the height of the image in the direction of flight is 0.96 in. During one frame interval (1/40 sec) a given point on the ground will advance 7.3 television lines. In one second this same point will have advanced 292 lines or nearly out of the picture. Even with attempts made to immobilize the optical image it may be necessary to expose film at 24 frames, although immobility of only a few lines duration will considerably help eliminate skip motion.

A serious loss of detail may ensue as a result of motion between recording camera and kinescope. All possible care must be taken to provide optical stability. Adequate shielding and isolation of deflection circuits will prevent spot deflection modulation. The use of 35 mm film of highest available resolving power is advisable.

Federal to Install PTM System in Pacific Northwest

The Bonneville Power Administration, which is operating one of the world's largest microwave communication system for a power utility, has contracted for an additional pulse-time-modulation microwave link to connect its John D. Ross sub-station in Washington with a similar station in Goshen, Oregon—a distance of 128 miles.

As in the initial installation, which was placed in operation during October 1950, equipment for the new link will be manufactured by Federal Telephone and Radio Corp., Clifton, N. J. Employing 14 channels of the 23 for which the installation may be equipped, the new Federal PTM system will provide facilities for telemetering, supervisory control, VHF mobile radio, and telephone communication. Provision is also made for the installation at a later date of a unique fault-location device that not only detects power-line faults automatically but records the date, time and location of each fault to within 500 feet.

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CUES for BROADCASTERS

(*Continued from page 43*)

sult of the experiences, Guy gave assurance that UHF transmitting plants will be reliable, stable and economical to build and operate, comparable with VHF stations, and that adequate technical information is now available with which to proceed with their planning, construction and operation.

Time Delay System for Network Programs

EDGAR T. CARTER, Studio Engineer, KUJ, Walla Walla, Wash.

EVERY station owner has undoubtedly wished that he could delay a program for a half minute, so he could sell a juicy one-minute spot announcement in the regular half minute station break time. With the device described below this can be done—provided there is a local production at the end of the network program from whence the lost half minute can be recaptured!

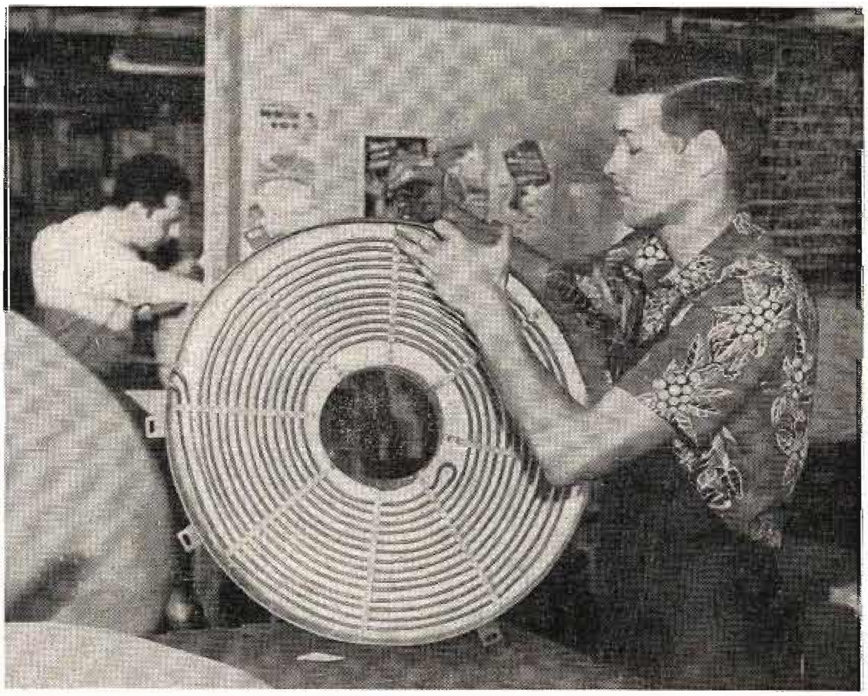
When recording at 7½ in. per second, 18 ft. 9 in. of tape will account for 30 seconds of recording or playing time. If one can record this amount of tape and then commence the playback, a delay of 30 seconds can be introduced in any program.

As currently used, the tape is guided around idler wheels attached to the side of the rack; from the recording machine to the top idler; down to the bottom idler; up to the top of the rack again; down half way; and thence over an empty reel and to the record-playback head of the second machine where it is played back. The tape is taken up on the take-up reel of the original machine.

The idler wheels are merely reels on which "leader and timing" tape are supplied, mounted on suitable spindles so they do not run too freely. There is little friction in the idler system. Improvements are obvious: well machined idlers; a few more of them, perhaps, to steady the tape; and a separate playback head to avoid involving the second recorder. But the scheme works as is!

The next step, which is quite feasible, but perhaps unethical, is to devise an arrangement which will speed up the playback a wee mite and take up all the 18 ft. 9 in. of slack during the half hour program period.

TO FREE ANTENNA REFLECTORS OF ICE



The problem of keeping TV and microwave antenna reflectors ice-free in the dead of winter has been solved by Workshop Associates, a division of the Gabriel Co., in Needham Heights, Mass., which mounts GE Calrod tubular heaters on the rear of the reflectors, quickly turning ice and snow into water which is drawn off through drain holes on the reflector surface. The Calrod heaters, rated between 500 and 2000 watts—depending upon location and weather conditions—are first assembled and placed in a false back where they rest on asbestos pads. These false backs, containing two 126-inch lengths of Calrod, are then mounted on the back of the reflectors.

Inductor Design

(*Continued from page 52*)

result, in the English-system of units, is:

$$D_h = 148 \frac{b}{\mu_r^2} \frac{E_{rms}}{N A_c f} 10^{14} \ldots(\text{in.})\ldots \quad (18)$$

It should be noted that this factor "b" is not equal to the hysteresis constant "a" furnished by Western Electric for their molybdenum permalloy cores. It can be shown that:

$$b = (3/8)\ \mu^3_r\ \alpha \times 10^{-10}$$

Since it is not practical to use the equation for D_h in a form independent of coil inductance, it is best to express it in terms as simple as possible and derive a different expression for each core that is to be used. The values for particular coils can then be substituted into this expression as needed. For instance, for the four cores which have been mentioned, the following expressions can be derived from Equation 9 by substitution of the appropriate hysteresis constants, core areas, and permeabilities:

Core A $\mu = 125$ $D_h = (633\ E_{rms})\ /Nf$
Core B $\mu = 60$ $D_h = (956\ E_{rms})\ /Nf$
Core C $\mu = 26$ $D_h = (885\ E_{rms})\ /Nf$
Core D $\mu = 14$ $D_h = (789\ E_{rms})\ /Nf$

(The reason why the constant first gets larger and then smaller is that core A is a different size from the others.)

Using Equations

Equations of this type can be used in two ways. First they can be used to express the voltage limitation on any given coil—that is, to specify the maximum voltage which can be used across the coil without lowering its Q appreciably. Or alternatively, if a certain voltage must be used across the coil, the equations can be used to specify the increase in the dissipation factor which will be suffered as a result.

For instance, for the 1.3 henry coil that has been used as an example, use of equation for Core A will show that if the voltage is held to 6.1 volts or less, there will be no more than a 10% increase in dissipation factor by hysteresis losses anywhere in the useful frequency range. Or, if the coil is to be used only at the specified frequency of 6 KC, the voltage may be allowed to go to 15.5 volts.

In order to verify the relations which have been derived, a series of very careful measurements of hysteresis dissipation factor was made for the sample 1.3 henry coil, and

(*Continued on page 73*)

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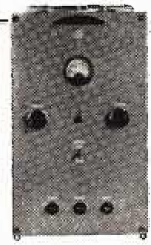

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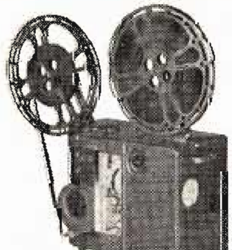

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TV Camera Chains • TV Film Chains • TV Field and Studio Equipment • Theatre TV Equipment the results compared with values predicted from equation for Core A. Fig. 9 shows this comparison. It will be noted that there is a slight drooping away from a linear relation for the higher voltage values. This is where the law of flux variation of Rayleigh,[4, 5] which has been assumed here, begins to break down, and the variation begins to tend toward that predicted by Steinmetz[6] for high flux densities. This merely means that when the equation for Core A is used to predict the increase in dissipation factor for relatively high terminal voltages, the results will be somewhat pessimistic, but this is in general not at all serious. (It should also be noted that this condition of a relatively low frequency of operation and a small number of turns is very nearly the worst possible case from the standpoint of hysteresis losses.)

The dielectric loss in the electric field set up by the coil is one of the most troublesome of all coil losses. It has one of the most serious effects upon coil performance; it is one of the most difficult to eliminate in an actual coil; and it is probably the most difficult of all to handle analytically. These computational difficulties are so serious, that in the usual method of coil design, the assumption is almost always made that the distributed capacitance of the coil is negligible—not because it usually is, but because there is no simple way to calculate the value of the equivalent series resistance to represent the loss.

With the present method of coil design, however, this loss is quite readily handled by a combination empirical and graphical procedure. It is apparent from Equation 7 that the dissipation factor D_{cap} will be directly proportional to the square of the frequency (since D_0 and f_0 will be constants for any given coil). Therefore the plot of dissipation factor versus frequency on a log-log plot will be a straight line of slope 2, as indicated in Fig. 10. But now the sum of this dissipation factor and those of the other two most important losses in the coil will no longer be the smooth symmetrical curve which was shown in Fig. 4. Rather it will be a seriously asymmetrical one such as the sum curve of Fig. 10.

The important thing to note from this figure is that for every particular relative positioning of D_e, D_c and D_{cap}, there will be a completely unique shape for the total dissipation factor curve. If any of these curves moves relative to the others,

(Continued on page 74)

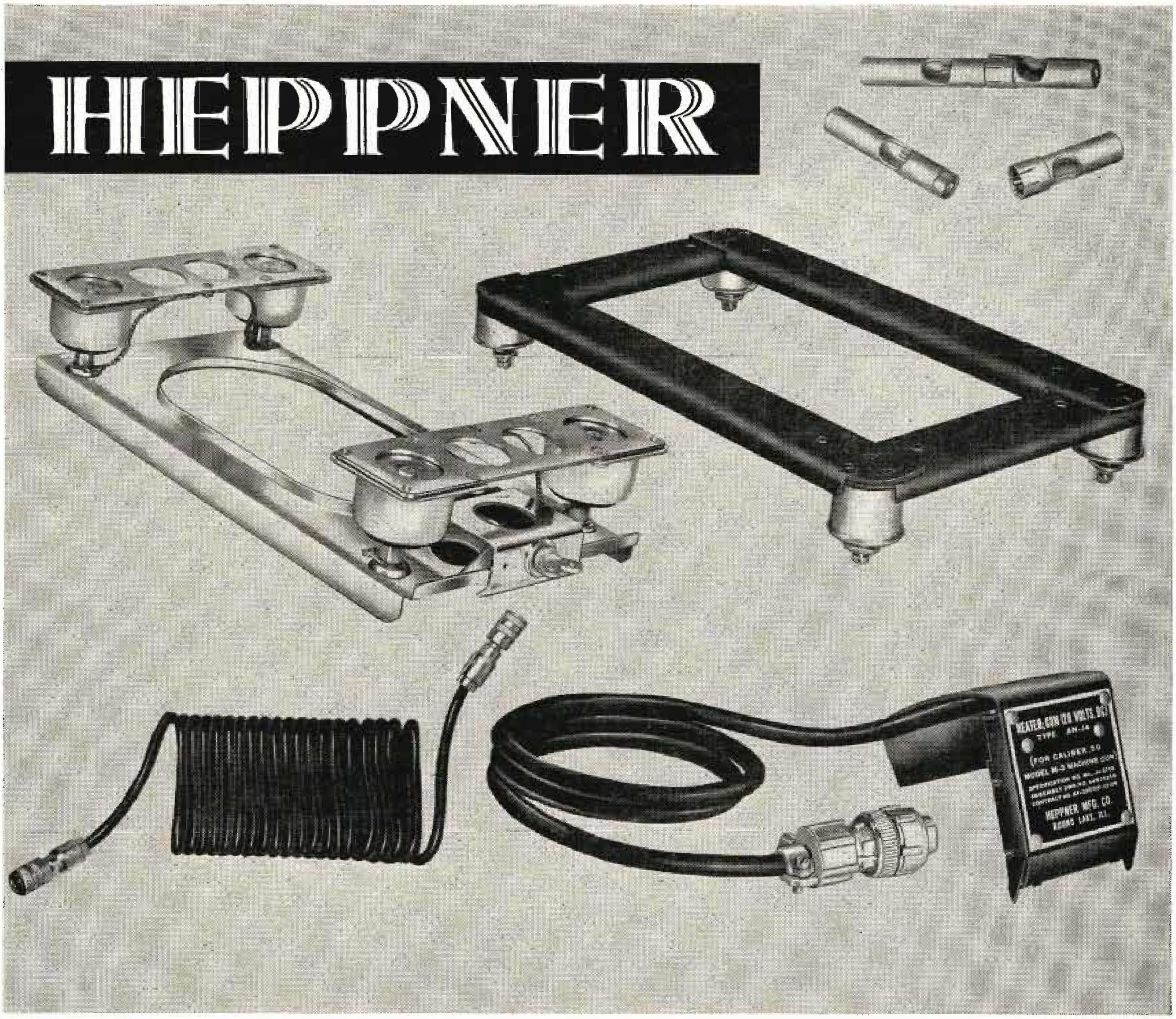
an entirely different shape will be obtained for the sum curve. Further, the converse is also true. For each possible total dissipation factor curve there will be one and only one possible relative positioning of the three component curves.

This fact, of course, immediately suggests the construction of a template of possible curve shapes, together with the component lines which are summed up in each. Such a template is shown in Fig. 11. The two 45° lines represent the D_c and D_e curves intersecting at some arbitrary position. A whole family of D_{cap} lines was then drawn in at varying relative positions to the two original lines, and the sum of the three was found in each case, thus yielding the family of curves that is shown. By use of this template it is thus possible to separate the three component curves given any experimentally determined sum curve. The template is merely placed over the experimental plot and the particular one of the family of sum curves which best fits it is found. The component dissipation factor lines are then readily drawn in.

It is now evident, however, that the simplified picture used for selection of the proper core in the beginning of this discussion and involving a family of smooth, symmetrical curves distributed along the frequency axis, must be modified a bit. There will actually be an infinite number of different possible curves for each core, corresponding to the different inductances which can be wound upon it.

What is actually done is to plot two curves for each core, representing the two extremes of all the possible curves for coils upon that core —one corresponding to the maximum inductance which can be wound (finest possible wire), and the other to the minimum inductance possible (largest wire the machine will handle). A plot similar to Fig. 4 is still used for selection of the proper core, but there are two curves shown for each core. The particular two which would be shown for the core A, for example, are shown in Fig. 12.

Plotting of these two curves for each core is not sufficient, however, for there would still be a possibility of ambiguity in the selection of the core, and the predicted results would be rather vague. For instance, for the particular 1.3 henry, 6 KC coil which has been used as an example, it is not at all obvious just how near the final dissipation factor would be to the relatively good value represented by the 343 millihenry coil and



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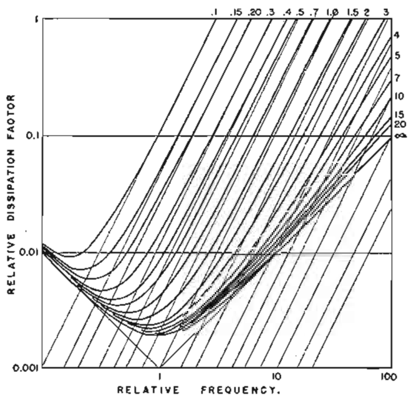


Fig. 11: Template of sum dissipation curves for separation of capacitance losses

how near to the rather poorer one when the inductance rises to 5.79 henries.

Fortunately a simple method of interpolation is possible using this same distributed capacitance template. It can be seen from an examination of Equation 7 and Fig. 10 that the position along the horizontal scale of the D_{cap} line will be proportional to the resonant frequency of the coil f_o. That is, doubling the resonant frequency of a coil will displace the D_{cap} line to the right an amount corresponding to a 2 to 1 increment along the horizontal frequency scale. Halving the resonant frequency would move it the same amount to the left, etc. Therefore, while the template is kept perfectly general, and the absolute resonant frequency is not specified for any of the curves on it, one is justified in choosing an arbitrary one of the curves as a reference and labeling all of the other curves in terms of the ratio of the corresponding resonant frequencies to the reference. See Fig. 11.

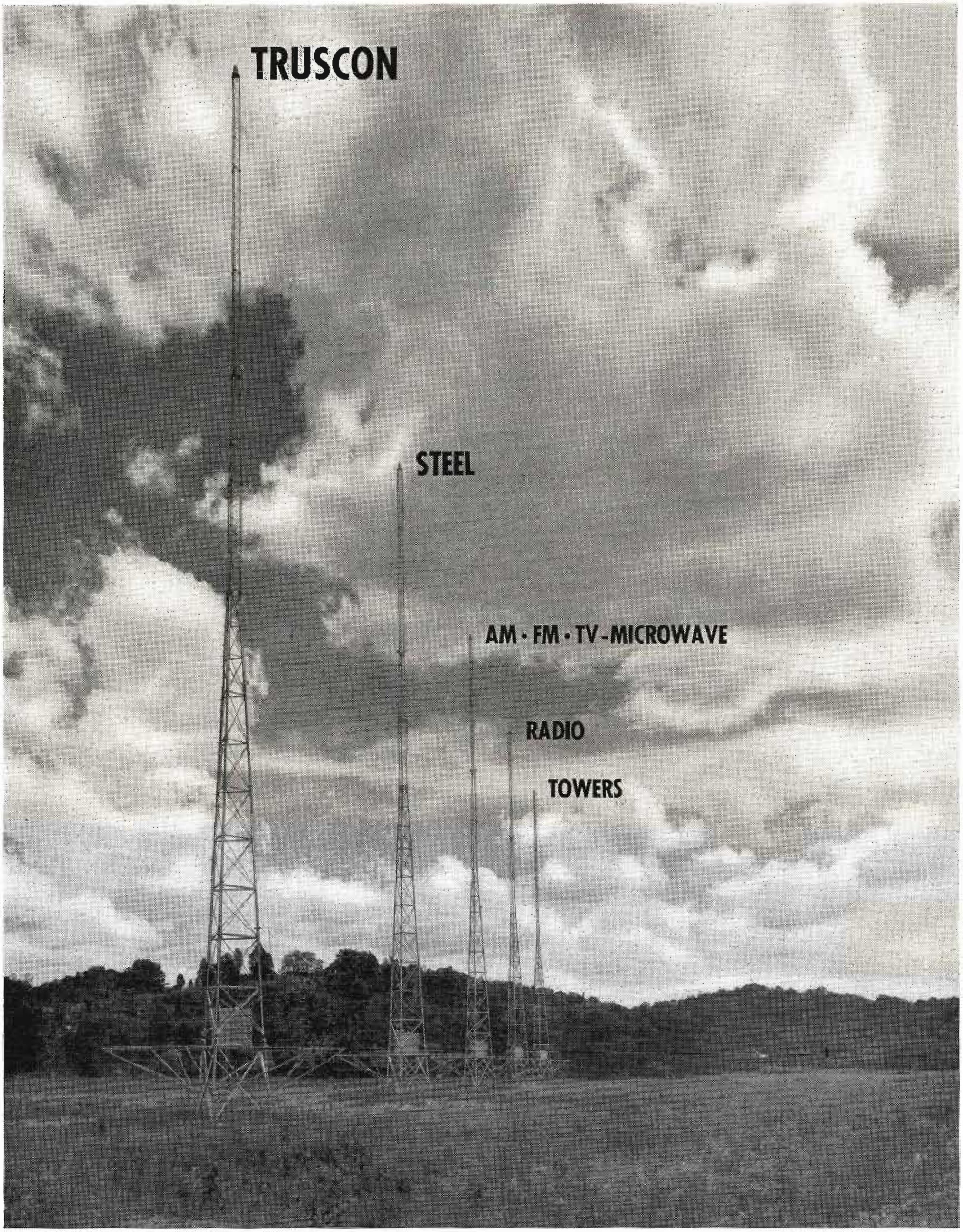
Now consider the expression for the resonant frequency of the coil:

$$f_o = 1/a\pi\sqrt{LC_d}$$

It is an experimental fact that the distributed capacitance of all coils wound on the same core (with the same type winding of course) is approximately the same. Physical reasoning shows that this result is reasonable since a decreased wire size means less capacity per turn but it also means that there are more turns.

But if distributed capacitance is assumed to be constant for all coils wound on a given core, the resonant frequency equation shows that the resonant frequency will be inversely proportional to the square root of the inductance of the coil. The position of the D_{cap} line will then also be inversely proportional to the

(Continued on page 78)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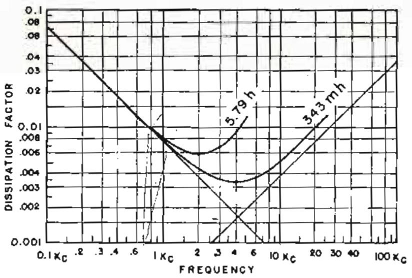

Fig. 12: Design curves of minimum and maximum inductance for core A, $\mu = 125$

square root of the inductance, on the arbitrary scale which has been set up. For instance, if one particular coil on a given core has a dissipation factor of shape identical to the curve marked 1.0 on the distributed capacitance template, a coil on that same core which has one-ninth the inductances should have a shape corresponding to the curve marked 3.0 on the template. Interpolation for the exact value of distributed capacitance loss thus becomes a relatively simple matter of matching curves and considering the ratio of inductances.

To see how this works out, consider the case of the 1.3 henry sample coil wound on core A. If the distributed capacitance template of Fig. 11 is placed over the total dissipation factor plots for core A, shown in Fig. 12, it will be found that the plot for the 5.79 henry coil on this core corresponds almost exactly in shape to the curve marked 0.5 on the template. But the desired inductance is smaller than the 5.79 henries by a factor of 4.45, so the resonant frequency should be higher by a factor of $\sqrt{4.45}$, or approximately 2.1. In other words, the final predicted dissipation curve for a 1.3 henry coil on this core should lie at a position of about 1.05, between the lines marked 1.0 and 1.5 on the arbitrary scale used.

Fig. 13 shows the final, measured value of the dissipation factor for the sample coil of 1.3 henries constructed according to the specifications laid down in this development.

It should now be obvious, incidentally, why it is that this distributed capacitance loss can be thought of as a limitation on the inductance of a coil. For from either Fig. 11 or Fig. 12, it is apparent that both the value of the maximum Q and the frequency at which it occurs will decrease as the inductance of the coil is increased. For a given core, therefore, there will be a maximum inductance for which any given Q and frequency range can be obtained.

As seen from Table I, the dissipa-

(*Continued on page* 80)

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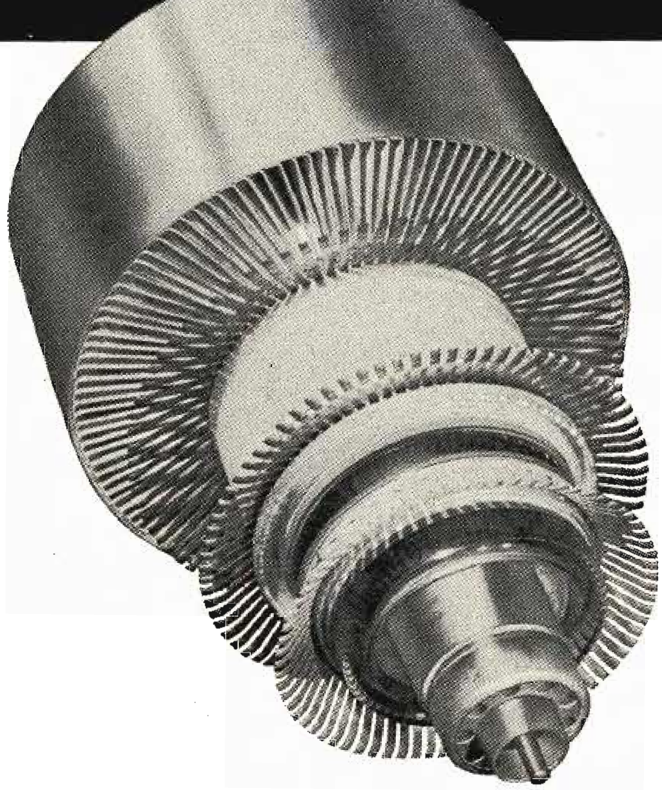

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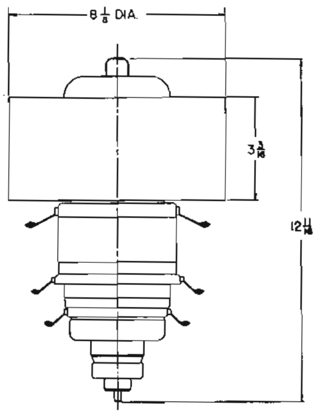

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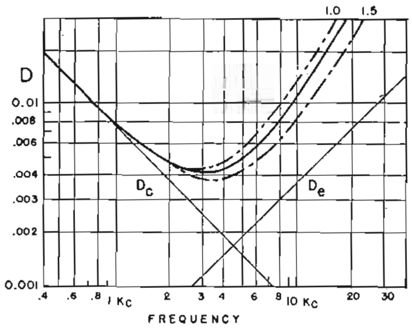

Fig. 13: Final predicted dissipation curve for 1.3 h coil on core A, Q max=250

tion factor due to residual loss is simply a constant of the core and is independent of all core and coil dimensions. Since it cannot be controlled, it enters into the design procedure only as a guide in the selection of core material. It should be noted that no coil, however well designed, can ever have a dissipation factor less than the residual loss dissipation factor, so it is important that the type of material used should have a residual negligible with respect to the net dissipation factors which are expected. For the particular case of molybdenum permalloy, this dissipation factor loss was so small that it did not enter into the design at all.

The reader should by now have begun to realize the tremendous simplification offered by the proposed design procedure over the conventional approach. With the usual methods a different value of each equivalent loss resistance is obtained for each coil wound upon a given core, and even changing the operating conditions of a given core coil will necessitate recalculation. For this procedure, however, it has been seen that the copper loss, the eddy current loss in the iron, the eddy current loss in the copper, the hysteresis loss, and the residual loss all lead to expressions which are identical for all coils on the same core. In fact two of these losses—the eddy currents in the iron and the residual loss—are constant for all coils using a given core material. Furthermore, the design procedure deals largely with charts, which are not only easier to handle than analytical expressions, but also show the manner in which all component losses, as well as the total loss, change with the independent variable.

For instance, the table in Figure 13 illustrates the design data which has been obtained for the 1.3 henry coil used as an example. It will be recalled that every one of these design requirements was obtained at

(*Continued on page 82*)

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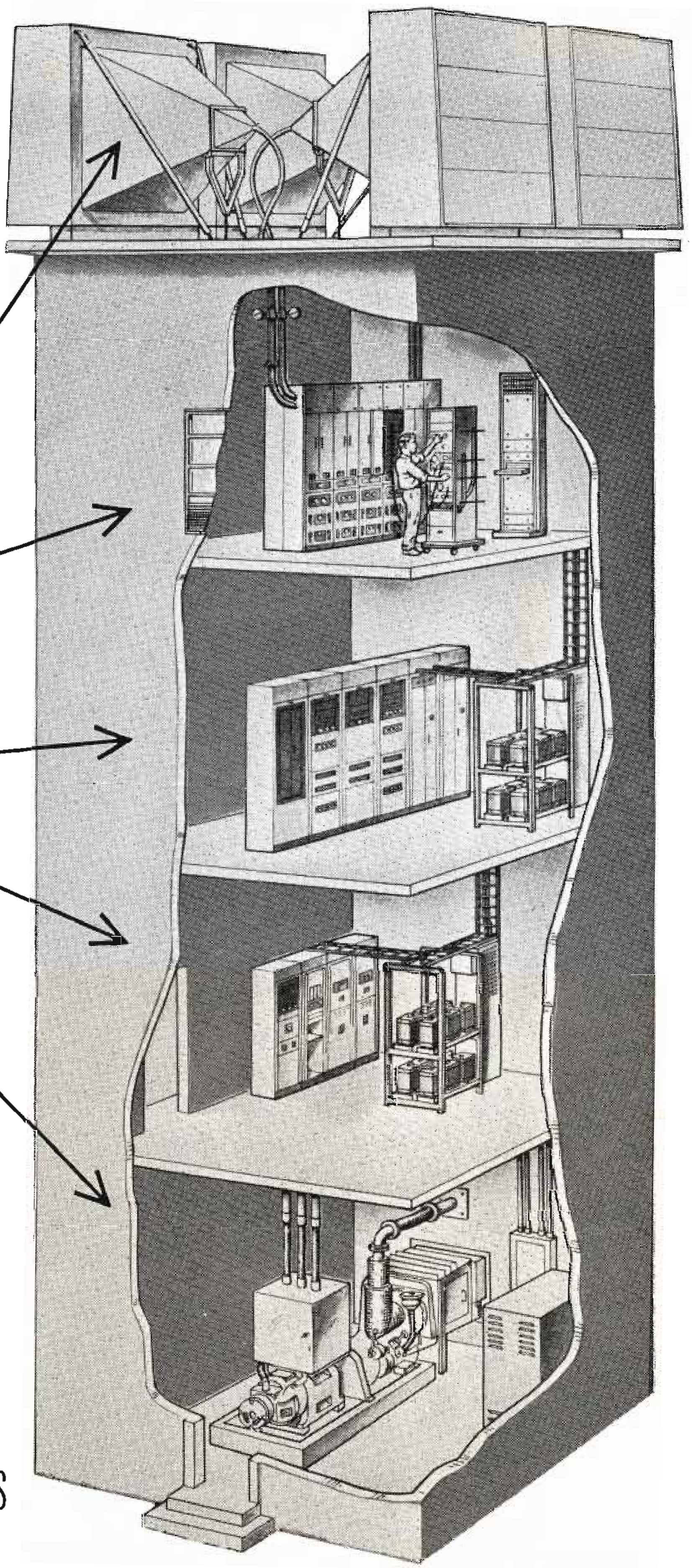

ON THE ROOF are the lens antennas, each with its horn tapering into a waveguide which leads down to equipment

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a glance either from a table or a graph, with the exception of the distributed capacitance, which involved taking a square root of the ratio of two inductances, plus some simple manipulations with a template. Furthermore, these design charts and tables are easily constructed once the procedure has been established. It is only necessary to wind two coils for each core to be used, one of maximum inductance and the other of minimum inductance. (Actually only the maximum inductance is absolutely necessary though the use of two provides a check.)

It should again be emphasized that the design concepts being advanced here are by no means limited to the design of toroidal coils. Fundamentally this paper is a new approach to the entire general problem of coil losses. For instance, the procedure is very useful in rapid determination of the applicability of a new core material, whether it is to be in toroids or in any other shape. By making a few simple measurements on a sample coil, varying the appropriate quantities, it is a simple matter to separate the losses and assess quantitatively from a few minutes' work the applicability of a given core material for any given applications.

By a combination of graphical manipulation and physical reasoning based on a few simple concepts, much arduous algebraic manipulation can be avoided, and a clearer understanding of physical phenomena involved in any inductor problem can be obtained.

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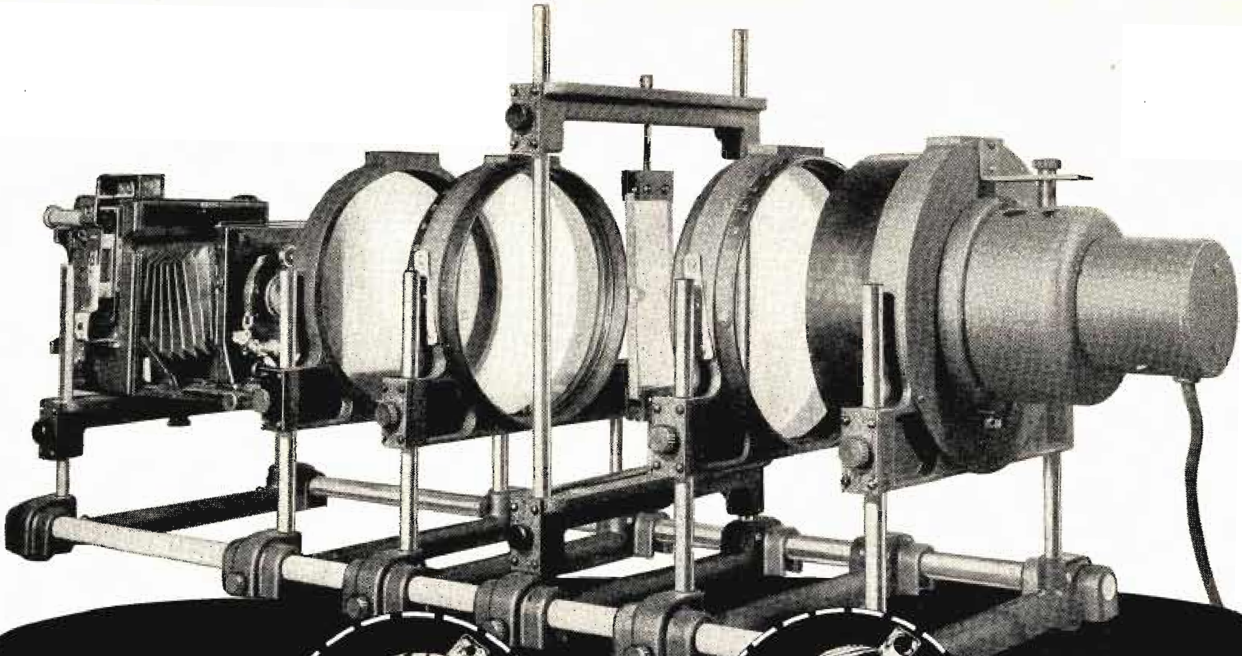
This work is abstracted from a thesis submitted to the Department of Electrical Engineering at the Massachusetts Institute of Technology in partial completion of the Master of Science degree. It was made possible through support extended to the Research Laboratory of Electronics at M.I.T. by the U. S. Navy Bureau of Ordnance contract Nord-9661.

The author is indebted to Mr. R. F. Field for supplying the data on air core toroids from which this determination was made. Mr. Field, also, seems to have been the first to construct a template of possible curve shapes.



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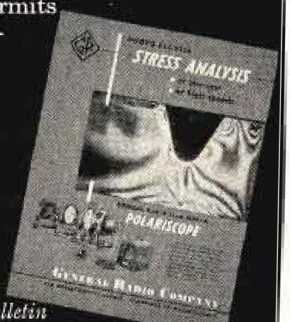

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(*Continued from page 37*)

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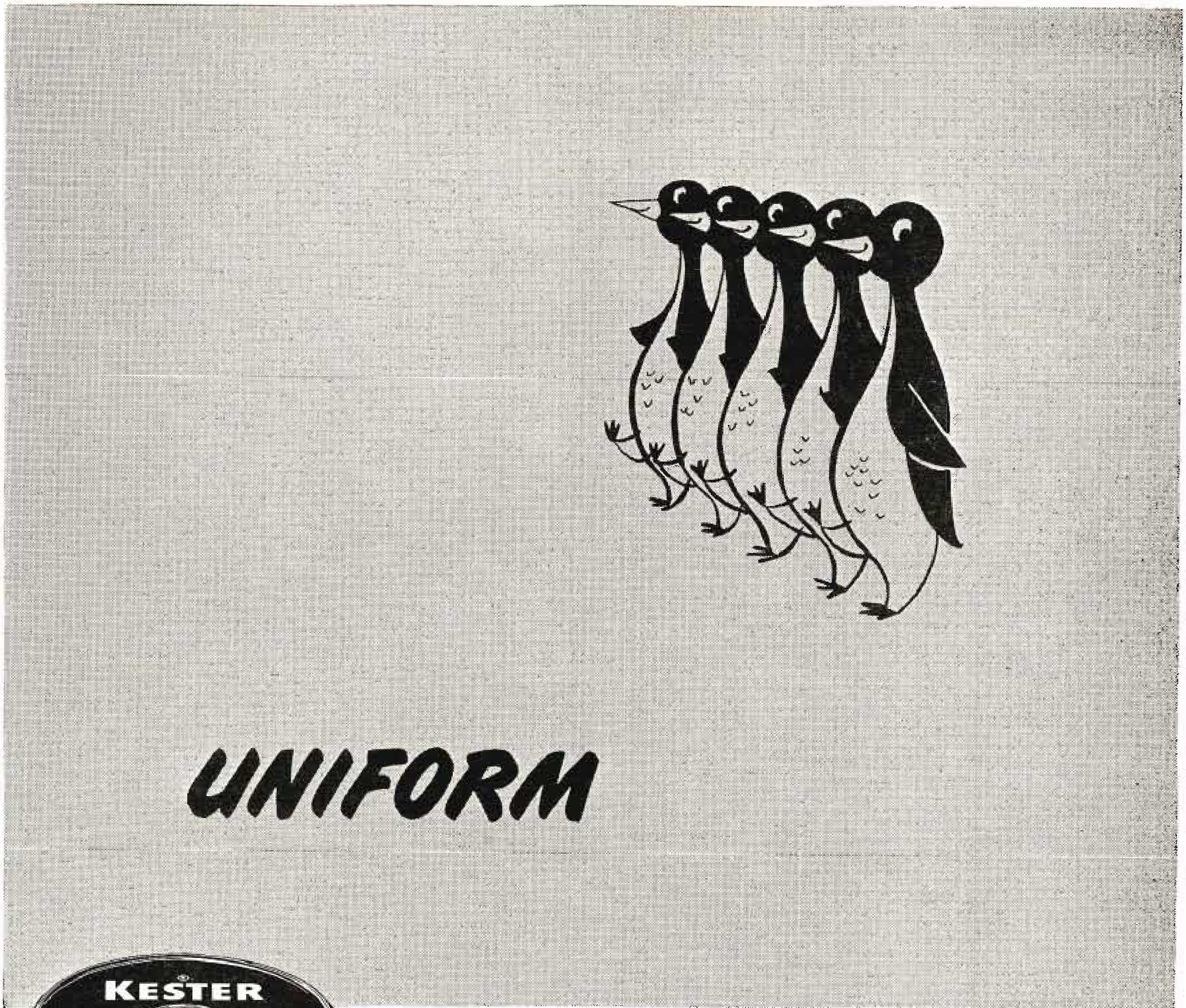
Connecting cable may be several hundred feet in length without appreciable high-frequency loss. The signal lead, plate voltage lead, and ground return lead are in one shielded cable. In a second four-conductor cable, filament voltage and ac power leads to the power switch in the pre-amplifier are carried from the main amplifier. Connections to both units are made with easily disconnected plugs.

Fig. (14) illustrates the construction of the pre-amplifier with case and control panel removed.

Terminal boards are not used, and except for a few tie-points, resistors and condensers are connected directly between elements to save space. All low level components, except those of the crossover selector circuit, are underneath the chassis where they are well shielded by the chassis and front panel. The case provides adequate shielding for the tubes and other parts.

All connectors can be seen in the bottom picture. They mount on a sheet metal bracket welded to the chassis. The cover plate over the bracket is not necessary for electrostatic shielding, but is used for protection from high voltages when changing tubes. The outside case, which is made of perforated metal, fits over the back of the amplifier with a cutout for the connectors. It is held in place with two screws to the connector bracket and four screws to the ends of the chassis.

On the front of the amplifier, the pilot lamp socket can be seen below the gain control shaft in the center of the chassis. The front panel with pilot lamp indicator and holes for control shafts mounts over the chassis and is held in place with the screws that fasten the case. Indicators for the controls are permanently marked by screen process on the panel, and the knobs are set to give correct indication during testing of each unit.



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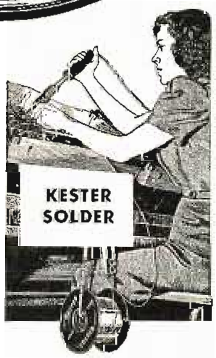

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Sweep Generator

(*Continued from page 40*)

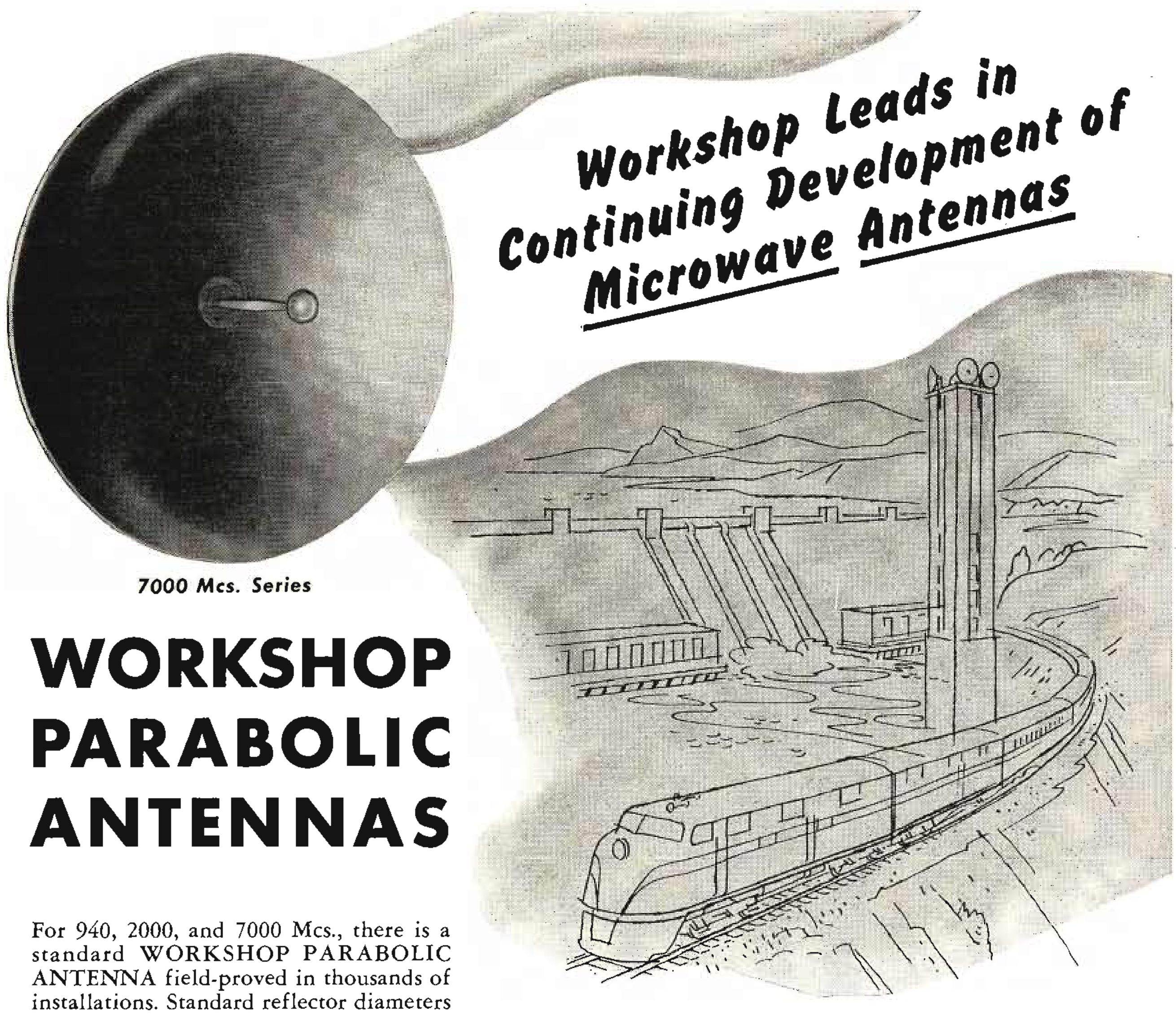
est frequency to its lowest frequency. Thus, zero output is obtained from the generator during this time, and a zero reference line on the oscilloscope trace is established. Since the FM takes place at a 60 cycle sine wave rate, the spot displacement of the oscilloscope will be a linear function of the oscillator output frequency when the oscilloscope sweep is a 60 cycle sine wave. A variable phase 60 cycle sweep source is incorporated in the instrument for use with oscilloscopes which do not provide this feature.

The marker oscillator is a duplicate of the sweep oscillator except that the marker contains no attenuator and is not frequency modulated. It has a hand calibrated dial which is accurate to within 0.25%. A sample of the marker oscillator output is combined with a sample of the sweep oscillator output in a type 1N72 UHF germanium diode, as shown in the block diagram of Fig. 8. The beat frequency is amplified by an audio amplifier of restricted bandwidth so that the amplifier has output only when the instantaneous frequency of the swept oscillator is within a few hundred cycles of the marker frequency. This audio frequency output is fed to a simple linear adder stage. Into this stage is also fed the demodulated output of the circuit under test when the input of the circuit is connected to the r-f output of the sweep oscillator. The output of the adder, which is a time varying voltage proportional to the amplitude-vs-frequency characteristic of the circuit under test, together with a superimposed marker pip, is brought out to terminals which are connected to the vertical amplifier of an oscilloscope.

The amplitude of the marker pip is controlled by means of a potentiometer in the beat amplifier; the amplitude of the response curve signal is controlled independently by means of another potentiometer which precedes the adder.

Since, with this method of marker injection, the marker signal does not appear in the circuit under test, only one connection is needed between the sweep generator and the input of the circuit. This arrangement not only simplifies connections but also eliminates the possibility of mismatch due to the marker being injected somewhere in the output cable or the input of the circuit. Moreover, the marker level cannot

(*Continued on page 88*)



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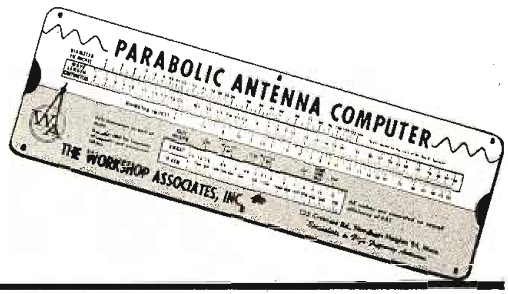

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affect the response curves of circuits such as mixers which may have a response that is a function of signal input level, nor can the marker beat with other signals to produce spurious pips on the response curve. The marker is always visible, even at frequencies at which the response of the circuit under test is zero.

To increase the accuracy with which the marker oscillator can be set, a crystal calibrator is included in the instrument. The calibrator consists of a 10 MC crystal oscillator, a 1 MC locked-in oscillator, and a harmonic generator to generate harmonics of 1 MC throughout the 470-890 MC band. A sample of the sweep oscillator output is mixed with the 1 MC harmonics in a second 1N72 UHF germanium diode. The beat frequencies are then amplified by a high sensitivity audio amplifier so that the amplifier has output when the sweep oscillator frequency sweeps through a harmonic of 1 MC. These audio beats are added to the beat produced by the variable marker oscillator, so that superimposed on the response curve are not only the marker pip but also a series of calibration pips. In use, the calibration pips are first reduced by means of a gain control in the calibration beat amplifier. The variable marker is then set, by means of its dial scale, to the harmonic of 10 MC nearest the frequency to be marked. Then the 10 MC calibration pips are turned up and the variable marker oscillator frequency is corrected, if necessary, so that its pip aligns exactly with the nearest 10 MC pip. The 1 MC locked-in oscillator is then turned on and the variable frequency oscillator is returned so that its pip is aligned with the desired 1 MC pip. After this adjustment the calibration pips can be turned off. In this way the marker can be set with crystal controlled accuracy to any harmonic of 1 MC within the 470-890 MC band. Frequencies which lie between harmonics of 1 MC may be obtained by interpolation. Thus, it is readily possible to set the marker to any frequency within the band to within 100 KC, or to any harmonic of 1 MC to within 0.005%.

To obtain 1 MC harmonics of relatively high amplitude throughout the 410-890 MC band, the output of the 1 MC locked-in oscillator stage is coupled through a series link circuit to the output circuits of the 10 MC crystal oscillator and the two tripler and doubler stages following the 10 MC oscillator. See Fig. 8. This link circuit couples energy at frequencies of 1, 10, 30, 90, and 180 MC to the 1N72 germanium diode. Across this diode will appear not only harmonics of each of these frequencies but also their modulation and cross-modulation products. The links are adjusted experimentally to give the most uniform distribution of 1 MC pips throughout the UHF band.

Large Flat-Face Cathode-Ray Tubes

In the article entitled "Large Flat-Face Cathode-Ray Tubes For Radar" appearing on pages 52, 53 and 94 in the December, 1951, issue of TELE-TECH, the author of the article was incorrectly designated as C. S. Szegho. Actually this article was authored jointly by Messrs. C. S. Szegho and R. G. Pohl of the Rauland Corporation, Chicago, Ill. The authors also gratefully acknowledge the interest of the U. S. Navy Electronics Laboratory at San Diego, Calif., in the possible use of such tubes which stimulated their work. They point out also that the following references may be of interest:

1. Cathode Ray Tube Displays, M.I.T. Radiation Laboratory Series, Vol. 22, p. 339, McGraw-Hill Book Co.
2. Machinery's Handbook, Industrial Press, 13th Ed. p. 414.

Defense Contracts

(*Continued from page* 33)

whose bid, conforming to the invitation for bids, will be most advantageous to the Government, price and other factors considered, provided that an award shall not be made to other than the lowest responsible bidder except in accordance with procedures prescribed by each respective department.

In many cases it has been found that from the time a bid quotation was submitted until receipt of an award costs have changed considerably. To protect himself, a bidder has the right to limit the time in which the Government may accept his offer.

Advertised Bids

Formal Advertising: Procurement of supplies and services in excess of one thousand dollars by competitive sealed bidding. This method requires that an invitation be issued by the procuring agency which fully describes the material or service to be procured. Specific methods of soliciting bids are established by regulation. Contracting Officers are required to solicit bonafide manufacturers or regular dealers and must permit sufficient time for the contractor to enable preparation of a bid. This method of procurement provides for the method of mailing of bid, display in public places, publishing in newspapers or trade journals, as well as setting requirements for methods of submission, modification or withdrawal of the bids. Other specific requirements established by regulation under formal advertising procedures include method of opening bids, recording of bids, rejection of bids, waivers of minor informalities or irregularities in bids, consideration of mistake in bids; information to bidders, and finally method of evaluating responsible bidder and the award to the lowest responsible bidder.

Government procurement officials must consider each of the foregoing requirements before making a decision. Failure to adhere to the requirements is a serious breach of regulations. It is recommended that all bidders become thoroughly familiar with the Armed Service Procurement Regulations.

Many bidders do not seem to exercise prerogatives when bidding under formal advertising procedures. A few examples are:

1—A bidder may request an extension of opening date of bids, if he cannot complete his bidding in time or if bid forms, specs. etc., are not available.

2—A bidder has a right to protest an award, if he believes that the solicitation was inequitable, or that his competitor was allowed an advantage or shown partiality.

3—Can request deletion of restrictive specifications in the invitations.

4—Can obtain clarification and revision of invitation description.

5—Can revise delivery schedules by submitting an alternate schedule.

Circumstances which permit negotiation are: national emergency; public exigency; purchases not in excess of $1,000; personal or professional services; services of educational institutions; purchases outside of the United States; medicines or medical supplies; supplies purchased for authorized resale; perishable subsistence supplies; supplies or services for which it is impracticable to secure competition by formal advertising; experimental, developmental, or research work; classified purchases; technical equipment requiring standardization and interchangeability of parts; technical or specialized supplies requiring substantial initial investment or extended period of preparation for manufacture; negotiation after advertising; purchases in the interest of national defense or industrial mobilization; otherwise

(*Continued on page* 90)

authorized by law; construction work.

Any military procuring agency can resort to negotiation when any of the above mentioned conditions exist.

An award may be protested several ways. The protesting bidder may (1) write directly to the Contracting Officer, stating the grievance and asking for a complete explanation of the actions taken. (2) The bidder can write directly to the Commanding Officer of the agency, and request the applicable facts. (3) The bidder may write directly to the chief of the technical service, e.g. Chief Signal Officer, etc. and request a review of the case. (4) Submit a request to his Congressman or Senator. (5) Write either to the Secretary of the Air Forces, Navy or Army or Defense for satisfaction. It is recommended that the first procedure be followed.

Activities of many buying departments have been established on such a basis that should a bidder submit a low bid and attach a letter qualifying his bid, an award cannot be made by the contracting officer unless some of the following actions are taken:

1. An engineer must review the bid to determine if it complies with the requirements.

2. A contract specialist or lawyer will check to see if exceptions are taken to the clauses or material.

3. An expert on finances will ask for information for the bidder to ascertain if he has the financial ability to perform.

4. An investigator will check the bidders' facilities and find out if he has the test equipment, space and facilities to manufacture.

When a few or all of the foregoing steps are taken, then the Contracting Officer may make an award if he has an acceptable recommendation, or he might submit the entire folder to an awards committee for more discussion and delay. As a result, it might take ninety days before a contract can be awarded. Whether or not the system has merit, this fact must be considered by the bidder attempting to do business with the military procuring agencies.

Low Bidding

Procuring agencies are charged with the responsibility of purchasing material for the government at the lowest expense to the nation. This does not mean that a low bidder will be awarded the contract in all cases. If a bidder does not have the technical ability, or lacks adequate finan-

(*Continued on page* 92)

cial resources, it would be to the government's detriment to make an award to a concern that could not deliver.

A low bidder must produce evidence of his financial ability and should be prepared to submit one or all of the following to the evaluating official or contracting officer:

1. The latest certified balance sheet and a profit and loss statement.
2. A flow chart showing how the bidder plans to employ funds on a monthly or weekly basis.
3. A letter from a bank, or reliable financing institution stating that the bidder enjoys a satisfactory credit line, and that credit would be extended for the contract in question.
4. A statement from the suppliers indicating that they would extend the necessary credit to enable completion of the contract, a list of all contracts to enable the evaluating official to determine the maximum working capital that will be required by the successful bidder based upon current backlog.
5. A personal guarantee.
6. A list of large dollar value contracts successfully completed.
7. A bid bond in those cases where the invitation specifies one is required.
8. Evidence of technical ability.

After a bidder has complied with the request of the evaluating agency, and has submitted all information regarding technical and financial ability, he may except a contract, if the results of investigation show his concern to be a reliable source. In some cases the bidder may be the lowest bidder, or even third or fifth low, in those instances where the lower bidders might have been disqualified due to their inability to prove financial or technical competence. Nevertheless, after a bidder has been investigated and receives a contract, regardless of if he were lowest or fifth lowest, he is legally obligated to produce under the contract, and must take every possible precaution to insure against default.

Should a bidder default in his contractual obligations, the government may terminate the contract and purchase against the contractor. If this is done, the contractor whose contract is terminated would be required to pay the difference between his bid and the next bid, should the government have to pay more for the material.

The government recognizes that a bidder, like any human being can make a mistake. Procurement regulations provide for mistakes in bid as follows:

1. MINOR INFORMALITIES OR

IRREGULARITIES IN BID: The contracting officer shall give to the bidder an opportunity to cure any deficiency resulting from a minor informality or irregularity in a bid. Examples: Inadvertent failure to furnish bid bond with bid; failure to affix corporate seal; failure to furnish required catalogs, cuts or descriptive data.

2. OBVIOUS OR APPARENT MISTAKES OF A CLERICAL NATURE: Any clerical or mistake obvious or apparent on the face of a bid may be corrected by the contracting officer. Examples: Obvious error in placing decimal point; obvious discount errors (1% 10 days, 2% 20 days, 5% 30 days), erroneous quotations of a lower price f.o.b. destination than f.o.b. factory.

3. MISTAKES OTHER THAN OBVIOUS OR APPARENT MISTAKES OF A CLERICAL NATURE: Any suspected or alleged mistake in bid other than the above, a contracting officer must obtain from the bidder, prior to award, either a verification of the bid or evidence in support of the mistake, whereupon the case shall be processed to the GAO, provided that:

If the bidder fails or refuses to furnish evidence in support of the mistake, the contracting officer shall consider the bid in the form submitted.

If a bidder furnishes evidence in support of a mistake, he must submit supporting evidence including work sheets, and other data used in preparing the bid, which set forth the complete facts on which the allegation of mistake is based. The bidder must also request definite relief as withdrawal of bid, change in bid price, etc.

EICO Buys Plant

To meet the constantly increasing demand for the complete line of its famous EICO test equipment Kits and Instruments, Electronic Instrument Co., has purchased a six story plant structure at 84-86 Withers St., Brooklyn 11, N.Y.

Video in Southern Hotels

Three Dallas, Texas hotel—the Adolphus, the Baker and the Stoneleigh—and the Barringer Hotel of Charlotte, N. C., have signed contracts with Master Video Systems, Inc., distributor of RCA hotel and multiple dwelling television systems, for the installation of complete, central television systems. The installation in the Baker Hotel embraces 588 television and radio units. Installations being made in the Adolphus and Stoneleigh hotels are for a minimum of 130 and 50 rooms respectively. The Barringer Hotel contract covers 100 rooms.

News of MANUFACTURERS' REPS

Gertsch Products, Inc., Los Angeles, has appointed three new factory representatives. Ronald G. Bowen, 852 Broadway, Denver 10, will cover Colorado, Wyoming and Utah. He also has an office in Salt Lake City. Harris-Hanson, 208 North 23rd St., St. Louis 3, Mo., will cover Missouri and Kansas: and G. Curtis Engel, 200 H. Ridgewood Ave., Ridgewood, N. J., will have Northern New Jersey and Southern New York state.

John B. Tubergen Co., Los Angeles, has been appointed Southern California representative for Mandex Manufacturing Co., Chicago, makers of plugs, sockets, connectors and other items for the electronic field.

D. M. Steward Corp., Chatanooga, Tenn., makers of steatites, ceramics, ferrites and barium titanates, has appointed the G. S. Marshall Co., Pasadena, Cal., to represent it in California, Arizona and New Mexico.

Helipot Corp., South Pasadena, Cal., has appointed the J. Y. Schoonmaker Co., 2011 Cedar Springs, Dallas, Texas, to represent it in Texas, Oklahoma, Arkansas and Louisiana.

Carl A. Stone Associates, with headquarters in Los Angeles has opened a Northern California Office in Palo Alto in the charge of Frank E. LaFetra, sales engineer. Mr. LaFetra is a graduate of Stanford University as an electrical engineer and before assuming charge of Carl A. Stone Associate's Office in Northern California was employed by Hewlett-Packard Co. of Palo Alto.

J. M. Cartwright & Son has been appointed Southern representative for The Workshop Associates, Division of The Gabriel Co. Mr. Smith, assisted by Mr. Everett Bean, will cover a territory including Tennessee and Mississippi.

JFD Manufacturing Co., Inc. of Brooklyn, New York has announced the appointment of The Millen, Durnin Agencies of Winnipeg, Canada as the sole and exclusive sales representative of its organization in western Canada. The Millen, Durnin Agencies will handle the complete JFD radio and television line, including antennas and accessories.

Burlingame Associates Expands Facilities

Burlingame Associates, 103 Lafayette St., New York, N. Y., widely known leading representatives for manufacturers of electronic equipment have leased an additional floor at the same address. Acquisition of this new space was necessary to provide for increased national promotional activities to further assist the manufacturer. The expansion program also comprises a fully equipped modern laboratory for product testing and servicing.

Suppressing L-O Radiation

(*Continued from page* 47)

crease the effective radiation surface.

e. Our present defense effort has made it necessary for the designer of civilian goods to conserve metals, especially the highly conductive ones which are most desirable for r-f shielding.

With the preceding facts in mind, the designer then proceeds to the task of selecting circuits and physical layouts to accomplish his ends. The following rather obvious points are listed so that it may be easier to follow a detailed discussion of each point. These are the general means for restricting the electromagnetic fields of the oscillator to the vicinity of the LO. Fig. 1 illustrates some of the following points:

a. The oscillator and mixer circuits must be enclosed in a conducting shield as completely as possible. Shield joints must be designed in accordance with the principle of minimum leakage consistent with ease of shield removal and economy of manufacture. The shield should be fastened to the next larger support member at points of as near equal potential as possible to minimize excitation of the larger surfaces.

b. All power supply leads entering the above mentioned compartment must be filtered for r-f.

c. The oscillator must be so designed that it produces a minimum of current in the surrounding metal. This may be accomplished by the following general methods:
   1. Single point grounding must be used for the entire oscillator circuit.
   2. The oscillator inductor must be oriented so that its field induces minimum currents in the surrounding metal.
   3. The oscillator inductor field may have to be restricted by such means as a complete coil shield or vestigial shielding such as a shorted turn surrounding that coil.

d. Since the mixer or frequency converter tube is driven by the LO, usually via control grid injection, it is necessary to design the band pass networks associated with the mixer tube for minimum transmission at oscillator frequencies.

The obvious, but uneconomical, way to design oscillator shielding is

(*Continued on page* 96)

to enclose the oscillator by means of soldered, "water-tight" joints in the shielding and possibly the use of double shielding. This is obviously not a reasonable approach to high production. The approach should be that since the shield must be inexpensive and readily removable, extreme emphasis should be placed on minimizing the magnitude of currents induced in the shielding by the LO. It is of even greater importance to prevent the actual conduction of oscillator current by the chassis and/or shielding. Once the oscillator currents in the shielding have been reduced to a sufficiently low value, the need for precious metals in the shield compartments and the need for multitudinous grounding fingers or mounting screws is minimized. Almost any crude metal box of rather low conductivity material, such as thinly plated steel, will adequately confine the electrostatic field, providing that there are no holes or slots in the shield across which a potential difference can exist. This can usually be accomplished, for the electrostatic field, by proper orientation of holes and slots. However, such is not the case for the electromagnetic field.

The presence of any holes will permit magnetic lines of force to "bulge" through the opening, thus permitting the excitation of currents upon the exterior of the compartment shield. These currents then excite the main chassis which is a fairly efficient radiator and the damage is done. From that point on, additional filtering of leads or careful placing of components within the oscillator compartment will be to no avail. Thus holes must be avoided at all costs. This means that supply leads must leave the compartment in a manner that prevents magnetic lines of force from accompanying the wire. The means of accomplishing this with a filter will be discussed later. One hole that is very difficult to avoid is that for the tuning shaft. It is possible to minimize leakage of this nature by use of either an insulated shaft in an elongated bushing (waveguide below cut-off attenuator) or by careful grounding of a metallic shaft together with care in minimizing excitation of the shaft by oscillator currents inside of the compartment. This latter approach is by far the most practical in a TV tuner. It admittedly does not allow the same degree of attenuation as the former method, but experience has proven it to be adequate.

Shield joints, whether fastened by screws or by spring pressure, should have as large an overlap as possible to minimize leakage which is inevitable in joints between metals that are not of the highest possible conductivity and so carefully formed that they provide an almost water-tight joint. This is the big point of departure from signal generator technique. Grounding fingers are no doubt desirable, but they are equally uneconomical. Since shields in TV receivers must be made of sheet metal in great quantity and at low cost, the tolerances that may be specified are of necessity loose. This means that the designer must be very cautious, especially when designing the joints, to provide for the necessary allowances and at the same time accomplish contact over as great an area as possible. A practical means for accomplishing this (see Fig. 2) lies in the use of a gasket of a metal textile to provide good contact between mating non-planar surfaces.

A further point of departure from signal generator technique lies in the choice of metals for the shield. Brass, copper, and silver are entirely uneconomical as base metals and are further unthinkable in view of the requirements of the defense program. On the other hand, high conductivity metals are desirable, in that smaller thicknesses are necessary for a given attenuation of a confined field and that good joints are more readily obtained. A metal thickness of about 10 times the "skin depth" is necessary to produce an attenuation of approximately 86 db in the field intensity. This would require approximately .003" of copper if the minimum frequency were 80 MC. This amount can be most economically produced by "overlay" techniques.

If overlays of copper are used, the shields should be formed with the copper on the inside. However, experience has shown that cold rolled steel will provide adequate attenuation in thicknesses of 0.030" or more, if the joints are plated with at least 0.0005" of copper. This latter shield, together with the previously discussed care in minimizing current density in the shielding will produce very satisfactory results. The main enemy of the effectiveness of such shielding is corrosion and care must be taken in handling and fabrication to minimize such tendencies.

The necessity for adequate low-pass filtering in the power supply leads is obvious. In the case of high voltage and automatic gain control lines, it is possible to use series resistor, shunt capacity filters. It is important that the capacitors not experience any anti-resonant effects

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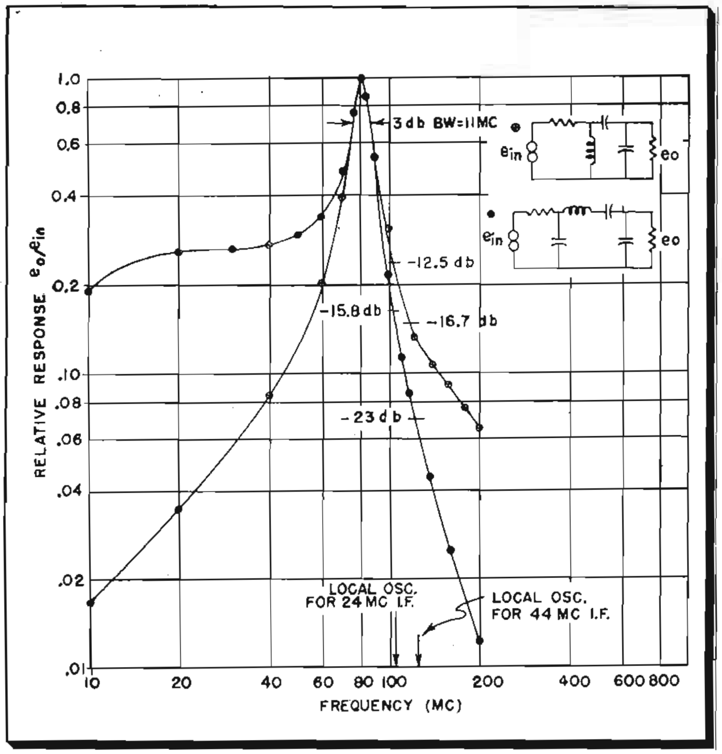

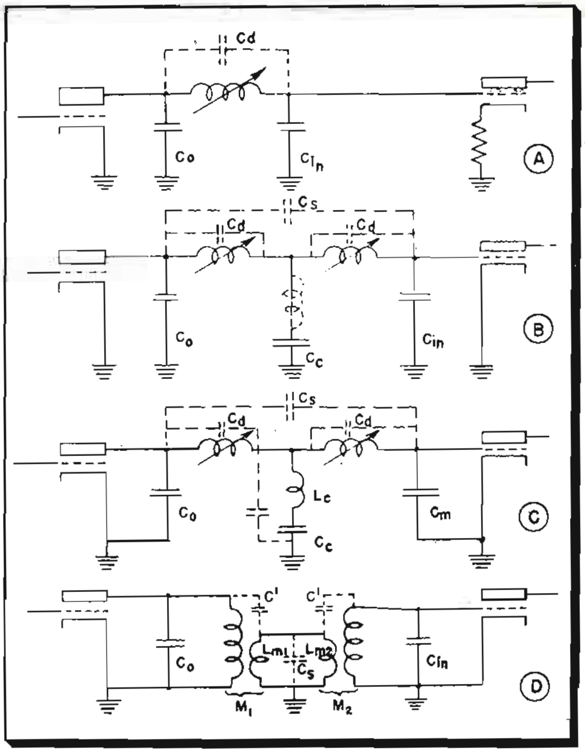

Fig. 8: (L) Comparison of selectivity of anti-resonant circuit (A) with high selectivity input (B) shows greater attenuation of (B) prevents reverse transmission of LO frequencies through r-f stage. Fig. 9: Mixer bandpass couplings circuits, stray reactances dotted.

within the tuning range of the oscillator. The use of series resistors of a few few hundred ohms on both the input and output of this filter usually prevents resonance in the supply leads exterior to the tuner. It is usually necessary to use LC filters in the filament leads to avoid excessive voltage drop. These filters must be designed to prevent any spurious resonances in the tuning range of the oscillator. See Fig. 3 for typical filters. Several types of capacitors are suitable for use in these filters. One type has been used by automobile radio manufacturers for years under the name of "spark-plate" capacitors. Fig. 4 illustrates such capacitors. This technique is applicable to the TV receiver if material of adequate insulation resistance and dielectric strength is used. Another alternative is the use of either disk or cylinder "feed-through" types of ceramic capacitors.

As mentioned earlier, it is of extreme importance to minimize the flow of oscillator tank currents in the chassis or shields of the tuner. Fig. 5 A shows an oscillator circuit that is very bad from the standpoint of causing conduction currents to flow in the chassis. A change to the circuit of Fig. 5 B will eliminate this portion of the difficulty.

It still remains to locate the oscillator inductor so that its magnetic field links the chassis and shielding as little as possible. In switch, turret, or permeability tuners, this can be readily accomplished by winding a coil with a fairly high ratio of length to diameter and the use of high permeability core material to confine the magnetic field, plus spacing from the chassis of at least two coil diameters. Most pure permeability tuners suffer from a rapid increase in chassis radiation at the high end of the tuning range. This may be due to the increased extent of the field about the oscillator coil when the core is fully removed from the coil. Hence, the use of combined permeability and eddy current shielding tuning is indicated. Naturally, the conducting shield used for eddy current shielding inductance variation must surround the inductor if the desired confinement of the field is to be obtained.

Some forms of continuous inductance tuning devices such as shown in Fig. 6, have a naturally extensive magnetic field. Since, for minimum back-lash, the oscillator inductor must be close to the tuning shaft, it is somewhat difficult to minimize excitation of the shaft. A partial solution to this problem has been the use of a conducting ring in close proximity to the oscillator coil field. This ring can also be used as an aid to tracking, due to its effect on the oscillator coil inductance. In the high VHF band, the effect of the ring is small, due to its looser coupling to the coil. Fortunately the shaft excitation has been found to be

Opportunities for Engineers

a major problem only in the 90 to 110 MC region where the shielding of the oscillator coil field is relatively great.

The problem of confining the local oscillator energy which is conducted from the shielded compartment by the antenna and i-f output leads is one which is readily susceptible to quantitative analysis. However, the results of analyses of this nature must be viewed in the light of maximum attainable figures, rather than the preordained result of following the schematic diagram that was analysed. This departure of results from theory can be minimized if care is taken in the analysis to include all the significant reactances.

The usual approach is to assume that for reverse transmission, the r-f amplifier tube is a passive network composed of the interelectrode capacitances and lead inductances. This is not true in general, but only in special cases. Pentode r-f amplifiers, in which there are a minimum of common impedances in the cathode circuit may be successfully analysed as a passive network. Cathode separation triode r-f amplifiers usually follow this theory also. However, the grid-plate capacity is not the only coupling. Above 200 MC, the cathode lead inductance may allow direct conduction of oscillator energy into the grid circuit, even with C_{pg} perfectly neutralized.

A somewhat different condition occurs with grid-separation amplifiers, since the plate current flows in the input (cathode) circuit. The plate current contains a component of LO signal due to the rather low plate resistance of the triode and this component appears across the transformed antenna impedance. See Fig. 7 for details. Normally, one would expect that the antenna component of LO signal due to a finite R_p would only be noticeable at frequencies so low that X_{cpk} was equal to or greater than R_p. This occurs about 65 MC for $C_{pk} = 0.5$ uuf. Sometimes an effect occurs above 200 MC in which the antenna radiation varies with g_m of the tube. This has been traced to regeneration in the r-f amplifier at frequencies well above the signal frequency, but close to the oscillator frequency. This is usually a result of the grid circuit impedance increasing due to L_g (see Fig. 7). Thus, it is essential to provide a high degree of antenna circuit selectivity at oscillator frequency if a grid-separation triode r-f amplifier is used. Such an input circuit and its selectivity curve compared with a simple anti-resonant circuit of equal Q is shown in Fig. 8. The popular "cascode" or driven grounded grid circuit affords another means of achieving high antenna circuit selectivity together with the passive isolation of the cathode separation input triode.

Much more can be said about proper design of interstage coupling circuits for LO energy suppression, but would be a subject for a paper in itself. Suffice it to say that r-f band-pass circuits between the antenna and mixer grid should have maximum "above band" rejection and those between mixer plate and r-f grid should have similar abilities. It is also essential that the stray reactances associated with practical components should be negligible all through the LO tuning range. Fig. 9 illustrates some of these circuits, together with the dangerous stray reactances which are shown dotted.

The degree of improvement in radiation reduction that can be achieved by the application of some of the previously discussed techniques is shown in Table II. The figures shown are results of measurement of a complete receiver, before and after radiation proofing, by the IRE field method.

In conclusion, a note of caution should be sounded. It is possible, by

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Suppressing L-O Radiation

(*Continued from page* 101)

careful circuit "tailoring" to produce substantial reductions in antenna radiation due to presence of two or more sources of leakage of opposite phase. In TV receivers, the frequency range is so great that such "bucking" is unlikely to hold over the frequency range and is certain to be impossible of attainment in mass production. It is necessary, if uniform results are to be achieved, studiously to avoid such cancellation phenomena. It is far more economical, in the long run, to put a few more cents into a good sheet metal design that is subject to simple inspection techniques, than to rely on "tricks" which will pile up rejects, or worse still, place radiating receivers in customers' hands.

Thanks are extended to Mr. E. G. Mannerberg without whose cooperation this paper could not have been completed.

1. K. A. Chittick, "Report of Engineering Conference on Oscillator Radiation of the F.C.C. on Nov. 1, 1949."

Synthane Sales Office

Synthane Corporation of Oaks, Pa., manufacturer and fabricator of laminated plastics for industry has opened an Indianapolis sales office.

Tele-Tech

Advertisers - February 1952

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

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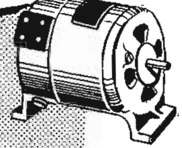

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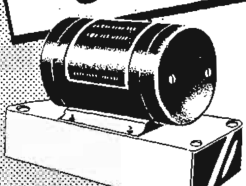

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MANUFACTURER	TYPE OR NO.	VOLTAGE	RPM	DIMENSIONS	SPECIAL INFORMATION
Stewart Warner	....	6VDC	....	2¼"x2¾"	¼"x½" Lg. shaft
John Oster	B-9-2	12VDC 1.4A	5600	2¼"x3¾"	¼"x7/16" Lg. shaft. Shunt Wd.
General Ind.	62800	13VDC 9A	6800	2⅛"x4"	¼"x¾" Lg. shaft. 1/12 HP
Emerson	D-26-BT	24VDC 24A	100	2¼"x5½"	160 Ft.-Oz. torque
Redmond	7-N	24VDC .96A	6000	2¾"x3¼"	Complete blower assembly
F. A. Smith	40H	115VAC 60 Cy	....	6"x5½"x5"	100 CFM blower ($12.95)
Western Elect.	FL	115VAC 400 Cy	6700	3¼"x4"x4½"	25 CFM blower
Signal Elect.	D-4272	24VDC .66A	2100	2¼"x2⅞"	¼"x1" shaft. 1/190 HP
Stromberg	D-4496	24VDC .45A	....	2½"x3⅛"	¼"x¾" shaft. .003 HP
Amglo	....	24VDC	....	1½"x2⅛"	Telephone ringing circuit motor
John Oster	A-16B-26R	26VDC	....	1½"x2⅛"	3/16"x5/16" shaft. Series Rev.
John Oster	DEST-8-1R	27VDC 1.4A	3800	2¼"x4⅝"	⅜"x¾" shaft. 1/40 HP
Delco	5069267	27.5VDC .25A	6000	1⅝"x2½"	¼"x1⅛" shaft. 1½ Oz-In Tq.
Western Elect.	KS5996-LD4	28VDC	....	2"x2⅞"	3/16"x7/16" shaft. Series Rev.
Bendix	M05B	28VDC 1.75A	3200	1½"x2½"	¼"x1⅛" shaft. Series Rev.
Bendix	E-11500-1	28VDC 1A	9000	1½"x2½"	¼"x1⅛" shaft. Series Rev.
Fractional Mtrs.	SH-280	28VDC 3.1A	3900	3¼"x5½"	¼"x⅝" shaft. Used in ART 13
Electrolux	20100	28VDC .1A	....	2"x2 15/16"	5/32"x⅝" shaft. 20 Deg. rotation
John Oster	A-21-E-12R	28VDC .4A	....	1½"x2⅜"	3/16"x⅜" shaft. Series Rev.
Emerson	D-26-BV	28VDC 3.1A	3900	2½"x3½"	¼"x⅝" shaft. 1/20 HP
Electrolux	16876	28.5VDC 1.8A	2200	3¾"x5"	¼"x1¾" shaft. 1/35 HP
General Elect.	2J1G1	57.5VAC 400 Cy	....	2¼"x3½"	Selsyn transmitter
General Elect.	5BN38HA10	80VDC .25A	3000	2⅞"x5⅛"	¼"x¾" lg. shaft
General Elect.	2J1F1	115VAC 400 Cy	....	2¼"x3"	Selsyn generator
Diehl	11-1	110VAC 60 Cy	....	4"x5¼"	Synchro repeater selsyn
Bendix	....	110VAC 60 Cy	....	3¼"x5½"	Synchro differential selsyn
Bendix	....	110VAC 60 Cy	....	3¼"x5½"	Synchro transmitter selsyn

DYNAMOTORS AND POWER UNITS

MANUFACTURER	TYPE OR NO.	INPUT	OUTPUT	DIA.	LGTH.	SPECIAL INFORMATION
Eicor	ML3415-254	27.5VDC 1.5A	250VDC .060A	4"	8⅜"	With bracket mounting
Eicor	ML3412-42	13.8VDC 2.45A	220VDC .070A	3⅜"	5¼"	No mounting
Western Elect.	DM53AZ	14VDC 2.8A	220VDC .080A	2¾"	4½"	With base plate
Westinghouse	1171187A	27VDC 1.4A	285VDC .060A	2⅛"	4½"	No mounting
General Elect.	5DY82AB52	27VDC 1.5A	285VDC .060A	2¾"	4½"	No mounting
Western Elect.	1171091B	27VDC 1.6A	285VDC .075A	2¾"	4½"	No mounting
Redmond	5047	27VDC 1.75A	285VDC .075A	2¾"	4½"	No mounting
Eicor	ML3415-254	27.5VDC 1.5A	100VDC .150A	3½"	5½"	With base plate
Eicor	ML3420-194	27.5VDC 4.0A	325VDC .200A	3⅜"	6½"	With base plate
C.Q.R.	355D2BA	27.9VDC 1.25A	220VDC .070A	3⅜"	5⅜"	No mounting
Continental	DM310A	28VDC .5A	100VDC .01A	2¾"	4½"	No mounting
C.A.Y.	DM32A	28VDC 1.1A	250VDC .060A	2¾"	4½"	With base plate
Pioneer	PE86M	28VDC 1.25A	250VDC .060A	2¾"	4½"	With base and filter
Bendix	DA-IA	28VDC 1.6A	230VDC .100A	3⅜"	5½"	No mounting
Redmond	DM5 3A	28VDC 1.4A	220VDC .080A	2¾"	4½"	With base plate
Redmond	5056	28VDC 1.4A	250VDC .060A	2¾"	4½"	With base plate
Eicor	ML-3420-90	28VDC 3.3A	400VDC .125 A	3½"	6½"	With base plate
Continental	DM33A	28VDC 5A	575VDC .160A	3½"	7½"	Cont. duty. No mounting
Winco	41S6	13VDC 13A 13VDC	250VDC .060A 300VDC .225A	4"x	8⅜"	With base plate Intermittent
Continental	DMX310A	12VDC 2.8A	150VDC .100A	2¾"	4½"	Cont. Duty. No mounting

MANUFACTURER	TYPE OR NO.	INPUT	OUTPUT	DIMENSIONS	SPECIAL INFORMATION
Pioneer	PE 55	12VDC .16A	500VDC 0.2A Cont.	7¼"x12⅛"x13½"	Pwr. Unit W/DM 19G DYN, Filter and Mounting
Westinghouse	PE 94C	28VDC 10.5A	300VDC .260A 150VDC .010A 14.5VDC 10A	8¼"x6½"x12½"	Pwr. Unit W/DA3A DYN, Filter and Mounting

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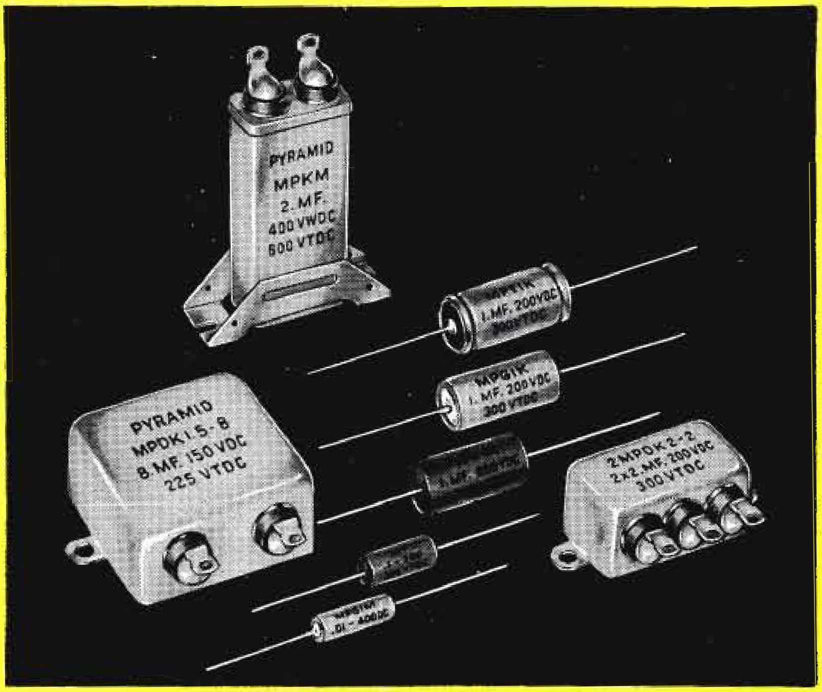

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