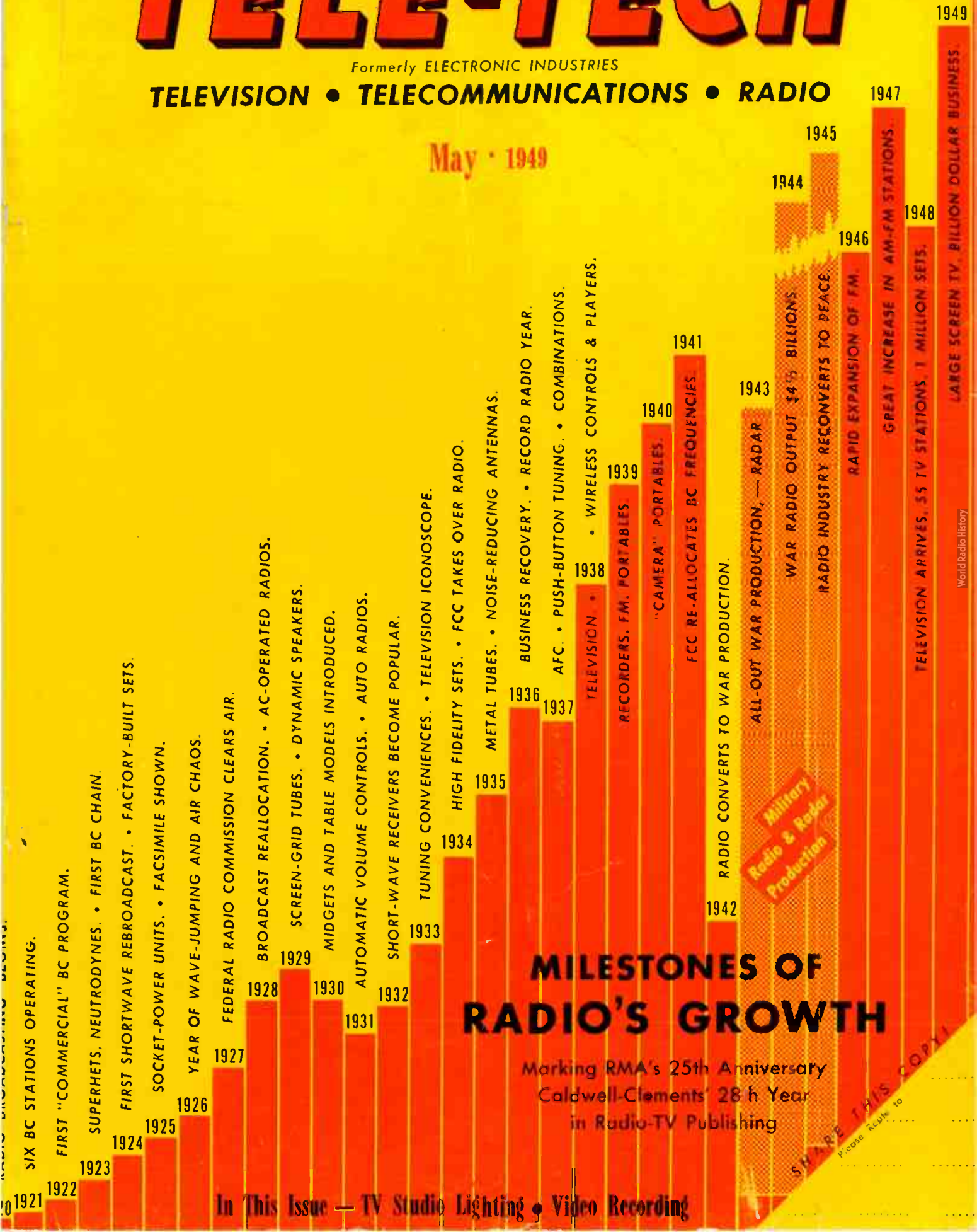
TELE-TECH

Formerly ELECTRONIC INDUSTRIES

TELEVISION • TELECOMMUNICATIONS • RADIO

May · 1949



MILESTONES OF RADIO'S GROWTH

Marking RMA's 25th Anniversary
Caldwell-Clements' 28th Year
in Radio-TV Publishing

In This Issue — TV Studio Lighting • Video Recording

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Norelco PROTELGRAM

LIFE-SIZE *more* LIFE-LIKE *Television!*

. . . from this 2½" tube

Chosen by these famous makers of quality projection TV receivers

ANSLEY • EMERSON
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PROTELGRAM is the result of nearly fifteen years of research by the world's greatest electronics laboratories. This scientifically designed, optically correct projection system makes possible, *for the first time*, a *life-size* distortion-free picture of nearly 200 square inches (20" diagonal) . . . a more *life-like* picture without glare or eyestrain. And from a tiny long-life, low-cost picture tube!

PROTELGRAM is the answer to the public demand for a bigger, clearer picture that is easier on the eyes. It produces a better than 16" x 12" non-reflecting picture that fills a flat screen *all the way to the corners*, and permits wide angle visibility, fatigueless viewing from 5 feet or 50! Small size and light weight make possible compact consumer units. Write to Dept. PB-5, North American Philips Company, Incorporated, 100 East 42nd Street, New York 17, New York.

PROTELGRAM for **life-size**, more **life-like** television

Norelco

An Exclusive Development of

NORTH AMERICAN PHILIPS

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TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

MAY, 1949

Editorial Contents

COVER: MILESTONES OF RADIO'S GROWTH — Besides marking the outstanding radio achievement or characteristic of each year, from the very beginnings of broadcasting by Westinghouse station KDKA, Pittsburgh, in 1920, the height of each yearly column is proportional to the volume of radio manufacturing and sales that year. Note that reflected in the chart is the rapid growth of radio in 1927 and 1928 following the clearing up of the "radio chaos" of 1925-26; the drop in sales during the great Depression of the 1930s; the effect of the general business setback of 1937; the sudden cut to war production in 1942; the towering heights of electronic war production in 1944 and 1945 reaching over three billions, or five tines top peacetime output, and finally the resumed industry growth with the advent of television.

DEPARTMENTS:

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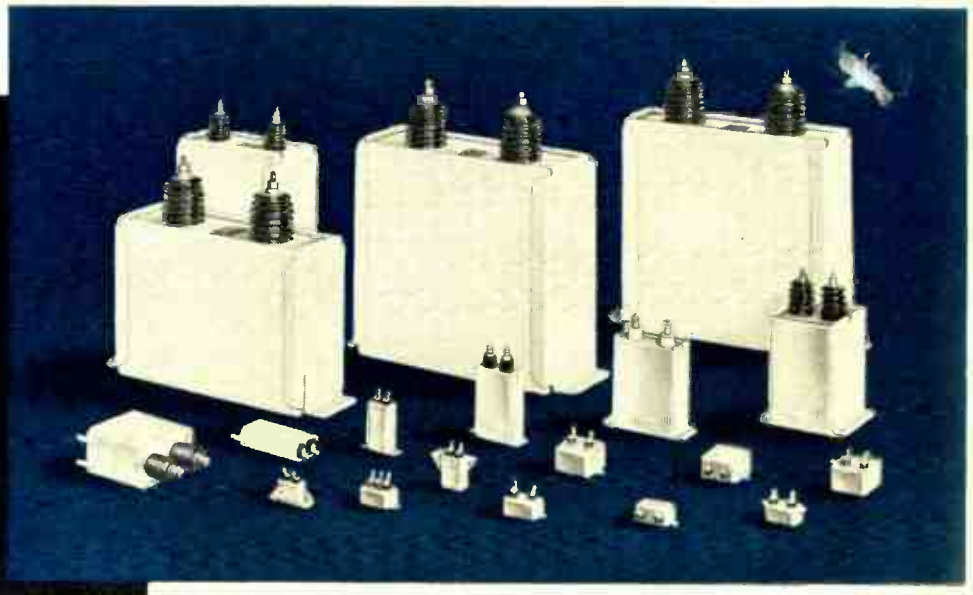

take your choice... FIXED PAPER-DIELECTRIC CAPACITORS

Readily available for DC electronic applications, these capacitors are manufactured in accordance with joint Army-Navy specifications JAN-C-25. Case styles include types CP 53, CP 54, CP 55, CP 61, CP 63, CP 65, CP 67, CP 69 and CP 70. Capacitance ratings are from .01 Muf to 15 Muf, and voltage ratings are listed from 100 to 12,500 volts.

These capacitors are constructed with thin Kraft paper, oil or Pyranol* impregnated, which provides stable characteristics and high dielectric strength. Plates are aluminum foil, manufactured according to detailed specifications. Special bushing construction provides for short internal leads, preventing possible grounds and short circuits. The cases have a permanent hermetic seal to provide longer life. A variety of mounting arrangements are available for various installation requirements. Write for detailed description and operating data: Bulletin GEA-4357A.

*Pyranol is General Electric's non-inflammable liquid dielectric for capacitors.

SAVE SPACE CUT COSTS

Less than one inch long, and only one inch square, this postage-stamp-size selenium rectifier offers radio builders substantial savings in production costs. Only two soldering operations and a minimum of hardware are necessary for installation in places where a rectifier tube and socket won't fit. They're built to safely withstand the inverse peak voltages obtained when rectifying (half-wave) 110-125 volts, rms, and feeding a capacitor as required in various radio circuits. Tests prove that selenium rectifiers will outlast the conventional type of rectifier tubes, at the same time costing less. Send for bulletin GEA-5238.

GENERAL ELECTRIC

Digest

TIMELY HIGHLIGHTS ON G-E COMPONENTS

HOLOS OUTPUT VOLTAGE CONSTANT

This 500-va voltage stabilizer is suitable for a wide variety of electronic applications where constant voltage is demanded. Voltage variations from 95 to 130 volts are absorbed almost instantaneously and output voltage maintained at 115 volts (plus or minus 1 percent). There are no moving parts, no adjustments to make. This unit will operate continuously at no load or short circuit without damage to itself. It will limit the short circuit current to approximately twice stabilizer's normal full load current rating. Other sizes available range from 15 to 5000 va. For details, check bulletin GEA-3634B.

WANT TO TIME TUBE LIFE?

Suitable for installation in radio transmitters, these G-E time meters provide accurate record of tube operating time. They record in hours, tenths of hours, or minutes. Ratings range from 11 to 460 volts. Installation on a panel or switchboard is simplified by quick-wiring leads. Timer harmonizes with other panel instruments in appearance and size. Dependability is assured by Telechron* motor drive. Also available for portable use or conduit and junction box mounting. Check bulletin GEC-472.

FOR YOUR TELEVISION SETS

General Electric's television cord set comes in 6-foot lengths, made of 2/18 Pot-64 brown Flamenol* rip-cord. Set has brown plastic plug and new brown Flamenol connector molded on opposite end. Rip-cord has smooth finish, resists oil, water, acids, alkalies, or sunlight deterioration. Rating is 7 amps., no. 18 wire. Set is designed for assembly on television receiver rear panel, automatically disconnects when panel is removed. Write for further information.

*Trademark Reg. U. S. Pat. Off.

DEPENDABLE CONTROL FOR AUTOMATIC DEVICES

G.E.'s multi-contact relays are inexpensive units built specifically for appliances and vending machines. Construction features assure quiet, reliable operation, and compactness makes them adaptable to a variety of devices such as coin changers, phonographs, and television receivers. Single-circuit contacts or combinations of contacts for multi-circuit application are attached to the same sturdy frame and coil assembly, affording a multiplicity of relay forms. Ratings are 5 amperes at 115 volts or 24 volts, a-c or d-c. Get details from Bulletin GEC-306.

General Electric Company, Section F667-1
Apparatus Department, Schenectady, N. Y.

Please send me the following bulletins:

- ☐ GEA-3634B Voltage Stabilizers
- ☐ GEA-4357A D-C Capacitors
- ☐ GEA-5238 Selenium Rectifiers
- ☐ GEC-306 Multi-contact Relays
- ☐ GEC-472 Tube Timers

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800 ohms/cmf

Temp. Coeff. of Resistance: ± 0.00002 max. from −50°c to +100°c

Karma

the improved electrical resistance alloy!

Higher Ohmage makes possible Smaller Resistors—Increased Savings

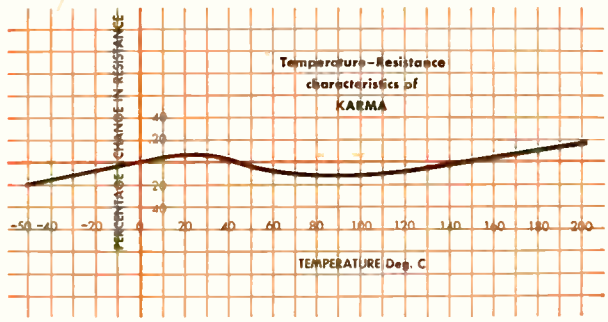
Compared with Manganin and Constantan (Advance*), the copper-base alloys widely used for high accuracy wire-wound resistors, the electrical resistivity of Karma* is exceptional — 800 ohms per circular mil foot, at 20°C, it is more than 2.7 times greater. Now you can wind even smaller precision resistors at still lower cost per ohm.

More Stable Resistance permits Wider Applications—at Wider Temperature Ranges

The comparably Low Temperature Coefficient of Resistance of Karma remains constant over a very much wider temperature range than that of Manganin or Constantan (Advance*). The "useful range" of Karma is more than 8 times that of Manganin and 4 times that of Constantan (Advance*). Karma, therefore, is especially adapted for service in precision resistors that are subjected to severe changes in temperature.

Low Thermal EMF Value against Copper assures Extreme Accuracy

In cases where error due to voltage generated by thermal EMF against copper must be confined to negligible proportions, Manganin has long been accepted as ideal for resistor windings. The thermal EMF value for Karma against copper is equal to that of Manganin itself!



High Resistance to Oxidation prolongs Electrical Properties

The superior surface oxidation resistance of Karma, essentially a nickel chromium alloy, enables it to retain its fine electrical properties longer than the copper-base alloys Manganin and Constantan (Advance*).

Higher Tensile Strength permits Faster Winding Speeds — saves Production Time

In addition to its outstanding electrical qualities, Karma affords physical advantages over the commonly accepted alloys. Its higher tensile strength permits faster winding speeds; its lower thermal expansion minimizes distortion and movement in windings.

In a word, this urgently needed Driver-Harris alloy offers *plus values all along the line.* Ask us about it. We shall be glad to supply you with complete data.

50TH YEAR
SPECIAL PURPOSE ALLOYS SINCE 1899
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1899 - 1949

KARMA* is manufactured only by

Driver-Harris Company

HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco, Seattle

Manufactured and sold in Canada by
The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

*T.M. Reg.U.S.Pat.Off. *Formerly D-H experimental alloy #331

PERFORMANCE FAR EXCEEDS PROMISE with

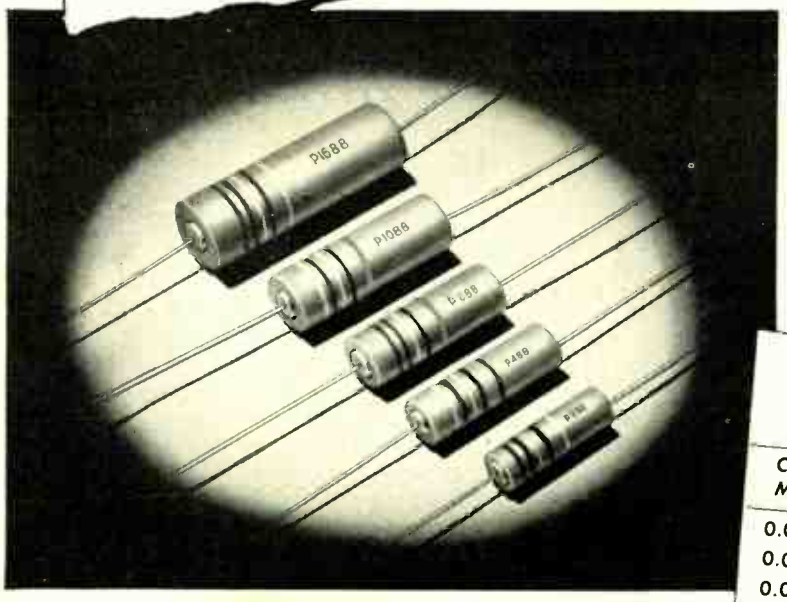
PERFORMANCE-INSURED DURANITE CAPACITORS

THE PROMISE

★ The new AEROLENE impregnant eliminates the necessity of stocking and using both wax and oil capacitors. One impregnant does the work of both. Results in lower inventories with corresponding reduction in manufacturing costs.

★ DURANITE capacitors show no deterioration in stock. May be stored in advance of actual use, with corresponding economy and convenience.

★ DURANITE does not dry out. Does not develop cracks or fissures. It stays tight throughout.



● Based on our lab and life tests, Aerovox has made several superlative claims for the exclusive DURANITE technique. And because DURANITE means a *new* impregnant, Aerolene, *new* processing methods, *new* casing material—Aerovox has sought not to confuse DURANITE capacitors with conventional molded tubulars.

For example: Note actual clipping from DURANITE introductory literature issued almost two years ago and based on units produced by our pilot plant. Then note the performance of a batch of initial-production DURANITES that were in a brief case and carried in planes, trains and autos many thousands of miles along the Eastern Seaboard from March through November (during the humid summer months), and just recently measured for insulation resistance by lab men of a leading radio manufacturer*. Could usual paper tubulars approach this performance?

Definitely—but very definitely—DURANITES are setting brand new standards of stability, dependability and durability.

*Name on request.

THE PERFORMANCE

AEROVOX TYPE P-88 DURANITE TUBULARS

Insulation Resistance after Nine Months*

Cap. Mfd.	Volts	IR in Megohms	Case Size
0.01	400	30,000	11/32 x 1 1/8"
0.022	400	35,000	13/32 x 1 3/8"
0.022	600	100,000	15/32 x 1 3/8"
0.10	400	24,000	17/32 x 1 5/8"
0.22	400	40,000	21/32 x 2"

*See accompanying text for conditions.

● *Sample DURANITES right off the production lines cheerfully sent for your own tests and conclusions. Meanwhile, let us quote on your TV and other severe-service capacitor needs.*

FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

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Heat dissipation can be

for resistors

Heat dissipation can be mighty tough . . . but not for IRC resistors. They are universally engineered for the lowest possible operating temperatures and maximum power dissipation within the smallest size units consistent with good engineering practice.

Long experience with the widest line of resistor types in the industry has provided IRC with a wealth of "know-how" on resistor heat dissipation. In Power Wire Wound Resistors for example, the complete range of tubular and flat types manufactured by IRC utilizes a special cement coating to attain rapid heat dissipation. This dark rough surface does double duty by effectively guarding the windings against harmful atmospheric moisture and corrosion. Use the handy coupon to get complete data on proven advantages of IRC Power Wire Wounds.

There are 52 specific types of IRC Power Wire Wound Resistors.

IRC Flat Wire Wound Resistors offer a higher space-power ratio.

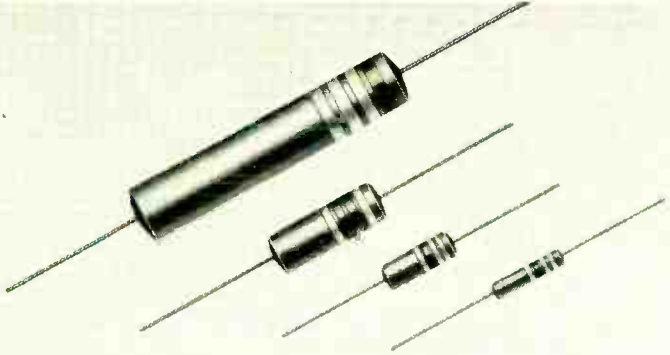
Adjustable types feature the exclusive IRC non-corrosive contact band.

Power ratings from 2 to 225 watts. Variety of 8 terminal types.

Windings are of highest grade alloy wire on tough ceramic forms.

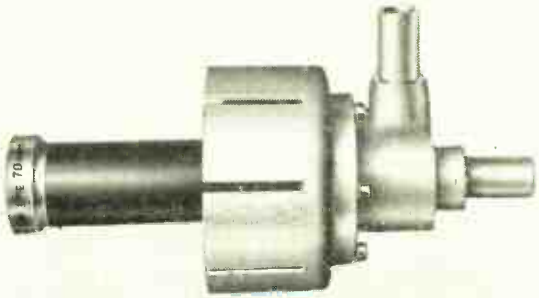
tough

too!



New, ADVANCED BT Resistors obsolete present performance standards for fixed composition resistors. Extremely low operating temperature and excellent power dissipation in compact, light weight, fully insulated units at ⅓, ½, 1 and 2 watts. These ADVANCED resistors meet JAN-R-11 specifications. All the facts are included in 12-page technical data Bulletin B-1.

Heat dissipation properties of aluminum are used to full advantage in housing and winding core of IRC Power Rheostats, 25 and 50 watts. Type PR Rheostats operate at full rating at about half temperature rise of equivalent units. Can be operated at full power in as low as 25% of rotation without appreciable difference in temperature rise. Direct contact between rheostat and mounting panel allows rapid conduction to panel of a portion of heat dissipated. Send for Bulletin E-2.



Water-cooled LP Resistors utilize high velocity water stream flowing in spiral path against thin resistance film. High power dissipation is made possible by centrifugal force holding water in thermal contact with resistance surface. Resistance film less than 0.001'' thick with active length much less than ¼ wave length at FM and television frequencies, gives excellent frequency characteristics. Resistance values 35 to 1500 ohms; 15% tolerance standard; power dissipation up to 5 K.W. ac. Bulletin F-2 gives all the facts.

If you have the heat put to you for speedy service on small order resistor requirements for experimental work, pilot runs, etc., you'll appreciate the advantages of IRC's Industrial Service Plan. This enables you to get 'round-the-corner service from the local stocks of your IRC Distributor. He's a good man to know . . . we'll gladly send you his name and address.

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Send me additional data on items checked below

☐ Power Wire Wounds (tubular) ☐ Flat Power Wire Wounds
☐ Advanced BT Resistors ☐ Power Rheostats ☐ Water-Cooled Resistors
☐ Name and address of our local IRC Distributor

NAME .....

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.....

TELE-TIPS

ATLANTIC PACT RADAR—Sir Robert Watson-Watt, visiting Washington last month, proposed that a radar screen be set up around th European nations taking part in the North Atlantic Pact agreement, similar to that already under Congress' consideration for US northern border.

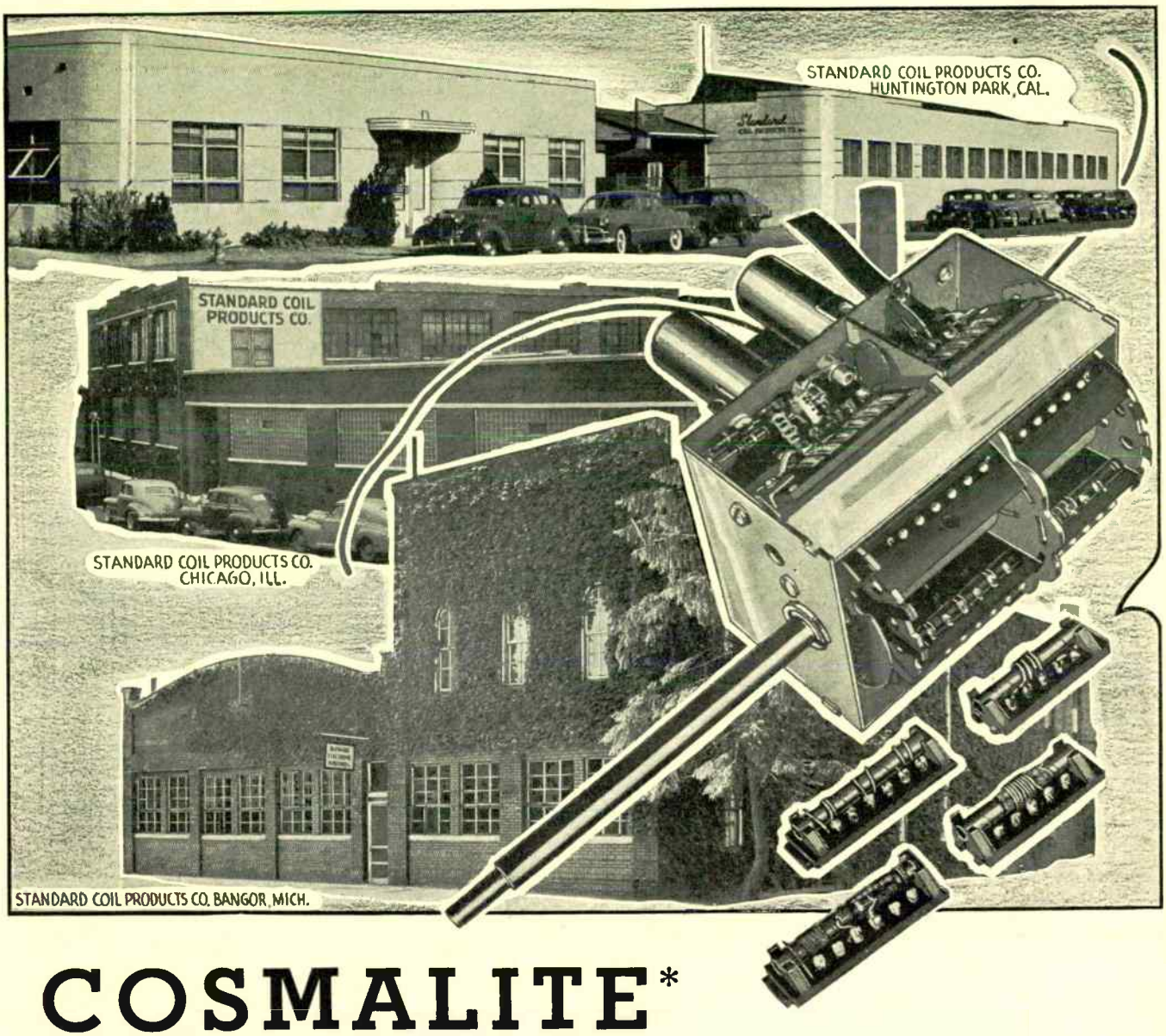
REMINGTON-RAND is a new name in commercial TV picture tubes. Already the South Norwalk, Conn., plant is in pilot production on 12LP4's, turning out 50 to 100 daily, under the direction of Engineer Marshall P. Wilder, with larger plans for the Fall. Since 1944, company has produced orthocons and image-orthocons for guided-missile and industrial TV systems of its own manufacture.

FM VIDEO may yet show some inherent advantages over present standard AM-TV pictures, according to engineers who are working to develop new operating possibilities theoretically available with frequency modulation of the picture signal. So don't write off FM-TV yet!

MEXICO CITY PARLEY RESULTS—The World Radio Conference plan for sharing shortwave broadcasting time comprises 32 huge pages of charts, and is the product of six months of work by 459 delegates representing eight-five countries. The plan charts the use of 235 broadcasting channels in the eight narrow shortwave bands between 6 and 26 MC.

PROJECTION TV is the ultimate for the home—this seems to be consensus of increasing number of industry figures who have studied public's desire for big pictures as contrasted with difficulties and drawbacks of large direct-view tubes. Prominent raster lines now showing up as unexpected annoyance of 16-inch viewing, a trouble due, contrarily, to the very excellence of spot focus.

PORTO RICAN PROFITS—Some radio men are considering Porto Rico for manufacturing and assembly operations, with decided benefits because of low labor costs and highly-favorable tax situation.



COSMALITE*

in STANDARD COIL PRODUCTS CO. TUNERS

Of course COSMALITE is used by the STANDARD COIL PRODUCTS CO., INC. in their Television and Auto Set Tuning Assemblies. It is the first choice of those who insist on precision and quality products at prices that are right!

The advantages of COSMALITE SHELLS FOR TELEVISION DEFLECTION YOKES are many. Of prime importance is the fact that we have available, without charge, the tools for punching and notching many types of Cosmalite shells and coil forms. This means attractive prices with quicker deliveries.

Consult us
on your needs!

* Reg. U. S. Pat. Off.

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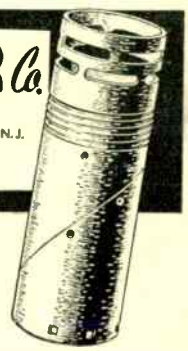


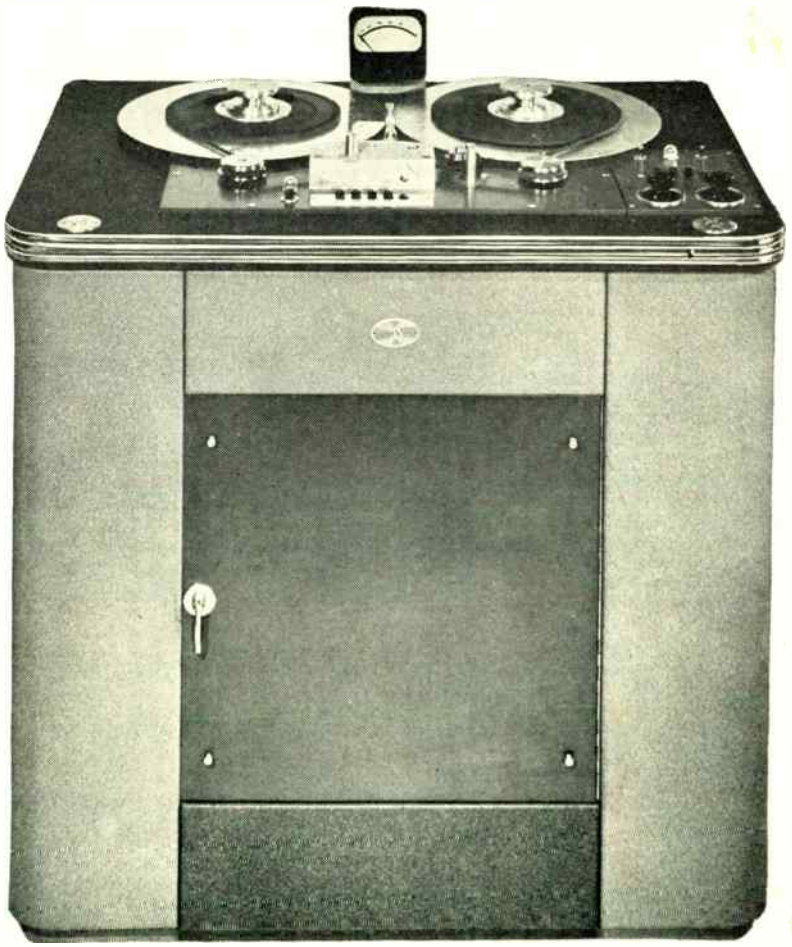
Now! A Top Quality Tape Recorder at a Reasonable Price

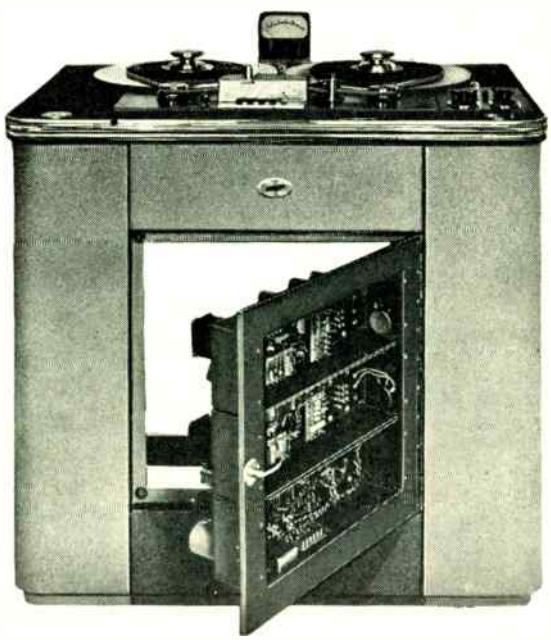
New PRESTO Magnetic Tape Recorder

AT LAST, a magnetic tape recorder that fully measures up to the most exacting requirements of broadcast network operations, independent stations and transcription producers, yet priced to have wide appeal.

Compare these specifications:

- Frequency response: 30 to 15,000 cps ± 1 db.
- Signal to noise ratio: Over 60 db below max. signal.
- Fast speed, 240 ft. per second forward and rewind, instantly reversible.
- Recording speeds 7½" or 15" per second (15" or 30" per second provided on request). Speed selection by special 2-speed motor.
- Reels direct mounted on motor shafts. Uses any type and size of reel up to 14".
- Erasing, recording and playback heads all mounted in separate housing — entire unit connected by plug-in for immediate replacement.
- Full-size illuminated scale V. U. meter on top panel.





Now! Greater Accessibility

Illustration shows how everything mechanical and electrical can be serviced from the front and top. Amplifiers and power supply are in swinging door behind removable panels. Mechanical units are mounted on top panel, hinged at rear so it can be opened upwards.

PRESTO

RECORDING CORPORATION

Paramus, New Jersey

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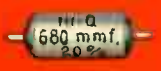
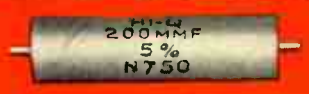
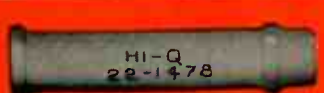
	CN-1 .200 x .375		SI-1 .234 x .437		CI-1 .250 x .562
	CN-13 .200 x .437		SI-13 .234 x 468		CI-2 .250 x .812
	CN-2 .200 x .625		SI-2 .234 x .687		CI-3 .340 x 1.320
	CN-27 .230 x .460		SI-27 .275 x .500		CS-1
	CN-7 .230 x .812		SI-7 .275 x .875		CS-2
	CN-19 .253 x .850		SI-19 .312 x .937		CS-3
	CN-3 .253 x 1.078		SI-3 .312 x 1.125		CS-4
	CN-4 .340 x 1.062		SI-4 .375 x 1.093		CF-1
	CN-5 .340 x 1.500		SI-5 .375 x 1.600		CF-2
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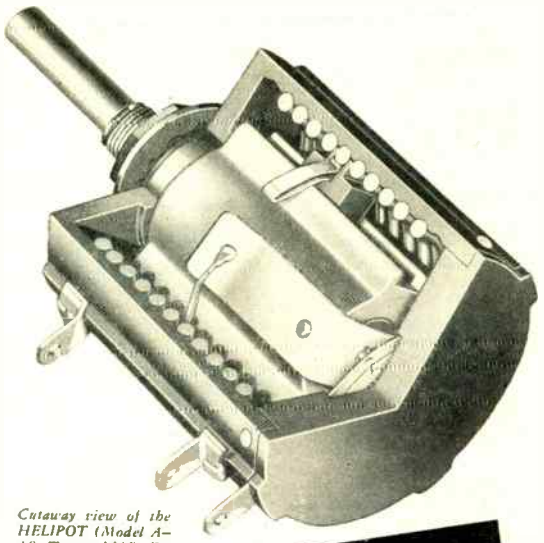


Cutaway view of the HELIPOT (Model A–10 Turn–1¼" Diameter)

THE BECKMAN Helipot

(Trademark of the HELical POTentiometer)

Provides *many times* greater resistance control in *same* panel space as conventional potentiometers!

IF YOU are designing or manufacturing *any type* of precision electronic equipment be sure to investigate the greater convenience, utility, range and compactness that can be incorporated into your equipment by using the revolutionary HELIPOT for rheostat-potentiometer control applications...and by using the new DUODIAL turns-indicating knob described at right.

Briefly, here is the HELIPOT principle...whereas a conventional potentiometer consists of a *single* coil of resistance winding, the HELIPOT has a resistance element *many times* longer coiled *helically* into a case which requires no more panel space than the conventional unit. A simple, foolproof guide controls the slider contact so that it follows the helical path of the resistance winding from end to end as a single knob is rotated. Result...*with no increase in panel space requirements*, the HELIPOT gives you as much as 12 times* the control surface. You get far greater accuracy, finer settings, increased range—with maximum compactness and operating simplicity!

COMPLETE RANGE OF TYPES AND SIZES

The HELIPOT is available in a complete range of types and sizes to meet a wide variety of control applications...

MODEL A: *5 watts, 10 turns, 46" slide wire length, 1¾" case dia., resistances 10 to 50,000 ohms, 3600° rotation.*

MODEL B: *10 watts, 15 turns, 140" slide wire length, 3¼" case dia., resistances 50 to 200,000 ohms, 5400° rotation.*

MODEL C: *3 watts, 3 turns, 13½" slide wire length, 1¾" case dia., resistances 5 to 15,000 ohms, 1080° rotation.*

MODEL D: *15 watts, 25 turns, 234" slide wire length, 3¼ case dia., resistances 100 to 300,000 ohms, 9000° rotation.*

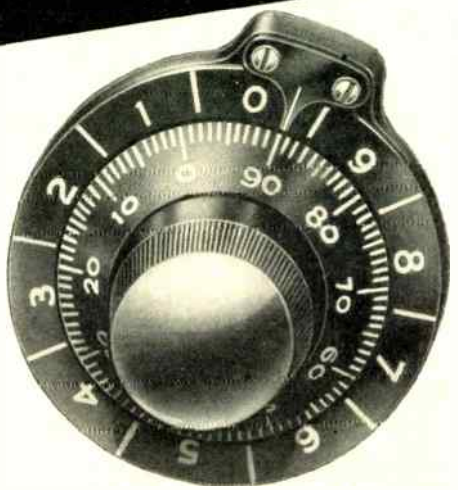
MODEL E: *20 watts, 40 turns, 373" slide wire length, 3¼" case dia., resistances 150 to 500,000 ohms, 14,400° rotation.*

Also, the HELIPOT is available in various special designs...with double shaft extensions, in multiple assemblies, integral dual units, etc.

Let us study *your* potentiometer problems and suggest how the HELIPOT can be used—possibly is already being used by others in your industry—to increase the accuracy, convenience and simplicity of modern electronic equipment. No obligation, of course. Write today outlining your problem.

**Data for Model A, 1¾" dia. Helipot. Other models give even greater control range in 3" case diameters.*

THE BECKMAN Duodial



The inner, or Primary dial of the DUODIAL shows exact angular position of shaft during each revolution. The outer, or Secondary dial shows number of complete revolutions made by the Primary dial.

A multi-turn rotational-indicating knob dial for use with the HELIPOT and other multiple turn devices.

THE DUODIAL is a unique advancement in knob dial design. It consists essentially of a primary knob dial geared to a concentric turns-indicating secondary dial—and the entire unit is so compact it requires only a 2" diameter panel space!

The DUODIAL is so designed that—as the primary dial rotates through each complete revolution—the secondary dial moves one division on its scale. Thus, the secondary dial counts the number of complete revolutions made by the primary dial. When used with the HELIPOT, the DUODIAL registers *both* the angular position of the slider contact on any given helix as well as the particular helix on which the slider is positioned.

Besides its use on the HELIPOT, the DUODIAL is readily adaptable to other helically wound devices as well as to many conventinnal gear-driven controls where extra dial length is desired without wasting panel space. It is compact, simple and rugged. It contains only two moving parts, both made entirely of metal. It cannot be damaged through jamming of the driven unit, or by forcing beyond any mechanical stop. It is not subject to error from backlash of internal gears.

TWO SIZES—MANY RATIOS

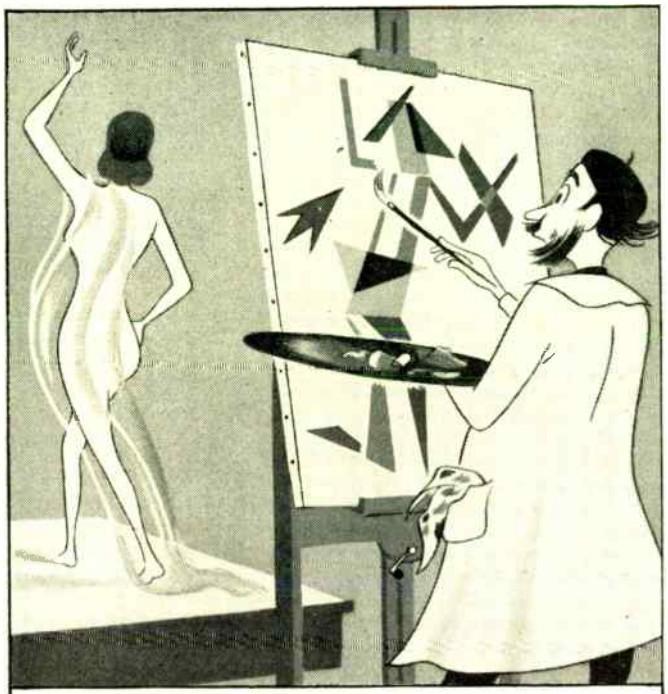
The DUODIAL is now available in two types—the Model "R" (illustrated above) which is 2" in diameter, and the new Model "W" which is 4¼" in diameter and is ideal for main control applications. Standard turns-ratios include 10:1, 15:1, 25:1 and 40:1 (ratio between primary and secondary dials). Other ratios can be provided on special order. The 10:1 ratio DUODIAL can be readily employed with devices operating *fewer* than 10 revolutions and is recommended for the 3-turn HELIPOT. In all types, the primary dial and shaft operate with a 1:1 ratio, and all types mount directly on a ¼" round shaft.

Send for this HELIPOT AND DUODIAL CATALOG!

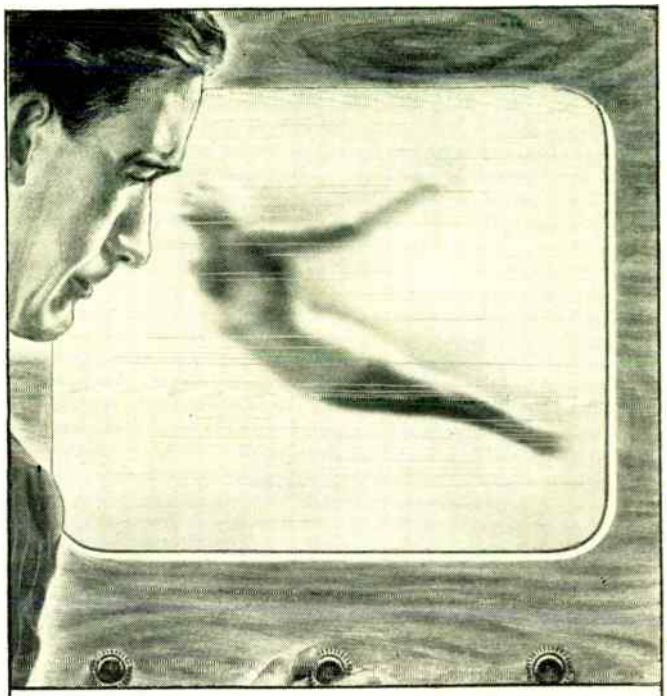
Contains complete data, construction details, etc., on the many sizes and types of HELIPOTS...and on the many unique features of the DUODIAL. Send for your free copy today!

THE Helipot CORPORATION, SOUTH PASADENA 3, CALIFORNIA

How to Improve the Picture



Use Curves



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The satin-smooth, *polyethylene* insulation of ATV line sheds water readily—thus avoiding subsequent impedance discontinuities. Besides, the new-type plastic insulation offers increased resistance to weathering—an important factor where lines run outside.

Count on Anaconda to solve your high frequency transmission problems, with anything from a new type lead-in line to the latest development in coaxial cables.

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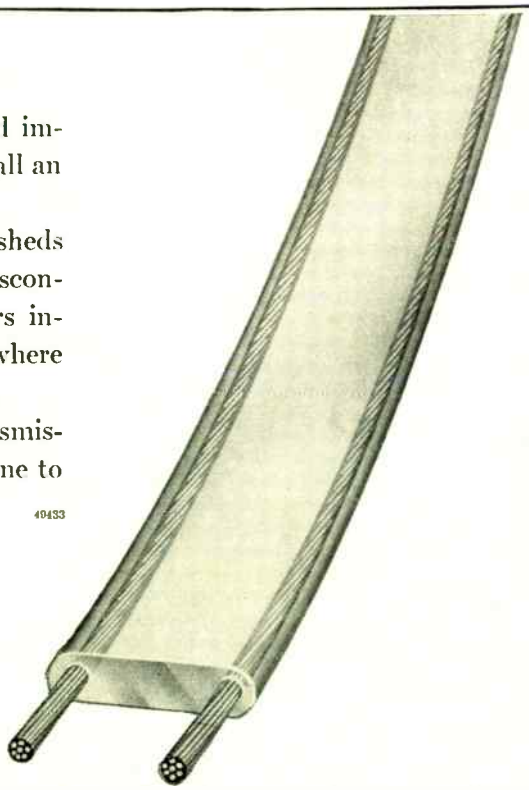

WRITE FOR ATV BULLETIN. Anaconda offers a complete selection of ATV Lead-In Lines for every need: for 75, 150 and 300 ohms impedance unshielded and shielded lines of high impedance. For an electrical and physical characteristics bulletin, write to Anaconda Wire & Cable Company.

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a complete line of hermetically sealed oil-filled HIGH-VOLTAGE COMPONENTS

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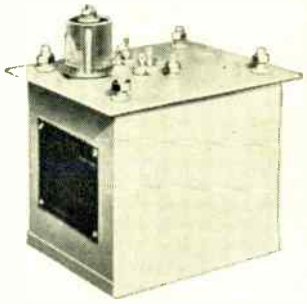


Pulse Transformers

Pulse transformers for use with either hard-tube or line-type modulators. Available in voltage ratings of 10 kv or above. These units are ideal for radar applications, stepping up or down, impedance matching, phase reversing and plate-current measurements. Also suitable for nuclear physics research work, television and numerous special applications in and out of the communications fields.

Resonant Reactors

Resonant-charging reactors, accurately designed and constructed for radar service. Usually required in ratings of 40 kv and below, 1 ampere and below and 300 henries and below. Higher ratings are being built, and can be considered. When required, small- and medium-size designs can be provided with 3 to 1 range of inductance adjustment.

Filament Transformers

Filament transformers available with or without tube socket mounted integral with the high-voltage terminal. Low capacitance. Ratings to match any tubes; insulated to practically any required level.

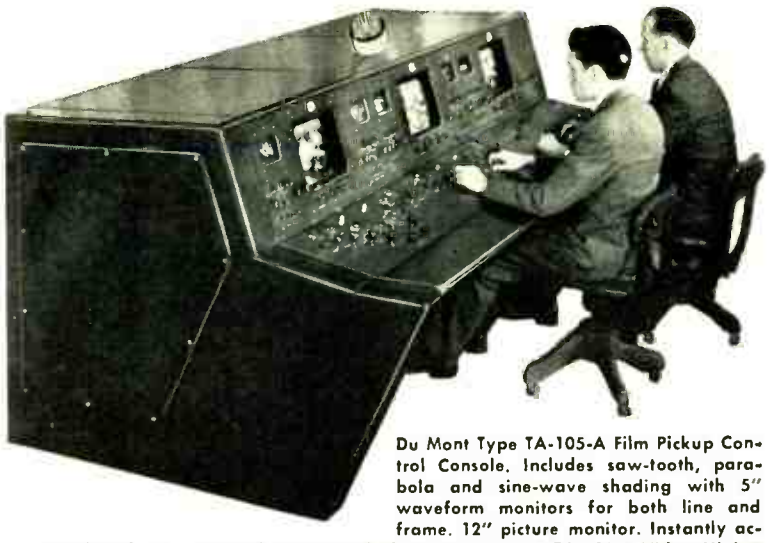
Illustrated here are typical high-voltage components manufactured by General Electric. They can be built to meet Armed Services requirements. All are oil-filled and hermetically sealed—with excellent ability to withstand mechanical shocks and to operate continuously for long periods in widely varying temperatures and atmospheric conditions.

Your inquiries will receive prompt attention. Since these components are usually tailored to individual jobs, no catalog is available. Please include with your inquiry, functional requirements and any physical limitations. *Apparatus Dept., General Electric Co., Pittsfield 42-304, Mass.*

GENERAL ELECTRIC

401-60

The Du Mont Types 5130-B and 5130-C 16 mm. television projectors are designed and built for the rugged requirements of film telecasting. Greater reliability for day-in-day-out operation. Readily accessible mechanism. Easily replaceable parts. Feature-length reel capacity. Maximum optical resolution. Greater light output. High-fidelity sound. Either type recommended, based on style and feature preference.



Du Mont Type TA-105-A Film Pickup Control Console. Includes saw-tooth, parabola and sine-wave shading with 5" waveform monitors for both line and frame. 12" picture monitor. Instantly accessible chassis. Integral design with the Du Mont Type TA-108-B Video Mixing Console and associated equipment which will handle four separate video or composite input channels with automatic or manual "fades" and "lap dissolves" between any video input channels.

For 16 mm. sound-film economy... maximum pictorial resolution... high-fidelity sound... good audience reaction and real sponsor satisfaction—

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Iconoscope Film Pickup SYSTEM

Here's fully-coordinated engineering. From projector to control console, there are no weak links. Each unit does its job as thoroughly as that job can and should be done.

First, a choice of two types of Du Mont projectors designed from scratch and built by specialized craftsmen to insure superlative images and sound from 16 mm. films. Then the Du Mont Iconoscope Film Pickup Head to translate pictorial resolution into precise electronic signals. Finally, the Du Mont Control and Video Mixing Equipment to monitor the pickups for a smooth-flowing program.

"Portions of this program have been on motion picture film" takes on new meaning when handled with Du Mont equipment throughout.

Details on request. Remember, Du Mont means "First with the Finest in Television" from camera to transmitter, and again to the finest telesets* made.

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Du Mont Type TA-103-A Iconoscope Film Pickup Camera. An ideal pickup head for film or slides, using the high-resolution Iconoscope Type 1850-A. Special rim light and back lighting arrangement. Available with fixed pedestal or sliding-track mounting for handling two or more image sources. Mechanical construction such that all components are readily accessible.

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Send for the Mallory Engineering Data Sheets on the RS series. They contain complete specifications for available circuit combinations with respective terminal locations, dimensional drawings — everything the engineer needs.

SPECIFICATION SHEETS

Specification sheets for all RS switches have also been prepared. These sheets are printed on thin paper to permit blueprinting. The sectional drawings indicate standard and optional dimensions—make it easy for you to order production samples built to your requirements.

There is a Mallory switch to fit your design—write for further details.

Design engineers who specify Mallory RS switches *know* they are getting the best that substantial construction and precision manufacturing can produce. They know that Mallory RS switches protect their good name because they provide maximum long-life and efficient dependable service.

Mallory RS switches are available with cam and ball type index assembly, or with positive indexing hill-and-valley double roller type index assembly.

These are the features that make Mallory switches famous for dependability and quality. All are advantages of extreme importance in television and high frequency applications where stability is essential.

- Insulation of high-grade, low-loss laminated phenolic.
- Terminals and contacts of special Mallory spring alloy, heavily silver-plated to insure long life at low contact resistance.
- Terminals held securely by exclusive Mallory two-point fastening—heavy staples prevent loosening or twisting.
- Double wiping action on contacts with an inherent flexing feature—insures good electrical contact with the rotor shoes throughout rotation.
- Six rotor supports on the stator—insure accurate alignment.
- Brass rotor shoes, heavily silver-plated—insure low contact resistance.
- All shoes held flat and securely to phenolic rotor by rivets—prevents stubbing—insures smooth rotation—*minimum of noise in critical circuits.*

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ANOTHER QUARTER-MILE—Along with the Radio Manufacturers Association's twenty-fifth anniversary, this year the radio-electronic industry celebrates its first quarter of a century of commercial operation. Its foundations, of course, were laid during the preceding quarter century, running back through the early 1900's.

But radio-electronic men look forward to far greater technical and industrial developments in the quarter century ahead. This next "quarter-mile", marked by TV, FM, and UHF, promises amazing achievements and progress, far overshadowing all that has gone before.

VHF—UHF?—Recent industry and public discussions of television assignments have demonstrated the confusion and futility of such terms as "Very High Frequency" and "Ultra High Frequency" in today's ever-widening electromagnetic spectrum. Such comparative definitions have already become meaningless and should be dropped from any further use. To avoid further confusion, let's get back to the absolute and specific, such as "50-MC", "500 MC" and similar numerical delineations that will leave no doubt as to what we talking about!

RADIO-GUIDED MISSILES SOON—Ominous new tasks for radio-electronic controls in warfare were outlined by Dr. Karl T. Compton of M.I.T. and General M. S. Fairchild, U.S.A., speaking at a House Committee hearing on a 3000-mile test range for guided missiles. General Fairchild told the committee that "within the next ten years we will be replacing guns and bombs with guided missiles and within fifteen years surface-to-surface guided missiles will have been perfected to the extent that they will have important applications in the field of tactical and strategic bombardment operations"—but only if research can be conducted over a long range. General Fairchild also said that missiles with ranges up to 500 miles would be ready in 1949, but as yet there is no range long enough to test them.

RED TAPE STIFLES IMPROVEMENTS—In any program of commercial equipment development, the designing engineer is above all cost-conscious, and can often balance a substantial part of his salary by saving a penny or so in the manufacturing cost of a component or item. This factor is of negligible or minimum importance in designing military equipment. In fact, the enormous cost of bucking red tape has prevented many excellent improvements being used or even getting reported.

TONS OF PAPER WORK—In looking back over published reports of production records of military equipment during the last war one is struck by the frequent, and at times, only, reference to *dollar* values as the only criterion of production levels. Any manufacturing company which did business then, cannot forget about the tons of extra unnecessary paper work that grew up around each job—no matter whether simple or complex. These reports, monthly, weekly, daily, and sometimes it seemed, hourly, covering many variations of the same data and made to different agencies, represented a useless task no one wanted.

DAILY REPORTS; EQUIPMENT STALEMATED—Going to non-technical groups it seemed doubtful if their thousands of reports were ever read, except by statisticians who gloried in how many millions of dollars we spent each day! In a number of cases daily production reports were insisted on to the extent that they had to be phoned in to Washington each day. Meanwhile the actual equipment, built under the stress of overtime scheduling, was being allowed to pile up for months before being shipped!

WASTED PRODUCTION ENERGY—One of the most needed research programs relating to military (and this refers to all the services) equipment needs, would be to figure up how much of this paper work is "necessary." Possibly a gigantic overall system of punched cards covering all contracts would permit pertinent data to be kept up to date by simple coded telegrams.

Certainly there should be better use for the energy spent in getting out these records, to say nothing of the saving in printed forms and filing facilities.

ST. ELMO'S FIRE, that legendary static discharge from ships' mizzentops and church steeples, which we used to read about in boyhood days, is now with us to plague home TV reception on tall isolated antennas—though little has been reported on it. A dozen times a year, either on cold clear starry nights or during low-lying thundercloud conditions, our own 50-ft. antenna sets up intermittent or continuous clicks and roars, which may spoil or even drown out the sound, while accompanying white spots flash across the picture screen. We have tried completely insulating the folded dipole from the grounded metal mast, also grounding its midpoint, without complete success. Next step will be to mount a series of needle points at the top of the mast to drain off the earth's electricity with least sparking.

The "Leadership" Plan in

Three Hazeltine and seven sub-contractors' engineers engaged in development of new types of electronic measuring and test equipment

How Hazeltine Electronics Corporation achieved greater usefulness of personnel and available facilities by teaming up medium-sized manufacturers under "leader"

MUCH interest was aroused by publication in March TELE-TECH of the Munitions Board Mobilization Plan for the Electronics Equipment Industry, a plan which, latest information indicates, is being motivated.

One of the most interesting aspects of this Plan, to judge by inquiries from readers, was that described as follows:

"Following the successful pattern employed in World War II in the electronics industry of providing leadership in educating numbers of companies to the point where they can assume the responsibilities of prime contractors—releasing their primes to devote more time and facilities to research, development and pilot production of new equipments."

What was this leadership plan? Who pioneered with it? Who helped to make it a successful pattern?

Seeking the answer to these questions, we went to Fred R. Lack, Industry Chairman of the Electronics Equipment Industry Advisory Committee of the Munitions Board, and to members of its Task Committee. They referred us to W. A. MacDonald, president of Hazeltine Electronics Corporation, another member of Task Committee No. 1, who contributed many of the ideas incorporated in The Munitions Board Plan.

"At the start of World War II," it was explained, "the situation was doubly difficult; the armed forces needed production and the electronic industry needed to get into production. There was a crying shortage of trained electronic engineers. Many qualified people were eager to get to work — but they lacked the know-how.

"At that point, the Navy asked Hazeltine to take the lead in a plan for production of military electronic equipment which would utilize the tremendous production capacity of home-radio receiver manufacturers. Hazeltine accepted, and other concerns followed the pattern or adapted it to their own operations."

From the Hazeltine archives, these facts were developed:

Although designs of much useful radio-electronic apparatus were available at the beginning of World War II, this equipment had been produced previously only in relatively small quantities and over a period of years. If it had ever been designed for large production, the practices and processes had been abandoned long since.

Much of the equipment of this class had been custom-built rather than designed for mass production. When it was required in quantities, it had to be either redesigned or the old slow process of manufacture followed.

With the advent of World War II, the few large companies of the

Electronic War Production

United States quickly became heavily overloaded both with engineering and production problems.

This condition resulted from three factors: (1) military business in peacetime normally flows to companies with the larger engineering organizations; (2) desire to place business where it will maintain research and engineering organizations needed in wartime; and (3) the volume of peacetime military business prior to World War II, the bulk of it being communications apparatus; radar and many of the other present apparatus of electronic equipment were yet in the dream stage.

The several large companies, RCA, GE, Westinghouse and AT&T, were first selected by the procuring Services to supply the electronic needs of the United States military forces, principally because of their potential production capabilities and the fact that they had substantial engineering departments. Additionally, they had had, with few exceptions, the only experience in manufacture of military equipment.

A fact that was perhaps not fully recognized was that, with the exception of RCA, the electronic activities of GE, Westinghouse and AT&T represented only a minor fraction of the country's useful production capacity. The electronic activity of all of the above companies combined in fact represented only 15% to 20% of the industry's output. The remaining radio industry output was divided among some 45 assemblers and some 100 to 150 parts suppliers.

Engineering Allocations Increased

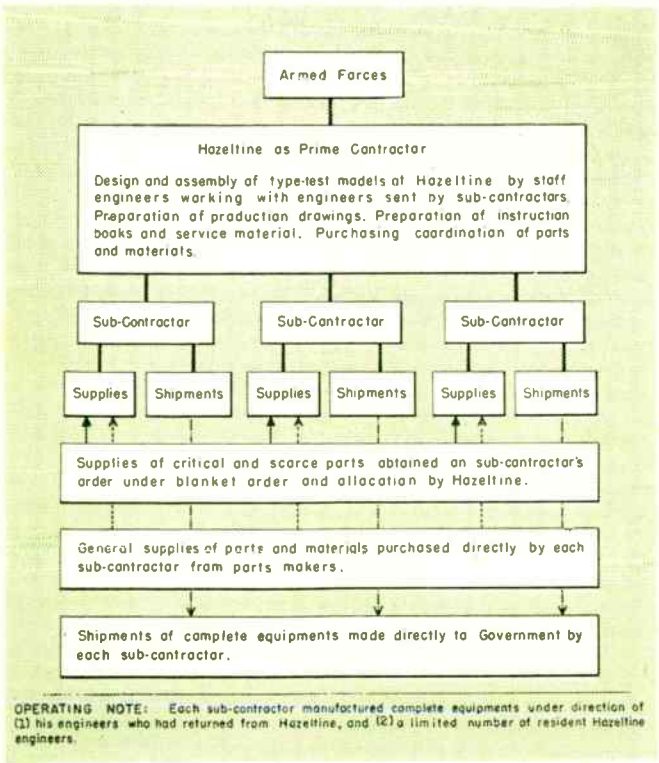
A survey of the radio industry early in 1940 disclosed that the average radio-set manufacturer devoted between 1½% to 2% of its total billings to engineering activities. Engineering activities included design, development and processing of models through to the so-called type test stage, just prior to manufacture. Subsequent examination of the engineering content required for a reasonable cross-section of military equipment, however, soon indicated that 10% to 15% was necessary to meet the special needs of the Services.

A second survey of the industry, made late in 1941, disclosed that although the several large manufacturers were heavily overloaded with military business, most of the industry including some large companies and the great percentage of medium and smaller companies, had little or no such orders from the armed forces. This was because the procuring Services were not convinced that the remaining companies were qualified to solve the engineering details involved in production of military equipment. This 1941 survey further disclosed that there were hundreds of acres of factory space available and unused, and thousands of skilled and semi-skilled workers idle.

On the other hand, however, there were insufficient engineers available to make up the difference between the 10% to 15% engineering content required for military work and the 1½% to 2% actually being used by the commercial radio industry. Either the manufacturer would have to increase his engineering staff, or he must reduce the volume of work that normally could be processed through his facilities, in

(*Continued on page* 66)

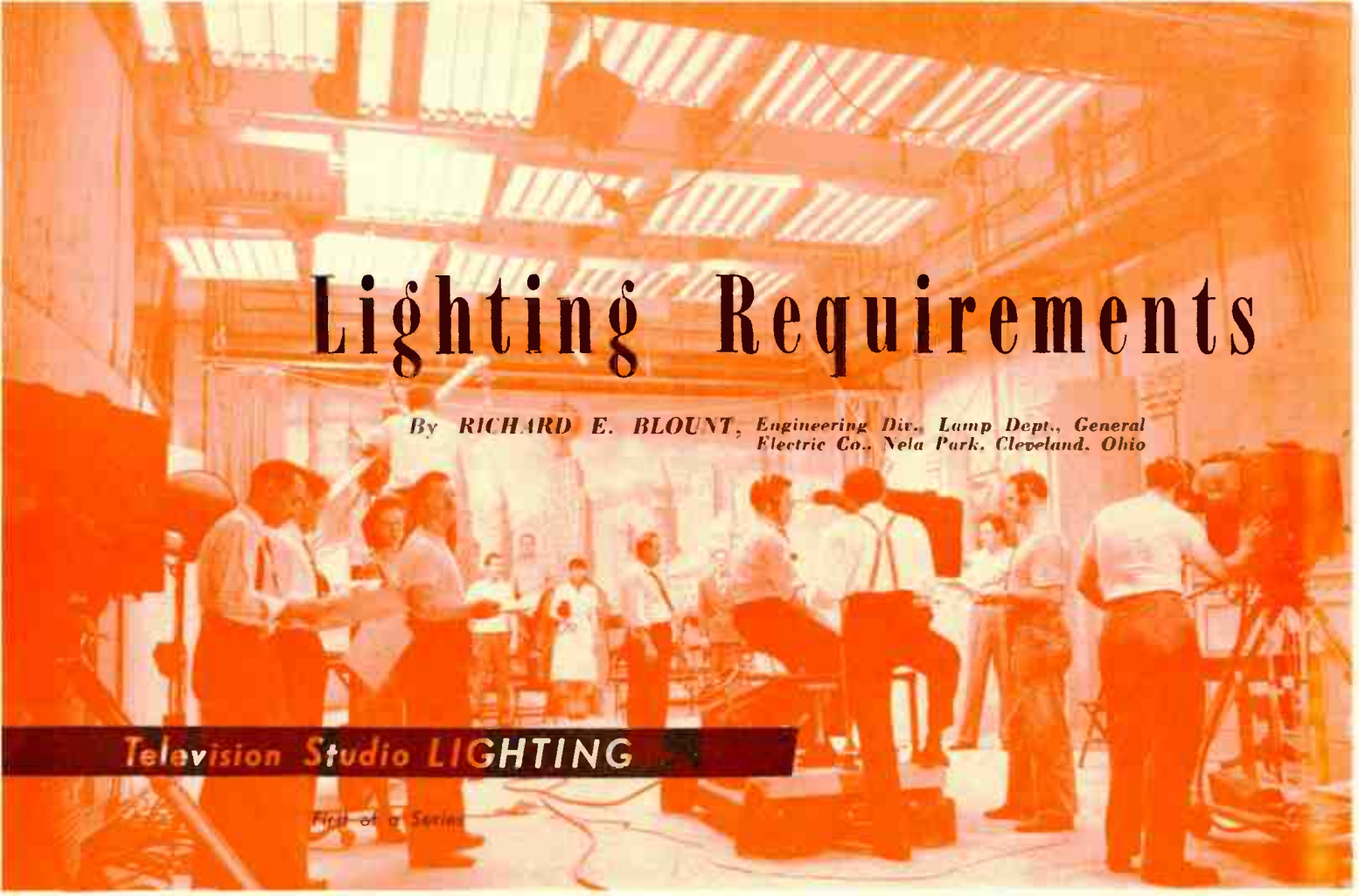
Chart shows how Hazeltine leadership plan worked during World War II to provide U. S. services with needed electronic equipment



Hazeltine engineer and two sub-contractors' engineers checking performance of new electronic apparatus in development laboratory

Lighting Requirements

By RICHARD E. BLOUNT, Engineering Div., Lamp Dept., General Electric Co., Nela Park, Cleveland, Ohio

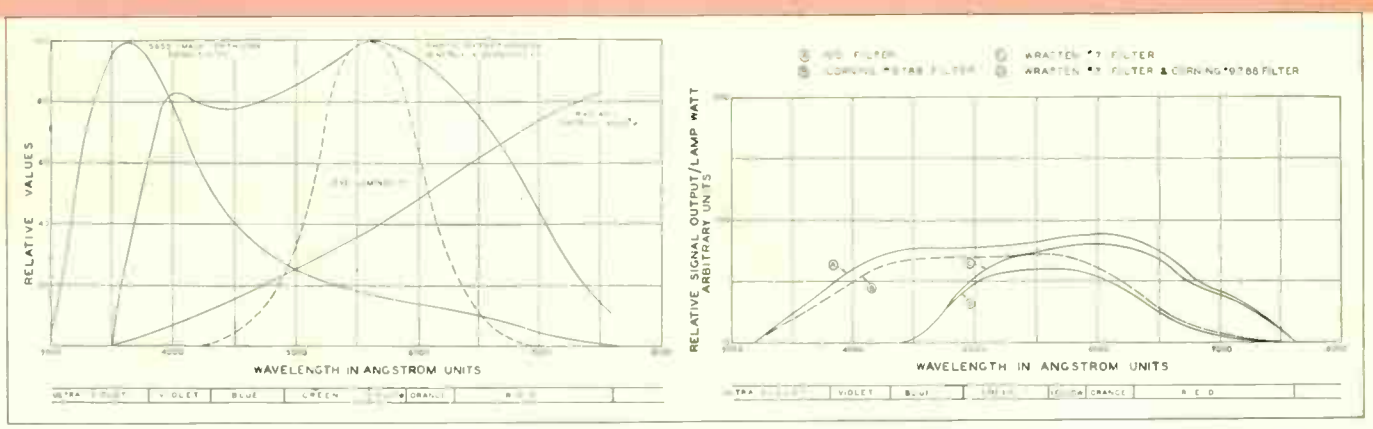


GOOD lighting, intelligently administered by a competent studio engineer, is essential if the full dramatic possibilities of television are to be realized. Good lighting means light sources of various types properly controlled to serve the many lightning needs of the television studio. Intelligent administration includes not only the proper manipulation of the lighting to assist in the program director's interpretation of the theme but also control of the lighting levels and color quality to fit the requirements peculiar to the camera tube and associated equipment.

The engineer's first task is to provide sufficient light over the staging areas to insure an acceptable signal-to-noise ratio. Secondly, the lighting must cause the viewing audience to focus their attention where the director wishes. Thirdly, light must produce a three-dimensional effect on the objects in focus. The characteristic features of the objects must be made to have depth by the creation of shadows and highlights in the proper places. In addition, the objects must be made to stand out from the background by the use of outlining highlights. Finally, the background or scenery should be adequately illuminated so that from a program-

Fig. 1: Photo-effectiveness curve of 5655 orthicon derived from 3000°K. incandescent light and camera tube's spectral response

Fig. 2: Relative signal output per lamp-watt of the 5655 orthicon using various filters to obtain more favorable spectral response



Camera equipment limitations, locale variations, necessitate carefully controlled light sources for superior picture quality

# of Television Studios

ming point of view, the locale of the action is established. The net result of these lighting arrangements is the creation of a mood that can be altered to suit the action by adjusting the balance of the various light sources.

These basic lighting requirements are also common to the stage and to the photographic studio but their attainment is different in some respects due to differences in the camera and viewing tube characteristics and fundamental differences in programming methods. Stage presentations are perhaps most easily lighted because the receptor is the human eye that responds almost instantly to a range of lighting levels of about 5,000 to 1. The photographer, either motion picture or still, can record a much more limited range of lighting levels and, if he is using black and white film, he must do it on media whose response to color differs from that of the eye. The television producer is limited at present to a combined camera and viewing tube lighting range of about 20 to 1 for any one picture and, as with photographic film, the color response of the camera tube departs radically from that of the eye. Therefore, as with black and white film, corrections by means of filters at the camera lens are necessary to render colors in approximately the same brightness scale as the eye views the original scene.

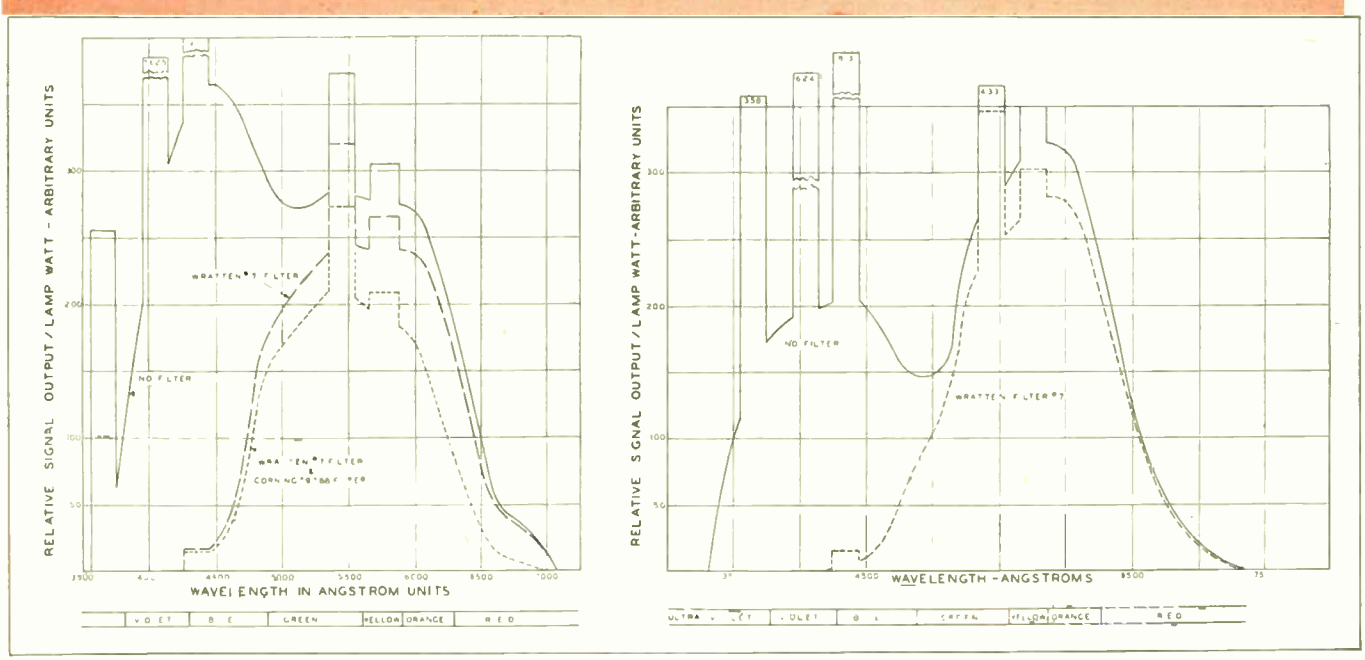
Good pictures can be obtained with television systems that will handle only a 20 to 1 range of brightness for one particular camera adjustment. In a typical shot, a man's suit may be the darkest portion of the picture, while his shirt, if white, probably is the brightest due to differences in reflection factors. A black suit with a reflection factor of 2%, and a shirt of about 70% results in a brightness range of 35 to 1. No detail will show in the suit since the controls will probably be adjusted to prevent "blooming" of the shirt. This situation can often be remedied by a more fortunate choice of garments. A buff-colored shirt will help a great deal since its reflection factor may be only 50%, resulting in a brightness range of 25 to 1. Further, a lighter colored suit may be substituted to materially decrease the ratio. This technic of controlling the brightness ratio should be utilized in scenery design and supporting property, as well as in the costumes of the actors. In general, faces of people should be brighter than the backgrounds. This treatment focuses attention on the actors and also prevents the DC restorer from causing faces to darken as so often happens when the actors move in front of brighter areas.

To carry out further the idea of controlled brightness, it must be remembered that the 5655 or 5769 image orthicons do not "see" colors as does the eye. (Fig. 1) An inspection of the sensitivity curves of these tubes shows that the greatest response (current output) is obtained from light in the ultraviolet and blue regions. Objects reflecting such radiation appear on the viewing tube as grey or white, whereas

(*Continued on page* 58)

Fig. 3: Photo-effectiveness of the 5655 image orthicon using 4500°K. white fluorescent light. Note exclusion of ultra-violet by filters

Fig. 4: Orthicon photo-effectiveness when 3500°K. light is employed. Extrusions in the curve are spectral lines of mercury



Voltage Multiplier Systems

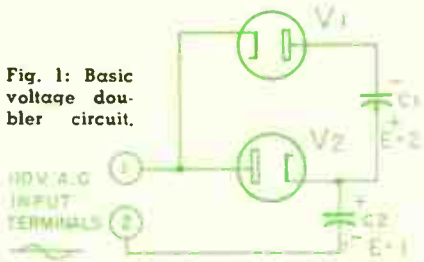


Fig. 1: Basic voltage doubler circuit.

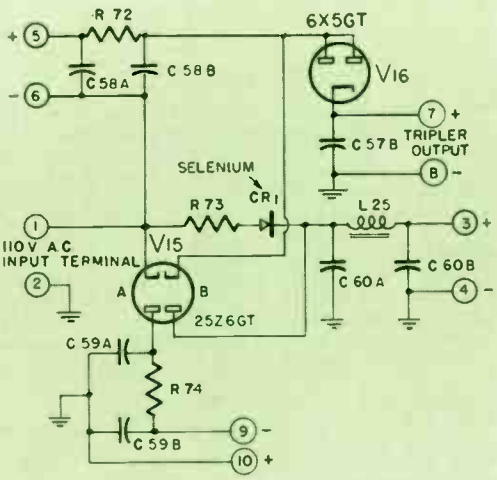
POWER supplies incorporating voltage multipliers are to be found in increasing numbers in modern television receivers. Such systems are being used not only to double the voltage, but in many instances are utilized for voltage tripling and quadrupling purposes. The circuits employed are both practical and ingenious and serve to save space, eliminate the weighty power transformer, and make for lower cost. Their growing popularity makes it well worthwhile for the engineer, technician or serviceman working with sets incorporating such supplies to become familiar with the basic circuits involved.

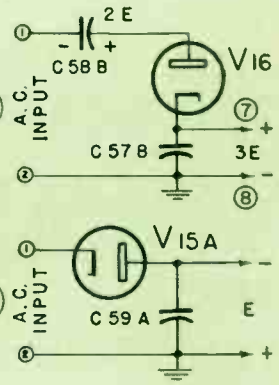
Voltage doubling circuits are not new and extensive use of them is found in many electronic devices. A brief review of the foundation circuit, however, will serve as a basis for analysis of tripling and quadrupling circuits used by various television receiver manufacturers. A typical doubling circuit employing two diodes (or a duo-diode tube) is shown above. At one alternation of the AC current, input terminal No. 1 will be positive and terminal No. 2 negative. V2 will then conduct and charge C2 with voltage (E) of a polarity as shown.

During the time V2 conducts, V1 is in a non-conducting state, inasmuch as the plate is minus with respect to the plus cathode. When the next alternation of AC current arrives, it makes terminal No. 1 minus and terminal No. 2 plus. V2 now no longer conducts, but V1 does conduct by virtue of its plate being plus with respect to the minus cathode. Since C2 was previously charged to peak line voltage, its charge in combination with the line voltage is now impressed across C1, thus charging C1 to 2E.

Thus by successive doubling, designers obtain sufficiently higher voltages to operate a receiver. Notable examples of this procedure appear herewith.

In this group the power supply section of certain Hallicrafter receivers are shown (Fig. 2 below left). At right Fig. 4 is shown how the negative single voltage source and the tripler stage are combined to quadruple. (Model T54).
On the positive swing of the AC line voltage, C60A charges through CR1 and R73 to voltage "E." During this time (V15-B being non-conductive). On the negative swing of the line AC, this voltage adds to the line voltage to charge C58B to double voltage through V15B which now conducts. During this time the Selenium rectifier is not conducting, making it a virtual open circuit.





On its positive swing, the line voltage adds to 2E across C58B, to charge C57B through V16 to a voltage 3E. Fig. 4b is again a simple half-wave rectifier where the plus polarity is connected to ground. Its output is approximately equal to the voltage obtained from terminals 3 and 4, except for reversed polarity. Added to the voltage across terminals 7 and 8, it provides a quadruple voltage, 4E, used as plate supply to the vertical and horizontal sweep amplifiers.
Fig. 3: (right) indicates the single and double voltage sections in simplified form.

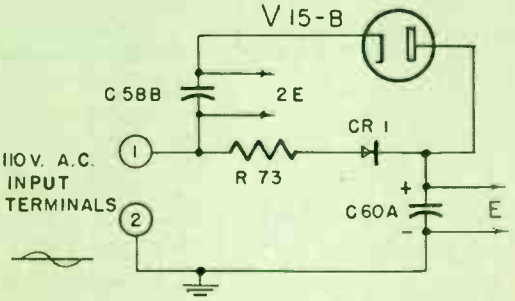
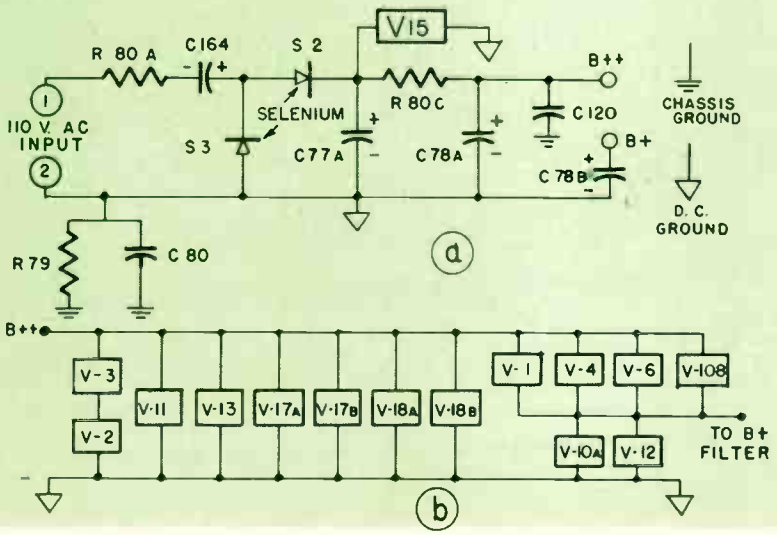


Fig. 5: A voltage doubling system of the Motorola TS-4F chassis is the VT-71 series. The unusual feature here is that the tubes themselves act as voltage dividers. The Two B voltages are delivered. The voltage multiplying takes place in a manner similar to that described above. R80A is used for current limiting.

In Fig. 5b, terminals as marked are connected to those in 5a. Plate voltage for V5 is taken directly from C-77A. For the other tubes the B++ output of the filter section is used. V3 and V2 are in series from B++ to DC ground, and that B+ is obtained by using the six tubes. V1, V4, V6, V10B, V10A, and V12 in a series-parallel combinaton.



in TV Receivers

By M. MANDL and N. SHER,
Television Instructors, Temple University Technical Institute, Philadelphia, Pa.

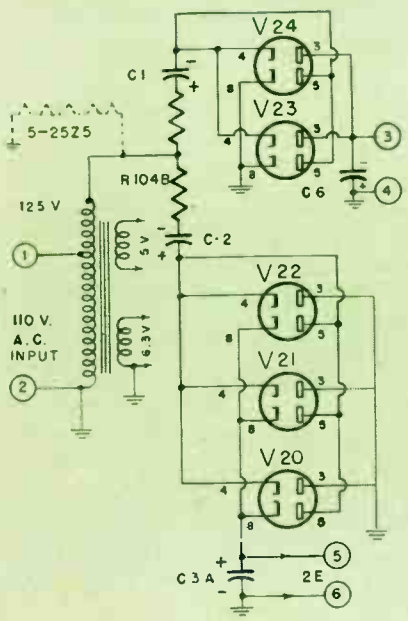
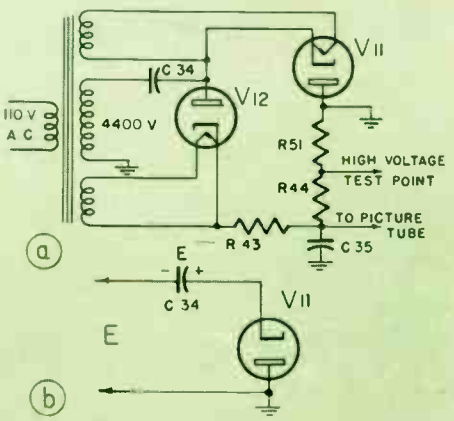


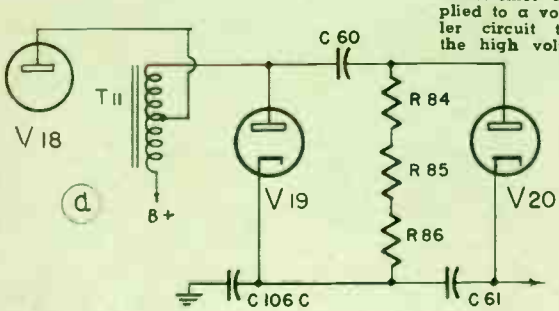
Fig. 6: In the Emerson, Model 571, five 25Z5 rectifier tubes are utilized. A parallel combination of two provides one doubler system and a parallel combination of three another doubler. The use of the rectifiers in parallel permits comparative larger amount of current to be used in TV receiver. The combined use of the two doublers, gives quadrupling action in the Emerson.
Fig. 6 shows the low voltage power supply section of this particular Emerson receiver. The 125 volts from the auto transformer secondary provides the heater voltage for the five 25Z5 rectifier heaters in series. Diode sections marked 3 and 4 of both V23 and V24 are paralleled as are sections 5 and 8 of these same tubes. Diode sections 3 and 4 of V20, V21 and V22 are in parallel as are sections 5 and 8. They are connected as a voltage doubler with positive output. A plate supply voltage proportional to 4E is used for the sweep circuits by combining the outputs of the two doublers. Output 4E in Fig. 6 is obtained from terminals 3 and 5.

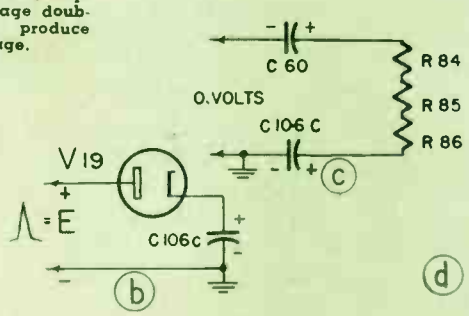


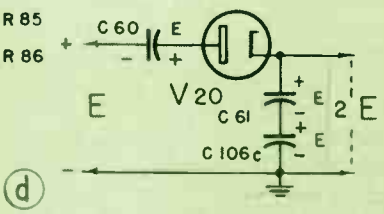
In the Farnsworth FV-200 set, Fig. 8a below left shows the picture tube power source. Here V18, used in the "beam relaxor" circuit which generates the horizontal sweep current, cuts off during the horizontal retrace, and a positive pulse is produced at its plate. This pulse is stepped up by the auto transformer and is supplied to a voltage doubler circuit to produce the high voltage.

Fig. 7a shows the DuMont RA-101 voltage doubler source of high voltage for the picture tube. This differs from the usual inductive fly-back or high frequency oscillator type of second anode supplies so common that a power transformer is used, with a secondary delivering 4,400. On the negative swing of this high voltage secondary, C34 charges to voltage E through VII, as shown in Fig. 7b.

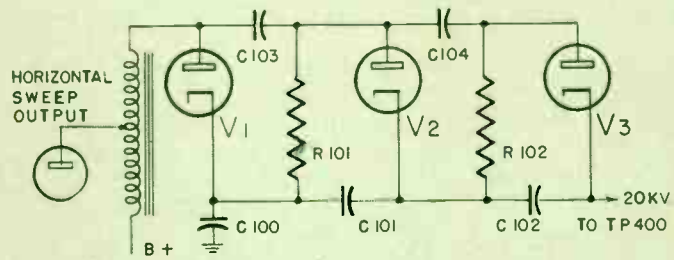
On the positive swing voltage E on C34 adds to the secondary voltage (input) to charge C35 through V12 and the limiter resistor R43. The charge thus placed on C35 is proportional to 2E. During this time VII is not conducting. R44 and R51 are used as a bleeder and voltage divider to facilitate voltage measurement during servicing. The voltage across R 51 is about 1% of the total.







During the pulse, C106C charges to voltage E through V19. Between pulses, C106C will discharge through R84, R85 and R86, thus charging C60. After several cycles each capacitor builds up to voltage E (Fig. 8c). During pulses, voltage E on C60 adds to pulse voltage, to charge C61 and C106C through V20 to a total voltage 2E, with voltage "E" appearing across each. (Figure 8d) The output is the sum of the voltages across C61 and C106C.



The Philco high voltage supply Fig. 9 (in the Model 48-2500 receiver) furnish somewhat over 20,000 volts for the TP-400 projector tube. This is a triple circuit using three sections. The output is the sum of the voltage across C100, C101, and C102, each of which is charged to approximately 7,000 volts. C103 and C104 are likewise charged to approximately 7,000 volts. The signal which is applied to the tripler is the positive pulse developed across the auto transformer of the horizontal output transformer from the horizontal fly-back during retrace.

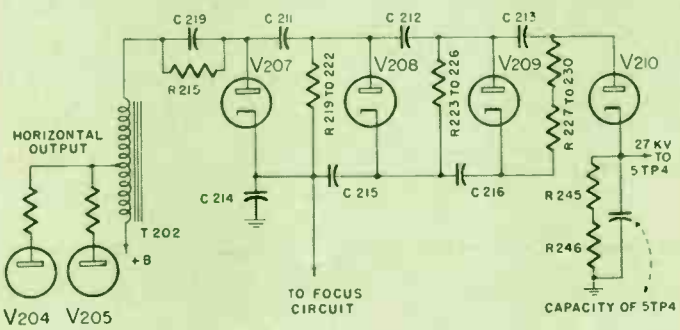


Fig. 10: The 5TP4 projection tube power supply of the General Electric Model 901 uses a voltage quadrupler circuit to furish 27,000 volts. The counterparts of C219 and R215 do not appear in the other high voltage sources, previously discussed. The values of these parts, (470 mmfd. and 47,000 ohms) are small enough so that C219 will be discharged through R215 between charging pulses. The DC voltage across C219 will be small compared to the voltages across the other capacitors and can be neglected insofar as its effect on the rest of the circuit is concerned. C219 and R215 will act to limit the charging currents flowing into the other capacitors.
From the cathode of V209 to ground a voltage of 3E appears since each capacitor (excepting C219) is charged to voltage "E"—the pulse voltage. When a positive pulse appears at the top of the auto transformer, the voltages across C211, C212, and C213 (each of value "E") add to the pulse voltage to charge the capacity between inner and outer wall coatings of the 5TP4 to a potential of 27,000 volts, (through V210).
The voltage across C214 is applied to a resistance voltage divider network from which focusing voltage for the 5TP4 is obtained. This use of the 5TP4 tube conductive coatings for a capacity is conventional. The high voltage is applied across inner and outer aquadag coatings, with the glass acting as the dielectric.

Barium Titanates as Circuit Elements

Characteristics and applications of piezo-electric ceramics in the production of numerous components for electronic circuits

Part Two of Three Parts

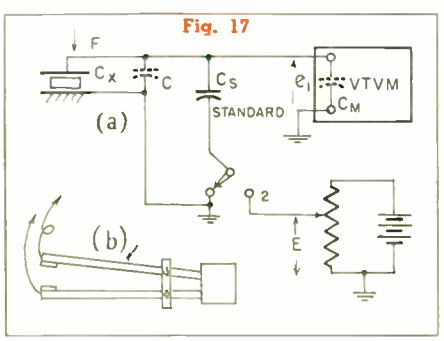
By A. I. DRANETZ, G. N. HOWATT, J. W. CROWNOVER,

Gulton Manufacturing Corp., Metuchen, N. J.

IN general, there are two systems for measuring the piezo effect of crystals: dynamic and static. Most of the former utilize measurements of dynamic impedance by bridges or other means, (ref. 25 page, 385 ff). Recently, Bauer has reported [19] a more direct low frequency system of measurement: thin electroded sheets are placed upon a small support and a driving pressure head placed thereon is driven by a magnetic speaker coil assembly at audio frequencies and the output voltage is measured. Although several measurement schemes have been used at the Gulton Mfg. Corp. the static system has proved most successful.

Here, an electroded sample ½" x ½" x .010" is placed on a rubber pad. A known weight is then applied through the arrangements, Fig. 17b. A high impedance voltmeter is connected to the leads of the jaws while they are closed (i.e., while the sample is compressed). Opening the jaws then releases the pressure and causes a charge to be built up between the electrodes, which is measured. Since the voltage measurement must be converted to charge, the element and stray capacitance must be taken into account. To do this, a simple circuit addition has been made and is shown in Fig. 17a.

Fig. 17



The test specimen is placed between the rubber jaws under full pressure with the switch in the (1) position. The voltmeter is shorted out momentarily to remove the induced piezoelectric charge. The upper jaw is then lifted and e_1 is noted on the voltmeter. The switch is then sent in position (2) and the voltage E is adjusted to give the same voltmeter reading. The equivalent circuit of the piezoelectric material itself is shown in Fig. 18(A). In the first instance,

$$e_1 = \frac{Q_1}{C_d + C_s + C_m} \qquad (1)$$

where C_d is the distributed capacitance. The charge Q_1 built up on C_d, C_s, and C_m before breaking the electrical connection is:

$$Q_1 = \frac{e_x c_x (C_s + C_d + C_m)}{(c_x + C_s + C_d + C_m)} \qquad (2)$$

$$e_1 = \frac{e_x C_x}{C_x + C_s + C_d + C_m} \qquad (3)$$

combining (1) and (2). Similarly with the switch in position (2) and the jaws closed

$$e_1 = \frac{e_x c_x}{C_x + C_d + C_m} \qquad (4)$$

$$Q_2 = \frac{EC_s (C_x + C_d + C_m)}{(c_x + C_s + C_d + C_m)} \qquad (5)$$

A combination of equations (4) and (5) yields (6) and (3) and (6) yields ( )

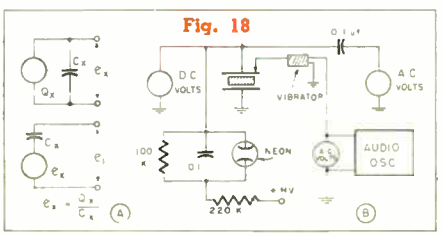
$$e_1 = \frac{EC_s}{(c_x + C_s + C_d + C_m)} \qquad (6)$$

$$e_x c_x = EC_s = Q_x \qquad (7)$$

In this manner, it is merely necessary each time to record the balancing voltage E and multiply it by the standard capacitance C_s, to obtain the piezoelectric charge which divided by the jaw weight gives the piezoelectric constant. To measure the hydrostatic sensitivity of barium titanate, the jaws are replaced by an oil pressure chamber. The sample is held in a modified automobile spark plug with the ungrounded lead brought out through its center lead.

We are also presently engaged in determining the induced piezo effect under various conditions using test equipment similar in nature to that of Bauer except that ten samples can be tested simultaneously in an oven up to temperatures of 180°C. (See Fig. 18B.) This

Fig. 18

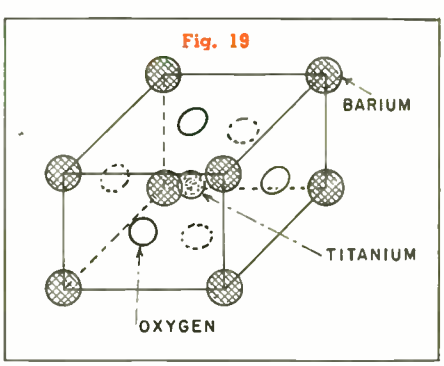


arrangement allows the sample to be charged with AC and DC potentials and further permits the sensitivity to be measured while charging with DC. The neon light is a short circuit indicator.

Physical Nature of Piezo Effect

The physical nature of the piezo effect in barium titanate is now partially understood. In a unit cell of barium titanate, the titanium ion is at the center of the barium octahedra and an oxygen ion is located in the center of each of the six sides of the cube, Fig. 19.

Fig. 19



The titanium atom is held in its position in the center of the cube not only by an ionic bond, but by a covalent bond as well, vibrating toward and away from the oxygens, and sharing electrons with them. Because of the electrostatic coupling between the atoms, the oxygen and barium ions vibrate to some extent with the vibrations of the titanium ion. Above 120°C, the Curie temperature, the titanium ion seems to move around in random fashion and the statistical average displacement of charge centers is zero.

Below this temperature, i.e. between 10°C, and 120°C, the titanium picks out a favorite neighboring oxygen and oscillates with it, sharing with it an electron. The resultant oscillations of the surrounding barium and oxygen ions are transmitted to the titanium ions in the immediate neighboring cells, and soon all the cells of a given group are oscillating in phase, with the center of oscillation of all the titanium ions shifted in the same direction. This spontaneous shifting of centers of oscillation of the titanium ion in a direction parallel to a crystallographic direction, the so-called c-axis is evidenced in X-ray studies by the change in "C" to "A" axis ratio from 1.0000 to approximately 1.0050 (as in Fig. 3) as the temperature is lowered through the Curie point. This spontaneous polarization thus results in a first order transition from the cubic to tetragonal cell structure as the barium titanate is lowered through the Curie temperature.

At the other two Curie temperatures a similar transition takes place. As the temperature is lowered through −5°C, the titanium ion suddenly shifts from its vibration in a direction toward one oxygen ion to a direction half way between two nearest oxygen ions .As the temperature is lowered through −70°C, the direction of vibration of the titanium ion shifts to that midway between 3 oxygen atoms, resulting in another phase change.

Several research groups have been growing single crystals of barium titanate by melting a mixture of TiO_2, $BaCO_3$, and $BaCl_2$ (Matthias[26,27,28]). Investigations are also being conducted to determine the effect of supplementary agents upon the growth and structure of the crystals[29,30]. These single crystals have aided in the study of the domain patterns in barium titanate. Normally, domains begin to grow simultaneously throughout the crystals and since the titanium ions can shift in either of the three cube-edge directions, the directions of spontaneous polarization of neighboring domains are almost perpendicular to each other.

The shifting of these centers of oscillations can be controlled to a relatively large extent by the application of an external potential, causing the growth of the favorably oriented domains at the expense of those in other directions, an effect similar to that of ferromagnetic domains. The accompanying lattice distortions are a direct measure of the piezo effect. The internal mechanical strains of the domain structure have been viewed under a microscope utilizing polarized light. A series of such pictures, taken by Matthias and von Hippel[24], show this effect upon domain structure of the variation in the applied potential.

Fig. 20

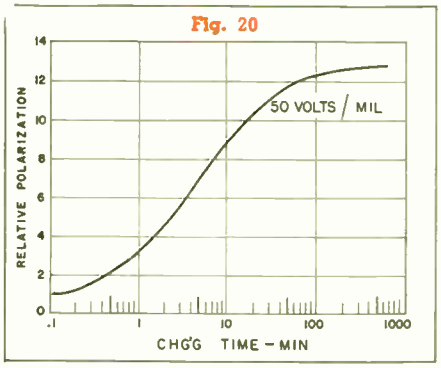
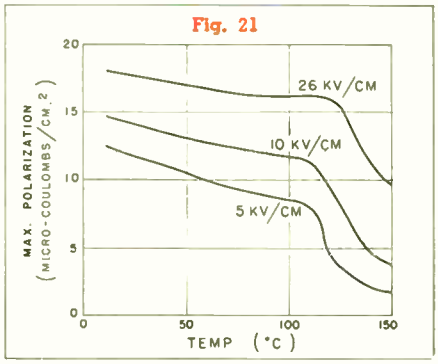


Fig. 21



This mechanical strain accounts in large measure for the creeping of polarization with increasing time of applied charging potential as shown in Fig. 20 and also limits the action of several domains turning into a single domain. Incidentally, when a high DC potential is applied across a barium titanate slug, one can hear a Barkhausen noise. Newton, et al.[31] have estimated that these "click" regions are approximately 10^{-9} cm^3.

It has been found that the maximum saturation polarization at field strengths of 20,000 volts/cm is (for a single crystal) approximately 16 microcoulombs/cm^2[32]. Hulm has also plotted the maximum polarization as a function of temperature for several fields Fig. 21.

While one reason for the limit in polarization is the mechanical strains caused by lattice distortion, another possible reason for the limiting polarization is the electric shielding action set up around some domains by surrounding domains, which because of different polarization directions offer different dielectric susceptibilities to the applied field.

At any rate, standard procedure for sensitizing a material is to apply a high DC field (up to 600 volts per mil) for a period of approximately one hour to line up many of the domains. Due to the mechanical wedging action, most of the domains so aligned keep their directions after a relaxation period of several days. The aligned dipoles then contribute to the piezoelectric coupling when strained mechanically or an electric field is applied, while the randomly oriented dipoles have a net piezo effect of zero.

Piezoelectric materials have many and varied uses in the fields of science and engineering. Of such materials barium titanate offers certain definite advantages. For example its extremely high dielectric constant permits barium titanate to be coupled to relatively low impedance circuits. While quartz is very stable

(*Please turn to next page*)

Fig. 22: Approximate operating temperature range of certain piezoelectric materials

	Lower Limit	Lower Working Limit	Upper Working Limit	Upper Limit
Rochelle Salt	Unknown Below −160° C	−30° C	45° C	Melts at 55° C
Ammonium Phosphate	Disintegrates −118° C	Unknown	Becomes electrically conductive 60° to 80° C	Unknown (over 100° C)
Barium Titanate	Unknown	Unknown	110° C	Loses piezoelectric properties at 120° C

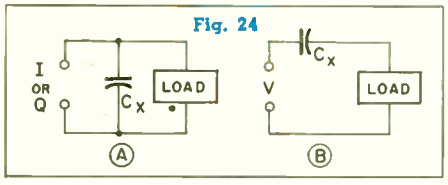
BARIUM TITANATES AS CIRCUIT ELEMENTS (Continued)

	1	2	3	4	5	6	7	8	9
	Bulk Velocity V_c CM. PER SEC.	Density ρ	Piezo Strain Coefficient e COUL./SQ. CM.	Young's Modulus ① $E = V_c^2 \rho$ DYNES/ SQ. CM.	Elastance (Compliance) l $S = \frac{l}{E}$ SQ. CM./DYNE	Piezo Stress Coefficient ① d = es COUL./DYNE	Specific Dielectric Constant K	Unit Capacitance $C_o = 8.85 \times 10^{-14}$ K FARADS/ SQ. CM. / CM.	Unit Open Ckt Output $V = \frac{d}{C_o}$ VOLTS/CM. PER DYNE/ SQ. CM.
Quartz—X cut	② 5.7×10^5	② 2.65	② 0.176×10^{-4}	8.61×10^{11}	0.116×10^{-11}	⑦ 0.0204×10^{-15}	② 4.5	0.398×10^{-12}	0.512×10^{-4}
ADP—45° Z cut	② 4.92×10^5	② 1.80	② 0.493×10^{-4}	4.37×10^{11}	0.229×10^{-11}	0.113×10^{-15}	② 14	1.24×10^{-12}	0.91×10^{-4}
Rochelle—45° X cut	④ 2.4×10^5	② 1.77	⑤ 5×10^{-4}	1.04×10^{11}	0.961×10^{-11}	⑧ 4.81×10^{-15}	⑥ 200	17.7×10^{-12}	2.72×10^{-4}
Rochelle—45° Y cut	⑤ 2.7×10^5	② 1.77	② 0.307×10^{-4}	1.29×10^{11}	0.775×10^{-11}	0.238×10^{-15}	② 10	0.885×10^{-12}	2.69×10^{-4}
Tourmaline—Z cut	② 7.54×10^5	② 3.0	② 0.333×10^{-4}	17.0×10^{11}	0.059×10^{-11}	0.0196×10^{-15}	② 5.5	0.487×10^{-12}	0.403×10^{-4}
Polycrystalline Barium Titanate	⑦ 4.2×10^5	5.55	—	8.0×10^{11}	—	⑩ 6.3×10^{-15}	⑪ 1200	106×10^{-12}	0.595×10^{-4}

Fig. 23: Table of crystal characteristics. (Footnotes referred to in table above are at left)

1. True if cross-coupling coefficients are neglected
2. Fry, W. J. Taylor, J. M., and Henvis, B. W., "Design of Crystal Vibrating Systems", Dover, N. Y. C., 1948, p. 173
3. Loc. Cit.—Bulk velocity estimated from given value of longitudinal velocity
4. Ibid., p. 4—Highly temperature dependent
5. Ibid., p. 60— " " "
6. Ibid., p. 61— " " "
7. Cady, W. G. "Piezoelectricity," McGraw-Hill, N. Y. C., 1946, p. 219, gives d = 6.9×10^{-8} statcoulombs per dyne, or 0.023 x 10^{-15} coulombs per dyne
8. Handbooks give values up to 20 times this figure
9. Estimated from longitudinal velocity $V_c = 3.8 \times 10^5$ cm./sec, measured in our labs
10. asured in our labs.—determined by static compressional method
11. Measured in our labs.—constant over normal temperature range

Fig. 24

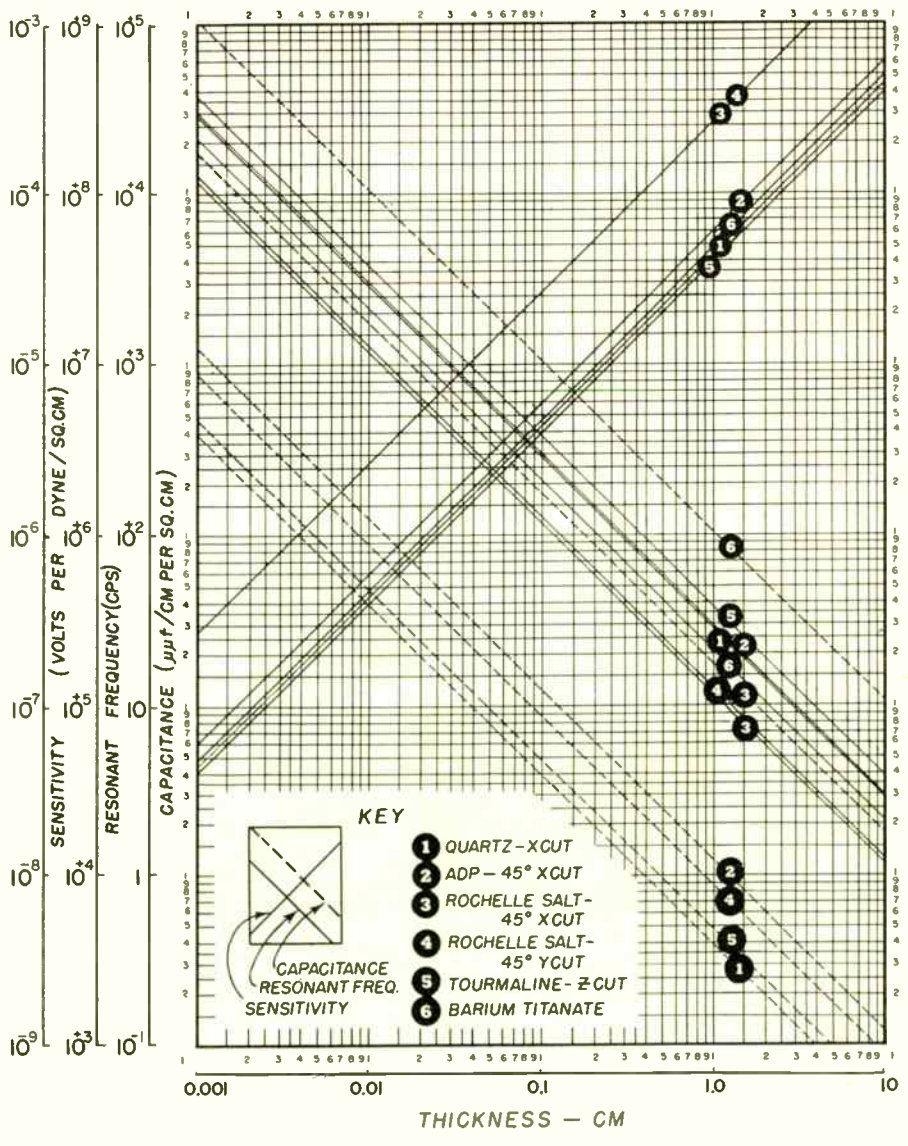


with regard to temperature, its high cost prohibits many uses. Other piezoelectric materials, besides exhibiting relatively small dielectric constants, are also severely limited in useful temperature range as indicated in Fig. 27, (from Bauer[1]) where a comparison of the temperature characteristics of Barium Titanate, Rochelle Salt, and Ammonium Phosphate is made.

One common use of a piezoelectric material is as a pickup element in either a dynamic or a static

(Continued on page 54)

Fig. 25: Chart for determining electro-mechanical characteristics of various crystals



Video Recording Technics

Video recording installation at Station WABD showing Eastman television recording cameras, video recording monitors and associated control equipment

Part One of Two Parts

Current engineering practice favors using 16-mm equipment in photographing programs directly off CR tubes — TV stations find increasing applications for these recordings

By GEORGE H. GORDON, *Eastman Kodak Co., Rochester, N. Y.*

(Mr. Gordon's office is at 342 Madison Ave., New York City)

THE ability to record a television program is an important and valuable part of television station operation. The process is analogous to the making of audio transcriptions in aural broadcasting and serves many of the same functions. A sight and sound recording of which copies may be made can be used to fulfill the following requirements: (1) a legal or documentary record of programs broadcast; (2) a transcription of a live show or special event program which may be used for syndication or for rebroadcast at a later date; (3) a record of programs, rehearsals, or auditions for the benefit of sponsors or advertising agencies; (4) a record of programs for study by the operations department of a broadcasting station; for instance to check lighting arrangements, camera angles, back drop reproduction, camera matching; (5) a method, when coupled with rapid film processing, for presenting large screen or theatre television programs.

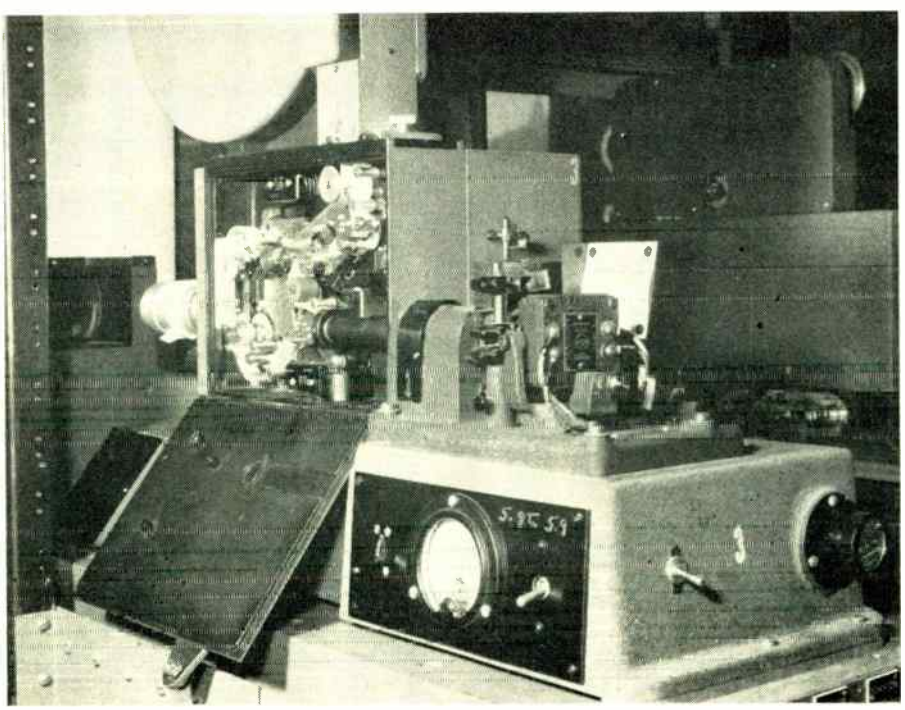
For any or all of the above uses the highest possible quality of recording of both picture and sound is desirable. In addition to technical standards, certain operational standards should be established. The basic specifications for a video recording system fall into two groups; the electronic equipment, and the photgraphic equipment. The cathode ray tube image to be photographed must be of the highest quality which the art can produce. The monitor, in order to be flexible in operation, should have high brightness, the ability to reverse horizontal sweep direction, the ability to produce pictures of either positive or negative polarity, and good control over average brightness and contrast. The basic photographic specifications are that the quality of the recording should be such that the rebroadcast image is comparable to the broadcast image from a film obtained by direct photography of the subject in the studio. The film speed should conform to American Standards Motion Picture Speed of 24 frames per second (both 16-mm. and 35-mm.) which coresponds to 36 ft./min. for 16-mm. and 90 ft./min. for 35-mm. film. At least one half hour of uninterrupted recording should be possible. The recording should be such that copies or prints can be made. Suitable means for recording sound synchronously with the picture should be provided so that the finished product is a composite sound-on-film print. For television purposes 16-mm. film has many advantages over 35-mm. film. The quality obtainable on 16-mm. film is more than adequate for television and in addition 16-mm. film usage reduces the size and the space requirements for all film handling equipment and the cost per minute of playing time is very much less than for 35-mm. film.

The most obvious problem in designing a suitable photographic camera for video recording is that of reconciling the 30 frames per second rate of American television with the 24 frames per second rate which is standard in motion pictures. Some attempts have been made to use a motion picture camera running at 30 frames per second and having a closed shutter angle of 180°. This method removes the interlace which the television industry has taken so much pains to provide, and also requires nonstandard sound recording and projection equipment. If projected at standard speed such recordings result in time distortion. A timing cycle has been devised which permits each motion picture frame to record a full television frame of both lace and interlace and also allows time for the film pulldown. Such a camera runs at 24 frames per second and has a closed shutter angle of nominally 72°. In Fig. 1 the television frame cycle and the shutter and pulldown cycle of such

(*Please turn to next page*)

a recording camera are indicated with respect to the same time scale. For the sake of simplicity only the total duration of television fields and frames is shown. Each field interval includes its share of blanking time as well as its scanning time. An open shutter interval of 288° at 24 frames per second corresponds to an elapsed time of 1/30-sec. which is the duration of a full television frame cycle. The closed shutter interval of 72° corresponds to an elapsed time of 1/120-sec. which is the duration of half a television field. Pulldown of the film must occur within this time. During the second open shutter interval of 1/30-sec. the film is exposed to a second full television frame, but the television frame is not scanned in the same order as the first one. After pulldown, the third motion picture frame is exposed to a third full television frame which is scanned in reverse order from the first one; that is, even lines then odd lines instead of odd lines then even lines. It is apparent that after four motion picture frames and five television frames the whole sequence has returned to the starting point. This process has converted five television frames to four motion picture frames, progressively omitting part of the television image to allow film pulldown, but still putting a full frame of television information on each motion picture frame. This five to four ratio is directly related to the 30 to 24 frame rate ratio. This sequence of events would occur regardless of the phasing between the motion picture cycle and the television cycle. Thus there is no need for interlocking the monitor and the camera provided a mechanical shutter is used. Synchronous power supplies for the camera and the synchronizing generator to establish basic frequency rates is all that is necessary. Electronic blanking of the monitor tube can also be used with counting or equivalent circuits permitting normal operation for the duration of 525 lines and then blanking the tube for the equivalent of 131¼ lines. In this case interlock must be provided to insure coincidence of tube blanking and film pulldown. In general, the start and end of the exposure occurs during scanning which forms the image. Thus the start and end of the exposure, commonly called the "splice", occurs at two places in the picture. By proper phasing of the camera and synchronizing generator one of the "splices" can be made to occur during the normal television blanking interval and only one "splice", which is in the center of the picture, occurs during the picture scanning and affects alternate motion picture frames. This condition prevails in Fig. 1. The timing cycle in the camera must be at least as accurate as the timing of the synchronizing generator. If the open shutter interval is slightly too long or short the "splice" will show as a relatively narrow horizontal area of over exposure or under exposure respectively. These markings are known as shutter bars or banding. They can be caused by improper shutter angle, a significant change in lens aperture and focal length from the value for which the shutter was designed, instability of the synchronizing generator, or hunting or oscillation in the shutter movement.

Close-up of the operating side of Eastman television recording camera with an RCA sound head for single system direct positive video recording at NBC



Practical 16-mm Camera

The Eastman Kodak Co. at the request of the National Broadcasting Co. and Allen B. DuMont Laboratories, Inc., has constructed a practical 16-mm. camera for video recording which utilizes this shutter cycle. The camera provides interchangeable magazines holding 1200-ft. rolls of film which is sufficient for approximately 33 minutes recording. The camera is powered by two 1800 RPM single phase synchronous motors. One motor drives the film transport mechanism which has a slot and spline accelerated 8-star Geneva pulldown mechanism with an 8-tooth intermittent sprocket. Normally the Geneva mechanism would produce a 135° pulldown period but is accelerated to produce pulldown in approximately 57°. The magazine take-up is gear-coupled and requires no belts. The periodic loading of the main drive motor by the intermittent mechanism causes some hunting or oscillation which makes this motor unsatisfactory for driving the shutter. The precision timing demanded by the shutter cycle is achieved by driving the shutter through specially-cut gears at 1440 RPM by a separate motor the rotor of which acts as a flywheel and provides for uniform shutter speed. The two motors are electrically locked together but have a floating mechanical coupling which insures that shutter closure and pulldown coincide. This phasing coupling insures that the motors start at the same rate but when the camera is at normal running speed each synchronous motor runs at the speed determined by power line frequency

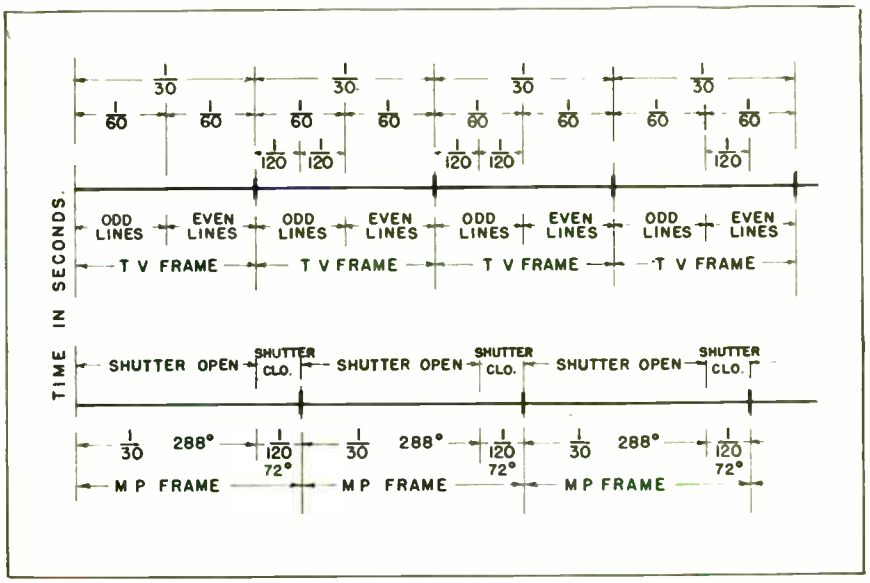


Fig. 1: Diagram illustrating the timing cycle involved in recording 30 frames per second television on motion picture film operating at 24 frames per second

and the coupling runs free.

In addition to the problem of shutter timing, a practical camera presents serious problems of design. As a result of the enormous linear accelerations required, a special intermittent mechanism is necessary if sufficiently rapid pulldown is to be achieved without film damage and with acceptable image steadiness. The expectation of continuous runs of 30 minutes requires new film gate design if emulsion pile up is to be avoided. In usual motion picture practice "takes" are rarely longer than three to five minutes, and then the cameraman has an opportunity to clean the gate. Take-up of the film is also a problem. For convenience, it is desirable to use standard 2-in. diameter plastic cores. Thus at the beginning of recording the take-up roll is 2-in. in diameter and increases to approximately 11-in. at the end of a half hour. To wind up film at a constant linear rate, the small roll must rotate much more rapidly than the large one and still not impose undue tension on the film. Normal motion picture practice is to use 16-mm. camera film in 400-ft. rolls which presents a very much less severe take-up problem. For simultaneous picture and sound recording on the same film strip the two motor drive is very advantageous because the shutter motor can be used to drive the film past the sound head with a much more uniform motion than is ordinarily achieved in single system cameras.

J. M. Wall, Inc. also manufactures a camera for video recording. It also has two motors, a phasing coupling, and 1200-ft. magazines. The intermittent mechanism utilizing a claw pulldown and pilot pins, however, is a modified version of the regular movement used in the regular 35-mm. Wall cameras.

Monitor Operating Requirements

The monitor used for video recording must provide exceptional image quality. The ability to reverse horizontal sweep direction is very desirable because the photographic processes used or equipment available may require a left-right reversed image in order to avoid printing difficulties or to obtain standard emulsion position in the projector. An image of negative polarity may also be required if a direct positive image on the film is desired for immediate use with minimum delay or for theatre television systems. This negative polarity implies that the blanking and synchronizing pulses are extracted from the incoming complete video signal and used without inversion. This permits inserting the blanking pulse on the cathode of the picture tube and thereby allows the black level of the picture to be set at will without retrace lines showing. In order to achieve maximum image definition wide band amplifiers are necessary. It might be desirable to boost high frequency response to increase contrast in fine detail which suffers degradation both on the tube face and in the photographic process. Such high frequency boost also increases the apparent noise level. In order to obtain sufficient brightness for adequate exposure of slow speed fine grain films the cathode ray tube must be operated at a high accelerating voltage. The tube should have an efficient phosphor which is aluminum backed for maximum brightness and contrast. Existing equipment has from 17 to 30 KV accelerating voltage. Whether 60 cycle voltage multiplier, radio frequency, or flyback power supplies are used, the output should be well filtered and have good regulation. In some designs a brightness gradient horizontally across the raster has been observed and photographed as a result of diminishing voltage while beam current was drawn. Some tubes operated under these conditions generate significant amounts of x-radiation. Measurements should be made, and, if necessary, shielding provided to protect personnel. The monitor should provide stable control over average brightness and contrast and have

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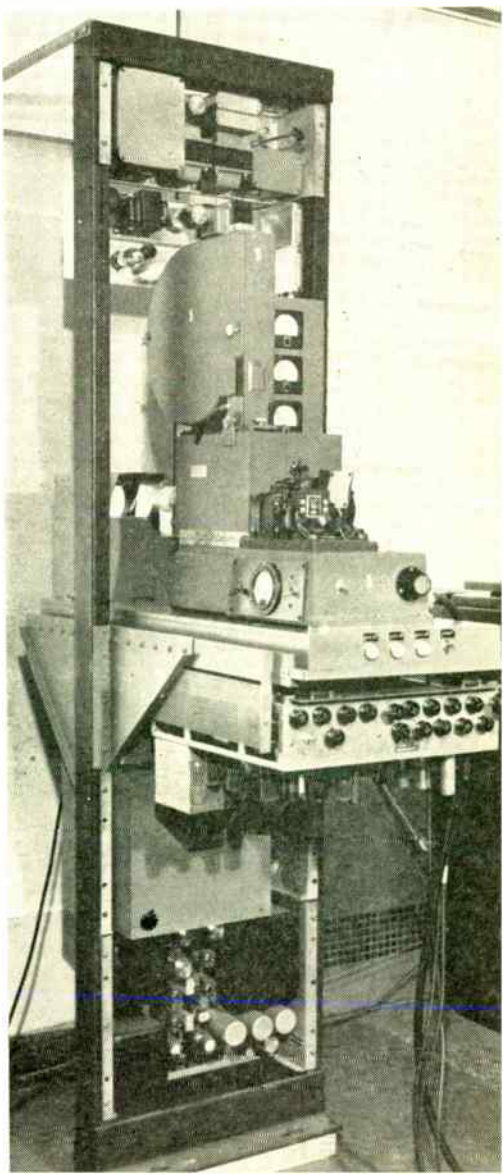
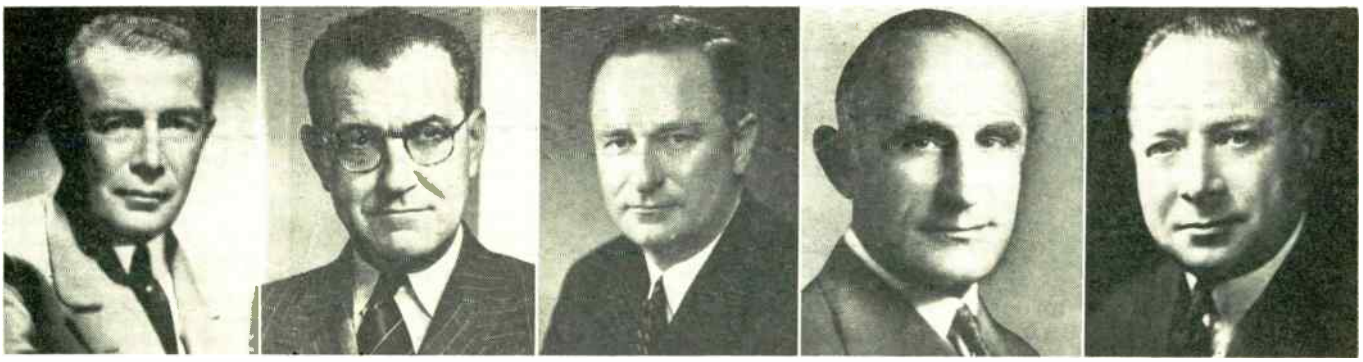
Single system Eastman television recording camera with RCA sound head. Equipment is installed as rack mounted monitor at NBC





E. F. McDonald, Jr. Zenith | Dr. W. R. G. Baker General Electric | Walter Evans Westinghouse | F. A. D. Andrea Andrea Radio | Gen'l. David Sarnoff RCA

Radio Industry Marks

The men and the ideas that have exerted leadership throughout a quarter century of pioneering and growth

Technical Roots into the Scientific Past

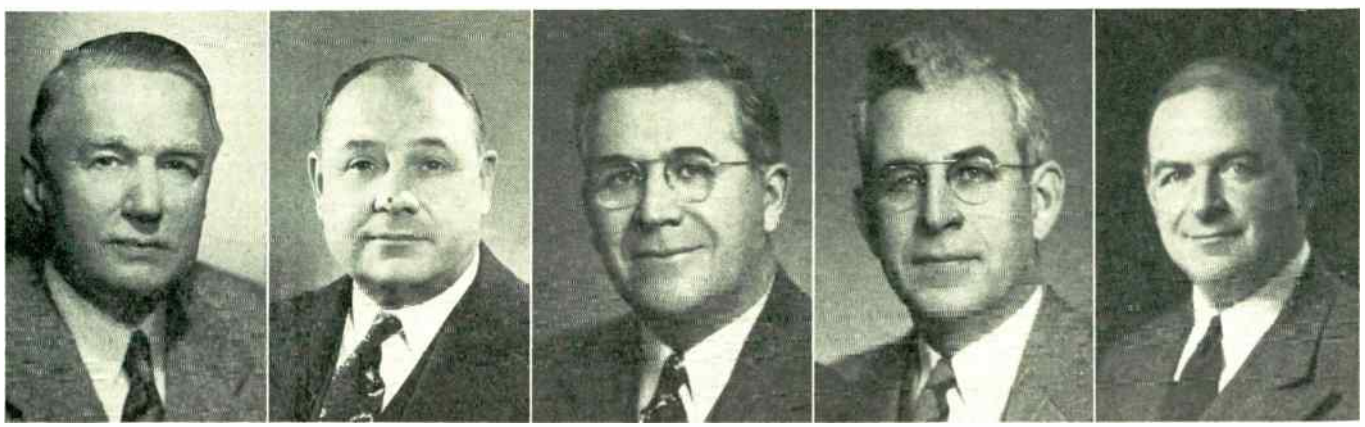
By RALPH R. BATCHER,
Consulting Editor TELE-TECH

THE development of so many new spectacular fields of engineering and science that are based on electronic principles, during the last decade, did not just "happen." Credit for the rapid perfection of these projects, many of which have now become complete businesses on their own, has usually been given to the group efforts of whole armies of young engineers and scientists working in enormous, perfectly equipped laboratories. In one way the placement of such credit is as it should be, because a lot of valuable work was done even without their making a first-hand study of any of the background and history of the problem.

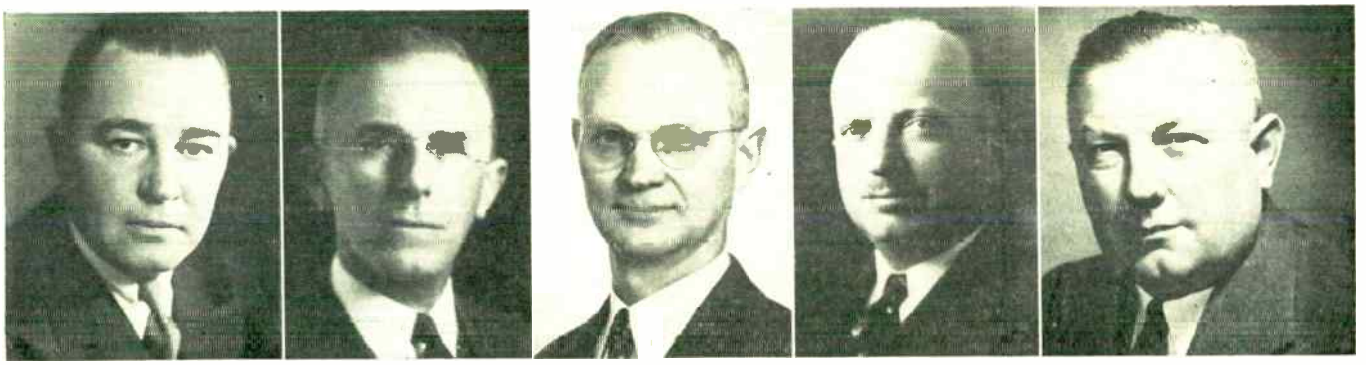
However the success of each of these ventures was possible only by their inheriting so many operating, practical electronic circuits and components to serve as a basis, and to a wealth of experience and know-how vested in the personnel of radio manufacturers who were given the drawings and ideas emanating from these "brain mills" and told to make up models and get them to work.

We now are approaching the twenty-fifth anniversary of the important factors behind U. S. supremacy in radio developments, the founding of the RMA to promote cooperation, develop test standards for quality and interchangeability of components, and establish standards of good engineering practice.

One has only to spend a few minutes in examining the background of all these matters to realize how much the present is linked to that mid-period of development when RMA was young—just as the engineers of that period were told that their ideas should be credited to the pioneers a quarter of a century before them—the early 1900's when one found Wm. Crookes, J. J. Thomson and P. Lenard reporting on the



E. C. Coolidge Croname | H. B. Richmond General Radio | Bruce Coffin Hytron | Lloyd Coffin Hytron | Fred R. Lack Western Electric



Leslie R. Muter
Muter Co.

Dr. R. H. Manson
Stromberg-Carlson

H. W. Clough
Belden

A. A. Berard
Ward-Leonard

J. M. Spangler
National Carbon

Twenty-fifth Anniversary

How present multi-billion-dollar radio and TV arts had their feeble beginnings 25 and 50 years ago

basic laws of electron flow in vacuum, Richardson and Wehnelt showing the advantages of heating cathodes to get a source of electrons, also that coating them with certain oxides gave still greater gains, and when Braun, Röntgen, DeForest and Fleming each developed from these lines of thinking different forms of tubes each having great import to subsequent history.

Marconi to Armstrong

In other lines of activity at that time one finds, along with the spectacular achievements of Marconi at the turn of the century, many developments that were reported by hundreds of scientists whose names are rarely heard but whose contributions are the commonplace items of the art. Heterodyne principles have always been the fundamental plan in most system operations but the name of Fessenden is rarely heard. Crystal rectifiers now the object of feverish activity as to new forms and applications rarely evokes the name of Pickard. Many characteristics of delay lines and wave guides utilize the basic concepts of the great Pupin—preceptor of the still greater Armstrong, destined to invent regeneration, the superheterodyne, superregeneration, and static-elimination through FM.

Many a modern researcher has wondered why the art suffered so long with the ponderous components of the broadcast art when the simplicity of microwave equipment must have been self-evident. Wireless communication started in the microwave region and much of the earliest work was done by Hertz and others in this range, until Marconi began to extol the advantages of the longer wavelengths, those in the kilometer range.

Thus again the art has completed a cycle and has now gotten back to first principles.

In the early twenties the science of communications had progressed and was then making money selling apparatus and service rather than stock certificates. There was such

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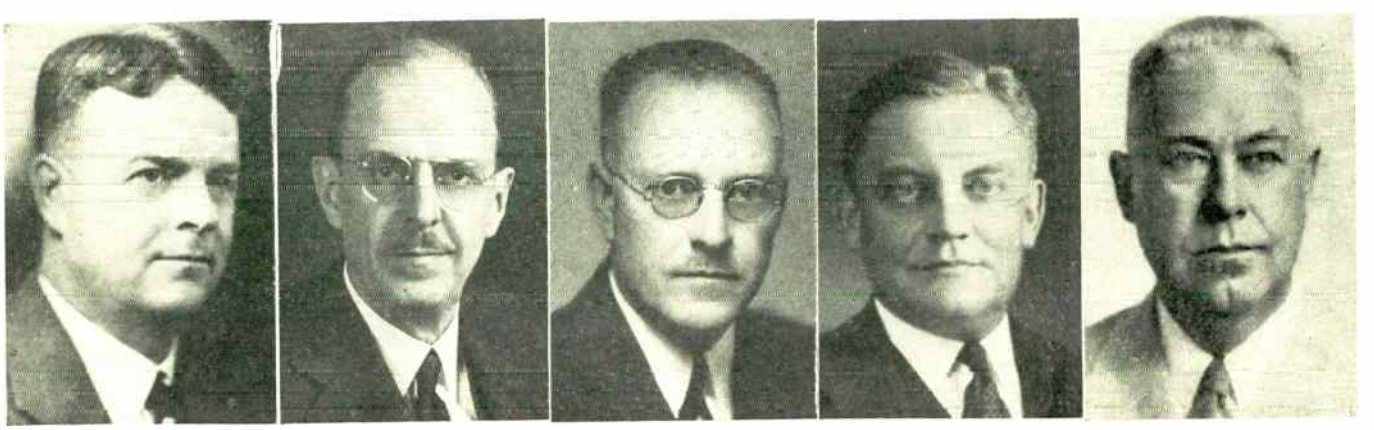


J. C. Daley
Jefferson Electric

Ralph Mueller
Mueller Electric

Glenn Browning
Browning Labs.

Octave Blake
Cornell-Dubilier

M. E. Fagan
Universal Winding

Ludwig Arnson, president of the 26-year-old Radio Receptor Company, New York, was first operator to transmit a CQD signal in 1903. Later he was the first American engineer to join the old Marconi company. Under Mr. Arnson's guidance, Radio Receptor was pioneer in building crystal sets, and later AC-operated receivers. It now builds commercial transmitters, air navigation equipment, and selenium rectifiers

activity that new laws with increased powers gave to the government the headaches of establishing frequency allocations. Industry needed more channels even then (although all of the "useless" wavelengths, those below 200 meters, were turned over to the amateurs since no one knew what to use them for) and set about to establish rigid standards so that more services could be established. First a minor part of the National Electrical Manufacturers Association, the radio industry soon found it had enough to do to warrant the establishment of an industry organization looking into the problems of this one radio field alone.

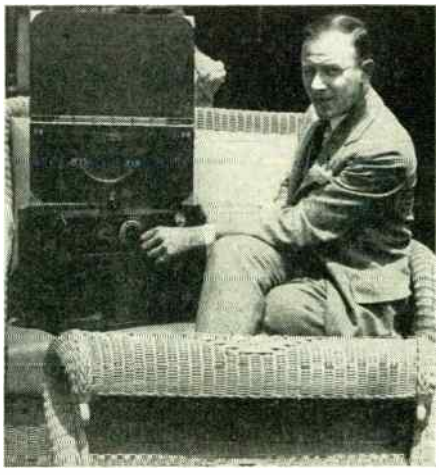
Birth of Radar

After twenty-five years of progress from the period whose high spots were cited above, we can now look back at a science that was rapidly becoming stabilized, but still with all the glamor of the preceding era. Many new principles and basic effects were being mentioned casually in reports by Alexanderson, Ballantine, Heising and Colpitts. A. H. Taylor and L. C. Young had just observed that short-wave radio signals could be reflected from boats passing their laboratory on the Potomac, an effect remembered and utilized later in radar.

Cathode-ray tubes were being considered as possible means of receiving television pictures. This was the easiest part of the job however, but Zworykin was already at work on the Iconoscope principle and Farnsworth on his own ideas on the proper solution to the television problem: that of converting scenes to a transmittable signal.

Engineers were then attempting to eliminate the big stumbling block affecting the progress of radio—that of keeping the batteries in order—so the AC operated tubes and circuits came about. It was then that the radio receiver business grew up. Engineers were interested in eliminating another trouble—a substitute for the ever-present gangs of headsets whenever the whole family wanted to listen to a program—and came up with loudspeakers, power amplifiers and higher fidelity. These developments were extended and started the public address business and the "talking" movies.

Dr. E. H. Armstrong, inventor of the regenerative circuit, 1912; superheterodyne, 1918; Super-regenerative circuit, 1920; means of eliminating static by frequency modulation, 1939. Awarded Legion d'Honneur, IRE Medal of Honor, Franklin Medal, Edison Medal, etc. Dr. Armstrong is Professor of Electrical Engineering, Columbia University, New York City. Pictured behind Dr. Armstrong is J. M. Poppele, for 27 years chief engineer of WOR, New York, and now also president Television Broadcasters' Association



J. McWilliams Stone, one of the founders of RMA, and after 28 years still heading Operadio Manufacturing Company, St. Charles, Ill., one of the first to develop a light portable battery radio with carrying case and loop antenna, here shown being demonstrated in an Atlantic City roller chair during the 1925 RMA Convention. In last 17 year Operadio has supplied loudspeakers to practically every U. S. radio manufacturer

Engineers then sought out methods of cheapening costs of radio receivers and came up with the seeming paradox of adding more tubes to reduce prices. Instead of using best quality, high "Q", lowest loss components they added a few more tubes in simplified circuits and got better results.

Magic of Superhet

Tuning simplicity and greater selectivity were both introduced by Armstrong's superheterodyne circuits, with an attendant boost in the broadcast receiver industry. This was the business, then as now, that fathered most of the sidelines that later became independent fields of activity. The superheterodyne receiver along with the work of Hazeltine in neutralizing spurious oscillations, eliminated the receiver squeals which had previously been considered a necessary evil.

Tubes, being used in so much greater numbers, because of lower prices, increased sales and more tubes per set, were then manufactured in quantities that upped their quality and lowered their costs.

A few experimenters in the early twenties, the writer included, put radio receivers in their cars, starting a vogue that is producing more of these special purpose receivers than the whole country used of regular receivers at the time!

Many of the greatest contributions of this period were from amateurs who opened up the whole short wave field in their efforts to find a signal that would be satisfactory in reaching their most distant friends. Their studies of skip distances and propagation phenomena, their modifications in circuits and tubes to handle these frequencies and their designs of antenna are now the accepted standards of today in all fields where these higher frequencies are used — air navigation, television, and half a hundred other services.

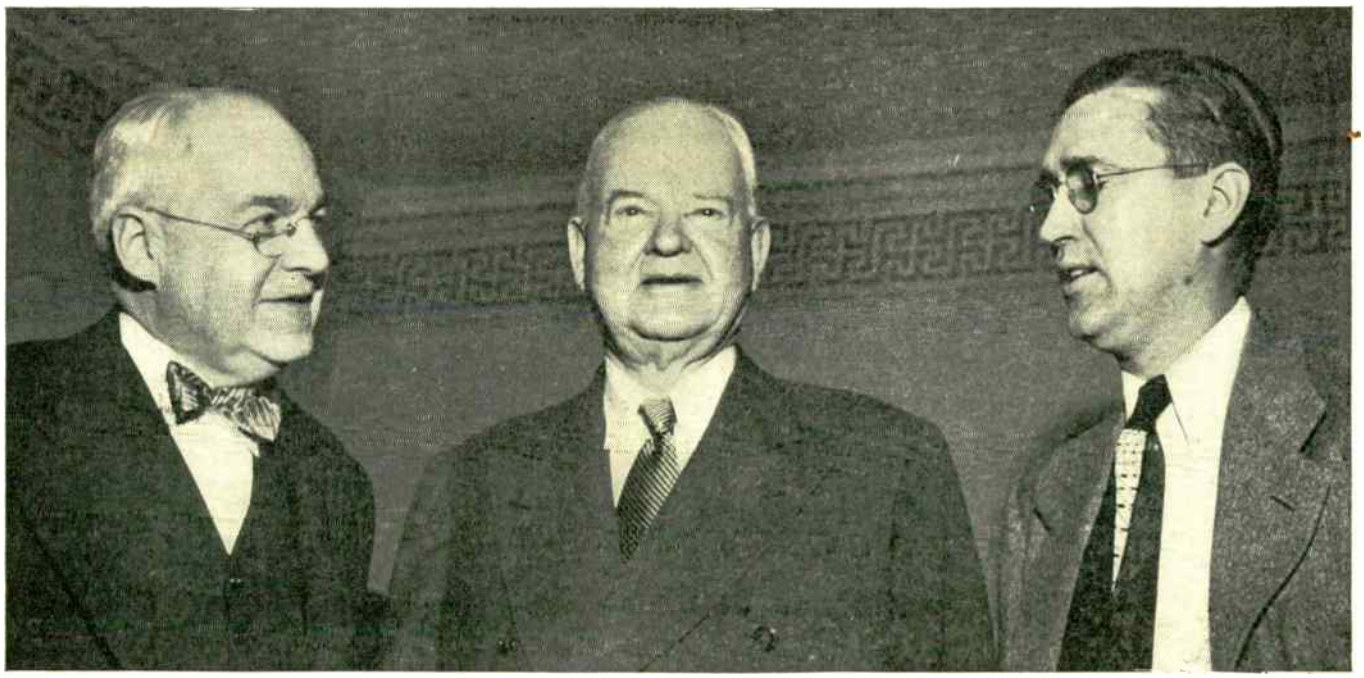
Art Is Stabilizing

And so after another quarter century we arrive at the present—but wondering about the future. We know that the thinking of our research groups today start the new industries of tomorrow. One needs only to examine the program of the recent IRE Conference in New York to see where new fields are sure to start. First there were few papers on the standard radio subjects — broadcasting, either AM or FM, on long wave services, etc. The art is stabilized in these fields and reports of research being done in these fields have given way to more spectacular subjects: resulting in around a dozen talks on each of the subjects of television, electronic computing apparatus, nuclear instrumentation problems, air navigation methods, new modulation methods, and the like.

Ralph R. Batcher, (author of the accompanying article) photographed in 1924 with the late Alfred H. Grebe and one of the contemporary Grebe home receivers designed by Mr. Batcher, who as Grebe's chief technical man, also engineered the construction and operation of pioneer broadcast station, WAHG, later WABC, (now WCBS)

Research By-Products

There were many interesting conclusions from this analysis. The research groups that are interested in exploring new scientific principles and experimenting in new lines are always on the move. The developments of one period for the most part have been forgotten at the end of the next decade as far as they were concerned, with entirely new problems to worry them. This research activity has always left new developments and new businesses behind for others to carry on—practical, working, profitable commercial developments that are providing a livelihood for thousands of others. For every big-name scientific researcher and new-field explorer, there are many dozens of engineers engaged in making practical use of their discoveries in directing the manufacture and operation of new equipment — and still other, and even larger groups engaged in the installation and maintenance of the equipment in the field. This is a business where there is a place for everybody.



Control of U. S. radio channels over a span of twenty-five years— In this picture, taken at the Radio Executives Club, New York, March 10, at center ex-President Herbert Hoover who as Secretary of Commerce, in 1921 set up first plans for policing the infant radio industry through co-operative efforts by the broadcasters. Secretary Hoover controlled all radio broadcasting through 1926. In 1927 full authority for all radio wavelengths was given to the Federal Radio Commission, pioneer engineer member of which was Dr. Orestes H. Caldwell (left), now editor of Tele-Tech and Radio & TV Retailing, who took a leading part in the formative reallocations of wavelengths, spectrum planning, and radio policy decisions of 1927-8-9.

Later successor to the Radio Commission was the FCC, present chairman of which, Hon. Wayne Coy, is seen at right.

An Instantaneous Audience

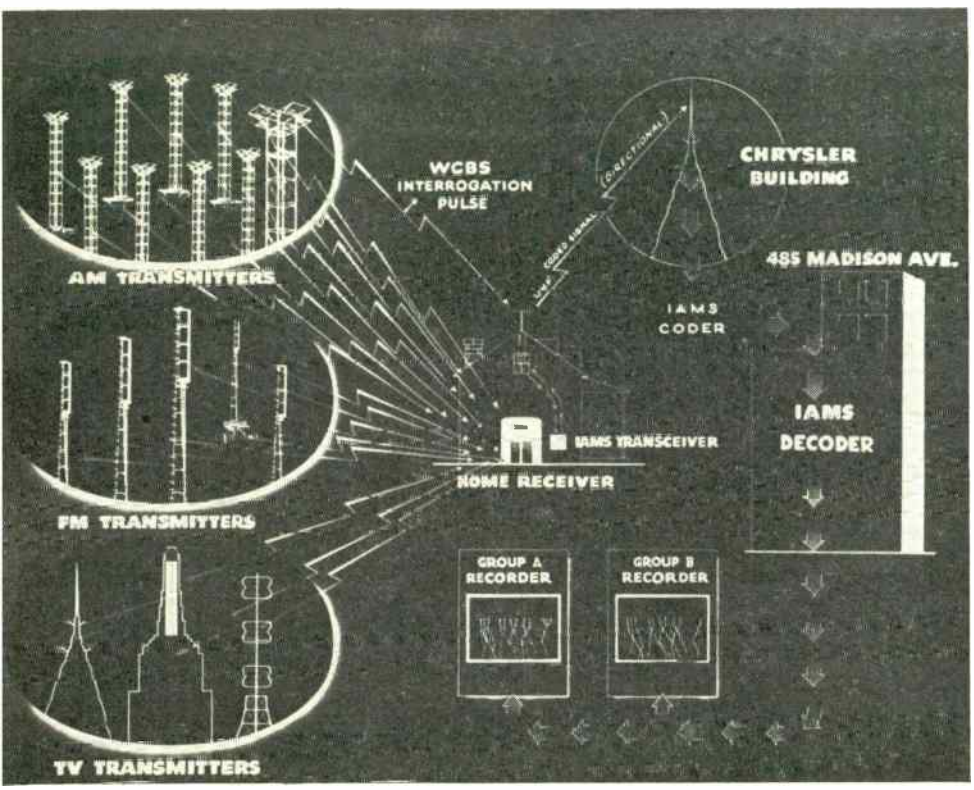


Fig. 1: Diagram illustrating overall operation of IAMS in New York City. AM listeners have not reported hearing the 7 KC interrogating pulse mixed with program material

UHF transceivers, responding to pulsed interrogating signals on AM station's carrier, permit a direct percentage reading of the listener intensity to any broadcast service

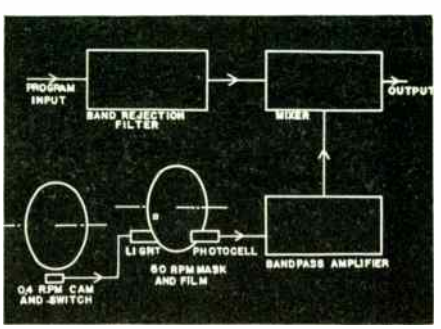
ONE of the major problems experienced by those engaged in evaluating audience reaction to various program types is that of the relatively long time interval required for the collection and compilation of data. In answer to this problem, the Engineering Research and Development Department of the Columbia Broadcasting System, under the direction of Dr. Peter C. Goldmark, has developed a new communication system that permits an instantaneous automatic measurement of AM, TV and FM audience samples.

A pilot model of this Instantaneous Audience Measurement System, (termed IAMS) has been in operation for some months in New York City testing an audience segment involving 1000 FM, AM and TV sets, and during this time it has successfully demonstrated its capability of providing the following types of information in a matter of seconds: (a) the number of sets turned on, (b) which one of three program material categories is being received, (c) the particular station within a category to which the receiver is tuned. It is also able to relate the response to particular subdivisions of the audience sample, such as the general geographical area or income group to which the set belongs. All of this data is presented in the form of a graph which indicates the degree of listening intensity of the sample continuously throughout the entire period of the survey. When it is considered that further refinements of the system may permit increasing the size of the sample and the variety of information derived therefrom, the possible impact on the broadcasting industry is tremendous.

In the overall operation of IAMS, a 7 KC pulse of 35 μsec. duration is inserted into the program material of the station conducting the survey (Fig. 1). This pulse serves to interrogate transceiver units, placed alongside the sets to be polled. Each transceiver then returns pulses of approximately 1.5 to 2 μsec. duration to a central point, via UHF; the number and interval between the pulses from a given unit being determined by the information the system is set up to collect. The output of the UHF receiver that gathers the response pulses actuates a coding system which converts the pulses to 1000 cycle signals, and these in turn are sent over telephone lines to remotely located IAMS decoding and recording devices.

The origin of the interrogating pulse is shown in Fig. 2. A cam, driven by a synchronous motor and rotating at 0.4 RPM, actuates a switch which flashes a light source every 2.5-min. This light is passed through apertures in a rotating disc where the light beam is broken mechanically to produce the 7 KC signal. The signal is then fed into a band pass amplifier where the pulse is brought to the desired level before being mixed with the program content. Meanwhile, the program material has been divested of its

Fig. 2: Method of obtaining 35 μsec. pulse from light source and injecting into carrier



Measurement System

7 KC component by means of a highly selective band rejection filter. The gap thus created is filled by the pulse in a mixer stage. In this regard, it is interesting to note that the presence of the interrogating pulse is not noticeable to the listener as evidenced by the lack of comment or inquiry during the time the pilot model has been in operation.

Upon arrival at the transceiver, the pulse is filtered out of the program context and amplified. This signal then causes a relay to close, which, in turn, sets a special clock in motion whose operation is synchronized with all the other transceivers as well as the master timer at the IAMS recording point. The timing clock, which makes one revolution in 2.5-min., drives a commutator whose contacts represent the sixty reporting time intervals available. (Figs. 3 & 4)

Depending upon the position of the rotary switch, as determined by the tuning of the sample receiver, certain commutator contacts will be energized. The pulse modulator in the UHF transmitter is therefore triggered as the clock hand passes through the appropriate sectors. These UHF pulses are generated a type 2C43 lighthouse tube and have a peak power on the order of 1 KW.

In earlier models the rotary switch was physically attached to the receiver being polled but later the method as shown in Fig. 5 was evolved. A short pickup wire is extended from the IAMS unit which gathers a signal from the local oscillator of the subject receiver and mixes it with a variable frequency oscillator in the transceiver covering the same frequency range. The resultant heterodyne is amplified, detected, and used to start a small motor. The motor rotates the switch and tunes the transceiver oscillator for zero beat. At this point the motor is de-energized and the switch has been positioned to be in accord with the frequency of the tuned receiver.

(*Continued on page 64*)

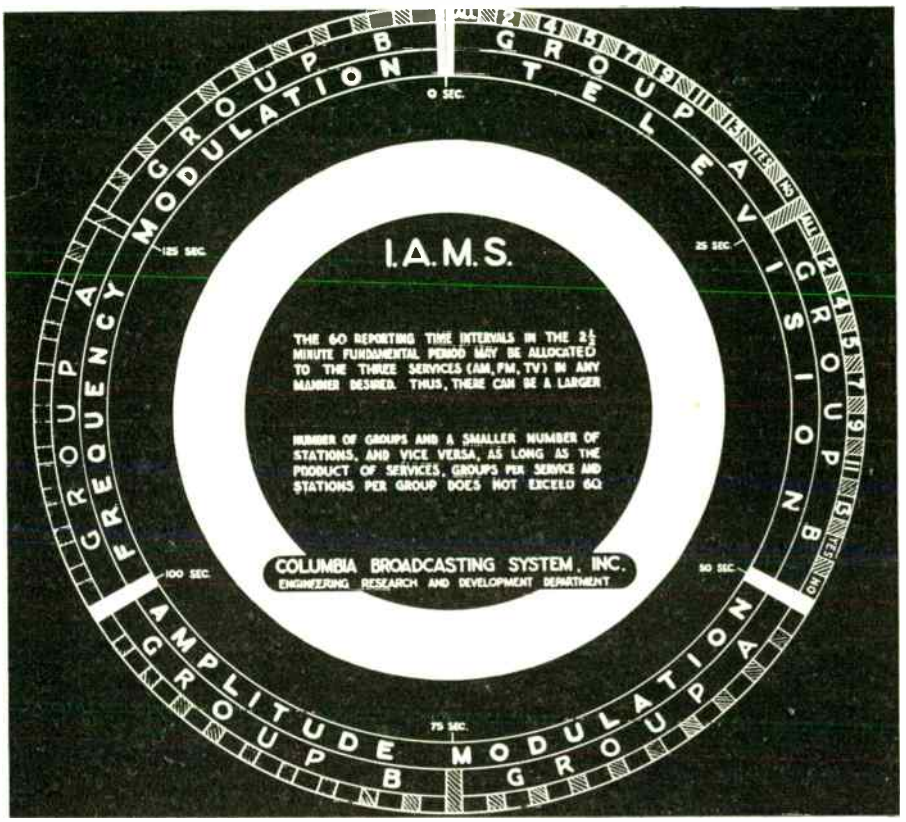


Fig. 3: Clock face for IAMS is divided into 60 reporting time intervals during one 2.5-min. revolution. System can be arranged to accommodate "yes" or "no" listener vote

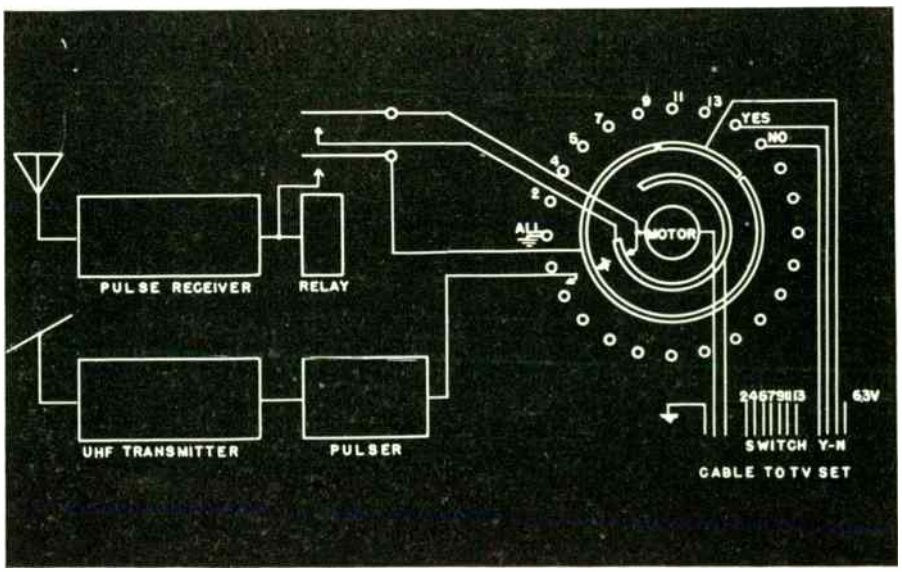


Fig. 4: Diagram of system where listener's tuning mechanism is mechanically connected to reporting commutator which in turn actuates UHF transmitter at the required moment

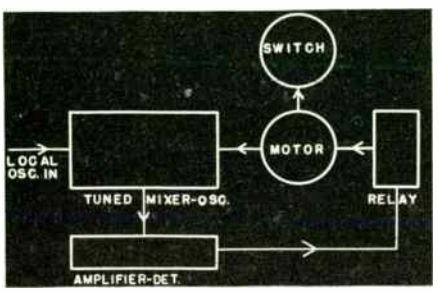


Fig. 5: The tuning of listeners' receivers can also be determined electronically by using a heterodyne signal as a control voltage on motor driving the reporting commutator

Noise Figures for

Analyzing six different circuits commonly employed in UHF

By PETER G. SULZER, Research Assistant, Pennsylvania State College Dept. of Electrical Engineering, State College, Pa.

IT is the purpose of this paper to derive expressions for the noise figures of various amplifiers that are commonly used as radio receiver input circuits. The circuits will be compared from the noise standpoint, and the proper application of each will be suggested. Although some of the results have appeared before, it is believed that they have not been presented in a convenient form suitable for discussion.

Since cascaded amplifiers will not be considered, it is possible to use a simplified method of derivation. While not as elegant as the available-power method, it is more direct for a single stage. It should be noted that if the available-power gain of the first stage of the receiver is reasonably high, the noise figure of the entire receiver is essentially that of the first stage. Therefore, results for a single stage are of practical value.

The effects of transit time and cathode-lead inductance are not considered.

The noise figure of a receiver may be defined as the ratio of the total noise power output of the receiver to the portion of that power resulting from thermal (Johnson) noise in the resistive component of the antenna impedance. Thus, the noise figure:

$$F = e_r^2/e_a^2 \qquad (1)$$

where e_r^2 is the mean-square output noise voltage referred to some convenient point such as the input grid, and e_a^2 is that portion of the mean-square output noise voltage resulting from antenna external noise, referred to the same point.

In the following work it is assumed that the receiver input circuit is an amplifier. In each case the noise power will be referred to the control grid of that amplifier. Certain resistances are associated with each amplifier circuit shown in Figs. 1 to 6: R_a is the antenna resistance whose magnitude may or may not have been transformed by the receiver input transformer and thus can, within reasonable limits, be set to any value desired. R_1 is the resistance appearing across the secondary side of the input transformer as a result of circuit losses and tube loading. R_{eq} is the equivalent noise resistance of the tube; and R_L is the plate load resistor. It is assumed that all reactances have been tuned out.

The thermal noise voltage e^2 across a constant open-circuited resistance R is: $e^2 = 4KTBR$, where K is Boltzmann's constant, 1.374×10^{-23} joule per degree Kelvin; T is the temperature of the resistance in degrees Kelvin; and B is the band width in cycles per second. When working with voltage gain rather than power gain, it is convenient to consider a voltage rather than a voltage squared. Thus, $e = \sqrt{4KTBR} = \sqrt{NR}$, where $N = 4KTB$. It must be realized, however, that because of the random nature of noise, powers rather than voltages must be considered in the final analysis.

Single-Ended Grounded-Cathode Amplifier

Referring to Fig. 1, the component of e_g, the control grid-cathode voltage, resulting from antenna thermal noise is: $e_g = (\sqrt{N R_a})(R_1/R_a + R_1)$. For convenience it is assumed here that the noise source R_a is at room temperature; this is not necessarily so. Then:

$$e_a^2 = (N R_a)(R_1/R_a + R_1)^2 \qquad (2)$$

Considering all noise sources, e_g has two components which are $(\sqrt{N})(\sqrt{R_a R_1/R_a + R_1})$ and $\sqrt{N R_{eq}}$. The two noise sources are R_a and R_1 considered in parallel, and R_{eq}. To obtain e_r^2, these components are squared separately, and added. Thus:

$$e_r^2 = N(R_a R_1/R_a + R_1) + N R_{eq} \qquad (3)$$

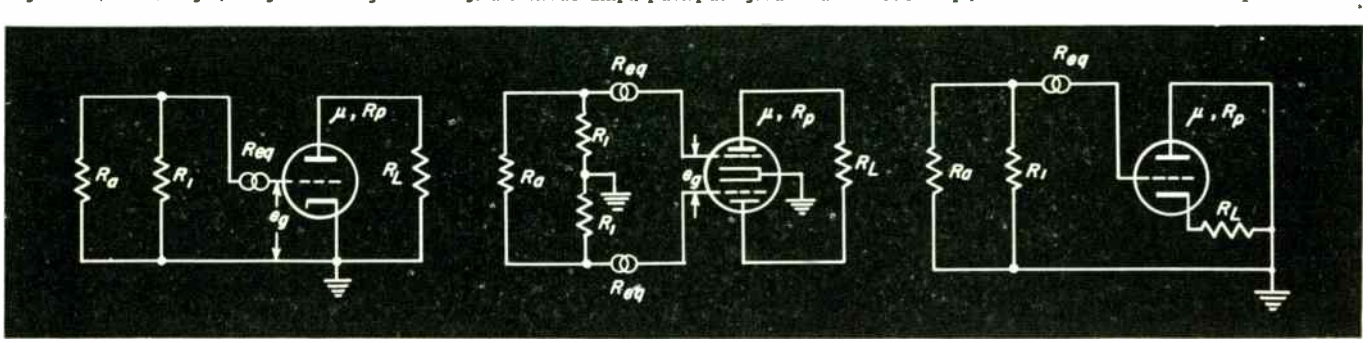
Substituting (2) and (3) in (1) yields:

$$F = 1 + \frac{R_a}{R_1} + \frac{R_{eq}}{R_a}\left(1 + \frac{R_a}{R_1}\right)^2 \qquad (4)$$

In general the equipment designer has little control over R_{eq} and R_1 (unless he intentionally lowers R_1 for broad banding). However, as mentioned above, R_a can be varied by changing the ratio of the receiver input transformer. It is therefore of interest to find the value of R_a giving minimum noise figure. Taking $\partial F/\partial R_a = 0$ and solving for R_a,

$$R_a = R_1/\sqrt{1 + (R_1/R_{eq})} \qquad (5)$$

Figs. 1-3: (Left to Right) Single ended grounded grid cathode amp., push-pull grounded cathode amp., and cathode follower analysis circuits.



Receiver Input Circuits

receivers and discussing suggested applications for each type

Thus, R_a must be less than R_1, and the familiar mismatch condition is indicated. To obtain the minimum noise figure, (5) is substituted in (4):

$$F_{min} = 1 + \frac{1}{\sqrt{1+\frac{R_1}{Req}}} + \frac{Req}{R_1}\sqrt{1+\frac{R_1}{Req}}\left(1+\frac{1}{\sqrt{1+\frac{R_1}{Req}}}\right)^2 \quad \ldots (6)$$

Push-Pull Grounded-Cathode Amplifier

The circuit of this amplifier is shown in Fig. 2. Proceeding as before, $e_a^2 = N R_a(2R_1/R_a + 2R_1)^2$; $e_r^2 = N(2R_aR_1/R_a + 2R_1) + N R_{eq} + N R_{eq}$ and:

$$F = 1 + \frac{R_a}{2R_1} + \frac{3eq}{2R_a}\left(2 + \frac{R_a}{R_1}\right)^2 \quad \ldots\ldots\ldots (7)$$

Likewise, for minimum noise figure:

$$R_a = 2R_1/\sqrt{1+(R_1/R_{eq})} \quad \ldots\ldots (8)$$

and:

$$F_{min} = 1 + \frac{1}{\sqrt{1+\frac{R_1}{Req}}} + \frac{Req}{R_1}\sqrt{1+\frac{R_1}{Req}}\left(1+\frac{1}{\sqrt{1+\frac{R_1}{Req}}}\right)^2 \quad \ldots (9)$$

which is the same as for the single-ended amplifier.

It is evident from Fig. 3, the circuit of the cathode follower, that exactly the same results will be obtained as for the grounded-cathode amplifier. Certain practical limitations of the cathode follower as a receiver input circuit will be discussed below.

Grounded-Grid Amplifier

The grounded-grid amplifier is shown in Fig. 4. The input resistance R_2 of the grounded grid tube is $R_2 = (R_p + R_L)/(\mu+1)$. The input resistance R_3 of the grounded-grid amplifier as a whole is R_1 in parallel with R_2. Then $e_a^2 = N R_a(R_3/R_a + R_3)^2$. The thermal voltage across R_{eq} is $\sqrt{N R_{eq}}$. To refer this voltage to the cathode, it is necessary to multiply it by A_{gp}, the voltage gain from control grid to plate, and divide by A_{kp}, the voltage gain from cathode to plate.

$$A_{gp} = \frac{\mu R_L}{R_p + R_L + (1+\mu)\frac{R_aR_1}{R_a+R_1}}$$

$$A_{kp} = \frac{(\mu+1)R_L}{R_p + R_L}$$

Performing these operations, evaluating the noise voltage from R_a and R_3 in parallel, and substituting in (1),

$$F = 1 + \frac{R_a}{R_1} + \frac{R_{eq}}{R_a}\left(\frac{\mu}{\mu+1}\right)^2 \frac{R_a+R_1}{R_1}^2 \quad \ldots\ldots (10)$$

It will be noted that if $\mu >> 1$, the same noise figures will be obtained for the grounded cathode and grounded - grid amplifiers. Therefore, in a practical case (5) and (6) can be used for calculating R_a and F_{min} respectively.

Cathode Coupled Amplifier

The cathode coupled amplifier is shown in Fig. 5. It is assumed that the tubes are identical and that R_K, the coupling resistance, is much greater than $(R_p + R_L)/(\mu+1)$, the input resistance of the second tube, so that it can be neglected as a noise source. As before, $e_a^2 = N R_a(R_1/R_a + R_1)^2$; $e_r^2 = N(R_aR_1/R_a + R_1) + N R_{eq} + N R_{eq}$ and:

$$F = 1 + \frac{R_a}{R_1} + \frac{2R_{eq}}{R_a}\left(1 + \frac{R_a}{R_1}\right)^2 \quad \ldots\ldots\ldots (11)$$

For minimum noise figure,

$$R_a = R_1/\sqrt{1+(R_1/2R_{eq})} \quad \ldots\ldots (12)$$

and:

$$F_{min} = 1 + \frac{1}{\sqrt{1+\frac{R_1}{2\,Req}}} + \frac{2\,Req}{R_1}\sqrt{1+\frac{R_1}{2\,Req}}\cdot\frac{1}{\sqrt{1+\frac{R_1}{2\,Req}}} \quad \ldots (13)$$

It can be seen that the equivalent noise resistance of tube 1 is effectively doubled by tube 2.

Wallman Circuit

The Wallman low noise amplifier is shown in Fig. 6. It will be noted that it consists of a grounded cathode amplifier driving a grounded grid amplifier. Thus, it is the cascade circuit used in DC amplifiers.

The input resistance R_4 of V_2 is $R_4 = (R_p + R_L)(\mu+1)$. The voltage gain A_{kp2} from cathode to plate of V_2 is $A_{kp2} = [(\mu+1)R_L/R_p + R_L]$. The voltage gain A_{gp2} from control grid to plate of V_2 is $A_{gp2} = \mu R_L/R_p + R_L + (1+\mu)R_p$, assuming identical tubes. The voltage gain A_{gp1} from control grid to plate of V_1 is:

$$A_{gp1} = \frac{R_3}{R_p+R_3} = \frac{\frac{\mu}{\mu+1}(R_p+R_L)}{R_p + \frac{R_p+R_L}{\mu+1}}$$

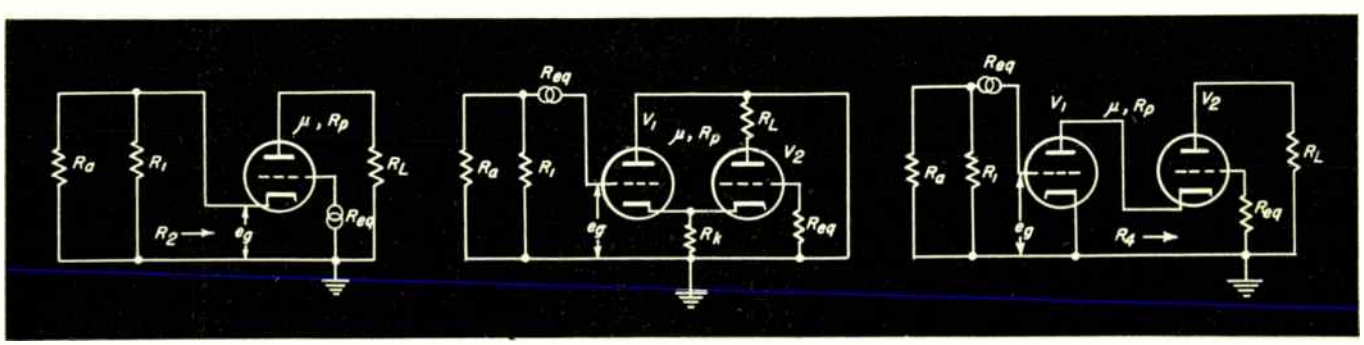
The over-all gain A of the amplifier is:

$$A = A_{gp1}A_{kp2} = \frac{\mu R_L}{R_p + \frac{R_p+R_L}{\mu+1}}$$

To refer the noise voltage of R_{eq} of V_2 to the control grid of V_1, it is necessary to multiply it by A_{gp2} and divide by A. Then $e_r^2 = N R_{eq} + N R_{eq}/(\mu+1)^2$. Since the noise power from the second tube is divided by $(\mu+1)^2$, it is usually insignificant and hence, the excellent performance of the Wallman circuit.

(Please turn to next page)

Figs. 4-6 (Left to Right) Diagrams used to develop noise figure equations for the grounded grid, cathode coupled, and Wallman low noise amp.



NOISE FIGURES
(Continued)

Evaluating e_a^2 as before and substituting in (1),

$$F = 1 + \frac{R_a}{R_1} + \left[1 + \frac{1}{(\mu+1)^2}\right]\frac{R_{eq}}{R_a}\left(1 + \frac{R_a}{R_1}\right)^2 \quad . . \quad (14)$$

Since, in a practical case, $\mu >> 1$, (5) and (6) can be used for calculating R_a and F_{min} respectively.

Circuit Comparison

Examination of Equations 6, 10, 13, and 14 shows that the circuits can be divided into two classes. The first includes the single-ended and push-pull grounded cathode amplifier, the cathode follower, the grounded-grid amplifier, and the Wallman circuit, which all have essentially the same noise figure with modern, high-μ tubes. The second includes the cathode-coupled amplifier, which is definitely inferior.

Considering the first class, there is, therefore, little choice between the different circuits so far as noise is concerned. However, the single-ended and push-pull grounded cathode amplifiers need neutralization if they are used with triode tubes, which is desirable because of the low R_{eq} of the triode tube. The push-pull circuit is easy to neutralize and is definitely superior to the single-ended circuit from that standpoint when used over a wide tuning range. It should also cause less loading on the input circuit because the effects of cathode-lead inductance are balanced out when using common-cathode tubes such as the 6J6.

The cathode follower provides no voltage gain, so the noise generated in the next stage is important. It is possible to realize some gain if a step-up transformer is used as an interstage coupling element, but the gain is small when working into a finite load impedance. Because of the low gain of the cathode follower it may not always be possible to ignore the thermal noise in its load impedance.

The grounded-grid amplifier usually does not require neutralization. However, its input resistance is very low, which may be undesirable if high input circuit selectivity is required and may also cause a loss in signal through mismatch. If the selectivity is improved by tapping the cathode across a small portion of the tuned circuit, R_1 may be lowered sufficiently to increase the noise figure.

The Wallman circuit has the great advantage that it can be used with triode tubes without neutralization. However it requires an additional tuned circuit which is placed between the cathode of V_2 and ground to provide a high impedance at that point. It is the degeneration resulting from the cathode of V_2 seeing the plate resistance of V_1 that makes the noise from V_2 negligible.

Considering the second class, the cathode-coupled circuit, like the Wallman circuit, has the advantage that it is stable with triode tubes. However, the noise figure is poor because the cathode of V_2 sees a low impedance (the cathode impedance of V_1) and therefore the degeneration in V_2 is small, making the noise from this tube significant. At the higher frequencies it is necessary to tune out the capacitive reactance appearing between cathodes and ground.

The choice of the best circuit for a given application will depend largely upon whether a pentode or a triode tube is to be used. With the pentode the customary single ended grounded cathode circuit would be employed, since neutralization would not be necessary. With the triode the other circuits considered become more useful. The choice will also depend upon the value of R_1, which is a function of the capacity and bandwidth of the first tuned circuit. To facilitate comparison, Fig. 7 was plotted for a typical pentode, the 6AK5 (R_{eq} = 1900, G_m = 5000), and a triode, the 6J6 (R_{eq} = 470, G_m = 5300). It shows the relation between F_{min} and R_1 for the circuits under discussion and for each tube type where applicable.

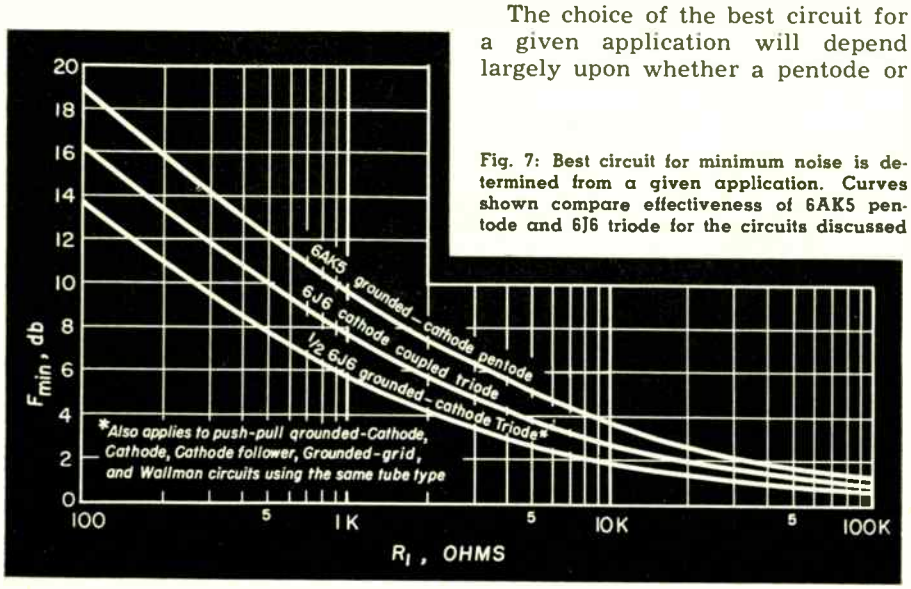


Fig. 7: Best circuit for minimum noise is determined from a given application. Curves shown compare effectiveness of 6AK5 pentode and 6J6 triode for the circuits discussed

It will be noted that the 6AK5 pentode gives the poorest noise figure, followed by the 6J6 cathode-coupled triode. The best noise figure as indicated by the third curve is provided by the 6J6 triode used in any one of the circuits included in the first class above. If R_1 can be made high enough, that is, if a high Q-tuned circuit can be used and if the input loading by the tube is small, the pentode is entirely satisfactory. These conditions are usually met at frequencies below 15 MC or so. Referring to Fig. 7, the 1/2 6J6 grounded-cathode triode is only about 1 DB better than the 6AK5 pentode when R_1 = 30,000 ohms. This 1 DB would, to consider a practical application, increase the range of a radar set by only 6% or a communications circuit by 12% and is hardly worthwhile in view of the greater circuit complication necessary. At higher frequencies, however, when lower values of R_1 are obtained either as a result of unavoidable circuit losses or intentional broad banding, the triode comes into its own. Thus, when R_1 = 1000 ohms, the difference mentioned above increases to 4 DB, which is well worthwhile.

The particular circuit used with the triode tube will depend upon the amount of circuit complication to be tolerated. The cathode-coupled amplifier is the easiest to use because it is highly stable. An RF choke can be used as the coupling element between cathode and ground and at the higher frequencies it can be made to resonate in the middle of the range desired.

The grounded-grid circuit is also stable if care is taken to secure a good RF ground for the grid. It will be evident from the following, however, that under some conditions the stage gain is so small that noise

(*Continued on page 57*)

WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by Tele-Tech's Washington Bureau

COY COUNTERS TV-SET OBSOLESCENCE—Support of the vast preponderance of the technical thinking in the radio-television industry that the present video sets will not become obsolete for many years and that nobody buying a TV receiver today is a "fraud" victim because suitable, low-priced converters can be provided, was given recently by FCC Chairman Wayne Coy, one of the ablest men ever to guide the helm of the Federal Communications Commission. Chairman Coy stated that he wished to assure present purchasers of television sets that, "wherever a television signal is available from a VHF transmitter, their set will render them fine service for many years and can be converted to render fine service for them if ultra-high frequencies are utilized for the present system".

FEARS UNFOUNDED—Shortly after Chairman Coy's statement, RCA Victor Executive Vice President J. G. Wilson stressed obsolescence fears are "unfounded" and "not based on scientific or economic facts". In another quarter, the Radio Manufacturers Association has created a committee of leading industry executives to formulate a comprehensive public relations information program on accurate television data. Lifting of the television "freeze" by the FCC is anticipated by May or June and action on the more than 300 pending video station applications will constitute the *piece de resistance* and main task of the FCC during the summer months.

RADIO PREPAREDNESS FOR NATIONAL DEFENSE—Three leading authorities of the government—FCC Chairman Wayne Coy, Maj. Gen S. B. Akin, Chief Signal Officer; and Leighton H. Peebles, Assistant Director of Production of the National Security Resources Board—and Brig. Gen David Sarnoff, RCA Board Chairman and retiring president of the Armed Forces Communications Association, all gave recent authoritative statements regarding the role of electronics, radio and television in the mobilization blueprint of the United States. Chairman Coy pointed out that standard broadcasting (AM) has more than doubled since World War II and television in the next six or seven years will have 800 to 1000 stations with 125 video transmitters in operation or under construction.

TV AS WARTIME AID—Television, Mr. Coy believes, possesses a "unique power" for instruction in civilian defense and in rallying the home front, while Gen. Sarnoff brought out television's importance in naval, army and air operations so that victory in any future war could go to the side that "sees farthest sooner", emphasizing the roles of video and radar. Gen. Akin depicted how integrated communications, wire and radio, combined in a single apparatus of smallest possible size is being produced by US manufacturers. Mr. Peebles estimated that 20 percent of the cost of all military production will be devoted to electronics-radio equipments, but he also advocated strongly standardization to the fullest degree, a goal of Western Electric vice president Fred Lack, the new AFCA president, in the manufacturers' planning.

MOBILE RADIO GROWTH PAINTED BY CHAIRMAN COY—Present 200,000 mobile radio units in vehicles and other portable stations, already authorized by the FCC, will grow to more than a half million (500,000 in 5 years)—this is the prediction of FCC Chairman Coy. Police blazed the trail since World War II with 4000 land stations and 50,000 mobile units compared to prewar 1600 land stations and 15,000 mobile units; 100 cities have radio systems for fire departments; railroads are using radio for main line operations and especially time-consuming job of switching yard freight classification; inter-city bus lines and trucklines moving rapidly towards coast-to-coast radiocommunications systems; 32,000 taxicabs are radio-equipped; power, gas and water utilities, including REA cooperatives, now operate more than 26,000 radio-equipped trucks; and petroleum industry employs walkie-talkies, radio-equipped trucks and even radio-equipped airplanes to patrol pipelines and to maintain communications with oil and gas drilling crews in deserts, mountains and even in Gulf of Mexico and off-shore California waters.

WAR ASSETS ADMINISTRATION ENDS ELECTRONIC-RADIO DISPOSAL—The War Assets Administration has now gone out of business in the disposal of the armed services' surplus of electronics and radio equipment in this country, except for the paper work of processing the documents, completion of the final audit reports covering the agents' and distributors' activities and settlement of all agency contracts. Out of the total surplus electronics-radio acquisitions by the WAA of $816,307,000 at original cost, the War Assets Administration made outright sales of equipment and parts valued originally at $584,310,000 through its agents and distributors and only received $63,672,000 cash payment. Approximately $300 million worth of the surplus was distributed by the WAA to state governments, counties, cities, universities and schools without charge, or was scrapped as obsolete.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

TELE-TECH's NEWSCAST

Bell TV Network Program

In 1949 the Bell System will double the number of miles of television network channels now available and will bring its network service to thirteen additional cities, according to the Long Lines Department of the American Telephone & Telegraph Company. By the end of this year there will be some 8,200 miles of television channels in operation, spread over a Bell System inter-city network which will then extend 2,850 miles and link 27 cities.

By summer, under present plans, the fourteen cities already on the Bell System's television network will be joined by Providence, R. I., and Wilmington, Del. By Fall it is expected that the following cities will be linked: Lancaster and Erie, Pa., and Rochester, N. Y., and Dayton, Columbus, and Cincinnati, Ohio. Toward the end of the year, it is planned to equip the existing coaxial route between New York City and Albany, N. Y. for television transmission and to extend it, by radio relay, to Syracuse, which would permit Bell System service to Schenectady, Utica and Rome as well.

Citizens Radio Rules Adopted

Rules for the licensing of Citizens Radio Service Stations on a regular basis have been adopted as final by the FCC and will become effective June 1, 1949.

The prelude to the Citizens Radio Service dates from May 1945, when the Commission's allocations report established a band for the operation of "citizens stations." In accordance with this allocation, technical regulations for citizens stations came into effect December 1, 1947, and were designated as Part 19 of the Commission's rules. To supplement these technical requirements, proposed regulations dealing with the licensing and administration of citizens stations were issued by the Commission August 12, 1948 as proposed rules. In finalizing these procedural requirements, the Commission is recognizing Citizens Radio as a full-fledged service.

Generally, any citizen of the United States who is 18 years of age or older will be eligible for a station license. Licenses will be valid for a period of 5 years and the station license is normally the only authorization that will be required for operation of a citizens station.

ELECTRONTYPE DESIGNER

J. T. McNaney, inventor of the Charactron, is shown examining one of the experimental tubes. The tube is the chief component of Electrontype, a new method of high speed communication (see TELE-TECH, March, '49, p. 47). Inset is closeup view of Charactron used for numerical displays. McNaney conducted experiments at the Consolidated Vultee Aircraft Corp., San Diego, Calif.

Hedges Succeeds Kobak to Head Radio Pioneers

William S. Hedges, vice-president in charge of planning and development of National Broadcasting Co., has been elected president of the Radio Pioneers Club, New York City, succeeding Edgar Kobak, president of the Mutual Broadcasting System.

Other officers named are Frank E. Mullen, president of Good Will Stations, Inc., Detroit, first vice-president; Arthur Church, president of KMBC, Kansas City, Mo., second vice-president; Paul W. Morency, general manager of WTIC, Hartford, Conn., vice-president and secretary; Orestes H. Caldwell, editor of Tele-Tech, vice-president and treasurer; Edgar Bill, president of WMBD, Peoria, vice-president, and J. R. Poppele, vice-president of WOR, vice-president.

TBA Names New Committees

Keeping pace with the immense growth of the television industry during the past year, the Television Broadcasters Association, Inc., 500 Fifth Ave., New York, N. Y., has embarked on a program of expanded activity, which, it is expected, will increase the services and staff on a considerable basis before the end of 1949.

Committee chairmen named by J. R. Poppele, president, for 1949 include: F. J. Bingley, engineering; Lawrence W. Lowman, program; G. Emerson Markham, commercial operations; Dr. Allen B. Du Mont, membership; O. B. Hanson, television station operations and standards; Mr. Lowman, finance; Paul Raibourn, publicity and promotion; Dean Kenneth Bartlett of Syracuse University, educational committee and Ernest A. Marx, chairman of the affiliates division.

TESTING TRANSMITTER SITE

A helium-filled balloon carrying a pulse transmitter and antenna is raised by RCA engineers who are studying TV transmission characteristics of site in the Philadelphia area. Receiving unit is mounted in a truck and is powered by a motor generator

Coming Events

May 2-4—International Scientific Radio Union and IRE, Joint Meeting, East Bldg. Lecture Room, National Bureau of Standards, Washington, D. C.

May 5-7—Acoustical Society of America, 20th Anniversary Meeting, Hotel Statler, New York City.

May 16 - 19 — RMA and Radio Parts Show, Hotel Stevens, Chicago, Ill. RMA 25th Anniversary.

May 26-27—Society of the Plastics Industry, Annual Meeting, Edgewater Beach Hotel, Chicago.

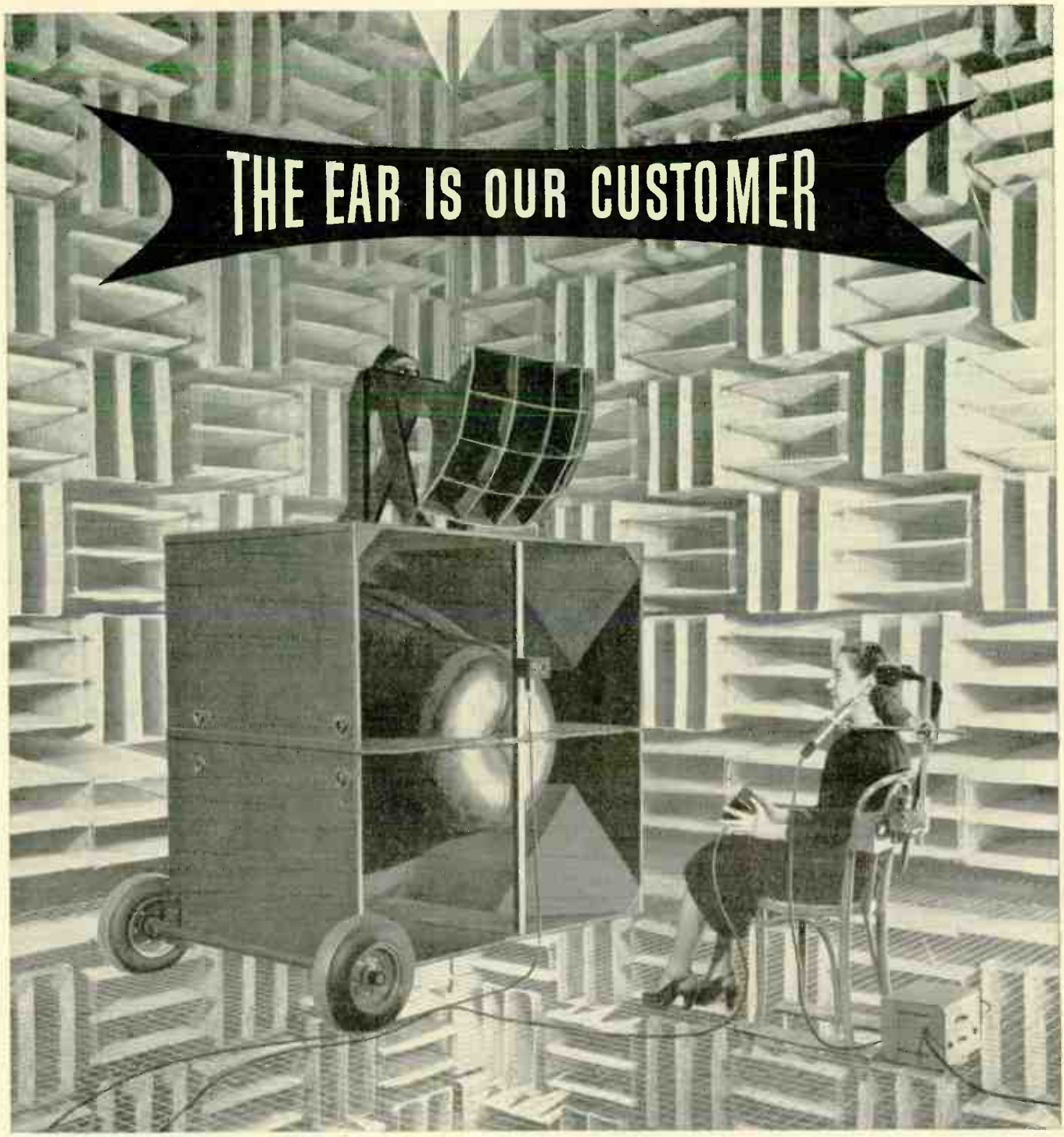
June 3-4—IRE, Dayton Section, Conference on Airborne Electronics, Biltmore Hotel, Dayton, Ohio.

June 20 - 25 — American Institute of Electrical Engineers, Summer General Meeting, Swampscott, Mass.

August 23-26— American Institute of Electrical Engineers, Pacific General Meeting, Fairmont Hotel, San Francisco.

August 29 - September 1 — Associated Police Communication Officers, National Conference, Hotel New Yorker, New York City.

September 26-28—National Electronics Conference, Edgewater Beach Hotel, Chicago.



What happens when you hear? What happens *inside* your ear when sound waves come in from a telephone conversation?

Bell Telephone Laboratories scientists have developed special apparatus to help answer these questions, for the telephone system is designed to meet the ear's requirements for good listening.

In the test pictured above, the young lady sits before loudspeakers in a soundproofed room with a small hollow tube, reaching just inside the ear canal. Sounds differing slightly in frequency and intensity come from a loudspeaker. The subject seeks to tell one from another, recording her judgment electrically by pressing a switch.

Meanwhile, the same sound waves pass down the hollow tube to a condenser microphone, and a record is made of the exact sound intensities she identified. Results help reveal the sound levels you can hear clearly and without strain—the sounds your telephone must be designed to carry.

Scientists at Bell Telephone Laboratories make hundreds of tests in this manner. It's just one part of the work which goes on year after year at the Laboratories to help keep Bell System telephone service the finest on earth.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting, for continued improvements and economies in telephone service.

New Lab & Test Equipment

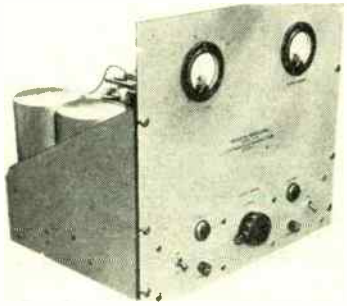
Voltage Regulator

A rated output of 0 to 250 VA is supplied by the new Stabiline voltage regulator, a unit which is completely electronic. Catalogued as

the 1E51002, the regulator measures approximately 11½ x 11½ x 10¼-in. and is fitted with carrying handles. It is rated at 95 to 135 volt input and its output is adjustable between 110 and 120 volts. The load power factor range is 0.5 lagging to 0.9 leading; waveform distortion is claimed never to exceed 3%.—**Superior Electric Co., Bristol, Conn.**

Regulated Power Supply

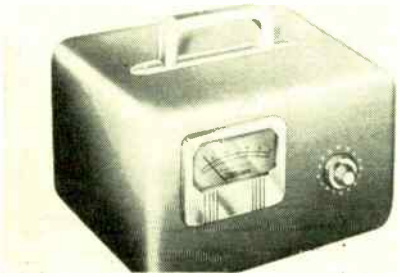
Designed for use in laboratories, broadcast stations or other applications requiring a closely regulated source of ripple-free DC,



model E-48 regulated power supply may be mounted in a standard relay rack or installed in a cabinet for bench applications. Ripple is less than .05 volts peak to peak with an input between 105 and 125 volts, 60 cycle, 750 watts. There is less than a .15% variation in output from no load to full load.—**Chatham Electronics Corp., 475 Washington St., Newark, N. J.**

Field Strength Meter

Measurement of actual picture signal strength is one of the operations performed by model FSM-1 field strength meter, a compact



portable television service instrument designed to facilitate and improve television installations. It also measures losses or gain of various antenna and lead-in combinations and is useful for checking receiver re-radiation. Model FSM-1 consists of a compact high-gain receiver with a calibrated meter to indicate signal level; each unit is individually calibrated. Power supply for operation from 120 volts, 60 cycles is self contained.—**Transvision, Inc., New Rochelle, N. Y.**

Slide-Wire Resistance Boxes

A useful substitute for more elaborate and expensive instruments, the 110 slide-wire resistance boxes are a practical combination

of accuracy, wide resistance range and size. Components are one precision non-inductive decade resistor unit and one continuously adjustable slide-wire resistor, the range of which provides continuous adjustment of resistance between the steps of the resistor. The fineness of adjustment made possible through the use of the slide-wire resistor is obtainable only with the more elaborate 4-dial decade resistance boxes, and the direct reading resistance range is useful over a ratio of 1,000 to 1.—**Technology Instrument Corp., 1058 Main St., Waltham 54, Mass.**

TV Signal Generator

Model TVG-1 signal generator is a complete self-contained test instrument that requires only the addition of a cathode ray oscillo-

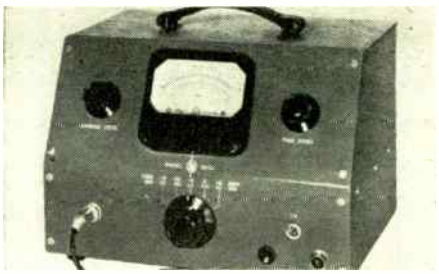
graph for visual alignment of television or FM radios. It provides a complete range of frequencies for the alignment of RF, oscillator, IF and trap circuits. Sweep frequencies are from 2 to 216 MC in 3 convenient ranges, all on fundamentals. Sweep width is adjustable from 100 KC to 12 MC bandwidth, ample width for the alignment of badly detuned circuits.—**Jackson Electrical Instrument Co., 18 South Patterson Blvd., Dayton 1, Ohio.**

Logarithmic Attenuator

The Kay-Lab Logaten is a wide range logarithmic attenuator whose output is proportional to the logarithm of its input for a range of 50 DB. Frequency response is flat from DC to 500 KC and only minor errors are found up to several MC. When a Logaten is plugged into a vacuum-tube voltmeter, oscilloscope or recorder, these devices read linearly in DB. It is adaptable to many applications involving electronic computers through the principle of multiplications and division by logarithms. It is also applicable where data having a great dynamic range must be recorded on a single sensitivity range of an instrument. Essentially, the Logaten is a network of non-linear circuit elements adjusted to give an output voltage which is accurately proportional to the logarithm of input voltage. Both input and output impedances are 10,000 ohms.—**Kalbfell Laboratories, Inc., 1076 Morena Blvd., San Diego 10, Calif.**

Microwave Power Meter

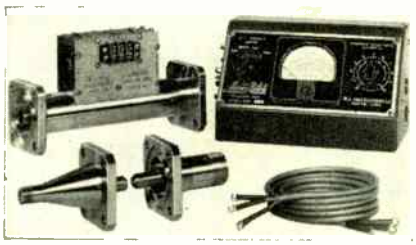
Designed to automatically indicate power developed in a standard barreter, the -hp-430A microwave power meter is self-balancing



and may be used over any frequency, depending on the associated barreter and mount. Power level is read directly on a 4-in. square meter face. No calculation or knob twisting is necessary once range selection and zero sets are made. The indicating meter is calibrated in DBM in addition to the linear milliwatt calibration.—**Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.**

RF Power and SWR Meter

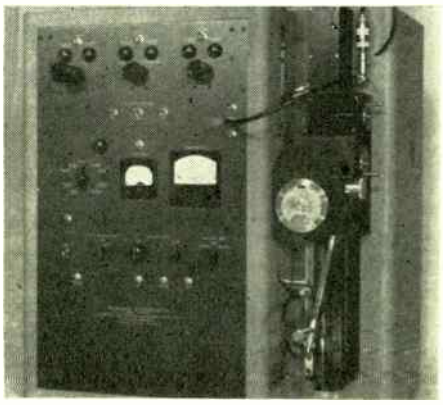
No correction factor over the entire frequency range of 50 to 500 MC is required for a new series of wide frequency range instru-



ments for measuring RF power and standing wave ratio on 51.5 ohm coaxial transmission line. A single meter reads incident power, reflected power, net power to load, and SWR of the load. Known as the MM100 series Micromatch, these units may be used with 1⅝ or ⅞ in. air line, and with RG-17/U and RG-8/U coaxial cable. Full scale power ranges of 100, 1200, and 4000 watts are available.—**M. C. Jones Electronics Co., 96 N. Main St., Bristol, Conn.**

Microwave Dielectrometer

Dielectric constant and loss of a wide variety of materials at nominal frequencies of 1000, 3000, and 9000 MC can now be measured



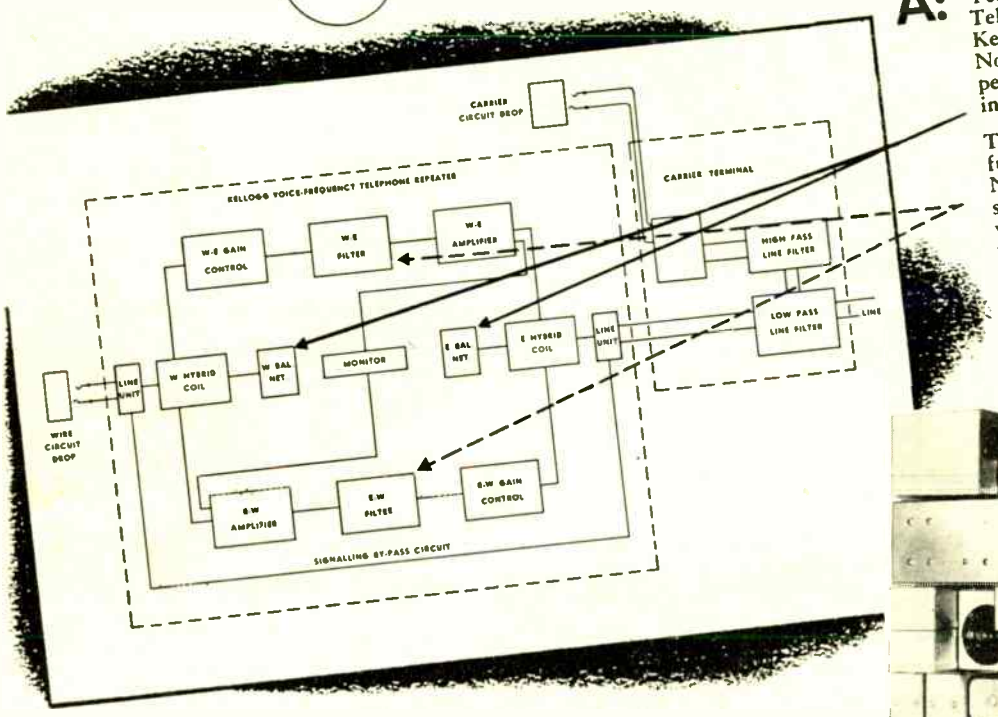
by a recently-developed microwave dielectrometer. The instrument consists of a slotted wave guide, precision traveling probe, modulated klystron oscillators, probe output amplifier, and associated power supplies. The sample to be measured is inserted ahead of a short-circuiting plug and the effect of this arrangement on the standing-wave pattern in the guide provides data for calculating the dielectric constant and loss of the material.—**Central Research Laboratories, Inc., Red Wing, Minn.**

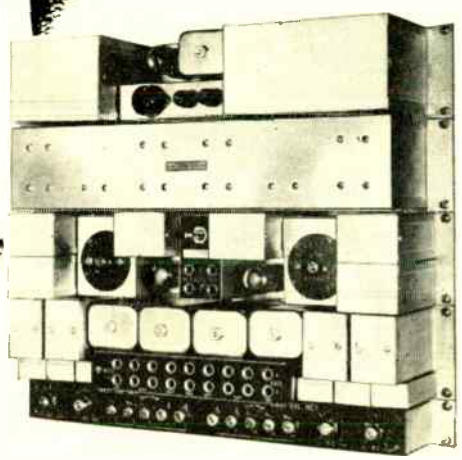
Here's a Question —with an unexpected answer!

Q: Can a reasonable gain be realized from a telephone repeater installed on a wire line over which a carrier system is operating *without* using a special balance network?

A: Yes—if a *Kellogg* Voice Frequency Telephone Repeater is used. The Kellogg Repeater with the standard No. 1 balance network will compensate for the low-pass line filter in the carrier terminal.

This is possible because of the skillfully engineered and manufactured No. 204-2 Filter Unit, which consists of two sharp cut-off, straight-walled, 300-2700 CPS band-pass filters.





By limiting the band of frequencies to be passed and amplified, the No. 204-2 Filter allows maintaining a high degree of balance with a relatively simple network. It thus permits maximum repeater gain on circuits upon which a carrier system is superimposed and on heavily-loaded cable lines. The No. 204-2 Filter also produces a quiet circuit. Its use greatly attenuates any noise voltages outside of the pass-band, eliminates carrier leak and cross-talk and 60-cy. hum induced by adjacent power lines.

Stable balance is easily obtained with maximum ease in the Kellogg Repeater with continuously variable potentiometers and a series of small capacity steps. An ordinary screwdriver quickly makes all adjustments, with no need for strapping. Gain adjustments are accurately calibrated in 1-db steps so gain is always known without necessity for measurement.

"Unit" construction facilitates adaptation to various circuit reqiurements, while a variety of line units may be obtained for different circuit or signalling functions. Kellogg Repeaters are available for operation from 24V or 48V battery or from a 105-125V 60-cy. AC power source.

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Chicago 38, Illinois

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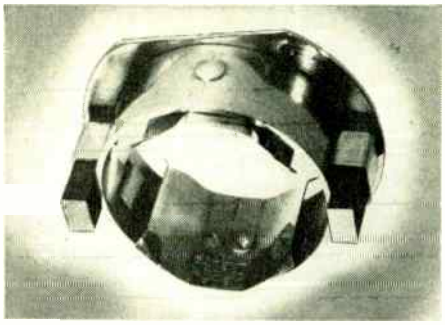
TV & Communication Components

Ion Trap

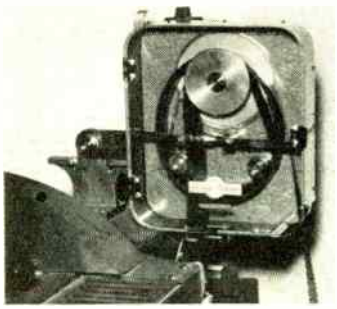
A new double magnet ion trap (model 7078) will compensate for shadowing on all sizes of television picture tubes having magnetic



deflection. Its field can be rotated 60° in either direction. The length of the trap, which can be furnished in any field strength up to 70 gausses, is not over 1 1/16 in.—**Heppner Mfg. Co., 4808 N. Drake Ave., Chicago 25, Ill.**

TV Projection Reel

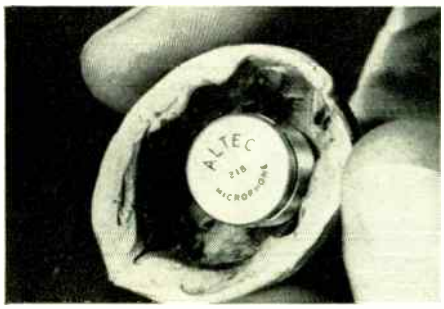
Housed in a 6 x 7-in. metal container with window front, a new TV projection reel permits the continuous projection of any 16-mm. film from 3 to 150 ft. long when spliced into



a continuous loop. In television, this unit serves as a vehicle for convenient and rapid handling of short commercials, engineering test films, program insert shots, and titles with moving backgrounds. There is no rewinding. The whole unit can be mounted on the television projector so that it folds back out of the way when not in use.—**Television Associates, Inc., 225 N. Michigan Ave., Chicago Ill.**

Microphone

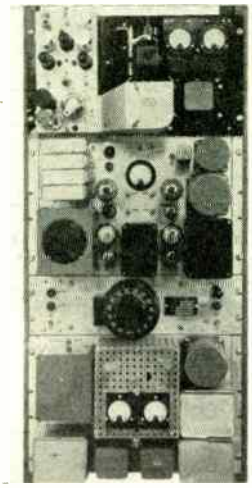
Uniformity of response over the entire spectrum is achieved by the 21B Altec microphone, a new component unprecedently small



in size and weighing less than ¼ ounce. The only moving element in the microphone is an extremely small diaphragm no larger than the human eardrum, yet the sound output from this tiny apparatus is somewhat greater than from conventional large microphones. Even though the microphone is omnidirectional and "blast proof", more net acoustic gain before encountering feedback is claimed. —**Altec Lansing Corp., 161 Sixth Ave., New York 13, N. Y.**

Microwave Equipment

Wide-band microwave equipment, model RTR-1A, was developed specifically for use in television stations. The system is comprised



of a transmitter (illustr.), receiver, 2 dipole antennas with parabolic reflectors and RG17U coax antenna lines. The equipment includes a directly frequency-modulated CW cavity magnetron oscillator, a wide-band video amplifier and modulator, and associated regulated power supply.—**Raytheon Mfg. Co., Waltham 54, Mass.**

TV Stabilizing Amplifier

A stabilizing amplifier (Type TV-16-A) for amplifying and improving television picture signals has been designed for use in studios

and at transmitters as a picture line amplifier, or as an amplifier for remote line and radio relay links. It will remove low-frequency interference from the signal, stretch and clip supersync, and restore DC to improve low-frequency response. A signal as small as 0.2 volt, peak to peak, can be raised to a standard picture line signal of 2 volts. The unit is mounted on an aluminum relay rack chassis, 7-in. wide, which fits into a standard 19-in. relay rack.—**General Electric Co., Syracuse, N. Y.**

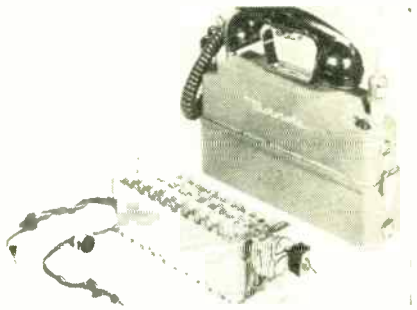
Mobile Radio

Operation of two-way radio in channels between stations now on the air without "spillover" into the adjacent channels is made

possible by the highly selective circuits which are part of the new RCA Carfone. The complete transmitter-receiver is contained in a single metal-shielded unit only slightly larger than a shoebox. Frequency range is between 152 and 174 MC. An automatic modulation control circuit locks the voice input level at a constant amplitude.—**RCA Victor Div., Radio Corporation of America, Camden, N. J.**

Portable 2-Way Radio

Embodying a complete crystal-controlled FM transmitter and superheterodyne receiver in a single compact housing, the "Handie-



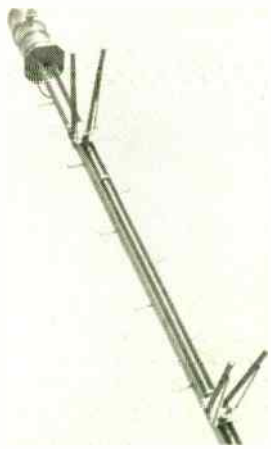
Talkie" is precision engineered to give dependable 2-way communications from 1 to 1½ miles between units to ranges in excess of 60 miles when used in aircraft. Less than 1 uvolt at the receiver will produce 0 DB noise quieting. Audio output of the 11-tube receiver is 4 milliwatts. RF power output from the 8-tube transmitter is 500 milliwatts. The power supply consists of 3 miniature 67½-volt batteries and 4 to 6 standard type D flashlight cells.—**Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.**

FM Relay Link

A new FM relay unit has been developed for use in the 920 to 960 MC band. It has been designated model 707 and is suitable for a single FM program channel or for multiple voice frequencies up to 5 channels when hooked up to supplementary terminal equipment. The unit contains a 5 watt transmitter with the Serrasoid modulator, a crystal-controlled receiver, and parabolic type transmitting and receiving antennas. All tubes and circuits are readily accessible from the front and the rear of standard type relay cabinets. —**Radio Engineering Laboratories, Inc., 35-51 36th St., Long Island City, N. Y.**

FM Antenna

A power gain of 1.6 and a power handling capacity of 10 KW are featured characteristics of the Multi-V FM broadcast antenna, a



two bay component which may be top or side mounted. The non-symmetrical arrangement of the radiators and its light weight (70 pounds) make the side model ideal for mounting on existing towers which are incapable of supporting heavy top mounted arrays. In addition, the top mounted version (illustr.), with its 20 ft. mounting mast, may be readily adapted to mounting on rooftops of downtown office buildings. Each element is essentially an unbalanced folded dipole formed in the shape of a V. This configuration results in an omnidirectional horizontal pattern. Elements are fed in phase by a single transmission line through a full wave phasing length, and are matched to the feed line by means of a quarter wave matching section. Voltage standing wave ratio varies from a maximum of 1.4 at 88 MC to less than 1.2 from 93 to 108 MC.—**Andrew Corp., 363 East 75th St., Chicago 19, Ill.**

Developed by MACHLETT

ML-5667

...gives demonstrably superior performance in 889RA sockets*

Use of the ML-5666 to replace 889A. carries the added advantage of the Machlett automatic-seal water jacket.

Government, communications, and industrial users of "889RA-type" tubes are now rapidly switching to the Machlett-developed 5667*.

If you are not already familiar with the unique qualities of this new tube, here is an opportunity to learn exactly why and how the ML-5667 ***(completely interchangeable with the 889RA)*** is convincingly superior by any standard of comparison.

GET ALL THE FACTS ABOUT THESE FEATURES:

- **Special anode construction and processing.**
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- **New filament design.**

* Adopted by Military Services, U. S. Government Agencies, and other large users as the standard replacement for 889RA, the 5667 is now their preferred tube type for 889RA sockets.

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Please send me "The ML-5667 Story" comparing the electrical and mechanical characteristics of the ML-5667 and the 889RA.

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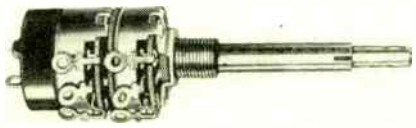
MACHLETT — OVER 50 YEARS OF ELECTRON TUBE EXPERIENCE

New Parts for Design Engineers

Dual Variable Resistor

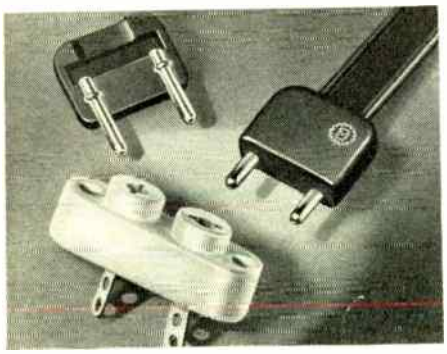
Two quiet, compact controls are combined on concentric shafts in the Midgetrol Dual, a new dual variable resistor for television and



other applications. Its 15/16 in. diameter makes it possible to move several key television adjustments from the rear of the chassis to the front. Four Midgetrol Duals can do the work of eight single controls now required to make adjustments on the average television receiver. The new units are fully insulated for high voltage; have special low-drift resistance element to meet temperature-humidity drift problem; and incorporate two-point shaft suspension which permits use of shorter bushing, provides more stable resistance values, less danger of damage in assembly, and longer life.—**P. R. Mallory & Co., 3029 E. Washington St., Indianapolis 6, Ind.**

RF Plug

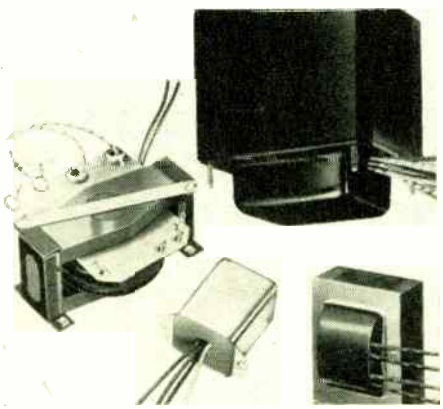
A new inexpensive plug is being manufactured for applications where 300 ohm poly-



ethylene ribbon type RF transmission line is used. Designated No. 37412, it fits into the standard Millen No. 33102 (crystal) socket with a pin spacing of $\frac{1}{2}$ in. and a diameter of .095 in.—**James Millen Mfg. Co., 150 Exchange St., Malden 48, Mass.**

Television Transformers

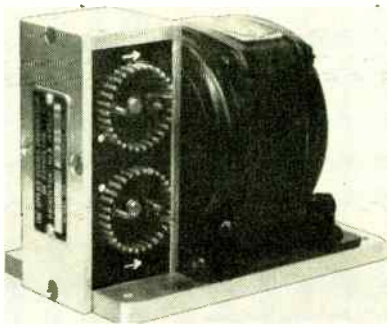
A complete line of television transformers designed to fit the circuits of leading TV receiver manufacturers are now available. In-



cluded in the line are television power transformers, vertical blocking oscillator transformers, vertical scanning output transformers, and a horizontal scanning output transformer. Manufacturer will supply upon request a complete listing of transformers with descriptions, dimensions and replacement guide.—**Chicago Transformer Div., Essex Wire Corp., 3501 Addison St., Chicago 18, Ill.**

Multichannel Switch

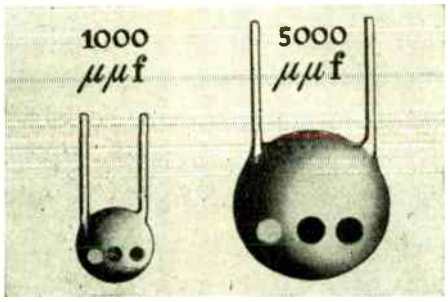
A new multichannel switch has been developed with a synchronous motor which assures constant sampling rates and allows the con-



stant use of an AC line voltage source whose frequency is automatically synchronized with the sampling operation. The 4-pole model (illustr.) is 2 x 3 x 4 in. and has 30 contacts per pole. The wiper is of the shorting type for flexibility. Standard models have sampling rates of 720, 360, 240, or 90 RPM. These units facilitate investigation of a large number of separate quantities or of a single quantity under a number of different conditions. In addition to telemetering applications, they may be used for display of characteristic curves and multichannel voltage comparison. —**The Applied Science Corp. of Princeton, P. O. Box 44, Princeton, N. J.**

Miniature Capacitors

Featuring small size and low inductance, the new Discap by-pass condensers are now available to TV and FM manufacturers who



find it desirable to eliminate the bulk factor of tubular and larger disc types. The 1000 μμf Discap, measuring only ½-in. in diameter is rated at 400 volts and tested at 1000 volts. The 5000 μμf Discap, measuring only ½ in. in diameter, carries a service rating of 600 volts and passes a 1200 volt test. An exclusive impregnation process does away with leakage problems.—**Radio Materials Corp., 1308 Belmont Ave., Chicago 13, Ill.**

Projection TV Lens

A corrective lens for use with the 5TP4 projection tube is incorporated in the barrel of the new F 1.9 projection television lens, cap-

able of projecting picture sizes from several inches to 7 x 9 ft. The corrective lens can easily be removed for use with flat-face type tubes. Entire assembly is 7 in. long; diameter is 4¼ in.—**Spellman Television Co., Inc., 130 West 24th St., New York 11, N. Y.**

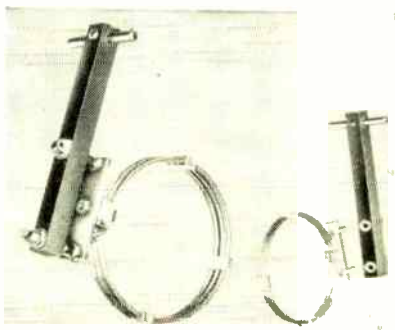
Ceramic Coil Form

A miniature ceramic coil form with adjustable powdered iron slug has been developed for sub-miniature component applications in

compact equipment. The coil form stands less than ⅝-in. high when mounted; form diameter is 3/16 in. Terminals are ring type (adjustable), and the form can accommodate solenoid or pie type windings. The ceramic body is grade L-5 (JAN-1-10), sibcone impregnated. Depending on the type of winding used, inductance changes of approximately 2:1 can be expected.—**Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.**

Impedance Matching Links

Matching of standard tank coils to a wide variety of impedances is now possible with B & W plug-in links, available in 3, 6, and



10 turns. On present swinging link assemblies, it is only necessary to replace the swinging link arm with a new one, into which the link coils are plugged. This is accomplished easily by removing the pin that forms the arm hinge and inserting the new arm.—**Barker & Williamson, Inc., 237 Fairfield Ave., Upper Darby, Pa.**

RF Inductors

Available in 10, 20 and 30 ampere ratings, a new line of heavy duty RF inductors have been designed for broadcast transmitters,

phasing and tuning equipment, RF heating equipment and heavy current filter circuits. These inductors are variable by means of tapping clips which may be either of the shorting or non-shorting type. Nominal inductances of 19, 38, and 65 microhenries are available in 10 ampere inductors; 20 ampere inductors are rated at 36, 53, and 76 microhenries, while the 30 ampere series are rated at 35, 49 and 71 microhenries.—**Andrew Corp., 363 East 75th St., Chicago 19, Ill.**

IN A RADIO SET

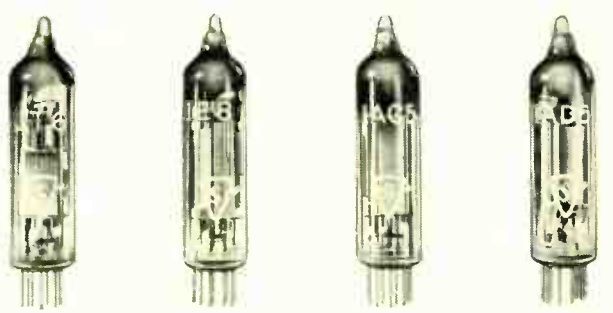
how small can you get?

Sylvania's four tiny new tubes hold the answer

The miniature radio set shown here is an example of what can be done through the use of Sylvania's new subminiature tubes.

These specially designed and engineered T-3 subminiatures are battery-type receiving tubes perfect for very small radios or amplifiers. Short tube leads provided in conventional pin arrangement permit these tubes to be plugged into appropriate subminiature sockets. They can be operated over a wide range of battery voltages. Low current requirements result in battery economy

Send for complete ratings and characteristics. Sylvania Electric Products Inc., Advertising Dept., R-1205, 500 Fifth Ave., New York 18, N. Y.



Type 1T6 (diode pentode)

Type 1E8 (converter)

Type 1AC5 (output pentode)

Type 1AD5 (RF pentode)

Four new Sylvania subminiatures shown in place in tiny radio set. Note size in relation to pencil.

SYLVANIA ELECTRIC

RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES, SIGN TUBING; LIGHT BULBS; PHOTOLAMPS

LETTERS . . .

Electrets

Editors, Tele-Tech:

Since electret research opens relatively new scientific problems, the undersigned as author of the electret article appearing on page 36 of the March, 1949, issue of Tele-Tech, believes the following facts should be emphasized.

As stated in Footnote 4, the numerical data in the article are experimental. Since electrets are in a developmental stage these data should not be considered as optimum design figures.

The U. S. Patents mentioned in Footnote 3 of the article illustrate the scope of the electret microphone problem, but the patents are not necessarily valid.

Confusion in reading the article will be avoided if the caption of Fig. 3 is changed to: "Equipment arranged as a capacitor. *Work done* against electret surfaces induces charges on *condenser plates.*"

32 S. Munn Ave. *E. D. Padgett*
East Orange, N. J.

TV Camera Errata

Editors, Tele-Tech:

It might be well to publish the following corrections to the diagrams in the article "New Design for Medium Definition TV Camera System" which appeared in September, 1948 Tele-Tech.

In Figure 3:
1. Connect 6SJ7 pulse amplifier plates to +225 v. through 0.25 megohm.
2. First video peaking coil should be in microhenries.
3. Coupling Condenser to 6SJ7 plate is 0.01 mfd.
In Figure 5:
4. The common B+ connection should be made to +225 v.

Cooper Union *J. B. Sherman,*
New York City *Associate Professor*

Black Phosphors for TV Screens?

Editors, Tele-Tech:

Your recent editorial comment "Are Screens too Bright" prompts us to toss in an observation of our own.

Early last year we had a patent search made of the state of the art with respect to the use of black or dark phosphors for use in cathode-ray-tube screens, and obtained information to the effect that two apparently valid schemes had patent coverage relating to the subject. One of these was of German origin, and the other by DuMont.

You may wish to ponder upon the significance of this idea, inasmuch as the development of a dark screen material should greatly eliminate the need for the gadgets currently offered for correction of CRT inherent faults.

There seems to be little reason why intensive research to produce such a phosphor might not be highly productive. An inert dye or other material might well be developed which would not interfere with the fluorescent properties of the phosphor appreciably, and yet give to the TV screen

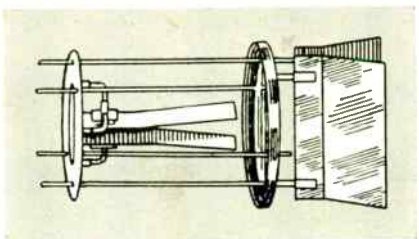
(*Continued on page* 54)

Another Du Mont "First"—the new Du Mont Type 5XP-! A multiple-intensifier design, it features deflection sensitivity never before achieved by a cathode-ray tube in either the low- or high-voltage category. Specifically:

At E_{b2} of 2000 volts and E_{b3} of 4000 volts, only 24 to 36 d-c volts/in. of deflection are required! This is approximately *three* times the sensitivity of a low-voltage tube such as Type 5LP-A. This superlative performance of the vertical plate system is due to the design of the plates and to a slight increase in overall tube length—only ⅞" longer than Type 5LP-A.

Also featured are the high ratios of E_{b3} to E_{b2} voltages—up to 10:1, and high overall accelerating potential—up to 25,500 d-c volts.

Because the usable vertical deflection is a function of the ratio E_{b3}/E_{b2}, the full-screen deflection available at ratio 1:1 is reduced to 2.5" at 2:1, 1.75" at 5:1, and 1.25" at 10:1 ratios, respectively.



Capacitance from D_3 to D_4 held to 1.7 μμf by virtue of this new deflection-plate design, despite longer length and closer spacing required for high sensitivity.

Another feature is the shielding between deflection plates D_1-D_2 and D_3-D_4 to prevent interaction between plate pairs. And for general shielding of the tube, Du Mont mu-metal shield Type 2502 is available.

A choice of phosphors is available, such as the P1, P2, P4, P5, P7 and P11 screens. The flat face makes for ease of visual measurement and photography.

As with all Du Mont tubes, Type 5XP- is available as a separate unit or in combination with a Du Mont oscillograph. Several Du Mont oscillographs already in use, notably Types 280, 256-D, 250-H and 248-A, are readily adaptable to this latest tube.

Write for detailed literature on the Type 5XP- tube and how it can be used in your Du Mont oscillograph.

DUMONT *for Oscillography*

ALLEN B. DU MONT LABORATORIES, INC., PASSAIC, N. J.
CABLE ADDRESS: ALBEEDU, NEW YORK, N. Y., U. S. A.

(*Continued from page 52*)

as well as other CR tubes a dark background in the absence of electron illumination. The increase in contrast in daylight or other room light would be great enough to offset a reasonable decrease in phosphor efficiency. The main objective of course would be to produce a CRT with a completely dark face in the absence of electron bombardment, thus reducing halation from interface reflection and the reflection from ambient light.

Tulsa, Okla.
Radio Station KVOO
L. W. Stinson, Engineer

Safety Council Films

A new series of six sound slide films, entitled "Human Factors in Safety," has been released by the National Safety Council, 20 N. Wacker Drive, Chicago 6, to aid management's foreman training program. The 35 mm., 33-1/3 rpm films comprise a visual training course for foremen that deals with production and job attitudes, as well as safety.

Cartoon technique is used in two of the films, and action shots of workers on the job add realism to the plant scenes. Narration is by professional radio announcers.

The six films are entitled, "The Secret of Supervision," "Teaching Safety on the Job," "People Are All Alike," "Everybody's Different," "Teamwork for Safety" and "Safety Case Histories."

Barium Titanates

(*Continued from page 30*)

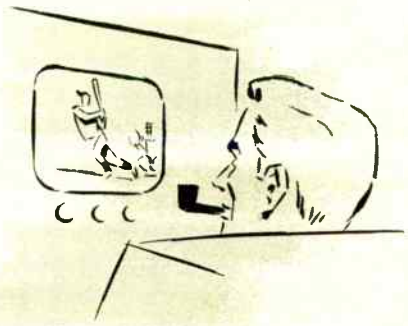
pressure gage. The most commonly used piezoelectric materials in this service are polycrystalline barium titanate, quartz (X cut), rochelle salt (45°X and 45°Y cuts), ADP (45°Z cut) and tourmaline (Z cut). Their unidirectional compressional characteristics and also their sources have been listed in Fig. 23.

When such a mechanical-to-electrical transducer is utilized, it may be represented in simplest form by a current generator feeding into a parallel combination of transducer capacitance and electrical load, or by its equivalent series form Fig. 24. Here the open circuit voltage is $V = Q/C_{xtal}$, in which Q is the charge generated by the mechanical stresses and C_{xtal} is the transducer capacitance (that measured between the electrical terminals). The charge per unit stress is given in column 6, the unit capacitance is given in column 8, and the open circuit voltage is given in column 9 of the table of Fig. 23.

The data in columns 8 and 9 have been plotted on the graph of Fig. 25, as a function of thickness for these various materials together with a family of curves showing the fundamental compressional resonant

(*Continued on page 56*)

from crystal set to television



LENZ has served the radio industry!

When the radio industry first appeared on the American scene 25 years or more ago, the Lenz Electric Manufacturing Co. was ready with the facilities required for the production of needed wires.

These facilities have grown with the industry, all through the days of the crystal set, right down to the present boom in Television equipment, Lenz Wires and Cables, have been used in the production of millions of electronic units of all kinds and their component parts.

Lenz will continue to be a leading source for properly engineered underwriters approved Plastic and Textile Hook-Up, Wires, Cables, Shielded Lead-Ins, and Harnesses for all types of electronic equipment, A.M., F.M., Television and Communications. Consult Lenz, now as always your source for engineered wires and cables designed for the job.

LENZ

LENZ ELECTRIC

MANUFACTURING CO.

1751 N. Western Ave. Chicago 47, Illinois

(*Continued from page 54*)

frequencies as a function of thickness. These three groups of curves make it possible to start with any one of the four parameters (i.e., resonant frequency, thickness, output capacitance, or unit sensitivity) and determine the other three.

For example, if a slab of barium titanate having a thickness resonance at 800 KC is needed the other characteristics are determined as follows. The intersection of the 800 KC line with the barium titanate resonant frequency line shows the thickness to be 0.265 cm. The intersection of this with the barium titanate sensitivity curve shows the piece to have a sensitivity of 1.9×10^{-5} volts/dynes/cm^2. The capacitance, as determined from the third family of curves is 4×10^3 μμf./cm^2.

When one studies these curves, several interesting points present themselves. First, both rochelle salts and ADP 45°Z cut are the most sensitive of all the materials listed, barium titanate being next in line. However, the rochelle salts have weaknesses as well. The 45°Y cut rochelle salts and ADP 45°Z cut have unit capacitances of less than 1% that of barium titanate. For example, a crystal of 45°Y cut rochelle salt .1 cm in cross section has a capacitance of 9 μμf., while a piece of barium titanate of identical size has a capacitance of 1000. The problem of loading a source of such high internal impedance may be troublesome in view of the fact that cable and stray capacitances often are several hundred μμf.

The 45°X cut rochelle salt is much better from the standpoint of output capacitance, a crystal of size identical to the above having a capacitance of about 170 μμf. However, at normal temperatures this material is quite temperature sensitive and hence is not entirely reliable, particularly in the case of a calibrated measuring device. Barium titanate, on the other hand, normally has a Curie temperature in the neighborhood of 120°C, and below 100°C this material is not temperature dependent.

However in using pressure gages the operating frequency should not be so high that spurious resonances are set up along the larger dimensions of the piezoelectric element. Furthermore, because equal pressure upon all faces (i.e., hydrostatic pressure) reduces the sensitivity by a factor of approximately 20, care should be taken to isolate the edges of the element from the medium in which the pressure is measured.

Such gages can, of course, be used to measure explosion pressures as well as rms values of alternating pressures. Our company has been in limited production of pressure gages for approximately two years.

Part III will appear in the June issue.

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Noise Figures

(*Continued from page 42*)

for the next stage is important. Assume that $R_1 = R_2 = 5000$ ohms and that the 6J4, a tube designed for this application, is used. The input impedance of the cathode circuit is $(R_p + R_L)/(\mu + 1) = 180$ ohms. For a minimum noise figure, taking $R_{eq} = 200$ ohms, $R_a = 980$ ohms. The antenna which then has a source impedance of 980 ohms sees a load of slightly less than 180 ohms. The voltage gain from cathode to plate is $(\mu + 1)R_L/R_p + R_L = 28$ (ratio). The net gain from antenna to plate is then only 4.4. If it is possible to increase R_L, the grounded-grid circuit becomes more useful because a higher value of R_L increases both the input impedance and the voltage gain.

The grounded cathode and Wallman circuits require additional circuit components when used with triode tubes as mentioned above. However, they appear to be capable of giving the best possible performance under difficult conditions.

Expressions have been derived for the noise figures of certain amplifiers that are useful as receiver input circuits. The conditions for minimum noise figure have been obtained. It has been shown that the ordinary pentode amplifier is satisfactory for low frequency, narrow band applications, and that the triode amplifier used with special circuits is desirable for high frequency, wide band use.

The writer wishes to thank Mr. R. E. Burgess of the National Physical Laboratory, Teddington, Middlesex, England, for his very helpful suggestions made during the preparation of this paper.

TELEVISION STUDIO LIGHTING

(*Continued from page 25*)

actually ultraviolet radiation is invisible to the eye and blue is seen as a low brightness color. When tungsten filament lamps are used, excessive response will be obtained not only in the red, (Fig. 2) due to the abundance of red light radiated by the lamp, but also in the blue due to the high sensitivity of the camera tube to even moderate amounts of blue light. This camera tube characteristic results in the appearance of both blues and reds on the viewing screen as light shades of grey, when actually the eye sees them as very dark colors and the yellow-greens as the brightest colors. Fluorescent lamps, particularly the 4500° and 3500° white lamps (Figs. 3 and 4) used in studios, result in a camera tube response to the reds and oranges which closely approximates that of the average eye because these lamps emit much less red light than filament lamps. Like all fluorescent lamps, however, they emit more ultraviolet and blue light than is needed for good color rendering. Such characteristics are easily corrected by the same methods photographers employ. All that is needed is a filter at the camera lens to suppress the undesired colors.

To eliminate the ultraviolet and to correct excessive response at the blue end of the spectrum with all light sources, a filter such as the Wratten #7 or #8 should be used, while a Corning #9788 filter is effective for reducing excessive response to reds. They may be used singly or in combination. Since, by their name, filters are subtractive in their operation, these two used in combination reduce the output signal by about 60%, making it desirable to use studio lighting levels of about 200 to 300 foot-candles. If economics dictate that only one filter can be employed, the red corrector, the 9788, should be selected. This passes 75% of the available energy and causes a marked improvement in the appearance of skin tones, hair, and lips and by reducing the frequent "5 o'clock shadow". With this filter only, it should be remembered that blues will appear as light shades of gray and in an attempt to control the brightness ratio, blue and ultraviolet reflecting materials should be used with caution.

Absence of Infra-Red

In addition to good tonal rendering of greens, yellows and reds, fluorescent lamps produce less sensation of heat to the actors than do tungsten lamps of comparable wattage. This is due to the absence of short-wave infrared radiation which predominates in the output from an incandescent filament lamp. Such short-wave infrared can be removed by the air-conditioning system only after it has been absorbed by some object and re-radiated as long-wave infrared.

The high luminous efficiency and the greater response of the camera tube to fluorescent light results in a fourfold gain in camera tube response over filament lamps of equal wattage. Thus it is desirable to employ as many fluorescent lamps as possible when designing a studio lighting installation. The slimline types of fluorescent sources are long and slender, and when they are used in trough reflectors the light may be controlled as desired in a

direction perpendicular to the lamp axis while spread broadly in a direction parallel to the lamp axis. These lamps should, therefore, be mounted horizontally so that a maximum amount of available light is directed into the set.

The low source brightness results in minimum glare, but makes it necessary to employ banks of lamps to obtain desired lighting levels. A six-lamp bank of fluorescent lamps consuming 300 watts will produce a maximum amount of light which is twice as effective as that from a 150-watt R40 reflector spot lamp. Of course, the fluorescent bank larger in size. However, it will illuminate a larger area and provide a shadowless type of lighting that is extremely desirable for basic flood illumination — building up the signal-to-noise ratio. Fluorescent lamps are also useful in scenery lighting where the units can be suspended above and slightly in front of the flats so that they will be flooded evenly with light. The instant-start characteristic of the slimline types is an added advantage because the lamps may be turned on and off as required.

Filament Light Sources

Filament light sources also fill a basic need in studio lighting. The small source size combined with high brightness makes it possible to control the light precisely as desired. As a result, the lamps are preferred as modeling and backlights, giving the effect of lights, giving the effect of depth, and a more two-dimensional picture on the viewing tube. In fixtures of proper design they may also be used for floodlighting, and occupy less space than a fluorescent bank, although the light does not quite equal the shadow-free result provided by banks of fluorescent lamps.

The installation of light sources requires careful consideration of the present and foreseeable future programming. Continuous studio presentations require more lighting equipment than programs that alternate with films or remote pick-ups. Shows that include a number of small sets have to be carefully lighted so that spill light from an adjoining set does not destroy the desired mood. In any type of presentation, lighting close to the set limits the motion of the actors and, if mounted high, provides too much top light. Floodlights should be mounted just high enough to allow

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TV Studio Lighting

(Continued from preceding page)

free passage of the operating staff and equipment. Modeling lights may be mounted slightly higher, while of course backlights should be high and to the rear of the subject, to provide a rim of light as seen from the camera positions. The point to be remembered is that the camera "sees" vertical surfaces and these areas must therefore be illuminated. Lighting equipment mounted high overhead builds up the horizontal surface footcandles primarily, and the vertical surface illumination only incidentally. The emphasis in most cases should be reversed.

Control From Single Location

For maximum operating economy and efficiency, all lights should be remotely controlled from a single location, preferably from the control room where the lighting man has a view of the pictures on all cameras. Besides power switches, controls should be provided to direct the lights toward any desired area of the studio. Elevation controls are needed and, ideally, the mounting height of the flood and modeling

fixtures should be adjustable in order to insure the proper source location for each type of program. Such an adjustment makes cleaning and relamping of the fixture easy and reduces the need of the step ladder, which is now a prominent piece of studio equipment.

The control position may quite properly include dimmers on the filament lamps (fluorescent lamps are not usually dimmed) to facilitate the creation of the desired mood. It must be remembered that as the voltage is decreased on a filament lamp, the color quality as well as the quantity of light changes. The shift in color occurs towards the red and emphasizes the importance of the red-correcting filter previously described.

Thus, the procurement of a good lighting system and the availability of personnel skilled in its operation is essential if the full value of the television equipment is to be realized. It should also be remembered that proper camera adjustment is necessary to gain the benefits of any lighting system, and that good lighting is a necessary tool in achieving the full dramatic possibilities of television.

MOBILE PICKUP FOR BROADCAST REMOTES, 25 YEARS AGO!

The 50-watt broadcast transmitter carried on the first car was assigned call-letters WGMU and operated on 63 meters. It was used as a remote pickup for the old Grebe station WAHG, in Richmond Hill, L. I., N. Y. Also designed by Ralph R. Batcher, author of the nostalgic article on preceding pages, was the receiving installation on Batcher's own car, second in the line, which used as antenna a four-turn loop surrounding the car.

WCFM Owned by Listeners

Owned and operated by 40,000 residents of Washington, D. C., WCFM is the first frequency-modulated, listener-owned station in the United States and it may become the key station in a proposed nationwide network having similar progressive characteristics and structure. The new station which was conceived under the auspices of the Cooperative Broadcasting Association maintains complete commercial facilities.

WCFM operates at 99.5 MC and its transmitter site is a five and one-half acre plot on a hilltop, 485 ft. above average terrain and 800 ft. above sea level, at West Falls Church, Va. Washington and the area within an 80 mile radius are served by WCFM's 3-KW transmitter and high-gain 8-element square loop antenna, manufactured by Federal Telephone & Radio Corp., Clifton, N. J.

Video Recording

(*Continued from page 33*)

sufficient metering to permit repeatable tube operating conditions. A measure of actual tube brightness in the same spectral region as the film sensitivity would be most useful. In practice, however, a reading of the average beam current and anode potential seems adequate. Contrast can be indicated by a video waveform monitor; however, a measure of the actual maximum and minimum brightness would be more desirable. This might be done by using a phototube, the output of which is amplified and presented either as a peak to peak voltage reading or as an oscilloscope trace. Considerable work remains to be done in correlating cathode ray tube operating conditions to the photographic results obtained. This is perhaps the most fertile field for improving the overall quality of video recording. The possibility of improving tone value reproduction by using non-linear or so called gamma correcting amplifiers in the monitor also needs investigation. With flat face tubes, focus modulation might be useful to give maximum electronic focus over the entire picture.

The basic systems of video recording may be classified as either single system or double system recording. Single system recording means that both picture and sound are recorded simultaneously on the same strip of film. Double system recording means that the picture and sound are recorded on separate film strips which are later printed on a single film strip to yield a composite print. Single system recording halves the film required and also reduces the amount of processing to be done. Cutting and editing the original film is very much complicated in single system work because the sound associated with a given picture frame is of necessity recorded some distance away from that frame. In 16-mm. film the standard procedure is for the sound to be 26 frames ahead of the picture. Another great handicap of single system recording is the compromise between picture and sound requirements which is necessary in choosing processing conditions. Double system recording is almost universal practice in the motion picture industry. The separate operations permit selection of film and processing to give optimum quality of picture and sound and

also the original picture and sound negative can be readily cut and edited.

Video recording may also be classified as a negative-positive system or as a direct positive system. The negative-positive system utilizes a normal positive image on the monitor tube and the film exposed in the camera is developed to a negative image. Sound should be recorded as a negative also, either single or double system. The picture and sound negatives are printed on a suitable film to yield a composite positive print for projection. This method is desirable when a large number of prints is required. In general, the negative-positive double system process will yield the best quality product. The direct positive system utilizes a negative image on the monitor tube and the film exposed in the camera is developed to a positive image. The sound may be recorded as a direct positive also for single system work, or as a negative in double system work.

Part II will appear in the June issue.

SMPE Will Vote on Adding TV to Name

Because of the close and fast growing relationships between motion picture and television engineering, members of the Society of Motion Picture Engineers have been asked to consider changing their name to the Society of Motion Picture and Television Engineers. This announcement was made by Earl I. Sponable, president of SMPE, at the 65th semiannual convention in the Hotel Statler, New York City, last month, and the question will be discussed at the next semiannual convention, Oct. 10-14, in the Hollywood-Roosevelt Hotel, Hollywood, Cal.

Two days of the five-day N. Y. convention were devoted to presentation of papers covering the various technical and business phases in making motion pictures for television. From a technical standpoint, current television broadcast operations favor the use of 16-mm recording and projection equipment which heretofor has largely been confined to amateur applications. Here however, cost considerations have precluded the achievement of commercial quality in the final product.

Dr. Allan B. Dumont, as guest speaker at the opening luncheon, discussed the relation of Motion Pictures to television. He pointed out that large screen theater television could be used to supplement theater fare in the near future because television systems will be developed to produce theatre programming the equal of the finest 35-mm movies. In discussing television and films further, Dr. Dumont also mentioned that present day high rental costs and comparative quality of films available made "live" programs cheaper than film for television networks.

INSTANTANEOUS AUDIENCE MEASUREMENT

(*Continued from page 39*)

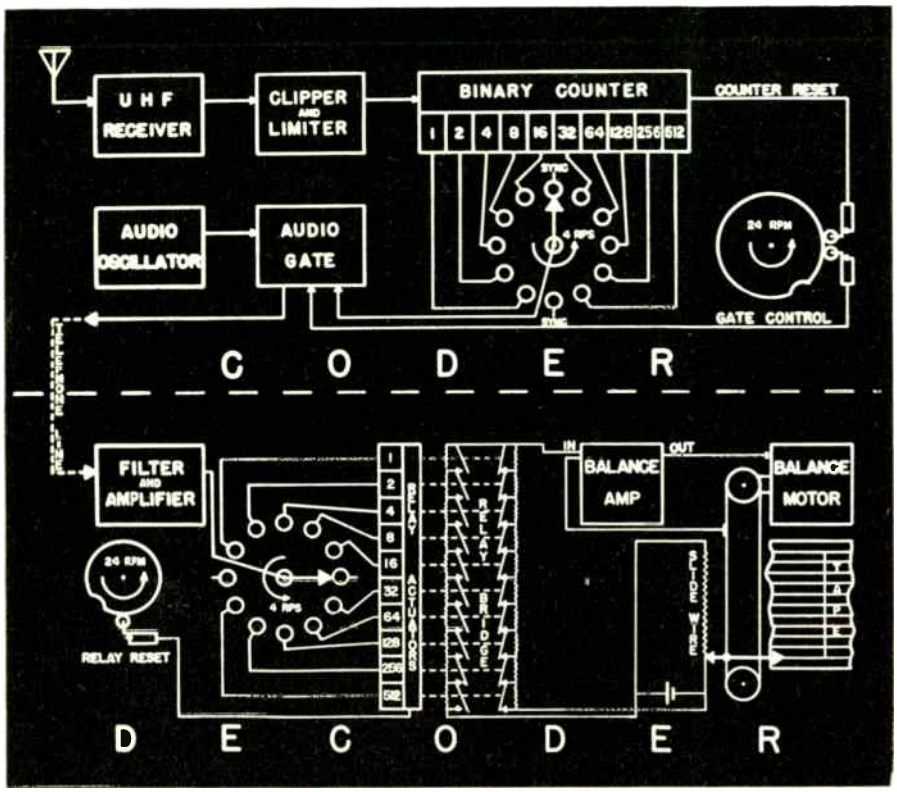

Fig. 6: Diagram showing the connections of equipment items used in relaying pulse count information from system's receiving point to graphical recorder

When the UHF pulses arrive at the system pick-up point, they are passed through a clipper and limiter to regulate their amplitude and shape before they enter the binary counter (Fig. 6). The counter is re-set every 2.5-min. by a synchronously driven cam-switch to permit the pulse count from the succeeding information time segment to be taken. Another set of contacts on the same cam-switch operates the audio gate and prevents the passage of code pulses to the telephone line during the re-set interval.

Since the received pulses have a duration of approximately 2 μsec. and arrive in random sequence during the 2.5-sec. interval, it is obvious that the probability of a false count, due to overlapping of the pulses themselves, or the intermingling of sequential pulse trains, is extremely small. Further, it is apparent that a much larger audience could be measured within the limits of the capabilities of the binary counter and its associated circuits.

By means of a 1000 cycle audio oscillator and an audio gate the count is converted into coded pulses which can then be transmitted by telephone line to the IAMS record-

ing center. There they are filtered to remove the line noise, and passed through an amplifier to counteract attenuation introduced by the line. Again, synchronous motors and a commutator are employed to distribute the amplifier output to a bank of relays in correct sequence. The relays, in turn, serve to vary the resistance elements in the arms of a bridge circuit. The changes in voltage thus produced are introduced into a balance amplifier whose output determines the movements of the balance motor. The latter, in re-positioning the moving contact on the slide wire bridge to balance, moves the graphical recording pen in accordance with the intelligence imposed on the relay bridge. A permanent record of the pulse group counted is placed on the graph in this manner.

As was the case in the coder unit, a cam switch driven by the 24 RPM synchronous motor re-sets the relay bank every 2.5-sec. to prepare the bridge to receive the next information segment count. Resistance tolerances in this section are held to an extremely narrow range since they directly affect the overall accuracy of the graphical record. In the present model the recording instrument is so arranged that information from all three main subdivisions is plotted on the same graph.

Since the frequencies employed by the system are in the vicinity of 500 MC, its response area is subject to roughly the same limitations as those which apply to FM and TV broadcasting. The average sized metropolitan district can be covered easily while reporting from outlying suburban and rural sets can be facilitated by the use of corner reflectors, careful placing of the UHF dipole, and other familiar methods. A peak power output in excess of 1 KW can also be obtained from the lighthouse tube although this hardly appears necessary. Insofar as the interrogation pulse is concerned, its coverage is limited only by the strength of the AM signal into which it is mixed. Even in locations where man-made electrical interference is very high, it has been found that the transceiver is capable of normal operation.

Audience measurement carried out by means of a network of IAMS installations, with each sub-unit controlled by the master interrogation pulse of a powerful clear channel AM station, could conceivably survey the entire area being serviced. Applied to the coverage of an entire broadcasting network it could become an awe-inspiring economic and sociological force. A hint of this was implied in one of the models demonstrated before the New York Section of the IRE by Dr. Goldmark and Messrs. J. Christenson, A. Bark, J. Wilner and A. Goldberg, where a "vote" switch was incorporated to permit the listener to vote "yes" or "no" in answer to questions broadcast verbally. It will be interesting to see the final form assumed by IAMS after it has come into general usage since it shows every indication of becoming a potent force in the industry.

Measurement Corp. Re-elects

At the annual stockholders' meeting of Measurements Corporation, Boonton, N. J., the following officers were reelected: John M. van Beuren, Convent, N. J., chairman of the board; Harry W. Houck, Mt. Lakes, N. J., president; Jerry B. Minter, Boonton, N. J., vice-president; Robert Meyer, Tenafly, N. J., secretary-treasurer and Nelson C. Doland, Sr. of Boonton, N. J., assistant secretary.

Measurements Corporation, founded in 1939, produces precision radio and television test instruments.

THE "LEADERSHIP" PLAN

(*Continued from page 23*)

proportion to the size of his technical staff. In the former case, the engineering staffs of the companies could not be increased because there were not sufficient engineers. In the latter case, if the work processed through the plant was reduced in proportion to the size of the engineering staff, it would not have produced the materials in sufficient quantities to meet military needs.

Hazeltine solved this problem in a particular way. However, the important lesson to be learned from this examination was that on an industry-wide scale the United States government was completely unprepared for transition from civilian to military production, occasioned by incorrect design, development and planning, and no serious steps had been taken to educate manufacturers in the type of equipment required for military use.

Hazeltine developed what has been termed a unique method of supplying services, facilities and equipment to the United States Government during the war.

Hazeltine was formed as a publicly-held engineering and patent holding organization early in 1924. Its patents include some hundreds of inventions in the radio and electronics field. Its engineering facilities include several laboratories in New York, Chicago and Los Angeles, maintained for the purpose of creating new electronic inventions and to assist its licensees in the home radio receiving set field (which represent a majority of the industry) in their current design, development and production problems. As a result of these two activities together, it has become thoroughly acquainted with the management and technical personnel of the entire radio industry, as well as being thoroughly informed on manufacturing and factory facilities.

When the National Emergency occurred, Hazeltine felt that there were two methods whereby it could contribute. One was by constructing new plants and facilities, and the other was to utilize already existing but unused facilities of the electronics industry. The latter plan finally was adopted and made effective, by Hazeltine serving the Government as a prime contractor, undertaking to design and develop electronics equipment, provide complete production drawings, compile the necessary instruction material, handle some or all of the material procurement, but to sub-contract out to other manufacturers, either in whole or in part, equipments that were required in very large quantities. This procedure was followed:

At a conference between Hazeltine and the Services the approximate equipment needs were discussed and reviewed. Hazeltine then would receive a Letter of Intent or other authorization that would permit it to carry forward the necessary preliminary examinations. In due course, so-called breadboard models exemplifying the practicability of the equipment would be completed and a further conference between Hazeltine and the Services would be held.

As a result of this conference, the technical performance of the equipment could be sufficiently well specified to establish its characteristics. At this time it would be reasonably well known what quantities of equipment would be required, together with flow rates and delivery dates. On this information it then was possible to establish the number and quality of sub-contrac-

tors that would be needed to participate in the final manufacture. The necessary manufacturers were contacted by both the procuring Services and Hazeltine and, if found satisfactory, were designated as Hazeltine subcontractors.

At this point, engineers, draftsmen and tool designers were assigned by each sub-contractor to report to the Hazeltine plant. This skilled personnel then worked in close harmony with the Hazeltine engineering and designing staff to complete work on so-called type test models of the equipment. This provided additional skilled man power, permitted education of engineers from each sub-contractor's plant, and permitted designers to lay out the equipment in a manner most easily produced by the contractors selected.

Moreover, the practice insured that similar types of equipment produced by several manufacturers were identical and their parts interchangeable. Prior to the completion of type test models, plans for production of the equipment were being carried forward by the staffs of the various sub-contractors involved so that by the time type test models were approved, the sub-contractors had procured some or all of their materials and had readied the plants for immediate production.

At this time also, the engineers working with Hazeltine were returned to the respective sub-contractors' plants, and some of the Hazeltine engineers were moved to the sub-contractors' plants, remaining there throughout the production as technical advisors, inspectors, etc.

The actual contact between the procuring Services and the manufacturer was only through the medium of Hazeltine. All changes and change orders were processed through Hazeltine, thus eliminating confusion where several companies were producing the same item. In this way it was possible to select a number of companies, depending upon the flow of equipment required, and have the combined striking force of an operation much larger than that of any single company, with the flexibility of a relatively small company.

Some equipments required at the rate of several thousand per week were produced by several large companies, while other equipments required at a much lower rate were produced by other companies much smaller in size.

When the needs of the Services were such as to require quantities of equipments in excess of the original estimate, it was found practicable in many instances to place these orders directly with the for-

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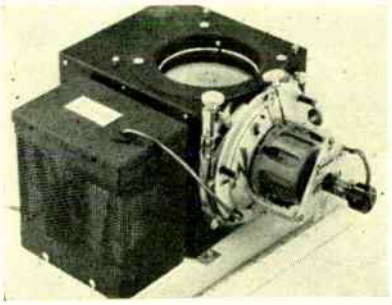
TV PROJECTION UNIT



Slight modifications of the Protelgram optical unit in projection television receivers can result in pictures 3-ft. high and 4-ft. wide when projected on conventional home movie screens. Only change necessary on a standard unit (one which produces a 200 sq. in. picture in units with built-in screens) is a conversion of the positioning and optical characteristics of the corrector lens. The design and the operating potentials of the TV receiver remain unchanged. Any chassis which drives the Protelgram unit in its present form will operate satisfactorily after the corrector lens is installed. When the modified receiver is placed 5½ ft. away from a screen, a 24 by 32-in. picture results. Moving the receiver to a distance 8 ft. away from the screen will produce a picture with dimensions of 3 by 4 ft. Protelgram units are manufactured by North American Philips Co., Inc., 100 East 42nd St., New York 17, N. Y.

The "Leadership" Plan

(*Continued from preceding page*)

mer sub-contractors as prime contracts, thus releasing Hazeltine to continue development work on new or more complex equipment. This general practice of sub-contracting differed from that which formerly had been standard in the following respects:

1. Provision was made for completely educating the engineering staff of each sub-contractor, long prior to manufacture in the plant.
2. The basic design was set up so that it reasonably met the manufacturing facilities at hand, thus eliminating innumerable technical differences between the prime and sub-contractor, and assuring a prompt start of the activity.
3. It provided but a single contact between the producing Services and the manufacturer, thus simplifying for the Services the question of dealing with many manufacturers.
4. By processing many equipments through a single prime contractor it greatly simplified the spare parts problem and tended to provide a degree of standardization difficult to obtain otherwise.

In World War II the Hazeltine leader type operation permitted large numbers of electronic manufacturers to make an essential contribution to the war effort in a minor fraction of the time that would have been required if each company had been individually instructed in the processes of learning how to design, develop and manufacture military equipment.

It permitted a slow build-up of the highly skilled personnel required for this type of work while the company was contributing importantly to the war effort. This staff build-up was accomplished without dislocation to other firms or industries.

In due course as experience was acquired and team work and organizations were perfected, such companies themselves would begin to function as prime contractors and to assimilate their fair share of the research, development and pilot production loads. Thus, through the intelligent application of current needs, an industry was educated while at the same time doing an outstanding job of research and production.

Moreover, that form of operation relieved the Services of the necessity for increasing the size of the Government groups, which otherwise would have been necessary to effect coordination and supervision of many individual manufacturers.

BOOKS

Waveforms

Edited by Britton Chance, F. C. Williams, Vernon Hughes, E. F. MacNichol and David Sayre Vol. 19 of the MIT Radiation Lab Series, published 1949 by McGraw-Hill Book Co., New York, N. Y. 859 pages, price $10.00

This volume describes the generation and use of precisely controlled voltages and currents as to time and amplitude. New methods of wave shaping by linear circuit elements and negative feedback amplifiers and the properties of vacuum tubes as nonlinear circuit elements are included and various types of multivibrators, blocking oscillators, and other basic circuits are discussed with special emphasis upon wave shape and stability. Other chapters are on linear and nonlinear circuit elements in modulation, demodulation.

Microwave Antenna Theory and Design

Edited by Samuel Silver (Univ. of Calif.). Vol. 12 of the Radiation Laboratory (MIT) series — Published by McGraw Hill Book Co. for the Natl. Defense Research Comm. 623 pages, (6 X 9), price $8.00.

A comprehensive survey of theory and design techniques of microwave antennas and a full discussion of antenna measurement methods are presented. This starts with a survey of electromagnetic and optical theory, followed by chapters discussing various types of antenna feeds and the complete antenna systems used for producing all principal types of microwave beams. The aberrations and special features of microwave optical systems are discussed in relation to rapid scan antennas.

WARE NAMED DIVISION HEAD

Paul Ware has been named head of the Electronic Parts Division of Allen B. DuMont Laboratories, Inc., Clifton, N. J. He is shown with the DuMont Inputuner, a device that incorporates a method of inductance tuning which he developed while associated with P. R. Mallory & Co., Indianapolis, Ind.

TELE-TECH

Advertisers May 1949

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

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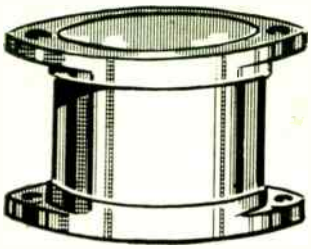

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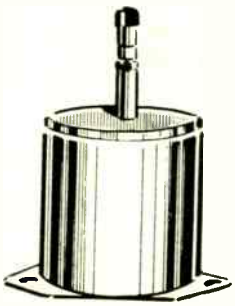

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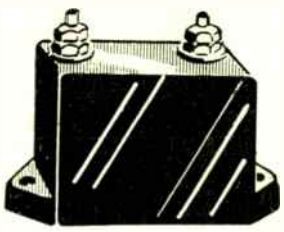
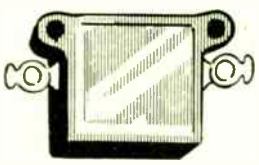


STYLE "B"

STYLE "C"



STYLE "D"

Cap. Mfd.	Wrkg. Volts	Mfr. Leg.	Price Each
STYLE "AA" CONDENSERS			
.02	3000	2	$4.50
.04	1000	2, 7	3.50
STYLE "A" CONDENSERS			
25mmfd	10000	8	$1.65
STYLE "B" CONDENSERS			
.00003	2000	2	$0.70
.000047	3000	1	.80
.00005	3000	2, 9	.75
.00007	1140	6	.70
.00009	3000	2, 7, 9	.75
.000091	3000	7	.80
.0001	3000	2, 7, 9	.80
.000107	3500	1	.85
.00011	3000	8	.95
.00137	3000	2	.95
.00175	1500	8	1.00
.0002	1430	6	1.00
.0002	3000	7, 8	1.00
.0002	5000	1, 8	1.05
.00025	5000	7	1.10
.0004	3000	2, 7	.95
.0004	5000	2, 7, 8	1.10
.0004	6000	1	1.55
.0005	2000	7	.95
.0005	3000	3	1.00
.00051	3000	7	1.00
.00055	3000	7	1.10
.0006	2500	7	1.05
.0006	5000	8	1.15
.000625	3000	7	1.05
.0007	3000	7	1.05
.00075	2500	2	1.05
.00075	5000	8, 9	1.15
.0008	3000	7	1.00
.0008	5000	2, 8	1.15
.001	4500	2, 9	1.25
.001	5000	7, 8	1.30
.0011	5000	2, 7	1.35
.00125	2000	7	1.10
.0014	5000	2	1.35
.0015	3000	7	1.10
.0024	3000	8	1.15
.0025	2000	1, 2, 7	1.10
.00275	2000	1, 7	1.10
.003	2000	7	1.20
.004	3000	2, 8	1.50
.005	2000	2	1.40
.005	5000	6, 8	1.70
.006	2500	7	1.30
.006	3500	8	1.45
.0068	3000	8	1.40
.008	3000	7, 8	1.45
.01	2000	1, 2, 3	1.55
.01	1000	7	1.35
.02	600	7	1.30
.02	2000	2, 8	1.60
.024	1500	3	1.60
.033	1500	3, 7	1.60
.056	1000	3, 7	1.70
.06	1000	8	1.70
.1	1000	8	1.75
STYLE "C" CONDENSERS			
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.0001	600	2, 7	.25
.0001	1200	7	.35
.0001	2500	4, 7, 8	.40
.0002	600	2, 7, 9	.25
.0002	2500	7	.40
.00024	2500	7, 8	.45
.00025	2500	2	.45
.0003	2500	7	.45
.00039	2500	7	.50
.0004	2500	2, 7, 9	.45
.0005	600	1, 7	.35
.0005	1200	2, 7	.40
.0005	2500	1, 2	.45
.001	1200	2, 7, 8	.40
.001	2500	6, 7	.55
.001	3750	7	.85
.0011	600	2	.35
.002	600	7	.35
.002	1200	2	.45
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.002	3500	8	.80
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.0039	2500	2	.60
.004	2500	2, 7	.60
.0045	600	8	.40
.0046	500	9	.45
.0047	2500	8	.65
.005	600	2	.35
.005	1200	7, 8	.45
.005	2500	7, 8	.60
.0051	1200	7	.45
.0051	2500	7, 8	.65
.0056	2500	8	.65
.006	600	7, 9	.40
.006	2500	7	.65
.0068	1200	7	.60
.007	600	8	.35
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.009	600	9	.50
.01	600	2, 7, 8	.40
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.01	2500	7, 8	.60
.0115	600	8	.40
.013	1200	3	.55
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.0175	1200	2	.55
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.033	1200	8	.50
.04	600	7, 8	.35
.073	250	8	.40
STYLE "D" CONDENSERS			
.00004	600	7	$0.20
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.00025	2500	6, 8	.35
.0005	1200	7	.30
.00051	2500	1	.35
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.001	1200	6, 8, 9	.35
.001	2500	6, 8	.40
.0011	2500	8	.40
.002	600	1,2, 9	.25
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.0044	600	8	.25
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.01	1200	6, 7, 8	.40
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.01	2500	2, 8	.50
.02	600	2, 6, 8	.25
.022	600	7	.25
.025	1200	7	.35
.027	600	7	.25
.03	600	2, 8	.25
.05	600	7	.30

Manufacturers' Legend

1 — Aerovox; 2 — Cornell Dubilier; 3 — Faradon; 4 — General Electric; 5 — Illinois; 6 — Mica-Mold; 7 — Sangamo; 8 — Solar; 9 — Sprague

This is only a partial listing. Write or wire for information on types not shown and for receiving set micas and silver micas.

We advise distributors to order immediately from this ad. Our standard jobber arrangement applies.

Manufacturers and Distributors: Write for our complete Mica Condenser Listing No. 103A.

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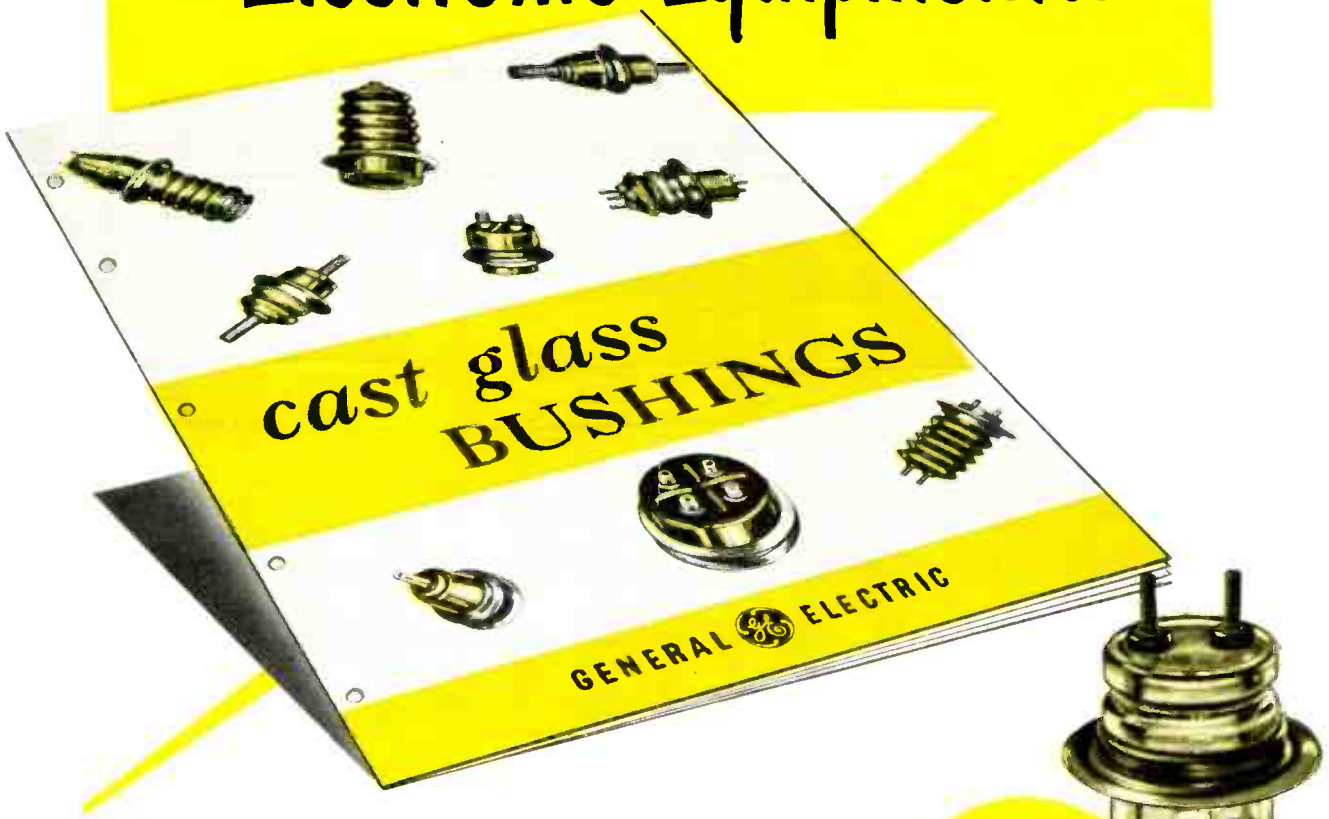
If you manufacture Electronic Equipment...



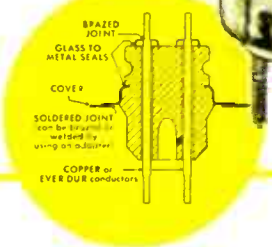
you'll want this NEW bulletin on glass bushings

General Electric is now offering to other manufacturers the cast glass bushings it has used so successfully on many types of electrical equipment.

These bushings are cast of a stable, low-expansion glass. Metal hardware is a special nickel-alloy steel, fused to the glass in casting. Bushings can be attached directly to the apparatus without gaskets — by soldering, welding or brazing.

The resulting joint between bushing and equipment is permanent, vacuum-tight, and of high mechanical strength. It is especially desirable for equipment subject to vibration, shock, attack by fungus growth or severe changes in temperature. It eliminates moisture problems and often permits more compact, light-weight design of equipment.

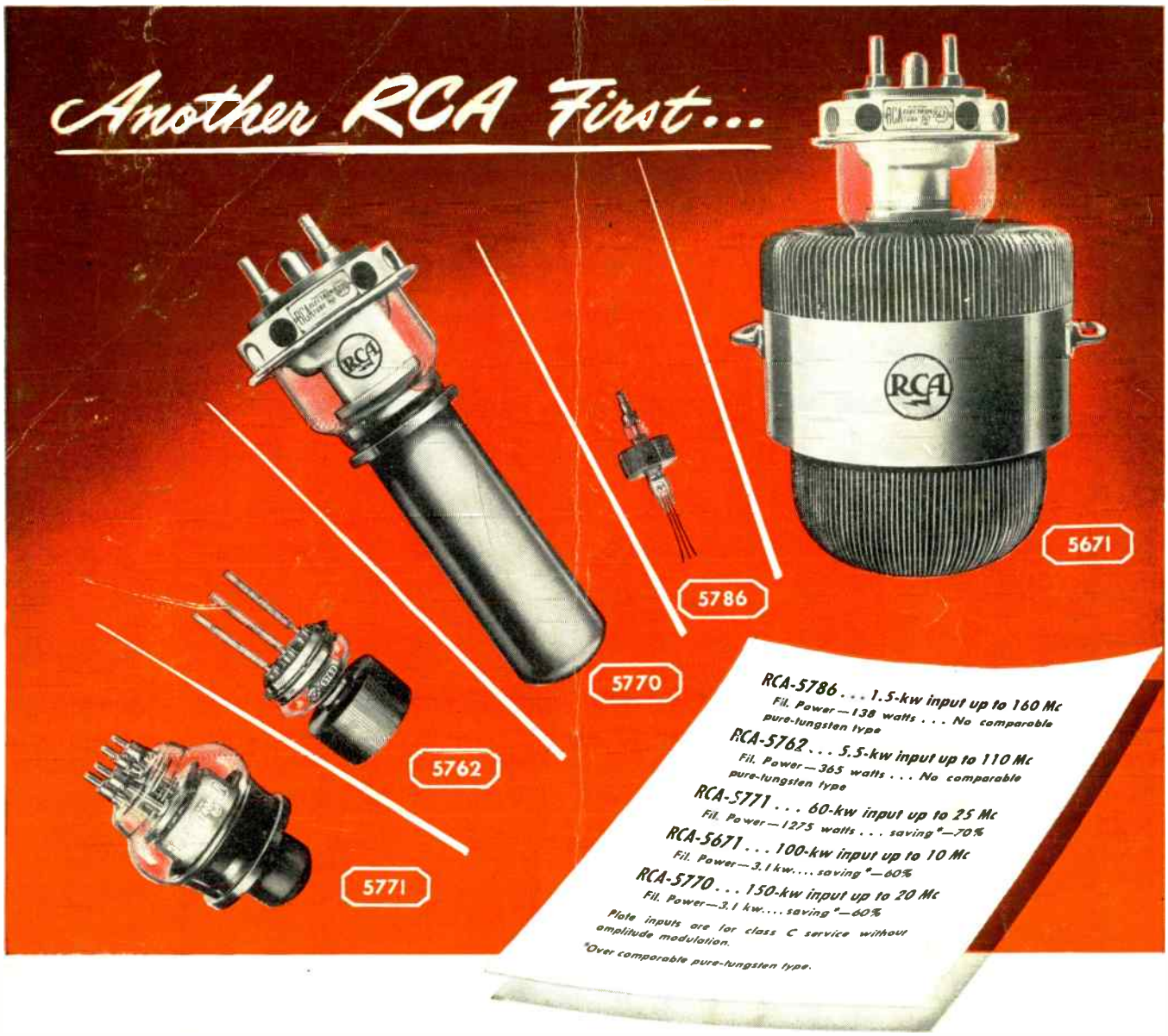
Our new bulletin, GEA-5093, contains a complete listing of standard designs now available — giving withstand voltages, current ratings and physical dimensions. A copy of this bulletin is yours for the asking. Just write *Apparatus Department, General Electric Company, Schenectady 5, New York.*



Glass bushings are currently available to meet dry, 60-cycle, flashover values of from 10 to 50 kv, and in current ratings of 25 and 50 amperes (large sizes up to 800 amperes). They may be single or multi-conductor and can be provided with a top flange to permit mounting tube sockets directly on the bushings. Diameters range from 1⅝ to 3⅜ inches and weight from 2½ oz. to 4 lb.

GENERAL ELECTRIC

401-57



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Five new RCA tubes, ranging in power input from 1.5- to 150-kw, and successfully utilizing economical thoriated-tungsten filaments which offer marked savings in filament power and the cost of associated power equipment.

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RCA Application Engineers are ready to consult with you on the application of these improved tubes and accessories to your specific designs. For complete technical information covering the types in which you are interested, write RCA, Commercial Engineering, Section 57ER, Harrison, New Jersey.

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