TELE-TECH

Formerly ELECTRONIC INDUSTRIES

TELEVISION • TELECOMMUNICATIONS • RADIO

Modern U. S. Bombers Cost Over $ Million Each — 45% for Radio-Electronic Equipment!

June • 1949

CALDWELL-CLEMENTS, INC.

Component Standardization in Armed Forces

Latest FCC Frequency Allocations

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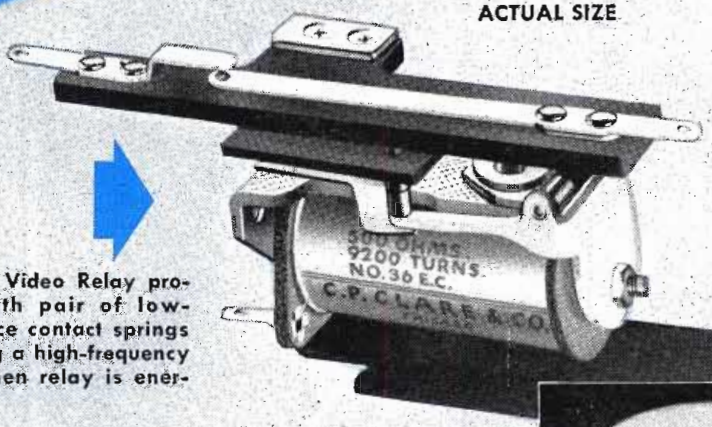
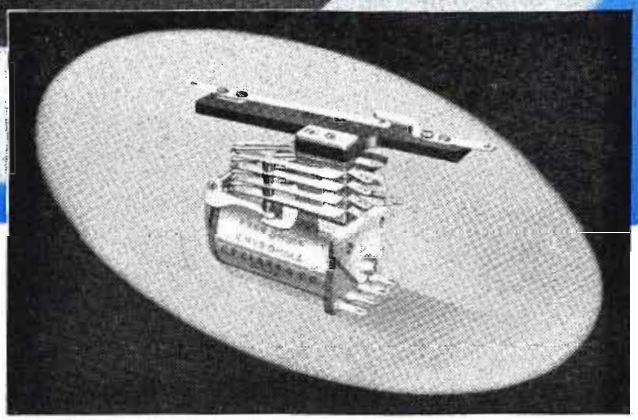
How Big does a Video Relay have to be?

ACTUAL SIZE



Type "J" Video Relay provided with pair of low-capacitance contact springs for closing a high-frequency circuit when relay is energized.

This Type "J" Video Relay shows how a number of auxiliary contact springs may be added for switching circuits which do not carry high-frequency currents.



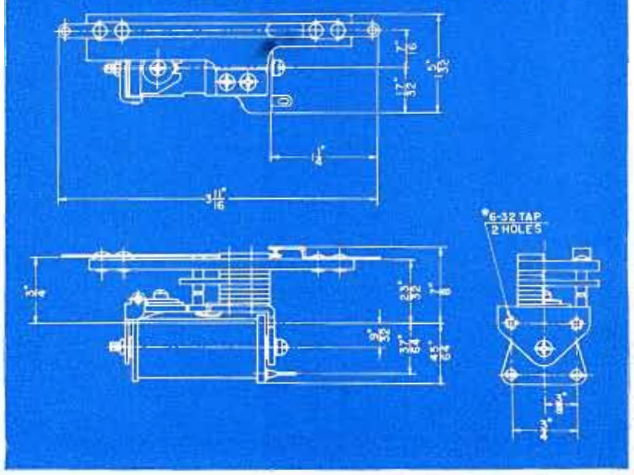
RCA Engineers posed this question to CLARE when available relays for their purpose proved too large, too cumbersome.

The close cooperation between engineers of the two companies which resulted has produced the CLARE Type "J" Video Relay, which meets every requirement for switching these high-frequency currents . . . and occupies but 7 cubic inches.

Success of this cooperation between RCA and CLARE engineers in developing a superior small-size, low-capacitance relay is not only important to this, the world's largest manufacturer of radio and television equipment, but it is of vital interest to every television engineer whose designs are often frustrated by the 17 cubic inches that other typical video relays require.

Clare sales engineers are located in principal cities. They will be glad to give you full information on this new video relay. Their counsel and advice may help you solve other relay problems. More and more, industrial designers bring their problems to Clare, whose long experience in meeting and solving them can save you many hours of tedious and costly experiment. Call your nearest CLARE sales engineer, or write to: C. P. Clare & Co., 4719 West Sunnyside Ave., Chicago 30, Illinois.

Dimensions of CLARE Video Relay



Capacitance of CLARE Video Relay

Tests show that this new CLARE relay with a contact gap of 0.025" has the following capacitances:

Interspring Capacitance, Contact Open

0.5 mmf. at 3 megacycles
0.5 mmf. at 10 megacycles
0.55 mmf. at 20 megacycles

Spring-to-Frame Capacitance, Contact Closed

1.4 mmf. at 3 megacycles
1.45 mmf. at 10 megacycles
1.8 mmf. at 20 megacycles

Write for Clare BULLETIN 106

CLARE RELAYS

First in the Industrial Field

Formerly ELECTRONIC INDUSTRIES

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

JUNE, 1949

Editorial Contents

CALDWELL-CLEMENTS, INC., Publication Office, Orange, Conn., Editorial and Executive Offices 480 Lexington Avenue, New York 17, N. Y., Tel Plaza 3-1340

Publishers also of RADIO & TELEVISION RETAILING

2 GREAT NEW TUBES FOR

WITH television racing ahead to new records in popularity—to ever higher figures in dollar volume—choice of picture tubes takes priority with designers and builders of receivers. The picture tube is the heart of the TV set. Cost, picture size, brightness—these must be carefully weighed in the light of the particular market at which a new receiver is aimed.

Good news to designers is G.E.'s introduction of the two tubes shown here. One—the 8½-inch type (8AP4)—dovetails with requirements of the low-priced receiver market where costs must be scrutinized down to the last penny. The 12½-inch aluminized tube (12KP4) matches the needs of that field of sale—also large—where picture size and quality come first.

Both tubes are G-E-designed to embody tomorrow's advanced engineering concepts. Both tubes are G-E-built to highest precision standards of quality!

CHARACTERISTICS

	8AP4	12KP4
Max bulb diameter	8 11/16 inches	12 9/16 inches
Min useful screen diameter	7¾ inches	11 inches
Heater voltage	6.3 v	6.3 v
Heater current	0.6 amp	0.6 amp
Focusing method	magnetic	magnetic
Deflecting method	magnetic	magnetic
Deflecting angle (approx)	54 degrees	54 degrees
Screen fluorescent color	white	white
Over-all length	14½ inches (max)	18 inches (max)
Bulb contact	metal-cone lip	J1-21
Base	B7-51	B7-51

MAX RATINGS, DESIGN-CENTER VALUES

	8AP4	12KP4
Anode voltage	10,000 v	12,000 v
Grid No. 2, voltage	none	410 v
Grid No. 1, voltage	—125 v	—125 v

TYPICAL OPERATING CONDITIONS

	8AP4	12KP4
Anode voltage	9,000 v	11,000 v
Grid No. 2, voltage	none	250 v
Grid No. 1, voltage for cut-off	—45 v	—45 v
Focusing coil current, d-c (approx)	120 ma	135 ma

NOTE: on Type 8AP4, the electron gun is designed for use with an external ion-trap magnet.

MASS TELEVISION MARKETS

TYPE 12KP4—A 12½-inch cathode-ray tube, all-glass construction. Aluminized screen. Offers *the brightest picture*—93 percent brighter (average) than a standard tube at 11,000 volts! Offers *a big picture*—95 square inches when the entire tube face is scanned; 75 sq. in. when standard raster of 3-by-4 aspect is employed. These areas are nearly half again as large as with the popular 10-inch type. . . . Here's the tube for TV-set manufacturers who put quality first, who wish to build consumer acceptance based on superior performance, on a larger, brighter, sharper picture. . . . *Here's the tube that's setting the pace in 1949 television!*

TYPE 8AP4—An 8½-inch cathode-ray tube with metal-cone envelope. Has plenty of picture area—47 square inches when the entire tube face is scanned; 36¾ sq. in. when standard raster of 3-by-4 aspect is used. . . . *Half the weight* of an all-glass tube, so ideal for small TV receivers that are lifted and moved about. . . . *Shortness of tube* (14½ inches) saves valuable space for the cabinet designer . . . *Requires a simpler, less costly circuit,* because the 8AP4's triode construction does away with need for a Grid-No.-2 voltage supply. . . . *Low in price,* up-to-the-minute in design—a combination that's putting this tube in first place with builders of small TV sets.

Size; responsibility; wide facilities for research, for manufacture—these identify a top source of supply for any manufactured article. Your source for picture tubes need be no exception. General Electric is actively engaged in every phase of television—has pioneered many important TV developments—brings to each tube type the knowledge gained from designing and building numerous other products in this field in which G-E leadership is acknowledged.

G-E tube engineers are ready at all times to consult with you on technical problems relating to the application of picture tubes to the receiver you may be designing. Your phone-call, wire, or letter will bring immediate, helpful response. General Electric's distributor-dealer facilities for replacing picture tubes in owners' sets are nationwide; your sales outlets and customers can count on tube service that is fast and reliable. Specify G-E picture tubes for value, quality, owner satisfaction! *Buy the best* for this best new market—television—that is generously rewarding the set builders who serve it well! *Electronics Department, General Electric Company, Schenectady 5, New York.*

You can put your confidence in—

GENERAL ELECTRIC

181-H1

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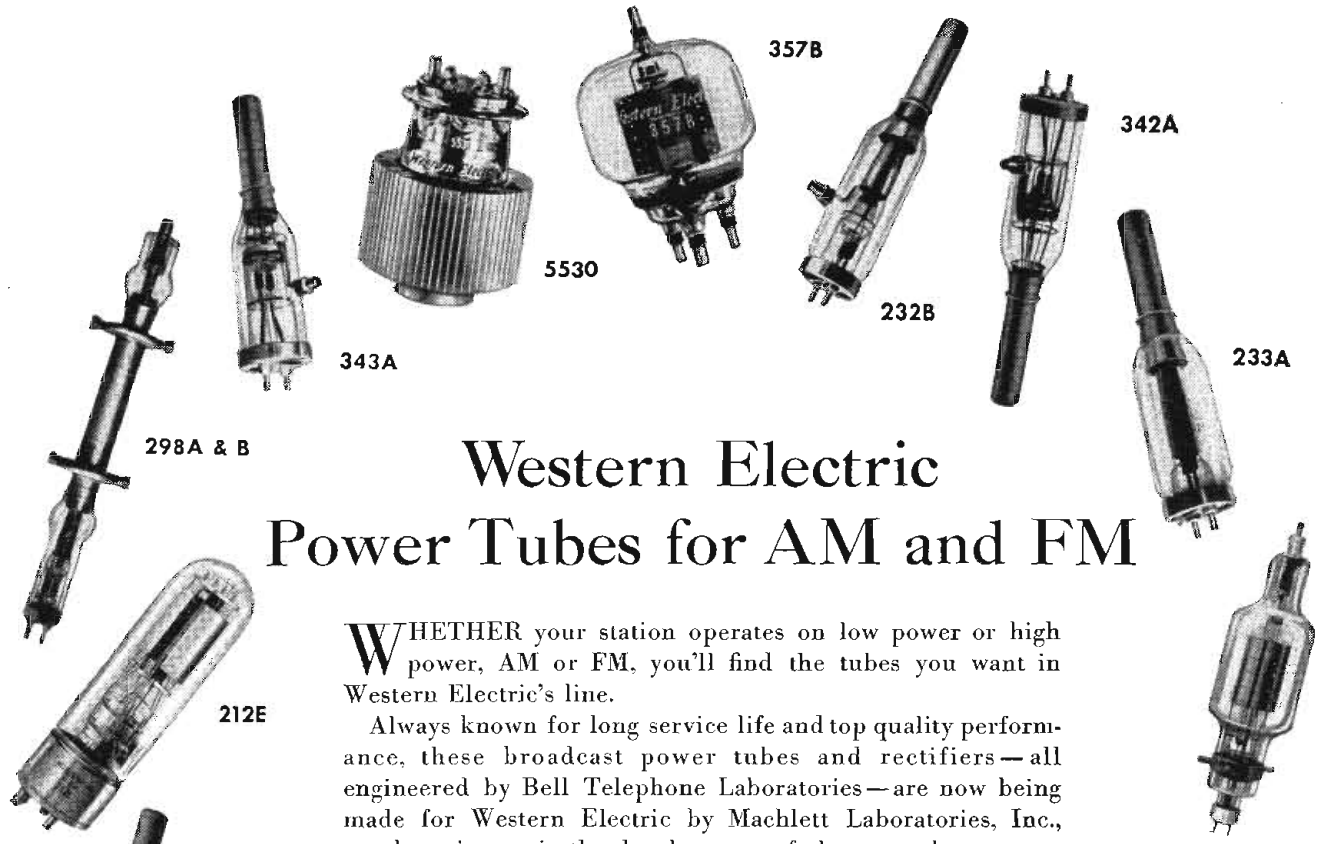

Western Electric Power Tubes for AM and FM

WHETHER your station operates on low power or high power, AM or FM, you'll find the tubes you want in Western Electric's line.

Always known for long service life and top quality performance, these broadcast power tubes and rectifiers—all engineered by Bell Telephone Laboratories—are now being made for Western Electric by Machlett Laboratories, Inc., another pioneer in the development of electron tubes.

Look over the listing of types below—and for further information, call your local Graybar representative or write Graybar Electric Co., 420 Lexington Ave., New York 17, N.Y.

Western Electric

—QUALITY COUNTS—

Western Electric's line of high power transmitting tubes includes:

212E	Air cooled triode, 275 watts
220C	Water cooled triode, 10 kilowatts
220CA	Forced-air cooled triode, 5 kilowatts
222A	Water cooled high vacuum rectifier, 25 kv. inverse voltage
228A	Water cooled triode, 5 kilowatts
232B	Water cooled triode. 25 kilowatts
232BA	Forced-air cooled triode, 8 kilowatts
233A	Water cooled high vacuum rectifier, 50 kv. inverse voltage
236A	Water cooled triode, 20 kilowatts
240B	Water cooled triode, 10 kilowatts
241B	Air-cooled triode, 275 watts
251A	Air-cooled triode, 1000 watts
255B	Mercury vapor rectifier, 20 kv. inverse voltage
270A	Air cooled triode, 350 watts
279A	Air cooled triode, 1200 watts
298A and B	Water cooled triode, 100 kilowatts
308B	Air cooled triode, 250 watts
340A	Water cooled triode, 25 kilowatts
341AA	Forced-air cooled triode, 5 kilowatts
342A	Water cooled triode, 25 kilowatts
343A	Water cooled triode, 10 kilowatts
343AA	Forced-air cooled triode, 5 kilowatts
357B	Air cooled triode vhf, 400 watts
363A	Air cooled pentode, vhf, 350 watts
379A	Air cooled triode, 1200 watts
5530	Forced-air cooled triode, vhf, 3 kilowatts
5541	Forced-air cooled triode, vhf, 10 kilowatts

Distributed by GraybaR — Offices in 100 Principal Cities

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Type 1301-A Low-Distortion Oscillator

Here's Your "PROOF-OF-PERFORMANCE"

AS ANNOUNCED by the Federal Communications Commission,* effective August 1, 1949 all a-m and f-m broadcast stations will be required to make proof-of-performance checks of over-all noise and distortion of the complete station at least once a year.

Many stations already make these measurements at frequent intervals as routine operating maintenance to insure the continuous high-quality service the modern transmitter system is capable of supplying.

General Radio instruments for these measurements have been available for some time, and are in regular use by the leading stations where this equipment has given accurate, convenient-to-use and trouble-free service.

The G-R Type 1932-A Distortion and Noise Meter meets all of the F.C.C.'s requirements for measurements of this type for both a-m and f-m services; the Type 1301-A Low-Distortion Oscillator is the ideal companion unit for use with the Type 1932-A. Both of these instruments are relay-rack mounted and can be supplied in panel finishes to match most existing installations.

TYPE 1932-A DISTORTION & NOISE METER

For measurements of sine-wave voltages, distortion and noise throughout the audio range. Over-all pass-band of the voltmeter circuit extends to 45,000 cycles, thus including all noise and distortion products contained in this range; particularly the 3rd harmonic of a 15,000-cycle test is included.

This instrument is continuously adjustable and can be set to any frequency quickly since it has only one main tuning control plus a small trimmer. With it measurements can be made on a-f distortion in radio transmitters, line amplifiers, speech amplifiers, speech input equipment to lines; noise and hum levels of a-f amplifiers, wire lines to the transmitter, remote pick-up lines and other station equipment.

Full-scale deflections on the large meter read distortions of 0.3, 1, 3, 10 or 30 per cent; range for carrier noise measurements extends to 80 db below 100% modulation, or 80 db below an a-f signal of zero dbm level. The a-f range is 50 to 15,000 cycles, fundamental, for distortion measurements and 30 to 45,000 cycles for noise and hum.

Type 1932-A Distortion and Noise Meter: **$575.00**

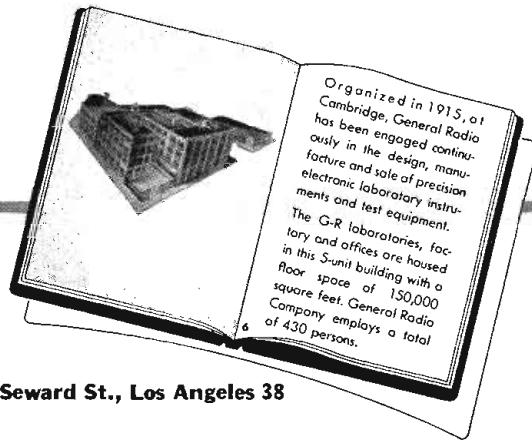
TYPE 1301-A LOW-DISTORTION OSCILLATOR

Especially designed for rapid measurements, this highly-stable oscillator has exceptionally low distortion. By means of push buttons, 27 fixed frequencies between 20 and 15,000 cycles may be selected in logarithmic steps. Any frequency between steps can be obtained by plugging in external resistors. The distortion over the entire range will not exceed the following percentages: with 5,000-ohm output, 0.1% from 40 to 7,500 cycles; 0.15% at other frequencies. With 600-ohm output 0.1% from 40 to 7,500 cycles; 0.25% from 20 to 40 cycles and 0.15% above 7,500 cycles.

The oscillator is calibrated to within $\pm(1\frac{1}{2}\% + 0.1$ cycle); the calibration is not affected by changes in load or plate supply voltage; drift is less than 0.02% per hour after a few minutes operation. The operation of the oscillator is unaffected by ordinary climatic changes.

Type 1301-A Low Distortion Oscillator: **$395.00**

*F.C.C. Rules and Regulations, Sections 3.254 and 3.46, as amended



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ATV 225

THE TESTED LEAD-IN LINE

Means More Set Sales

● Since late in 1947 Anaconda ATV* 225 Shielded Lead-In Lines** have been in operation in various sections of the United States.

Comparative results are now conclusive. ATV 225 means no more weather interference, no more moisture, or dirt troubles, no "snow," no "ghosts," no re-radiation from nearby installations, auto, truck or airplane ignition.

In a word, pictures are clear and clean as never before. And because service call-backs are negligible, (instead of ruinous) there's more time for selling sets. And there's lots of replacement business on out-of-date, unshielded lead-in lines . . . with scientific, time-*tested* ATV 225. It's now generally available. Order today.

Specifically, ATV 225 offers:

1. High impedance—matches receiver input circuit.
2. Extremely high signal to noise ratio.
3. Low attenuation—full signal strength.
4. Stable performance and long life under all weather conditions.
5. Fire resistant—meets Underwriters' requirements.
6. Operates in conduit without change in electrical properties.

49447

*Reg. U. S. Pat. Off.
**Patent Applied for.

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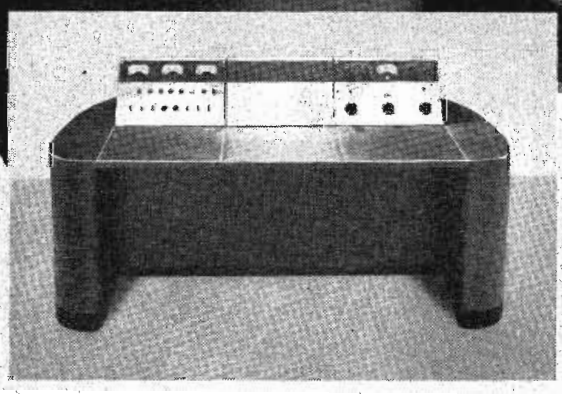
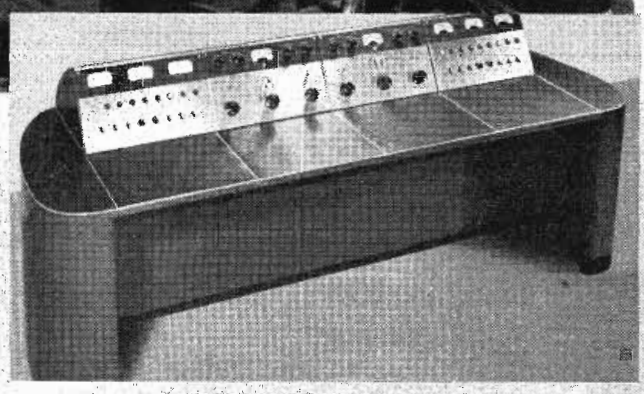
Station man's dream come true... ADD-A-

RCA Transmitter Control Console, type BTC-1A—as versatile and handsome a control console as ever graced a transmitter room. With this BTC-1A you add control turrets and desk sections as your station grows. The left turret is the transmitter control section. The right turret is the audio control section. No equipment obsolescence here when you add on units.

A few of the many combinations



BTC-1A Control Console—with transmitter-control turret, audio control turret, and blank turret for additional facilities such as special meters, jack fields, ringdown, etc. Front panels are bottom-hinged. Rear covers are removable.



Typical console set-up for two transmitters, such as: two AM transmitters, two FM transmitters, or one AM and one FM transmitter. The turrets bolt to the desks. Desk sections bolt to each other. Knockouts for the wiring are provided in all desk and turret sections. All meters are recessed behind turret panels.

UNIT Transmitter Control Console

Fits every plant—AM, FM, TV, or any combination

THIS IS THE MOST FLEXIBLE and versatile control console ever engineered for broadcast service. With it you can handle audio mixing and transmitter switching operations in stations using RCA 3-, 5-, 10-, or 50-kw FM transmitters—or RCA 5-, 10-, or 50-kw AM transmitters. And by simply adding units to this basic console, you can also handle audio, video and transmitter switching for any combination of transmitter set-ups—starting with a single AM, FM, or TV transmitter and going to two or more AM and/or FM transmitters *and a television transmitter.*

The BTC-1A starts with the basic unit shown in the picture at the left. It includes one r-f transmitter control turret and one audio control turret—mounted on a two-section desk having removable end-sections.

The *r f control turret* contains all power control switches and pilot lights for normal operation of the transmitter; transmitter start; transmitter plate voltage; overload reset; time delay by-pass; manual-automatic control; day-night power switching; tower lights; and a spare switch and pilot lamp. And there is mounting space for three remote indicating meters.

The *audio control turret* includes: a standard VU meter and range switch; an 8-position selector switch that permits monitoring all important circuits, a monitor gain control; and individual bridging pads that enable you to equalize the level of the signal sources. Control of six inputs . . . one microphone, a remote circuit or oscillator, two lines, two turntables . . . is handled by three high quality mixers and associated transfer keys.

• • •

Call your RCA Broadcast Sales Engineer for *all* the details. Or write Dept. 87F, RCA Engineering Products, Camden, N. J.

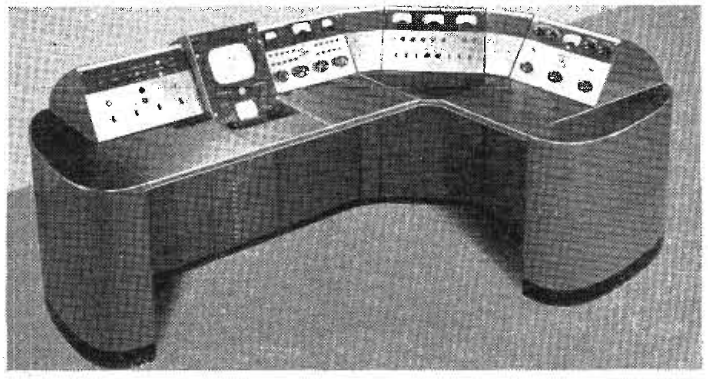
BROADCAST EQUIPMENT

RADIO CORPORATION of AMERICA

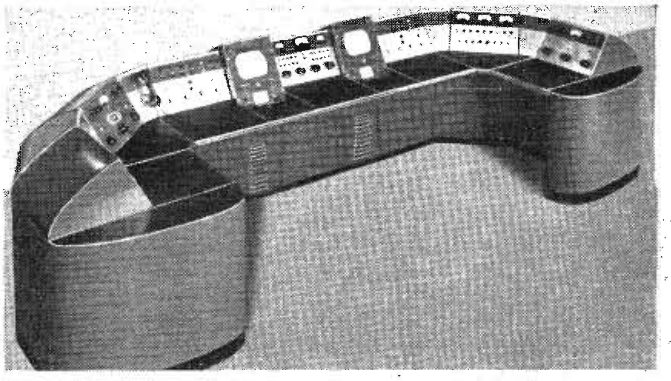
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

possible with the BTC-1A console

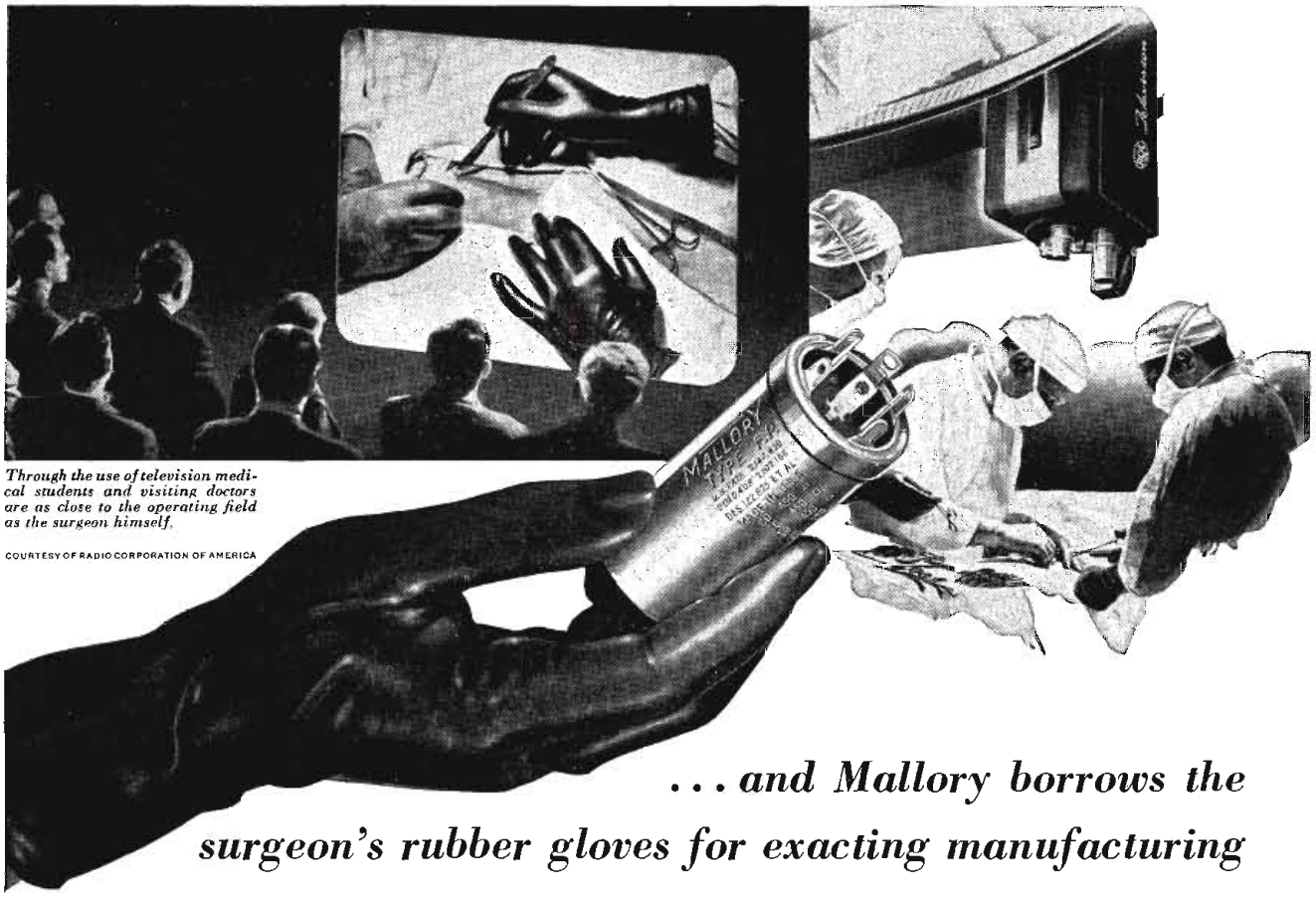


Typical console set-up for an RCA 5-kw television transmitter, and one AM or FM transmitter. From left to right: (1) TV transmitter control; (2) picture monitor; (3) TV audio monitor; (4) blank turret; (5) AM or FM transmitter control; (6) blank turret; and (7) AM or FM transmitter control.



De luxe set-up for combined centralized control . . . AM-FM and TV. Extreme left and right sections are the AM (or FM) transmitter controls. Each includes a transmitter-control, audio-control, and blank wing turret. Center turret controls (for RCA 5-kw TV transmitter) are, left to right: TV power, picture monitor, TV audio, preview monitor, TV program switching.

Teaching Surgery by Television!



Through the use of television medical students and visiting doctors are as close to the operating field as the surgeon himself.

COURTESY OF RADIO CORPORATION OF AMERICA

. . . and Mallory borrows the surgeon's rubber gloves for exacting manufacturing

There are more rubber gloves in this picture than you can see. They are worn by Mallory craftsmen in assembling the Mallory FP Capacitor. Thus no human hand* touches any vital part during processing and assembly.

Mallory knows there can be no compromise with quality—in television. New standards are essential for long life, dependability and trouble-free operation. The "rubber glove" technique is typical of Mallory's exacting standards.

Mallory FP Capacitors are accustomed to severe service—have been operating at 85° C. for years. Even though this extreme temperature may not be apparent in your particular model, it's good to know that Mallory gives you an extra margin of safety. So make it Mallory and be safe.

FP is the type designation of the Mallory developed electrolytic capacitor having the characteristic design pictured. Adopted as standard by RMA, it is famous for dependable performance.

**The chlorides present in perspiration cause destructive corrosion which shortens the capacitor's life in the field.*

P. R. MALLORY & CO. Inc.

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

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Controls — Vibrators
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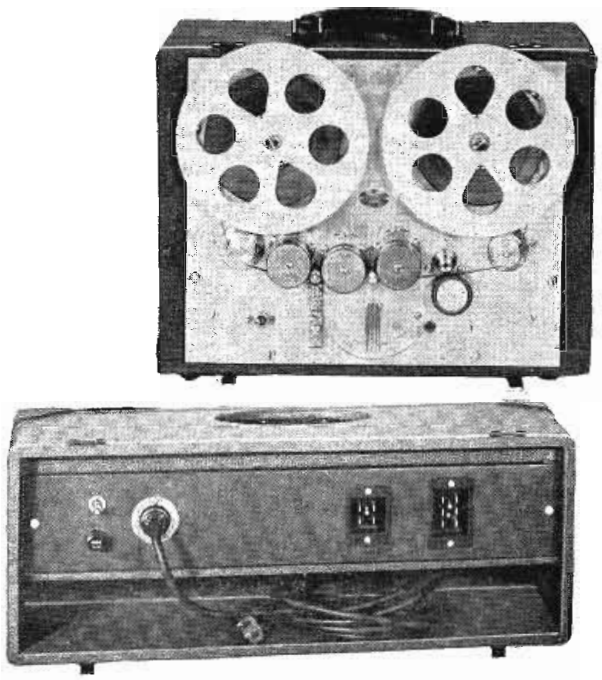
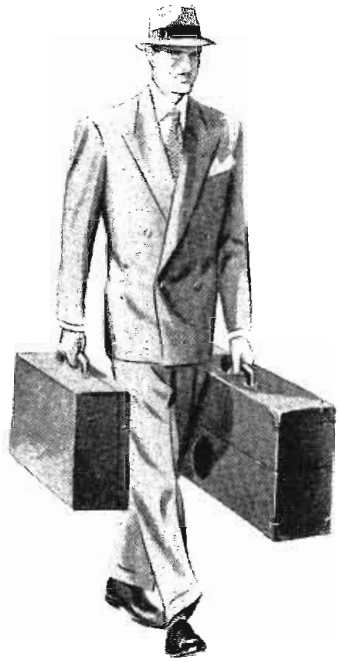


comparisons

indicate this is the world's finest recorder of its type

NEW PRESTO

Portable Tape Recorder 900-P



Complete in two easily portable cases—one containing the recorder, the other the amplifying equipment.

MANY OUTSTANDING FEATURES:

- Three separate heads for superior performance (and for monitoring direct from tape). One head each to erase, record and play back.
- 3 microphone channels with master gain control in recording amplifier.
- Weston type 30 V.U. meter with illuminated dial to indicate recording level, playback output level, bias current and erase current.
- 2-speed, single motor drive system. Toggle switch to change tape speeds from 7½" to 15" per second.

Don't choose your tape recorder until you see the *new* Presto Portable Tape Recorder. Write for complete details today.

Write today to be put on our mailing list for "The Presto Recorder," new house organ of practical ideas for anyone in the recording and broadcasting field.

PRESTO
RECORDING CORPORATION
Paramus, New Jersey

Mailing Address: P. O. Box 500, Hackensack, N. J.
In Canada: WALTER P. DOWNS, Ltd., Dominion Square Building, Montreal

WORLD'S LARGEST MANUFACTURER OF INSTANTANEOUS SOUND RECORDING EQUIPMENT AND DISCS

TELE-TIPS

CITIZENS RADIO regulations go into effect this month, and the FCC points out that besides communication uses on farms, construction jobs and in times of emergency or wireline destruction, the Citizens Radio channels can also be used for garage-door and gate openers, model airplane control and sign switching. The latter uses must be intermittent so as not to interfere with communication in the 460-470 MC band.

RADAR & FISH—Radar, first developed to save men and cargoes, is now operating on the high seas of the Pacific to save fish. Intent on conservation of marine life from sardines to sharks, the California Fish and Game Commission's newest patrol boat, the 83-foot *Albacore*, has been equipped with GE's "packaged unit" radar set and is now patrolling the waters of northern California from Morro Bay to the Oregon line.

TV SETS INCLUDE FM—already by nearly 50%. Thus out of 250 current TV models, 115 will receive FM. DuMont, Stromberg-Carlson, Crosley Howard and Garod include FM in all their models. And Admiral, Andrea, Ansley, Farnsworth, Freed, Magnavox, Sparton, U. S. Television, Westinghouse and Zenith include FM in more than half their current models, according to FMA president, Bill Ware.

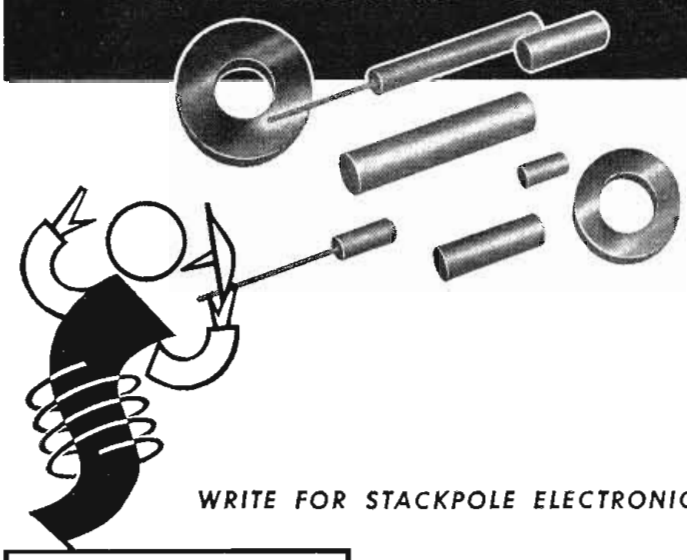
JACKING UP TV—Ten years ago manufacturers of home receivers were announcing that their instruments were "Equipped for Television" (?) because an additional audio input jack had been included on the rear apron of the chassis. Oddly enough, today only three manufacturers are providing phono input jacks on their television receivers, and so far no one has extra provisions for FM or AM tuners.

BC LISTENING REPORTS—Along the line of last month's CBS IAMS article, Sindlinger & Co., in Philadelphia, are applying locally similar equipment called Radox, which a group of Chicago business men has decided to back. One of these investors is Ralph Bard, ex-Asst. Secretary of the Navy. Radox now has about 200 homes in Philadelphia wired so that the programs listened to are recorded every 2 minutes in a central station. Results very revealing. Advertisers and broadcasters will find this info of great value.

REEL EXASPERATION—One exasperated user of home tape recorder equipment reports that most of his troubles are encountered in trying to thread tape onto new reels. Why, he asks, don't tape manufacturers follow the lead of typewriter ribbon manufacturers and rivet little hooks at each end of the tape that would engage in the reels? Why not indeed?

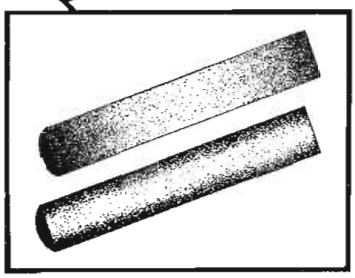
"DADDY, WHAT A BIG TUBE!"—Already a television generation is growing up that knows no movies. John Meagher of RCA, Camden, has had television sets in his home for many years, and his six-year-old son had never been to a movie until recently, when he made his first visit to the cinema. "O Daddy," he gasped, "isn't that a tremendous television tube!"

IT'S STACKPOLE FOR IRON CORES!



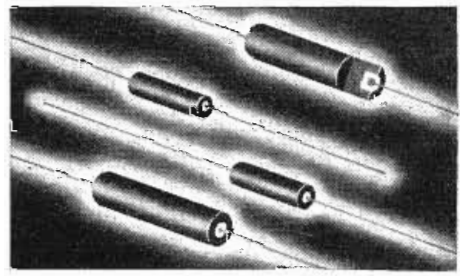
The rapid increase in the use of molded iron cores throughout electronic engineering has resulted in large part from Stackpole engineering that has made new and improved types available at attractive prices. In addition to dozens of standard broadcast, permeability tuning and high frequency types, Stackpole offers numerous others, a few of which are illustrated below.

WRITE FOR STACKPOLE ELECTRONIC COMPONENTS CATALOG RC-7



◀ SIDE MOLDED

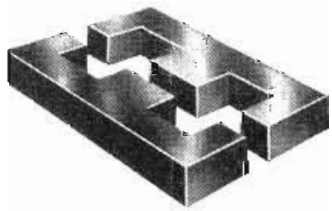
Extra density of pressure extends evenly the entire length of the core. Resulting uniform permeability makes Stackpole Side-Molded Cores outstandingly superior for tuning applications. Broadcast band and short-wave types available.



TRANSFORMER CORES ▶

for filter coils in carrier frequency equipment.

Assure constant inductance over a given frequency range. Widely used where constant inductance, limited only by predetermined saturation point of core, is needed for various currents.

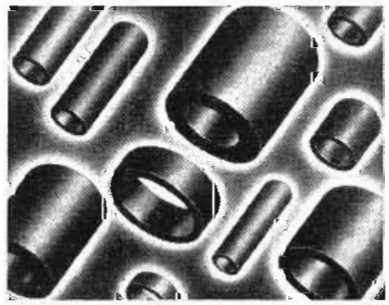


CHOKE COIL CORES ▲

Ideal for audio, "hash," r-f chokes and others. Reduce coil dimensions and increase "Q." Insulated leads connect to coil and permit point-to-point wiring. Frequency ranges from 100 cycles to 175 megacycles.

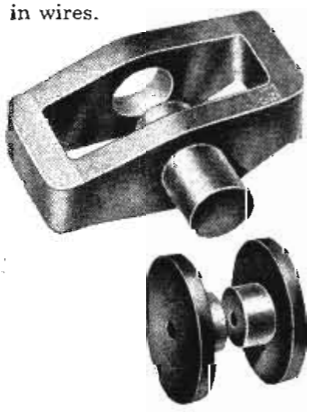
HIGH-RESISTIVITY CORES

Made of a special material showing resistance of practically infinity. Reduce leakage currents and noise troubles, minimize voltage breakdown possibilities between coils and core; and, where cup cores are used, eliminate heavily insulated lead-in wires.



◀ SLEEVE CORES

By permitting use of smaller cans of less critical and less costly materials, these cores assure a high order of tuning efficiency in greatly reduced size. In some instances, it may not even be necessary to use cans.

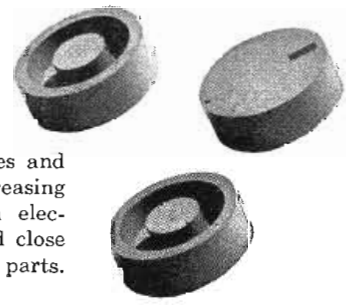


◀ TELEVISION CORES

From horizontal deflection and flyback transformer cores to I.F. and other types, Stackpole offers a complete line. The types illustrated here assure remarkably uniform results, save on assembly costs.

CUP CORES ▶

These unique, self-shielding units are available in a wide range of shapes and sizes and are finding steadily increasing use throughout modern electronics. Can be mounted close to chassis or other metal parts.



ELECTRONIC COMPONENTS DIVISION

STACKPOLE CARBON COMPANY, St. Marys, Pa.

AER-O-COM

ALL-WEATHER TRANSMITTERS

USE

ADLAKE RELAYS

For dependable service at ANY temperature!

The Adlake Mercury plunger Type Relay, with its +200° —38.8° temperature range, is naturally suited to power control and time delay in Aerocom's new VH-200 all-weather radiotelephone transmitter. Aerocom demands dependability, and dependability in relays means Adlake.

The mercury-to-mercury contacts in Adlake Relays completely eliminate failures caused by low contact pressure, contact burning, pitting, and sticking—and the inherent high surface tension of mercury gives an ideal snap action to the contacts.

In addition, Adlake Relays bring these advantages to any relay job:

- **Hermetically sealed contact mechanism, impervious to dust, dirt, and moisture.**
- **Silent and chatterless operation, producing high-fidelity modulation with a low noise level.**
- **Adlake armor design, which protects relays against outside vibration or impact.**

Whatever your relay needs, there's an Adlake Relay to do the job. You'll want to see our free illustrated folder for full details. Write for it today: The Adams & Westlake Company, 1117 N. Michigan, Elkhart, Indiana.

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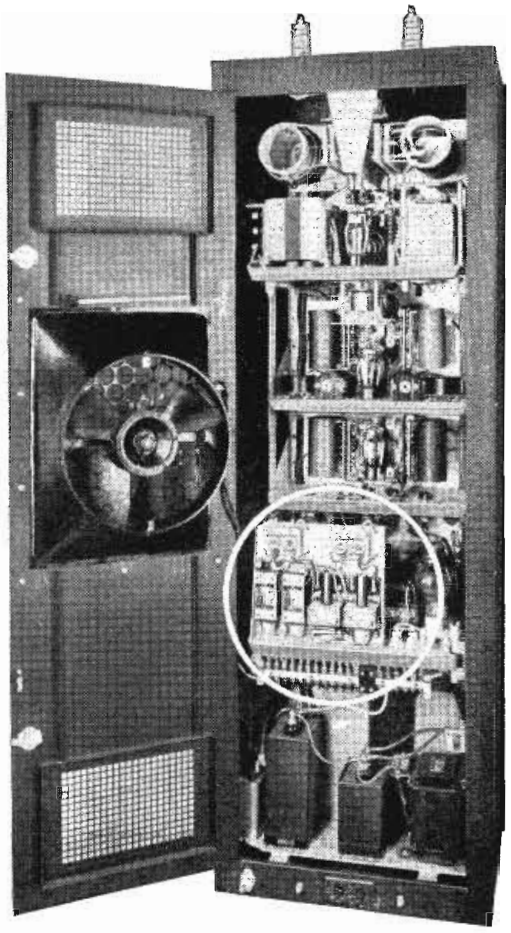
Adlake TRADE MARK

Manufacturers of Adlake Hermetically Sealed Mercury Relays for Timing, Load and Control Circuits

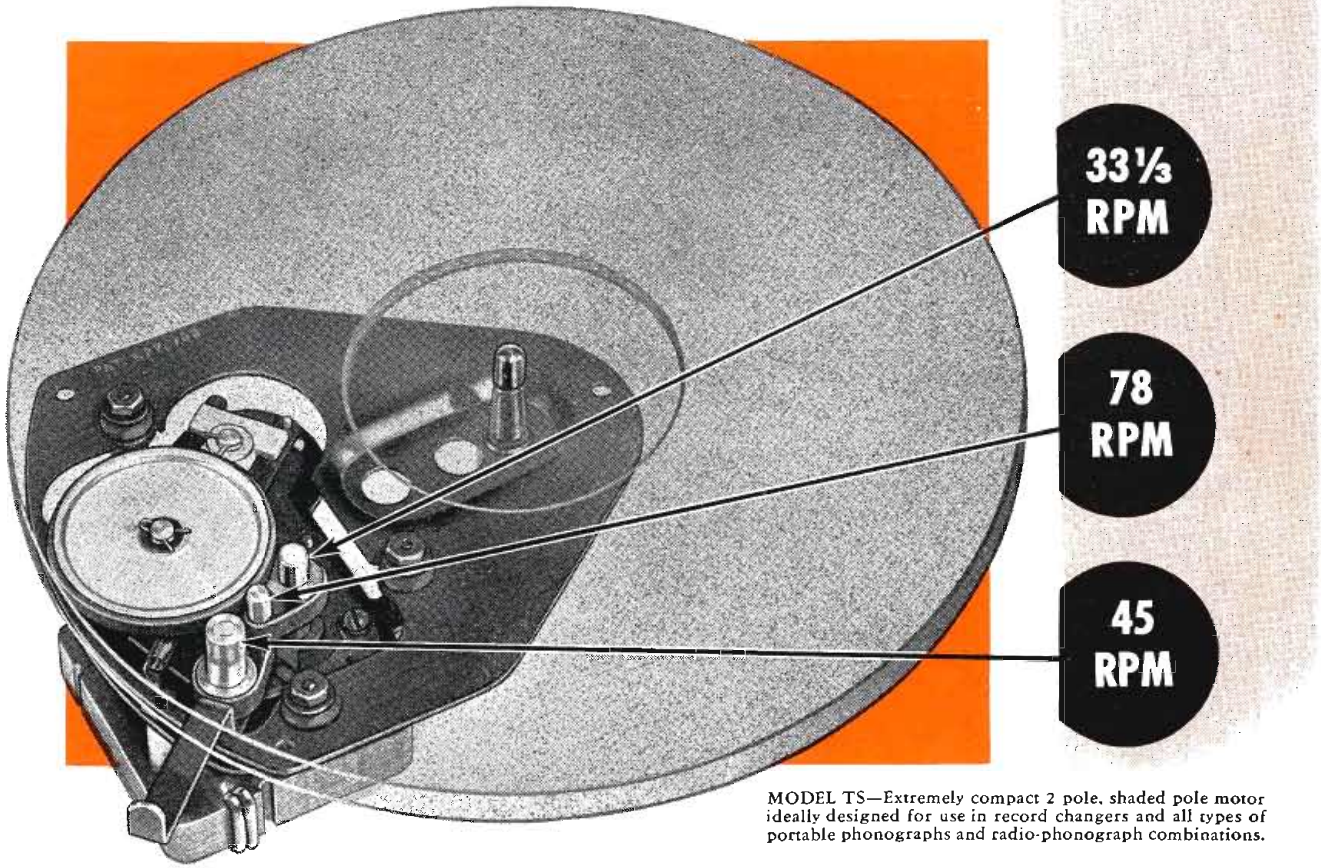


ABOVE—Rear view of Aerocom's Model 12GLX-2A, showing installation of Adlake Relays. Relays are (from left to right) Model 1200-87-5, Model 1200-87-3, Madel 1040-87-1BP, and Model 1040-85-3.

BELOW—The new Aerocom VH-200, all-weather transmitter.

NOT ONE...NOT TWO...*But*

3 SPEEDS



MODEL TS—Extremely compact 2 pole, shaded pole motor ideally designed for use in record changers and all types of portable phonographs and radio-phonograph combinations.

with this revolutionary New G PHONOMOTOR!

Here it is . . . General Industries' newest development in phonomotors . . . a dependable, single-powered unit for *all three* types of records—78 RPM, 33⅓ RPM and 45 RPM.

Speed shifting is accomplished by means of an external shift lever which ingeniously positions various spindles in contact with the idler wheel. At 78 RPM, the rotor shaft is in direct contact with the idler wheel. For the slower speeds, the rotor shaft is automatically disengaged and one of two secondary spindles is moved into contact with the idler wheel to produce the desired speed. Both secondary spindles are driven from the rotor shaft by specially compounded oil-resistant Neoprene belts.

For additional information—specifications, blueprints and quotations—write, wire or phone *today.*

The GENERAL INDUSTRIES Co.

DEPARTMENT L • ELYRIA, OHIO

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The most important paper dielectric capacitor development since the war.

Smaller than conventional paper tubulars—highly heat- and moisture-resistant—non-inflammable—rugged—vibration-resistant—conservatively rated for −40°C. to +85°C. operation.

Write for Sprague Bulletin 210A. Samples on request to quantity users.

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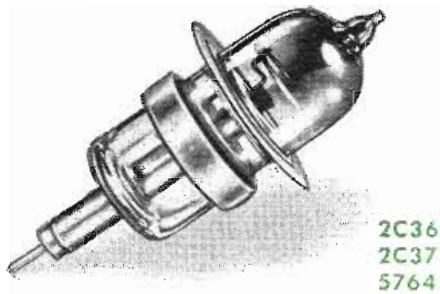

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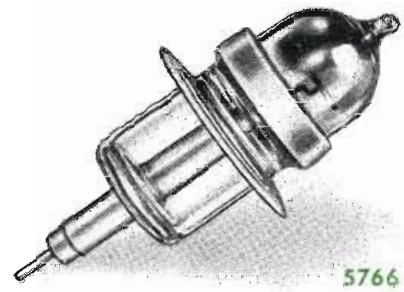

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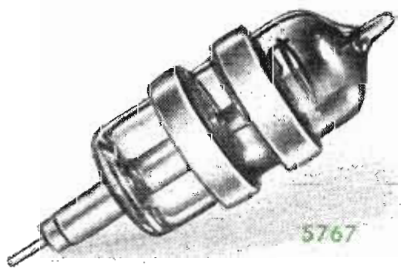
for UHF . . . Sylvania Rocket Tubes



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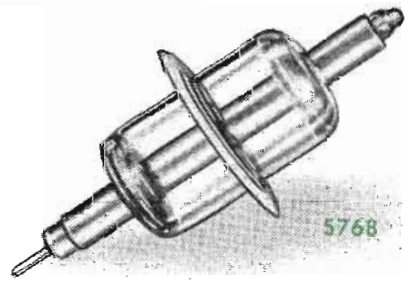
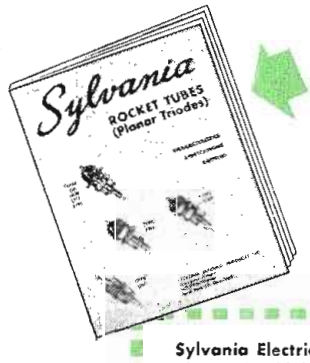


5768

Sylvania Rocket Tubes are especially designed for efficient operation at ultra-high frequencies. Whether you need amplifiers, or cw or pulsed oscillators, for operation at frequencies of 250 or 3300 mc, you'll find the types you need in Sylvania's line of Rocket Tubes.

The stretched, parallel-wire grid construction of these Sylvania tubes eliminates buckling — results in stable, uniform operation. Unique cathode design minimizes mechanical and electrical discontinuities in cathode structure. Disc-seal construction gives low inductance. Design permits continuous tuning over wide frequency ranges.



Bulletin gives characteristics, ratings and applications. Mail coupon for your copy.

SYLVANIA ELECTRIC

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Please send me your bulletin, "Sylvania Rocket Tubes." I am also interested in receiving literature on your other products in the fields of:

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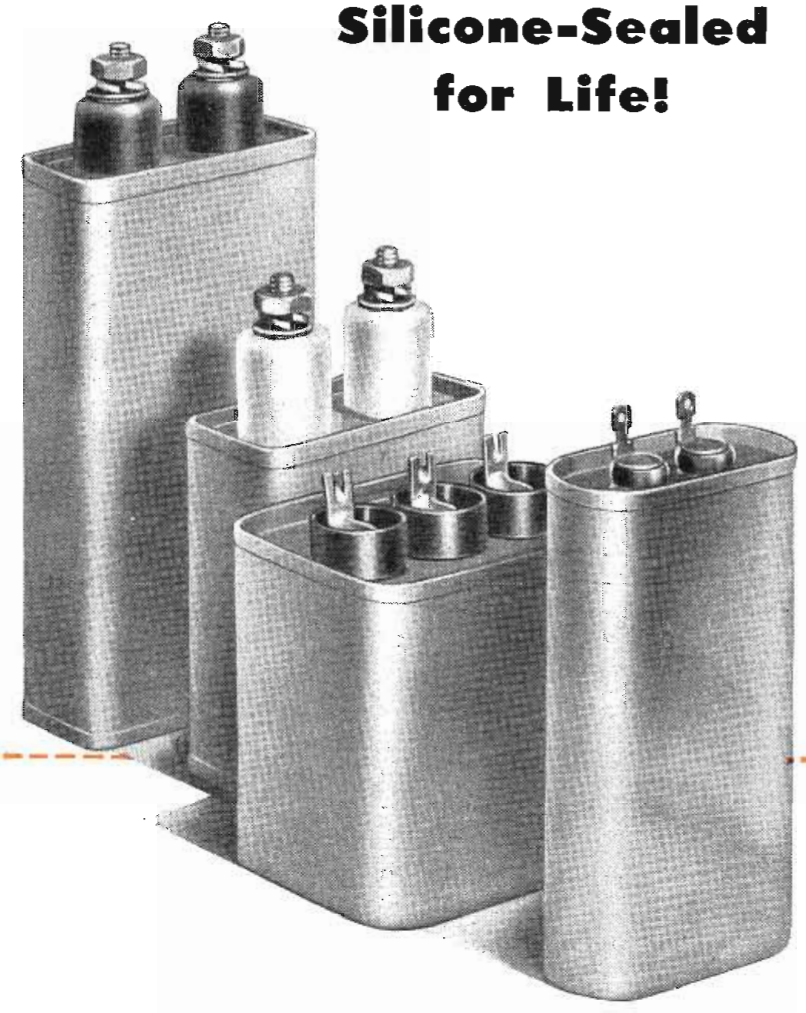
CAPACITORS

Silicone-Sealed for Life!



Silicone—the amazing new synthetic—made headlines when General Electric brought it out during the war. It's news again today—for G.E. has now made Silicone bushings and gaskets a *standard feature* of all its specialty capacitors up through 5000 volts.

This means that your new G-E capacitor is sealed positively, permanently—for maximum life. For Silicone seals by compression alone, without the use of contaminating adhesives. It will never shrink, loosen or pull away—it remains elastic at any operating temperature a capacitor will ever meet. Moreover, it is impervious to oils, alkalies and acids, and its dielectric strength is permanently high.

This exclusive G-E feature—with the use of highest grade materials, with strictest quality control and individual testing—make General Electric capacitors finer and more dependable than ever before. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

Silicone bushings used with capacitors 660-v a-c, or 1500-v d-c and lower.

Silicone bushings and plastic cups used with capacitors 660-v a-c, or 1500-v d-c and lower.

Silicone gaskets and plastic stand-offs used with capacitors rated 2000-v d-c and lower.

Silicone gaskets and porcelain stand-offs used with capacitors rated 2500-v to 5000-v d-c.

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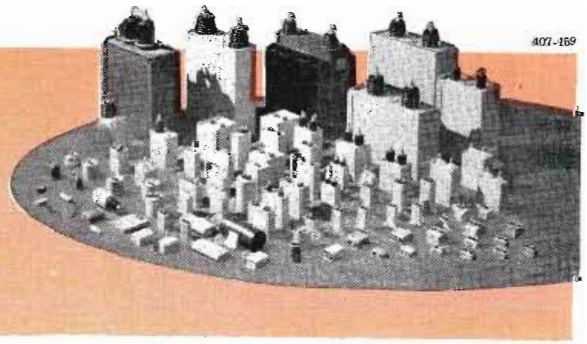
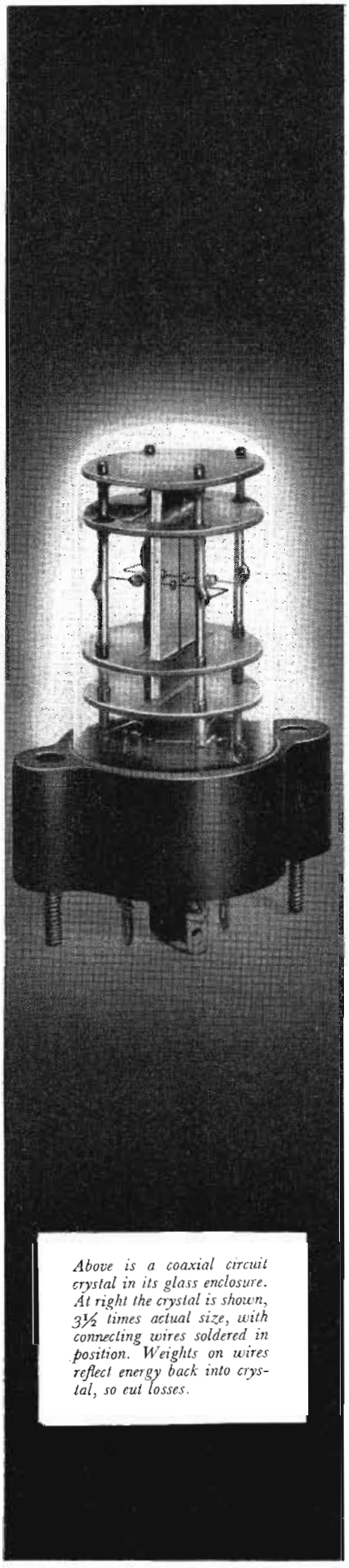
Specialty Capacitors FOR

- Motors
- Luminous-tube transformers
- Fluorescent lamp ballasts
- Industrial control
- Radio filters
- Radar
- Electronic equipment
- Communication systems
- Capacitor discharge welding
- Flash photography
- Stroboscopic equipment
- Television
- Dust precipitators
- Radio interference suppression
- Impulse generators

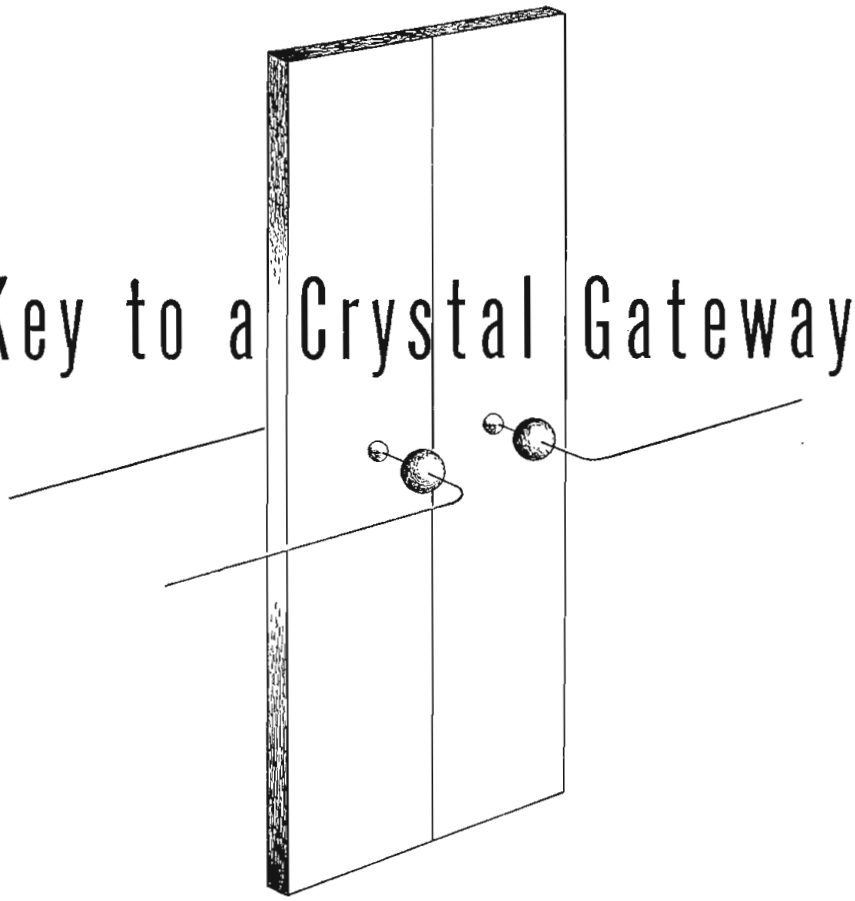
AND MANY OTHER APPLICATIONS





Above is a coaxial circuit crystal in its glass enclosure. At right the crystal is shown, 3½ times actual size, with connecting wires soldered in position. Weights on wires reflect energy back into crystal, so cut losses.

Key to a Crystal Gateway



How would you solder a wire to a crystal? This must be done for most of those wafer-thin plates of quartz used in electrical circuits. They play a big part in the myriad-channel telephone system that utilizes coaxial cables.

This is how Bell Laboratories scientists solved the problem: A spot of paste containing silver is deposited on the crystal and bonded to it by oven heat. The crystal is then vapor-plated with a thin layer of silver. Then a fine wire is soldered to the spot by a concentrated blast of hot air. The result is a rugged electrical connection to the surface of the crystal which does not interfere with its vibrations.

Sealed in glass tubes, the crystals are precise and reliable performers in the telephone system. Each is a crystal gate to a voiceway, separating *your* conversation from the hundreds of others which may be using a pair of coaxial conductors, at the same time.

This spot of paste, this tiny wire, this puff of air are among the tremendous trifles which concern Bell Telephone Laboratories in finding new ways to improve your telephone service.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

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

LITTLE PLANTS MUST HELP—The new bombers being ordered by the Air Force cost about one million dollars apiece, and from 40 to 50% of this cost goes into radio, radar and electronic equipment.

Air Force officials report that they can find plenty of manufacturing plants ready to make the planes, the propellers and the engines. But when it comes to the radio-electronic equipment, available plant capacity is far short of the huge output that will be needed when the air program gets into full swing.

THE LESSON OF 1943-45—Just as during the past war, we needed to turn to small plants and manufacturing groups scattered all over the nation, so we shall now need to enlist smaller radio groups and laboratories to help in the vast air equipment program. But these "little businesses" need experimental contracts in advance to teach them how to handle Government work. And they need financial aid and elimination of the red tape that now makes it almost impossible for the little fellow to take on Government work, with its endless guarantees, inspections, material and labor requirements, and slow pay.

FINANCIAL MOBILIZATION BOTTLENECK— To supply electronic equipment needed in case of a war emergency we have only about half the required capacity in all our big plants. But hundreds of small electronic producers scattered all over the U. S. could be mobilized to make up the balance. These smaller companies should be given practice contracts right now.

But most such small groups cannot afford to take on military assignments and then wait months for payment. They need financial help to buy supplies and equipment. Local banks ask 6% and require personal endorsements of notes by the principals,—a hazard to families and homes.

All this points to the urgent military need for simple government financing of these vital small electronic plants. At a time when we are sending $570,000 per hour to Europe, some way should be found to meet the small financial needs of electronic plants whose output may turn the future tide of victory.

UNFREEZE IN SEPTEMBER?—August or September seem best bets for FCC's withdrawal of the TV freeze which has been holding up all station planning and construction. Delays in completing the Ad Hoc Committee's report have accounted for much of this hold-up. Endless squabbles concerning theory, data, conclusions, etc. coupled with time-consuming discussions that led nowhere, have drawn out from weeks to months the period for preparation of this report.

Meanwhile, Senator Johnson, in his blast at the FCC thinks the result of the Committee's report will show an engineering basis for the conclusion that the present VHF allocation for TV was especially arranged for the benefit of the radio monopolies,—unfair as this may be. But as to final date for lifting the freeze, we hazard no more guesses. It's just a matter of wait and see!

AM UNCERTAINTIES—The NAB Convention left a lot of AM broadcasters feeling pretty doubtful about the future of "radio". The present mix-up we are in regarding getting more TV stations on the air, plus the uncertainties surrounding the use of the uh frequencies for TV, prevents anyone from charting a clear course for TV enterprises; hence we live on a sort of day-to-day schedule that is highly unsatisfactory to the forward-looking planner.

The FCC needs more efficient personnel in all departments. From the viewpoint of the engineer, the thing that seems to loom menacingly on the TV allocation horizon is the possible entrance of political pressure into the technical allocation problem. This will upset any plan based on good engineering. It is pressure of this type that may lose to the rural listener all the advantages of clear channels for AM.

TELEVISION TODAY — By Wayne Coy, Chairman FCC

"We have some 60 TV stations on the air in more than 30 cities, covering areas containing 40 per cent of the population of this country. Sixty more stations are under construction. More than 300 applications are pending. In another six or seven years we may have between 800 and 1000 stations. More than 1,500,000 sets have been produced. In two years from now that figure should go up to 6,000,000 and at the end of five years it is estimated that 18,000,000 sets will have been produced."

STANDARDIZATION

By Col. LOUIS J. TATOM, USA and Capt. HENRY E. BERNSTEIN, USN

Co-Directors—Armed Services Electro Standards Agency, Ft. Monmouth, N. J.

IN the early days of World War II, both the Army and the Navy recognized the need for reducing the vast number of different styles and types of components used in radio, radar and related equipments. There were hundreds of parts having identical electrical values and characteristics and designed to perform the same function, but they were not physically interchangeable. Some of them were of poor quality and were unsatisfactory for military applications. Accordingly, separate organizations were formed by the Signal Corps of the Army and the Bureau of Ships of the Navy to effect standardization within these individual services.

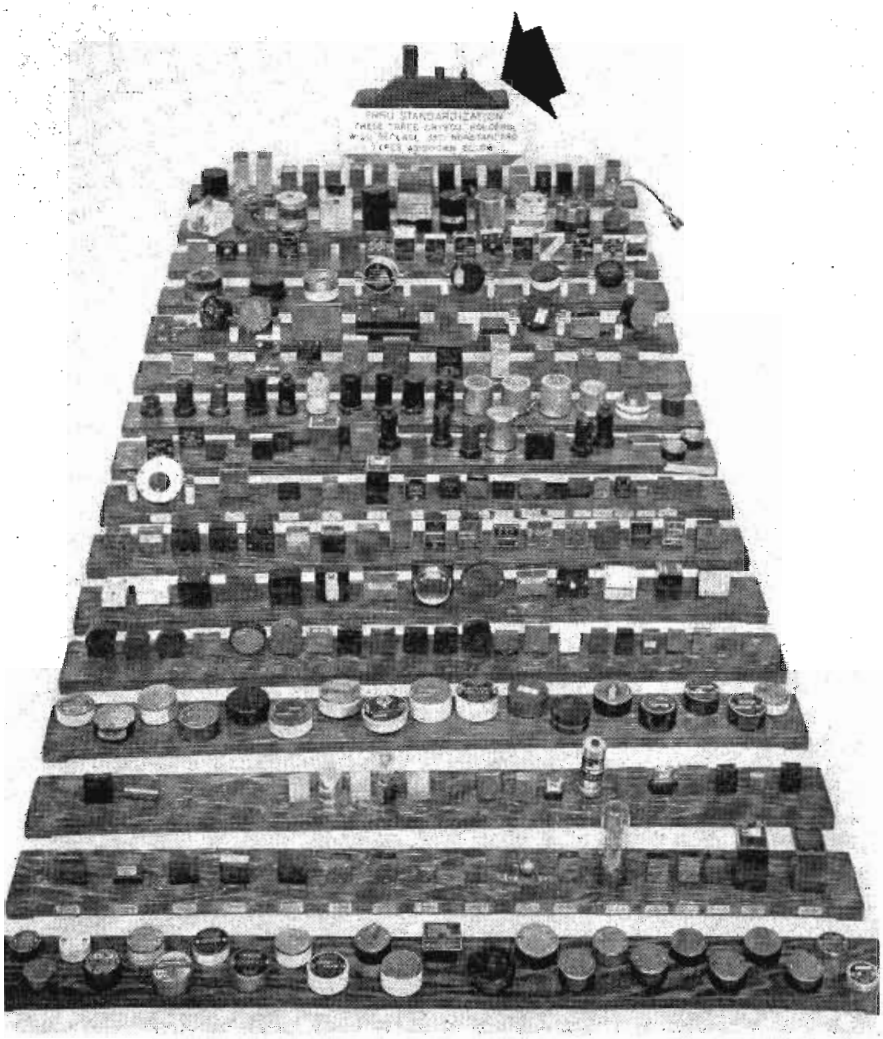
The necessity for joint cooperation in the standardization program soon became apparent and in December of 1943 the "Army-Navy Electronic Standards Agency" was established for this purpose. Concurrently the standardization of electronic parts extended to other branches of the Army and bureaus of the Navy, with coordination being effected by the single joint organization. This Agency was a smoothly working "merger" activity long before service "unification" was written into the National Security Act of 1947.

In February, 1949, a new charter was signed by the assistant secretaries of the three departments of the National Military Establishment, outlining the functions of this organization and redesignating it as the *Armed Services Electro Standards Agency*. This Agency, referred to as ASESA as a matter of convenience, is staffed by personnel from the three departments—the Army Signal Corps, the Navy Bureau of Ships, and the Air Force Air Materiel Command—actually working side by side on joint projects of common interest.

Employing 126 persons, the Agency now occupies five buildings just outside the main area of Fort Monmouth, N. J., near the Signal Corps Engineering Laboratories. On behalf of the Agency, we extend a cordial invitation to sales and technical representatives of radio-electronic manufacturers to visit the establishment at any time and to see for themselves how its work affects almost everyone in the industry.

Military electronic equipment, like all other equipment intended for military use, must be built to "stand the gaff". It must be able to operate under a wide variety of conditions and to withstand severe shocks and vibration as well as extremes of temperature and humidity. At the same time, this tough equipment must be made as small

Prize example of standardization. .Three small crystal holders at top of photograph replace 350 non-standard holders used by various armed services during the war



Some Reforms of the ASESA

Adopted 3 crystal holders to replace 350 different holders formerly used . . . Reduced 37,000 types of indicating instruments to 3,700 standard types . . . Reduced 10,000 different sizes and shapes of transformer cases to 22 standard sizes

in The Armed Forces

ASESA
A Joint Agency of the Armed Forces engaged in preparation of STANDARDS for Electronic & Electrical components
ARMED SERVICES ELECTRO STANDARDS AGENCY

and light as possible. The component parts, or the bits and pieces, that go to make up this equipment must individually meet the military requirements of the end items for ruggedness and dependability.

The Research and Development Board Electronics Committee[1], acting through its Components Panel, coordinates research and development work on electronic components in the various government laboratories, in universities and in industry. The sole purpose of this work is to improve the quality and dependability of components for military electronic equipment. Strong emphasis is placed on miniaturization and unit packaging of whole subassemblies. The result of this research and development work is passed on to ASESA where it is incorporated in all new and revised specifications for standard components.

Since the electronics industry ultimately has to make these components for government use, close coordination with industry is necessary so that the specifications will be practical and feasible in manufacture. Members of the Standards Agency meet frequently with various members and committees of industry and the Radio Manufacturers Association to collaborate on the preparation of all new "JAN" (Joint Army-Air-Navy) specifications for standard components. Industry is cooperating wholeheartedly with this program, and is benefiting directly from the advances being made in the science of electronics and the resulting improvements in the various components.

Capt. H. E. Bernstein (left) and Col. L. J. Tatom, co-directors of ASESA. Standard JAN fixed capacitor in Capt. Bernstein's hand replaces other six non-standard types shown.

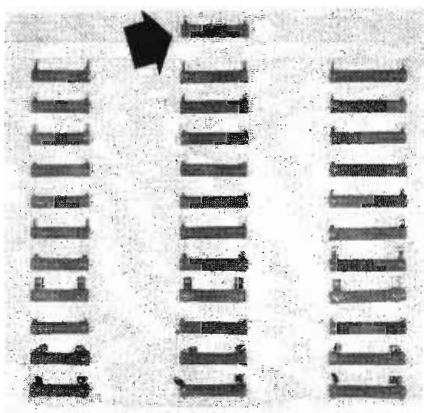
When a new or revised specification is completed and concurred in by the interested services, it is processed through the Munitions Board Standards Agency and issued to the services as a National Military Establishment (NME) document, though it is still designated as a JAN specification.

In addition to responsibility for the preparation of Jan specifications for standard components, ASESA also has the very important responsibility of designated approved sources of supply for each one of these parts. When a JAN specification is issued, appropriate manufacturers are invited to submit samples of their products made under this specification, for qualification testing and approval. This testing work is done for ASESA by the Signal Corps Engineering Laboratories, Fort Monmouth, N. J., and the Navy Material Laboratory, Brooklyn Navy Yard, N. Y. When an item is found to meet the specifications, a qualification approval certificate is issued by ASESA to the manufacturer of that item, designating him as an approved source of supply. This information is then given to all procurement and contracting officers of the Army, the Navy and the Air Force.

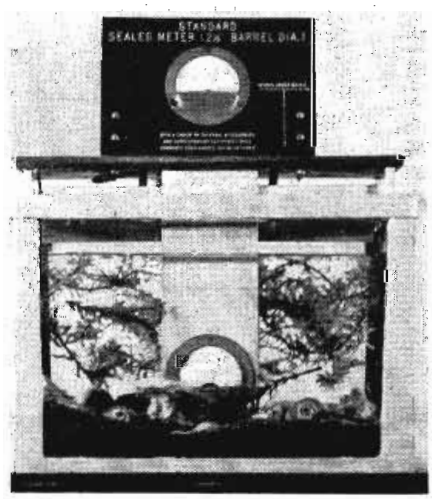
It is axiomatic that the value of any standard depends upon the extent of its use. Each JAN specification contains a clause making it encumbent upon all procurement and contracting officers to purchase only these standard JAN components for maintenance stock and to specify JAN components in all new electronic equipment. A complete list of approved suppliers who have proven their ability to manufacture these standard parts is prepared periodically by ASESA and published in the Joint Army-Navy-Air Force Qualified Products List. This provides procurement officers and manufacturers with ready information as to where these standard parts may be procured, and insures

(*Continued on page* 56)

JAN-R-26, Style RW-35, standard resistor (arrow) replaces 33 non-standard types below



Equipment made to JAN specifications stand up! Meter in fish tank was submerged in January 1948 and is still working perfectly



New FCC Mobile Frequency

Six major service categories involved in latest FCC order revising current operating regulations and frequency assignments, effective July 1

A new set of rules and frequency allocations for mobile radio and other varied specialized non-broadcast services has been issued by the FCC and will become effective on July 1, 1949. This action affects the six existing major service categories as follows:

1. *Experimental General Mobile Radio*, by incorporating it into three new classes of service, namely, *Land Transportation Radio Services, Domestic Public Mobile Radio Service*, and *Industrial Radio Services*.
2. *Emergency Radio Service*, by substituting for it rules governing a new category to be known as *Public Safety Radio Services*.
3. *Miscellaneous Radio Service* (the present Part 11 of the Commission's Rules and Regulations) by substituting for it a new category to be known as *Industrial Radio Services*.
4. *Utility Radio Service*, present Part 17, by cancelling it and transferring Power Utility and Petroleum Pipeline stations to the new *Industrial Services* and Transit Utility to the new *Land Transportation Radio Services*.
5. *The Railroad Radio Service*, present Part 16, by cancelling it and transferring it to the new *Land Transportation Radio Services*.
6. *Maritime Mobile Service*, by assigning to it twelve frequencies with 100 KC separation between adjacent frequencies in the 152-162 MC band. One of these frequencies (156.80 MC) was agreed upon at the 1947 Atlantic City International Radio Conference as an international maritime calling frequency for the VHF band. This new allocation compares with the present total of nine frequencies with 60 KC separation between adjacent frequencies.

The latest frequency allocations are charted below.

(Footnotes for numbers in parenthesis shown on page 62)

Band—MC	Service	Class of Station	Nature of Service	No. Channels & Freqs. Alloc. (MC)
1.75-1.8	Fixed (1) Mobile (1) Radio location (2)			
1.8-2.0	Radio-navigation (4)	Loran	Loran	
25.01-25.33 (5, 6)	Land mobile	Base, Land mobile	Industrial	16 (25.02-25.32)
25.85-26.10 (5)	Broadcasting	International Broadcasting		
26.10-26.48 (5, 6)	Land mobile	Base, Land mobile	Remote pickup broadcast — base, mobile	19 (26.10-26.48)
26.95-26.96 (5)	Fixed	Fixed	International fixed Public	(26.955)
26.96-27.23 (7)			Industrial, scientific, medical equip.	(27.12)
27.23-27.28 (5,7)	Fixed mobile	Fixed, Land, Mobile		
27.28-27.54 (5, 6)	Land mobile	Base, Land mobile	Industriol	13 (27.29-27.53)
29.7-29.8 (5, 6)	Land mobile	Base, Land mobile	Industrial	5 (29.71-29.79)
29.8-29.89 (5)	Fixed	Fixed	International public, Aeronautical—Fixed	8 (29.81-29.88)
29.91-30.0 (5)	Fixed	Fixed	International public, Aeronautical—Fixed	8 (29.92-29.99)
30.56-32.0 (5, 6)	Land mobile	Base, Land mobile	Industrial	2 (30.58-30.62)
			Industriol; Land Transportation	5 (30.66-30.82)
			Land Transportation; Public safety	8 (30.86-31.14)
			Public safety	21 (31.18-31.98)
33-34 (5,6)	Land mobile	Base, Land mobile	Public safety	3 (33.02-33.10)
			Industrial	7 (33.14-33.38)
			Public safety	15 (33.42-33.98)
35.00-35.04 (5, 6)	Land mobile	Base, Land mobile	Industrial	(35.02)
35.04-35.20 (5, 6)	Maritime mobile Land mobile	Coast, Ship, Base, Land mobile	Industrial; Maritime Mobile	4
35.2-36.0 (5, 6)	Land mobile	Base, Land mobile	Domestic public Land Transpor.	20
37-38 (5, 6)	Land mobile	Base, Land mobile	Public safety	11 (37.02-37.42)
			Industrial	11 (37.46-37.86)
			Public safety	3 (37.90-37.98)
39-40 (5, 6)	Land mobile	Base, Land mobile	Public safety	25 (39.02-39.98)
42-44 (5, 6)	Land mobile	Base, Land mobile	Public safety	24 (42.02-42.94)
			Industrial	42.98
43.0-43.2 (5, 6)	Maritime mobile Land mobile	Coast, Ship, Base, Land mobile	Industrial Maritime Mobile	5 (43.02-43.18)
43.2-44 (5, 6)	Land mobile	Base, Land mobile	Domestic public; Land transport.	20 (43.22-43.98)
44-50 (5, 6)	Land mobile	Base, Land mobile	Land transport.	15 (44.02-44.58)
			Public safety	77 (44.62-47.66)
			Industrial	58 (47.70-49.98)
54-72 (5)	Broadcasting	TV Broadcast	Channels 2, 3, 4	3 (55.25-71.75)
72.0-76.0 (5)	Fixed (9, 10)	Operational fixed	Operational fixed	50 (72.02-74.58)
72.0-76.0 (5)	Fixed (9, 10)	Operational fixed	Operational fixed	15 (75.42-75.98)
76-88 (5)	Broadcasting	TV Broadcast	Channels 5, 6	2 (77.25-87.75)
88-108 (5)	Broadcasting	FM-Broadcast	FM Channels 201-300	100 (88.1-107.9)
108-118	Aeronautical Radio-navigation	Radio-navigation land	Localizer	39 (108.1-111.9)
			Omni dir. range Radio range	59 (112.1-117.9)
118-132 (11)	Aeronautical mobile	Aeronautical, Aircraft	Airdrome Control	33 (118.1-121.3)
			Aeronauticol mobile	(121.5)
			Aeronautical utility — land, mobile	2 (121.7-121.9)
			Private aircraft	5 (122.1-122.9)
			Flight test; Flying school	3 (123.1-123.5)
			Aeronauticol mobile	42 (123.7-131.9)
152-156.25 (5, 6)	Land mobile	Base, Land mobile	Domestic public	3 (152.03-152.21)

Allocations for Non-Broadcast Services

Band—MC	Service	Class of Station	Nature of Service	No. Channels & Freqs. Alloc (MC)
			Land transport.	4 (152.27-152.45)
			Domestic public	6 (152.51-152.81)
			Industrial (12)	9 (152.87-153.35)
			Industrial	6 (153.41-153.71)
			Public safety	12 (153.77-154.43)
			Industrial	2 (154.49-154.57)
			Public safety	27 (154.65-156.21)
156.25-157.45 (5)	Maritime mobile	Coast, Ship	Maritime mobile (13, 14)	(156.3)
			Maritime mobile (13)	2 (156.4-156.5)
			Maritime mobile (13, 15)	(156.6)
			Maritime mobile (13)	(156.7)
			Maritime mobile (16)	(156.8)
			Maritime mobile (13)	3 (156.9-157.1)
157.45-161.85 (5, 6)	Land mobile	Base Land mobile	Land transport.	4 (157.53-157.71)
			Domestic public	6 (157.77-158.07)
			Industrial	6 (158.13-158.43)
			Domestic public	4 (158.49-158.67)
			Public safety	13 (158.73-159.45)
			Land transport. (17)	39 (159.51-161.79)
161.85-162.00 (5, 19)	Maritime mobile	Coast	Coast (13, 18)	(161.90)
			Coast (13)	(162.00)
173.2-173.4 (5, 20)	Fixed, Land mobile	Base, Fixed, Land mobile	Industrial	4 (173.225-173.375)
174-216 (5)	Broadcasting	TV Broadcast	Channels 7, 8, 9, 10, 11, 12, 13	7 (175.25-215.75)
328.6-335.4	Aeronautical Navigation	Radio-navigation land	Glide path	
400-406	Meteorological Aids	Radio sonde		
450-460 (5, 6)	Land mobile	Base, Land mobile	Remote pickup broadcast — base, mobile	20 (450.05-451.95)
			Land transport.	20 (452.05-453.95)
			Public safety	20 (454.05-455.95)
			Industrial	20 (456.05-457.95)
			Domestic public	20 (458.05-459.95)
460-470 (5)	Fixed, Mobile	Fixed, Land Mobile	Citizen radio	
470-475 (5)	Broadcasting	Facsimile Broadcasting		
475-500 (5)	Broadcasting	Broadcasting		
500-890 (5)	Broadcasting	TV Broadcasting		
890-940 (5, 24)	Broadcasting, Fixed		Industrial, scientific, medical equipment	(915)
940-952 (5, 24)	Fixed	FM Broadcast STL (25)		
952-960 (5, 26)	Fixed	International Control; Operational Fixed		
960-1215 (27)	Aeronautical radio-navigation			
1300-1365 (28, 29)	Aeronautical radio-navigation	Surveillance radar (Pulsed emission only)		
1365-1660 (28, 29)	Aeronautical radio-navigation	Radio-navigation (incl. altimeter)		
1660-1700 (28, 29)	Meteorological aids (Radio sonde)		Radio sonde	(1680)
1850-1990 (5, 24)	Fixed	International Control; Operational Fixed		
1990-2110 (5)	Fixed, Mobile	TV pickup; TV-STL (30)		
2110-2200 (5, 24)	Fixed	International Control; Operational Fixed		
2450			Industrial, scientific, medical equipment	
2450-2500 (5)	Fixed, Mobile (31)			
2500-2700 (5, 24)	Fixed	International Control; Operational Fixed		
2700-2900	Aeronautical Radio-navigation; Meteorological aids			
2900-3246 (32)	Radio-navigation			
3246-3266	Radio-navigation	Racon	Racon	(3256)
3266-3300 (32)	Radio-navigation			
3500-3700 (5)	Mobile	Land; Mobile (Except TV Pickup)		
3700-4200 (5)	Fixed	Common carrier fixed		
4200-4400	Aeronautical radio-navigation	Altimeter		
5000-5250	Aeronautical radio-navigation			
5250-5440 (32)	Radio-navigation			
5440-5460	Radio-navigation	Racon	Racon	(5450)
5460-5650 (32)	Radio-navigation			
5850			Industrial, scientific, medical equipment	
5925-6425 (5)	Fixed	Common carrier fixed		
6425-6575 (5)	Mobile	Land; Mobile (Except TV Pickup)		
6575-6875 (5, 24)	Fixed	International Control; Operational Fixed		
6875-7125 (5)	Fixed; Mobile	TV Pickup TV-STL (30)		

(Continued on page 62)

Pickup being handled with truck in motion using self contained gas-engine generator. State capitol at Austin, Texas in background

Simplified Handling

Permanent facilities installed in coach permits transporting complete televising needs in "ready-to-use" condition

By WILLIS McCORD, Manager, Tele-Specialties Dept., Allen B. DuMont Laboratories, Inc., 515 Madison Ave., New York City

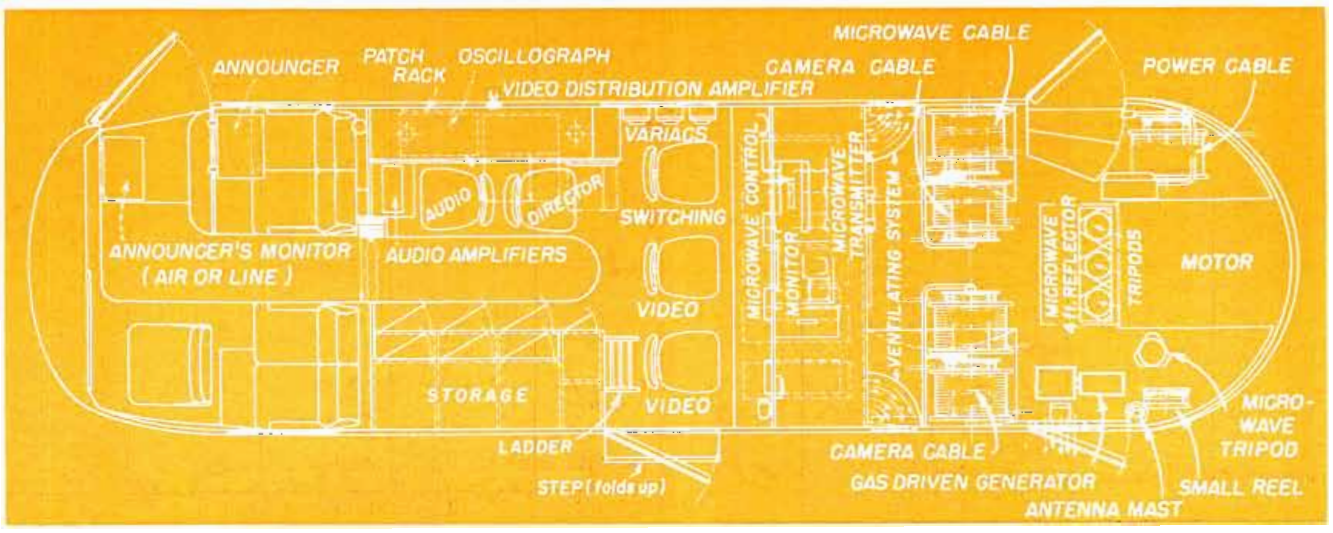
AS daily operating TV time-on-the-air is increased to more than round-the-clock schedules and as television audiences become more discriminating as to programs, management has had to develop more varied entertainment. This means going after new program sources and in many cases going to unusual locations for spot events. Simplified television broadcast facilities are a present day requirement since, in addition to regular assignments at locations where permanent installations are impractical, pickups may be called for emergency events at a moment's notice. Also, in modern television operation it is frequently necessary to move quickly from one program site to another so that a single unit will be able to handle several "remotes" during the day.

The layout of complete camera and program linking facilities for remote pickups has long been a problem under study by the DuMont Network. Many hundreds of events have been handled with a great variety of equipment setups.

A quite flexible portable camera chain, control and monitoring setup was first engineered (see Tele-Tech, March 1948, pages 42-45, and March 1947, page 42) under a rigid specification set up for the same high quality required for permanent studio operation. In fact many stations are now using this portable equipment for their permanent studio installations, since the switching and controls arrangement was laid out so that the cameras could be set up and switched in with the full ease of operation usually afforded by a master studio console. Experience has shown however, that even with all the simplicity of such a setup it would be difficult to layout a single simple arrangement that would satisfy all possible users at different parts of the country—just as experience has indicated that each TV station installs somewhat different facilities in their main studios and transmitters. For this reason, in the overall planning for handling television remotes several variations in basic units can be selected.

In many cases assignment to a job affords no opportunity to make an advance survey of the facilities and possibilities so that all emergency requirements must be anticipated. The final DuMont solution for this is a special coach, the Telecruiser (Fig. 1) permanently

Diagram of the interior of the special coach shows location of the various equipment items and working area provided remote crew members



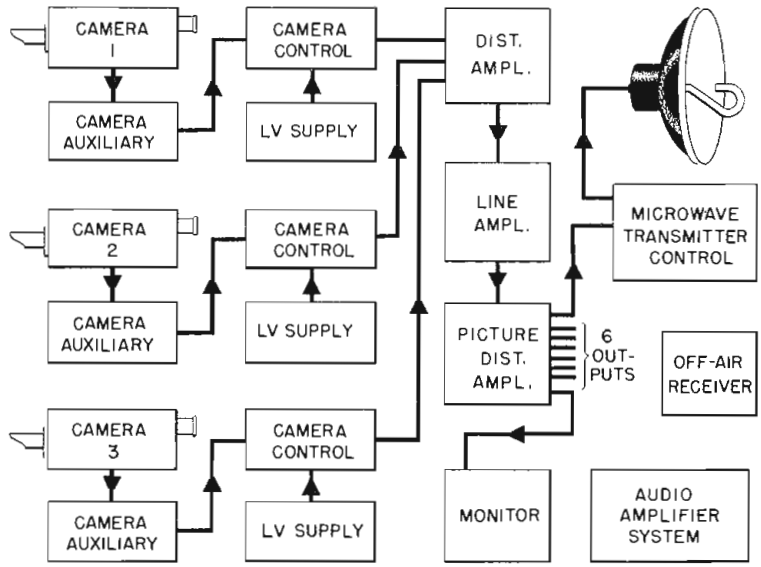
# of Television Remotes

fitted with necessary equipment. Included are the technical units needed for both video and sound pickup, a microwave relay link, power and signal handling cable reels, and all necessary conveniences for personnel while operating and for comfort in traveling (Fig. 2). Accommodations in the front compartment provide for the driver and for passengers while traveling and, permit a complete operating staff for average broadcasts to be taken along. This compartment is arranged for announcer's use during a broadcast where needed.

Facilities for 3 Cameras

The Telecruiser contains full facilities for handling three Image Orthicon Cameras so that unusual events can be adequately handled, Fig. 3. All equipment, except the camera and the microwave bowl, is shock mounted and have fixed interconnections for immediate use. Audio and video cable outlets are provided at several places in the cruiser to permit monitoring, announcing, etc., with the most convenient handling.

The cruiser itself, is a passenger type coach made by the Flxible



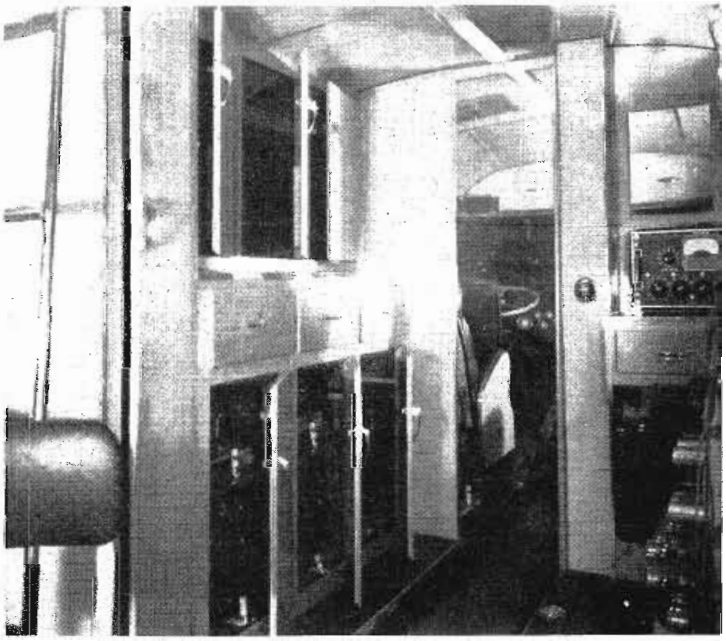
Block diagram showing the basic equipment of a three camera chain usually supplied

Coach Company, and powered by a 144 HP Buick engine. On the highway it has a speed comparable to a passenger car and can be readily dispatched from one station to another.

The top deck will hold three tripods, one of which may be used for an RCA microwave relay system and two for cameras, or all can be used for cameras. When a higher relay mount is available and needed, a microwave cable reel provides a 200-ft. extension. This roof deck is 6-ft. wide and 19-ft. long. A de-

(*Please turn to next page*)

(Left) Camera chain storage unit cabinets are made of solid oak, fully lined with foam rubber for shock protection. Distribution amplifier can be seen at right in lower corner. (Right) Close-up view of the video distribution amplifier, uncovered and pulled forward for inspection



TELEVISION REMOTES (Continued)

mountable guard railing is erected when the platform is in use and provides safety for the camerman and announcer who might otherwise be in danger of falling. With the hatch leading to the roof located inside (Fig. 3) control is exercised over those reaching this platform and those not having business there may be kept off.

In order to operate a remote pick-up considerable cable must be transported and provision has been made in the rear compartment for storing this cable neatly on reels. There are five large reels, three of which will accommodate 250-ft. of camera cable; another accommodating the 200-ft. of microwave control cables; and the fifth accommodating the 250-ft. of #8, 4-conductor power cable. These cables in operation feed out through a pair of ports in the rear of the unit at the roof level and from this high point are easily carried across sidewalks at a height which will not obstruct traffic.

A motor, easily moved from one reel to another, supplies power for pulling this cable in after use. This feature saves considerably on time and eliminates a lot of back-breaking work by winding in the cable in a net manner to prevent its being kinked or damaged.

The microwave relay transmitter and parabolic reflector are stored in this compartment along with the tripods and other accessory equipment. A small collapsible dolly is also carried in the compartment and can be used to transport the cameras or, if the equipment is removed from the unit, serves as a console table for the monitor units.

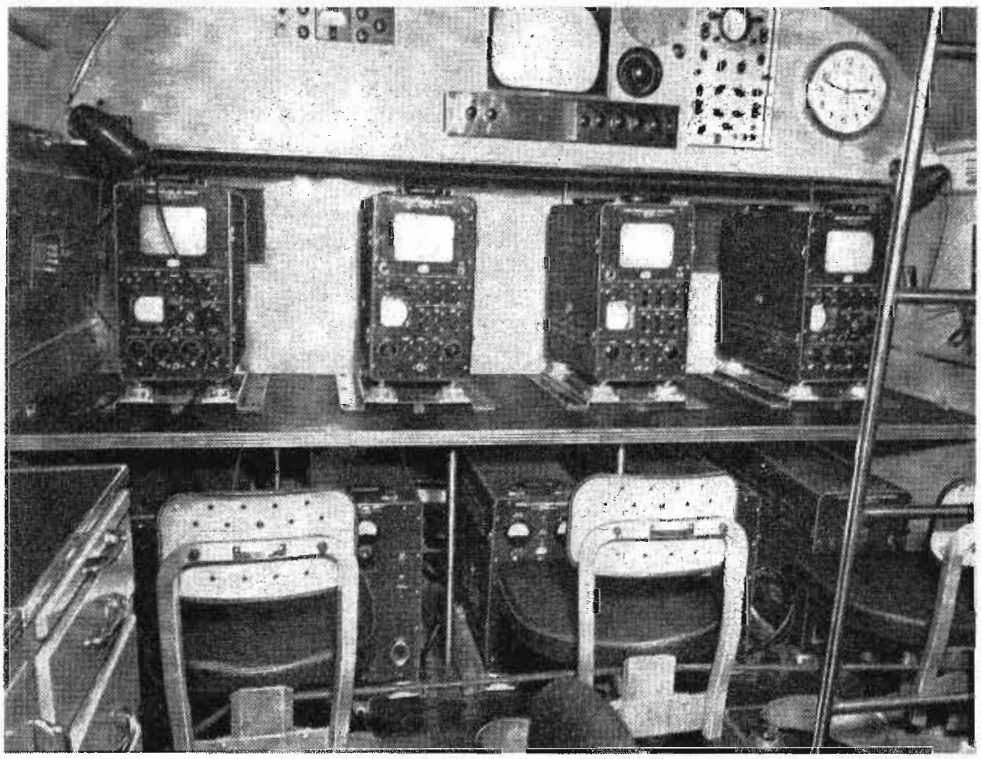


Photo showing equipment arrangement at camera control and video switching positions

Author checking power supply unit which slides out on a track for easy accessability

Utilization of Space

Efficient utilization of the space within the cruiser centers on an operating area in the midsection Fig. 6. Here a complete operating crew would consist of three video operators, one of which handles switching, an audio operator and the director. The latter two operating positions are at the side bench containing audio amplifiers, a patch panel, monitoring oscillograph, and the video distribution amplifier with its power supply.

This amplifier is shown in Fig. 5 pulled out on a track for servicing but normally it retracts into the cabinet and is completely enclosed. It is connected through a video patch panel to provide eight separate outputs for distribution to external line connections and various monitor positions in the cruiser. The Director, seated at this spot during program, is provided with a pull-out table and his own loudspeaker. The sound operator sits at director's left at the audio control unit and patch panel which provides distribution of one or more audio system outputs. The 24-position patch panel is provided for use in handling the program sound, cueing, private phone lines and the microphones. From this patch panel wires are carried through conduits to the exterior where they terminate in connectors. There are four microphone inputs, one on either side of the unit, one at the roof level and one in the announcer's compartment.

Cupboards overhead provide general storage and a window over the

(*Continued on page* 58)

Two sound recording units at Station WABD, Dumont Television Network, New York

Video Recording Technics

Part Two 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 main advantage of direct positive single system recording is that the film consumed is reduced to a minimum and the finished composite positive is available in the shortest possible time. If prints are required, a fine grain duplicate negative may be made from the direct positive film, and the negative used to make the necessary number of prints. In this case, the sound track may be printed from an original sound negative which was recorded as double system. Some loss of definition inevitably will occur in each printing operation, therefore if a multiplicity of prints are required the negative-positive system is preferable to the direct positive system. If only one copy is needed and time is important, the direct positive system has much to recommend it. Such a procedure, coupled with very rapid processing, is the basis for a system of theatre or large screen television.

A number of other combinations of monitor tube image polarity with negative or reversal film are available but have little to recommend them. The historical background of 16-mm. film as an amateur product reversal processed to a positive image has led to the establishment of a standard position of the film in the projector such that the emulsion side of the film is toward the lens. This is opposite to the standard for 35-mm. film which is almost universally produced by negative-positive processes. It is desirable to produce video recordings which yield prints with standard emulsion position. This avoids the necessity of refocusing the projector if these prints are intercut with direct photographic films and particularly simplifies the problem of sound reproduction because the sound optics of the reproducer are not readily refocused. In the same manner, the printing of 16-mm. composite prints which are perforated on one side only may be difficult unless due attention is given to the orientation of the sound track on the sound negative and the left-right orientation of the image on the picture negative. The proper combination can only be established after consideration of the sound recording facilities and printing facilities available for a given installation.

To satisfy the requirement that video recordings should give rebroadcast quality comparable to that from direct photographic films the recordings should resolve all detail available in the high quality monitor image and the contrast should be held to the level which fits the film pick-up head. No definite standards have been set up by the industry, but the great majority of studies have indicated that films satisfactory for rebroadcast should be slightly lighter in over all density and of lower contrast or density range than films for good theatre projection. A rough specification, subject to modification in terms of results obtained in a given installation, might be a maximum picture density of 2.2 or 2.4. No distinction exists between sound tracks for projection or broadcast, therefore standard practice should be followed.

Standard Films Satisfactory

The requirement for high resolving power and low graininess (high signal to noise ratio) can be met by standard film products which have spectral sensitivity, speed, and contrast characteristics suitable for video recording. Fortunately, these films are also among the lowest cost film types available. The present 525 lines, 30 frames per second

(*Please turn to next page*)

television system can present about 480 lines in the vertical direction and, before rebroadcast by the transmitter, the equivalent of approximately 600 lines horizontally. For a raster imaged on a 16-mm. film frame, this corresponds to about 65 television lines/mm.

Rating Resolving Power

Photographic resolving power is rated by the number of pairs of equally wide white and black lines per millimeter recorded. Thus, for resolution of the television scanning lines the film should be rated, in photographic terms, for at least 33 lines/mm. Because of the effect of object contrast and processing conditions on resolving power measurements, and the contrast reduction of the fine detail in the television picture by blooming, lens flare, etc., a considerable safety margin should be allowed. In practice, the most widely used films have rated resolving powers of approximately 100 lines/mm. For instance, Eastman 16-mm. Fine Grain Sound Recording Safety Film, Type 5373 is rated at 90 lines/mm., and Eastman 16-mm. Fine Grain Release Positive Safety Film, Type 7302 is rated at 120 lines/mm., when each film is subjected to its own standard processing. Type 602 DuPont Safety Sound Recording Film and Fine Grain Positive Type 605 are rated at 80 and 100 lines/mm. respectively. All of these films distinctly resolve the scanning lines of the television raster.

For a negative-positive system of video recording, the picture negative film should be processed to a gamma (slope of the straight line portion of the characteristic curve) of approximately 0.7 as measured from a sensitometric exposure such as that obtained with an Eastman IIb Sensitometer. This is in keeping with normal motion picture practice for picture negatives, and will permit recording a brightness range on the monitor tube of at least 30 to 1 on an almost linear portion of the film characteristic. This negative characteristic is suitable for normal printing techniques by commercial motion picture laboratories. A suitable film for picture negatives is Eastman 16-mm. Fine Grain Sound Recording Safety Film, Type 5373 which is designed to be used at a control gamma of about 0.6 and may be readily developed to the gamma desired for video recording use.

For direct positive recording, the camera film is processed to yield a contrast directly suitable for projection or rebroadcast. In this case a film of inherently high contrast is desirable. With appropriate contrast of the negative image on the monitor tube, the film should be processed to a gamma of about 2.2. If a film such as Eastman 16-mm. Fine Grain Release Positive Safety Film, Type 7302 is used, the gamma is only slightly less than is normally produced (2.5) when this film is processed by commercial laboratories. The exact control gamma established for either type of recording is influenced by the setting of the monitor tube, the processing facilities available, and the characteristics of the film pick-up head. The above recommendation can be given only as a starting point about which to conduct careful tests.

Color Sensitivity Not Essential

Inasmuch as the subject has already been reduced to monochrome by the television system, there is no specific requirement for color sensitivity of the film used for video recording. With monitor tubes operated at high voltages and with aluminized efficient phosphors, the slower commercial films are practical. A white phosphor is of advantage in visually adjusting the monitor, but a blue phosphor may be as efficient photographically. The previously mentioned films for picture recording, as well as other films of this type, are color blind or sensitive only to blue and near ultra violet. With respect to sensitivity they are also referred to as positive type films. The use of color blind films is advantageous because of their generally lower cost, and the ability to load magazines and process the film with relatively bright red or yellowish green safe lights. The increased speed of color sensitized or panchromatic films is chiefly a function of widening the spectral band to which they respond, and hence this speed increase is not realized if the films are exposed to light of relatively narrow spectral bands such as is emitted by most phosphors. Ordinarily photographic exposure meter and film speed ratings are based on continuous spectra resembling tungsten lamp illumination or daylight and produce very anomalous results when applied to the conditions of video recording.

Determining proper exposure for video recording is in the last analysis an empirical process, but the operating region may be conveniently determined by the following method. The selected film should be exposed in the recording camera to a raster with normal sync pulses but no video modulation. The lens aperture should be fixed at the value which produces minimum shutter bar. The average beam current, which is approximately a linear function of tube brightness, is set at various definite levels from just above cut-off to slightly more than twice the value recommended by the tube manufacturer for a 50% AC axis picture. The steps can conveniently be a power of two series, as 1, 2, 4, 8, etc. μamps. The

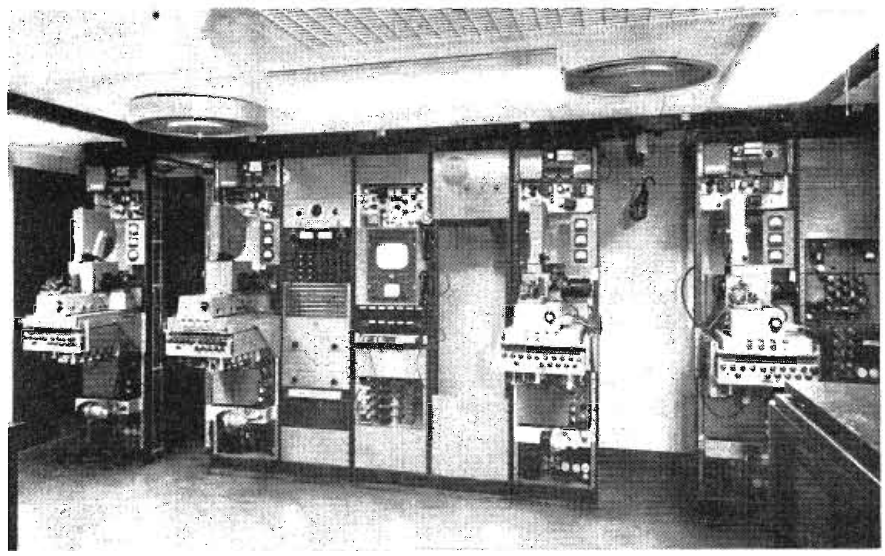
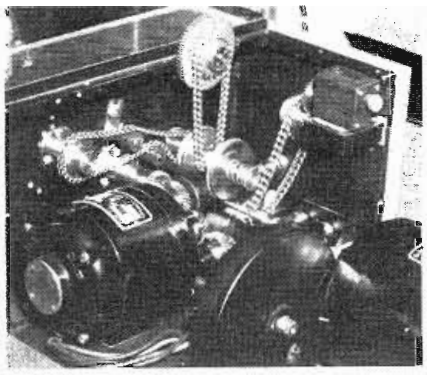
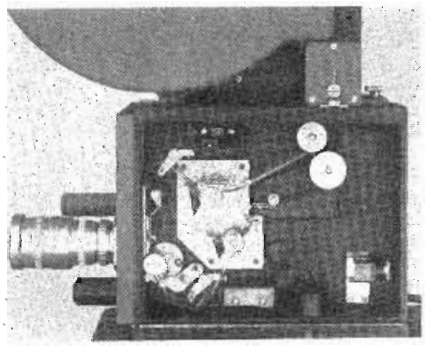


Photo of installation at NBC shows four recording units and control equipment racks

exposed film should be processed in the manner intended to be used for the actual recording operation. For instance, for negative - positive work, the film should be processed to a gamma of approximately 0.7 and the processing conditions and gamma should be known and reproducible. The density produced on the film by each value of beam current is plotted as an ordinate against the beam current plotted logarithmically as the abscissa. From this curve the range of brightness, in terms of beam current which produces an approximately linear density-log brightness relationship on the film can be determined. The arithmetic average of the maximum and minimum beam currents of this range should be the average beam current for a 50% AC axis signal. If the curve does not show a range of brightness, or beam current, of at least 30 to 1 which includes the linear portion of the curve, or the average beam current so indicated is too high, the exposure must be adjusted by varying anode potential on the tube, the lens aperture, or the processing conditions. Once the proper average beam current has been determined, this curve also indicates the maximum and minimum beam current to produce a properly exposed picture. This information on average, maximum, and minimum brightness or beam current may be correlated with the metering or waveform monitoring equipment to insure reproducible operation of the picture tube. Obviously pictures with a predominance of light or dark areas, i.e., other than 50% AC axis signals, will result in greater or lesser values of average beam current; but the maximum and minimum values should be held constant. Two or more recording cameras are necessary for continuous recording of programs of longer than 30-min. duration, or as a stand-by for maintenance purposes. For either situation the recordings from each camera and monitor installation should be as nearly identical as possible in all respects. The exposure level and contrast of the recording made by each camera may be adjusted by the above procedure so that the average beam current and degree of modulation to produce equal film densities is known for each monitor. A final check on this may be made by exposing film to the same signal, for instance a test pattern, in each monitor and camera set up and processing the film at the same time. The negatives should be intercut in short lengths and inspected by projection. Very little difference between the film sections should be observed. The images of the raster on the film must be of identical size and location with respect to the film perforations.



Gear train side of an Eastman television recording camera for single system recording



Operating side of silent model of Eastman TV recording camera shows threading path, intermittent sprocket and loop loss indicators

Convenient Adjustment Procedure

A convenient procedure for making this adjustment is to insert a piece of processed film with a suitable image in the gate of each camera in turn and illuminate the camera gate with the shutter open. The image of the film will then be projected on to the face of the monitor tube. The size and position controls may then be adjusted to superimpose the raster on the projected image. A note of caution is in order regarding the reading of film densities which are formed by a scanning exposure. Unless the area read by the densitometer is uniform the results may be very misleading. As an extreme case, if lack of interlace produced unexposed lines alternating with lines of full exposure and very high density, and the densitometer measured an area including equal numbers of both types of lines; the reading would show a density of approximately 0.3 or 50% transmission. The density actually produced by the exposure might be many times greater.

The final image produced by video recording has undergone an extraordinary sequence of transformations, and the variables of the overall system which can affect the ultimate quality are legion. Therefore, to produce consistently good results the whole process must be controlled as rigidly as possible at every step, beginning with consistent signals from the studio cameras, and continuing through to the film pick up camera that rebroadcasts the program. The electronic problem of getting a good and unchanging image on the monitor tube is essential for successful video recording. This requires calibration of all electrical controls and careful evaluation of the significance of these controls in terms of the image formed on the film. The value of average beam current readings has been discussed, the problem of monitoring contrast or brightness range has not been so well worked out. More studies of actual operations are needed to establish the proper use of peak to peak video voltage readings, video waveform monitors, or photocell readings. The record of the motion picture industry in producing technically good pictures and the manufacturers' years of experience in producing the film show that the purely photographic part of the overall process can be controlled on a large scale commercial basis to such a degree that variations in picture quality are barely detectable by a trained observer. Control of the whole process requires the establishment of a good operations plan and adherence to it. Careful mechanical maintenance, frequent tests and continuing sensitometric control are essential for all stages, from the original camera film to the prints. It goes without saying that optimum sound - on - film quality requires scrupulous maintenance of equipment and attention to exposure levels and processing conditions. One other phase of the photographic process which might be considered is the control of dirt. Finished prints free from scratches and dirt either on the print itself or printed from the negative, will be obtained only if proper film handling techniques are used from the time the raw stock film is removed from its original container to final projection of the prints. This means careful handling in clean rooms, clean

(*Continued on page 53*)

Operational Experience with Single Sideband

System finds broad application when carrier spectrum is crowded and when circuits exhibit high attenuation, high noise level, or heterodyne interference

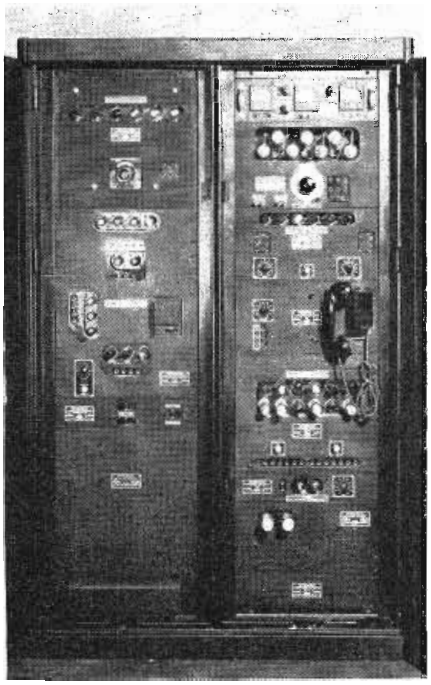
By F. S. BEALE, Design Engineer, Industrial Electronics Div., Westinghouse Electric Corp., Baltimore, Md.

WITH the first modern single sideband, suppressed carrier, power line communications systems recently installed on several public utility systems in the country, a number of questions have recurred frequently. These are 1) when to consider such single sideband power line carrier equipment; (2) how the arrangement of the equipment differs from existing AM equipment; (3) what are the differences in operation, and (4) what has been the experience with the equipment in live channel service.

In answer to these questions, first of all, it must be obvious that single sideband carrier equipment is more expensive since it employs more apparatus. It is natural then that the prospective user wants to know what conditions will justify the additional investment.

Four factors that can justify this expense are: (1) crowded carrier spectrum; (2) very long channel circuits, or circuits having high attenuation for other reasons; (3) circuits exhibiting high noise levels in the carrier spectrum, and (4) the reduction of intercarrier heterodyne interference. Crowding of channels in the carrier spectrum is being faced today in some sections of the country. Interference between adjacent or harmonically related channels, where it exists, has resulted from one or more of the following reasons, or combinations of them. (a) Improper allocation of frequencies. (b) "Forced" closeness of frequency assignments. Due to number of channels and due to poor transmission characteristics of the power line. (c) Use of two-frequency channels where modern automatic simplex would be satisfactory. (d) Excessive carrier transmitter power output. (e) Excessive carrier receiver sensitivity, with automatic volume control uncontrolled. (f) Poor receiver selectivity or adjustment. (g) Splatter due to overmodulation of carrier transmitter. (h) Some transient interference will be produced when the carrier transmitter is keyed in single-frequency channels, whether manual or voice controlled, but the latter display more of this form. Use of low pass filters in the RF output circuit of the carrier transmitters will aid in reducing it.

Fig. 1: Single frequency automatic simplex AM carrier telephone set with single sideband assembly panel (left rack center) added



Attempts to establish communication over very long power line circuits, or circuits having unusually high attenuations at any frequency have resulted in an increase in carrier transmitter output power, or an increase in carrier receiver sensitivity or automatic volume control range, or some combination of these. This practice results in the effect of broadening all receiver selectivity curves in the new channel, permitting adjacent channels to interfere any time carrier is not present in the new channel. The new higher power transmitters, similarly, will interfere with existing adjacent channels and those harmonically related.

Power line circuits showing high noise levels in the carrier spectrum have, in some cases, steadfastly refused to yield a satisfactory channel to AM equipment at any frequency in the regular spectrum. Combinations of higher carrier transmitter power output and sharper receiver selectivity have been used to provide a partially successful answer in other cases, usually with sacrificed audio signal quality.

In addition to offering a better answer than that given by AM equipment to the above problem, single sideband offers to reduce heterodyne interference between the carrier signals of adjacent and harmonically related channels because the amplitude of the transmitter carrier is radically reduced. It may be suppressed to 50 DB below full output level, or more.

Basic single sideband equipment is the same as that used in making up AM carrier sets. Fig. 1 shows a single frequency automatic simplex AM carrier telephone set to which a Single Sideband Assembly panel (left rack center) has been added.

The Single Sideband equipment uses the AM carrier equipment without modification of any unit except the carrier transmitter and the carrier receiver. The carrier transmitter is modified by converting the Master Oscillator to a Class A RF amplifier. Similarly, the carrier receiver must be modified since the AM detector is useless. Here the detector is simply removed from the circuit, and the RF output is delivered directly to the Single Sideband Assembly panel and the Demodulator Unit. Block diagrams of the AM equipment and the resulting Single Sideband equipment are shown in Fig. 2.

The Single Sideband Assembly panel mounts the various units required by the particular type of carrier set involved. A two-frequency set requires two carrier oscillator units, while only one is required by any single-frequency assembly. A mixer is used to convert the heterodyne oscillator frequency of the superheterodyne receiver to an intermediate carrier frequency

Power Line Carrier Equipment

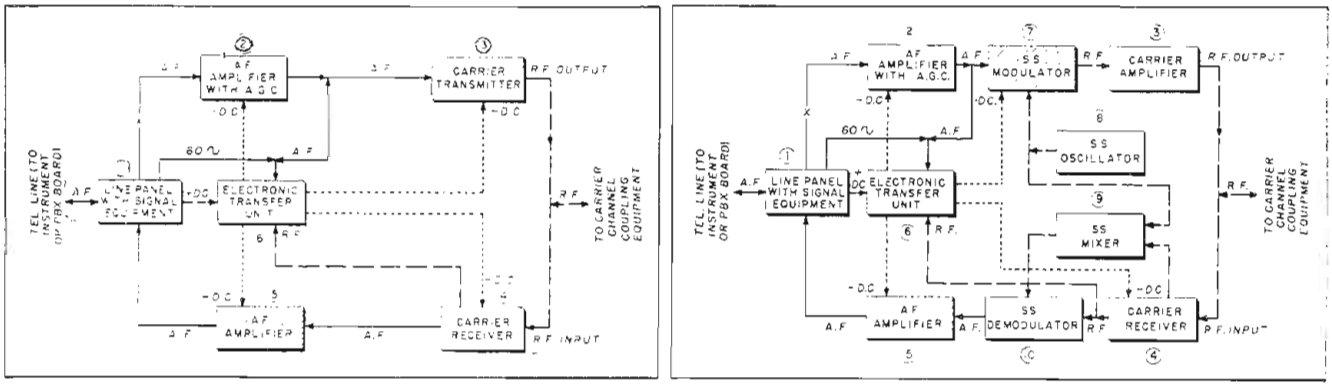


Fig. 2: (Left) Block diagram of single frequency automatic simplex AM carrier telephone set. In "Standby" condition the shaded units 3 and 5, under ETU control, are shut down. (Right) Block diagram showing AM arrangement when the single sideband assembly is added

and this is used in the demodulator to recover the audio signals from the receiver output. Variations are apparent in the physical appearance of a set only in that they affect the height of the assembly panel.

The Single Sideband Oscillator unit is shown in Fig. 3, and Figs. 4 and 5 show two other Single Sideband Units. Fig. 6 shows the Electronic Transfer Unit, also a new development and the heart and brains of the voice-control system of single frequency operation whether AM or Single Sideband.

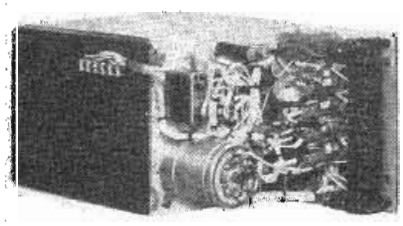
The user of the new Single Sideband equipment will not have to learn any laboratory techniques to set up and place it in operation. Only six adjustments in the Single Sideband Assembly need be made, in addition to the 13 basic to the AM equipment. (Adjustments, such as balancing the hybrid circuit in two-frequency equipment, line-tuning apparatus, etc., being disregarded.) A cathode ray oscilloscope is suitable for making all six of these new adjustments, with one setup.

The means by which the carrier frequency energy is suppressed, to about 50 DB or better, and which permit deriving but one sideband frequency group, are really quite simple. Fig. 7 shows how the balanced modulator circuit modulator circuit functions. The more perfect the center tapping at "y" the better the suppression of f_2 signals from the output circuit. F_1 signals can appear at the output only as a result of the unbalancing section of f_2 on the bridge circuit of Fig. 7(b), and will be delivered then only in the form of modulation products.

In Fig. 8(a) two balanced bridge modulators are shown with the audio input circuits added and the method of deriving output indicated. Any residual carrier that comes through is due to unbalance of one sort or another. One modulator therefore delivers output signals consisting of products of modulation only. These include the upper and lower sideband groups of frequencies as shown in Fig. 8(b-i). When the second modulator circuit is added, and its carrier frequency supply is shifted forward in phase 90° with respect to the signal supplied to the first modulator, Fig. 8(b-ii), and an opposite 90° phase shift is introduced in the audio signal supply; the outputs of the second modulator, also including upper and lower sidebands, may be combined with those of the first by series connection of the two output windings. If all four signals have equal amplitudes two will be found to be additive and to result in a signal twice the amplitude of either as in Fig. 8(b-iii). The other two signals will be found to have sub-

(*Please turn to next page*)

Fig. 3: Rear view of single sideband oscillator unit. Note temperature controlled oven for frequency determining parts and calibration chart on rear of cover. Oscillators are individually calibrated against a secondary frequency standard and provide 36 frequency ranges. Assigned carrier frequency stability is within 10 cps in 50-150 KC band



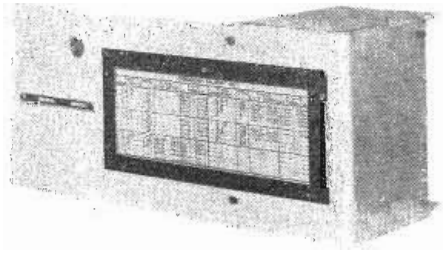
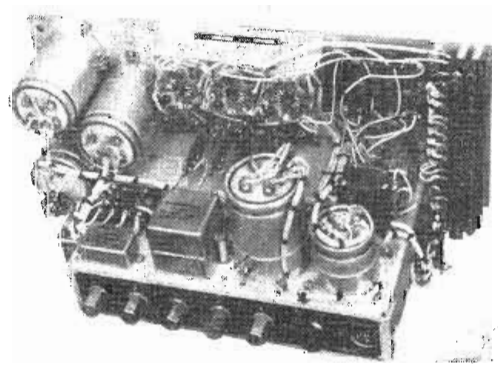


Fig. 4: Rear view of single sideband modulator unit. Assembly includes two phase shifting networks for RF and AF signals (Fig. 8), two balanced bridge modulator circuits, and three stage amplifier which permits this unit to be used as a low level transmitter



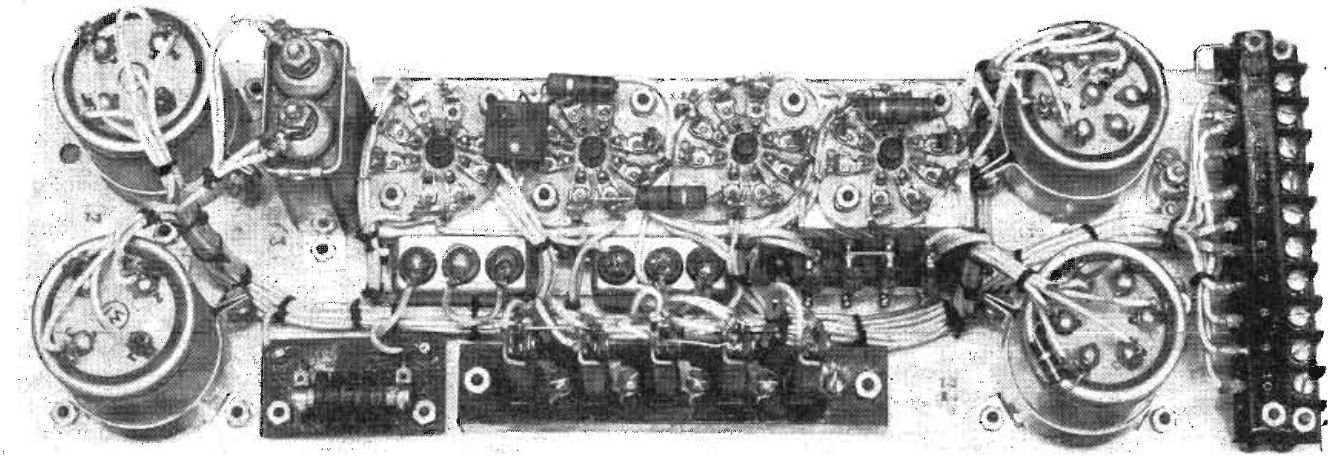


Fig. 5: Rear view of single sideband demodulator unit. Balanced demodulation circuit uses two 6SA7 tubes which feed two stage audio amp.

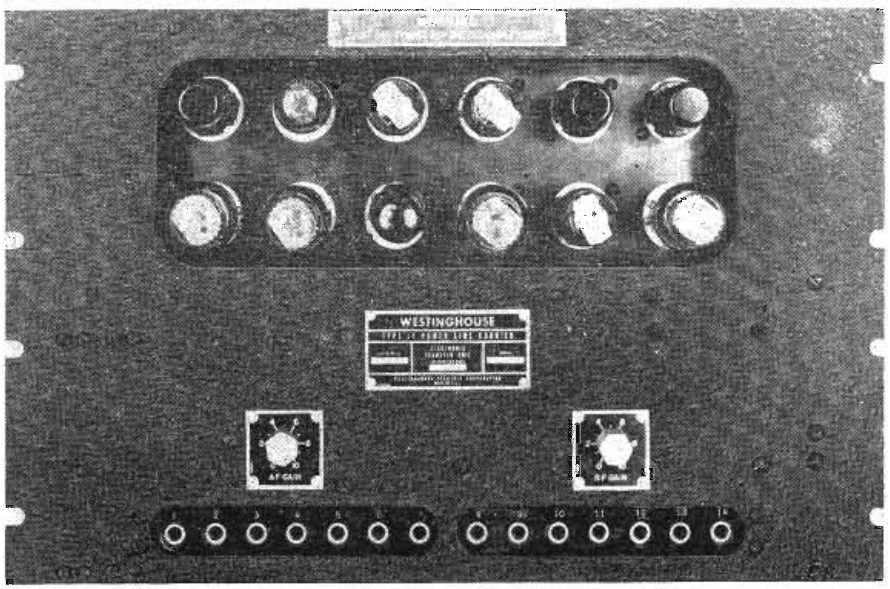
tractive polarity and they exactly cancel because they were adjusted to have equal amplitudes. Thus, the final output consists essentially only of one sideband signal.

Setting up a channel is essentially the same as for AM. Carrier oscillators are set to frequency. Each oscillator is hand-calibrated at the factory and the 50 to 150 KC spectrum is covered in 36 ranges. The lowest and highest frequency of each range is given to the nearest ten cycles. Oscillators may be set to given frequency assignments with complete assurance that, when the temperature controlled oven has stabilized, synchronization can be obtained quickly.

The most radical difference in the adjustment procedure comes in the adjustment of carrier transmitter (amplifier) and receiver frequencies. These units are not tuned to the frequency of the carrier oscillator but to approximately the mid-frequency of the selected sideband group. This may be done by either of two simple methods: (1) Supply a 1500 cycle audio tone to the modulator, and use the resulting sideband output for the adjustment of the transmitter amplifier and the carrier receiver or (2) if the frequency range of the Single Sideband oscillator can be shifted in the right direction 1500 cycles without band changing, the output may then be used as in (1) to adjust the transmitter and receiver, after which it should be set to its assigned carrier frequency.

When considering this procedure in the light of AM channel frequency assignments and adjustments, it will be seen that a choice is open. The frequency to which the AM oscillator would be adjusted may be taken as the frequency to which the Single Sideband oscillator is adjusted. This means that the upper sideband group of frequencies will encounter the same attenuation in tuners and line traps as is experienced by the same sideband group in AM equipment. The second choice, for upper sideband transmission, is to set the Single Sideband oscillator to a frequency 1500 cycles lower than the assigned carrier frequency on the AM basis. The latter method is perhaps the best of the two since it results in somewhat higher transmission efficiencies in line tuners and better use of line traps. It must be noted that tuning of tuners and traps should then be at the carrier channel frequency assignment, not at the Single Sideband oscillator frequency.

Fig. 6: Electronic transfer unit provides high speed voice control of "transmit"-"receive" conditions. Listening party can interrupt speaker at any time and hears signal within .003-sec. (response time) when speech level is equivalent to about 35% modulation. Timing for complete channel reversal is adjustable between .028 and .0320-sec.



The equipment has been used to establish telephone communication over channels having attenuations of about 30, 40 and 60 DB using automatic simplex operation employing the Electronic Transfer Unit. The 66 and 115 KV power line circuits involved are 233, 262 and about 300 miles in length. Excellent voice quality has been obtained, and the high speed Electronic Transfer Unit has demonstrated remarkable ability to separate voice signals from noise, whether on the telephone line or on the carrier channel. In one in-

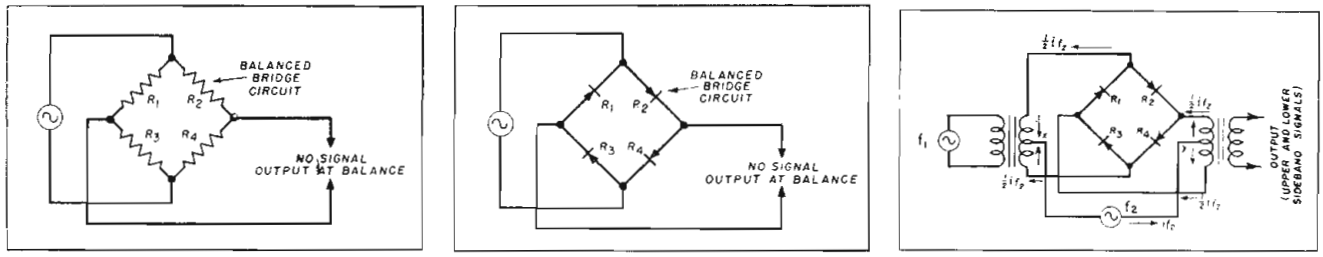


Fig. 7: The "Ring Modulator" combines bridge and centertap-feed circuits to mix two separate signals, to suppress one of the two from the output, and to deliver only the products of modulation. In circuit (a) (left) there is no output for signal input when $R_1/R_2 = R_3/R_4$ In. (b) (center) dry disc rectifiers replace the resistors, while in (c) (right) adding transformers having perfect centertaps at x and y permit applying f_2 (carrier) without having it appear in either input or output circuits. f_2 voltages polarize the rectifiers alternately in pairs to unbalance the bridge. f_1 signal energy is thus transmitted to the output and then under these conditions $R_1 = R_4$; $R_2 = R_3$; $R_1/R_2 \neq R_3/R_4$

stance, after a channel had been in operation almost a month, a very severe case of power line noise developed. A slight reduction in RF channel sensitivity of the Electronic Transfer Unit restored near normal operation. An oscilloscope was connected to the RF output of the receiver and the amplitude of the noise picture shown on the screen was almost without exception larger than the amplitude of the voice signals received from the remote station; yet the transfer unit was giving good control of the equipment.

Noise Conditions Overcome

This particular equipment also encountered two other noise conditions and successfully met them. One consisted of the typical noises of a hi-line telephone circuit. 60-cycle hum on this line was loud enough to cause trouble with the 60-cycle signalling equipment, but this and the typical harmonics of 60 cycles did not interfere with the voice control system. The other noise was that existing in the operating room and which was bad at each end of this channel. The latter was completely offset by the use of special telephone handsets, containing noise-cancelling microphone construction, in place of the regular telephone handsets.

Another installation has involved establishing communication over a circuit that measured about 80 DB attenuation, although this value was far above estimates and expectations. This equipment operates on the two-frequency system. Audio quality is excellent, and volume levels are as high as the balancing of the telephone hybrid circuits will tolerate.

The Single Sideband Oscillators have demonstrated their stability, well as calibration. For single-frequency operation, the initial frequency settings were found, upon zero-beat test, to be less than 500 cycles apart. They were adjusted to zero-beat and allowed to operate without readjustment. One or two checks would be made each day to determine the amount of drift that separated oscillator frequencies. At no time has the maximum difference reached as much as 10 cycles and on the average it appears to stay under 5 cycles.

All experience with this equipment, to the end of 1948, has involved telephone communication. However, the record of stability, which the Single Sideband Oscillator is steadily building for itself, indicates that no troubles should be experienced from this source in those telegraphic types of carrier service involving the use of audio tones. The lowest of these tones is 150 cycles and the tone receiver audio filter response is 12 cycles broad at 3 DB down, which therefore includes the expected drift of the Single Sideband carrier oscillators.

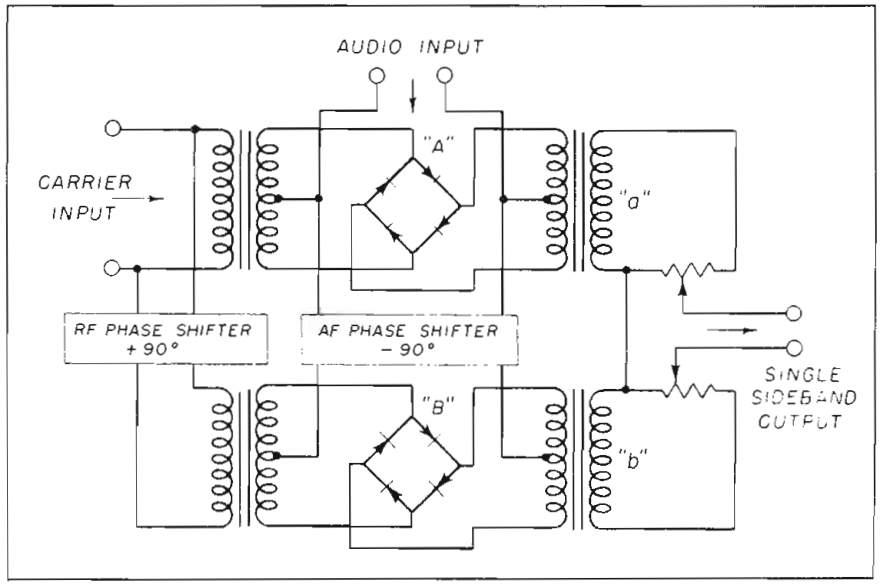
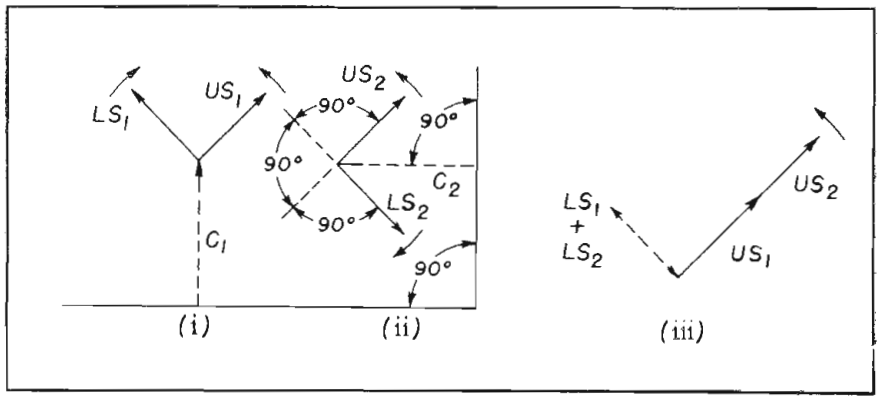


Fig. 8: (a) (Above) Basic schematic for suppression of carrier and delivery of only one sideband from output with vector diagrams illustrating the operation shown in (b) (below)



Barium Titanates as Circuit Elements

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

Part Three of Three Parts

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

Gulton Manufacturing Corp., Metuchen, N. J.

IN recent years, the chemical industry has been interested in a rapid and convenient means of detecting corrosion in pipes, tanks and other chemical containers. An outgrowth of this need has been the ultrasonic thickness gage.[1] This equipment, which utilizes the fact that sound vibrations of the proper frequency set up standing waves through the thickness of a metal, consists of a variable frequency oscillator, the tank circuit of which is connected to a piezoelectric crystal, Fig. 26.

When the crystal is placed against a piece of metal and the oscillator

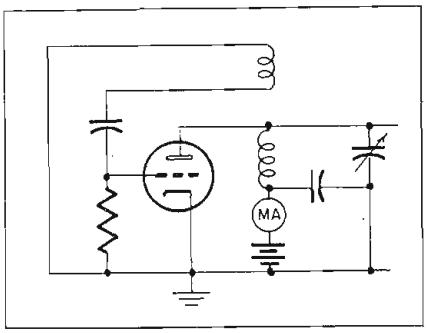


Fig. 26

tuned through a fundamental or harmonic resonance of the metal, the amplitude of vibration within the metal wall becomes large and internal damping of the material causes a sharp increase in the loading of the oscillator. The frequency of this resonance then indicates the wall thickness. Such instruments may be used to measure, for example, steel walls ranging in thickness from 0.125 to 12-in. and the accuracy has been claimed to be better than 5%.

For most seismometer work the application of piezoelectric crystals has been circumvented because of the extremely large loading capacitance of long connecting cables. Here the characteristics of ceramic materials have proved of advantage and the development of a piezoelectric seismometer of barium titanate weighing 2 to 3 pounds has been made.

In this unit, a bimorph element is held cantilever fashion to the unit housing. The other end supports a suitable mass. The sensitivity of this unit has been found to be 0.5 volts (cm/sec.) in effective frequency range of from 10 to 100 cps. This type of instrument can be built having a capacitance of 0.2 μfd, which is greater in some cases than the capacitance of a cable 2000 ft. in length.

Pressure Driving Devices

A coaxial tweeter built experimentally in this laboratory using barium titanate as a driving element, increases the frequency response of a 12-in. speaker from 6 to 12 KC. It consists of a conical shaped diaphragm driven at the center by a bimorph type element. The convex shape of the diaphragm provides a broad beam of radiation in contrast to a narrow beam produced by conventional tweeters. With such a unit it is not necessary to use a cross-over network between magnetic speaker and piezoelectric tweeter because of the capacitive nature of the tweeter. As a matter of fact, by its increasing the power factor of the load with its high capacitance the tweeter aids in the proper loading of the output tube.

Ultrasonic Vibrations in Liquids

It is generally known that ultrasonic vibrations aid the penetration of dies into fabrics. While development of these technics is still in the infant stage, there appear to be good possibilities that a mosaic as large as several square feet in area made up of many small discs or slugs of piezoelectric barium titanate appropriately placed in the dye solution can be used to increase efficiency and speed in the dye industry.

Acoustic delay lines are today seeing increasing use in mathematical computers and other similar instruments. While quartz has, up to the present time, been the principal source and detector of acoustic radiation, it is likely that here again barium titanate, because of its relatively low cost, will be used as a substitute. In the industrial field there are hundreds of uses for these readily produced ultrasonic vibrations.

The successful application of piezoelectrically active barium titanate in the fabrication of such devices as microphones and phonograph pickups has created great interest by the electro-acoustics industry because of the new design approach which the piezoelectric ceramic material facilitates. It has enabled many major phonograph pickup manufacturers to produce pickups with a sensitivity great enough to directly replace many rochelle salt type pickups where humidity and temperature are not serious factors and do not have to be considered in design. These qualities of barium titanate result in extremely simple and inexpensive designs. The use of rubber bearings and numerous damping pads may be avoided along with the accompanying mechanical energy losses that are encountered with their use.

Both the phonograph and microphone bender elements consist of two silver faced 0.010-in. slabs of

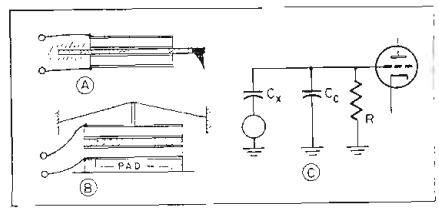


Fig. 27

barium titanate soldered on each side of a suitable metal armature Fig. 27(a) and (b). The phonograph pickup element is a canti-

lever system, with the needle producing the displacement. The microphone element is supported by rubber pads at both ends and connection to the diaphragm is made by a small rod at the middle of the element.

The elements are precharged to induce piezoelectricity by connecting the two leads together and applying a high DC potential (600 V) for a period of one hour between this connection and the armature. In this manner, the two titanate slabs are charged in opposite directions, so that upon being bent, (one slab being compressed and the other stretched) the induced voltages are additive.

While the electrical equivalent circuits of microphone and pickup elements are essentially the same, the approach to design is necessarily different because the microphone element is a pressure device while the pickup element is of the displacement type. The equivalent circuit for either case is shown in Fig. 27c. In the case of the microphone, the cable capacitance, represented by C_c, is normally 250-1250 $\mu\mu$f. while the input grid resistor is 5 meg. This combination makes the midband, as well as the high frequency response, fairly independent of the load.

The design of a microphone element is approached generally in the following manner. The thickness of the ceramic is normally 0.010-in. and while the thickness may be varied, this is convenient from the standpoint of strength, production facilities, and handling. A double supported beam is chosen in preference to the cantilever because it eliminates inverse bending effects which would appear in the cantilever system with a very stiff driving rod. The length of the element is chosen to bring the first resonance above 4500 cps. This length can be calculated from the formula

$f = (\pi/2l^2)(\sqrt{YK}/e)$

where: Y = Young's modulus, 8×10^{11} dynes/cm^2; K = radius of gyration = $t\sqrt{12}$, where t = .028-in. since the thickness of armature and solder joint is .008-in.; f = 4500 cps and e = 5.55 gms/cm^3.

When these values are substituted in the equation, the suitable length is found to be 1.65 cm.

The last of the variables is the element width. For a given bender, the open circuit output voltage is $V = FK_1 d/C$; where F is the force applied to the diaphragm, K_1 is a mechanical gain factor, d is the piezoeffect of the material, and C is the element capacitance. Since only the capacitance is a function of width, and this is linear, one would expect the open circuit voltage to vary hyperbolically with width. Experimentally this is found to be true for widths as small as 40 mils. Technics have been developed by Mr. S. W. Howatt and Mr. George Enot of this company to cut on a production basis elements as small as 0.020-in. in width. However for widths smaller than .040-in. the experimental values drop below the theoretical curve for two reasons. First, at very narrow thicknesses slight electrode chipping at the edges becomes relatively larger compared to the total electrode area. And more important, at very small widths, the compliance of the ceramic element becomes so large that most of the force exerted upon the diaphragm is used to overcome the diaphragm stiffness and to drive the enclosed air volume rather than to drive the ceramic element. This is analogous to the termination of a high impedance voltage supply by a low impedance load. A small improvement can be brought about by the thickening of the armature to give greater bending stresses in the external fibers; however, this improvement in the open circuit voltage is attained at a sacrifice of reduction in capacitance.

A curve showing the theoretical and experimental variation of open circuit voltage of a microphone element as a function of width with a constant 1000 cycle pressure is shown in Fig. 28. For the smallest

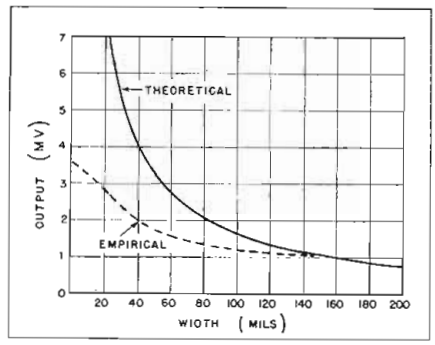


Fig. 28

widths used, .020-in., the curve approximates the curve $V = A/\sqrt{\omega}$, where A is a constant.

When one calculates the output voltage at the end of a cable from this curve he finds that the maximum midband output is attained when the transducer capacitance approximates the cable capacitance. At present, a crystal of approximately 250 $\mu\mu$f is being loaded with a cable of the same capacitance. The practical usable low frequency is that at which the sum of crystal and cable reactance is equal to the resistive load. With a 5 megohm resistance, the response with the above mike and cable goes down to 50 cps.

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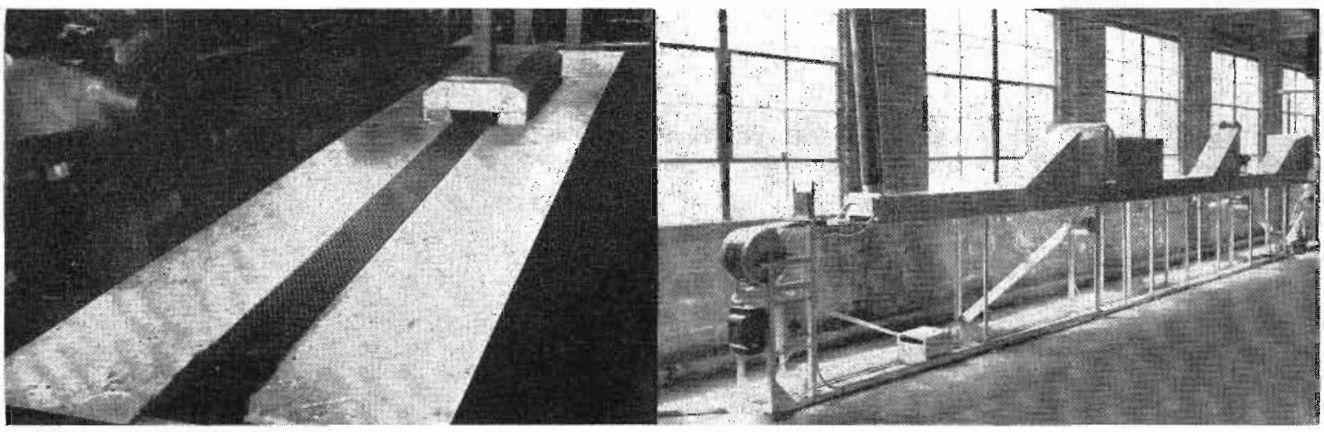
At Gulton, in the preparation of pickup elements, the ceramic material is prepared in a continuous strip (right) on belts with the necessary accessories—doctor blades, drying kilns, etc. They are then fired, coated with silver (left), cut up, and mounted in cartridges



BARIUM TITANATES (Continued)

The curve of Fig. 29 shows the output frequency response of a completed crystal microphone utilizing an element 0.025-in. wide

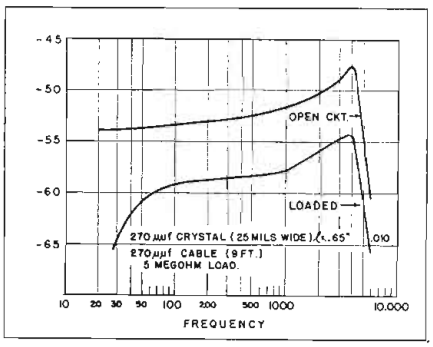


Fig. 29

with a diaphragm 1.85-in. in diameter. The resonant peak has been damped by an acoustic cloth filter cemented to the inside of the protective grill. It will be noted that the open circuit output is −52 DB, well within the sensitivity required for hearing aid uses. It also has the advantage over rochelle salt of extremely long life.

In hearing aid work, the resonant frequency of the total system is generally reduced from 4500 to 2500 cps. This allowable increase in length of the piezoelectric element yields a higher mechanical advantage with proper impedance matching to the diaphragm and gives approximately 3 DB more output utilizing the same diaphragm mentioned above, bringing the microphone to a level of −49 DB. In most hearing aids, a diaphragm 1.35-in. in diameter is used. With such a diaphragm, the element of lower resonance gives a microphone with a sensitivity of approximately −52 DB.

While the sensitivity of the ceramic piezoelectrics is somewhat under that of rochelle salts, they offer several important advantages: the piezoelectric charge per unit area with a given force as well as the dielectric constant is much higher than rochelle salt, thereby allowing for the design of elements much smaller in size yet possessing fully as good loading characteristics. The piezoelectric sensitivity of barium titanate does not vary with temperatures and the ceramic can be used up to 100°C over long periods of time. The sensitivity of rochelle salt, however, varies considerably with temperature, and above 55°C rochelle salt melts and becomes useless for further use. Furthermore, humidity has no effect upon barium titanate while rochelle salt dissolves in moisture.

In the case of ceramic phonograph pickups similar advantages have already brought about their introduction on a production scale using the "GLENNITE"[2] element of piezoelectric barium titanate. A breakdown photograph of the As-

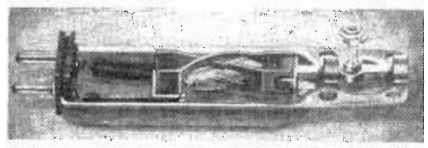


Fig. 30

tatic 78 rpm unit, as shown in Fig. 30, illustrates the simplicity of construction.

A table of characteristics of both the 78 rpm and 33-1/3 rpm units utilizing a "GLENNITE" element

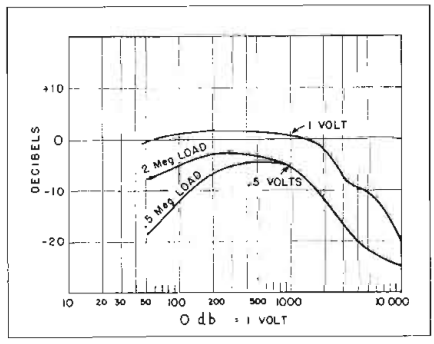


Fig. 32

are shown in Fig. 31 and the frequency response characteristics are shown in Fig. 32. While the fundamental resonance of the microgroove pickup occurs at 1000 cps, the peak is flattened considerably by the use of korogell pads placed on either side of the ceramic element.

The cable loading problems encountered in microphones is not encountered in phonograph pickups because of the close spacing of the amplifier to the pickup. However, because of the relatively small capacitance of the microgroove pickup element, a 1/2 meg. input resistor in the first amplifier stage causes a droop in the low frequency response. Consequently, there is now a growing tendency to replace this with input potentiometers of higher resistance.

While not a great deal of development for medical purposes has been accomplished, it should be mentioned that barium titanate and quartz pressure gages were successfully used by Kirby and Thurston at the Pennsylvania State College in the detection of gallstones by a probing method.[1] Barium titanate is, of course, generally suited for medical instruments because the normal sterilizing temperatures do not affect the piezoeffect.

Because of the extremely high dielectric constant and good thermal stability of certain bodies of titanate, their use as coupling and bypass capacitors becomes immediately apparent. Both cost and size of such units are comparatively small.

Delay Lines

In numerous electronic devices, such as pulse circuits, the microoscillograph, and counting circuits, there is a need for delay lines. In some cases, where comparatively long delay lines are essential, acoustic transmission media such as mercury are used. For other applications distributed lines are used, but their use is often restricted by the long lengths of cable necessary for sufficient time delay. Because of the high dielectric constants of barium titanate, such a material can be used to produce a required line much more conveniently. Toward this goal, the M.I.T. research group has built for experimental use a pancake ceramic coil coated with silver, as shown in Fig. 33. This development represents a possible future

Fig. 31: Table of Glennite phonograph pickup characteristics

	78 RPM	33 1/3 RPM
Dynamic Compliance	0.6 X 10^{-6}	0.8 X 10^{-6}
Nominal Output (volts)	1 volt	0.5 volt
(100 cps Test Record)	Columbia 10,004-M	Columbia Sliding Freq. #281
Needle Radius	0.0027"	0.001"
Tracking Wt.	22 gms	6 gms
1st Resonance	3500 cps	1000 cps
Element Capacitance	1000 μμf	600 μμf
Needle Type	Sapphire (Permanent)	Osmium Tipped Stainless Steel (Replaceable)

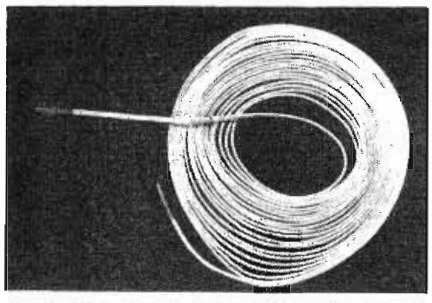


Fig. 33

commercial use of ceramic materials.

Difficulty encountered in many circuits of maintaining constant capacitances when the temperature is varied, has led to the use of temperature sensitive circuit components purposely inserted to compensate for the temperature drifts of regular circuit elements. The constant temperature coefficient of capacitance of certain titanate bodies over wide temperature ranges makes them extremely useful as a thermal capacitor, appropriately called "THERMACON". The characteristics of several bodies now available are shown in Fig. 34. The most remarkable feature of

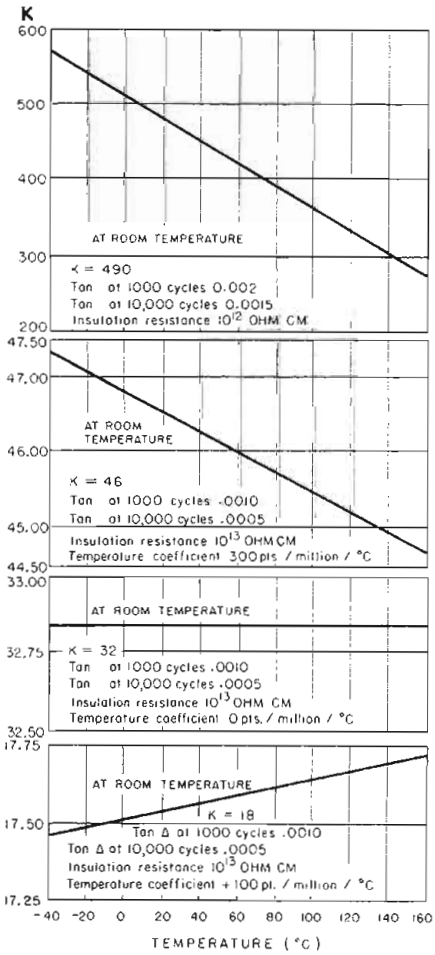


Fig. 34

these materials is the linearity of the temperature effect.

While some work has been done to date upon the uses of a non-linear capacitor, the work, sponsored principally by Army and Navy appropriations, has not as yet proceeded beyond the basic investigation and circuit blue print stage. Fig. 12 and 15 (in Part 1) showed that the capacitance of a dielectric can be varied by a factor of 5 by a suitable change in voltage. The maximum rate of change occurs at approximately 25 volts per mil, and this maximum coefficient is approximately −4% change per volt per mil.

Over a limited range the change is fairly linear. Because of the relatively high bias necessary to get the optimum voltage coefficient, research is being undertaken to develop materials the voltage coefficient of which can be utilized at much lower biasing gradients. Furthermore, since these ceramics exhibit some hysteresis as well as temperature coefficients, this research must be extended to develop materials exhibiting reproducible characteristics, low hysteresis, and good thermal stability. Nevertheless, preliminary experiments are being carried out to develop circuits in which the titanate ceramics can be put to use.

Frequency Modulation

The most obvious use of a non-linear capacitor is as the modulating device of a frequency modulated oscillator. Experiments have been carried out in which a commercial FM-TV booster was made to oscillate at 90 MC by the removal of

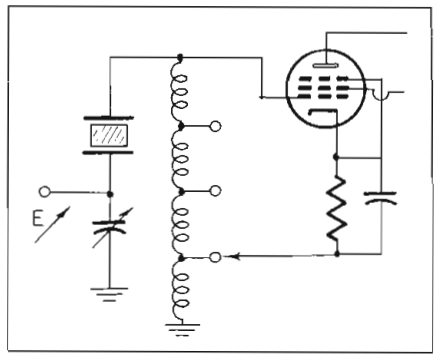


Fig. 35

loading resistors in the tuned grid and tuned plate circuits. The non-linear capacitor (body #87-12) was placed in series with the grid tuning element as shown in Fig. 35.

Application of 50 volts bias to the non-linear condenser was found to bring about an increase of more than 2 MC in the oscillator frequencies.

A simple amplitude modulation device, proposed by Roberts', Fig. 36, combines in a single unit essen-

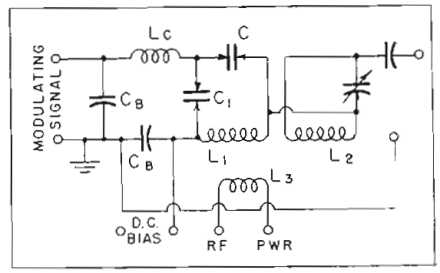


Fig. 36

tially the function of a frequency modulator and frequency discriminator output circuit. In this circuit RF power is supplied to L_3 from an external source. The tuned circuits, connected in series opposition, are both tuned to the same frequency and to one side of the frequency of the RF source such that with no signal input, the output signal is zero. The application of an input signal changes the capacitance of non-linear condensers C_1 and C_2, hence tuning the circuit connected to L_{1A} toward or further from resonance, thus producing a difference in potential across L_1 and L_2 which represents the output signal.

If the output of the amplitude modulator is detected and the RF

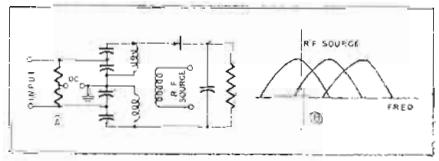


Fig. 37

eliminated, the unit becomes essentially an audio amplifier. Of course, RF power must be supplied. In this regard, the development of a similar amplifier utilizing a push-pull input, Fig. 37 is under way in our laboratories. Here two tuned circuits with no signal are again tuned to identical frequencies, but off the RF source frequency, as shown by the curve of Fig. 38b. When an audio signal is applied, the resonant frequency of one tuned circuit is raised while the other is simultaneously lowered and since the output is the difference of these responses, an output voltage is produced.

In another arrangement, the two tuned circuits are shifted an equal amount in opposite directions from

(*Continued on page 52*)

Direct Reading Vector Impedance

Accuracy, versatility, and low cost keynoted in design of new instrument
Magnitude and phase angle values of unknown impedance are read separately

By: Technical Staff, VFB Line Corporation, 702 Anneslie Road, Baltimore 12, Md.

A new application of simple electrical circuits has resulted in the design of a vector impedance bridge of unusual versatility and flexibility. This device, known as Model 100, Fig. 4, measures values of impedance directly in polar form, giving separate readings for magnitude and phase angle by means of the two-null method. Included in the capabilities of the device is the measurement of the limiting cases of impedance—inductive reactance, resistance, and capacitive reactance—over the entire range of magnitude. The scales are arranged in

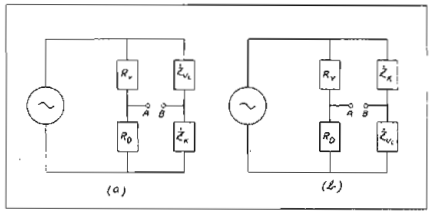


Fig. 1: Positional arrangement of bridge arms for measuring impedances containing a) inductive and (b) capacitive reactance

such a manner that, although the electrical circuits measure or respond to impedance only, values of inductance, resistance, and capacitance are indicated directly. An additional feature of the device is, that transformer-winding turns ratios can be read on an inverse scale by means of a special connection with one of the bridge arms switched out of the circuit.

This overall performance is made possible by means of a unique expedient which enables the functions of matching the magnitude and matching the phase angle of the unknown impedance to be performed each independently of the other. The magnitude is matched by the combined action of the decade resistance arm and the continuously-variable resistance arm. The phase angle is matched by means of a constant-magnitude, variable-phase-angle arm, referred to below as the CMVPA arm. The ratio range of the decade resistance arm working in conjunction with the continuously variable resistance arm is from 1 to 1000; the range of the CMVPA arm is from −90° to +90° in five-degree steps, at a constant magnitude of 1000 ohms. Thus, a balance can be obtained with any value of unknown impedance having a magnitude of from 1 ohm to 1 megohm, and lying in either the first or the fourth quadrant.

In Fig. 1 (a and b):

R_V = continuously variable resistance arm (100 to 1000 ohms).

R_D = variable decade arm (1 to 100,000 ohms).

$\dot{Z}_K$ = CMPVA arm.

$\dot{Z}_{U_L}$ = unknown impedance having phase angle in first quadrant (voltage leading current).

$\dot{Z}_{U_C}$ = unknown impedance having phase angle in fourth quadrant (voltage lagging current).

In Model 100, the arrangement of Fig. 1(a) is used to measure values of Z_{U_L}, X_L, L, and R on the linear scale or arm R_V; while that of Fig. 1(b) is used to measure values of C

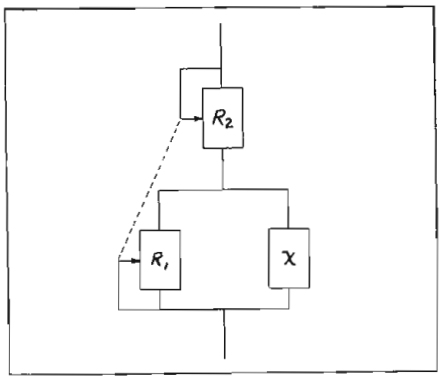


Fig. 3-a: Simplified schematic of the constant magnitude variable phase angle arm

Fig. 2: Diagrams showing vector relationship between: (a) R, X, and the impedance resulting from the parallel combination of R and X; (b) common voltage, branch currents and total current for R and X in parallel

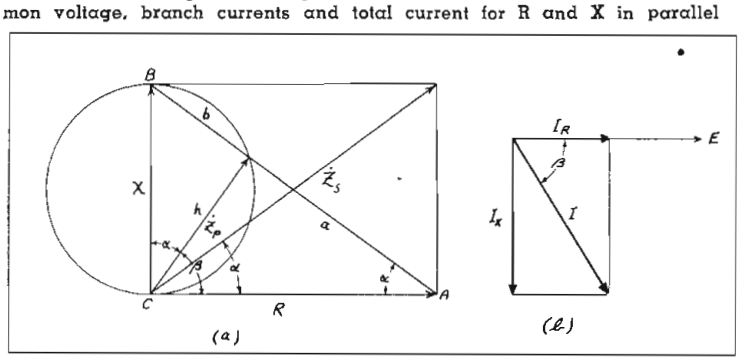
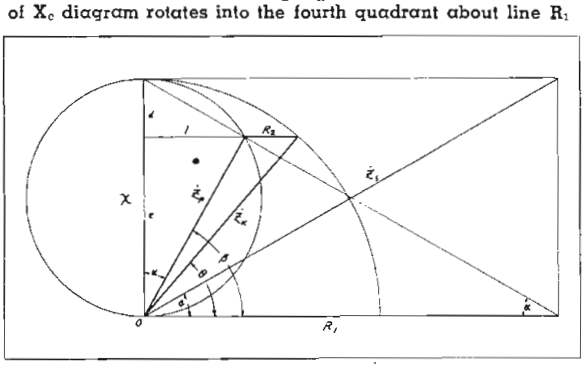


Fig. 3-b: Diagram showing the vector derivation of R_1 and R_2 as functions of X and θ. (Only X_L is shown.) For derivation of X_C diagram rotates into the fourth quadrant about line R_1



Bridge

on the linear scale and those of Z_{U_6}, X_C, and R on the inverse scale. It is felt that this is a good practical arrangement, although not necessarily the best one. Perhaps one in which *all* unknown quantities to be measured are connected in one position only, in such a manner that all but C are measured on the inverse scale, is better. Such an arrangement, which promises to give greater accuracy because of the almost complete balancing out of distributed wiring capacities, is under investigation. However, with the present model the arrangement of Fig. 1(b) gives greater accuracy for values of R above 10,000 ohms, although that of Fig. 1 (a) is more convenient to set up, and is therefore recommended for all values of R below this figure.

For the measurement of transformer-winding turns ratios, Z_K is switched out of the circuit entirely, and is replaced by one winding of the transformer under test. Another winding is connected in place of Z_{U_6}, Fig. 1(b). It is necessary that the two windings be connected series-aiding, otherwise the search for a null becomes meaningless. When the windings have been properly phased, the turns ratio is readable directly on the inverse scale as a value greater than unity. If a null is not obtainable, it then becomes necessary to interchange the windings, keeping the same phase relationship. In most cases there will be no doubt as to which winding has the greater number of turns, since that winding will also have the greater DC resistance, and, if all other windings of the transformer

Table I—Nominal Accuracies

Electrical Quantity	Range		
	± 2% Accuracy	± 5% Accuracy	± 10% Accuracy
C (μf.)	.01 to 1	.001 to 10	.0001 to 100
L (hy.)	.01 to 1	.001 to 10	.0001 to 100
T	1 to 10	1 to 100	1 to 1000
X_C, X_L, R, Z_C, Z_L, (ohms)	100 to 10K	10 to 100K	1 to 1M

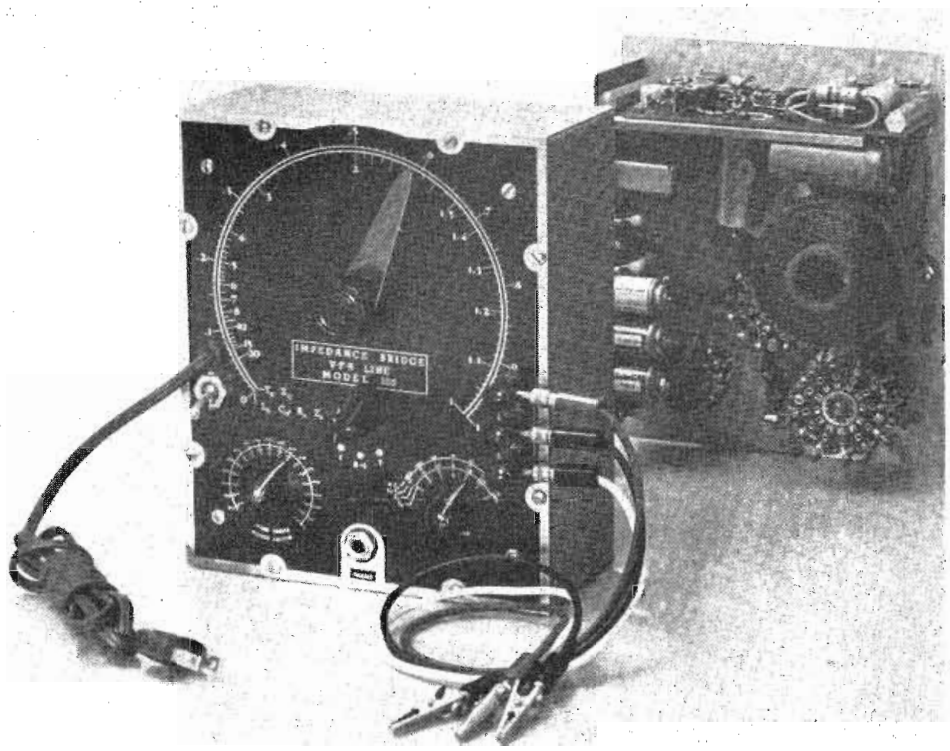


Fig. 4: External appearance, and rear internal view of the Model 100 Impedance Bridge

be open-circuited, the greater inductance.

A frequency of 1591 cycles was chosen to permit simplification of the scales since at this frequency 0.1 h and 0.1 μf. both have 1000 ohms reactance.

Bridge-Balance Considerations

When the arms of the bridge are electrically in balance, a minimum signal will be present across the points A and B of Fig. 1. A zero signal is of course desirable, but cannot usually be realized because:

1. The so-called continuously-variable resistance arm is made up of small increments of resistance, each being the resistance of one turn of the winding of the linear wire-wound 1000-ohm potentiometer;
2. The CMPVA arm is variable in five-degree steps only;
3. At the null point the second harmonic in the signal becomes comparable to, or even greater than, the fundamental. However, the null obtained over most of the range is sharp enough to be detected without difficulty.

The condition for a perfect null is that the waveform of voltage at point A be an exact replica of that at point B, and that the two waveforms be exactly in phase. Conversely, when a perfect null has been obtained, the two waveforms must be exactly equal to and in phase with each other.

In order to explain the theoretical

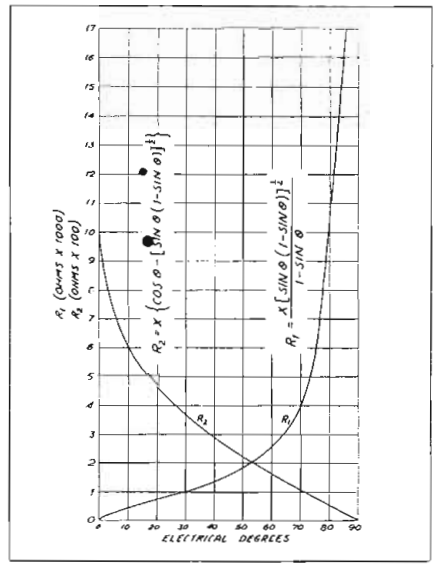


Fig. 5: Graph showing values for R_1 and R_2 (CMVPA) with θ ranging between 0 and 90°

basis for the CMPVA arm, it is necessary to consider the behavior of a resistance and a reactance connected in *parallel*. In Fig. 2(b), the direction of the vector representing the impressed voltage is taken as the reference direction, since the voltage is common to both branches of the circuit. The current through R is of necessity in phase with this voltage, while that through X (taken as inductive for this discussion) lags the voltage by 90°. Thus, the total current lags the impressed voltage

(*Please turn to next page*)

VECTOR IMPEDANCE BRIDGE (Continued)

by some angle β between 0° and 90°. Now:

$\beta = \tan^{-1} I_X/I_R$,
$= \tan^{-1} (E/X)/(E/R)$
$= \tan^{-1} R/X$.

However, when the two are in *series,* the current lags the voltage by some angle α such that:

$\alpha = \tan^{-1} X/R$.

Thus,

$\tan \beta = 1/\tan \alpha$
$= \cot \alpha$
$= \tan (90° - \alpha)$;

and $\alpha + \beta = 90°$.

In Fig. 2(a), X and R are shown in the correct phase relationship. The line $\dot{Z}_S$ represents the series impedance in magnitude and direction. The line AB is equal to the line $\dot{Z}_S$ by construction. X is the diameter of a circle to which R is tangent at point C. From C a line is drawn to the point where the line AB intersects the circle. By geometry this line, h, is normal to AB, and is therefore the altitude of the triangle formed by R, X, and AB.

Then, by geometry, $h = \sqrt{ab}$.
But; $a = R \cos \alpha = R^2/Z_S$,
and; $b = X \sin \alpha = X^2/Z_S$.
Substituting: $h = RX/Z_S$.
Now, by algebra:

$\dot{Z}_P = (RjX)/(R+jX)$
$= (R^2jX+RX^2)/(R^2+X^2)$
$= (RX/Z_S^2)(X+jR)$.
$Z_P = RX/Z_S$.

Therefore, h in Fig. 2(a) correctly represents $\dot{Z}_P$, and is, in fact, identical with it in both magnitude and direction, since β in Fig. 2(a) is equal to $90° - \alpha$, which was shown above to be necessary.

That is, the semi-circle of diameter X and to the right of X is the locus of all points which, when connected to the point of tangency of the semi-circle and R, represent the parallel impedance formed by X and R as R varies from 0 to infinity for a given value of X, the particular point on the semi-circle defined by a given value of R being that point where the line joining the extremities of X and R intersects the semi-circle.

Fig. 3(a) shows the arrangement of the components of the CMPVA arm. X is 1000 ohms, either inductive or capacitive, depending upon whether the desired phase angle lies in the first quadrant or the fourth quadrant, respectively. R_1 is a resistor variable from zero to infinity, and R_2 is a resistor variable from 1000 ohms to zero. These two variable resistors are ganged in such a manner that one increases as the other decreases, and vice versa.

Fig. 3(b) is the same as Fig. 2(a), except for the addition of a few lines and angles. With X as radius, an arc is described joining X and R_1. From the upper end of $\dot{Z}_P$ the line R_2 is drawn parallel with R_1 to meet the arc. From the point of intersection a new line, $\dot{Z}_K$, is drawn back to 0, making an angle θ with R_1, and *equal in length to the line X.* This line $\dot{Z}_K$ is the vector sum of the two lines $\dot{Z}_P$ and R_2 in series, and is equal in magnitude to X for any value of θ between 0° and 90°. This is true in the fourth quadrant, when X is capacitive, the whole diagram being rotated about the line R_1.

It is apparent from the diagram that for any value of θ between 0° and 90°, and for any fixed value of X, there will be a unique pair of

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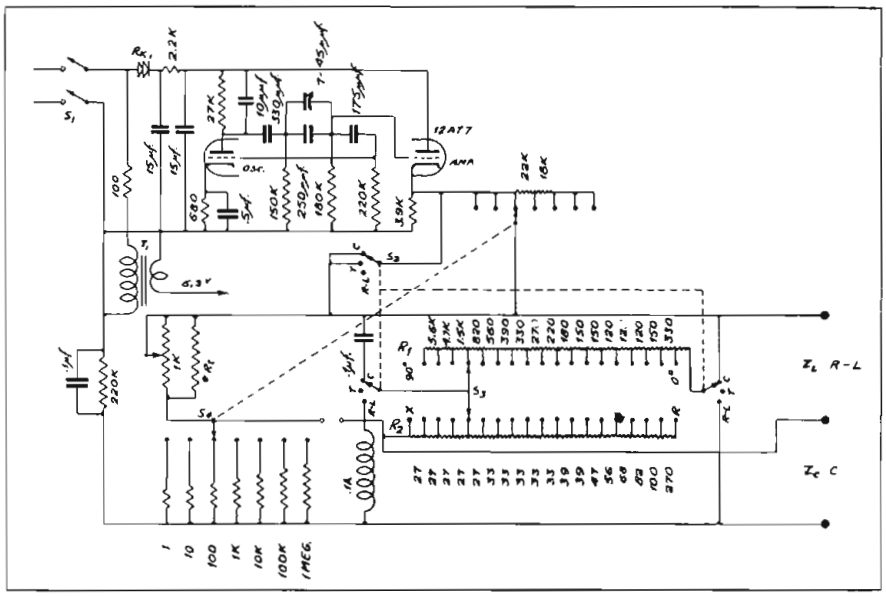

Fig. 6: Model 100 circuit diagram. Selenium rectifier provides DC power to 12AT7 tube

Table II
Suggested Principal Measurements to be Made by Model 100

Inductance	Capacitance	Impedance	Turns Ratio	Miscellaneous
Chokes: Filter RF Coils: Focusing Peaking Spkr Voice Networks: Compensation Cross-over Transformer: Leakage Winding Deflection Yokes	Capacitors: Air Ceramic Electrolytic Mica Oil Cable: Coaxial ($\mu\mu$f/ft.)	AF Surge-Transmission Line: Microphone Speaker Telephone Cutter Heads Filters Loaded Transformers Headphones Microphones (direct or through matching transformers) Pickup Heads Tube: Output circuits to ground Cathode & Screen to ground	Transformer Windings Sections of same winding to determine position of taps.	Detecting shorted turns of transformer windings. Anolysis of feedback circuits Ports selection—attenuation networks Checking autosyn or selsyn windings for shorts, opens, and unbalances.

New Principle for Broad Band Antennas

By M. W. SCHELDORF, *Research Director*

J. F. BRIDGES, *formerly Research Engineer*
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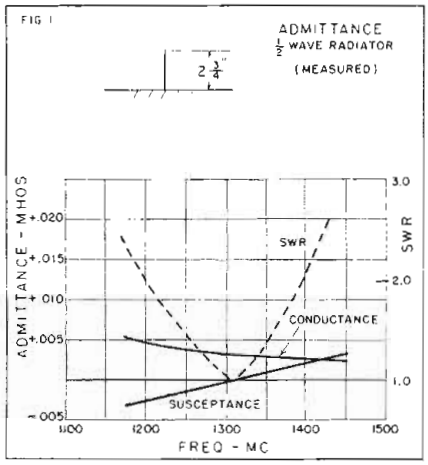
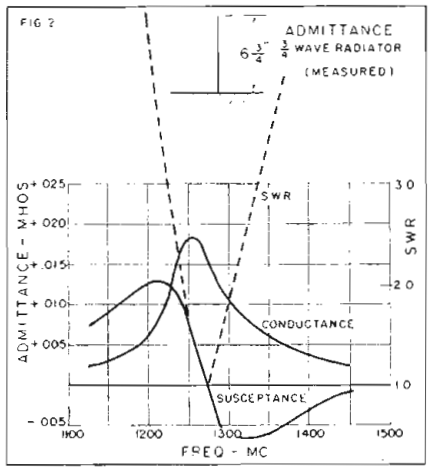
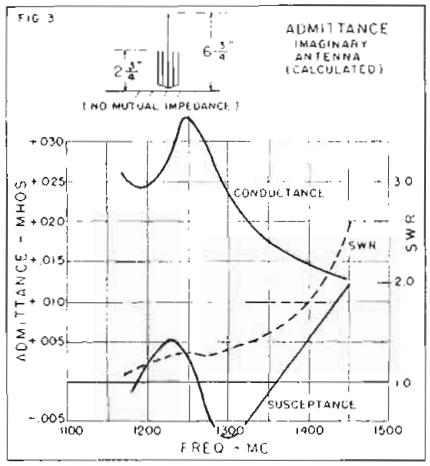
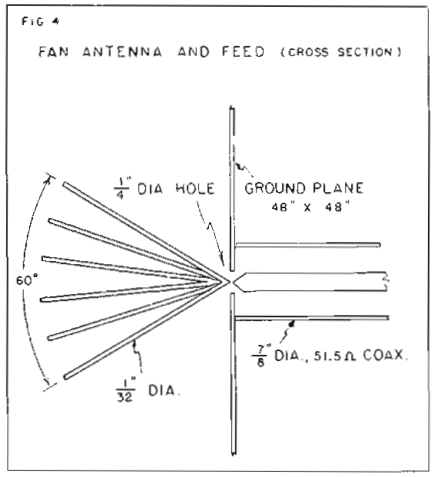








A COMMON necessary characteristic of all broad band antennas is that the structure provide a relatively large effective surface area over which the conducting surfaces may flow.

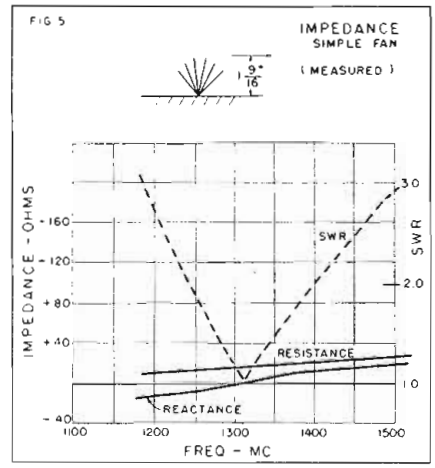
One structure that satisfies this requirement is the fan, where a large surface area is replaced by a multiplicity of small linear conductors. The fact that there are a number of conductors in a fan unit will lead the investigator to inquire what may happen if the elements are not equal in length. An especially interesting possibility is recognized by anyone familiar with the impedance characteristics of linear radiators which differ in length by multiples of one-fourth wavelength.

Consider the antennas of Figs. 1 and 2. Here we have shown the experimental results of measuring the admittance of a vertical half wave and a vertical three-quarter wave radiator over ground. As is expected, the first antenna shows a shunt resonance, with a generally constant conductance in series with a susceptance of positive slope, both low in magnitude. The second antenna shows a series resonance with a peaked conductance in series with a susceptance of negative slope, both high in magnitude.

Imagine connecting these antennas in such a manner as to combine the admittances and thereby produce cancellation of the reactive parts of the impedances. This is not a new concept, but, to our knowledge, there has been no practical application of the principle.

To illustrate the band width improvement, we have calculated on Fig. 3 the admittance resulting from a combination, in parallel, of four half wave and one three-quarter wave elements (assuming no mutual impedance, for simplicity).

Band width is more specifically shown by standing wave ratio values. Hence, for each of the conditions described, we have chosen an imaginary matcher which would give the best band width and have calculated the values of SWR into the systems that result. Note that the simple antennas are narrow in band width, but the combination has a broad band characteristic as predicted.



In order to apply the principle to fan antennas, we have become familiar first, with the behavior of fans in general. We have set up

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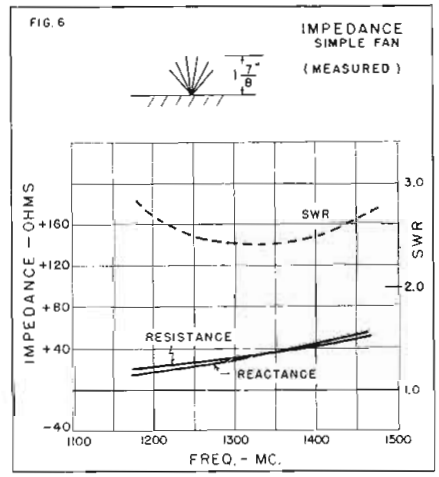
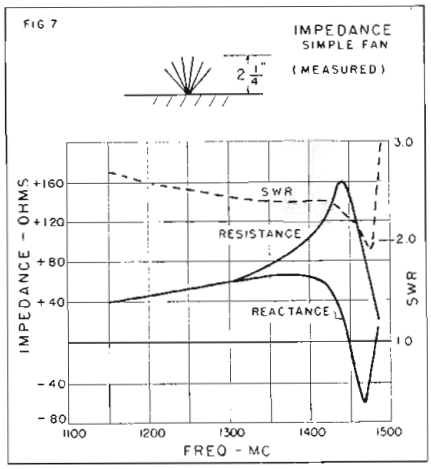
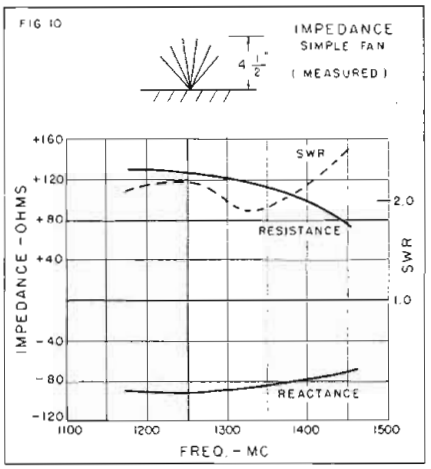


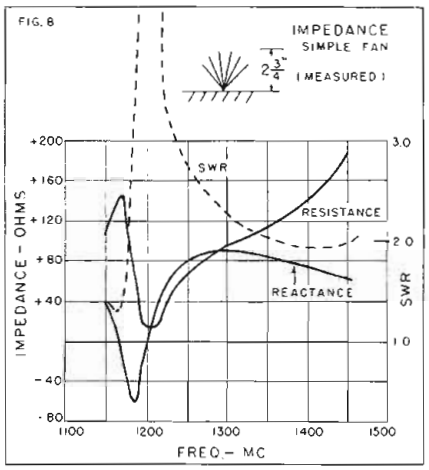
BROAD BAND ANTENNAS (Continued)

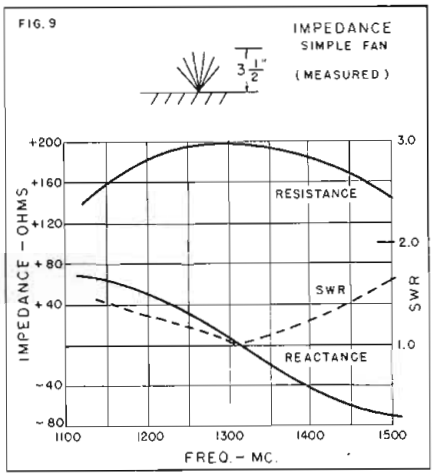
various length 60° six-element fans over a ground plane as shown in Fig. 4 and measured the input impedance. (See Figs. 5 to 10.) As before, we have shown the best band width by assuming the appropriate matcher for each case. It is obvious that a certain amount of band width improvement over that secured from single elements is realized, in accordance with previous experience. We wish to show that by the use of a combination of lengths, the band width can be improved considerably beyond the best condition for any of the simple fans.

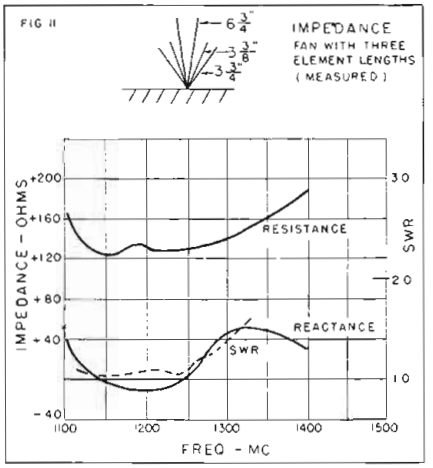
Fig. 11 shows the experimental results of an antenna with three element lengths. The presence of mutual impedances between the component elements prevents the possibility of predicting the individual lengths. The adjustments are entirely experimental and a number of trials are necessary. We have secured a band width of 10.9% (based on SWR limit of 1.10). The best simple fan gave a band width of 5.3%.



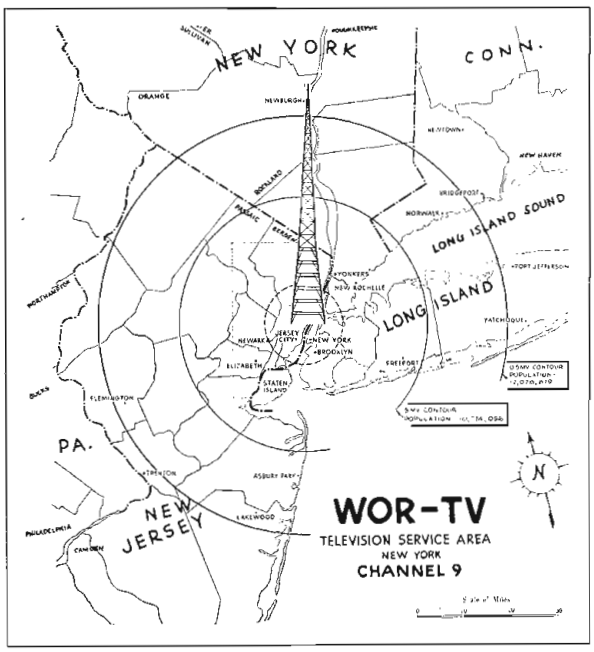


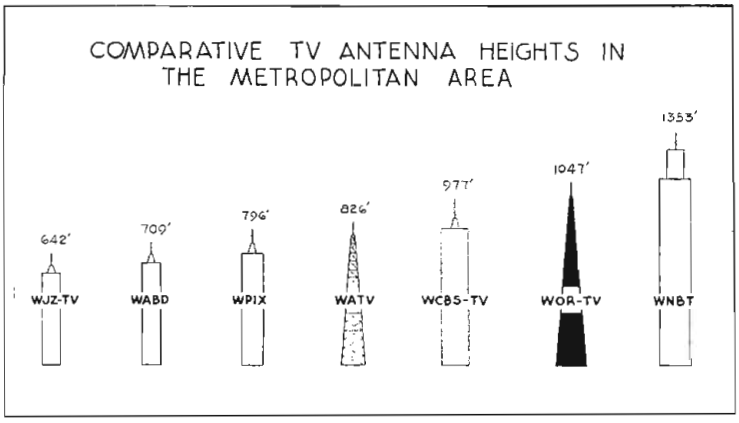






Predicted field strength contour map of WOR-TV, the video partner of Mutual's key New York Station, which is scheduled to begin operations in "midsummer" on Channel 9, 186-192 MC. The station's tower, across the Hudson River from Manhattan at North Bergen, N. J., will rise 760 ft. above the ground and 1047 ft. above sea level, making it the state's tallest structure. Close to 400 ft. has already been built. A glass-enclosed microwave relay station is to be constructed at the 555-ft. level to pick up broadcasts from the station's mobile units, and to serve as a distribution unit feeding power to the tower's lights and illuminated signs. The tower will be topped by a six bay turnstile antenna, and will house a 5 KW General Electric 6B visual transmitter operating at 2.04 KW, and a 2.5 KW GE-65 aural transmitter operating at rated output. WOR-TV's studios are under construction in buildings at 7 West 66 St., New York City. Heights of TV antennas in New York City area are also shown.





WASHINGTON
News Letter

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

CHIEF SIGNAL OFFICER PRAISES PATRIOTISM OF RADIO MAKERS—The declaration of Major General S. B. Akin, Chief Signal Officer of the Army, to the House Appropriations Committee that patriotism is a strong influence in the electronics-radio manufacturing industry which bends all possible efforts to supply the requirements of the Armed Services, was a tribute worthy of serious attention by that industry since General Akin, one of the few present Generals with decorations for gallantry in action during World War II, is not ever given to spreading about compliments unless deserved. It is also of great significance since the equipment procurement and research programs of the Signal Corps, Air Force and Navy are of definite importance to the industry's manufacturing and research concerns during the current business fluctuations. While the funds for procurement for the North Atlantic Defense Pact countries have not yet been disclosed in detail for the supplying of radio-electronic apparatus, the U. S. Armed Services have revealed their next fiscal year's requirements to Congress with the funds to become available after July 1.

ARMED FORCES TO SPEND $330 MILLIONS—The Signal Corps will spend a total of $105 million for procurement, with $30 million additional for research and development; the Air Force requires $115 million and perhaps $10 or $15 million more; and the Navy plans to purchase $57 million for Fleet and Shore Station modernization of its radio-electronic facilities, together with an additional $15 million for Naval Aviation electronics apparatus. Leading officers of the Armed Services indicated, incidentally, to Tele-Tech's Washington bureau their interest in the publication of the radio-electronic manufacturing industry's national preparedness mobilization plan in the March issue of Tele-Tech.

FCC COMMISSIONER WEBSTER REAPPOINTED FOR SEVEN-YEAR TERM—Generally regarded as the foremost authority in the government on mobile radio questions, especially marine, aviation and police services, FCC Commissioner Edward M. Webster was renamed by President Truman to another seven-year term on the FCC. His reappointment had been expected because of Commodore (Coast Guard) Webster's distinguished career in governmental radio service, including most of his career as the top communications officer of the Coast Guard and from 1934-42 as FCC Assistant Chief Engineer. His confirmation by the Senate is regarded as assured although the Senate Interstate Commerce Committee plans a brief hearing, probably not until early June, to ascertain Commissioner Webster's views on television and FM broadcasting as well as on the mobile radio services. He has been serving on the Commission since March 18, 1947, having taken the place of former FCC Chairman Paul A. Porter when the latter took over the helm of the Office of Price Administration (OPA).

BROAD-BAND MULTI-CHANNEL SYSTEM IN 400-500 MC MOBILE RADIO SOLUTION—Although there were misgivings on the part of three Commissioners that the allocation plan had substantial defects which might mean important revisions would become necessary in the immediate future, the FCC after months of staff work and study by the Commissioners announced its final rules and regulations and allocations blueprint for the Mobile Safety and Special Radio Services early in May. The new rules and allocations become effective July 1. Outstanding feature of the FCC's determination in the mobile allocation plan was the emphasized endorsement of the future need of many of the Mobile Radio Services to be established in the higher bands of 400-500 MC range with the multi-channel broad-band system of transmission to be utilized as proposed to the FCC in October and December, 1948, by the Bell Telephone Laboratories.

FCC'S COY SEES TV PROGRESSING, EVEN WITH FREEZE PROLONGED—By the end of 1949, FCC Chairman Wayne Coy predicts the present 1,500,000 television sets in use will be doubled, but the Commission chieftain on the eve of this departure as chairman of the U. S. Delegation to the Paris Telegraph Conference feels the television station "freeze" holding up some 300 station construction permit applications will be in effect for another three or four months.

FLASH! FCC ANNOUNCES FREEZE-LIFT, UHF PLANS

The FCC has just released its time-table for lifting the television "freeze" and making the UHF allocation. Official announcement says it will be early fall before final decision. 6-MC TV operation is planned for lower half of UHF band. Commission also opens door for 6-MC color on VFH and/or UHF channels, if color can be received by minor modifications of ordinary receivers. (This provision is considered very surprising.) Upper half of UHF band will be kept for TV research on stratovision, polycasting, and high-definition television.

TELE-TECH's NEWSCAST

Airborne Radio Conference, Dayton IRE Meet, June 3-4

A technical conference on airborne electronics will be conducted under the sponsorship of the Dayton section of the IRE on June 3rd and 4th in the Dayton Biltmore Hotel, Dayton, Ohio. An inspection tour of the Air Material Command Engineering Division at Wright-Patterson Air Force Base is planned for the afternoon of the third and will be followed by a banquet at which F. R. Lack, vice president of Western Electric, will be the principal speaker. Exhibits will be open from 9:00 A. M. to 5:00 P. M. during the two day conference. The following papers will be presented in morning and afternoon sessions on Saturday, June 4th:

"Aircraft Communications Equipment and Theory" —J. D. Woodard, Manager Aviation Engineering, RCA, Camden, N. J.
"Air Navigation and Traffic Control" — Dr. D. Ewing, Director of Development, Air Navigation Development Board, CAA, Wash., D. C.
"Antennas for High Speed Aircraft" — J. F. Byrne, Vice President, Airborne Instruments Laboratory, 160 Old Country Rd., Mineola, N. Y.
"Radio Wave Propagation in Lower Atmosphere" — Dr. H. G. Booker, Professor of Electrical Engineering, Cornell University, Ithaca, N. Y.
"Design Trends in Components for Airborne Electronics" — F. J. Given, Ass't Director of Transmission Apparatus Dev., Bell Telephone Laboratories, Murray Hill, N. J.
"Psychological Aspects in the Operation of Airborne Electronics System" — Dr. P. M. Fitts, Aero Medical Laboratory, Air Material Command, Wright-Patterson, A. F. Bare, Dayton, Ohio.

TV Output Running Over 2 Million Sets Yearly

More than 515,000 television receivers were produced during the first quarter of 1949, or at the rate of over two million sets annually. Earlier figures for the quarter had included only the outputs of TV makers who are RMA members, thus omitting some 25 other active television producers including one very large Mid-West manufacturer. When these substantial outputs are included, total U. S. television production for the January-February-March quarter of 1949 is computed at 515,500 television sets.

Co-Channel TV Stations Trying New "Off-Set" Carriers

A new "off-set" method of transmission is currently being tested between NBC's New York City and Washington television stations on the same frequency, Channel 4. Although there have been enthusiastic reports over the RCA synchronized carrier system (Tele-Tech Jan. '49) in use up to now, this newer method appears to hold much more promise in minimizing the so-called "Venetian Blind" effects.

In the previous synchronized system, a centrally located monitor post controlled the carrier frequency of one of the co-channel stations. In the new arrangement, the carriers instead of being accurately synchronized are "off-set" from each other by half the line frequency or about 8 KC. The width of the interference pattern bars is thereby reduced to a matter of one-line width and so becomes unnoticeable in the picture. Gain is of the order of 10 DB, depending on the precision of the crystals and the stability of the carrier difference. Normal variations and the drift expected when best-quality crystals are used, do not alter the expected gain in interference reduction to any great degree.

The system was developed by RCA researchers in their Princeton Laboratories, and with the successful completion of the tests now being conducted, a greater number of stations on each channel can be expected in the future with little or no increased operating or purchase costs to any of them.

NEW TV TUBE DEVELOPED UNDER DE FOREST'S DIRECTION

American Television Inc., 523 S. Plymouth Ct., Chicago, Ill., has announced availability of a new type cathode ray tube for television which the makers say will reduce "gray glare" and minimize eye fatigue in prolonged viewing. Termed the "Eye-Saver," this type is reported to cut down glare and highlight halation through the use of a new fluorescent material in which each granule of the phosphorescent coating powder is surrounded with an opaque substance. Both 10 and 12 in. sizes are now in production with 16 in. sizes due to be available soon. Production costs are said to be practically equal to those of tube types currently marketed so that corrected tubes can be sold at no increase in price. Photograph above shows U. A. Sanabria (left), president of American Television Inc., and Dr. Lee de Forest, director of research, who supervised development of "Eye-Saver" tubes

Coming Events

June 3-4—IRE, Dayton Section, Conference on Airborne Electronics, Biltmore Hotel, Dayton, Ohio.
June 16-18—American Physical Society, Semi-Centennial, Massachusetts Institute of Technology, Cambridge, Mass.
June 20-24—American Standards Association, Seminar on Technic and Organization of Standardization, Room 503 Engineering Societies Bldg., 29 West 39th St., New York City.
June 20-21—IRE, Conference on Electron Devices, Princeton Univ., Princeton, N. J.
June 20 - 25 — American Institute of Electrical Engineers, Summer General Meeting, Swampscott, Mass.
June 27-29 — American Physical Society, Conference in conjunction with American Association of Physics Teachers, Univ. of Washington, Seattle, Wash.
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 26-22—National Electronics Conference, Edgewater Beach Hotel, Chicago.

New Parts for Design Engineers

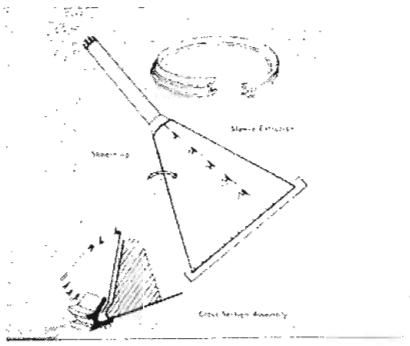
Interference Filters

Electrically suppressing radio interference caused by aircraft DC motors and generators in the frequency range from 150 KC to 400

MC, type FA 203 radio interference filter (illustr. left) is rated at 50 amps., 50 volts DC. Other units are available from ½ to 400 amps. The FA 215 (illustr. right) is designed for operation in 115 volt AC 400 cycle circuits. It effectively reduces radio interference from power supplies and dynamotors and other electrical equipment operating at 400 cycles. Other units for 400 cycle operation range in current carrying capacity from 1 to 50 amps.—**Filtron Company, Inc., 38-25 Bell Blvd. Bayside, N. Y. C., N. Y.**

TV Tube Sleeve

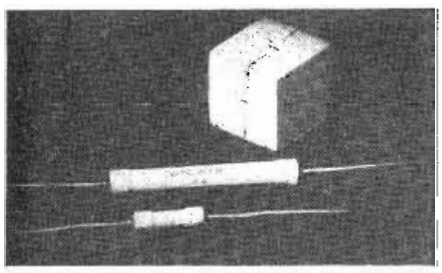
Because the high second anode voltage is present over the entire cone of the new metal TV picture tubes the plastic sleeve



has been designed to facilitate mounting and insulating the tubes. All metal portions of the tube are covered by the plastic sheathing and the extruded plastic mounting ring, which covers the rim. **Anchor Plastics Co., 533 Canal St., New York, New York.**

Resistors

Noise level of a new line of high stability carbon resistors is so low that they are said to approach wirewound resistors for quiet



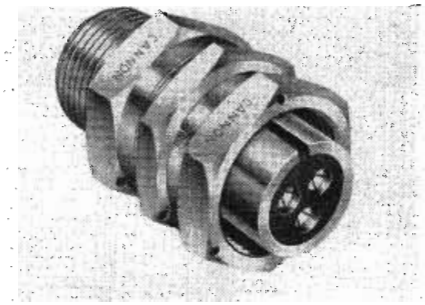
operation in high gain audio frequency applications. The resistance element is a homogeneous carbon layer of almost monomolecular thinness in the higher resistance values. Hence, these units are free of the customary sizzling and frying noises commonly associated with composition carbon resistors. Normally made to tolerances of 1%, it is expected that all resistors delivered in the American market will adhere to that figure for the life of the component.—**Welwyn Electronic Components, Inc., 234 E. 46th St., New York 17, N. Y.**

Capacitor Assembly

The Capaci-Ring is a capacitor assembly designed to simplify the problem of socket terminal RF by-passing. It combines in a compact, shielded unit 4 separate mica capacitors isolated from one and other. Sections are provided for heater, screen, and cathode with the lead from each section properly located adjacent to the appropriate socket terminal. Lead inductance is, as a result, extremely small. Type 6MA is designed for use with the standard 7-pin miniature tube socket. The unit mounts with the same fastening required to mount the socket itself. No additional chassis fabrication is needed. The terminal arrangement is such that the by-passing requirements of all the 7-pin miniature RF pentodes can be satisfied. Each of the 4 sections of the Capaci-Ring has the nominal capacitance of 500 μμf. Greater capacitance values and other terminal arrangements can be supplied on special order. —**The Compton Co., Bethesda, Md.**

Vibrationproof Connectors

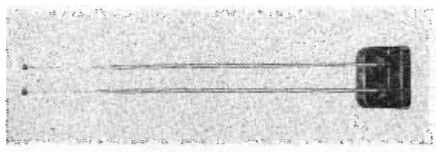
Several new features, including radio-shielding, pressurizing, moistureproofing have been added to the Cannon line of vibration proof



AN-type connectors. This series has been tested in actual aircraft operation to 30 Gs. For insulating material a new synthetic resilient material with high dielectric has been adopted that will function satisfactorily at —70° to +390° F. Inserts are one-piece design. Radio shielding is accomplished by sphere and cone joints made in accordance to Navy Bulletin RE49A-501A. Shell material is aluminum alloy with Dural coupling nuts. Low millivolt drop contacts are copper alloy, silver plated. **Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif.**

Indoor Antenna

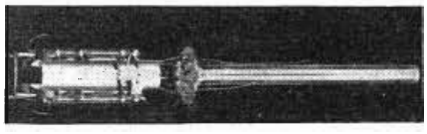
Orienting easily in all directions, the newly-designed TVI-49 indoor antenna gives excellent reception on every channel. Its polished



aluminum telescopic dipoles have been designed to harmonize with living room furnishings. It is sturdily constructed, weighted perfectly, and will not tip over. List $6.95.—**Ward Products Corp., 1523 E. 45 St., Cleveland 3, Ohio**

Television Gun Mount

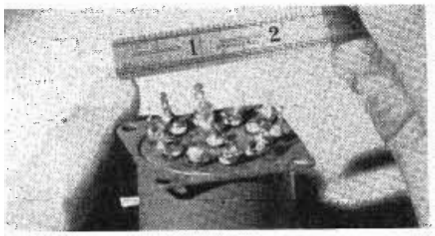
Among the first to initiate volume production of complete television gun mounts, Haydu Brothers are manufacturing mounts



of three-pillar construction. Greater stability and geometrical strength is claimed, as well as increased rigidity and evenness of spacing of supported parts.—**Haydu Brothers, Plainfield, N. J.**

Miniature Terminal

Because of the extremely small size of a new type terminal construction, a large number of them can be mounted in limited



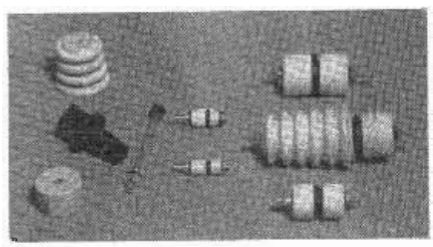
spaces. The photograph shows ten such terminals mounted in a hermentically sealed transformer case cover with a 1¾ in. diameter. Their construction, employing ceramic bushings and rubber gaskets, provides a permanent hermetic seal that is proof against mechanical fracture, extremes of temperature, and the entrance of moisture under all conditions imposed by JAN-T-27 requirements. They can be used with transformer designs requiring high potential tests of up to 1,000 volts.—**Chicago Transformer Div., Essex Wire Corp., 3501 Addison St., Chicago 18, Ill.**

Grid Bias Cell

Available in 2 voltages, 1.5 volts and 1.75 volts, a new miniature grid bias cell provides a constant potential for bias of electronic tubes and circuits, where no current is required of the cell. Since it is a potential device only, its EMF is lowered by even a fraction of a mocroampere drain but it is unaffected by AC of any frequency. At audio frequencies, the cell has a non-reactive impedence of between 250 and 1,500 ohms. It will operate satisfactorily over a temperature range from —60° C to +60° C. The cell does not produce noise in high gain amplifiers.—**P. R. Mallory & Co., Indianapolis 6, Ind.**

Terminals

A line of steatite-neoprene compression type terminals has been developed for use in hermetically sealed transformers and capaci-



tors, including oil-immersed, and other electronic equipment where relatively high voltages are involved. Among advantages claimed for these components are: freedom from surface tracking tendencies; ability to meet severe cycling requirements under military specifications; high resistance to mechanical and thermal shock even under extremes in temperature; high voltage and current carrying capacity for space occupied; complete engineering service available, including laboratory facilities, under supervision of the inventor, R. U. Clark.—**Lundey Associates, 964 Main St., Waltham 54, Mass.**

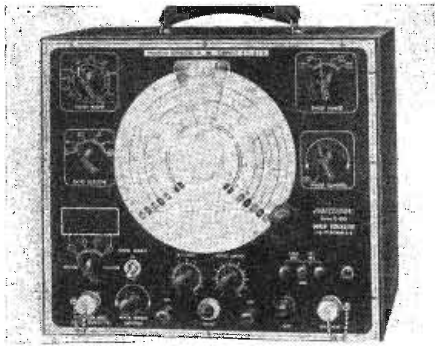
Printed Circuit Elements

Extremely fine spacings, thick conductors, and low cost characterize a new line of miniature printed circuits which are being Screening". The micro-screened pattern Screening. The micro-screened pattern may have any desired size or shape; the lines may be of almost any material and can be deposited on metal, glass, plastic or paper bases. Line widths and spacings of .001-in. and accuracies of .0002-in. are attainable in production. Conductivity is exceptionally good because the deposit may be made thick.—**Glass Products Co., 108 N. Dearborn St., Chicago 2, Ill.**

New Lab and Test Equipment

Sweep Signal Generator

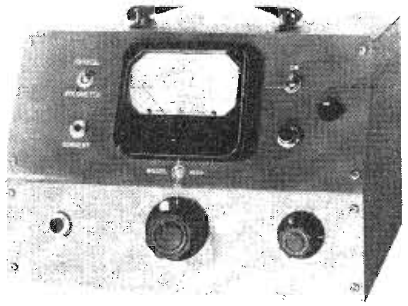
Continuous frequency coverage from 2 to 240 MC is provided for FM and TV alignment by the Series E-400 wide range sweep signal



generator. A direct-reading turned aluminum tuning dial with approximately 6 ft. of 2-color etched scales is incorporated. A direct reading vernier scale is also included which reads to 1 part in 1500 for critical applications and odd frequency spotting. A terminated RG/U type coaxial RF output cable provides for non-reactive injection of test signals plus open line impedance for utmost flexibility.—**Precision Apparatus Co., Inc., 92-27 Horace Harding Blvd., Elmhurst, L. I., N. Y.**

Standing Wave Indicator

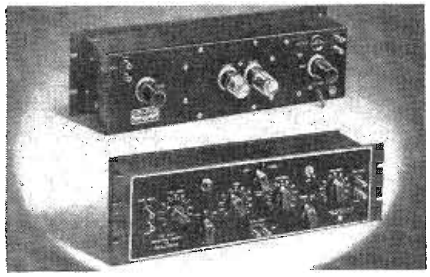
Relative audio voltages detected by a crystal rectifier or bolometer may be measured by a new standing wave indicator, known as the



—hp— 415A. Although it has been designed for use with the —hp— 805A parallel plane slotted line, it may be used with other slotted line systems. In conjunction with a slotted line, the 415A will determine flatness of a coaxial or waveguide system, measure impedance, locate sources of reflection and determine percentage of reflected power. It operates on a single fixed tuned frequency or one KC. Other frequencies from 300 to 2,000 cps can be supplied on special order.—**Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.**

Oscilloscope Amplifier-Sweep

An oscilloscope amplifier-sweep unit has been developed for use with any of the Millen line of basic 2-, 3-, and 5-in. rack panel os-



cilloscopes. The new No. 90921 unit consists of horizontal and vertical amplifiers, a hard tube saw-tooth sweep generator and power supply mounted on a standard 5¼-in. rack panel.—**James Millen Mfg. Co., 150 Exchange St., Malden 48, Mass.**

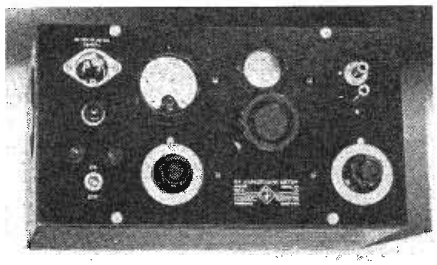
Kilovoltmeter

Designed to measure television and x-ray voltages up to 50,000 volts DC, the model 4000 kilovoltmeter is a 20 microampere in-

strument with an input impedance of 1250 megohms. Basic sensitivity is 50,000 ohms per volt. All voltage is dissipated in the shielded polystyrene probe, test leads are shielded and the shields are connected together for greater safety. A "normal-reverse" key is provided so that the probe may be used regardless of the polarity of the voltage under test.—**Bradshaw Instruments Co., 348 Livingston St., Brooklyn 17, N. Y.**

RF Capacitance Meter

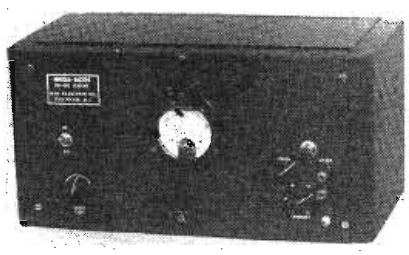
Rapid testing and measurement of small capacitors (up to 1200 μμf) is provided by type 1612-A RF capacitance meter. Measure-



ment is made by substitution method in which the capacitance of a calibrated air capacitor is reduced to re-establish resonance after an unknown capacitor is connected. Resonance is indicated by maximum deflection of a meter. Two ranges are provided: 0 to 80 μμf and 0 to 1200 μμf. Range switching is accomplished automatically as the dial is rotated and measurements are made at a frequency of 1 MC.—**General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.**

Noise Diode

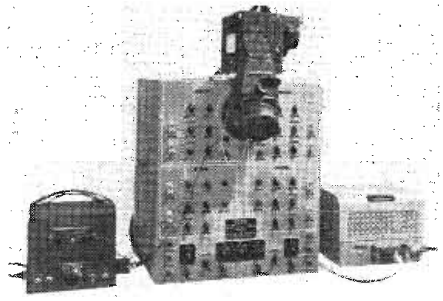
Noise figure of an FM or television receiver can be read directly with the aid of a new device called the Mega-Node. This instrument



is a calibrated source of random noise covering the frequency range of 0 to 220 MC. Output impedances of 50, 70, 100, 150, 300 ohms and infinity are selected by a front panel switch. Noise figure ranges of 0 to 17 DB at 50 ohms, 0 to 23 DB at 300 ohms are available. The meter reads directly in DB on a linear scale.—**Kay Electric Co., Pine Brook, N. J.**

Four-Channel Oscilloscope

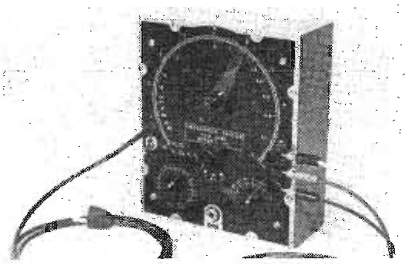
Versatility of model H-4GRT oscilloscope is enhanced by the use of 4 independent channels, each with its own horizontal and ver-



tical amplifiers all operating into one four-gun cathode ray tube. Two of the channels are provided with DC amplifiers and the other two with AC amplifiers. The former permits examination of sub-audible phenomena while the latter have a frequency response to 500 KC. The two sweep generators are arranged so that the whole unit may be used as a dual channel AC instrument or a dual channel DC instrument with separate generators for each channel. All channels may be used with either sweep, thus allowing comparison of two, three, or four phenomena on a common time base.—**Electronic Tube Corp., 1200 East Mermaid Lane, Philadelphia 18, Pa.**

Impedance Bridge

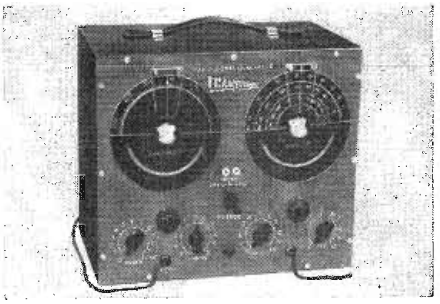
The model 100 universal impedance bridge is a small, compact instrument designed for the measurement of any value of impedance



up to 1 megohm by means of the 2-null method. In the impedance-limit positions it is capable of measuring capacitance from 100 μμf to 100 μf, inductance from 100 μh to 100 h, and resistance up to 1 megohm. Included is a high-stability oscillator of good wave-form set at 1590 cycles. This frequency was chosen to simplify the calibration of the main impedance scale.—**VFB Line Corp., 702 Annesle Rd., Baltimore 12, Md.**

Sweep Signal Generator

Complete frequency coverage from 0 to 227 MC with no band switching is provided by model SG Sweep Signal Generator, a new in-

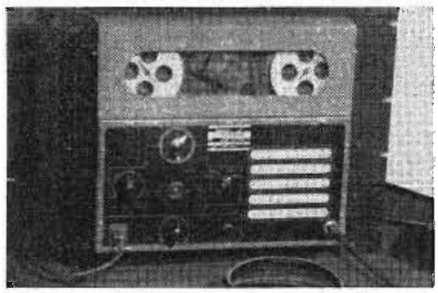


strument with a built-in marker generator. Crystal controlled output makes possible production of crystal controlled signal from 5 to 230 MC. Output impedance is 5 to 125 ohms. RF is provided for alignment of traps for IF channels when a DC voltmeter is used as the indicating medium. Power supply is completely shielded and filtered to prevent leakage.—**Transvision, Inc., New Rochelle, N. Y.**

TV, Sound & Communications Components

Airport Wire Recorder

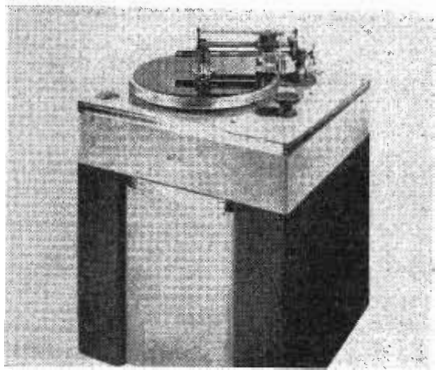
A wire recorder which automatically records outgoing and incoming control tower traffic has been developed in a relay rack



model which can easily be attached to any control tower radio equipment. Recording mechanism is actuated by a special voice-operated switch, with a three second lag to allow for pauses in speech. Wire spools are available for a total elapsed time of 1 or 2 hours. An elapsed time indicator permits the tower operator to spot any radio traffic for future reference. A unique input bridging circuit enables voice of tower operator and voice of pilot to be cleanly balanced and smoothly recorded.—**Terminal Radio Corp., 85 Cortlandt St., New York 7, N. Y.**

Recorder

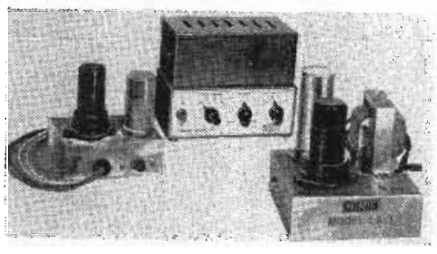
Designed for standard and microgroove recording model 66-G combines the best features of Presto's dual motor gear drive with



the overhead mechanism and turntable of the 8-N recorder. The cutting head is the Presto 1-D. For maximum performance, it is recommended that the 66-G be used with the Presto 92-A recording amplifier and 41-A limit amplifier. List $996.—**Presto Recording Corp., Paramus, N. J.**

Equalizer-Amplifiers

Model EA-3 (extreme right) is the most recently developed of three equalizer-amplifier units which can be used in conjunction



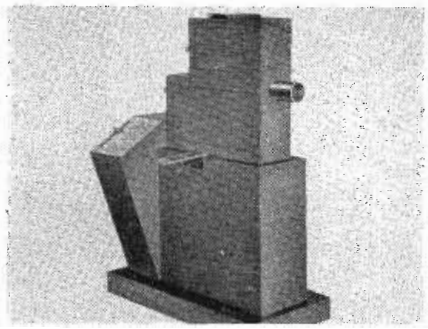
with the Astatic magneto-induction pickup cartridge. Model EA-1 (extreme left) was designed for installation in radio sets and audio amplifiers and provides the necessary equalization and preamplification to adapt magneto-induction cartridges to standard phonograph input circuits. Model EA-2 (center) is self-powered and provides adjustable "bass boost," adjustable treble "roll-off", and selection of "turnover frequency."—**Astatic Corp., Conneaut, Ohio.**

TV Tubes

Remington-Rand Vericon 12½-in. television picture tubes, an outgrowth of wartime research by the company's electronic division in connection with the armed forces' guided missile program, are now being installed in home television receiving sets by a number or nationally known set manufacturers. The tube meets all RMA specifications for the 12LP4 picture tube and is now in regular production.—**Picture Tube Production Div., Remington Rand, Inc., Wilson Ave., South Norwalk, Conn.**

TV Slide Projector

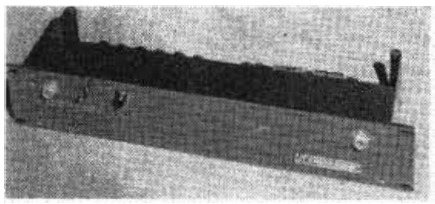
The Telop is a television optical projector for use with TV film cameras. It is invaluable for flashes of newsphotos, temperature or



time, for station and sponsor identification, titles, announcements, and aides to lectures. This unit is a dual projector of opaque cards, glass slides, small objects and strip material; one object can be faded to another instantly or gradually by lap dissolve or superimposition. The focal length of the lens was made sufficiently great to permit the use of a diplexer between the Telop and the TV camera and therefore one TV camera can be used for two film projectors and the Telop. The use of one camera chain is not tied up exclusively by one slide projector.—**Gray Research & Development Co., Inc., 15 Arbor St., Hartford 1, Conn.**

Wide-Band Chain Amplifier

Model 202 wide-band chain amplifier, composed of two stages of six 6AK5 tubes, has a gain of 20 DB and a band width of 200



MC. With a standing wave ratio of less than 1.5 DB, the transmission characteristic is ±1.5 DB from 100 KC to 200 MC at any impedance level of 200 ohms. A traveling wave circuit is used to achieve the wide band width. Mutual inductance coupling between sections of the delay-lines in the grid and plate circuits of the tubes insures a substantially linear phase shift over the band width.—**Spencer-Kennedy Laboratories, Inc., Dept. TT, 186 Massachusetts Ave., Cambridge 39, Mass.**

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 20 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.**

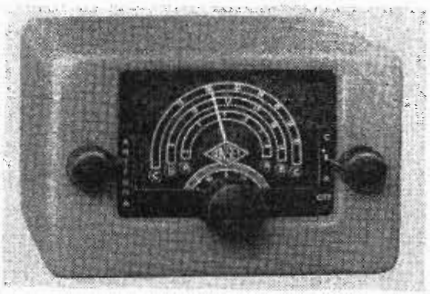
3-Speed Turntables

Available in single and dual motor types, type 15 turntables will reproduce any recording up to 12 in. in diameter at 33 1/3, 45 or

78 RPM. The heavy cast aluminum turntable accurately machined and dynamically balanced is supported by a steel shaft, 2½ x ½ in., which turns in a solid brass bearing with a single ball thrust. There is minimum wow and flutter with superior speed regulation. Turntable noise is well below signal. There is no rumble from blank grooves or low volume portions of the record. 78 RPM standard pickup is instantly interchangeable with the microgroove pickup.—**Presto Recording Corp., P. O. Box 500, Hackensack, N. J.**

Short Wave Converter

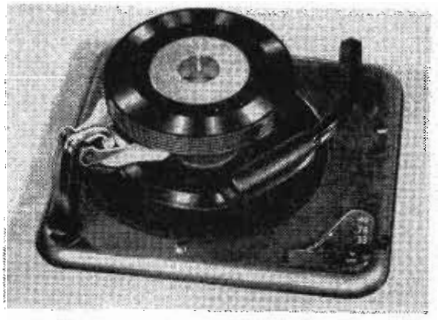
Deriving its power from the automobile set with which it is operating, a new mobile short wave converter will provide reception



on all frequencies between 3 and 30 MC. The unit's high sensitivity permits reception of amateur, short wave broadcast, and other short wave signals from all over the world with good volume when using the regular auto antenna. A bandspread dial is incorporated in order to permit fine logging of frequencies.—**Gonset Co., 72 E. Tujunga Ave., Burbank, Calif.**

3-Speed Changer

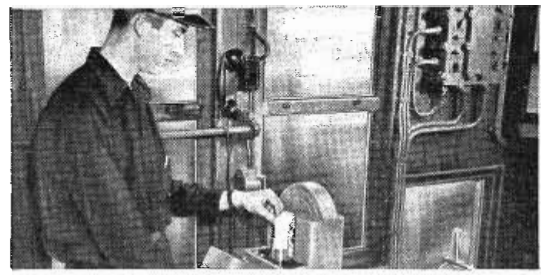
A new automatic record changer (model 700F33-45) has been developed which will play records of all sizes and speeds with



the same pickup arm. The new changer has a conventional spindle diameter, and the problem of the large hole diameter of the 45 RPM record is overcome by use of plastic adaptor buttons. This unit is directly interchangeable with earlier 1- and 2-speed models and, consequently, can be used as a replacement for older record changers.—**General Instrument Co., 829 Newark Ave., Elizabeth, N. J.**

RADIO-TELEFAX UNITS WITH SYLVANIA TUBES

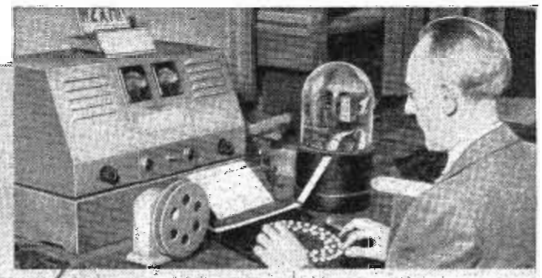
SPREAD THE NEWS OF INCOMING SHIPS!



Pilot boat Captain sending written message of arrival of the big ship through Link unit equipped with Sylvania tubes, and in short order . . .

★ ★ ★

. . . message arrives in Western Union Marine News room as facsimile reproduction, then is transmitted by an operator and simultaneously appears on tickers at offices of newspapers, customs, pastal and immigration authorities, taxi, steamship companies and many athers.



Link radio equipment used in Western Union Marine Reporting Service

RADIO-TELEFAX, a new type of telegraph communication, reports ship arrivals as part of Western Union's Marine Reporting Service.

Out at sea, the captain of the New York Pilot Boat spots incoming liners, writes a message such as "SS QUEEN ELIZABETH INCOMING AT 1644" on a telegraph blank and inserts it in an automatic Telefax transmitter. The unit then transmits it to Western Union over a VHF radio channel. It arrives as a *facsimile* of the sent message!

And inside this Link equipment, rugged Sylvania tubes, operating smoothly, do their part in this important marine reporting service. Find out more about the complete Sylvania line of Radio Tubes . . . see your Sylvania Distributor or write Radio Tube Division, Emporium, Pa.

SYLVANIA ELECTRIC

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

Barium Titanates

(*Continued from page 39*)

the reference frequency. The input voltage, instead of push-pull, is applied in series with the DC bias, so that an AC signal shifts both response curves in the same direction. Because the input voltage is not divided in this system, it has twice the sensitivity of the first system. However, the input impedance will obviously be only half that of the first scheme.

While no rigorous calculations have yet been made for these amplifiers, rough approximations assuming tuned circuit Q's of 50 and utilizing a new experimental material have indicated that amplifications of at least 5 can be expected. It is hoped that this work will lead to the development of completely sealed inexpensive miniature audio amplifier assemblies which will eliminate the use of vacuum tubes. Such an amplifier could also be used as a preamplifier in a microphone head, thereby facilitating the use of long and inexpensive high capacitance cables. An encouraging aspect of this circuit is the high impedance inputs and low impedance outputs that may be attained, as compared to the germanium "transistor"[1] amplifier which draws power from the previous stage.

Other uses of non-liner dielectrics have been proposed. Roberts[1] has analyzed the operation of a phase shifter using non-linear capacitors, and Donley[2] has reported on the use as a frequency converter. Both Roberts and Donley have reported upon the use of non-linear dielectrics as harmonic generators.

Producing the Ceramic

In order to produce sheets sufficiently thin to lend themselves to the production of piezoelectric transducers and high capacity-to-volume condensers, in conjunction with the Squier Signal Labs. at Fort Monmouth, a new ceramic process was developed[1] and improved by Mr. Frank Hudanick and Mr. Matthew Plesher of this company.

This process consists of preparing a paintlike suspension of the extremely fine grained raw materials, de-airing such a suspension, and doctoring it on a moving metal belt. After drying, the unfired sheet ceramic is stripped off the belt in a continuous process. These large sheets are cut into sizes convenient for handling and firing and are fired to the extremely high temperature of 2500°F to obtain maximum den-

sity; (averaging 5.64 gms/cm^3). The highest density in materials fabricated by ordinary means is on the order of 5.4 gms/cm^3. This high density naturally produces a material with higher dielectric strength and results show the dielectric strength of this type of ceramic to be between 50 and 100% higher than ceramics produced by other processes.

Sheets may be fabricated between .003 to .030-in. thick and can be processed up to 16 sq. in. in area. The fired ware is then coated using a ceramic fired-on silver. Close control must be maintained to obtain the proper thickness and bonding properties of the silver. The various sizes of sheets required are then cut from the large silvered sheet by means of an abrasive wheel.

General Bibliography

Field, N. J., de Bretteville, A. P., and Williams, H. D., "Phase Change in Barium Titanate Crystals", **Phys. Rev.** 72, pp. 119-120 (1947).

Mason, W. P., "Piezoelectric or Electrostrictive Effect in Barium Titanate Ceramics", **Phys. Rev.** 73, pp. 1398-99 (1948).

Cherry, W. L. Jr. and Adler, R., "Piezoelectric Effect in Polycrystalline Barium Titanate", **Phys. Rev.** 72, pp. 981-982 (1947).

van Santen, J. H., and Jonker, G. H., "Effect of Temperature on the Permittivity of Barium Titanate", **Nature** 159, pp. 333-334 (1947).

Rooksby, H. P., "Compounds of the Structural Type of Calcium Titanate", **Nature** 155, p. 484 (1945).

Smith, G. S., "Important New Dielectrics", **Chemical Age**, pp. 429-431, Nov. 10, 1945.

Wul, B., "Barium Titanate: a new Ferroelectric", **Nature** 157, p. 808 (1946).

Video Recording

(*Continued from page 31*)

equipment such as film magazines, camera gates and sprockets, careful handling and cleaning during or after editing, and good printer and projector maintenance.

The effort expended in obtaining the best possible quality of picture and sound negative or direct positive recording is wasted if good prints are not obtained. Motion picture printing may be classed as continuous or step and also as contact or optical. In continuous contact printing the negative and raw print stock are moved emulsion to emusion past an illuminated aperture. This is by far the most common procedure. Continuous optical printing involves moving the negative past an illuminated slit which is optically imaged on the raw print stock which is also moving at the proper rate. Its greatest use is in sound track printing. Step contact printing involves moving the negative and raw print stock in emulsion to emulsion contact intermittently frame by frame into a printing aperture which is intermittently illuminated by a light source

(*Please turn to next page*)

(*Continued from preceding page*)

and a shutter. Step optical printing involves intermittent frame by frame illumination of the negative and the illuminated frame is imaged optically on the raw print stock which is also synchronously advanced frame by frame. This method permits either enlargement or reduction of image size. The fastest printing is continuous printing and quite good results are attainable, but the best definition is obtained by step printing. Step printing is generally used in making duplicate negatives, master positives, etc. Of course only continuous printing can be used for sound tracks. A given printer may have more than one "head" so as to print the picture and sound with only one passage of the raw stock through the printer. To achieve usable definition, contact printing must be done with the negative and print stock emulsion to emulsion. Optical printing permits printing through the support of the negative if desired in order to adjust the image orientation for the sake of obtaining standard emulsion position in the projector. If facilities and time permit, video recordings should be step printed for maximum definition.

Timing and Adjustment

Well made picture negatives should require little or no "timing" or adjustment of printing exposure from scene to scene, from one recording camera to another, or one day's recording to another, if such negatives are intercut. In practice this has been achieved to the point where the greatest cause for timing is variation in signal characteristic between the various television cameras in the studio. Such uniformity is very desirable because timing is both expensive and time consuming. Once the standards and the fact that the difference between these standards and usual motion picture practice is deliberate, are established, most commercial motion picture laboratories are well prepared to produce consistently the photographic characteristics demanded by the video recording operation. The actual processing technic used may vary from laboratory to laboratory, depending on facilities available and the demands of other work. For instance, Eastman 16-mm. Fine Grain Sound Recording Safety Film, Type 5373, which is recommended for picture negative recording is usually processed in the same developer as

used for regular motion picture negative, but the same characteristics can be obtained with very much shorter developing time, and hence greater footage rate, in the developer usually used for release prints.

However, the effective film speed is lower under these conditions. Provided the exposure determination was based on it, either development procedure is satisfactory.

The requirements placed on the lens of the television recording camera are not severe. Fairly high apertures, approximately f/2.0, are required in the existing systems. If the lens will resolve the scanning lines, little overall improvement in the film is noticed with increasing optical quality of the lens. The major difference will be that the lines are resolved over a larger portion of the frame if the lens used has a flatter field. The usual flat face monitor tube has some electronic defocusing at the edges, making it difficult to judge whether the lens selected is any better than another one. The lens should be coated for reduction of internal reflections which lead to flare and contrast reduction as well as some loss of effective speed. Lens flare can best be judged by observing fine detail of low contrast. The final focusing should be done by exposing film in the camera at various focus settings and examining the developed image with a fair degree of magnification.

The author wishes to acknowledge that a great many of the ideas and methods discussed here were the result of his very pleasant association with the personnel concerned with developing the video recording installations at the Allen B. DuMont Laboratories, Inc., the National Broadcasting Co., and the Columbia Broadcasting Systems, Inc.

NEW NAMES AND ADDRESSES

The New York City office of the Andrew Corp. at 421 Seventh Ave. is temporarily closed. All inquiries should be directed to the main office at 363 East 75th St., Chicago 19.

Michael Scott, former sales manager of Hallicrafters has established the Michael Scott Company, manufacturers' representatives for electronic and television equipment, 8 Todd Road, Cohasset, Mass.

Columbia Wire & Supply Company, assemblers of all types of cord sets, wire and wire products, have moved into their own new and larger building at 2850 Irving Park Road, Chicago 18, Illinois.

Standardization

(*Continued from page 23*)

the application phase of the standardization program.

By reducing the multiplicity of types to a few standard types, manufacturing cost is reduced and the problem of procurement and supply is greatly simplified. Considerable bulk storage is eliminated, bin space requirements in the various depots are reduced, and Navy shipboard binning of repair parts is made feasible. This naturally reduces the number of catalog items, stock records, shipping documents, and other paper work which, in turn, is reflected in reduced personnel requirements and in more efficient supply operations.

Interchangeability, which makes it possible to use any standard part in any piece of electronic equipment where it is applicable, is the ultimate goal of design and maintenance people. The advantages are obvious.

High quality and dependability are probably the most important objectives of the standards program. Just as a chain is no stronger than its weakest link, so each piece of electronic communication or control equipment is no more reliable than the parts and materials of which it is made. Since the failure of an important piece of electronic equipment at a crucial time could cause the failure of a mission and serious loss of life, dependability is of paramount importance. JAN components and materials are designed to give that dependability.

Revising Old Specifications

To date, about 80 percent of the conventional component parts and materials used in electronic equipments are covered by JAN standard specifications. This work is progressing as fast as personnel limitations will permit. However, the task will never be completed; it is a continuing process. Improvements in the electronics field through research and development, as well as new military requirements, necessitate constant revision of old specifications. The trend toward miniaturization and the ever-increasing demands for smaller and lighter equipments has opened a whole new field for standardization.

Although most electronic components are covered by JAN specifications, many are actually not available to the services as maintenance parts or to manufacturers of new

equipments. It is therefore necessary to grant waivers for the use of approved substitute parts. Since many of these standards parts are new items and most of them are specialized for military requirement, the parts manufacturers are not currently producing them for commercial use, and are therefore unable to make them for the Government in small lots at a reasonable price. To overcome this difficulty and make JAN parts available when and where they are needed, several plans are now under consideration by the services and the Munitions Board[1] to make large-order buying possible and thus induce industry to produce these parts.

Standardization and establishment of adequate approved sources of supply for standard items are essential features of the Industrial Mobilization Planning program. In any emergency, if the component parts and materials are quickly available in adequate quantities, the equipment manufacturers can readily assemble and deliver the finished end items. Conversely, if the bits and pieces—and the right kind of bits and pieces—are not available, then equipments cannot be delivered when needed.

With view toward having JAN electronic components in current production, the Chairman of the Munitions Board recently requested the American Standards Association to consider the adoption of the JAN components as American Standards for commercial use where applicable. Acting favorably on this request, the Association has set up the organizational machinery for considering and processing these JAN standards into American Standards. Several important equipment manufacturers are already using JAN parts, when available, in their high-grade commercial equipments where dependability is of prime importance.

[1] The Research and Development Board is part of the National Military Establishment.

Mission of the ASESA

1—*To reduce the number of styles and types of electronic components used in the manufacture of military equipment of all kinds.*

2—*To insure their quality and dependability.*

3—*To achieve a high degree of interchangeability.*

Television Remotes

(*Continued from page* 28)

audio control unit permits visual contact with the announcer in the front compartment of the cruiser. Power supply units and synchronizing generator are located below the desk. All units are shock mounted and are attached to a ball bearing type drawer slide which allows them to be pulled forward and out from under the desk surface as illustrated in Figs. 5 and 7 so that they may be serviced or removed completely. Behind them are the air conditioning ventilator ducts to remove the excess heat generated when in use.

The microwave relay control, a line or signal pickup receiver monitor, cathode ray oscillograph speakers etc., are located on the bulkhead over the camera control desk, Fig. 6. These units are all convenient to the operators and may be viewed by all personnel in the unit.

Opposite this control position are three cabinet units—each consisting of lower and upper cabinets and a drawer to house the three cameras and their components. Each lower cabinet accommodates one camera, stored complete with

viewfinder separated from pick-up head. Sponge rubber-lined drawers provide place for lenses, lens turrets and accessories of each camera. The cabinets store camera auxiliary units and spare parts. A removable ladder leads to the roof deck hatch and an outside door from center compartment is provided.

The front compartment provides comfortable reclining leather seats for the driver and four others. Doors completely isolate this compartment from center section. When broadcasting from inside an announcer's table is clipped into position and microphone plugged into a convenient outlet. Large windows give the announcer a good view of outside action. Stabilizing jacks nullify spring action when the vehicle is stationary and a broadcast is in progress.

Almost any commercial land power source may be used with the provisions made to adapt for single phase two wire, single phase three wire, 115-230 volts or a 3 phase four wire source. In addition, a small motor generator rated at 3 KW and the current capacity of 32 amps. is installed so that a dual camera chain may be operated independent of any outside power source. This unit starts automatically when a 60 watt load is applied. It has even been proved feasible to put a camera on the roof and actually drive down the street with a picture from this camera showing on the monitor tube. (Fig. 1.)

A 15 KW 115-volt regulated motor generator, mounted in a station wagon unit is under construction. This auxiliary power source can be plugged into the power distribution system by a connection panel on the cruiser.

The total operating power requirement of 6 KW is largely dissipated as heat. In order to maintain a comfortable operating temperature two large exhaust fans capable of removing 800 cubic feet per minute have been provided. Air conditioning can also be employed when necessary by either a small unit which will provide partial cooling or a large unit which will be adequate to maintain moderate temperatures under extreme heat conditions.

16-in. Glass TV Tubes

Sixteen-in. glass television tubes are now being produced by Zetka Television Tubes, Inc., 131 Getty Ave., Clifton, N. J. Only metal tubes joined to glass fronts had been available in the 16-inch size heretofore.

BOOKS

Photofact Television Course

By A. C. W. Saunders, and B. V. K. French. Published 1949 by Howard W. Sams & Co., Indianapolis (7) Ind. 215 Pages 8½" x 11", Price $3.00.

The appearance and contents of this book result from a rare combination of skills—based on lectures and classroom illustrations by an educator well known for his skill in presenting radio subjects in simple form, and the precise painstaking editing by a radio engineer and a staff well equipped to see that all statements are sound and accurate. The whole problem of understanding television receivers is covered, at least from the viewpoints of those engaged in installation, service, manufacturing and (to an unusual degree) engineering. While the material is presented as a home study course in 18 sections, the method of handling is suitable for reference use.

The text is concise and the material well selected. Explanations are simple and accurate and the illustrations are highly informative. All factors relating to television receivers and antennas are covered, starting with the cathode ray tube and working back to the description of the circuits that make it function.

PERSONNEL

Orville Sather has been appointed assistant manager of CBS-TV technical operations. He has been field technical supervisor for the past two years.

Louis G. Pacent, president and technical director of Pacent Engineering Corporation, New York City, has been appointed consulting engineer by the Plessey International Limited of Ilford Essex, England. He is a Fellow of both AIEE and IRE, and is a past President of the Radio Club of America.

Frank R. Norton, formerly principal research engineer of Bendix Radio Division, Baltimore, Md., has been named chief engineer of the company's television and broadcast division. Before joining Bendix in 1945, he had been affiliated with Bell Telephone

Daniel E. Noble, director of research and vice president in charge of communications of the Communications & Electronics Div. of Motorola, Inc., Chicago, heads the company's new laboratories in Phoenix, Ariz. being used for military communications research

Harold M. Heimark of Oak Park, Ill., has recently taken over the duties of chief engineer for Doolittle Radio, Inc. of Chicago, builders of precision radio communication equipment.

The JFD Mfg. Co., Inc., has announced the appointment of **Israel Pollack** as head of their ballast manufacturing department. He was formerly with the Signal Corps Radar Labs, production engineer in the Air King Radio Corp. and chief engineer of Paramount Industries.

George W. Brucker has been named Designing Engineer for power electronic equipment in the Industrial & Transmitting Tube Division of the General Electric Co., Schenectady. **Harry C. Steiner** has been appointed designing engineer for industrial tubes and **Thomas A. Elder** has been named designing engineer for transmitting tubes in the same division.

Following 6 months in the television and microwave engineering department of Raytheon Mfg. Co., Waltham, Mass., **William E. Neill** has been appointed sales engineer of the department. He came to Raytheon from WFIL-TV, Philadelphia, where he was assistant chief engineer for television.

(*Continued from page 25*)

Band—MC	Service	Class of Station	Class of Service	No. Channels & Freqs. Alloc. (MC)
8500-9000	Radio-navigation			
9000-9300 (32)	Radio-navigation			
9300-9320	Radio-navigation	Racon	Racon	(9310)
9320-9500 (32)	Radio-navigation			
9500-9800	Radio-navigation			
9800-9900 (5)	Fixed	Fixed		
10600			Industrial, scientific, medical equipment	
10700-11700 (5)	Fixed	Comman carrier fixed		
11700-12200 (5)	Mobile	Land: Mobile (Except TV pickup)		
12200-12700 (24)	Fixed	International Control; Operational Fixed		
12700-13200 (5)	Fixed; Mobile	TV-Pickup; TV-STL (30)		
16000-18000 (5)	Fixed; Mobile			
18000			Industrial, scientific, medical equipment	
26000-30000 (5)	Fixed; Mobile			
Above 30000		Experimental		

Frequency Band Allocations for Government Use (in MC)

24.99-25.01; 25.33-25.85; 26.48-26.95; 29.89-29.91; 30.00-30.56; 32-33-34-35; 36-37; 38-39; 40-42; 108-132; 132-134; 148-152; 162-174; 216-220; 225.0-328.6; 335.4-400.0; 960-1215; 1300-1700; 1700-1850; 2200-2300; 2700-3300; 4200-5650; 7125-9800; 9900-10000; 10500-10700; 13200-16000; 18000-21000; 22000-26000; above 30000

(1) This allocation shall terminate not later than the date when the Atlantic City Table of Frequency Allocations becomes effective as provided by Article 47 of the Atlantic City Radio Regulations. Pending further action by the Commission, this band is not available for the fixed or mobile services. As soon as necessary rules and regulations are provided by rule making proceedings, frequencies in this band will be made available for a disaster communications service comprised of amateurs and other non-government and government groups operating fixed, land and mobile stations, and consisting of a single integrated service for the handling of emergency communications in times of disaster.

(2) This band is temporarily allocated to the radiolocation service for a period of six months from the effective date of this order (Order (Order, FCC 49-190, adopted February 17, 1949), subject to possible temporary continuance beyond that time for such additional period or periods as the Commission may find necessary; **Provided, however,** That this temporary allocation, or any temporary continuation thereof, shall be subject to the use-in-derogation provisions of Article 7 of the Cairo General Radio Regulations and Chapter III of the Atlantic City Radio Regulations; **And provided further,** That this temporary allocation, or any temporary continuation thereof, shall terminate not later than the date on which the Atlantic City Table of Frequency Allocation becomes effective as provided by Article 47 of the Atlantic City Radio Regulations; **And provided still further,** That this temporary allocation, or any temporary continuation thereof, shall be subject to earlier cancellation or modification by the Commission, without the necessity of a hearing, if during any period when such allocation is in effect the Commission shall, in the course of proceedings undertaken by it to determine whether a radiolocation service should be provided on a permanent basis, reach conclusions which, in the opinion of the Commission, require such cancellation or modification. This temporary allocation, or any temporary continuation thereof, is strictly limited to a radiolocation service for the location of petroleum deposits in the Gulf of Mexico. Stations in this service shall be located within 150 miles of the shoreline of the Gulf of Mexico.

(4) In any particular area the Loran system of radionavigation operates either on 1850 or 1950 KC, the band occupied being 1900-1906 or 1900-2000 KC.

(5) On the condition that harmful interference will not be caused to service operating in accordance with the table of frequency allocations, the following classes of stations may be authorized to use frequencies in this band: (1) Experimental stations engaged solely in scientific or technical radio experiments not related to an existing or proposed service nor intended to develop a proposed service or specific use of radio (2) contract developmental stations, and (3) export developmental stations.

(6) Fixed stations listed in "Class of Service" column allocated

frequencies in this band, may use the frequencies allocated to such services on the condition that harmful interference will not be caused to services operating in accordance with the table of frequency allocations.

(7)Emissions from industrial, scientific, and medical equipment using the frequency 27.12 MC must be confined to the band 26.96—27.28 MC.

(9)Operational fixed stations may be authorized to use frequencies in this band in accordance with columns 10 and 11 of the table of frequency allocations, on the condition that harmful interference will not be caused to the reception of television stations on channels 4 or 5. In any area in the continental United States, the Aviation service and Marine service may each be authorized to use four of the frequencies in the band 72-76 MC listed in column 10 for operational fixed stations in these services.

(10)Fixed stations in the Domestic Fixed Public service may be authorized to use any of the frequencies in the band 72-76 MC indicated in column 10, on the conditions that (a) harmful interference will not be caused to the reception of television stations on channels 4 and 5, and (b) that harmful interference will not be caused to operational fixed stations.

(11)Public correspondence in the frequency bands allocated exclusively to the aeronautical mobile service is not permitted.

(12)The use of the frequencies in the block 152.87-153.35 MC may be authorized in any area, to Remote Pickup broadcast base and mobile stations on the condition that harmful interference will not be caused to the Industrial Radio services.

(13)The use of the frequencies 156.27, 156.33, 156.39, 156.45, 156.51, 156.27, 156.63, 156.69, 156.75, 156.87, 156.93, 156.99, 157.05, 157.11, 157.41, 157.47, 161.85, 161.91 and 161.97 may be authorized to base and land mobile stations in the Public Safety Radio Services on the condition that no harmful intereference will be caused to the maritime mobile service. Public Safety Service operations at points within 150 miles of coastal areas and navigable gulf, bays, rivers and likes, may be authorized only after a factual finding indicates that, on an engineering basis, no harmful interference will be caused to the maritime mobile service.

(14) The International intership service has priority on this frequency.

(15) The international port operational service, on a simplex basis, has priority on this frequency.

(16) The frequency 156.80 MC has been designated for world-wide use for safety, calling and intership and harbor control communications in the maritime mobile service.

(17) The use of the frequencies in the block 159.51-161.79 MC may be authorized to base and land mobile stations in the Public Safety Radio Services, in any area, on the condition that harmful interference will not be caused to stations in the Railroad Radio Service.

(18) In the Chicago area only, the frequencies 161.85 MC and 161.91 MC may be authorized to base and land mobile stations only for train communications in the railroad Radio Service.

(19) The use of the frequency 161.9 MC may be authorized to coast stations in any area except at Chicago, Ill. At Chicago, Ill., and in those areas where additional assignments to coast stations of the primary VHF coast station frequency 161.9 MC would cause harmful interference to the reception of that frequency, the use of the frequency 162.0 MC may be authorized to non-government coast stations (F3 emission only). The use of the frequency 162.0 MC will be on the condition that harmful interference will not be caused to government stations in the government band 162-174 MC and in any area, except at Chicago, Ill., the coast station frequency 161.9 MC will be assigned before assignments are made on the frequency 162.0 MC.

(20) In order to provide for inter-communication for safety purposes between government and non-government stations in the maritime mobile service, the frequencies 157.2 and 157.3 MC are allocated exclusively in all areas, to government stations in the fixed and mobile services, and the frequencies 173.225, 173.275, 173.325, 173.375 MC are allocated exclusively, in all areas, to non-government stations in the fixed and land mobile services.

(21) The United States will permit interim use of the band 220-231 MC for the British radar distance indicator system at specific U. S. gateways of international air routes. The interim use at these locations will terminate not later than Jan. 1, 1952. Until Jan. 1, 1952, the frequency band 235-240 MC will be available for allocation to the amateur service in those areas where interference is caused to the operation of the British or Canadian radar distance indicator system by amateur operation in the 220-225 MC band.

(24) Frequencies in this band will be selected for assignment in such a manner that, on an engineering basis, the lowest frequency in the band is assigned which will not cause harmful interference to stations in that area already assigned frequencies in accordance with the table of frequency allocations.

(25) Interim FM relay stations may be authorized to use the band 940-952 MC on the condition that harmful interference will not be caused to stations operating in accordance with the table of frequency allocations.

(26) Frequencies in this band will be selected for assignment in such a manner that, on an engineering basis, the highest frequencies in the band is assigned which will not cause harmful interference to stations in that area already assigned frequencies in accordance with the table of frequency allocations.

(27) The band 960-1215 MC is for distance measuring and other functions related to those performed in the band 1365-1660 MC.

(28) The fixed and mobile services which were operating in the band 1300-1600 MC on April 2, 1948, may be authorized to continue to use such frequencies until December 31, 1952, on the condition that harmful interference will not be caused to the aeronautical radionavigation service.

(29) In non-military aviation, it is not anticipated that the altimeter function will be performed in the band 1365-1660 MC except in coordination with other functions required for an aeronautical radionavigation system.

(30) Interim television relay stations may be authorized to use frequencies in this band on the condition that harmful interference will not be caused to stations operating in accordance with the table of frequency allocations.

(Please turn to next page)

(*Continued from preceding page*)

(31) The radiolocation service may be authorized the use of the band 2450-2500 MC solely for purposes other than radionavigation or safety, on the condition that harmful interference will not be caused to the fixed and mobile services.

(32) The radiolocation service may be authorized to employ this band for radiolocation purposes on the condition that harmful interference will not be caused to the radio navigation service.

Vector Impedance Bridge

(*Continued from page 42*)

values of R_1 and R_2 giving the constant vector sum Z_K.

It remains, then, to derive expressions for the dependent variables R_1 and R_2 in terms of the argument θ.

For plane geometry, $l = \sqrt{de}$;
but, $e = Z_K \sin\theta = X \sin\theta$,
whence, $d = X - e = X(1 - \sin\theta)$.
Substituting: $l = X\sqrt{\sin\theta(1-\sin\theta)}$.
By proportion, $R_1/X = l/d$, or
$R_1 = X\, l/d$.
Substituting:

$$R_1 = X \frac{\sqrt{\sin\theta\,(1-\sin\theta)}}{1-\sin\theta}$$

Now: $l + R_2 = Z_K \cos\theta$,
or, $R_2 = Z_K \cos\theta - l = X\cos\theta - l$.
Substituting:

$$R_2 = X\left\{\cos\theta - \left[\sin\theta\,(1-\sin\theta)\right]^{1/2}\right\}$$

Fig. 5 plots the values of R_1 and R_2 for all values of θ from 0° to 90°.

In Model 100, R_1 and R_2 are varied in steps of five electrical degrees by means of 24-position, shorting-type, ganged switch wafers. The proper value of $\triangle R$ is connected between any two particular adjacent switch points to give correct values of total R over the range. This expedient works well, since it is usually not necessary to know the value of θ closer than ±2.5°. The values of $\triangle R$ used throughout for both R_1 and R_2 are shown on the schematic, Fig. 6. It will be noted that R_1 in the 90° position is open-circuited.

The electrical circuit comprises three functionally separate parts:

1. The self-contained power supply, working directly from the 115-V, 60-cycle, line, consisting of a selenium rectifier and an R-C filter;

2. The simple, but highly stable, phase-shift oscillator which can be set exactly on frequency (1591 cps), by means of the 7-45 μμfd. trimmer, and which feeds the load through a cathode follower;

3. The bridge proper, consisting of the function switch, trimmer resistor for R_V, equalizing resistors, and the three arms whose functions have been described.

The instrument (Fig. 1) is contained in a grey case 3 x 7 x 8½-in. A jack is provided for plugging in the high-impedance headphones which are necessary for detecting nulls. Three binding posts permit connecting the component to be tested in the proper position and a function switch is provided to set up the bridge arms for the kind of electrical quantity to be measured. Magnitude of the unknown impedance is determined by the combined action of the decade resistance arm and the continuously-variable resistance arm; while the phase angle is found quickly by rotating the knob of the CMPVA arm. Each of these operations yields a null, the second null naturally being a more pronounced null that the first.

A little familiarity with the device permits a great variety of impedance values, selected at random, to be measured rapidly in polar form (which can be converted to rectangular form very easily), within the inherent accuracy limitations of the device. In the design and development of the circuits involved, the main objective has been to provide easy, rapid, reliable performance at low cost, and it is felt that in Model 100 this objective has been attained.

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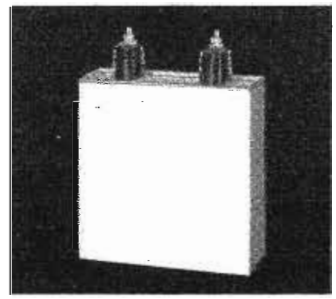

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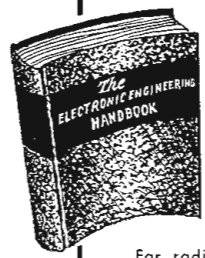

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BULLETINS

Contact Rivets

Electrical contact rivets manufactured by Gibson Electric Co., 8350 Frankstown Ave., Pittsburgh 21, Pa. are described in catalog C-12, published by the company. Included is a description of the electrical contact materials in which the contact rivets are furnished, as well as the standard sizes of the flat, crowned, and the pointed contact rivets. (Mention T-T)

Connector Supplement

A 12-page supplement to the Cannon Electric type "K" bulletin has been issued by Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif. Among the new insert arrangements are various layouts having 1 to 8 coaxial contacts. (Mention T-T)

Resistors

"Technical Data on Welwyn High Stability Carbon Resistors and Welwyn Pyromatic Resistors" is the title of an eight-page catalog released by Welwyn Electronic Components, Inc., 234 East 46th St., New York 17, N. Y. Engineering data on the construction, tolerance and range, stability, as well as temperature and voltage coefficients are included (Mention T-T)

Coaxial Cable

A semi-flexible coaxial cable (type 737) is featured in bulletin 48 recently released by the Andrew Corp., 363 East 75th St., Chicago 19, Ill. Five pages are devoted to accessories specifically designed for use with the new cable. (Mention T-T)

Electronic Control Devices

Ward Leonard Co., Mount Vernon, N. Y. has announced the publication of its new catalog entitled "Electronic Control Devices." Containing over 200 pages, this new catalog gives full descriptive and up-to-date technical data on Ward Leonard's complete line of resistors, rheostats, relays, contactors, motor starters, controllers, and control accessories. Complementary copies are available for those who request them on company letterheads. (Mention T-T)

Waveguide Assemblies

"How to Select Flexible Waveguide Assemblies" is the title of a new brochure which is being made available by Technicraft Laboratories, Inc., Thomaston-Waterbury Rd., Thomaston, Conn. Of special interest is a discussion of rigid-flexible combination assemblies showing the attachment of flexible to rigid waveguides without the use of flanges. (Mention T-T)

TELE-TECH

Advertisers June 1949

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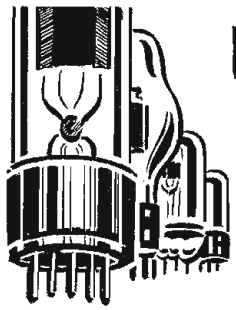

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350-20	1446	12	.2 Amp	G-3½	Min Scr	.07
350-14	49	2	.06	T-3¼	Min Bay	.06
350-15	386	120	3 Watts	S-6	Can Bay	.11
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LB-102	1195	12-16	.50CP	RP-11	DC Bay	.14
LB-104	313	28	.17 Amp	T-3½	Min Bay	.11
LB-105	1816	13	.33 Amp	T-3½	Min Bay	.12
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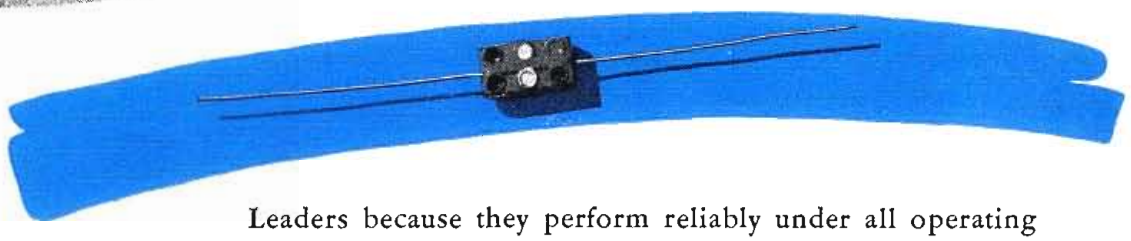
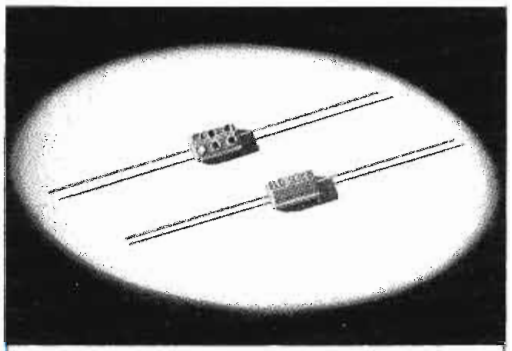
EL-MENCO CAPACITORS

Leaders



Leaders because they perform reliably under all operating conditions, these fixed mica dielectric capacitors are used in electronic applications wherever long life and successful performance are demanded.



CM 15 MINIATURE CAPACITOR

Actual Size $\frac{9}{32}$" x $\frac{1}{2}$" x $\frac{3}{16}$"
For Radio, Television and Other Electronic Applications
2 to 420 mmf. capacity at 500v DCw
2 to 525 mmf. capacity at 300v DCw
Temp. Co-efficient ±50 parts per million per degree C for most capacity values
6-dot standard color coded

Each tiny El-Menco Capacitor must pass life and humidity tests; meet standards set by the United States Army and Navy; pass tests at double their working voltages; prove their dielectric strength, temperature co-efficient and capacitance drift, and have their insulation resistance double-checked. These little leaders are molded in low-loss bakelite and wax-dipped for salt water immersion seal. They're available in a wide range, all impregnated, all precision-made, all JAN, RMA and RCM color-coded.

Why not protect your product's performance with capacitors made under these rigid conditions?

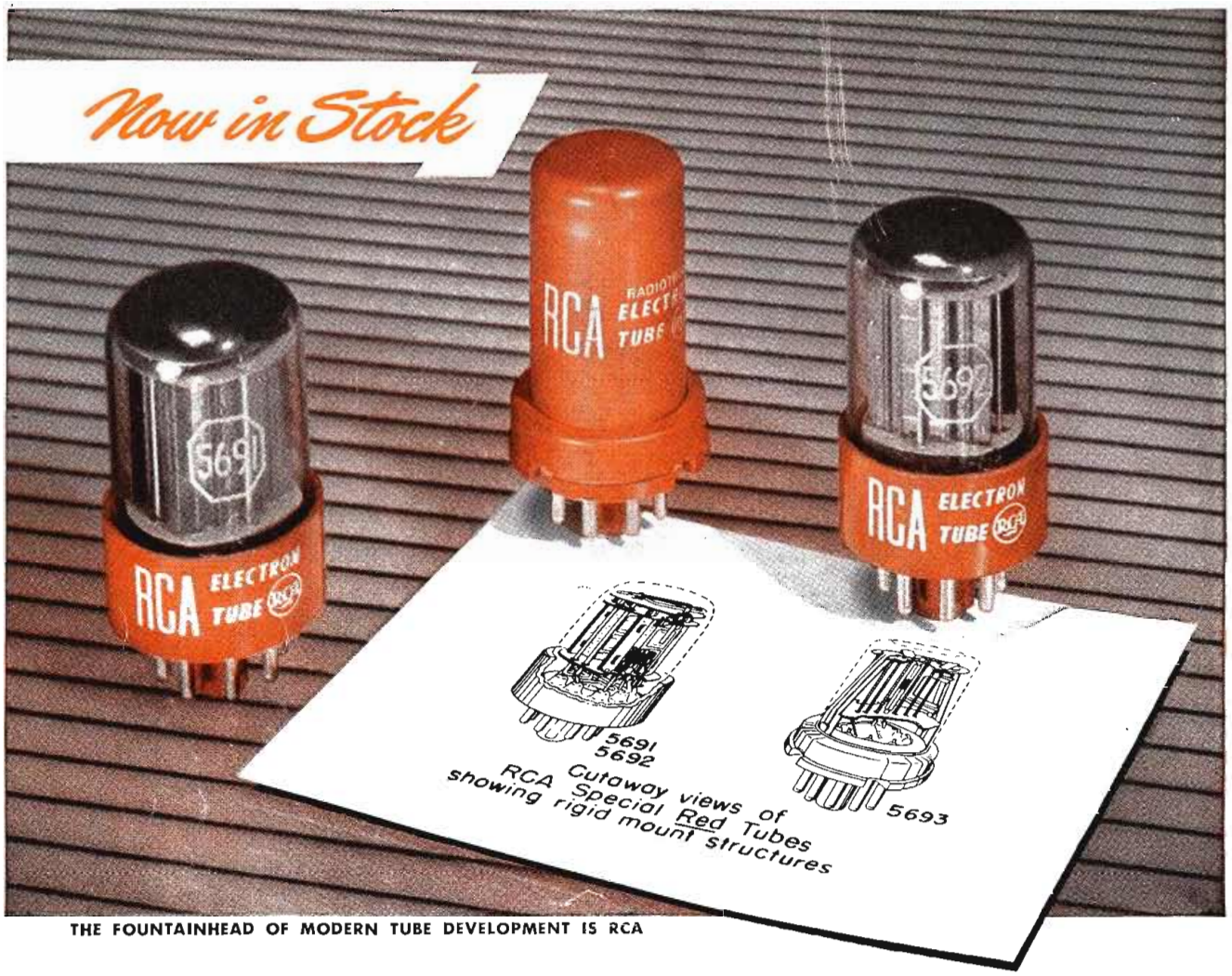
Specify **EL-MENCO**
TESTED • RELIABLE • LEADERS!

THE ELECTRO MOTIVE MFG. CO., Inc.
WILLIMANTIC CONNECTICUT

Write on your firm letterhead for Catalog and Samples

MOLDED MICA **El-Menco** MICA TRIMMER
CAPACITORS

FOREIGN RADIO AND ELECTRONIC MANUFACTURERS COMMUNICATE DIRECT WITH OUR EXPORT DEPT. AT WILLIMANTIC, CONN.
ARCO ELECTRONICS, INC. 135 Liberty St., New York, N. Y.—Sole Agent for Jobbers and Distributors in U.S. and Canada



THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

RCA SPECIAL RED TUBES

Minimum life—10,000 hours!

● *Another RCA First* . . . these new Special Red Tubes are specifically designed for those industrial and commercial applications using small-type tubes but having rigid requirements for reliability and long tube life.

As contrasted with their receiving-tube counterparts, RCA Special Red Tubes feature vastly improved life, stability, uniformity, and resistance to vibration and impact. Their unique structural design makes them capable of withstanding shocks of 100 g for extended periods. Rigid processing and inspection controls provide these tubes with a minimum life of 10,000 hours when they are operated within their specified ratings. Extreme care in manufacturing combined with precision designs account for their unusually close electrical tolerances.

RCA Application Engineers will be pleased to co-operate with you in adapting RCA Special Red Tubes to your equipment. Write RCA Commercial Engineering, Section 57FR, Harrison, N. J. For RCA Special Red Tubes to be used as replacements in equipment now in use, see your local RCA TUBE DISTRIBUTOR.

TABLE OF RECEIVING-TYPE COUNTERPARTS	
5691 (0.6 A. heater)	6SL7GT (0.3 A. heater)
5692	6SN7GT
5693	6SJ7

RCA Special Red Tubes can be used as replacements for their counterparts in equipment where long life, rigid construction, extreme uniformity, and exceptional stability are needed.

SEND FOR FREE BULLETIN—Booklet SRB-1002 provides complete data on RCA Special Red Tubes. For your copy write to RCA, Commercial Engineering, Section 57FR, Harrison, N.J.

TUBE DEPARTMENT

RADIO CORPORATION of AMERICA

HARRISON, N. J.