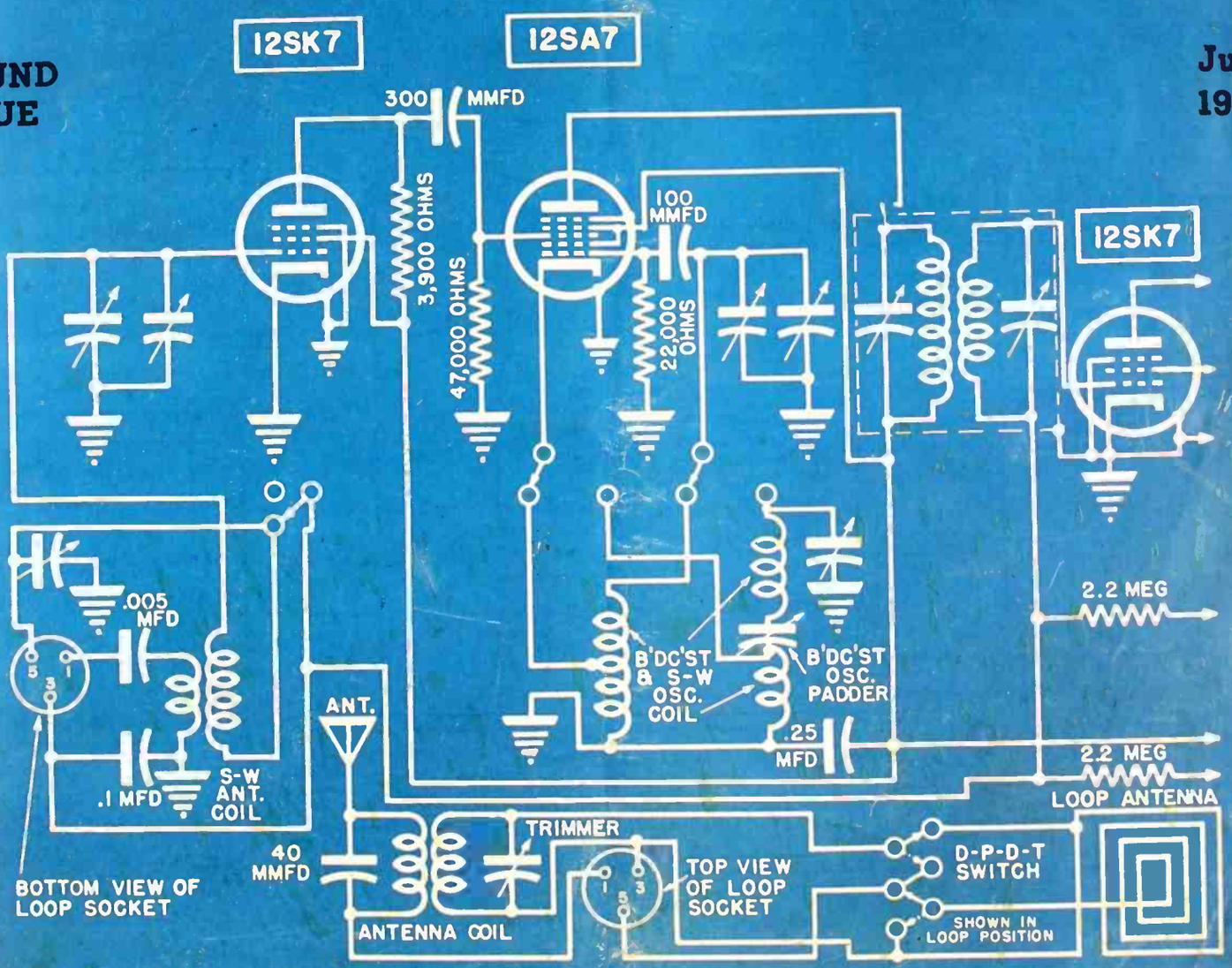
RADIO · TELEVISION · ELECTRONIC

SERVICE

SOUND ISSUE

July 1946



Input circuits of 2-band 5-tube a-c/d-c receiver covering 535 to 1720 kc and 5.6 to 24 mc.

(See page 40)

THE TECHNICAL JOURNAL OF THE RADIO TRADE

My Card, Sir!

These cleverly designed postcards establish your service shop as the leader in your community. Drop them into the mailbox and watch your business perk up overnight. No more idle waiting for customers, no more wondering how to make your service grow. For only 1¢ postage per card — and no other expense — you can reach every live prospect with radios to repair, with dollars to spend. Your C-D jobber can supply you with four different postcard styles to permit follow-up mailings. Cards are imprinted with your name and address — FREE OF CHARGE.

All these sales aids help to make your shop headquarters for radio service in your community.

- NEWSPAPER MATS
- MATCH BOOKS
- COUNTER CARDS
- STATIONERY DECALS
- SHIPPING LABELS
- POSTCARDS
- "C-D CAPACITOR" CATALOGS

let yourself grow! See your local C-D jobber today and order these powerful sales builders. Most of them are free. Get on the "C-D Capacitor" mailing list now, write direct to: Cornell-Dubilier Electric Corp., South Plainfield, N. J. Other plants at New Bedford, Worcester and Brookline, Mass., and Providence, R. I.

CORNELL-DUBILIER
WORLD'S LARGEST MANUFACTURER OF
CAPACITORS

MICA • DYKANOL • PAPER • ELECTROLYTIC

BY HANDLING G-E RADIO TUBES

GOOD business is waiting for you, at a return that will mean handsome profits! And the way to secure these quick-money sales is to *handle G-E radio tubes!*

Owners of radio sets requiring new tubes—every home in your area has one or more such sets—prefer G-E tubes because that's the brand they know best, and respect the most. The famous G-E monogram is found everywhere, on radios, lamps, irons, refrigerators, other household appliances that have given long, dependable service. *Radio owners buy General Electric both by force of habit and from conviction*—and they'll be *your* steady customers for tubes once they see the G-E sign on your door!

Time to stock and sell G-E tubes is *now*, while this hungry market—further stimulated by G.E.'s national electronics advertising—still is looking for a convenient supply source in your neighborhood. Write for information about tube selling rights to *Electronics Department, General Electric Company, Schenectady 5, N. Y.*

Every tube dealer and service man should have G.E.'s Tube Characteristics Booklet ETR-15. Send for your free copy today!

GENERAL ELECTRIC

176-E4-8850

FIRST AND GREATEST NAME IN ELECTRONICS

. . . A READY SUPPLY
OF ELECTRONIC EQUIPMENT and COMPONENT PARTS

available for immediate delivery
to wholesalers, retailers and manufacturers

Here is merchandise you need. Electronic merchandise you can sell at a profit, with or without further processing. And there's plenty of it! Enough to "plug the gap" until your normal sources of supply can replenish your shelves and stockrooms.

RAYTHEON

Excellence in Electronics

It's Army and Navy gear—now being returned to the regular channels of trade by the War Assets Administrator. Acting as agent, Raytheon has a plentiful supply for you—together with a carefully indexed, easy-to-choose-from catalog that's literally bursting with news about the kind of goods you *want, need,* and *can obtain* right away. *Send for this catalog*—it means business for you. Good business, ready business, profitable business.

Most of the equipment is in the communications field—but there are large supplies of components too, electrical and electronic parts that you and your customers can find immediate use for. It's all in the catalog—carefully described—priced—easy to find and easy to order. And of course it's all top-quality equipment, made to Government specifications by America's finest electronic manufacturers.

You'll be missing a bet if you don't take immediate advantage of this opportunity to *sell merchandise at a profit.* The market is hungry for this equipment. The business is there. Get your share of it.

Sending for the Raytheon catalog is the first step. Do that at once. Then get in touch with Raytheon for technical advice and merchandising plans for speedy action.

RAYTHEON MANUFACTURING COMPANY

Acting as Agent of the
War Assets Administrator under Contract No. SIA-3-46

60 East 42nd Street, New York
West Coast Office: 2802 N. Figueroa St., Los Angeles 31, Cal.

RAYTHEON MANUFACTURING COMPANY (S7)
60 East 42nd Street, New York 17, N. Y.

GENTLEMEN: Send your new Catalog of salable and immediately-available items of war surplus electronic equipment to

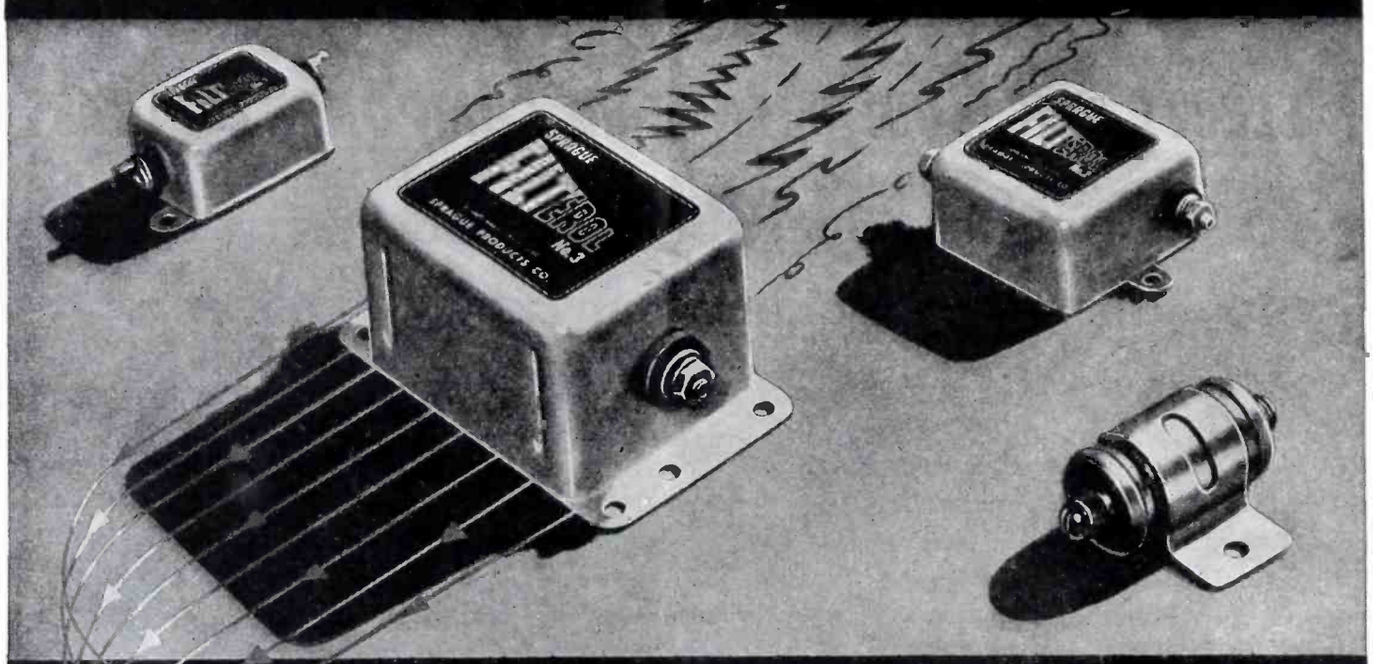
Name.....

Firm Name.....

Street Address.....

City..... *State*.....

GOODBYE TO MAN-MADE RADIO NOISES!



SPRAGUE FILTEROL

The famous wartime 3-terminal network noise filter development

GET THIS NEW CATALOG!

Contains complete details, dimensions, data, etc, on Sprague Capacitors and *Koolohm Resistors for every radio service, amateur and experimental need.

Trademarks Reg. U. S. Pat. Off.

Don't waste time trying to stop man-made radio noises with plug-in filters or by other old-style, inefficient methods. Instead, install Sprague FILTEROLS directly across the line or terminals of the offending device. Do the job in the same efficient manner that made these amazing Sprague 3-terminal networks the outstanding filters for all types of war equipment!

FILTEROL TYPES 1, 2 AND 3

These light-weight, highly compact filters are rated 1, 10 and 35 amperes respectively at 115 volts A.C. They provide effective filtering throughout the entire broadcast band. Their basic circuit is a Sprague 3-terminal network of which the can is one terminal. Selection is based on current rating, the filter used having a rating *higher* than the continuous operating current of the device being filtered. Unexcelled for all small motors, flashing signs and similar radio noise producers.

FILTEROL TYPE 4

This unit incorporates a famous Sprague *HYPASS Capacitor and provides exceptionally high attenuation at frequencies above 5 mc. and is effective up to 150 mc. or more. It is designed for filtering small devices having continuous current ratings up to 20 amperes.

Be the acknowledged interference expert in your locality! Get next to FILTEROLS today!

SPRAGUE PRODUCTS COMPANY

NORTH ADAMS, MASSACHUSETTS

JOBBING DISTRIBUTING ORGANIZATION FOR PRODUCTS OF THE SPRAGUE ELECTRIC CO.

14 RIDER MANUALS

Cover 60 million Radio Sets Now in American Homes

The fourteen volumes of Rider Manual, issued during the past sixteen years, are the only single source upon which radio servicemen can depend for authoritative servicing data on sixty million receiving sets now in American homes. These sets, all issued before 1942, are the ones most likely to develop faults.

In this connection it is significant that Rider Manuals, covering American receivers sold between 1920 and 1942, continue their unchallenged leadership in the field of radio servicing reference books.

The reason for this is that they have consistently demonstrated their reliability, their accuracy, and their completeness — their value as timesavers when localizing troubles in faulty receivers. In them will be found such vital material as receiver schematics, voltage data, alignment data, resistance values, chassis layouts and wiring, and trimmer connections.

Volume XV, now in preparation, will represent the wealth of experience we have gained from sixteen years of specialized publishing for the radio servicing industry. It will be bigger, contain expanded servicing information that will save each individual service man hundreds of hours every year he uses it. This vital information will not be available from any other source.

Check the list below. Order from your jobber today.

NOW IN FOURTEEN VOLUMES

Volumes XIV to VII	each volume	$15.00
Volume VI		11.00
Abridged Manuals I to V	(1 volume)	17.50
Record Changers and Recorders		9.00

GET ON THE MAILING LIST
First Post-War Issue
Now In the Mails
"SUCCESSFUL SERVICING"

This monthly publication, dedicated to the financial and technical advancement of the radio and electronic maintenance man, is yours for the asking. Just . . .

— — — — — — — — MAIL COUPON — — — — — — — —

JOHN F. RIDER PUBLISHER, INC.
404 (b) Fourth Ave., New York 16, N. Y.

Name .....
Address .....
City .....
State .....

JOHN F. RIDER PUBLISHER, INC.

404 FOURTH AVENUE, NEW YORK 16, N. Y.

Export Division: Rocke-International Corp., 13 East 40th Street, New York. Cable ARLAB

RIDER RADIO BOOKS KEEP YOU IN TOUCH WITH SUCCESS

This new Rider Book, soon to be announced, will be of lasting usefulness to every maintenance man, student, instructor or engineer interested in any phase of radio.

The Cathode Ray Tube at Work
Accepted authority on subject . . . 4.00

Frequency Modulation
Gives principles of FM radio . . . $2.00

Servicing by Signal Tracing
Basic Method of radio servicing . . 4.00

The Meter at Work
An elementary text on meters . . . 2.00

The Oscillator at Work
How to use, test and repair 2.50

Vacuum Tube Voltmeters
Both theory and practice . . . 2.50

Automatic Frequency Control Systems
—also automatic tuning systems . . $1.75

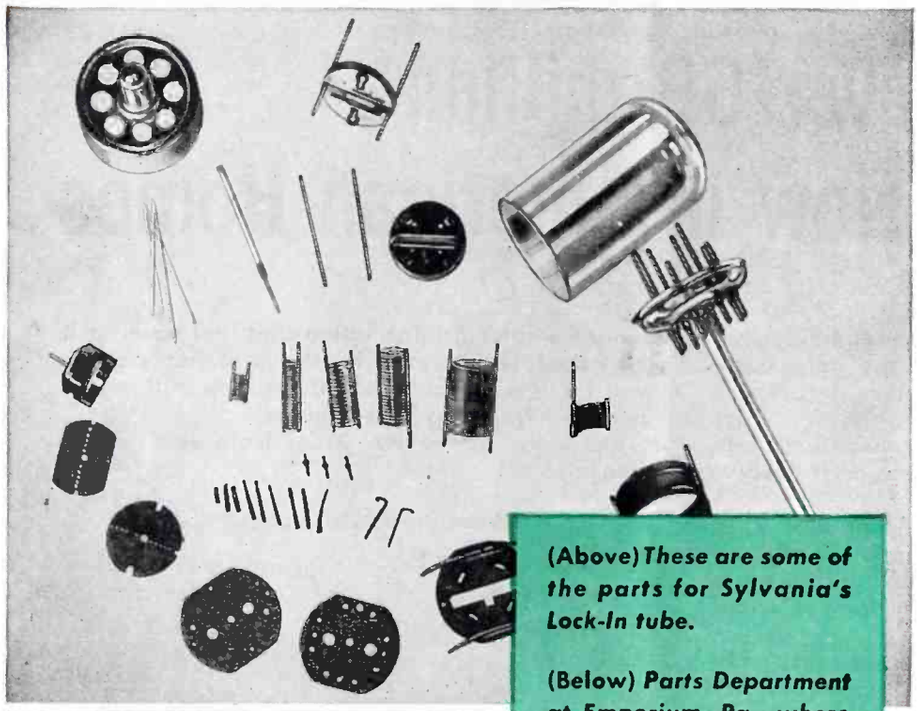
A-C Calculation Charts
Two to five times as fast as slide rule . 7.50

Hour-A-Day-with-Rider Series—
On "Alternating Currents in Radio Receivers"
On "Resonance & Alignment"
On "Automatic Volume Control"
On "D-C Voltage Distribution" . 1.25 each

SYLVANIA NEWS
RADIO SERVICE EDITION

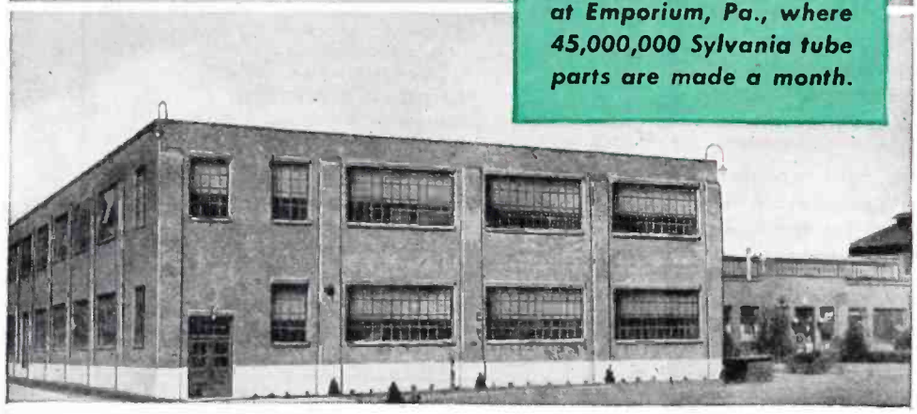
JULY *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1946

SYLVANIA MAKES OWN TUBE PARTS AS AN EXTRA GUARANTEE OF QUALITY



(Above) *These are some of the parts for Sylvania's Lock-In tube.*

(Below) *Parts Department at Emporium, Pa., where 45,000,000 Sylvania tube parts are made a month.*



"Do it right" has always been a guiding principle of Sylvania tube production.

For instance, at Sylvania's Emporium, Pa. Tube Plant, there is a Parts Department that makes over 45,000,000 precision tube parts a month.

Sylvania even has its own Tungsten Plant, where fine wire filament for Sylvania tubes is made—to safeguard the quality of this vital tube element.

QUALITY *AND* QUANTITY

By making its own parts, Sylvania can (1) control raw materials and processing to an extent not surpassed by any other tube manufacturer, and (2) provide a constant supply of parts for rapidly increasing tube production.

You benefit by receiving tubes that have been tested and proved at every stage of manufacture—quality *SYLVANIA-MADE* tubes.

Share Wheat And Fats.
Fight Famine!

RADIO · TELEVISION · ELECTRONIC
SERVICE

Trends in Sound

LOUDSPEAKERS

A Discussion of P-M Type Speakers and Their Application to P-A Work

by S. J. ARTHUR

MANY SERVICE MEN undoubtedly look back on the early days of public-address systems and recall how simple it was to decide which loudspeaker to use. There were so few types then, there was really little choice. Today, the situation is vastly different.

The least expensive class of speaker is the direct-radiator cone type, Figs. 1 and 2. These commonly range in nominal sizes: 2", 3", 4", 6", 8", 10", 12", 14", 15" and 18". There are one or two types slightly different than these nominal diameters, and some specials of larger diameter, but those shown are the generally procurable sizes under normal conditions. These speakers when mounted on suitable baffles use normal wattage inputs of from 1 watt to 30 watts, the exact ratings of the various sizes depending on the amount of copper (usually used) in the voice coil and the magnetic energy in the air gap as determined by the kind and volume of p-m used.

Voice coil impedances are generally 4 ohms on the smaller types and 6-8 ohms on the larger, although some large cones have small voice coils with the lower impedance. There are some special lines of smaller cone speakers which have impedances of between 2 and 3 ohms, and a type used for intercommunication work with impedances in the 40- to 50-ohm range. However, the 4- and 8-ohm impedance types are the generally accepted standards.

There is another fundamentally different type of cone speaker which has limited application. This is the so-called *magnetic-type* in which a vibrating reed drives the cone; Fig. 3. As the coil which actuates the reed is essentially high impedance, this type speaker can be connected directly in the plate circuit of the power tube

*Although only p-m speakers are analyzed in this paper, their basic designs are applicable to field coil types, where increased coil heat is a factor.

Fig. 1. Typical cone speaker using *slug* of alnico.

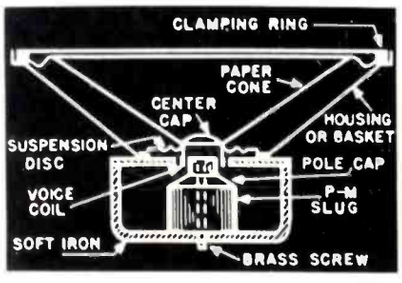


Fig. 3. Magnetic reed-type cone speaker.

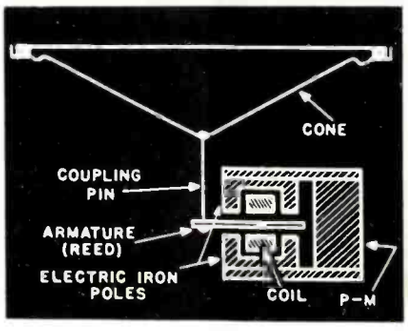
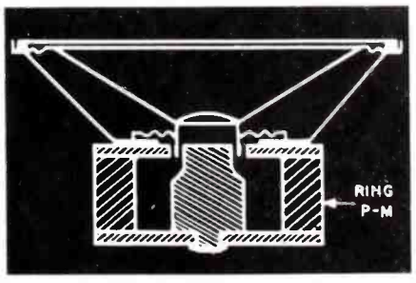


Fig. 2. Typical cone speaker using a ring of alnico.



without an output transformer. It is only suitable for low-power applications and its response is much inferior to the conventional moving coil type of cone speaker.

Where amplifier power is an economic consideration, the efficiency of the speaker is of great importance. For a given size cone and voice-coil structure, there are speakers with both large and small magnet volumes. There are two common magnetic structures; one using a slug magnet, Fig. 1, and one using a ring magnet, Fig. 2. Generally the slug type has less magnetic material than a ring type on a given size cone or voice-coil structure. Thus the type of Fig. 1 would be less efficient that the one in Fig. 2, unless of course a better p-m material is used for the Fig. 2 speaker. P-m materials commonly used are alnico (blue or green) and alnico V. To judge the effectiveness of a magnetic assembly information covering the magnetic energy in the air gap should be studied. These data are invaluable in comparing speakers on a cost-efficiency basis.

All direct-radiator speakers are intended for use with some sort of baffle. There are many types of baffles, the simplest being a flat baffle, Fig. 4. The flat baffle is not often used in modern work as a very large size is required to prevent a *hole* in the response curve at the lower frequencies. This is due to the sound from the rear of the cone cancelling that from the front where the wavlength of a bass tone becomes about equal to the width of the baffle. A cabinet with the back open suffers the same disadvantage (Fig. 5), but this is overlooked where convenience is more important, such as in portable systems. Here the cone is often mounted in the cover of the amplifier case, or two speakers are mounted in the two halves of a single case.

Another type baffle is the cabinet, closed at the back. These are made for practically every size of speaker. They have the disadvantage of cabinet resonance which peaks the response markedly at some frequency depending on the size of the cabinet; that is, the smaller the cabinet the higher the peaked frequency. In commercial designs this frequency is usually well below 1,000 cycles, even in the smallest cabinets. However, the use of dampening material in the cabinet reduces this peaking effect to a tolerable amount and sometimes small slits or holes in the back are used for this purpose with varying success. Fig. 6 illustrates typical closed cabinet baffles. The larger type is sometimes referred

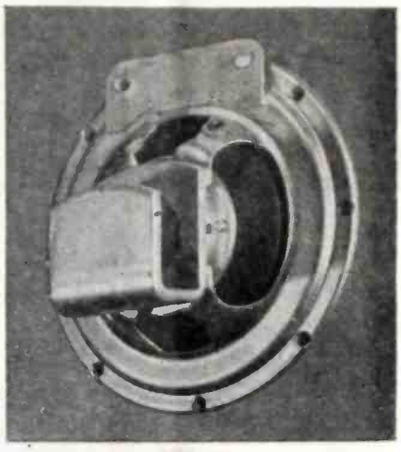


Fig. 3a. Permanent-magnet speaker using alnico V. (*Courtesy Quam-Nichols Co.*)

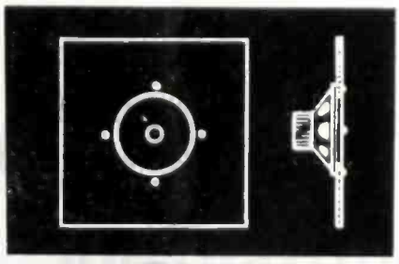


Fig. 4. Cone on flat baffle.

Fig. 5. Cone in open-back cabinet.

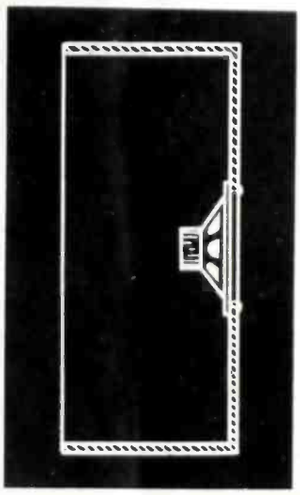
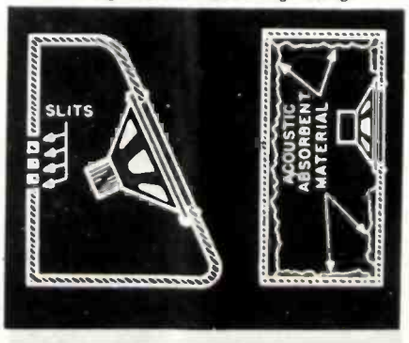


Fig. 6. Left, cone in closed cabinet with slits in back for relief of cavity. Right, *infinite* baffle showing acoustic absorbing lining.



to, although inaccurately, as an *infinite* baffle.

One of the most effective methods of reducing cabinet resonance and smoothing out the bass response is by use of the *bass reflex* design. A common method of accomplishing this is by having a properly proportioned opening in the cabinet just below the cone, Fig. 7.

Where coverage in opposite directions is required using a single speaker, the bi-directional short horn baffle is sometimes used. A sketch of this arrangement is shown in Fig. 8.

Another kind of baffle is the radial or 360° type, shown in Fig. 9. The response in this case is not too good, and the higher frequency coverage suffers. This type is intended for mounting overhead. When the speaker design is such that low frequencies are radiated, sound distribution over a wide area is effected. This type speaker and other cone speakers using horn baffles or projectors, Fig. 11, are subject to disagreeable resonances due to the necessarily small back enclosure on the cone. Absorbing material, small openings, etc., reduce this effect but usually not sufficiently to make the usual commercial models of these speakers entirely satisfactory. The applications of the direct radiator cone and baffle type of speaker are numerous and varied. Most good designs produce relatively good output up to 5,000 or 6,000 cycles, directly in front *only*, as the higher frequencies are beamed quite sharply. The low-frequency response is good, and depending on the size and type of baffle used, the lower frequency cut-off can be extended down to the region of 40 cycles in the larger sizes particularly. Thus this general class of speaker is suitable where both music and speech are to be reproduced over a relatively wide angle of coverage on the low frequencies, with reasonably acceptable quality in both.

Much more effective speech coverage over the desired area can be secured with horn and diaphragm-unit speakers. The cone speakers usually overemphasize the bass and suffer on the higher frequencies too much to give as effective results as the other type. (The advantages of the horn and driver type will be covered later.)

It can be generally stated that no direct-radiator cone speaker approaches the effectiveness of coverage over a given area with as uniform response and as high efficiency as the horn and unit type, with the possible exception of the low-bass-note reproduction. The nearest approach is a very efficient cone structure with a

large horn projector, but the response of this type usually has bad peaks and depths throughout the range by comparison. This type does, however, if properly designed, afford better low-frequency range than the regular horn and unit type of the same length.

There are special voice-reproduction type cone speakers, mounted in special baffles, in which the low frequency end is suppressed compared to the higher frequencies. These are chiefly useful in low-power, low-cost installations.

Unless particularly designed and constructed of materials to withstand weather, the cone type is primarily intended for indoor use.

In installations using microphones in the same room or area, direct-radiator types will cause feedback unless placed a good distance away or the level kept down. This is due to their property of radiating low frequencies over a wide angle.

This type speaker is particularly useful in installations where diffuse coverage of music, announcements, etc., are desired in a large hall, pavilion or the like, where the noise level is not too high and where it is preferable that the individual sound sources are not apparent.

The other general class of loudspeakers in common use is the horn and diaphragm driver unit type. In most of these the driver unit is separate, being designed to screw onto or be bolted onto, the horn. The ordinary sizes are *approximately* 3", 4", 5" and 6" in diameter, although these sizes are not exact, varying with different manufacturers. There is considerable variation in the efficiency and maximum power-handling capacity of any given size of different manufacture. Some 3" units will handle no more than 10 watts, while other brands will withstand 20 watts. The 4" to 6" sizes are nominally rated at 25 watts, the chief difference between sizes being in efficiency; the largest size produces more output with less distortion and less heating when used on equivalent horns. Heating, of course, affects the ultimate life of the unit.

The ratings of power and the efficiencies depend upon the amount of copper (or aluminum) in the voice coil and the magnetic energy density in the air gap, as in the cone-speaker units. In addition, the design, materials used and construction, greatly affect the maximum power capacity and the life of these units. They carry higher power, are more efficient, and are subject to much greater forces than the average cone speaker. Hence they are designed and built with much greater care and precision.

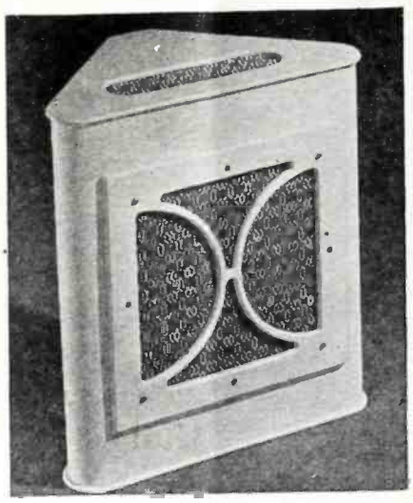


Fig. 6*a*. Corner type speaker cabinet, available with 6", 8", 10" and 12" speakers. (*Courtesy Vibraloc Mfg. Co.*)

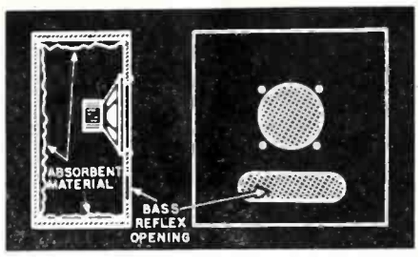


Fig. 7. Bass-reflex cabinet for cone speaker.

Fig. 7*a*. Jensen reflex type cabinet.

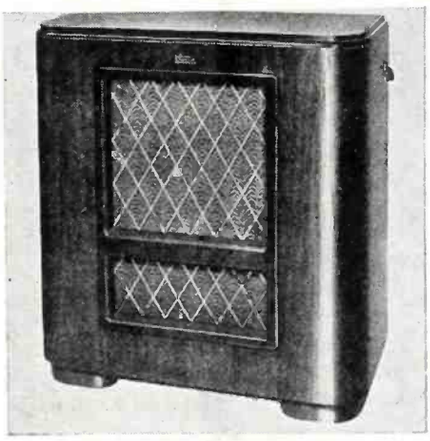
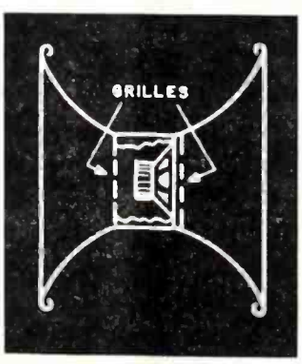


Fig. 8. One type of bi-directional cone baffle utilizing both back and front radiation.



Voice-coil impedances are nominally 8 ohms for 3" diameter units and 16 ohms for the larger sizes, except for one make of 3" unit which has an impedance of 18-20 ohms.

Ring-Type P-M

Most diaphram-type driver units use ring p-m's to get the relatively high-flux density required in the air gap. The material used is usually either alnico (*blue or green*), although one high-impedance 3" unit uses alnico V. Here again it is important to consider the cost of various brands of one size, with efficiency in mind, as measured by the efficacy of the magnetic material. Thus the magnetic density in the gap, or the relative flux density, for comparable size air gaps, should be compared. The weight of the magnetic material is an unreliable guide unless the type of alnico used is known.

Driver Unit Design

The design of the usual driver unit differs from the cone type in that the three essential parts—the magnetic assembly, the sound chamber, and the diaphragm—can be disassembled. This permits the diaphragm to be replaced, if necessary, in those units provided with automatic centering means. In those designs having no such provision, the whole unit or at least the *head* assembly must be returned to the manufacturer for diaphragm replacement. A typical driver unit in the 5" and 6" class is shown in Fig. 12. This type uses dowel pins to align the diaphragm, sound chamber, and magnetic assembly. A single cavity sound chamber is used. Another type using a plug in the sound chamber is shown in Fig. 13. This design extends the response to about 7,000 cycles more uniformly than the other sound chamber, in this size unit. A 3" commercial unit using a similar principle is shown in Fig. 14.

Another design chiefly useful for speech reproduction, due to intentional suppression of the lower frequencies in the voice range, is shown in Fig. 15. The diaphragm is the annular or ring type.

Diaphragm Structure

Diaphragms are of aluminum alloys or molded plastic material, both of the thermoplastic or thermalsetting types. The latter are usually incorporated in a base of cellulose fibres, cotton fabric, linen, silk, or similar materials. The phenolic impregnated fine cotton or

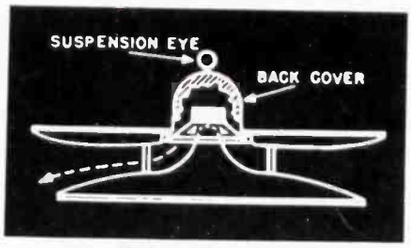


Fig. 9. Section of radial baffle for a cone speaker.

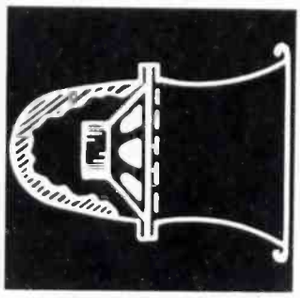


Fig. 11. Cone in short horn baffle.

Fig. 12. Conventional horn driver unit: 5" type.

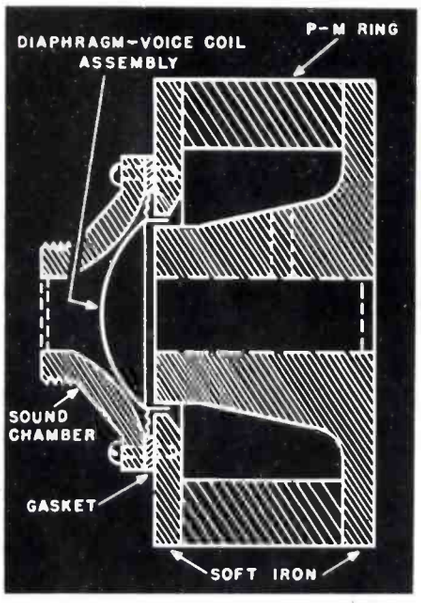


Fig. 10. Radial 360° horn with driver unit. (*Courtesy Atlas Sound Corp.*)

Fig. 12*a*. Driver unit for 25-watt powers. (*Courtesy University*)

linen material can be molded very light and accurately today, and it is by far the most reliable and rugged for commercial diaphragms. The fabrication of the voice coil and its leads is a most important factor in determining the abuse a unit can withstand. There are several good designs but the effective result depends upon the use of proper materials and careful control of the manufacturing processes. All reliable manufacturers run *life* tests on a percentage of production run units. Only those makes which withstand continuous running at full-rated power, day after day, can be considered as near trouble-proof in service as the Service Man has a right to expect.

The conventional sizes and types of driver units described are intended to be used as horns. There are many types. Straight trumpets, used in the past, are almost obsolete as they occupy too much room and are difficult to mount. The re-entrant and folded horns have almost entirely replaced the trumpet. The former has found widest p-a applications.

Re-entrant horns are available in lengths from about 1′ to somewhat greater than 2′ in steps of approximately 2″. There are four ranges that

Fig. 12*b*. Large horn driver. (*Courtesy Atlas Sound*)

usually provide maximum acoustic performance: 1′, 1¼′, 1½′ and 2′. Most manufacturers provide a threaded throat with a 1⅜-18 thread to accommodate standard driver units in the 5″ to 6″ class. Some manufacturers make special horns and units which are bolted in place, and of course cannot be

Fig. 13. Horn driver with plug-type sound chamber.

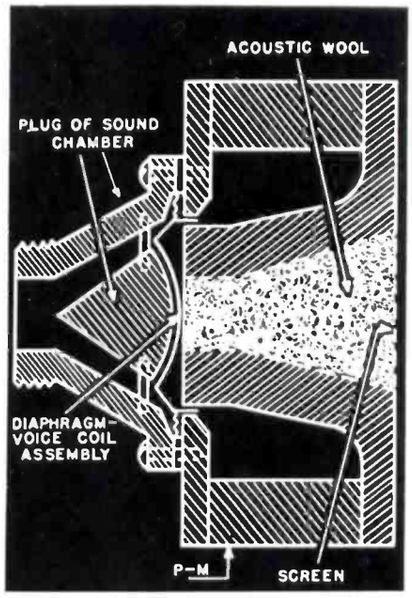
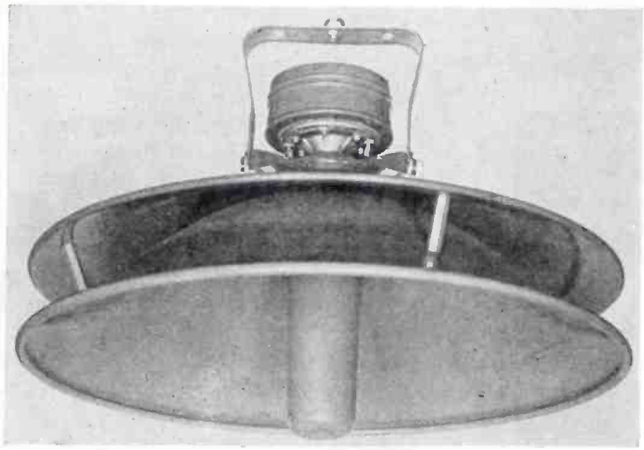


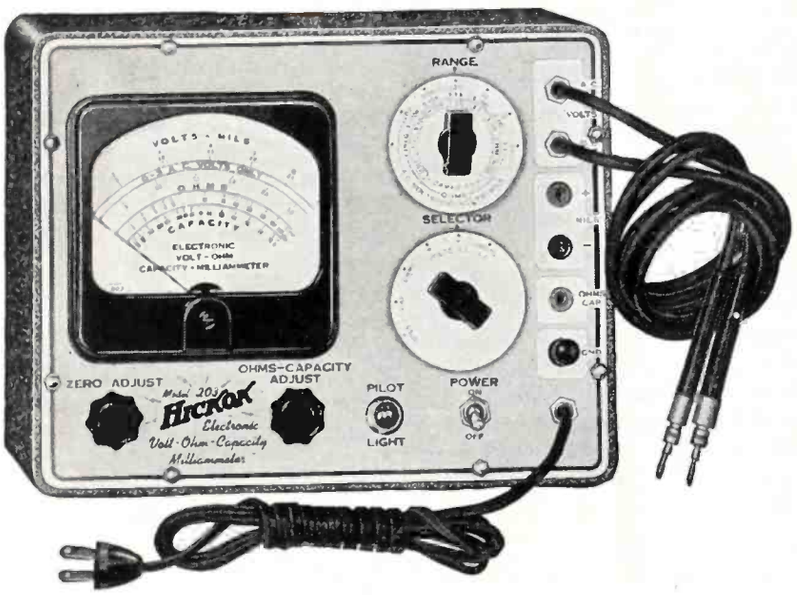
Fig. 10*a*. Radial cone speaker, with a 12″ speaker. (*Courtesy University Loudspeaker, Inc.*)



THE NEW HICKOK 203

five instruments in one

An Electronic Volt-Ohm-Capacity-Inductance-Milliammeter



This new Hickok Model 203 is much more than an improved volt-ohm-milliammeter for it also measures capacity and inductance.

An excellent test instrument for all radio and electronic service work. Accurately measures wide ranges of inductances, capacitances, resistances, currents, and voltages, A. C. and D. C., easily and quickly.

This new Model 203 has a wide range of *capacitance* coverage with a ratio of 1,000,000,000 to one. It also provides for *inductance* measurements.

Features extreme accuracy in A. C. measurements at frequencies ranging well over five megacycles. Regulated power supply, five tubes and a pilot light. Write for literature, or see your distributor. Our deliveries are pretty good now.

SPECIFICATIONS

1. **Power Supply Required:**
   105-125 V, 50-70 cycles, A-C.
2. **Consumption:**
   20 watts at 115 V
3. **Ranges:**
   a. Volts, A-C: 0-3, 12, 30, 120, 300, 1200
   b. Volts, D-C: 0-3, 12, 30, 120, 300, 1200
   c. Mils (D-C): 0-3, 12, 30, 120, 300, 1200
   d. Cap: 0-10,000 mmf in 2 ranges
   0-1000 mf in 5 ranges
   Ind: 50 mh-100 henries (use conversion chart)
   e. Ohms: 1.0 ohm to 10,000 megohms in 7 ranges
4. **Frequency:**
   A-C up to approximately 5 megacycles.
5. **Input Impedance:**
   a. Volts D-C: 15 megohms
   b. Volts A-C: 12 megohms
6. **Tube Complement:**
   2 6X5GT A-C rectifiers
   1 6SJ7 cathode follower
   1 6SN7GT vacuum tube voltmeter
   1 0D3/VR150 voltage regulator

Dimensions: 9" x 11½" x 7"
Weight: 13 lbs.
Meter: Model S44A
Satin-chrome finish panel
Blue baked crackle lacquer finished case

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10521 DUPONT AVENUE • CLEVELAND 8, OHIO

used with any other unit or horn respectively.

The horns, with driver units intended for them and their frequency ranges appear in table 1. These data are only approximate, varying with the manufacturer; cutoff is not necessarily sharp and definite in these speakers.

The 3″ size driver unit is used in two quite different types of horn speakers. One type is similar to the above larger types, in that the unit is separate and threads into the re-entrant horn. It is suitable for voice only having a frequency range of approximately 300 to 5000 cycles flat, but tapering off gradually at the low-frequency end.

The other type horn using a 3″ driver unit is assuming importance in that it is finding wide application in p-a work. In this type the unit and horn are manufactured as one integral assembly, as shown in Fig. 17. This type loudspeaker is approximately 9″ overall length, with an 8″ bell, and will handle 10 to 12 watts input safely. The frequency range covered is from between 100 and 200 cycles to 5000 to 6000 cycles. It thus will give fairly tolerable music reproduction, but is excellent for speech to accentuate the important frequencies for good intelligibility, yet not sacrificing naturalness to a disagreeable degree. The parts are in general, not replaceable, except by the manufacturers.

A shallower type re-entrant horn is also being made now. This type is primarily intended for speech reproduction, having a frequency range of about 250 to 5000 cycles in the larger sizes, and about 400 to 5000 cycles in the smaller sizes. It has found wide application in marine systems where space is at a premium. Even the large sizes do not protrude farther from the wall or bulkhead than most other equipment mounted there.

There are various sizes of this type horn, the large size most widely used

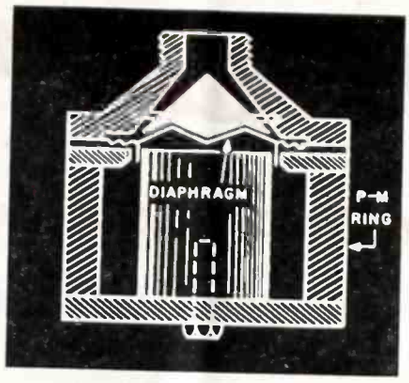


Fig. 14. Three-inch type driver unit with sound chamber plug.

being about 10″ deep and 15″ diameter. The larger sizes accommodate the 4″ to 6″ units with a 1⅜-18 thread. About the smallest size, which also has found considerable application in intercommunication p-a installations is only about 5″ deep and takes the 3″ unit. Fig. 18 illustrates several types designed to conserve space.

Another type of horn, used chiefly in theatre work and the like, is the folded or curled horn. They are mainly useful in applications where horn-driver units must be used for high output and efficiency at much lower bass frequencies. This requires an exceptionally long horn with relatively heavy, non-resonant walls, and the curled horn is the logical solution.

A very useful type horn where a single overhead sound source is required is the radial or 360° horn, referred to in connection with cone units, Fig. 19. When designed for use with driver units, (i.e., with small throats) it is possible to obtain much more uniform response than with those types using cone speakers. In the conventional sizes used, that is, 2′ to 2½′ in diameter, the low-frequency range does not extend as far down as with an equivalent cone-speaker type. However, with reproduction of lower frequencies down to 150 cycles approximately, they are satisfactory for music as well as speech in industrial plants, skating rinks and similar installations. Here it is more important to reproduce the essential ranges of voice and music with as much power as possible, than to sacrifice the middle or upper frequencies so as to get the deep bass tones.

Horn and driver-unit loudspeakers find their greatest application where high efficiency and the best sound coverage over a specified area is required. At any given frequency their radiation angle is less than a cone type, with few exceptions. This is particularly true at the very low frequencies as the output of this type drops off rapidly, by comparison. These properties allow a relatively large percentage of sound to be *laid down* over a desired area, and less sound radiates to unwanted areas where microphones may be placed. Hence much more power can be radiated and with less amplifier power, before feedback occurs, than with a system using cone speakers.

Horn and driver-types are far superior to other types in noisy locations as both the shape of their response and their ability to convert a large percentage of amplifier power to effective sound, where it is wanted, enables

Approx. length	Approx. bell diameter	Approx. range
1′.....	13″ to 14″	150-250 to 4000-7000
1¼′....	19″ to 21″	125-175 to 4000-7000
1½′....	23″ to 25″	100-150 to 4000-6500
2′.....	26″ to 30″	85-125 to 3500-6000

Table I

Fig. 15. Horn driver unit with annular type diaphragm.

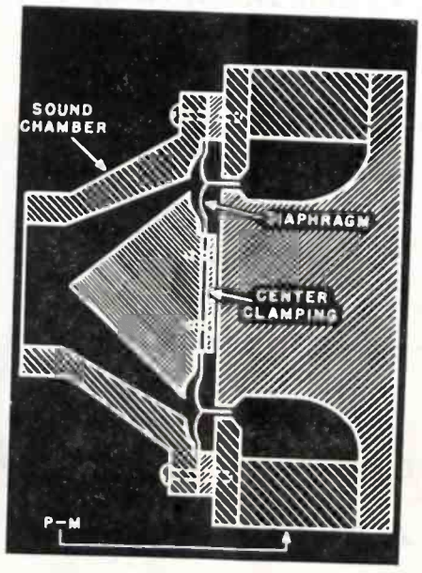


Fig. 15*a*. Annular driver. (*Courtesy Jensen Radio Mfg. Co.*)

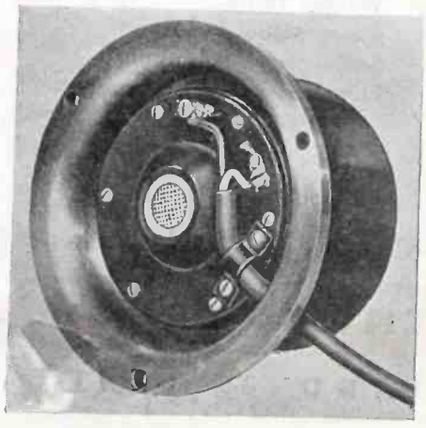
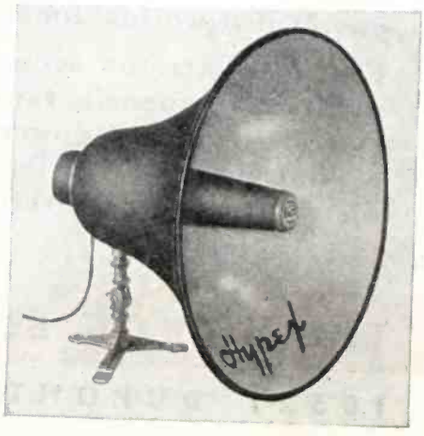


Fig. 15*b*. Projector with annular drive. (*Courtesy Jensen*)



Type	Satisfactory for	Kind of Use	Power Capacity	Efficiency	Comments
Small cones in cabinets and short horn baffles, etc.	Average quality speech and music.	Indoors: quiet offices, small halls, chapels, using several for adequate coverage where rigid.	Low.	Low.	Low register predominates. Guard against microphone feedback (if used).
Large cones in infinite and bass-reflex cabinets.	Speech. Best music quality of single-channel speakers.	Indoors: halls, studios, small theatres, cabarets, etc., with low-to-medium noise level.	Medium.	Low.	Lows diffuse. Highs good only on axis of cone. Guard against feedback to microphone in announcing systems.
Cones in radial baffles.	Passable speech and music.	Indoors: small dance halls or restaurants—360° when suspended overhead.	Depending on size of cone used.	Low.	Very diffuse. Guard against feedback. Lower register over-accentuated and *boomy* usually.
Weatherproof; medium size cones, high efficiency type, in projector horns.	Good quality music and fair quality speech.	Outdoors: fairgrounds, arenas, etc., where background music over reasonable distance is more important than speech intelligibility.	Medium to high.	Medium.	Moderately directional.
Smallest horn and driver unit assembly types.	Speech, good. Music, passable.	Intercommunication systems, noisy offices and shops, small halls, pavilions using several if required. Indoors and outdoors.	Medium.	High.	Less low bass than cones; less diffuse; less feedback to microphone, if used. Gives *punch* to speech.
Radial horns and driver units.	Speech, good. Music, passable to fair.	360° coverage from overhead position. Good for coverage in large industrial shops, skating rinks, etc. Indoors or outdoors.	High.	High.	Fairly flat speech response. Low bass lacking but adequate. Microphone may usually be used directly beneath speaker.
Large horn and driver unit types.	Speech, best high intensity. Music, fair on large types; passable on smaller sizes.	Sports arenas, noisy pavilions, and recreation areas, shipyards, industrial shops, airports, etc., where clear speech or music can be obtained, where required, even with considerable noise level present.	High to very high.	High.	Flat speech response. Bass tones extended by larger size horns. Area of coverage more directive. Less trouble with microphone feedback. Echo and reverberation effects more easily reduced.
Suppressed bass horn and driver unit types.	Speech, primarily.	For obtaining intelligible speech under extremely noisy conditions, such as on shipboard, rolling mills, railroad locomotives, etc.	Low to very high depending on size selected.	High.	Overemphasized speech frequencies cause unpleasing quality except under noisy conditions. Low feedback and echo effects.

Table II

A condensed tabulation showing comparative uses, limitations, etc., of the various type speakers.

speech particularly, to *cut through* the noise.

These same properties, plus the rugged and weatherproof construction used by all reliable manufacturers, make this type speaker the most suitable for outdoor use such as at ball parks, pavilions, beaches, sound trucks airports, etc., as well as for indoor use where they will not be nursed, as in industrial plants, rinks, sports arenas, railroad stations, etc. A very important use is in large reverberant spaces such as armories, aircraft hangars, large depots, etc. *Particularly* those types which do not transmit the lower

(*Continued on page 28*)

Fig. 16. Straight trumpet horn and reflex horn, showing reduction in overall length in reflex horn at same length air column.

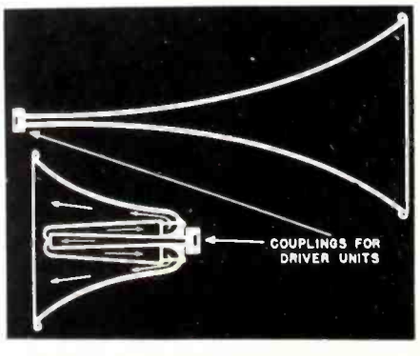


Fig. 16*b*. Reflex speaker trumpet with a 4½' air column. (*Courtesy University*)

Fig. 16*a*. A 6' folded horn. (*Courtesy Atlas*)

Trends in Sound

MICROPHONES

by

RICHARD L. STEWART

THE MICROPHONE IS ESSENTIALLY an instrument for converting sound waves into electrical energy. Characteristics of interest to the Service Man are audio voltage output of the microphone, durability, frequency range, pick-up field, and terminal impedance. These characteristics influence the choice of microphone to be used in any p-a system installation.

The first point to determine is what type of microphone is best suited for a particular installation. Or expressed another way, what characteristics should microphones have for particular services.

Where a microphone is to be used indoors for speaking, it is desirable to eliminate those sounds originating in back of the microphone, particularly audience noise, room echo, and acoustic feedback. For this service, the unidirectional microphone is best suited. A unidirectional microphone will respond best to sounds originating directly in front of it, or slightly to one side. In addition, the frequency response should be limited to voice frequencies. The directional quality of a microphone is only partly due to the type, and is often influenced by the casing employed.

If the microphone is to be used for orchestral reproduction, it should not only have a wider frequency response but a wider response pattern. A microphone with a cardioid pattern response is better suited for this type of work. Its response curve is heart shaped, with the microphone at the inward peak point. This type of microphone will pick up sound equally well from all directions within a 180° angle, yet attenuate sounds originating in back of it.

The bi-directional microphone is used almost exclusively in radio broadcasting studios where the orchestra is placed on both sides of the microphone.

For outdoor or portable use, ruggedness of construction and susceptibility to weather conditions are as important as service requirement.

Another frequency characteristic of the microphone is its frequency response at varying distances. Some microphones attenuate high frequencies more rapidly than low frequencies, depending on the distance from the microphone. This becomes an important factor where orchestral reproduction is involved.

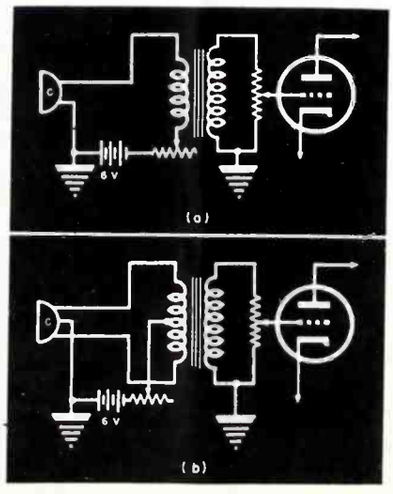
The output voltage and impedance of the microphone are important only insofar as the design of the amplifier is concerned. The output voltage of the microphone will determine the amplification necessary for rated output, while the impedance will influence the selection of the appropriate input matching network.

Microphone Types

There are five main types of microphones: (*1*) carbon granule, or button microphone; (*2*) velocity, or ribbon microphone; (*3*) condenser microphone; (*4*) Rochelle salt, or crystal microphone; and (*5*) moving coil, or dynamic microphone.

There are two types of carbon button microphones, single and double-button types. The single-button type is used exclusively for voice reproduction, and has an output impedance ranging from 50 to 100 ohms. Its frequency response is poor, particularly at the higher audio frequencies. When used as a close-talking microphone, the output voltage will range from .2 to .5 volt across the primary or the microphone input transformer, depending on the quality of the microphone.

Fig. 1. Two typical input circuits for single and double-button carbon microphones.



The double-button carbon microphone is similar to the single-button type, except that two units are arranged in a push-pull arrangement. Its frequency response is somewhat better, being essentially flat from 60 to 1,000 cycles, rising slightly to 6,000 cycles, and then falling off rapidly beyond this point. It develops about .05 volt output. The output impedance is about 200 ohms. Both types require the use of low-voltage batteries, with the single-button type drawing about 40 ma, and the double-button type about 20 ma. Two typical input circuits are shown in Fig. 1.

Carbon button microphones are characterized by high microphone noise level, or *hiss*. In addition, the carbon granules have a tendency to cake up in the presence of moisture, or when the button circuit is continuously being broken while current is flowing. Carbon microphones are used extensively for outdoor portable work involving speech only. Their high output voltage reduces the number of amplifier stages necessary to drive the final amplifier.

The velocity or ribbon microphone consists of a metallic ribbon suspended between two permanent magnets. This metal ribbon is stretched tight so that its natural period is above the audible range. This type of microphone is highly directional, and is constructed for both uni-and bi-directional applications, depending on the construction of the microphone casing.

Its frequency response is essentially flat from 10 to 5000 cycles, with only a slight loss to 10,000 cycles. The output impedance of velocity microphones is high, so that most types incorporate a small mike-to-line transformer to reduce the impedance where long microphone cables are to be used. The average output voltage is about .03 volt. Since it is fragile and susceptible to weather conditions it is used indoors. Typical circuits are shown in Fig. 2.

The condenser microphone is con-

More business for you . . .

with these new

Cunningham Traffic Stoppers

See your CUNNINGHAM Distributor today

Now Cunningham offers you these *full-color* window and counter cards designed to sell your service and increase your business. These easel-type cards measure approximately 10½ x 15 inches—will attract attention to your shop and let customers know you handle top-quality Cunningham Electron Tubes.

With the servicing business at an all-time high, you can't afford to miss the opportunity of building up your future trade now, while servicing demand is heavy. You can do it by putting yourself out front with Big "C". So, put these business-building displays to work for you *today*

AND LOOK FOR MORE
CUNNINGHAM SALES AIDS SOON

Listen to "THE RCA SHOW," Sundays, 2:00 PM, EDT, NBC Network

A QUALITY PRODUCT FOR RADIO SERVICE-DEALERS
BY THE RADIO CORPORATION OF AMERICA

Type	Output voltage	Impedance	Frequency response	Service
Single-button carbon	.2 to .5 v.	Low	60 to 4,000	Voice only.
Double-button carbon	.03 to .08	Low	60 to 6,000	Voice and limited music; outdoor.
Velocity	.01 to .04	High	10 to 10,000	Music, directional — bi-directional; indoor, studios.
Condenser	.0002 to .0006	High	40 to 10,000	Music, directional; indoor, studios.
Crystal	.005 to .03	High	20 to 15,000	Music-voice, directional; indoor—outdoor.
Dynamic	.01 to .03	Low	20 to 10,000	Music-voice, non-directional; indoor—outdoor.

Fig. 6. Comparative characteristics of six types of microphones.

structed in the form of a capacitance (about 200 mmfd), with one plate fixed and the other responsive to air pressures. A polarizing voltage in series with this capacitance, through a high-value resistor, sets up a varying a-f potential in response to sound pressures on the movable plate.

Since the cable capacitance would seriously affect the frequency response of this type of microphone, a small one-tube preamplifier is usually incorporated in the microphone casing. The output of this amplifier is then fed into the input of the amplifier unit.

The output voltage of a condenser microphone is on the order of .0005 volt. Since the mike is a high-impedance type, it may be coupled directly to the grid of the preamplifier tube. The output voltage of the preamplifier stage is a function of the circuit employed and the stage gain.

Condenser microphones are somewhat directional, particularly for the higher frequencies, with a fairly uniform frequency response from 40 to 10,000 cycles. The necessity for a preamplifier stage makes them somewhat bulky for portable work. Thus their use is usually limited to indoor or studio operations. A condenser microphone input circuit is shown in Fig. 3.

Crystal microphones are constructed of Rochelle salts in much the same manner as crystal pickups. Since this type of microphone is sometimes constructed of a number of crystal cell units, the output voltage will vary, with the multicell types giving higher voltage outputs; voltage output will range as high as .04 volt.

Crystal microphones are high-impedance units and may be coupled directly to the grid of the amplifier input tube, provided the cable is less than ten feet long. Longer cables require the use of line matching transformers. The frequency response is excellent, being fairly uniform to 15,000 cycles. Since it is a pressure-type microphone, it is semidirectional, depending on the construction of the pressure device.

A typical input circuit is shown in Fig. 4.

The moving coil or dynamic-type microphone is probably the most popular type in use today, since it is not only rugged in construction, but its all

(*Continued on page 35*)

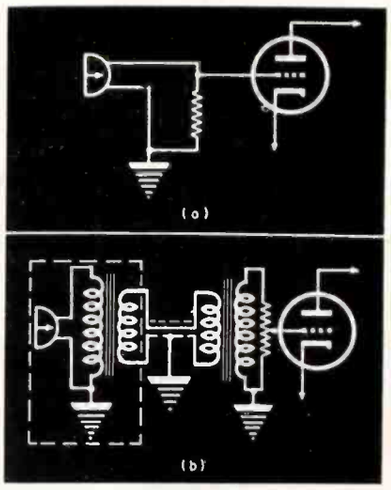


Fig. 2. Velocity or ribbon-type microphone input circuits.

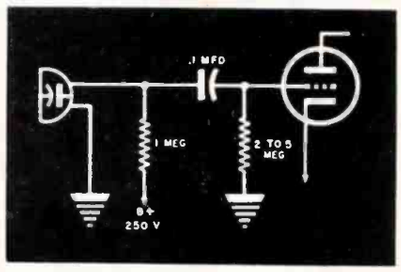


Fig. 3. Input circuit for a condenser microphone.

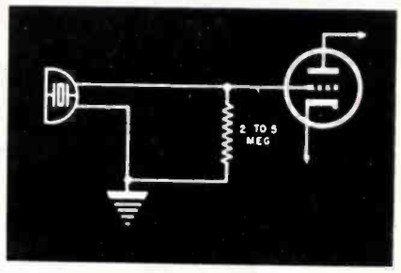


Fig. 4. Crystal-microphone input circuit.

Fig. 5. Input circuit for a moving coil or dynamic type microphone.

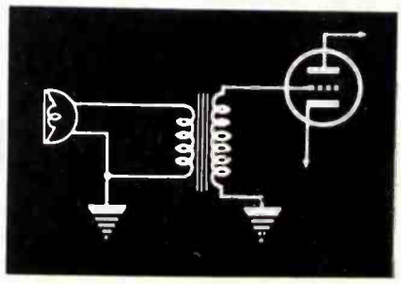
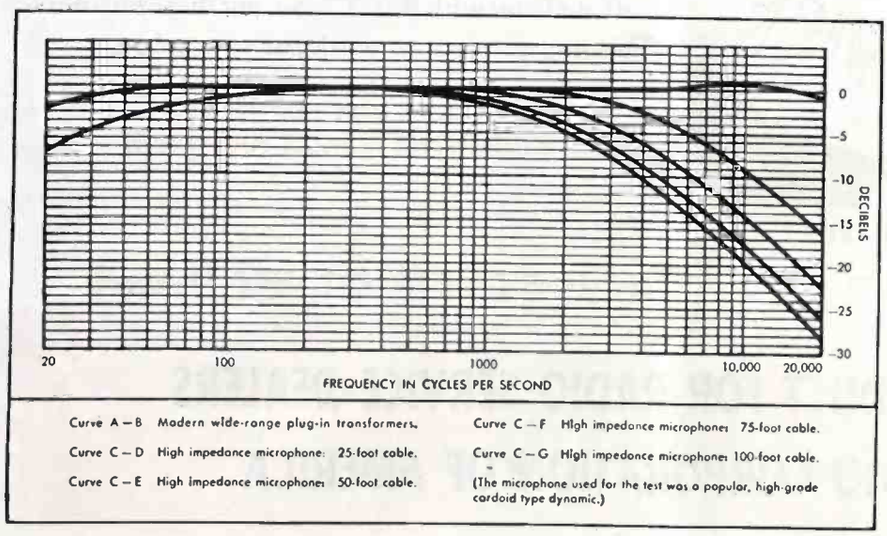
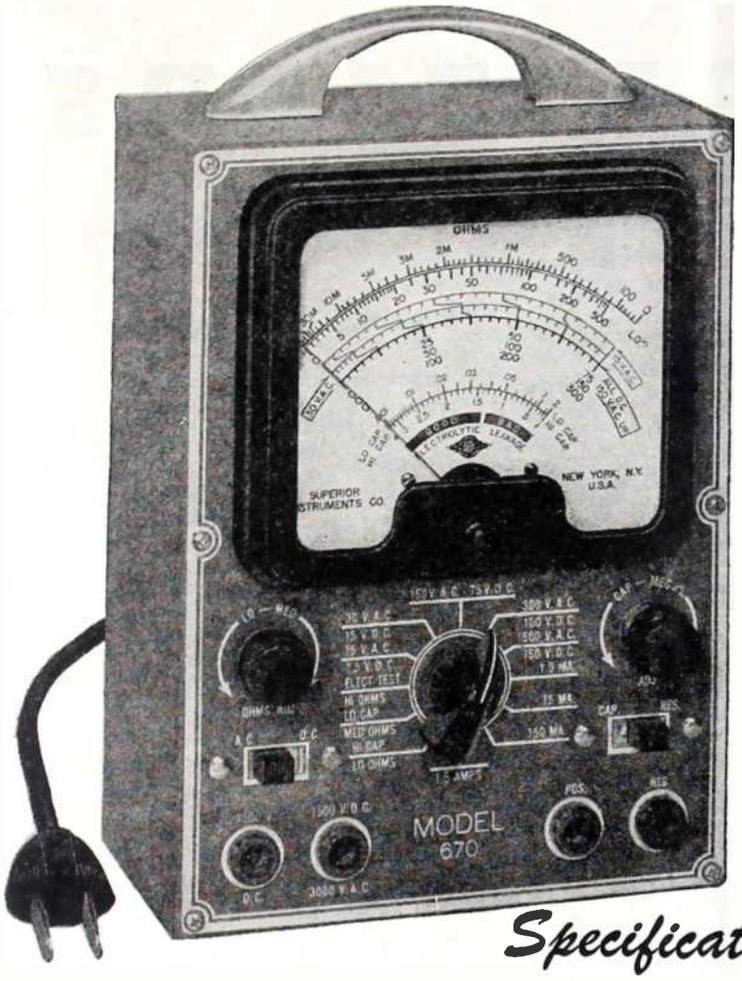


Fig. 7. Plot illustrating microphone (using a cardioid dynamic) losses caused by cables. Curves above 400 cycles represent only losses due to various lengths of cable commonly used; they do not indicate microphone response. (*Courtesy Newcomb*)



NOW AVAILABLE FOR IMMEDIATE SHIPMENT!



The New Model 670

SUPER-METER

A Combination

VOLT-OHM MILLIAMMETER plus CAPACITY REACTANCE INDUCTANCE and DECIBEL MEASUREMENTS

Added Feature:

The Model 670 includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

Specifications:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes

RESISTANCE: 0 to 500/100,000 ohms 0 to 10 Megohms
CAPACITY: .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics)
REACTANCE: 700 to 27,000 Ohms 13,000 Ohms to 3 Megohms
INDUCTANCE: 1.75 to 70 Henries 35 to 8,000 Henries
DECIBELS: —10 to +18 +10 to +38 +30 to +58

The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

$28.40 NET

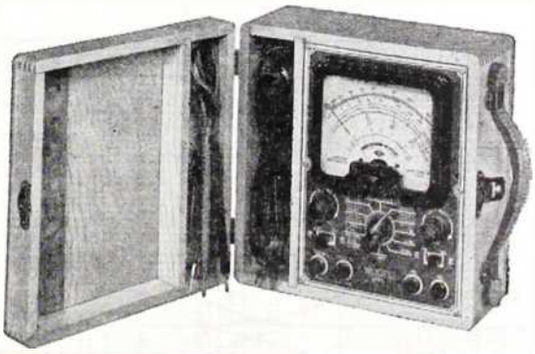
Please place your order with your regular radio parts jobber. If your local jobber cannot supply you, kindly write for a list of jobbers in your State who do distribute our instruments or send your order directly to us.

Model 670P

The Model 670P is identical to the Model 670 described in detail except housed in a hand-rubbed, portable oak cabinet complete with cover.

The Model 670P comes complete with test leads and all operating instructions.

$35.75 NET



SUPERIOR INSTRUMENTS CO.
Dept. B 227 FULTON ST., NEW YORK 7, N. Y.

P-A AMPLIFIERS

by KELVIN R. MARTIN

WHETHER THE SERVICE MAN builds his own p-a amplifier or buys a commercial type, it is wise to be familiar with the various technical features, terminology used, and the adaptability of the apparatus to service conditions.

Amplifier Characteristics

The power rating of amplifiers is designated in watts output. However, this information is inadequate, unless suitably modified by additional information such as hum level, distortion and load across which the maximum output is measured.

Hum level in an amplifier should be down at least 50 db for units rated at 25 watts or less, and 70 db for higher power amplifiers. A 50-db voltage ratio of hum to signal would be approximately .3%, for 70 db about .03%.

The rating of the output of an amplifier should also include the percentage distortion for maximum rating. This should not exceed 6%. Most amplifiers can be driven to give higher output at higher distortion levels, but excessive distortion precludes its use.

The output should also be measured across a dummy resistance equal in value to the voice coil impedance of the speaker or speakers used. If the output is measured across a 500-ohm load, some allowance should be made for the lower gain that will ensue when connected to a voice coil.

Fig. 3. A 15-watt portable system which includes amplifier, pair of 10" speakers, crystal microphone and speaker cables and plugs. (*Courtesy Bell Sound Systems*)

The quality of an amplifier may be gaged from its frequency response. A good amplifier will give uniform output within 1 db or about 20% for power, 11% for voltage, over the 60 to 8000-cps frequency range. Any greater variation than this will result in poor performance. This response should be obtained with tone controls at minimum settings.

Amplifiers are usually rated in terms of db gain. This gain is computed in terms of power input to power output. The power output is easily found by measuring the voltage drop across a dummy load resistor, across the secondary of the output transformer. As an example let us assume that this load resistance is 10 ohms, and that the maximum output rating of the amplifier is 50 watts. Then the voltage across the resistor should read:

$$P = E^2/R \text{ or } E = \sqrt{P \times R} = 500$$
$$= 22.3 \text{ volts.}$$

The gain of the audio signal generator which has been connected to the input of the amplifier is then advanced until this voltage reading is obtained across the load resistor. Then the signal generator voltage is noted.

However, it is at this point that care must be observed in obtaining a true figure. Since the power input will be a function of the input voltage and the resistance across which it is developed, the size of the input resistance will affect the db-gain figure attained. Thus, if a 5-megohm resistor were used at the input, instead of a .1-megohm resistor, two varying resultants would be obtained. Using the previously mentioned amplifier as an example, assuming that the input voltage is .1 volt, the input power computed for the 5-megohm resistor would be $.002 \times 10^{-6}$ watts; for the .1-megohm resistor it would be $.1 \times 10^{-6}$

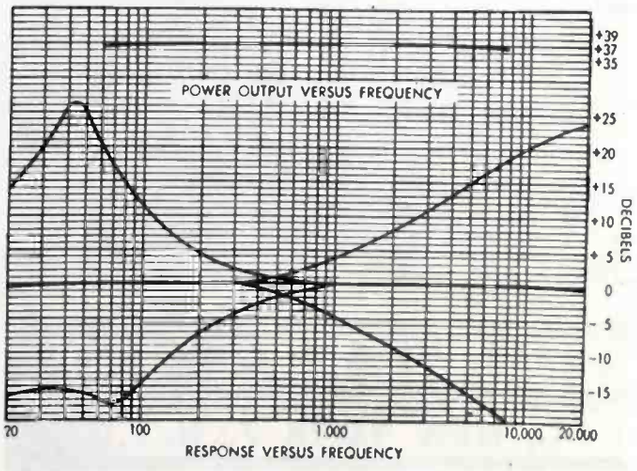


Fig. 2. Response versus frequency curve of amplifier shown in Fig. 1. (*Courtesy Newcomb Audio Products Co.*)

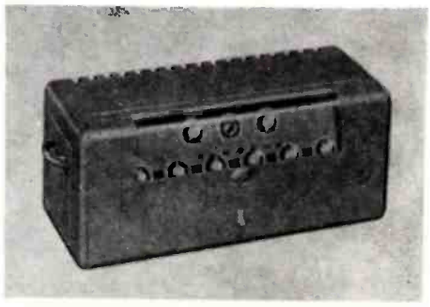


Fig. 1. A 30-watt amplifier with a 20 to 20,000-cycle response. Uses an electron-ray tube to indicate volume and overloads. Bass range is from —17 to +24 db; treble range from —24 to +24 db.

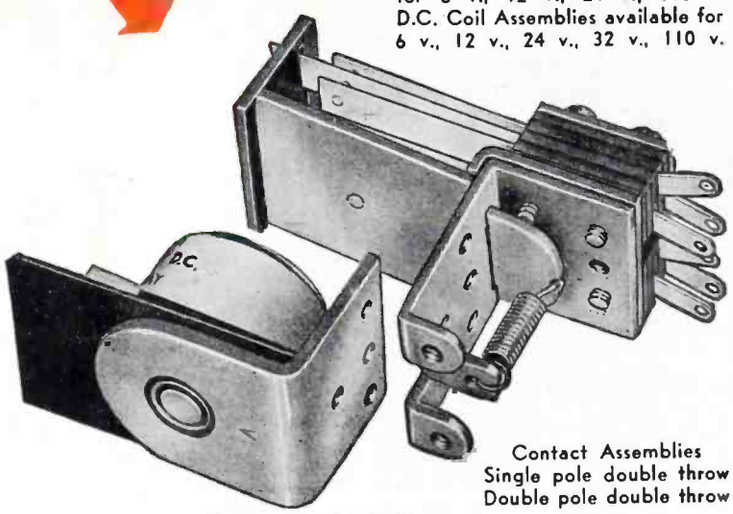
New! Series 200

A RELAY BY GUARDIAN with Interchangeable Coils

BUILT IN TWO PARTS

★ Two basic parts—a coil assembly and a contact assembly—comprise this simple, yet versatile relay. The coil assembly consists of the coil and field piece. The contact assembly consists of switch blades, armature, return spring, and mounting bracket. The coil and contact assembly are easily aligned by two locator pins on the back end of the contact assembly which fit into two holes on the coil assembly. They are then rigidly held together with the two screws and lock washers. Assembly takes only a few seconds and requires no adjustment on factory built units.

A.C. Coil Assemblies available for 6 v., 12 v., 24 v., 115 v.
D.C. Coil Assemblies available for 6 v., 12 v., 24 v., 32 v., 110 v.



Contact Assemblies
Single pole double throw
Double pole double throw

SERIES 200 RELAY

On Sale at Your Nearest Jobber NOW!

See it today! . . . this amazing new relay with interchangeable coils. See how you can operate it on any of nine different a-c or d-c voltages—simply by changing the coil. Ideal for experimenters, inventors, engineers.

TWO CONTACT ASSEMBLIES

The Series 200 is available with a single pole double throw, or a double pole double throw contact assembly. In addition, a set of Series 200 Contact Switch Parts, which you can buy separately, enables you to build dozens of other combinations.
Instructions in each box.

NINE COIL ASSEMBLIES

Four a-c coils and five d-c coils are available. Interchangeability of coils enables you to operate the Series 200 relay on one voltage or current and change it over to operate on another type simply by changing coils.

Your jobber has this sensational new relay on sale now. Ask him about it. Or write for descriptive bulletin.

GUARDIAN ELECTRIC
1617-J W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

volts. Since gain in db=10 log W_1/W_2, the computed gains would be 100 db for the 5-megohm resistor, and between 70 and 80 db for the .1-megohm resistor. Thus the db rating would be a function of the input resistance used in the computation. Since, in actual practice, the input impedance rarely exceeds .1 megohm the latter figure is more correct. If transformer input is used to the first a-f amplifier, the input impedance is always .1 megohm or less.

What power output amplifier to use is usually a perplexing problem. It is always best to buy one whose power output is higher than thought necessary.

The amount of power necessary for a particular installation can only be arrived at in a very general way. To be on the safe side, one watt of power output should be allowed for every 25,000 cubic feet of space indoors, or 1000 square feet outdoors. This is not a straight line function, since more power should be allowed for indoor areas under 500,000 cubic feet or outdoor crowds covering a square foot area under 25,000 square feet. Factors which influence these figures are local noise level, and speaker efficiency. For example, the noise level in a church would be relatively low, whereas in a political meeting noise would be much higher.

Tone Controls and Inputs

There are two other points to be noted in the amplifier. These are the tone control circuits and the input systems. Tone controls are an important adjunct to any p-a system, since they permit adjustment of amplifier characteristics to local conditions. For example, reverberation and feedback, or absorbtion by draperies may be compensated for by adequate tone controls. An important point in this respect is to note if the tone controls influence the volume level of the amplifier. Some tone controls will accentuate bass notes by reducing the treble response, and vice versa. This type of control is not as good as the one which accentuates either bass or treble without affecting the level of amplification for the remaining portion of the audio spectrum. Therefore, the Service Man should look for amplifiers in which the tone control is described as increasing the bass or treble response from – db to + db.

Microphones

An amplifier which features a number of input channels, with mixing circuits, can be used for more purposes and is more versatile than one which is limited to one or two channels.

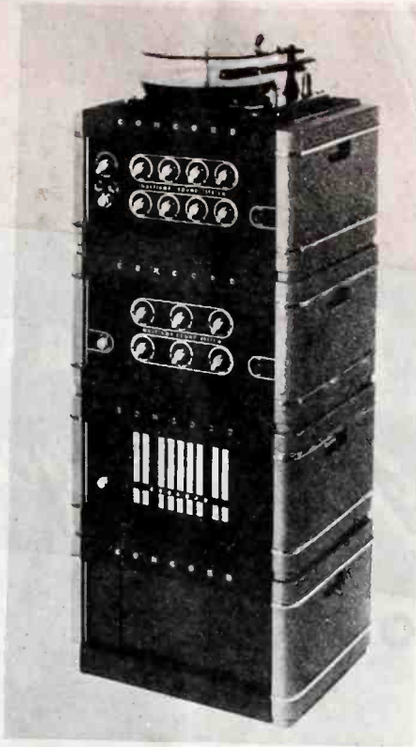
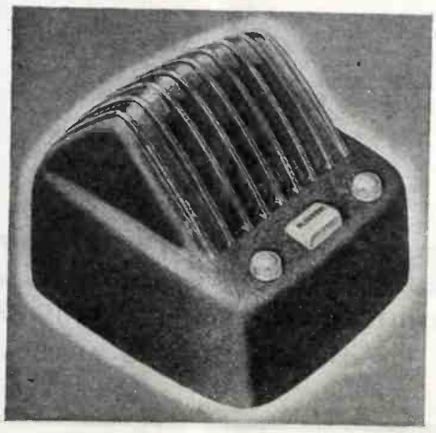


Fig. 4. Add-a-unit type amplifier. Cabinets are cast aluminum. See page 38 for additional data. (*Courtesy Concord Radio*)

Fig. 5. A 14-watt portable p-m system using a dynamic hand-type microphone. (*Courtesy Newcomb*)

Fig. 6. Ten-station intercommunications unit with switch control and *finger-tip touch* talk switch. (*Courtesy Operadio*)



Microphones and Inputs

Different types of microphones require different types of input systems. Again, the length of cable between the microphone and the amplifier will determine the appropriate input impedance. Phono record players vary in output voltage, but in general supply much higher voltages than microphones.

Mixer Circuits

Mixer circuits are invaluable where more than one audio source is to be used, such as a microphone and record player. However, for particular fixed installations, the needs should be noted before purchasing, since these additional features will increase the cost.

Volume Level Indicators

Volume-level indicators are a help where an operator is used in conjunction with the use of an amplifier. These usually take two forms, some systems using a meter and others two neon lights. The meter indicates when the full undistorted output of the receiver is being used or any intermediate point. One commercial amplifier features two neon lights, one set to indicate 30%, the other 100% of rated output. The controls are then set so that the 30% indicator flashes with every word, while the 100% neon indicates that the amplifier is being overloaded.

Amplifier Control

In operation, the amplifier should never be operated at full output, except for peak surges. This is particularly true in orchestral reproduction. By allowing some leeway for these peaks, better performance will be obtained.

Amplifier Systems

In one recently announced amplifier system are featured a microphone, table stand amplifier, and reproducing pick-up. A jack permits the use of high-impedance headphones for monitoring while recording, and a visual indicator facilitates accurate adjustment and regulation of volume. Another control permits adjustment of tone when the instrument is used for recording and reproducing records.

TELEVISION/F-M Receiver Features

An Analysis of the Audio System, I-F and R-F Stages and Alignment Problems.

by R. B. CARWOOD

THE F-M AUDIO SYSTEM of television receivers differs only slightly from the a-f system in standard f-m receivers. From Fig. 1 we note that the frequency allocation of a television signal with the f-m channel is clearly defined. The bandwidth of a television signal f-m signal is 50-kc or 25-kc each side of the carrier, as compared with a standard f-m signal which is 150-kc wide, or 75-kc each side of the carrier.

The i-f frequency of the television f-m receiver is 8.25 mc. Since the local receiver oscillator is tuned above the incoming signal, to receive a television signal in the 54-60 mc band, the video carrier would be at 55.25 mc, the f-m signal carrier at 59.75 mc, and the local oscillator at 68 mc.

Because of the problems involved in keeping the local oscillator on frequency, or without drifting, the i-f channel acceptance of the audio i-f channel is purposely broadened so that slight variations in oscillator frequency have no appreciable effect on the sound transmission. In addition, the fine tuning control, brought out to the panel, may be reset to correct for oscillator drift.

Since the r-f portion of the television receiver is used to receive and amplify the entire television signal, the f-m audio portion may technically be said to start at the i-f section. A typical circuit is shown in Fig. 2. The signal fed into the i-f portion is already at i-f frequency, and any subsequent action will be dependent on the strength of the signal delivered, and the interference present. Aside from local noise sources, the picture signal associated with the sound signal is the most likely source of interference, since it lies in the adjacent channel. However, the picture signal is amplitude modulated, and would be automatically suppressed in the limiter stage, so that intereference from this source is negligible. In addition, the f-m i-f transformers are band-pass

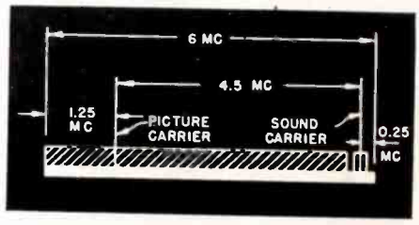
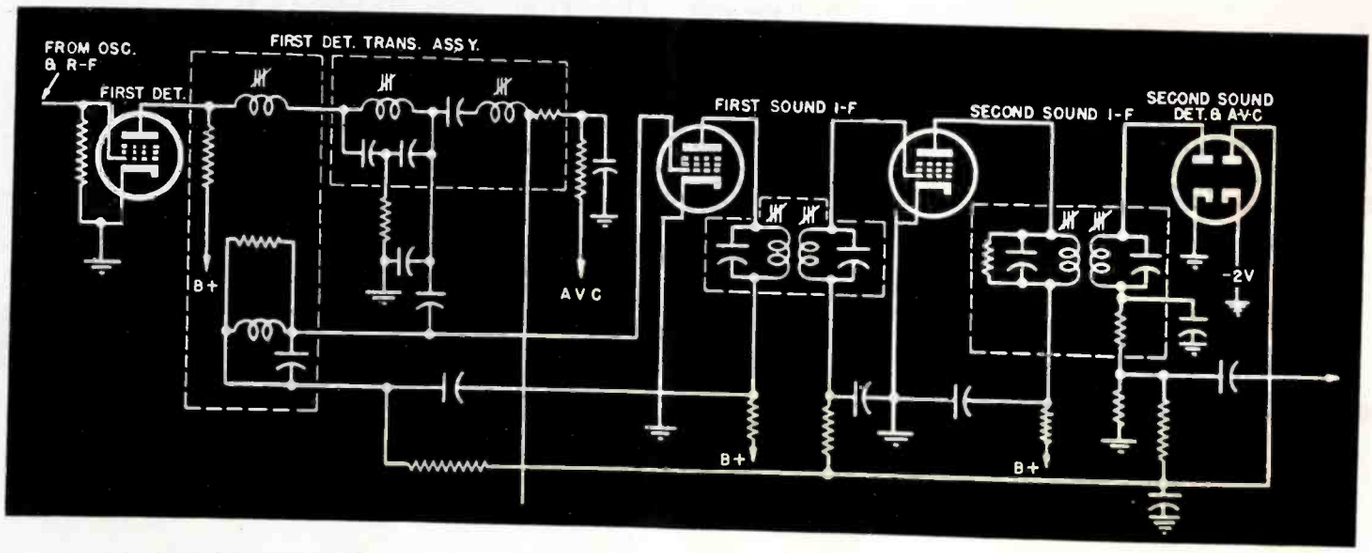


Fig. 1. Make-up of television channel. Note the 50-kc width of sound channel.

tuned for 200 kc, or 100 kc each side. The nearest picture signal is 500 kc away from the audio carrier, and the likelihood of any interference from this source is remote. The usual

(*Continued on page* 34)

Fig. 2. First detector and i-f amplifier television circuit.



SERVICING HELPS

by FRANK C. KEENE

WHY CAN A POWER-TRANSFORMER *receiver be grounded, but not an a-c/d-c power supply type?—B. A. Benz.*

Supply circuits for both power transformer and a-c/d-c receivers are shown in Fig. 1. It will be noted that in the supply system using the power transformer, there is no direct connection between the line and the receiver chassis, whereas in the a-c/d-c type, one side of the electric main is connected directly to the chassis, when the line switch is closed.

Electric mains usually have one side of the feeder at ground potential. When a universal type receiver is plugged into an a-c outlet, the polarity of the incoming voltage does not matter, since polarity relationship exists between the two wires of the main. However, when one of these lines is connected to ground, the other wire will always be at a potential either plus or minus 110 volts in relation to ground.

•

HOW CAN THE PROPER TRIMMER *location be found for alignment in multiband receivers; which band should be aligned first?—G. Murakami.*

A typical three-band receiver r-f section is shown in Fig. 2. The three capacitors, *C*, are the main tuning capacitors, while C_1, C_2 and C_3 represent the trimmers located on top of the tuning sections.

If the padders are maintained in a strip, and the appropriate padder to adjust is not known, the easiest method for determining the correct padder is to press against the movable portion of the trimmer capacitor with an insulated rod, preferably polystyrene, while a signal is being received. If there is any change in volume, that padder is the correct one for adjustment. The same method may be used in conjunction with a signal generator and output measuring device for all bands. A pencil sketch should then be made of the various trimmer locations for reference.

In checking the various bands by this method, the high-frequency end of the band should be used, since even small changes in trimmer capacitance will usually affect the volume considerably. This method is most effective if the oscillator trimmer bank is used for band-trimmer location.

Once the trimmer sequence for the oscillator band is determined, the same sequence will be found to obtain for the r-f and antenna trimmer banks.

In some receivers, the antenna trimmer for the highest band or possibly the r-f trimmer, will be omitted. In these receivers, the coils are usually used for trimming. This is done by increasing or decreasing the inductance of the coil by moving the last turn, and then cementing it in place. The appropriate coil may be found by noting the number of turns, since the higher the frequency, the less turns in the coil.

All-band receivers sometimes feature an i-f trap circuit in the antenna stage. This trap circuit is aligned by feeding a very strong i-f frequency signal into the antenna, and then adjusting the trimmer capacitor for minimum response. This trap will usually be found as a separate unit located near the antenna stage.

Another trimmer not usually found on a trimmer bank is the series padder for aligning the low-frequency end of broadcast and police bands. These trimmers are represented by C_{13} and C_{14} in the oscillator section of Fig. 2. They are usually located near the oscillator section of the tuning capaci-

(*Continued on page* 31)

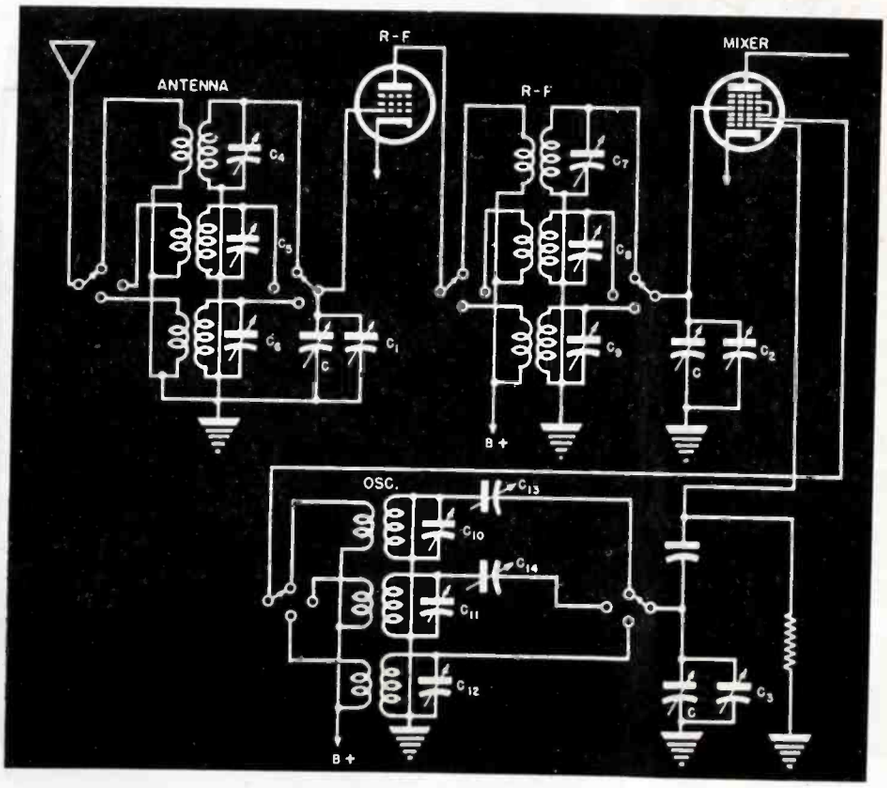


Fig. 2 (*Murakami query*). The r-f section of a typical 3-band receiver.

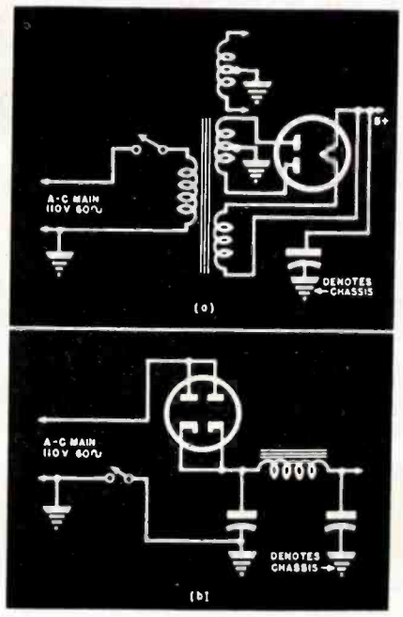


Fig. 1 (*Benz query*). Supply circuit for both a transformer type and a-c/d-c receiver.

LOUDSPEAKERS

(*Continued from page* 15)

frequencies strongly are excellent for these applications. This type will give the best speech intelligibility because there is little low frequency to cause the disagreeable echoes or hangover, and because the sound can be directed at the listening audience and away from reflecting surfaces of side walls, roof, etc.

The foregoing is not meant to infer that a single speaker of the proper type is adequate. Naturally, several are required in the large installations to coverage the desired areas properly.

Where large power from a single source is required to provide a direct effect, as from the position of a public speaker, several driver units may be used on one large horn by the use of adaptors. The use of *bull* or superpower horns with large single driving units in outdoor applications requiring high power has not proven satisfactory. For instance, one speaker failure and the system becomes useless and then again these speakers are useless for any but limited applications. Large high-power driver units have definite limitations in safety factor and frequency range. It is far preferable to use multiple horns, or some type of multiple drive horn, Fig. 20.

The types of loudspeakers covered so far do not include the very high quality, wide range reproducer systems which are available to a limited extent today. These systems include dual (or sometimes triple) channels, a low frequency *woofer* to reproduce the bass frequency range from say 40 cycles to the *cross-over* frequency, and a high-frequency *tweeter* to reproduce the range from the *cross-over* frequency to the range between 10,000 and 15,000 cycles. The high-frequency cut-off and the low-frequency cut-off vary with different designs. A single speaker cannot be used for this range, as it is not yet possible, due to the opposing requirements of low-and high-frequency speaker design, and the present knowledge of the art, to build an efficient loudspeaker to cover it smoothly.

These systems are intended only for reproduction of very high quality material, such as the best live f-m programs; high-quality, low-noise transcription records; direct high-quality microphone pickups, etc. Noise, distortion and limited frequency range all become extremely objectionable on such a reproducer system.

This type speaker system consists

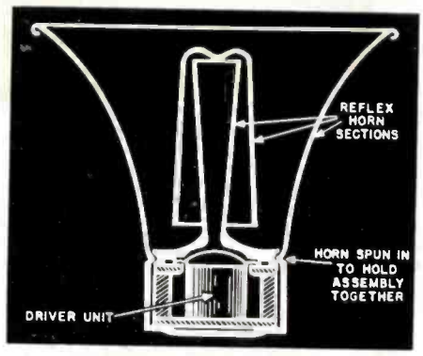


Fig. 17. One design of integral reflex horn and driver unit assembly.

Fig. 17*a*. Reflex air-column paging speaker with 12-watt power. (*Courtesy University*)

of the two-speaker channels and a dividing network which is interposed between the output of a high-quality amplifier and the two speakers; Fig. 21. It can be seen that the dividing

(*Continued on page* 30)

Fig. 17*b*. Integral horn and driver-unit speaker. (*Courtesy Atlas*)

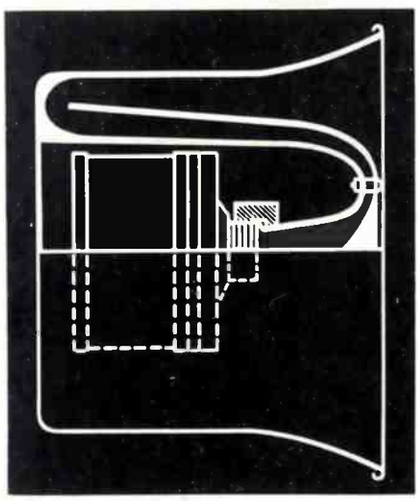
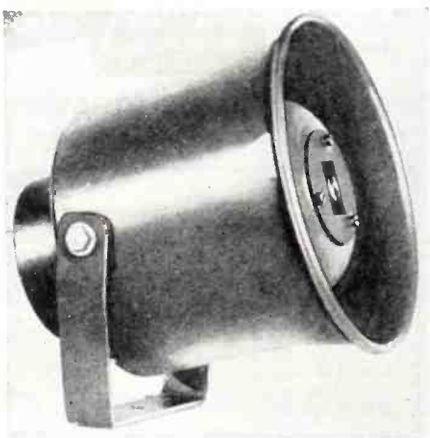


Fig. 18. Section of small re-entrant horn and driver unit speaker for speech applications.

Fig. 18*a*. Small folded horn for speech with 3" driver unit. (*Courtesy Atlas*)



LOUDSPEAKERS

(*Continued from page 29*)

network separates the low- and high high-frequency tones and feeds each into their corresponding speakers. These networks are always designed for specific amplifier and speaker impedances and frequency ranges, so that only those supplied or designed by the manufacturer of the speaker system can be used. Input impedances of these systems vary. Some values used are 8, 20 and 500 ohms. The *cross-over* point referred to is the frequency at which the dividing network separates the low- and high-frequency tones. It varies from about 300 to 1500 cycles in two-way systems.

Fig. 18*b*. Reflex air-column 8-watt speaker. (*Courtesy University*)

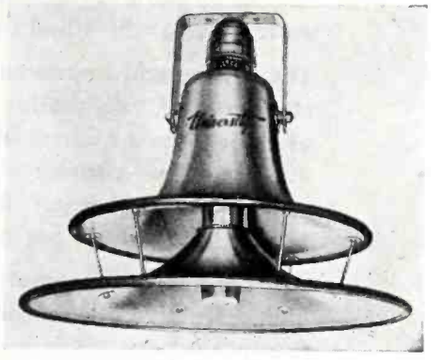


Fig. 19. Radial reflex projector with a 5' air column. (*Courtesy University*)

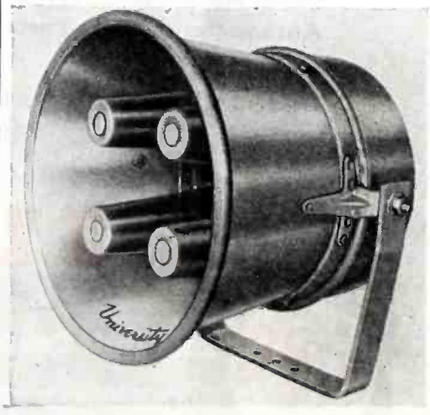
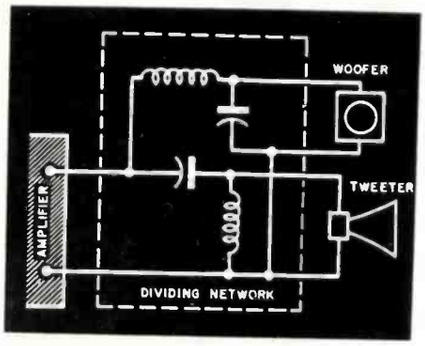


Fig. 20. Multi-driver 100-watt speaker. (*Courtesy University*)

Credits

The author is grateful to Arthur J. Sanial, chief engineer of Atlas Sound

Fig. 21. Circuit of woofer, tweeter, and dividing network of amplifier.



Corporation and electroacoustic consulting engineer, for his kind assistance in preparing and checking the text and illustrations of this paper.

[A discussion of *Sound Trends* will be continued in the August issue of SERVICE. Featured will be another article on speakers, an analysis of pickups and additional data on sound accessories.]

•

SERVICING HELPS

(*Continued from page 26*)

tor. The appropriate band for these type trimmers may be found by the pressure method previously outlined, except that a signal at the low-frequency end of the band should be used, where their change in capacitance has the greatest effect.

There is no exact formula for the proper sequence of trimmer adjustment. However, it is advisable to align the i-f before proceeding with the r-f portion of the receiver. For a particular r-f band, the oscillator should be aligned first, then the r-f section, and finally the antenna. It is always best to go over the alignment at least twice. Where a series oscillator padder is used for a band, this should be aligned first, before adjusting the parallel trimmer for the high-frequency end.

The proper band sequence is a function of the band-switching method used. In general, it is best to start with the high-frequency band and work back to the lowest frequency. After all bands are aligned, the high-frequency band should then be rechecked.

In Fig. 2, C_1, C_2 and C_3 represent trimmers located in the tuning gang capacitor. These trimmers should be adjusted on the highest band, since only slight changes in their capacitance will materially affect the high-frequency alignment.

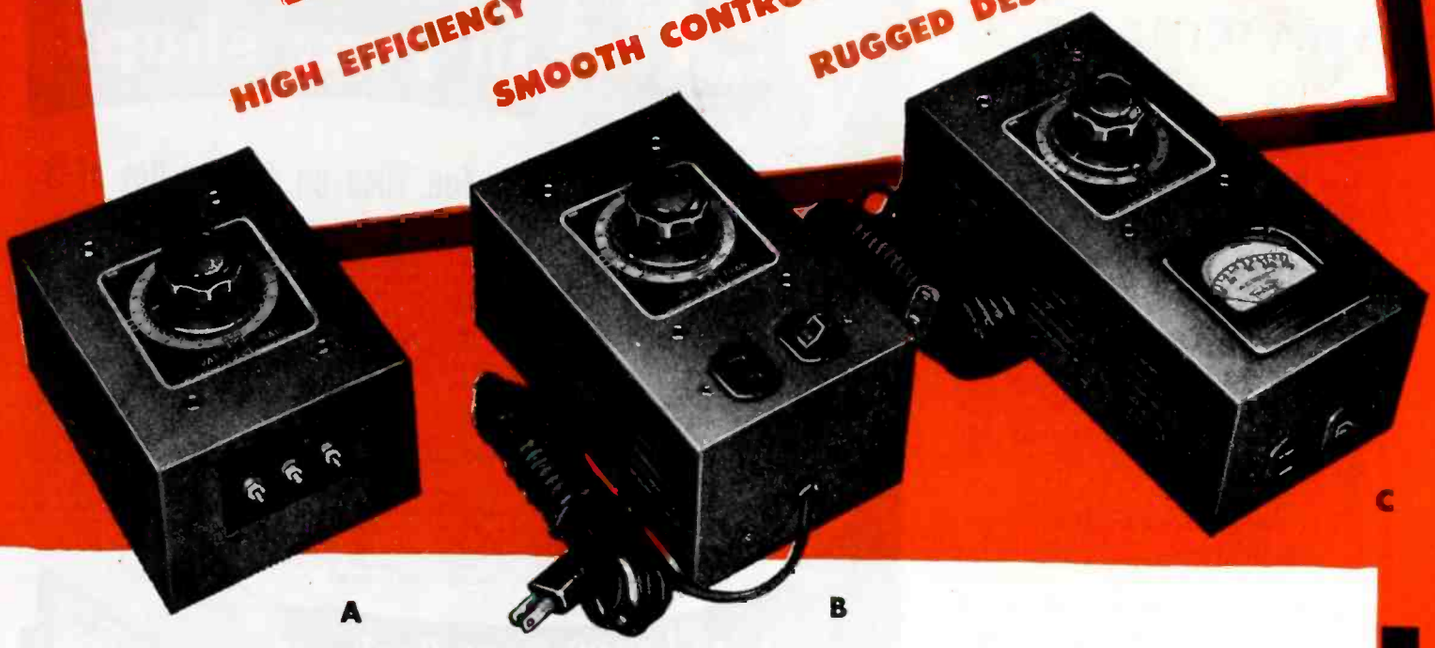
Another point to remember in alignment is that the best possible signal should be used since strong signals tend to detune circuits. Again appropriate dummy antennas should be used with signal generators for proper alignment of antenna stages.

The best method for checking loop antenna receivers is to use a short rod antenna in conjunction with a signal generator. The radiating antenna should be several feet away from the receiver loop for best results.

VARITRAN

(VARIABLE VOLTAGE TRANSFORMER)

EXCELLENT REGULATION
HIGH EFFICIENCY
LOW TEMPERATURE RISE
SMOOTH CONTROL
NO DISTORTION
RUGGED DESIGN



A B C

The UTC Varitran is a simple autotransformer whose turns are arranged on one layer with the insulation removed so that every exposed turn may be used as a tap of the winding. A special non-fusing contact, having resistance to minimize circulating currents, is mechanically arranged so that it can be moved to any position on the winding, permitting the exact voltage desired to be obtained.

STANDARD VARITRANS

Standard Varitrans are designed for 115 or 230 volt service.
The respective output voltages are 0-130 and 0-260 volts.

Type	Input Voltage	Output Voltage	Watts	Maximum Amps.	Figure	Net Price
V-O	115 volts	0-130	230	2	A	$10.10
V-O-B	230 volts	0-260	230	1	A	12.45
V-1	115 volts	0-130	570	5	B	14.25
V-1-M	115 volts	0-130	570	5	C	23.80
V-2	115 volts	0-130	570	5	A	11.90
V-2-B	230 volts	0-260	570	2.5	A	14.85
V-3	115 volts	0-130	850	7.5	A	17.85
V-3-B	230 volts	0-260	850	3.75	A	23.80
V-4	115 volts	0-130	1,250	11	A	26.15
V-4-B	230 volts	0-260	1,250	5.5	A	33.30

UNIVERSAL VARITRANS

Universal Varitrans have two 110 volt Primary windings (110 or 220V connection) and a 28 volt variable secondary winding. This winding can be used as a 0-28 volt low voltage source. It can also be used in autotransformer connection with the primaries to effect . . . 115 in/87 to 143 out, 220 in/192 to 248 out, 220 in/82 to 138 out, 115 in/202 to 258 out.

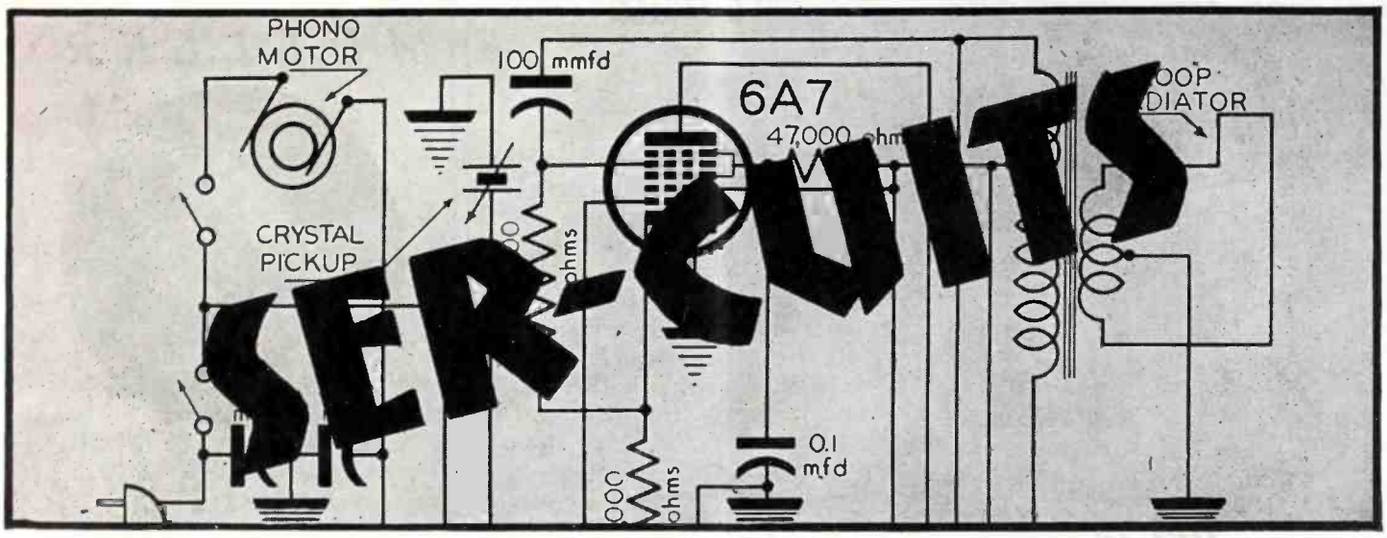
Type	Max. Amps. Output	Approx. Dimensions	Approx. Weight, Lbs.	Figure	Net Price
VL-O	1.5	4½x6½x2½	5	A	$ 8.30
VL-1	3.5	4½x6½x3	7	A	9.50
VL-2	6	4½x6½x4	10	A	11.90
VL-3	11	5x7x5	15	A	19.00

PRICES ARE SUBJECT TO CHANGE

United Transformer Corp.

150 VARICK STREET • NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"



SER-KUITS

by **HENRY HOWARD**

CIRCUIT DATA THIS MONTH covers the ECA a-c/dc- model AE using push-pull af.

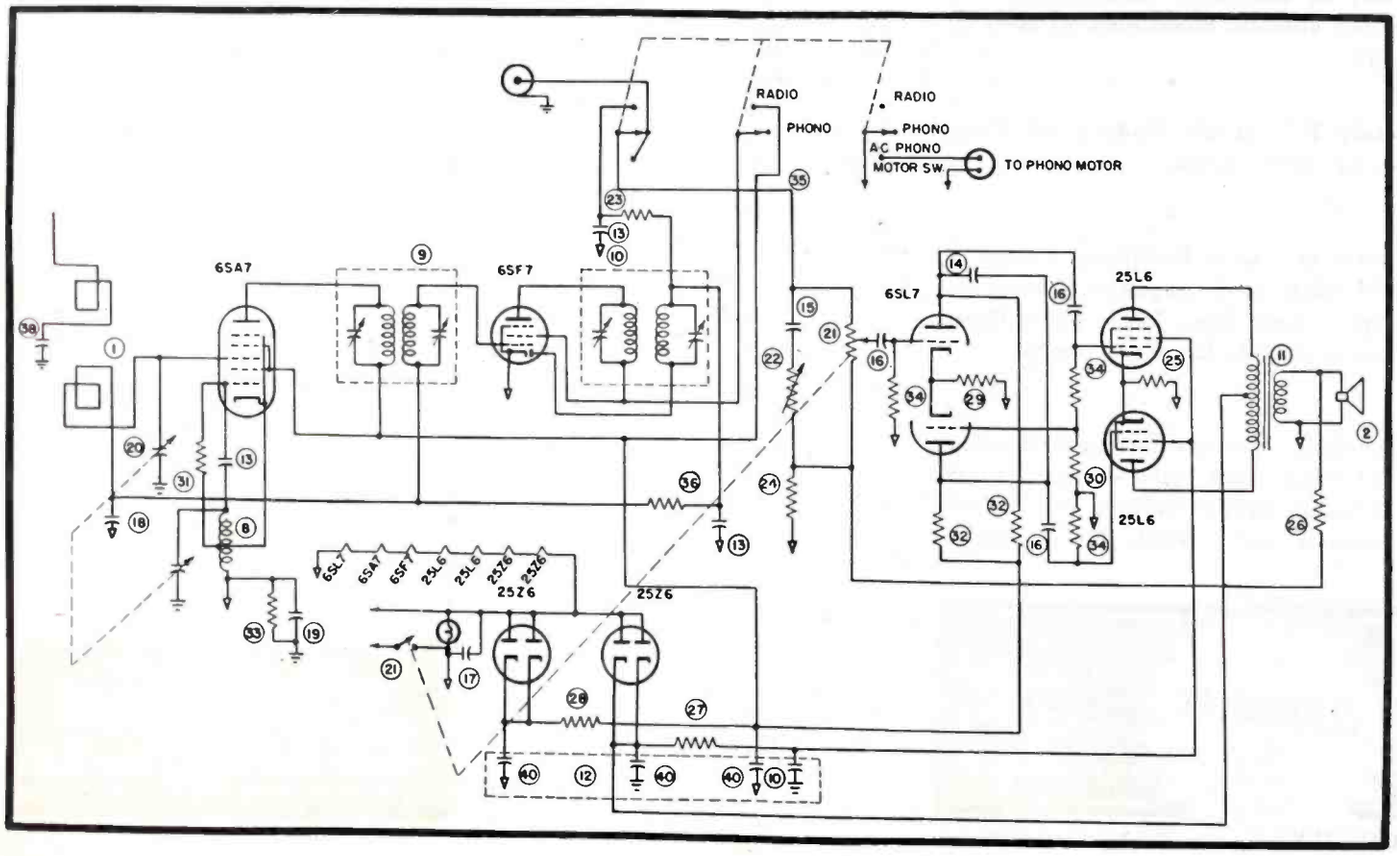
ECA AE Chassis

A 250-mil series a-c/d-c model with a pair of rectifiers and push-pull audio, ECA type AE, is shown in Fig. 1. In this model a 6SA7 is followed by a 6SF7 i-f and detector, 6SL7 first audio and inverter, and a pair of 25L6s. On phono, the plate and screen supplies are opened on the i-f amplifier. A degenerative link from the voice coil through a 100-ohm resistor to the low side of the volume control, is tied in with a variable tone control, which appears across the entire volume control. A 33-ohm resistor shunts the low end of the control to ground. A .002-mfd capacitor is used in the tone circuit.

For *B* power a conservative arrangement employing two 25Z6s provides perfect isolation between the power output stage and the remainder of the receiver. One tube with paralleled elements supplies the 25L6 plates directly from rectifier output and the screens from the filter output.

Fig. 1. ECA AE 250-mil a-c/d-c receiver with a pair of rectifiers and push-pull audio. List of parts at right.

13	CONDENSER 100
14	CONDENSER 250
15	CONDENSER .002 ufd 400 V.
16	CONDENSER .02 ufd
17	CONDENSER .05 ufd
18	CONDENSER .05 ufd 200 W.V.
19	CONDENSER .2 ufd 200 W.V.
20	VARIABLE CONDENSER
21	VOL. CONTROL WITH SWITCH
22	TONE CONTROL POT.
23	RESISTOR 47 K
24	RESISTOR 33
25	RESISTOR 82 10% 1 WATT
26	RESISTOR 100
27	RESISTOR 1500 10% 1/2 WATT
28	RESISTOR 1500 10% 2 WATT
29	RESISTOR 2.2 K
30	RESISTOR 18 K 10%
31	RESISTOR 22 K



(Continued from page 24)

trouble encountered in this respect is the presence of the sound signal in the picture, and not vice versa.

Most television receivers employ two i-f stages, with the second stage of limiter design, so as to prevent any amplitude modulation from affecting the signal. A more elaborate system involves the use of two limiter stages to provide even better limiter action.

The signal from the limiter stage is then fed into the dscriminator, which removes the r-f portion of the signal, and the audio signal is then amplified in the conventional manner.

Alignment of the f-m receiver portion should be undertaken in accordance with standard practice. However, some care must be exercised in aligning the i-f to proper frequency. Since the adjacent picture signal is quite close in frequency, it is necessary that the center frequency of the i-f transformers be exact. For example, if the i-f transformers were tuned to 8 mc, the possibility of interference from the picture signal would increase. Since the intensity of the picture signal is high, at least as high as the f-m signal, some interference would be noted in spite of the limiter stages. If the i-f frequency were shifted in the other direction, the possibility of interference from the television signal two channels away would be increased.

This interference is serious, due to the poor selectivity of the r-f portion of the receiver, which does not usually employ a separate r-f stage, but feeds the signal directly into the converter or first detector. In addition the amplitude of the signal is normally much higher than that of standard b-c signals. Exact i-f frequencies are essential. Again, in alignment of the f-m i-f, the narrow bandwith of the signal requires an exact adjustment of the i-f bandwidth; this, in spite of the wide response of the i-f channel. This is because of the drift of the local oscillator, which is bound to occur. A non-uniform response of the i-f will cause serious distortion of the audio signal when the local oscillator drifts.

It is not necessary to have a high-frequency signal generator to align the audio section of the teleyision signal. As a matter of practice, it is actually better to align the f-m receiver at i-f frequency, for a greater degree of frequency is thus possible. In addition, since most interest in the television receiver centers on the picture, and

the eye is more critical than the ear, it is important that most of the alignment effort be expended in this direction. Again, if the audio receiver is properly aligned, correct alignment of the picture channels will give good audio fidelity.

The alignment of the r-f portion of the television receiver should never be influenced by the response of the f-m portion of the receiver. This is due to the fact that the point of optimum audio response means shifting the center-point alignment which is not necessarily the best point for the reception of the picture signal. This is another reason why the f-m portion should be aligned after the r-f section.

MICROPHONES

(*Continued from page* 18)

around characteristics make it ideal for all types of p-a work. Its construction is very similar to the p-m type speaker. It has a low impedance on the order of 20 ohms, permitting its use directly into a mike cable. The frequency response is fairly uniform over the audio spectrum, with a slight drop in output for frequencies above 10,000 cycles. Since it is a pressure type, slight directional characteristics are available. The output voltage is about .01 volt for normal operating levels.

In Fig. 5 appears a typical circuit.

Comparative characteristics of the various microphone types discussed in this article are shown in the chart of Fig. 6.

In a recent analysis of low-impedance microphones, R. D. Newcomb of Newcomb Audio Products, pointed out that high-impedance dynamic

(*Continued on page* 36)

Fig. 8. Plug-in transformer for low-impedance microphone inputs. (*Courtesy Newcomb*)

MICROPHONES

(*Continued from page 35*)

microphones, when used with long lines, lose high frequencies; Fig. 7.

Mr. Newcomb said that the kind of treatment microphones will receive is an important purchasing factor. If the microphone will be subject to considerable abuse, as in a night club, a low impedance microphone should be used, so as to obtain the advantage of its much more rugged cable.

Discussing these cables he said: "This inherent ruggedness of the cables is due to the fact that they are made of two relatively heavy-gauge wires, instead of the very fine, single wire, necessary with high-impedance microphones to minimize the capacity between the wire and outer shield. Since the successful use of high impedance microphones with even a 25' cable depends upon the reduction of cable capacity to an absolute minimum, it follows that cable for high impedance microphones is limited to this very fine, delicate center conductor."

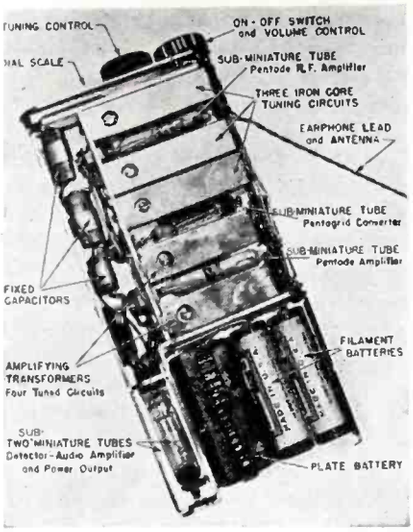
Fig. 9. Combination crystal microphone and desk stand. Frequency response is 70 to 7,000 cps. Voltage developed by normal speech is .0394 volt.

(*Courtesy Electro-Voice, Inc.*)

RECEIVERS TO VETERANS

William J. Halligan, left, and Tobe Deutschmann, with one of the eighteen S-40 Hallicrafters receivers presented to veterans at a recent drawing in Boston, Mass.

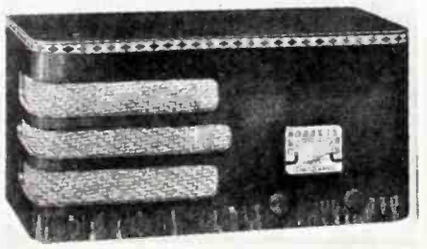
NEW MODELS



Pocket type 5-tube super using sub-miniature tubes, produced by Belmont Radio. Receiver is 3" wide, ¾" thick and 6¼" high.

Above. Lear model 561 5-tube one-band table model with a built-in loop. Below, Lear model 563 single band, 5-tube model. Both receivers use Alnico V p-m speakers.

Five-tube farm model battery receiver recently announced by John Meck Industries. Uses 5 miniature tubes that draw 1.4 volts.



TRENDS IN SOUNDS

[Highlights of New Equipment]

AN ADD-A-UNIT AMPLIFIER-PHONO system that provides power ranges of 30, 45, 60, 75 and 90 watts for two to six channels, has been developed by Concord Radio Corporation.

Basic 30 and 45-watt amplifiers have been produced. The 30-watt unit, which has a 60-watt peak power output, uses two 7B4s, one 7F7, one 7A4, four 6V6s and two 6X5s. The 45-watt unit (90-watts peak) tube lineup includes two 7B4s, one 7F7, one 7A4, six 6V6s and two 5Z4s.

Both amplifiers have bass and treble equalizers. Two high-gain microphone channels and two phono or program channels are also provided. The microphone channels have a db gain of 120/125 at 1000 cycles, 100,000-ohm input, with tone controls normal. Medium gain channels have a gain of 83/88 db also at 1000 cycles with a 100,000-ohm input.

Frequency ranges of both amplifiers are 50 to 10,000 cycles within 2 db. Impedance ranges are: 1.3, 2.7, 4, 5.3, 8, 16, 125, 167, 180, 200, 250, 415, 460, 500 and 600 ohms.

The hum and noise levels of the microphone channels are 60 db below 30 watts.

When additional power is necessary, a plug-in type power stage can be used.

An output indicator, using two neons, is provided on the monitoring panel. One indicator offers *normal* guidance, and the other is for *overload*. A calibrated dial permits setting at any predetermined value.

A 15" multicell Diacone speaker, model 603, incorporating a metal high-frequency diaphragm and a low-frequency cone coupled together by a mechanical dividing network and driven by a single 3" voice coil of edgewise wound aluminum ribbon, is now available from Altec Lansing. The metal high-frequency diaphragm operates into a multicellular horn to assure uniform sound distribution over a wide area.

Speaker uses alnico V and has a horizontal distribution angle of 60° and a vertical distribution angle of 40°. The voice coil impedance is 15 ohms; and power rating is 18 watts.

A line of microphones, amplifiers, speakers and baffles, automatic and manual record changers, portable sound systems, horns and a portable disc-recorder and playback unit, has been announced by the sound equipment section of RCA.

Microphones include velocity types. One is a bi-directional microphone, sensitive to a frequency range of 50 to 9,000 cps, and designed for audition studios, stage and recording work.

Another type, for outdoor work, uses a styrol plastic diaphram. Called the *Aeropressure* microphone, it has a reversible paracoustic baffle for either sharp or broad directional use. Frequency response is 60 to 10,000 cps.

Amplifiers include a 10-tube 25-watt unit, with a frequency response of 30 to 10,000 cps. Two other units, of 6- and 15-watt power output, are also available.

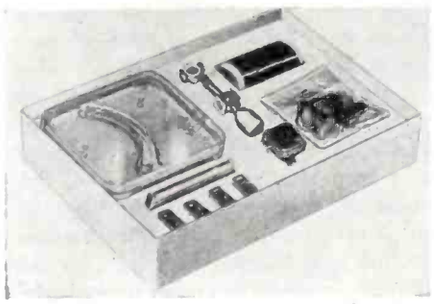
In the line of portable turntables and record players are one manual and two automatic. The manual turntable can play sixteen-inch recordings either at 78 or 33 1/3 rpm. The automatic record changers will play either ten 12" recordings or twelve 10" discs.

Where it is desirable to move recording equipment from place to place, a portable disc recorder is available. Turntables rotate at 78 rpm and can accommodate discs of any diameter from 6" to 12".

NEW PRODUCTS

KITCRAFT CRYSTAL KIT

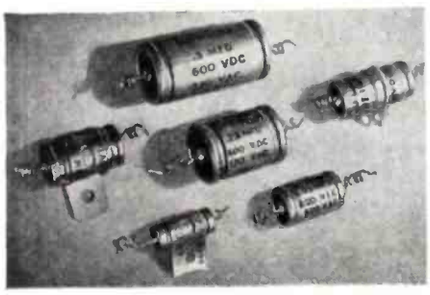
A crystal set kit designed to teach the principles of radio during construction has been prepared by Kitcraft Inc., 614 N. San Vicente Blvd., Los Angeles 46, California. Supplied with galena crystal and a 20-page illustrated manual containing diagrams, theory and building and operating instructions, written by Richard M. Gardner, radio instructor, Los Angeles city schools.



* * *

CORNELL-DUBILIER FEED-THRU CAPACITORS

Hermetically sealed feed-thru capacitors in metal cylindrical containers (.01 to .5 mfd) equipped with universal side mounting brackets with foil ends swedged have been announced by Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey. The d-c rated voltages are 600 volts, a-c rated voltages 330; both at 15 amperes.



* * *

B & W MINIATURE R-F COILS

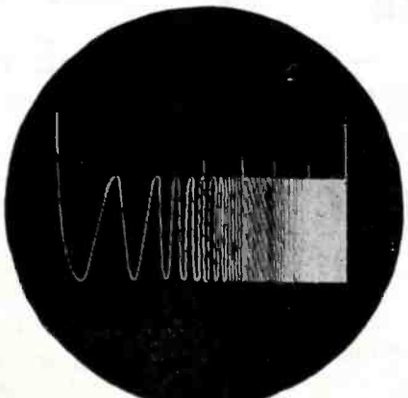
"Miniductors", a peacetime adaptation of the wartime miniature r-f coils developed by Barker & Williamson, 235 Fairfield Ave., Upper Darby, Pa., are now being packaged in standard 2" and 3" lengths. Supplied in diameters of ½", ⅝", ¾" and 1", and each diameter is available in four winding different pitches.

* * *

CLARKSTAN SWEEP FREQUENCY TRANSCRIPTION

A 100-10,000 cps sweep frequency transcription for audio system response checks has been announced by the Clarkstan Corp., 11927 W. Pico Blvd., Los Angeles 34, California.

Developed by Wayne R. Johnson, the recording has a repetitive rate of 20 cps recorded at constant amplitude below 500 cps and constant velocity above 500 cps. The sweep is logarithmic. There is a synchronizing pulse of 200 microseconds duration at start of sweep to lock the oscilloscope. Frequency markers are provided at alternate thousand cycles. Frequency response variations are said to be held within plus or minus one decibel. Made on 10" vinylite at 78 rpm and on 16" at 33⅓ rpm, the latter recorded with NAB curve.



Oscillographic recording of Clarkstan transcription.

* * *

CML DUAL POWER SUPPLY

Regulated power sources for *B* and C power, CML 1115, have been produced by Communication Measurements Laboratory, 120 Greenwich St., New York, N. Y.

The *B* supply furnishes a variable d-c voltage from 180 to 300 at 70 ma. Maximum ripple is said to be of less than 25 mv. Negative side of the supply is isolated from the chassis, so that the

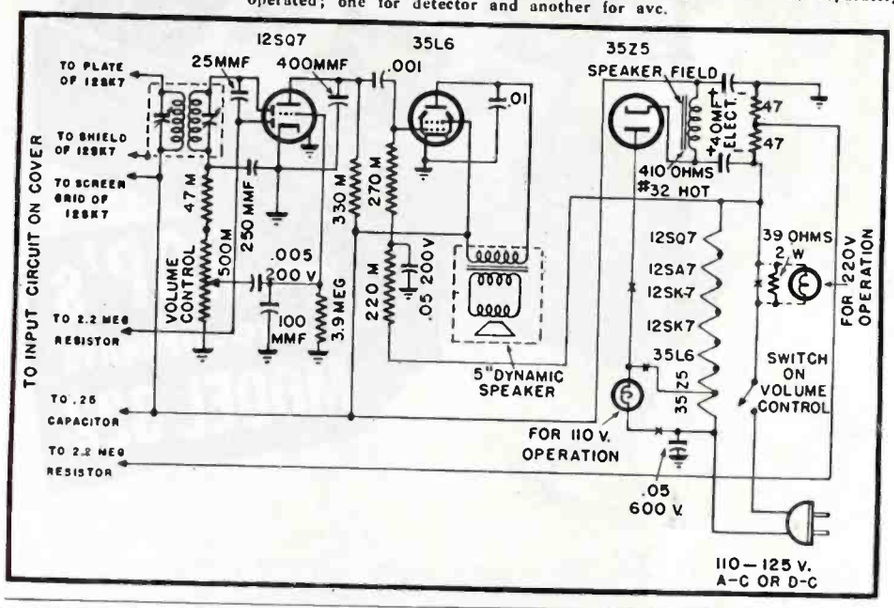
(*Continued on page* 44)

TWO-BAND A-C/D-C 5-Tube Receiver

[See Front Cover]

INPUT CIRCUITS OF A 2-BAND a-c/d-c 5-tube model with many unusual features appear on the front cover this month. In this receiver, Pilot B-3, the frequency coverage is 535 to 1720 kc and 5.6 to 24.0 mc.

Detector, a-f and power-supply system of Pilot B-3. Note that the 12SQ7 diodes are separately operated; one for detector and another for avc.



A 12SK7 tuned r-f amplifier is resistance coupled to an untuned 12SA7 first detector which feeds a standard 12SK7 i-f amplifier.

Quite an unconventional antenna system is used. An antenna-selector switch, located at the rear of the cabinet, permits the choice of either loop or external antenna for best b-c reception. For improved s-w reception an external antenna is required, but this is irrelevant to the selector switch which involves b-c only. The external antenna is connected to a b-c antenna coupling transformer the primary of which is bypassed for s-w by a 40-mmfd capacitor. Tracing the circuit, we find a 3-prong loop socket connected through a .005-mfd blocking capacitor to a s-w coupling transformer and to chassis and *B*—.

In s-w position, the s-w transformer acts in the usual manner, feeding sig-

---

(*Continued from page* 40)

nals directly to the r-f amplifier grid. The bandswitch connects the low side of the secondary to the avc bus, shorting the b-c antenna components. In the b-c position, however, the s-w secondary acts as a loading coil in series with either the loop or the b-c transformer secondary, depending upon the position of the d-p-d-t selector switch. With the switch in loop position, the loading coil is connected to the inside turn of the loop, the outer end going through a .1-mfd blocking capacitor to ground. The transformer secondary is shorted in *loop* position.

Throwing the selector switch to *outside antenna*, the loading coil is connected through the b-c antenna transformer secondary to the .1-mfd capacitor and to ground. In this position the loop is shorted. This is a neat method of handling the antenna problem, permitting either loop or external antenna reception. The usual methods require a sizeable antenna to contribute much additional pickup, at least 25′ to do any good at all.

The r-f resistance-coupling components consist of a 3,900-ohm plate load, 300-mfd coupling capacitor and 47,000 ohm grid leak. Looking at the oscillator section. we find that the s-w circuit is a straight grounded-plate hot-cathode Hartley while the b-c coil has a padder introduced between the grid section and the plate section. Both grid and cathode are switched from coil to coil.

In the intermediate and output portion of the model (*cover*), we find that the 12SQ7 diodes are separately operated, one for detector, the other for avc, with 25 mmfd coupling. Avc is fed to the r-f and i-f stages through a 2.2-megohm resistor, but there is also a parallel bias supply coming

(*Continued on page* 42)

NEWS

R. H. MAYER NOW V-P OF ST. LOUIS MICROPHONE CO.

Rollin H. Mayer has been elected vice-president and general manager of the St. Louis Microphone Company, 2726-28 Brentwood Blvd., St. Louis, Mo.

The company will manufacture dynamic microphones, including noise-cancelling dynamics, noise-cancelling differentials, a dynamic color-mike in plastic, etc.

R. M. Bennett is chief engineer.

R. H. Mayer

* * *

GELARDIN VISITS ENGLAND

Albert Gelardin, president of the Micro Sonic Corporation, visited England to accelerate deliveries of his British made, automatic record changers.

* * *

PHILCO AUTO SERVICE MANUALS

Auto service manuals have been prepared for members of the *Philco Service* organization in this country and abroad. Receiver circuits are divided into four

(*Continued on page* 43)

•

COVER

(*Continued from page* 41)

from the *C* voltage divider which also runs through a 2.2-megohm unit. The divider is a tapped 47-ohm resistor from power line to *B*— with an electrolytic at each end, the full *IR* drop being used for bias on the 35L6 power tube, the tapped section for the lower avc bias. A *C* filter of 220,000 ohms and .05-mfd keeps down the ripple in the power amplifier. The main filter consists of a pair of 40-mfd capacitors and the speaker field.

A special-resistance line cord is available for 220-volt operation with 550 ohms from line to *C*— and 666 ohms from line to *B*—.

sections with selected tests for each to expedite servicing.

* * *

SECOND EDITION OF DEELEY'S ELECTROLYTIC CAPACITORS

The second edition of *Electrolytic Capacitors* by Paul Deeley, chief engineer of the electrolytic division of the Cornell-Dubilier Electric Corporation, has been published. Book offers the basic theory of operation, processes of fabrication, the types and characteristics, as well as new applications of electrolytic capacitors.

* * *

CY READ JOINS MONTGOMERY WARD

Cyrus T. Read has resigned his post on the engineering staff of Hallicrafters to become supervising buyer of electronic equipment for Montgomery Ward & Co. Chicago.

* * *

SYLVANIA APPOINTS GRAHAM TECHNICAL RELATIONS MANAGER

Virgil M. Graham has been appointed manager of technical relations for Sylvania Electric Products Inc. He was formerly manager of the Sylvania industrial apparatus plant at Williamsport, Pa.

* * *

LESTER REJOINS RADIO WIRE TELEVISION

Frank Lester has been named head of the amateur division by Radio Wire Television Inc., 100 Avenue of the Americas, New York City.

Mr. Lester was previously with R. W. T. from 1928 to 1941. He was chief engineer for ECA from 1941 to 1946.

* * *

RCA SELF-SERVICE UNITS FOR MERCHANDISING OF TUBES AND PARTS

A *store planning service* for self-service merchandising of radio tubes and parts has been announced by the RCA tube department.

Constituting a line of 22 individual units, each of which may be used singly or in combination with other units to meet different requirements, the self-servers are made of heavy-gauge sheet steel, finished in gray, with red, white, and black trim lines.

One sales server is designed primarily for displaying unpackaged parts, and is used principally for midfloor display islands.

Another item, a counter unit, is provided for use where customers want items that are not on open display, for wrapping packages, and for taking in cash receipts.

NEW PRODUCTS

(*Continued from page* 39)

+ *B* may be grounded if it is desired to use the supply as a source of grid bias.

A variable d-c voltage from 0 to 75 is furnished by the *C* supply. Maximum ripple said to be less than 7 mv.

* * *

WINCHESTER MULTIPLE CONTACT CONNECTOR

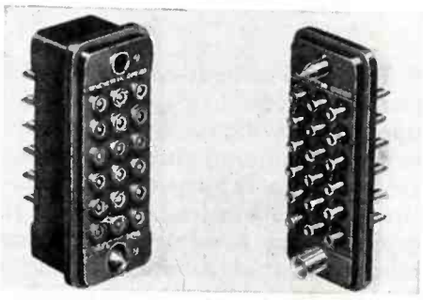
A self-separating connector that is said to have spring loaded contacts has been announced by the Winchester Co., 6 East 46th Street, New York 17, N. Y.

Molded of Melamine plastic with one-piece inserts.

Two guide pins, acting as ground contacts, perform additional functions of alignment and polarization.

Minimum air gap of ⅛" is said to be maintained between all contacts. Contacts are designed for use with a maximum wire size of 16 AWG.

Available in two sizes: 18 contacts (QRE18) and 12 contacts (QRE12).



* * *

RCP VACUUM-TUBE VOLTMETER

An a-c/d-c vacuum-tube volt, ohm and capacitymeter, type 668, has been announced by Radio City Products Co., Inc., 127 W. 26th St., New York City, N. Y.

The d-c voltmeter has direct reading, sensitivity 160 to 16 ohms, six ranges to 6,000 volts. A-c voltmeter also has direct reading, input resistance 160 to 16 megohms, seven ranges to 6,000 volts and meaures signal and output voltages from 10 to 10,000 cps. Ohmmeter (direct reading) has seven ranges to 100,000 ohms. Capacitymeter has seven ranges from 0.00005 to 2,000 mfd.

* * *

MAGUIRE SQUARE-WAVE UNIT

A square-wave instrument that converts output of audio sine-wave generators to square waves to facilitate tests of frequency response, distortion, phase shift, etc., has been developed by Maguire Industries, Inc., Brigeport, Conn.

Input frequency range, 2 to 200,000 cps; impedance, 75,000 ohms; voltage, 6 to 150.

Output frequency range, 20 to 20,000

cps (waveform said to be square to 1%; 2 to 200,000 cps total response).

Uses one 5Y3GT; two 6V6GT; one 6H6GT; and one 6SH7.

* * *

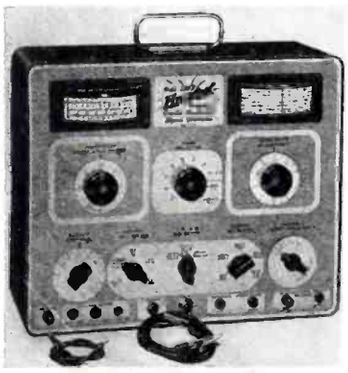
HICKOK UNIVERSAL CRYSTAL-CONTROLLED SIGNAL GENERATOR

A signal generator, types 288X and 277X, with amplitude-modulation coverage from 100 kc to 110 mc and 100 kc to 160 mc frequency-modulation coverage, with three variable bandwidths of sweep (0-30 kc, 0-150 kc and 0-450 kc), has been developed by the Hickok Electrical Instrument Company, 10521 Dupont Avenue, Cleveland 8, Ohio.

Frequency modulation at two self-contained modulating frequencies: 60 cycles and 400 cycles. Provisions for external f-m and a-m to 15,000 cycles.

Continuously variable audio frequency from 0-15,000 cycles. A 60-cycle synchronized sweep voltage is available for use with an oscillograph.

Dimensions, 14" x 16½" x 8".

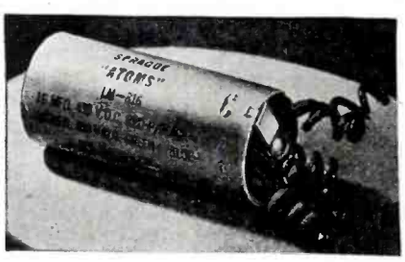


* * *

SPRAGUE UNIVERSAL VERTICAL CHASSIS MOUNTING CAPACITORS

Universal etched foil dry electrolytic replacements for vertical chassis mounting, type LM, have been announced by the Sprague Products Company, North Adams, Mass. Designed to replace screw can mounting and will fit any chassis hole from 3/16" to ⅞" diameter.

Have separate positive and separate negative leads which can be connected together to obtain common positive or negative sections.



* * *

NATIONAL OSCILLOSCOPE

An oscilloscope using the 2AP-1A with a 2" screen, CRU, has been an-

(*Continued on page* 46)

NEW PRODUCTS

(*Continued from page* 45)

nounced by the National Company, Inc., Malden, Mass. A panel switch permits use of a built-in 60-cycle sweep or external audio sweep for securing the familiar trapezoid pattern for modulation measurements.

Supplied in a table model but may be converted to the rack model type by addition of a rack panel.

* * *

FREED MEGOHMMETER

A megohmmeter, 1020, to measure leakage resistance of insulating materials, capacitors, cables, motor and transformer windings, has been announced by Freed Transformer Company, Inc., 72-78 Spring Street, New York 12, N. Y.

Range is 1 to 1,000,000 megohms in six overlapping ranges.

The voltage applied to the unknown is 500 volts and is said to be independent (less than 1%) of the value of the unknown.

Uses two 6C6s; two 6SH7s, one VR 105, one VR75, one 1V and one 6X5.

Size: 9½" x 10½" x 8".

* * *

FTR-F-M/TELEVISION LEADIN WIRE

A line of polyethylene insulated twin conductor f-m and television leadin transmission cables has been announced by Federal Telephone and Radio Corporation, Newark, New Jersey.

Manufactured for 100, 200 or 300-ohm lines.

* * *

LEAR 3-GANG VARIABLES

Mass production of 3-gang variable capacitors has been announced by Lear, Incorporated, of Grand Rapids, Michigan.

Elmer Crane, Lear v-p, at desk, with 3-gang variable.

* * *

METROPOLITAN ELECTRONIC MULTIMETER

A 5,000 ohms-per-volt multimeter, type 680, has been announced by Metropolitan Electronic & Instrument Co., 6 Murray St., New York 7, N. Y.

Measures d-c voltages to 1500; a-c voltages to 1500: resistance to 2 megohms; d-c current to 150 ma and db to +58.

Uses a 150-microampere meter movement shunted down to a sensitivity of 200 microamperes.

Measures 4" x 6½" x 7".

* * *

SOLAR CAPACITOR EXAM-ETER

A capacitor analyzer, model CF Exameter, is now available from Solar Manufacturing Corporation, 285 Madison Avenue, New York 17, N. Y.

Features a *quick-check* oscillator circuit for spotting intermittent, open-circuited and short-circuited capacitors without the necessity of unsoldering them.

Contains a d-c bridge to check capacitances from 10 mmfd to 2000 mfd and resistances from 100 ohms to 7.5 megohms. Capacitor power-factors up to 55% are read on an auxiliary bridge scale.

Has a 4½" meter in a vacuum-tube-voltmeter bridge null indicator, which is also used to measure electrolytic capacitor leakage currents under rated voltage

from a self-contained continuously-adjustable d-c voltage supply.

An electronic test circuit supplements the bridge for measurements of capacitor insulation resistance up to 10,000 megohms.

* * *

FTR MIDGET SIZE SELENIUM RECTIFIERS

A 1¼" x 1¼" x 11/16", 5-plate, square stack selenium rectifier has been designed by Federal Telephone and Radio Corporation.

Known as type 403D-2625, the rectifier consists of five squares of selenium plates on aluminum base plates, connected in series, with center contact.

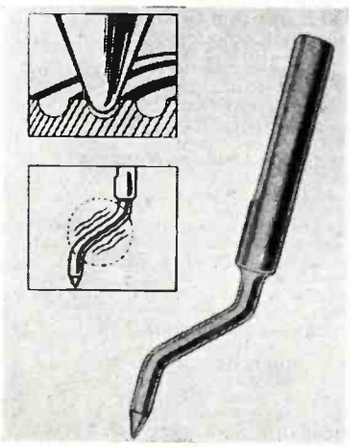
Unit has a rated current carrying capacity of 100 ma d-c and a peak inverse voltage of 330.

* * *

WALCO NEEDLES

A series of phono needles available with a choice of three different playing points—sapphire, ruby and precious metal—have been announced by Electrovox Company, Inc., 31 Fulton St., Newark 2, N. J.

Needles have a spring shank.



* * *

PYRAMID CAPACITORS

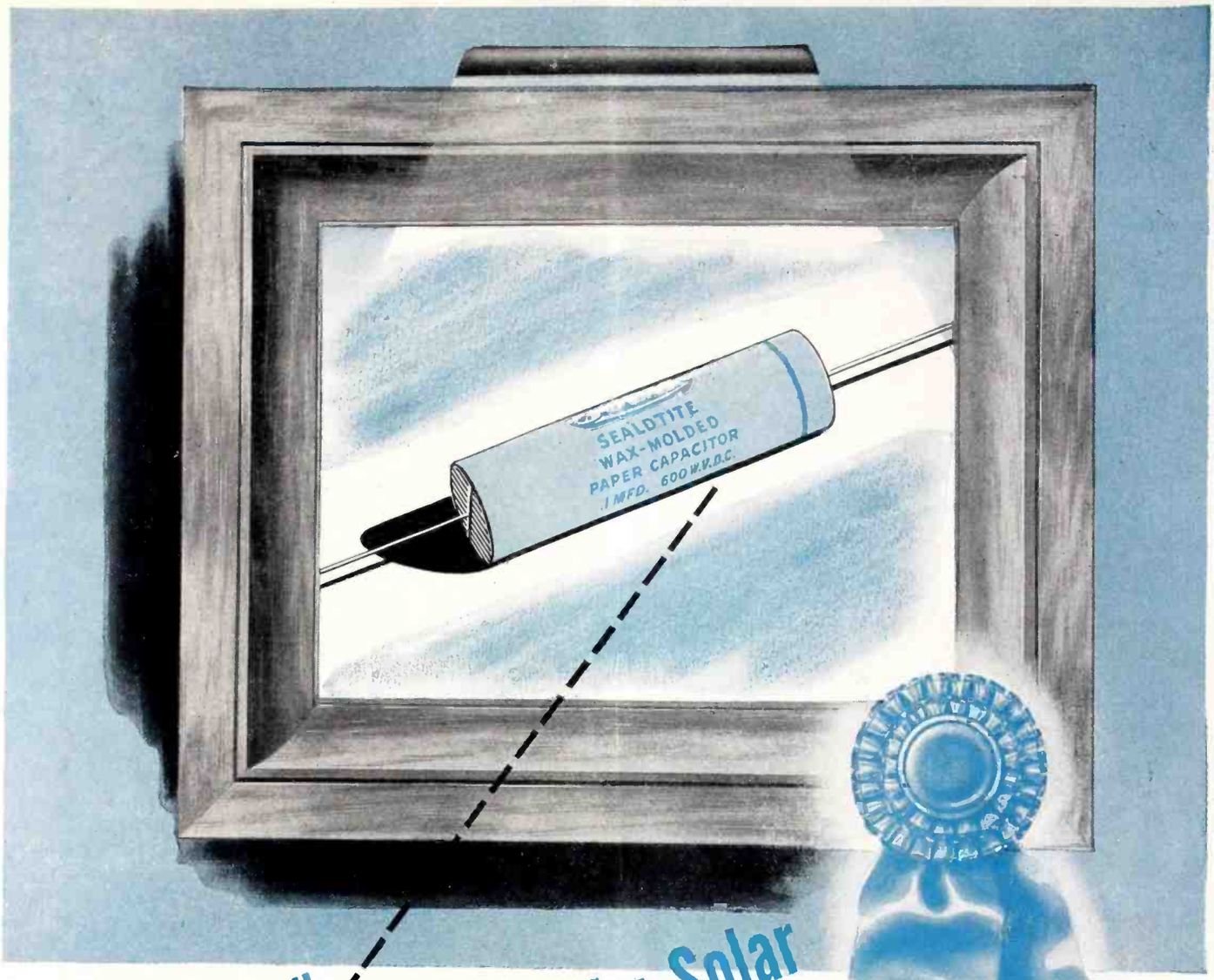
Dry electrolytics in sealed metal tubes and screw-base aluminum cans, and wax-filled impregnated cardboard tubes, single and duals, have been announced by Pyramid Electric Company, 415-421 Tonnele Avenue, Jersey City 6, N. J.

JOTS AND FLASHES

OVER 9,000,000 FAMILIES ARE CONSIDERING the purchase of television receivers, according to Frank Mansfield, director of sales research for Sylvania. In the survey recently completed, he learned that 45.1% are thinking about buying a television set. Over 50% said that they will pay from $100 to over $200 for a television set. . . . There'll be no merger of Emerson Radio and General Instrument according to a joint statement issued by Ben Abrams, Emerson president and A. Blumenkrantz, General Instrument president. The decision was made after a meeting of the board of directors of both companies. . . . E. G. Brown has resigned as ad manager of Hallicrafters and joined Burton Browne, advertising agency. Rollie Sherwood, sales manager, has assumed Mr. Brown's duties. . . . DeWald Radio has purchased a two-story building at 37th Avenue and Northern Blvd., Long Island City. Occupation is expected during the early part of October. The present plant at 440 Lafayette Street, N. Y. C. will be retained. . . . William Balderston has been elected executive vice president of Philco Corporation. . . . Brush Development has produced a flexible paper magnetic-type recording disc that can be folded and mailed; known as the "mail-o-gram." . . . Emerson Radio of Pennsylvania has moved to 223-25 North Broad Street, Philadelphia, Pa. . . . Ray Squibb has joined the sales staff of Marsh Agencies, Seattle, Washington, and will cover that area for National Union. E. O. Sandstrom has been elected treasurer of National Union. Paul Schuette has been named secretary and Jerome V. Deevy, assistant secretary. . . . Standard Radio & Electronic Products Company, 135 E. Second Street, Dayton 2, Ohio have released the first issue of their news bulletins "Srepco News". . . . Lifetime Sound Equipment Company, Toledo, Ohio has taken on an additional 2,500 square feet of floor space. . . . Walter M. Norton is now director of a distribution department at RCA that will guide the activities of the market research, education and training, regional managers and the distributing corporation of RCA Victor. . . . Ronald Bowen has been named Rocky Mountain states sales representative for Electronic Laboratories. His offices will be at 1886 South Humboldt Street, Denver, Colorado. B. G. Twyman, 6406 N. Fairfield Avenue, Chicago will represent Electronic Labs in St. Louis and eastern Missouri. Marc Donnelly will represent Electronic Labs in Honolulu. He'll be located in the Aloha Building. . . . The United Cinephone Corp., Ripley Company and the I-R Manufacturing Co. have been merged into a new unit, the Ripley Co., Inc., Torrington, Conn. . . . Allyn W. Janes is now with Gawler-Knopp, Inc., 1060 Broad Street, Newark, N. J. . . . Gerber Sales Company have moved to 739 Boylston Street, Boston 16, Mass. . . . Rex M. Gaynor, treasurer and merchandising manager of Walker-Jimieson Inc., 311 S. Western Avenue, Chicago, died in the recent Hotel LaSalle fire in Chicago. . . . Leo J. Galanek is now chief engineer of Regal Electronic Corp., 20 W. 20th Street, N. Y., N. Y. . . . A catalog describing plasticon capacitors, silicone capacitors and standard receiver type capacitors, has been released by the Condenser Products Co., 1375 N. Branch Street, Chicago, Ill.

ADVERTISERS IN THIS ISSUE

SERVICE INDEX—JULY 1946

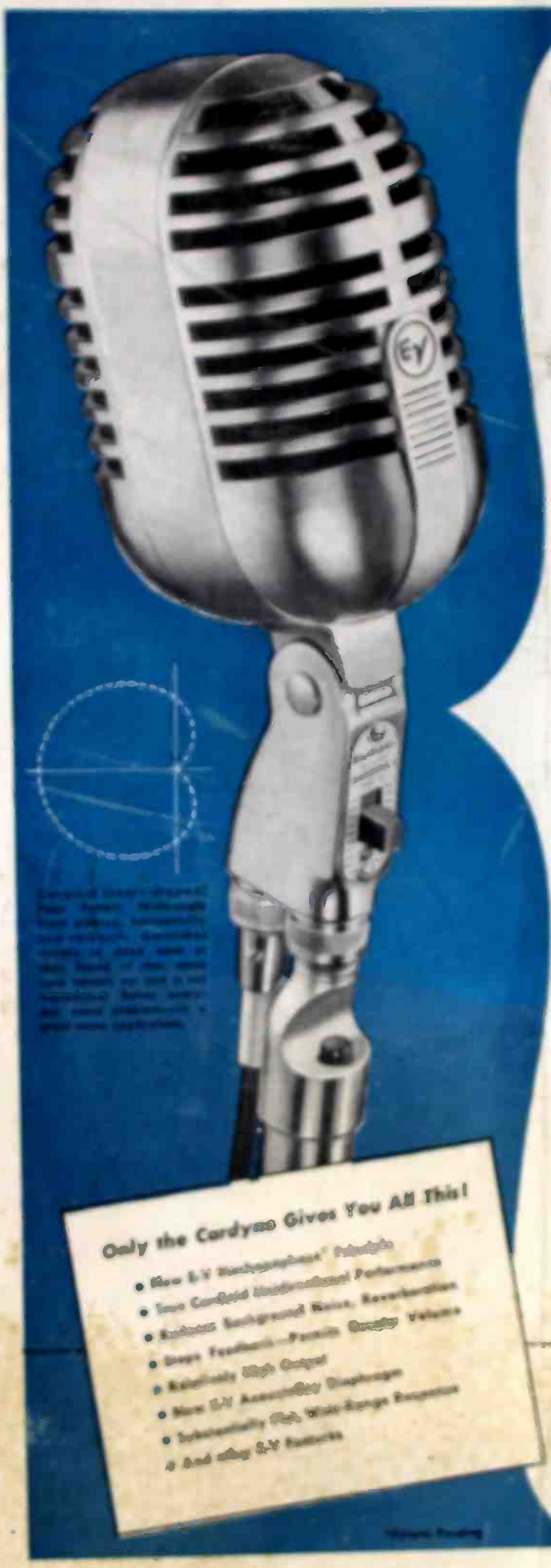


"Sealdtite" a modern masterpiece by Solar

"Sealdtite" paper capacitors, solidly molded in a cylinder of wax, are truly a masterpiece of modern mass-production. Preferred by radio designers everywhere, the superior moisture-resisting qualities of "Sealdtite" capacitors have made them a "must" for modern receivers and electronic equipment. When "Sealdtite" capacitors are specified, there is no compromise between quality and manufacturing economics as there is in ordinary cardboard tubulars.

SOLAR CAPACITOR SALES CORP.
285 MADISON AVENUE • NEW YORK 17, N. Y.
ELECTROLYTIC, PAPER and MICA CAPACITORS

SOLAR



Announcing

NEW Electro-Voice CARDYNE

Now you get More Features... More Advantages than ever... in a Single Head

Cardioid Dynamic Microphone

New E-V developments bring you true cardioid unidirectivity . . . smooth, wide-range response . . . high output . . . and other desirable advantages in a rugged single-head dynamic.

Through the exclusive new E-V Variphase® principle, the CARDYNE virtually eliminates unwanted sounds . . . gives you only the sound you want, with greater definition and fidelity. Substantially reduces background noise and reverberation. Increases effective working distance from microphone. Stops feedback. Permits increased loudspeaker volume. Gives extremely accurate pick-up and reproduction of music and speech . . . indoors and outdoors. Highly suitable for the most exacting sound pick-up work . . . in studio and remote broadcasting, disc and film recording, public address and communications.

Trim, modern, functional design, finished in rich satin chromium. Smooth, fast tilting action. "On-Off" switch. Rugged built to withstand severe operating conditions. Available in 50, 250, 500 ohms impedance, or Hi-Z (direct-to-grid, 25,000 ohms). Low impedances balanced to ground. Also available without "On-Off" switch. Send now for *Cardyne Bulletin No. 131.*

CARDYNE II. Model 731. List Price **$75.00**
Frequency response, substantially flat, 50-12,000 c.p.s.

CARDYNE I. Model 730. List Price **$55.00**
Frequency response, substantially flat, 50-10,000 c.p.s.

No finer choice than

Electro-Voice

ELECTRO-VOICE, INC., 1239 South Bend Ave., South Bend 24, Indiana
Export Division: 13 East 40th St., New York 16, N. Y., Cables: Arlab