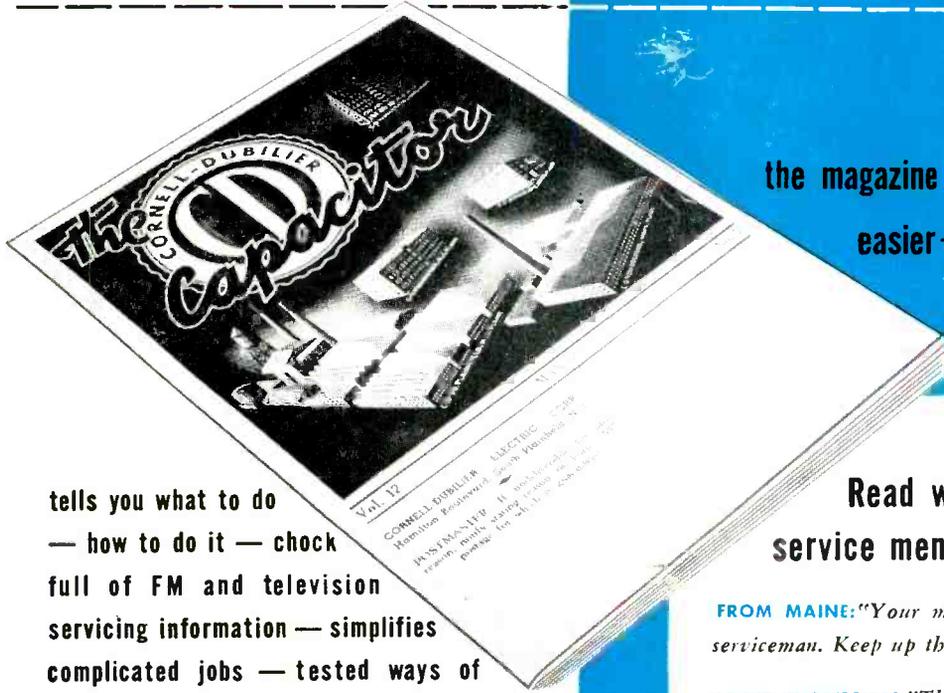
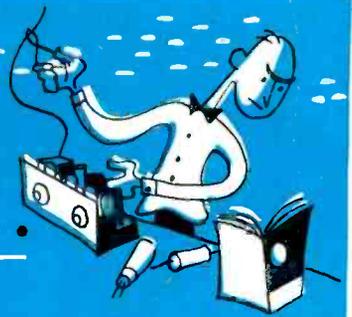




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# to servicemen...



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tells you what to do  
— how to do it — chock  
full of FM and television  
servicing information — simplifies  
complicated jobs — tested ways of  
boosting shop traffic

Here's a magazine which can go a long way toward making your shop *the* radio shop in your community. Every month it is loaded with ideas — not impractical, day-dreamy schemes which look good only until you try using them—but down-to-earth, tested plans which have actually been used with success by other servicemen just like yourself. Its convenient, pocket-size pages contain valuable technical data — latest dope on new type tubes — notes on trouble shooting — yes, and dozens of helpful hints which will help you to repair any radio ever made easier, better and twice as fast. Accept "The Capacitor"—every month—with C-D's compliments. Put it to work in your shop speeding up repair jobs — building bigger profits. *Don't wait! Mail coupon below NOW so your FREE subscription will start at once.*

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# KEN-RAD

DIVISION OF GENERAL ELECTRIC COMPANY

SCHENECTADY, NEW YORK

# EDITORIAL

## Annual Sound Issue

SOUND INSTALLATION, SERVICE AND MAINTENANCE has been for years a solid business builder for Service Shops. The increased use of p-a has kept many a Service Man on an overtime schedule. With the advent of high-gain intercom; paging systems; simplified recording and playback on discs, wire and paper; home talkies, and the corresponding development of new and improved components and accessories to accommodate these applications, Sound has become one of the most effective income-building mediums of the modern Service Shop.

To this enterprising industry, this issue of SERVICE has been dedicated, with the publication of articles on amplifiers, speakers, transformer matching, magnetic recording and playback with wire and paper, pickups and the merchandising of Sound today. Each of the articles, prepared by a leading specialist in Sound, covers a very important phase of the field.

The article by Thomas Arthur (page 18), for instance, presents for the first time a thorough analysis of the various types of magnetic recording-playback wire and paper units available today. The use of magnetic wire and paper for recording and playback is destined to become one of the most important factors in Sound. Several manufacturers have already announced inclusion of magnetic recording in their home instruments, and others have announced special models for home and professional use. Service Men should keep abreast of this rapidly growing factor in Sound.

The all-important subject of merchandising receives an unusually thorough treatment by Sidney Harman (page 30). Here's an article with dozens of facts on how to sell Sound today.

In an article on replacing speakers (page 22), S. Zuerker and N. S. Cromwell reveal how Service Men can make more money by substituting the newest type speakers in both p-a and home receivers.

Another *must* reading article appears on page 28 by Raymond E. Lafferty: *A Nomograph for Multi-Speaker Matching*. In this article, Lafferty explains, with the aid of an unusually simple chart, how to match amplifier output to a number of speakers.

As in the past, SERVICE will continue to feature Sound articles. In the July issue, for instance, will appear an article describing in detail how to choose the proper p-a system. There'll be a discussion, too, of phono-record cutting and reproducing.

Watch for these and many other authoritative articles which will help you step ahead with Sound today.

# RADIO · TELEVISION · ELECTRONIC SERVICE

Vol. 16, No. 6

June, 1947

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Editorial Director

**ALFRED A. GHIRARDI**  
Advisory Editor

**F. WALEN**  
Managing Editor

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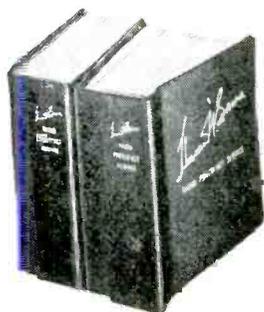
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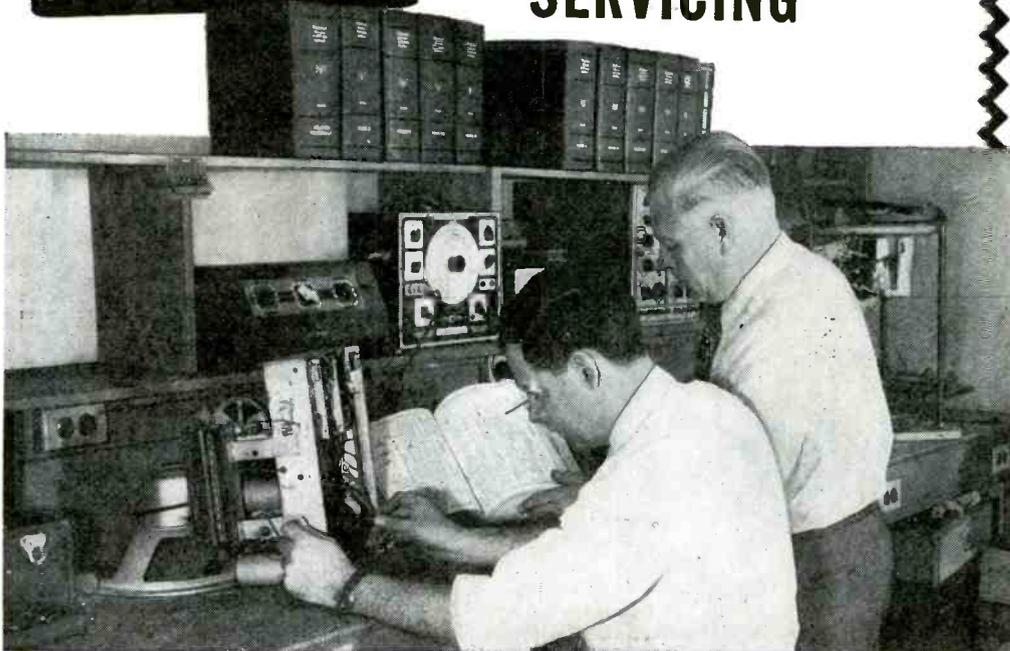
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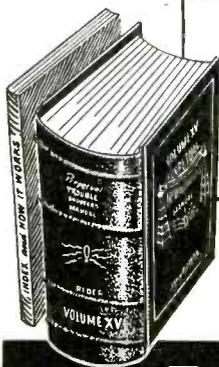
Volume XV, covering sets issued during 1946 and some unpublished pre-war models, is full of features resulting from "Sixteen Years of Continuing Service for the Radio Servicing Industry." For example, "clarified-schematics", which break down the composite diagrams of hundreds of complicated multiband receivers into individual schematics of each circuit as it exists with each turn of the wave band or equipment switch.

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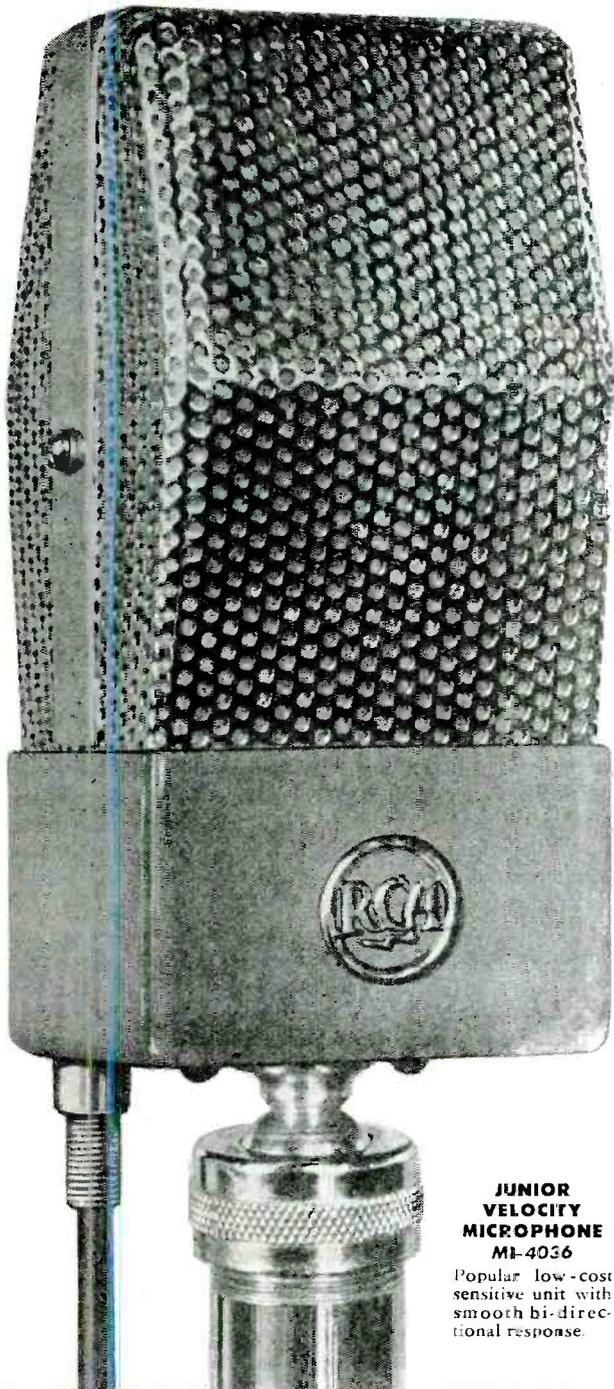
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Popular low-cost sensitive unit with smooth bi-directional response.

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Descriptions and specifications of RCA microphones, amplifiers, loudspeakers and intercoms . . . just printed . . . waiting for you. Get them now. Address: Dept. 76-F, Sound Equipment Section, RCA Camden, New Jersey.



**VARACOUSTIC MI-6203,04**



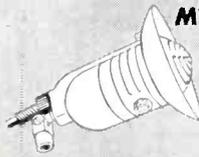
An extremely versatile velocity type. Has variable directional characteristics . . . a wide range of application.

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*...because it is Simpson-built!*

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The Model 260, like other Simpson test equipment, is made almost entirely within the various Simpson plants. Each component part has been designed and completely tooled and manufactured in our own plants, with very unimportant exceptions. The Simpson Model 260 is not an assembly job, as is true of so many testers on the market. Its unvarying quality is the result of control at every minute step of its manufacture. That is why your investment in a Simpson Model 260 is a lifetime investment in that famous Simpson accuracy which lasts as long as the instrument itself.



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20,000 Ohms per Volt D.C.  
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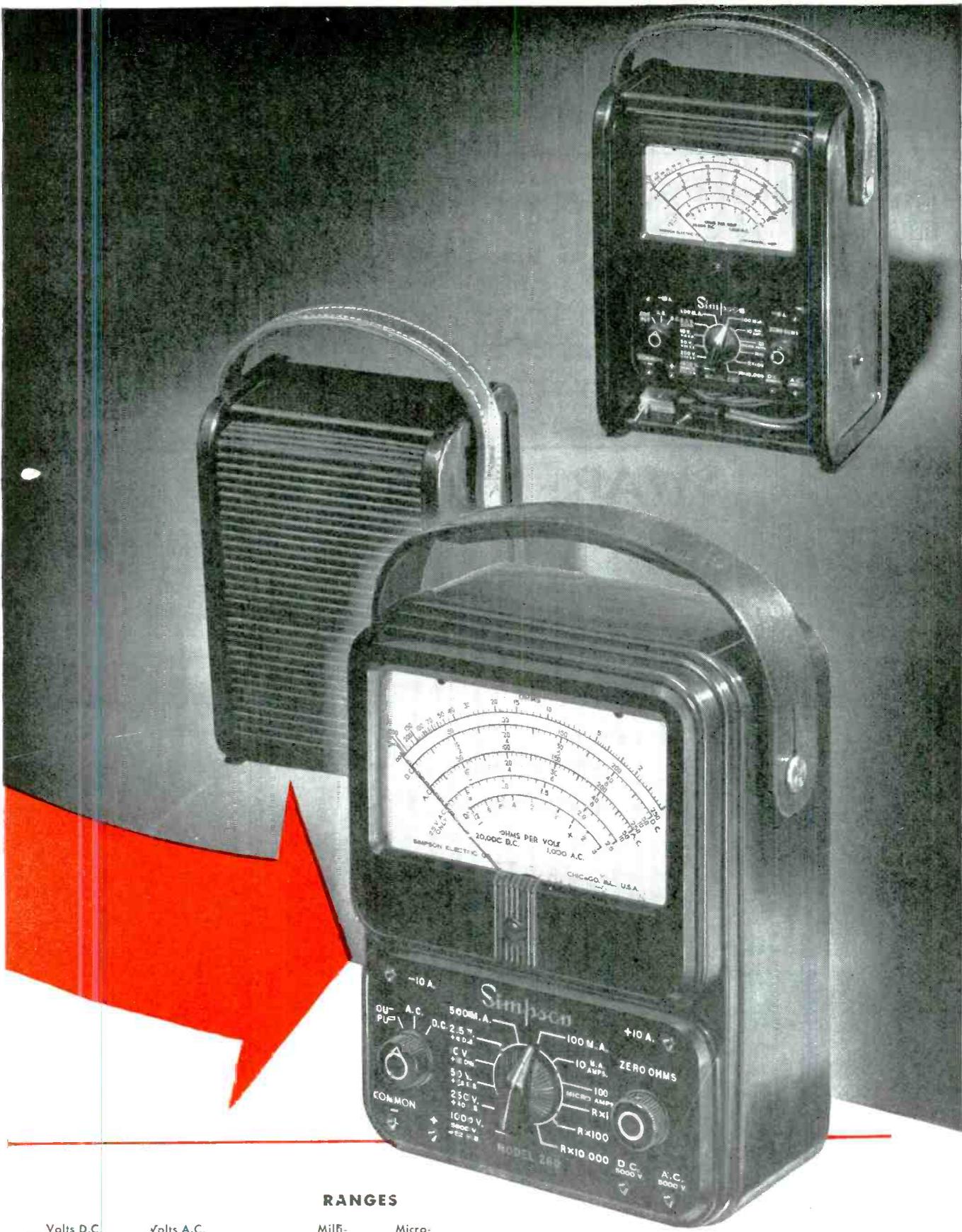
Resistance readings are equally dependable. Tests up to 20 megohms and as low as 1/2 ohm can be

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Model 260 . . . . . \$38.95  
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Both complete with test leads

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Volts D.C. (At 20,000 ohms per volt)	Volts A.C. (At 1,000 ohms per volt)	Output	Mil- amperes D.C.	Micro- amperes D.C.	Ohms
2.5	2.5	2.5 V.	10	100	0-2000 (12 ohms center)
10	10	10 V.	100	100	0-200,000 (1200 ohms center)
50	50	50 V.	500	Amperes D.C.	0-20 Megohms (120,000 ohms center)
250	250	250 V.		10	
1000	1000	1000 V.			
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(5 Decibel ranges: -10 to +52 DB)

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**FOR SALE**—RCA station allocator 171, \$10; signal tracer CA-10, \$5.50; both like new. Robert Syverstein, Inkster, N. Dak.

**FOR SALE**—Supreme tube tester VOM, condenser tester model 599, all in one case, \$30. Clyde J. Bacot, North Trumberton, N. C.

**FOR SALE**—Model 7002 Philco set tester made by Simpson, absolutely brand new, 20,000 ohms per volt, \$35. Eugene Burnett, RFD No. 1, Box 296, Homestead, Fla.

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**FOR SALE**—Masoc amplifier, spkr., mike, good condition. Trade for sig. gen. or cash. Frank Miles, Darlington, Ind.

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trol, 1/4" shaft, 20c; 3-tube phono amplifier, less tubes and spkr., \$1.25; 35Z5, 55c; 12SL7, 60c. M. Boxer, 126 Graham Ave., Brooklyn, N. Y.

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**FOR SALE**—Solar C-1-60 Exam-meter, new in original shipping carton. Purchased May '46, never used. Complete with test leads, instruction book, etc., \$45, f.o.b. C. W. King, Box 182, Crisfield, Md.

**FOR SALE**—Hickok 191X sig. gen., x'tal controlled; 156 indicating trace-ometer; 305 scope, \$125 ea.; RCA 170-A audio channel, used 5 mo., \$300; Simpson 260 20,000 ohms per volt analyzer,

\$25; Vomax vac. tube volt-meter, \$45. L. C. Peters, 1043 31st Ave., North, Nashville, Tenn.

**FOR SALE**—Battery eliminator ATR-1, excellent condition, \$30; Electric eye set-up, light source, eye, amplifier and relay, boxes, etc. Cleveland Radio Service, 3516 Connecticut Ave., Washington 8, D. C.

**FOR SALE**—Jackson multimeter; sig. gen.; tube tester; sig. tracer; pyrometer; flat iron thermometer; radio tubes; condensers; resistors; speakers; service manuals; vacuum cleaner belts; refrigeration tools. Complete equipment, purchased 1941. Russell L. Thompson, R.F.D. No. 2, Farmville, Va.

**SWAP**—Hickok 900 appliance tester, never used. For good 35mm camera. Warren DuRant, Manning, S. C.

**WANTED**—Part-time work, radio service work in shop or appliance store in Phila., Penna. Saturdays and evenings free for position. Herb J. London, 873 N. Marshall St., Philadelphia 23, Penna.

**SELL OR SWAP**—Motorola auto radio filterpac, 323C4, in perfect condition. Input 115 V. a-c, output 6 V. d-c, 10-15 amps. Paul Kitterman, Radio Service, Corydon, Ind.

**SELL OR SWAP**—Triplet analyzer, ideal for a beginner, has 3 meters; a-c, d-c and d-c milliammeter. N. Gregory, 36 Lenox Rd., Peabody, Mass.

**SELL OR SWAP**—Melssner analyst, used 4 months; or RCP VTVM 665A and Triplet 666H pocket meter; for Hickok 285X or 177 sig. gen., or what have you? Will answer all replies. R. P. Williams, 301 W. 154th St., Apt. 3, New York 30, N. Y.

**SWAP**—Wurlitzer amplifier with 8" spkr., 8 tubes, complete, in perfect order. Need test equipment or short wave receiver, or what have you? Clyde E. Davis, 342 S. Converse, Spartanburg, S. C.

**FOR SALE**—Latest model Philco a-c, d-c portable radio, 1 mo. old. Never used on battery. Cost \$58, will sell for \$48, or will swap for Sky Buddy or similar receiver in A-1 condition. Richard A. Ross, 36 Dearborn Ave., Rye, N. Y.

**WANTED**—VTVM in good condition, will trade RCP model 488, 1946 multi-purpose meter, guaranteed good as new, \$71.50. Lake Region Radio, Osakis, Minn.

**FOR SALE**—Hickok ae-51X tube and set tester. Factory modernized and recalibrated. Brand new Dayco 410 tube and set tester in oak case; Westop 507 r.f. meter with coupler, brand new. Write for details. Russell Mohr, New Palestine, Ind.

**FOR SALE**—Back issues of radio magazines, used radio parts, tubes, radios, testers, all in good condition; books on radio and electricity. Write what you need; all letters answered. Prices reasonable for quick sale. Watts Radio, West Granville, N. Y.

**WANTED**—41 Olds deluxe radio 982215; Rider vols. 3 & 4. For sale—Garrard RC-30 record changer, \$45; Philco changer for model 42-1010. Eilers' Radio Service, Box 204, Gladbrook, Iowa.

**FOR SALE**—Howard Sams vol. 1 in binder, \$12; set 5 Supreme manuals, \$6; assorted parts and tubes; crystalline osc., \$40; Electronics Design model 100 VTVM with edprobe, \$40. Mac's Radio Service, 14 Hinkley St., Bath, Maine.

**FOR SALE**—Astatic L-70 crystals, brand new, fresh stock, \$2 each. C. O. D. or prepaid. Sidney Kaplan, 262 Sumner Ave., Brooklyn 21, N. Y.

**FOR SALE**—773 Weston tube tester, \$20. A-1 shape; Rider's manual 7, new, \$12; 1175-B Triplet sig. gen. in A-1 shape, \$20. John Brown, 1326 9th St. South, St. Petersburg 5, Fla.

**FOR SALE**—Signal tracer. I'm closing shop, will sell brand new SPECO model STAP a-c, d-c for \$27.50, cost me \$44.95. Send check, money order or C.O.D. M. H. R. Hoffman, 4112 Gallatin St., Hyattsville, Maryland.

**WANTED**—Rider manuals; also 3-way portables in any condition. Will swap, or pay cash. John Saul, 916 Mercer St., New Castle, Penna.

**SWAP**—G.E. tube and battery tester TC3-P with test leads. Slightly used, in excellent condition. Has black imitation leather carrying case included. \$35. John C. Johnson, Box 313, Doylestown, Ohio.

**FOR SALE**—70% discount on radio tubes, all new and in cartons. Send for list, all letters answered. Cassel Radio Service, R.D. No. 4, Irwin, Pa.

**WANTED**—Rider manuals. State in letter volumes available and price. Lucien Michaud, 275 Bates St., New Bedford, Mass.

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radio subjects. Make sure your meaning is clear. No commercial advertising or advertising offering merchandise to the highest bidder is acceptable. Obviously, Sprague assumes no responsibility in connection with merchandise bought or sold through these columns or the resulting transactions.

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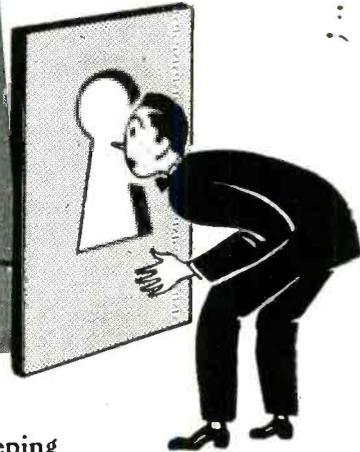
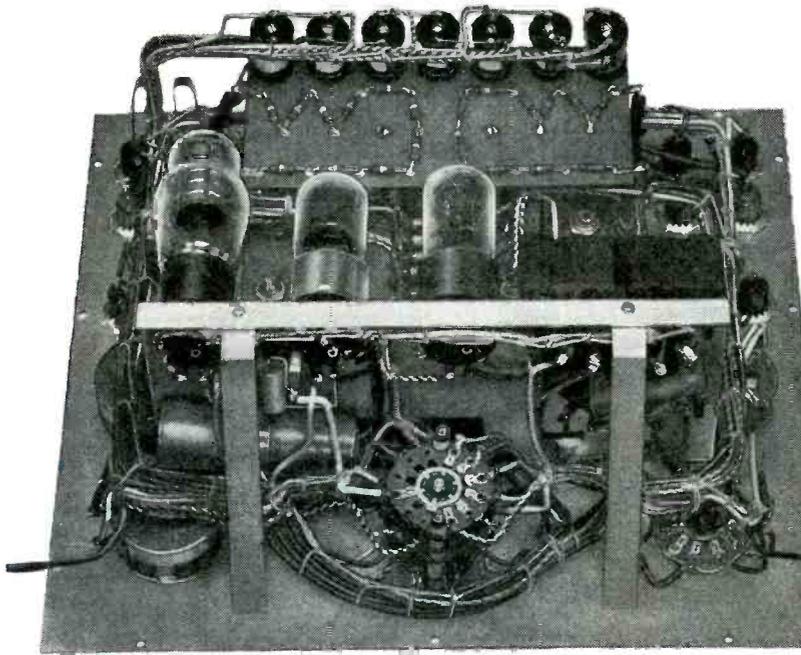
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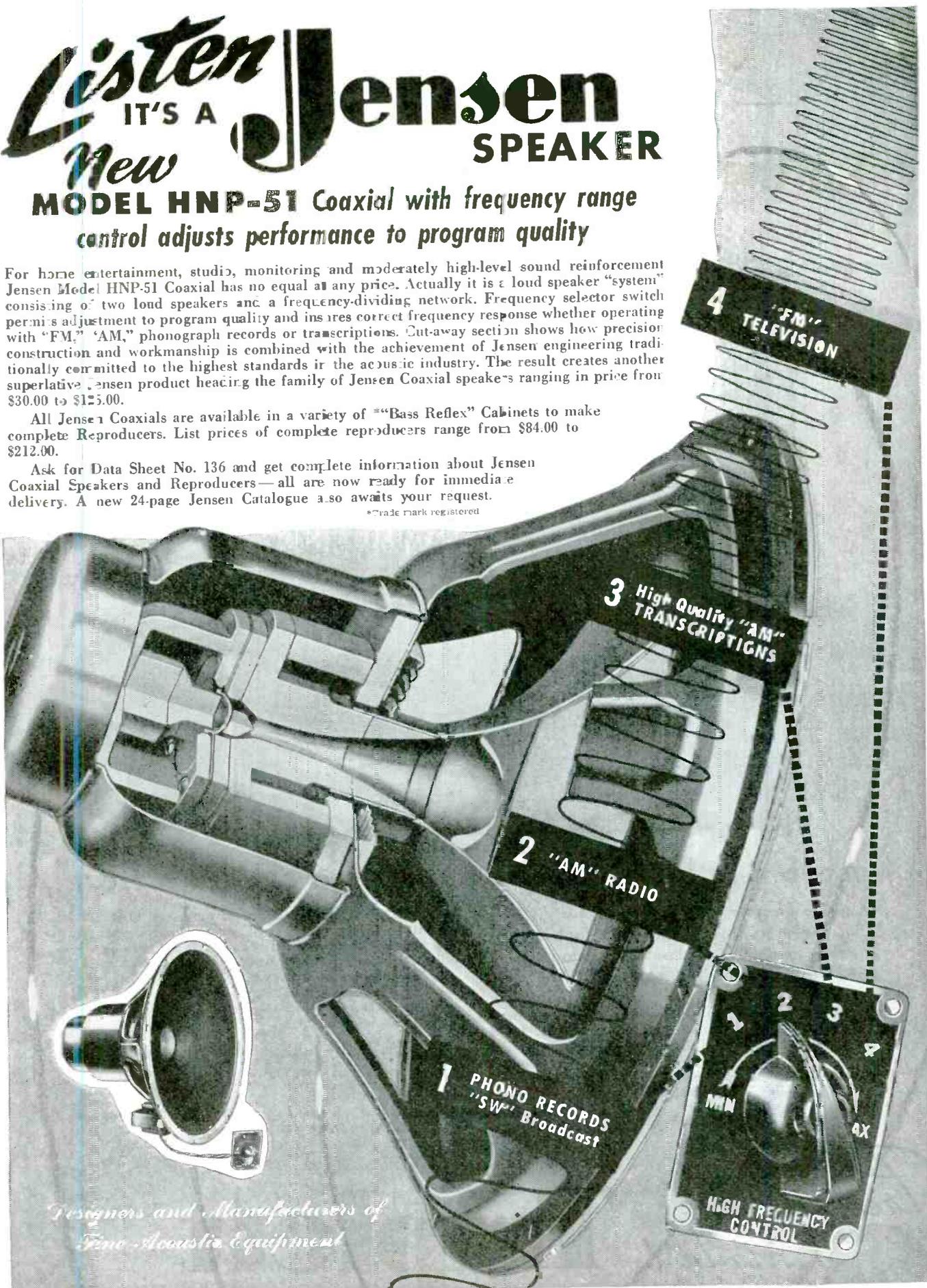
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For home entertainment, studio, monitoring and moderately high-level sound reinforcement Jensen Model HNP-51 Coaxial has no equal at any price. Actually it is a loud speaker "system" consisting of two loud speakers and a frequency-dividing network. Frequency selector switch permits adjustment to program quality and insures correct frequency response whether operating with "FM," "AM," phonograph records or transcriptions. Cut-away section shows how precision construction and workmanship is combined with the achievement of Jensen engineering traditionally committed to the highest standards in the acoustic industry. The result creates another superlative Jensen product heading the family of Jensen Coaxial speakers ranging in price from \$30.00 to \$125.00.

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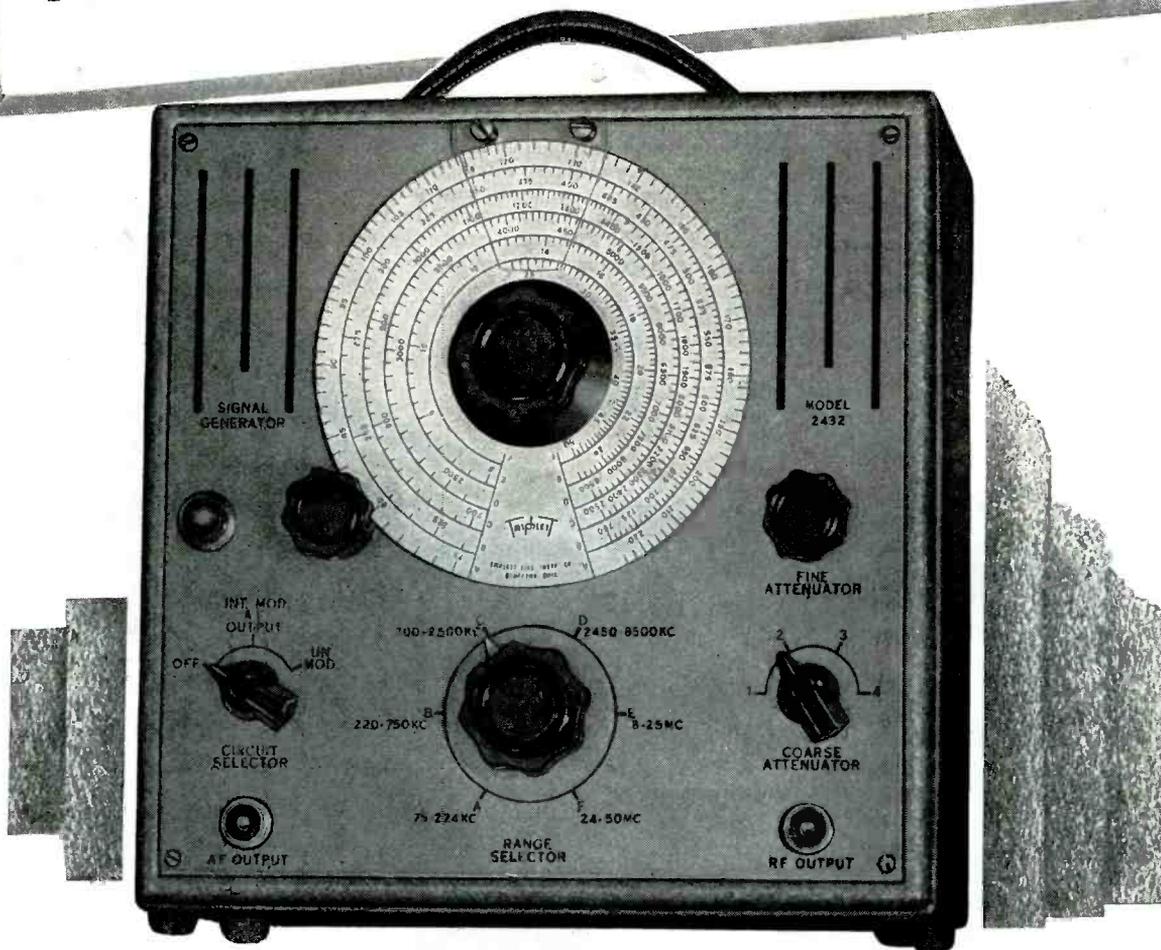


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Another member of the Triplet Square Line of matched units this signal generator embodies features normally found only in "custom priced" laboratory models.

**FREQUENCY COVERAGE**—Continuous and overlapping 75 KC to 50 MC. Six bands. All fundamentals. **TURRET TYPE COIL ASSEMBLY**—Six-position turret type coil switching with complete shielding. Coil assembly rotates inside a copper-plated steel shield. **ATTENUATION**—Individually shielded and adjustable, by fine and course

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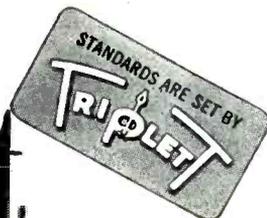
There are many other features in this beautiful model of equal interest to the man who takes pride in his work.

Write for descriptive folder — Address Dept S67



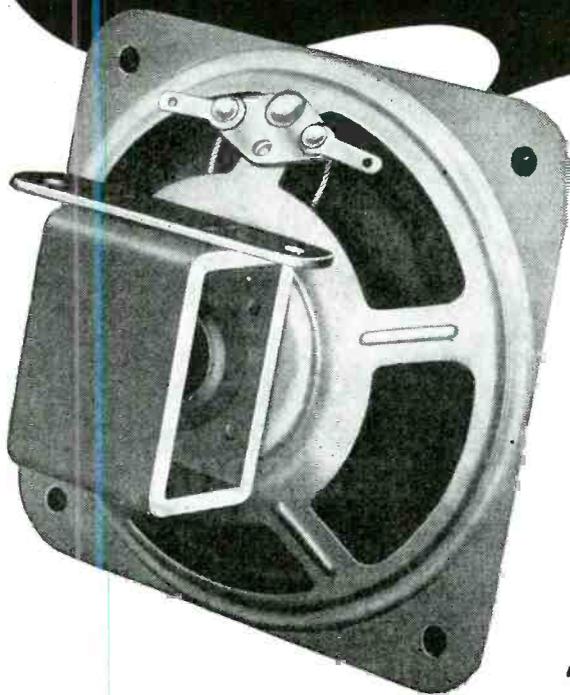
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# SYLVANIA NEWS

## RADIO SERVICE EDITION

JUNE

Prepared by SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa.

1947

### IT PAYS! — IDENTIFY YOUR STORE WITH THESE FREE AND LOW-PRICED SELLING AIDS

Take full advantage of these specially prepared sales aids—it pays! High quality store identification is one of the best means of indicating the type of service you're prepared to offer.

And when these attractive display pieces show that you're selling the finest line of radio tubes made—well, you have the ideal way of building up sales! Note eye-catching variety below.



This attractive display stands approximately 3½ feet high. Available in 10-inch size for counters.

**FREE—**



Get this low-priced weatherproof service banner—46" x 28". For truck, shop, window! 40¢ each; 3—\$1.00.

**FREE—**

Decal for store doors or windows; and dummy cartons in standard and 20" sizes.



14½" high by 10¾" wide by 7" deep, this colorful display is fitted with flasher unit that lights message every other second! A must for your window. Only \$2.00.



Wonderful new 15" diameter clock, in color. Telechron movement sealed in oil; case in brown crinkle finish with silver-colored rim. Only \$8.50.



### SUPPLEMENT SYLVANIA'S ADVERTISING CAMPAIGN

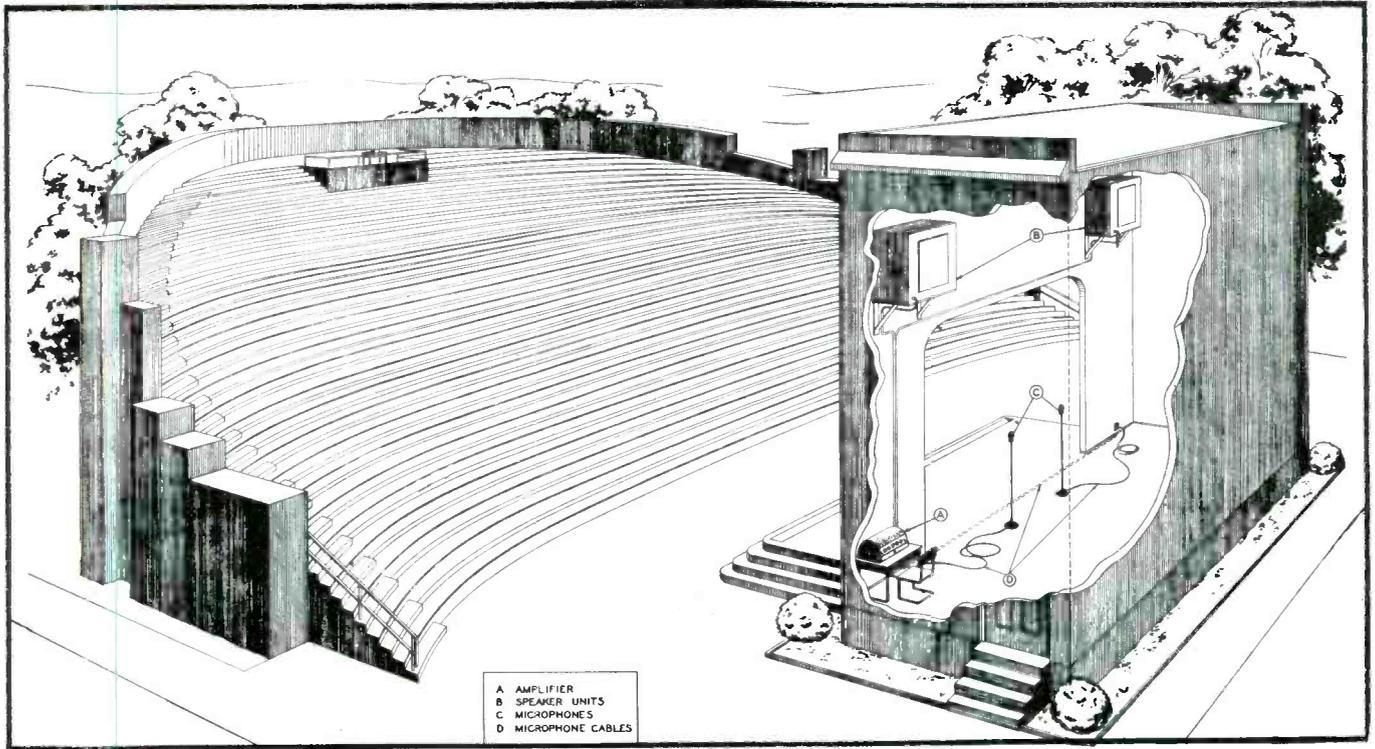
with the sales aids shown. Life, Collier's, Saturday Evening Post, with a combined weekly circulation of close to 12,000,000, carry ads that sell you, your product and service. To profit from this national campaign use these tested, "on the spot" selling aids.

Order from your Sylvania Distributor or write Sylvania Electric Products Inc., Emporium, Pa.

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# SERVICE



## A 25-30 WATT AMPLIFIER

[See Front Cover]

A FOUR-STAGE 25-30 watt amplifier with three microphone input stages, and built in mixing controls for microphones or low-level lines is diagrammed on the cover this month: RCA MI-12290 and 12298. Each of the input stages is resistance-capacity coupled to the mixer stage.

Two jacks are provided for phonograph pickup connection; one jack is connected to the control grid circuit of a microphone stage, and the other jack is connected through a volume

control to the control grid circuit of the mixer tube. The first jack allows the amplifier to be used with a low-level phonograph pickup.

Three low-impedance high-gain inputs (150-600 ohms) are provided for the microphones; and one high-impedance high-gain input and one high-impedance moderate gain input (0-1 megohm) are provided for the phono.

Three 6J7s are used as input amplifiers. A fourth 6J7 tube functions as the mixer stage. The mixer is

coupled to a 6SN7/GT which acts as a phase inverter. Four 6V6/GTs are connected in push-pull parallel to serve as the power amplifier stage.

### Degeneration

Inverse feedback is provided via a tertiary winding of the output transformer to the cathode of the third-stage tube.

The output transformer is tapped to  
(Continued on page 40)

Above: A typical outdoor p-a installation. (Courtesy RCA).

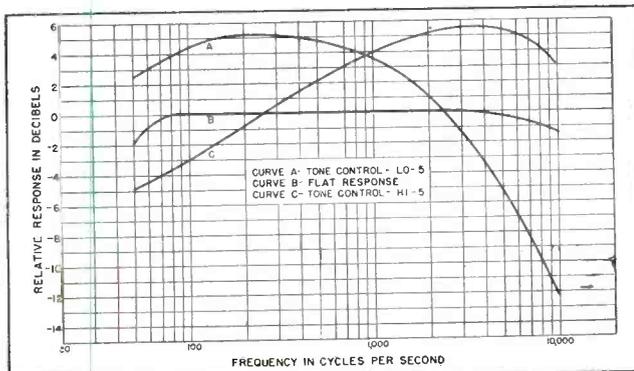
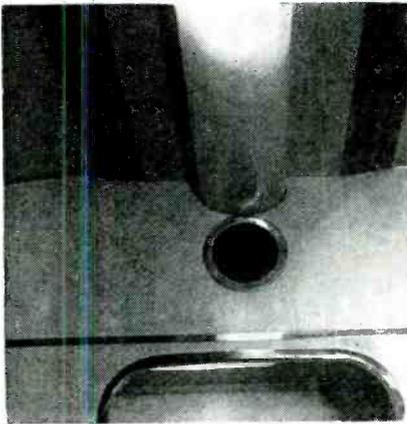


Fig. 1. Frequency response of the 25 to 30-watt amplifier.

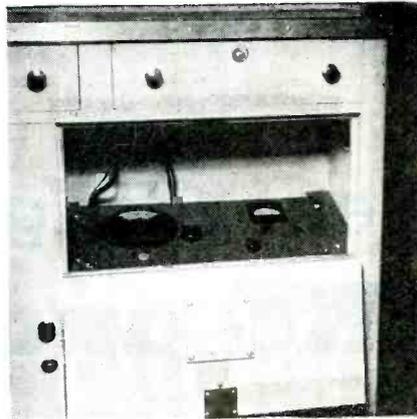
Fig. 2. Front view of the amplifier.



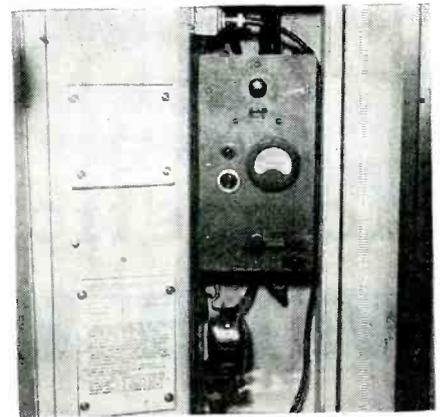




Bulkhead mounting of loudspeaker in coach.



Receiver mounted in observation car.



Control box in conductor's compartment. Full operating instructions appear in printed forms mounted in door.

impedance. The power gain is 105 db from microphone input and 72 db from the phonograph input, both based on a 50,000-ohm input source impedance. Power output of each amplifier is 15 watts, with less than 5% total harmonic content, measured at 400 cycles with a supply voltage of 117.

A 6C5 (or 6J5) is used in the second-stage voltage amplifier, and 6SC7s are used in the first-stage voltage amplifier and driver inverter. A 6L6GT is used in the push-pull power output.

#### Club Car, Buffet Lunch Counter

A receiver<sup>6</sup> was mounted on a rack type panel and installed face down in the ceiling. To simplify operation, only the tuning and volume controls and output meter were extended through the panel.

The conductor compartment was equipped with a monitor speaker, a microphone and holder and a control box including a switch, output meter and volume control for the monitor speaker.

#### Observation and Dining Car

This car was equipped with a radio tuner, microphone and holder and control similar in appearance to that at the club car lunch counter.

In operating the system from any control point the output meters are used to maintain a consistent operating level. To simplify operation there is no separate microphone volume control, although the level is easily corrected

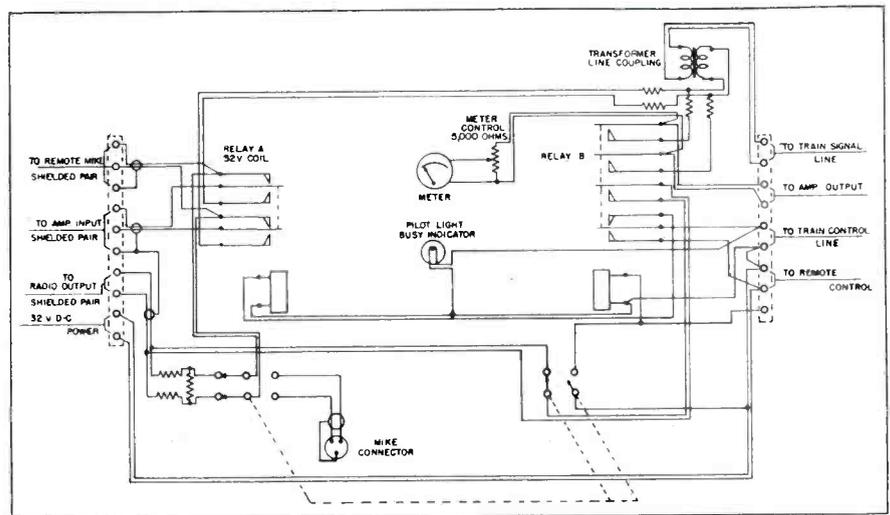
Rear view of rack-mounted amplifier. Shock mountings are at base of chassis.



by the operator changing his distance from the microphone.

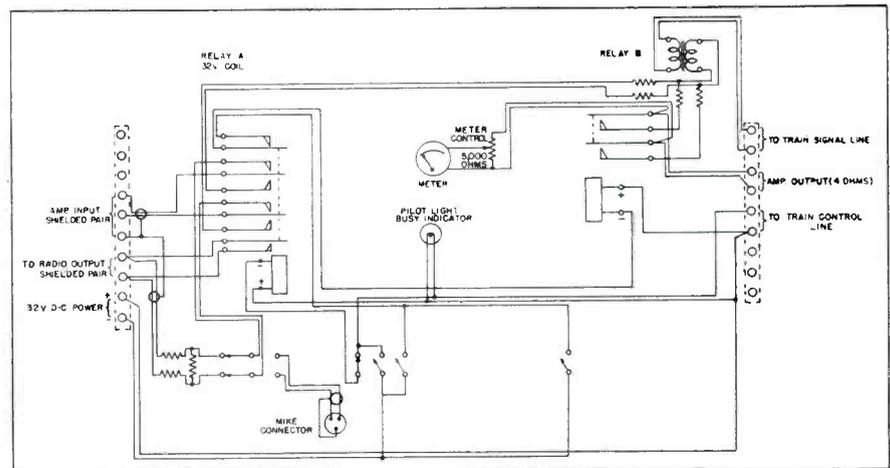
The antennas<sup>6</sup> used on the cars with the radio tuners were developed especially for trains. They are coupled to

the sets by coaxial cable and input transformers and provide good reception in areas of low signal strength with very little interference from the train's other electrical equipment.



Control box circuit. Through this circuit, with the three-position switch in normal position, receiver output power from the output transformer is introduced through a resistor network and the contacts of relay A into the input of the 15-watt amplifier and then reproduced through the loudspeakers in the car. These speakers are permanently connected to the amplifier. Volume is controlled from the receiver chassis and regulated by means of an output meter. With the switch in this position, an announcement can be made from another control point; the train control line is energized at this time, and relay A serves to transfer the amplifier input to the train signal line to pick up the announcement.

Observation-car control circuit. The switch contacts are shown in normal position for playing of the receiver in the local car. Rotating this switch clockwise to a non-locking position operates the left and center contact groups, connecting the microphone to the amplifier input, energizing the train-control line and operating relay B, which in turn connects the amplifier output to the train-signal line for transmission to all cars.



# Magnetic Recording-Playback WITH WIRE and PAPER

An Analysis of the Design, Application and Operation of the Latest Types of Magnetic Playback-Recorder Equipment

by THOMAS ARTHUR

MANY TYPES OF MAGNETIC RECORDERS are now on the market or are in production. It is well, therefore, for the Service Man to familiarize himself with the design features and application characteristics.

## Wire Recorders

Present day magnetic wire recorders have appeared in several different designs. Fundamentally, all utilize basic designs developed by pioneering physicists and engineers.\* Refinements have been incorporated in recording-reproducing heads, which include a properly designed recording-reproducing winding on a laminated core of the best magnetic steel for the purpose, a bias winding and an erasing winding; Fig. 1.

## Operation of Units

Generally most commercial models operate in the following way:

A stainless steel (or a magnetic

\* Armour Res. Foundation, etc.



Differential drive unit of a magnetic wire recorder-reproducer. (Courtesy Brush)

plated) wire .004" in diameter, is moved across the recording head. Many have adopted a standard speed of 2 feet per second. In recording, high frequency energy of 30 to 40 kc is applied to the erasing winding. This removes previous recording or other spurious magnetizations on the wire, as it passes over the first air gap, which is about .010" wide, before it reaches the second air gap. This air gap (recording gap) is nar-

row, about .002" wide, for if it were too wide for a given wire speed, the positive and negative half cycles of the higher audio frequencies would tend to cancel each other.

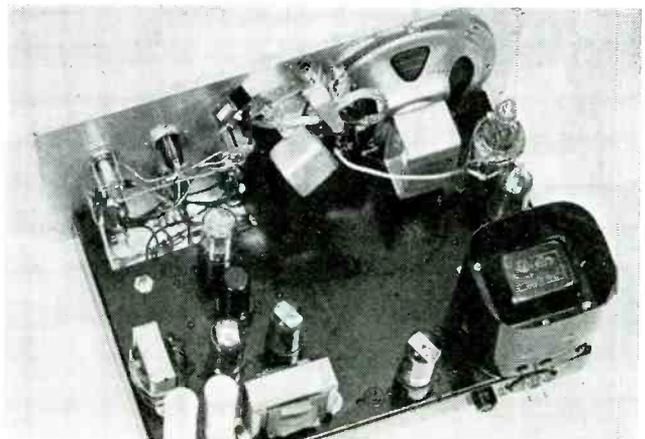
Wire is magnetized longitudinally (to eliminate distortion since the wire turns on its own axis) as it passes over this air gap by simultaneous field action, magnetic fields induced by the audio signal fed to the recording-reproducing winding, and by the field induced by the bias winding. This winding is energized by the same supersonic frequency as the erasing winding, and serves to place the audio modulation on a straight line portion of the recording wire's magnetic characteristic; Fig. 2 (p. 46). The strength of this bias current, and the design of the bias winding are adjusted to the proper value by the manufacturer.

In reproducing, the wire is rewound while all energy is removed from the head, then is run over the head again. This time the supersonic oscillator is not connected and voltage is induced

Portable paper-tape recorder. (Courtesy Indiana Steel)



Amplifier used with paper-tape recorder. The amplifier uses two voltage stages with a 6SN7, phase inverter with 6SC7, two 6V6s in pushpull output, an equalizer network, and a Hartley oscillator for bias supply.



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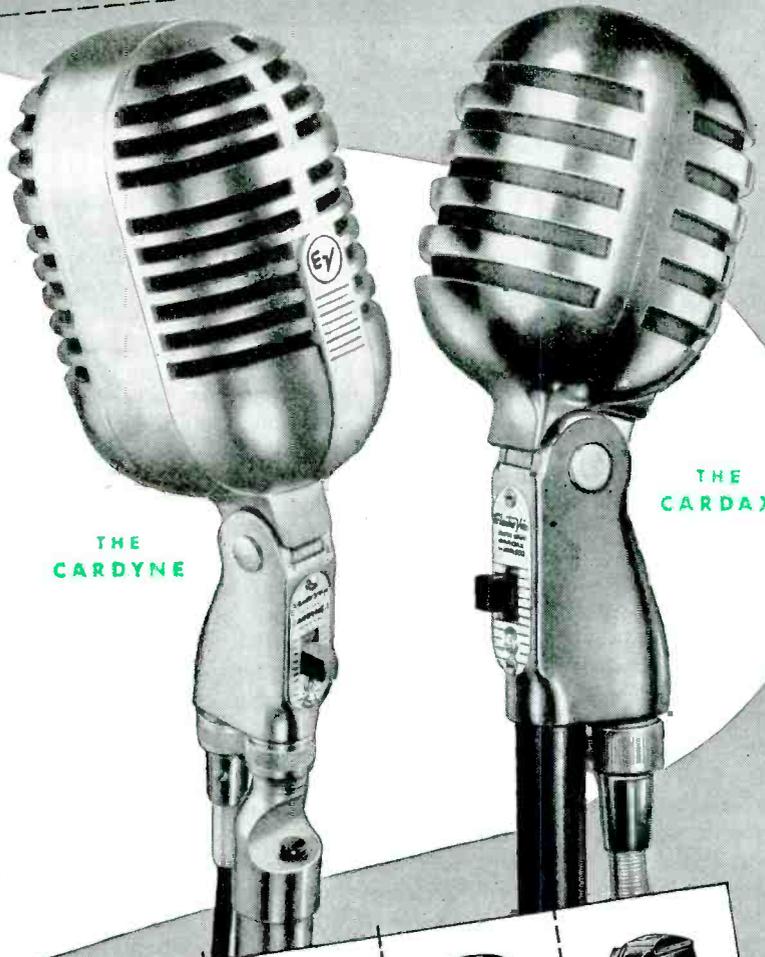
● Only ELECTRO-VOICE provides such a complete line of microphones. With outstanding developments in Unidirectional, Differential†, Bi-directional, and Non-directional types . . . in Dynamic, Crystal, Carbon and Velocity models . . . you can more easily obtain the microphones best suited to your needs.

● Proved in critical service, E-V Microphones are widely used today by leading manufacturers and sound engineers in all kinds of applications. They are produced from finest materials under E-V quality control. Consult our engineers.

**THE CARDYNE**—True cardioid unidirectional dynamic microphone, with exclusive E-V *Mechanophase\** principle, *Acoustalloy* diaphragm, smooth, wide range response, and high output.

**THE CARDAX**—The only high level cardioid crystal microphone with Dual Frequency response for high fidelity voice and music, or rising characteristic for extra crispness of speech.

†Patent No. 2,350,010 \*Electro-Voice Patents Pending



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V-3, V-2, V-1 Velocity	640 Dynamic	630 Dynamic	605 Dynamic 905 Crystal	610 Dynamic 910 Crystal	600-D Dynamic 210-S Carbon 602 Differential	205-S Differential
					606 Differential	Comet Crystal Comet-D Dynamic

A portion of the Complete E-V Line is shown here

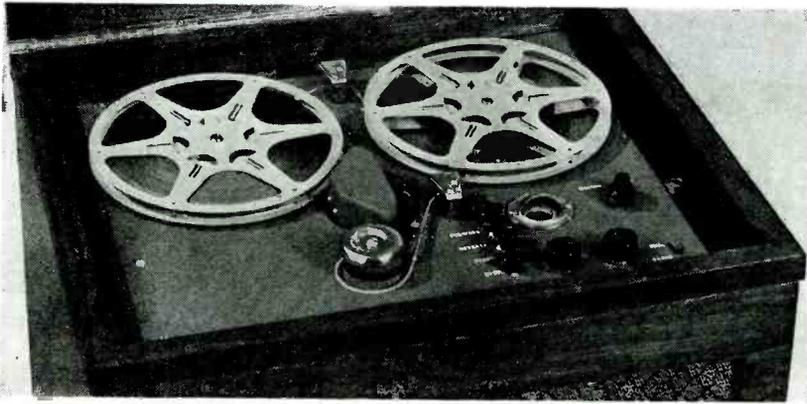
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Magnetic paper-tape home-type recorder-reproducer. (Courtesy Brush)

in the recording reproducing winding only, as the wire passes over the narrow gap in accordance with the signals previously recorded on it. This winding is now connected to the input of an audio amplifier to which is connected a loudspeaker or headphone as desired.

One recently-announced model includes a hum bucking coil on the head. This is connected in series with the record-reproduce winding in such a way that external inductive fields which would be picked up by that winding and added to the signal, are also picked up by the hum bucking coil. Thus the output cancels that induced in the working coil.

It will be noted from the foregoing, that the average speed now used is far slower than was possible in early models. By the application of proper magnetic materials, size of wire, closer design tolerances, and supersonic biasing this important improvement was made possible. Thus current type wire recorders permit one hour of continuous recording with a small spool of wire, and a reasonably good frequency range, low distortion, dynamic range, and noise

level. Improved recording and reproducing circuit design have also helped to make this possible.

In addition, many of the improvements can be ascribed to the overcoming of problems involved in the wire-driving mechanisms. To maintain constant speed of the wire past the recording gap, it is necessary to do more than simply wind the wire from one spool to the other. The preferred method uses a capstan or drum, driven by a constant-speed motor, which pulls the wire over the head. These capstans are designed so that slippage of the wire is negligible, as little as a few hundredths of one per cent in the better models. This is the same principle used in the *sound sprocket* in film-sound recording cameras. The capstan also provides mechanical filtering through fly-wheel and damping action, thus not only maintaining constant average speed but also taking out speed variations causing *wows*. In addition to the capstan drive, several models utilize magnetic clutches on the spool drives to keep the wire tension constant. Thus, wire breakage is almost eliminated. There is one type of wire

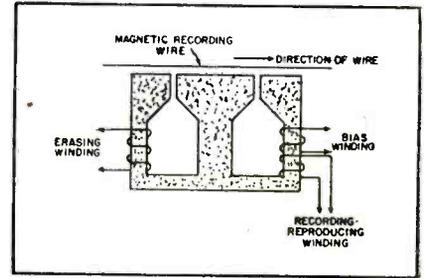


Fig. 1. Erasing and record-reproduce gaps and windings in a single head.

unit in which the wind-up spool includes the features of the capstan by making this spool a large thin drum, like a turntable, and designing it to give mechanical filtering action.

These design features also permit smaller wire spools to be used. In older models using small spools, the increase in diameter from the hub to the outside when freely wound, and using the take-up spool to pull the wire across the head, resulted in a considerable variation in wire speed from beginning to end. The slower speed at the beginning resulted in loss of the higher frequencies.

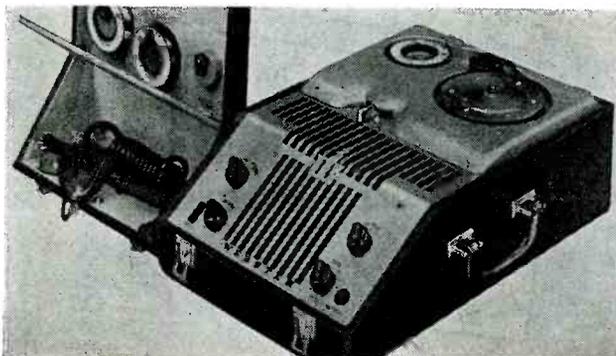
Some models incorporate a level winding mechanism to lay the wire in even layers on the spools.

Another feature used is that of either applying brakes automatically to the spools whenever the wire is stopped. In one case the driving motor is automatically stopped while there is still about  $\frac{1}{2}$  layer of wire on either spool. These features are particularly necessary in rewinding as many machines use a rewind speed four to eight times greater than recording speed, to save time.

Another model accomplishes the foregoing characteristics by using

(Continued on page 46)

Wire recorder-playback unit, available with three spools of wire for two fifteen-minute and a half-hour recording. (Courtesy Webster-Chicago)



Stromberg-Carlson home-type wire recorder for use with receiver amplifying system.



SILVER

906

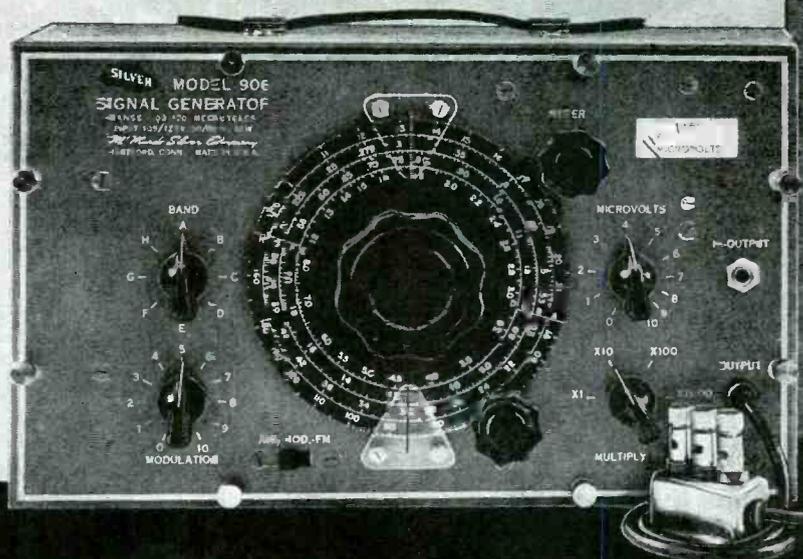
AM-FM SIGNAL GENERATOR

90KC—170MC-AM

90KC—210MC-FM

8990 NET

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# Speaker Replacements

## Installing Alnico V Speakers In Place of Prewar P-M and E-M Types; Application of Resonance, Power-Handling, Impedance Matching and Magnetic-Weight Factors In Making Speaker Selection

by **S. ZUERKER** and **N. S. CROMWELL**

*Electronics Department  
General Electric Company*

THE MAJOR PORTION OF SERVICE work involves removal of defective components and replacement with new parts. The loudspeaker has often been a major exception to this rule, due to its relatively high cost and the fact that in many cases the Service Man felt that it could be repaired with comparatively little work and at a good profit. This is not always the case, however, and serious thought should be given to the relative merits of repair and replacement.

It is often the Service Man's first thought to replace cones, voice coils, field coils, and so forth, when such treatment is indicated. This action will generally correct the trouble at hand, but it is a tedious and exacting job, many times the result of which is not completely satisfactory in all respects. A stray piece of foreign matter between the voice coil and surrounding metal parts can ruin an otherwise well done cone replacement job and make the best loudspeaker worthless.

Recent developments in loudspeaker manufacture, due to the new Alnico V magnet material, better designed materials, and closer control of assembly have resulted in loudspeaker designs which are far superior to those of the past. The development of the aluminum-foil voice coil has increased

the maximum power which modern speakers can handle and added years to the useful life of a speaker by maintaining its alignment through long use and wide ranges of temperature and humidity.

These reasons often make it wise to discard old loudspeakers requiring repair and replace them with new units. The use of a new Alnico V speaker in place of electrodynamic or old p-m loudspeakers provides increased efficiency, better tone quality, and a positive repair job.

Therefore, the factors which should decide whether to use a new speaker or repair the old one are . . . (1), relative costs of the job to Service Man and customer, taking into consideration the service time required; (2), possibility of obtaining greater efficiency and better tone with a replacement unit; (3), size and quality of the speaker requiring repair; and (4), relative customer satisfactions to be obtained with the two jobs. When all the factors are carefully balanced, complete replacement will be indicated as the wiser course in a surprisingly large percentage of the cases.

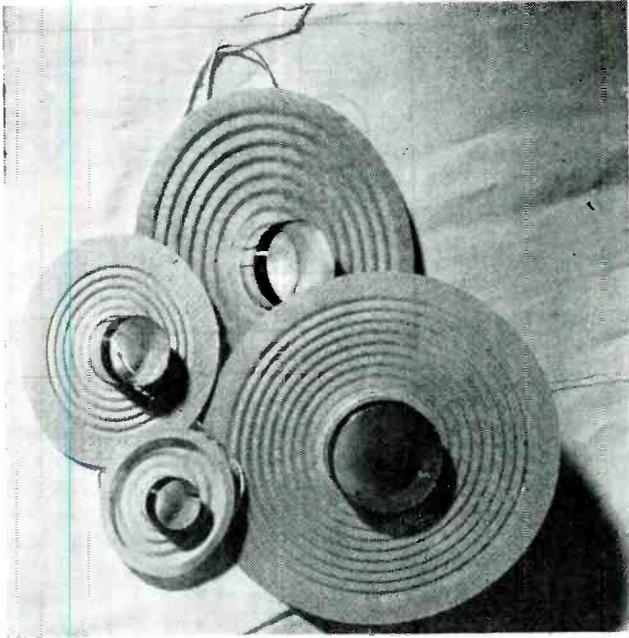
### **Changing P-M to Alnico V**

Assuming that replacement is indicated, the actual job of replacement

and the advantages to be gained can be stated in general as follows:

The simplest case is obviously the replacement of a permanent-magnet type. Here, in many cases, the job is one of simple substitution, sometimes with minor changes which will be discussed later. If the speaker to be replaced is an Alnico V type, the advantage to be gained is the saving of time and exacting work which is required in cone and voice coil replacement. If it is an old type of permanent-magnet speaker, additional advantages are to be gained. It is probably not generally known that a speaker using a magnet of a given weight of Alnico V will out-perform a similar speaker using the same weight of the prewar magnet materials two- or three-to-one. This means that the actual acoustic output of a receiver will be increased in the same ratio, making an output stage of 5 watts with an Alnico V speaker usually perform as well as a prewar p-m speaker driven by a 10-watt amplifier. The relation of magnet weights of various materials to sensitivity of the speaker is illustrated in Fig. 1. In spite of the variation in magnet size, a range of more than 5 to 1, all three speakers will be equally loud.

This increase in efficiency and power is desirable in almost any case,



Aluminum-foil based voice coils used in Alnico V speakers.



Four and 12"-type speakers using aluminum-foil based voice coils.

but can be seen to be of tremendous help in increasing the power of portable or farm radios with low-power output stages. Suppose such a set had an output stage capable of delivering 225 milliwatts of power to a prewar loudspeaker with a 2-ounce magnet. Replacing the speaker with an Alnico V type using a 3-ounce magnet will give the same increase in sound power output as would be obtained by increasing the output of the power stage to 1 watt, about the equivalent of adding three additional power tubes to the chassis. All of the increase in output is obtained without adding at all to the battery drain or, in case of a-c/d-c sets, to the B-supply requirements. This point in itself is sufficient to make it very desirable to use a replacement Alnico V speaker.

In addition, the increase in sound power output makes it possible for the loudspeaker manufacturer to adjust the tone of his product to the most generally pleasing quality instead of working to obtain the maximum sound by using lightweight papers. Again, this means that portable or farm radios can be made to sound just as pleasing as the small home radio, and makes the home set sound better than has been possible in the past.

If the speaker to be replaced is an electro-dynamic type, the job will require somewhat more work, but not enough to make it difficult. The increase in efficiency will vary according to the design of the electrodynamic

speaker and the manner in which it is used in the B-supply circuit.

Before looking at the factors involved in the actual replacement; it would be well to enumerate the advantages to be gained:

In small sets the new speaker will usually afford a gain in output of several times, and in large sets, although the output gain will not always be very great, the elimination of residual hum caused by using the speaker field as part of the B-supply filter circuit will be an important factor.

The power handling abilities of the Alnico V speaker are large due to the elimination of heating caused by the field coil. Without this heat, the voice coil itself can handle greater power before reaching a dangerous temperature, and will maintain its shape and alignment for longer pe-

riods. This is particularly true when the voice coil is wound on aluminum foil.

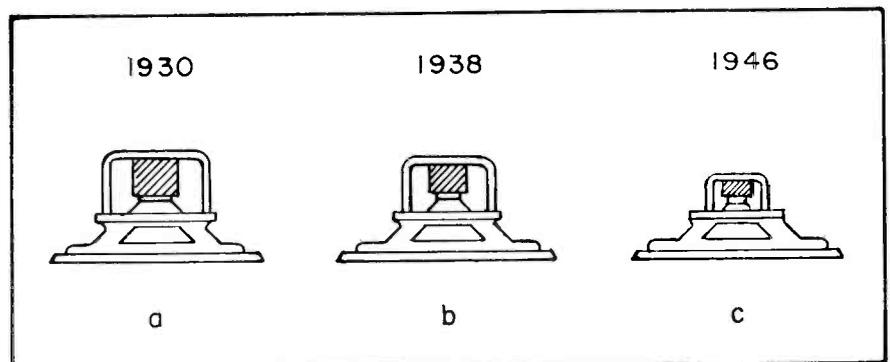
Another feature of the new speakers is their complete dustproofing which prevents foreign material from working its way into the air gap. This is extremely important in maintaining the original tone, free of buzzes and distortion, for long periods of time, and only speakers which are completely dust-proofed should be used for both replacement and new work.

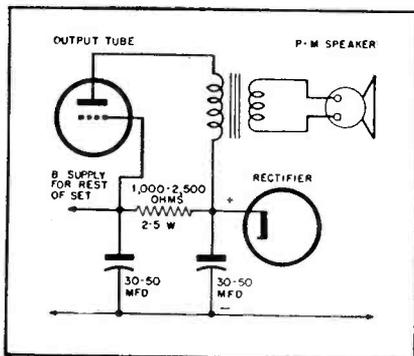
#### Changing E-M to P-M

The physical changes required in substituting an Alnico V speaker for an electrodynamic type may involve some simple circuit changes.

If the speaker field is found to be connected directly across some B-volt-

Fig. 1. How magnet-design progress has affected the size of speakers. In 1930, a 5.5 ounce Cobalt-steel magnet was used; in 1938 Alnico I, II or III weighing approximately 3 ounces was used, and in 1946 Alnico V, weighing one ounce, was introduced. Speakers shown are all of the 4" type and provide equal volume.





Figs. 2 and 3. Circuits illustrating how to change a e-m speaker system for a p-m installation.

choke and will keep the cost of the job low.

### Magnet Weight

There is a great variety of magnet sizes to be chosen from in each range of speaker size. For example, representative weights to be found in 5¼" speakers are .68 ounce, 1 ounce, 1.3 ounces, 1.47 ounces, 1.92 ounces, 2.15 ounces, 2.98 ounces, and 3.16 ounces. The Service Man need not find this array confusing if the basic factors of speaker performance and the characteristics of the ear are kept in mind. The ear cannot detect the difference in output between a speaker using a 1.3-ounce magnet and one using a 1.47-ounce magnet. On the other hand, the difference between speakers using a 1.3 and 3-ounce magnets, respectively, will be of the order of two-to-one, in power again equivalent to doubling the output of the audio power stage.

The general rules governing choice of magnet size, then, are:

(1)—Disregard differences of only 10% or 15% in magnet weight.

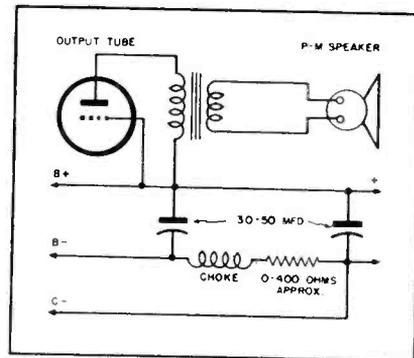
(2)—Let the quality and type of set judge whether to use a heavy or light magnet. Farm or portable sets should use speakers with a generous amount of magnet material. Inexpensive a-c/d-c sets might use a speaker with a lightweight magnet.

(3)—Specialized cases will, of course, vary from these general rules. Some customers may want as much volume as possible from their sets, or may desire better tone and be willing to pay for better speakers. Each such specialized case will require an individual decision.

(4)—It should be remembered that in a given type of speaker, the size of the magnet makes little or no difference in tone. In most cases, however, a large increase in magnet size in a given type of speaker, from 1.3 ounce to 2.98 ounce, for example, will be accompanied by an increase in the voice-coil diameter. This change in voice coil may have considerable effect on tone quality, and it may be necessary to compare the two in the set being repaired in order to choose the more suitable of the two.

### Resonance

Speaker resonance (primary resonance of cone) plays a very important



age point, in which case the field resistance will be 2000 to 3000 ohms, the replacement is a simple matter. It is only necessary to remove the two leads from B— and B+ and install the new speaker. In this case there will be a saving of power required from the rectifier tube, resulting in longer tube life, less heating, and, in some cases, higher B voltages available for the set. In some instances this increase in voltage will be helpful in increasing power output and sensitivity, but if the original voltages are to be retained, an additional series filter resistor can be added to the B-supply circuit. If such a resistor is added, its rating must be at least twice the power it will be required to handle.

If the speaker field is used as a B-supply filter choke in an a-c/d-c type receiver it is usually necessary to make a simple circuit change.

If the field is in the + side of the B supply, the output-tube transformer plate return should be connected to the first filter capacitor, and a resistor added; Fig. 2.

If the speaker field was in the negative side of the B supply and especially if the voltage across it was used for biasing purposes it will be necessary to replace the field with a resistor or choke of a resistance equal to the field resistance. A resistor should be tried first, but if the hum level is excessive a combination choke-resistor or a choke alone should be used; Fig. 3. In either case the total resistance should add up to resistance in the original design.

Replacement of an e-m speaker with a p-m speaker in larger sets follows the same pattern as the one outlined for a-c/d-c types except that in more of the cases a choke will probably be necessary to keep the hum level sufficiently low.

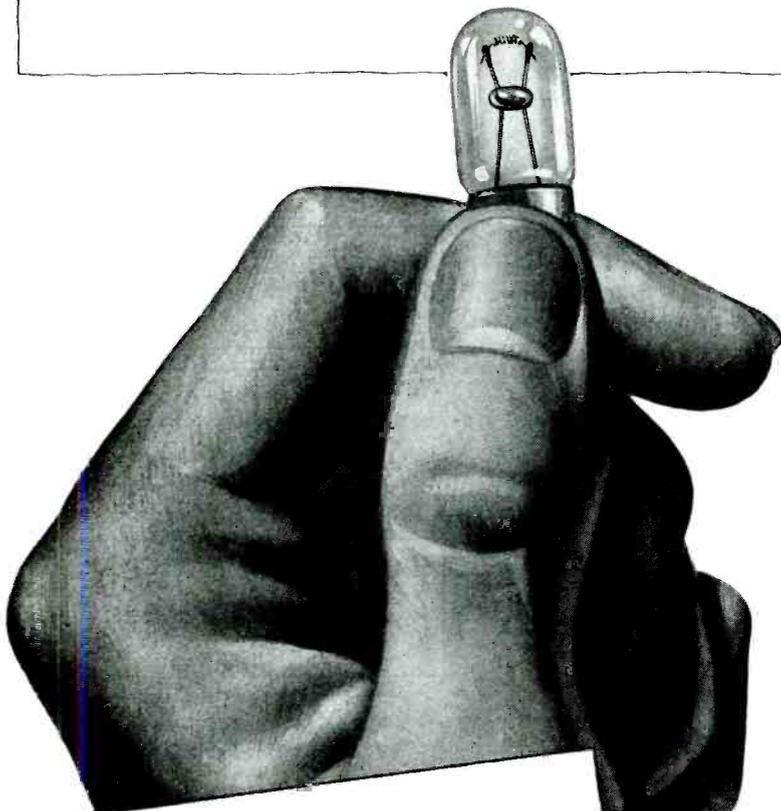
In some cases where the field coil of the old speaker is still in good condition, it is possible to bolt the old speaker, or the field structure cut from the old speaker, to the inside of the cabinet. This will perform well as a

part in the overall loudspeaker action. In general, the lower the resonance, the better the low-frequency response, and, providing this low-frequency response can be properly used, the better will be the tone of the set in which the loudspeaker is used. Normally, the resonance is controlled by the manufacturer to center around a frequency which has been found to be optimum for the vast majority of cases. If, for example, 5¼" speakers were made with resonances centering around 100 cycles, the overall result would not often be as pleasing as with resonances closer to 160 cycles. This is due to the fact that the output transformer and speaker baffle (cabinet) attenuate frequencies below 200 cycles to such an extent that at 100 cycles very little output can be realized from the speaker itself. Because this is true, the bass rise at resonance will be largely lost, and the set may sound as if it has less bass response than it would with a 160-cycle resonant speaker. In addition, the cones required to produce 100 cycle 5¼" speakers would have such fragile edges as to make them unable to withstand the power which the speakers should be rated to handle.

### Additional Resonance Factors

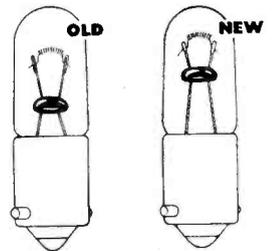
Other factors also affect the choice of resonance. Cabinets, record-playing mechanism, gang capacitors or other components may have a resonance sufficiently strong to cause acoustic feedback into the speaker, resulting in boominess, howl, or rumble. In these cases, it is necessary to choose a loudspeaker having a primary resonance removed from that of the offending component, the resonance chosen being either higher or lower depending on the practicability of each. In certain cases it may be found impossible or difficult to completely remove hum from a set. This may be caused by the use of a speaker having its resonance close to 120 cycles, this resonance being excited by second harmonic (Continued on page 42)

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# Servicing Helps

## CONNECTING PILLOW-TYPE SPEAKERS<sup>1</sup>

THE INCREASED USE of pillow-type speakers has developed quite an installation-market for the Service Man. These small speakers have a variety of effective applications in the home, hotel and hospital, and can be connected in many ways to receiver amplifiers or special amplifiers.

Typical connections to modern receivers, using dynamic speakers, are shown in Figs. 2 and 3. On sets having single-tube output (Fig. 2) the output transformer should be shunted by a 5,000-ohm resistor rated for at least 2 watts. The speaker and cord should be isolated from all d-c potential by a .001-mfd. 600-volt capacitor. The 5,000-ohm resistor is an average value and can be varied somewhat, if necessary, depending upon the output tube characteristics. One to ten pillow-speakers may be operated by this arrangement, using a 100,000-ohm parallel resistor.

Connection to receivers having push-pull output is shown in Fig. 3, and requires a resistor of higher value and wattage. Up to twenty pillow-speakers can be operated with this arrangement.

To permit the alternate operation of either the pillow-speaker or regular speaker, a dpdt switch or jack can be mounted on the cabinet or chassis.

The recommended connection of many pillow-speakers to a suitable amplifier is shown in Fig. 4. Each speaker requires a signal voltage of approximately 5 volts and about .001 watt of power. Thus 100 speakers would require 100 x .001 watt or .1

watt and have a combined impedance of 30,000/100 or 300 ohms. On amplifiers using pentode or beam power output tubes, the pillow-speaker should be shunted by a resistive load of approximately 1/5 their combined impedance to reduce distortion due to the capacitive reactance reflected by the speaker. For 100 units having a combined impedance of 300 ohms, a 1-watt resistor of about 60 ohms should be used in parallel. This would then require a .5-watt amplifier having a 50-ohm output impedance.

For larger installations, proportionately smaller corrective load resistances may be used. For instance, in an installation using 1,000 speakers (total impedance 30 ohms) the line feeding the speakers can be shunted by a 6-ohm 10-watt resistor. This would then require a 5-watt amplifier, having an output impedance of 6 ohms in order to obtain the proper operating triode output tubes.

In most cases, effective volume can be controlled by changing the position of the speaker under the pillow. However, if individual volume controls are desired, a 1/4-megohm variable resistor may be used in series with each pillow-speaker. A signal voltage of 10 volts should then be supplied to the line, and each speaker with its volume control may be considered as having an average impedance of 130,000 ohms. The power required remains practically the same.

<sup>1</sup>Hushatone; Brush Development Co.

## PREAMPLIFIER FOR VARIABLE RELUCTANCE PICKUP

RECENTLY, DEVELOPMENT of a variable reluctance-type pickup was announced.<sup>1</sup> This pickup is quite unique in that it responds to vibrations only in a lateral direction and in addition has practically no frequency discrimination since its voltage output is proportional to the stylus velocity.

The pickup, which is a low-output voltage device, operates best when it is coupled to a preamplifier; Fig. 6. The amplifier, using a double triode, provides impedance matching and amplification.

<sup>1</sup>G. E.



Fig. 1. Pillow-type speaker (Courtesy Brush)

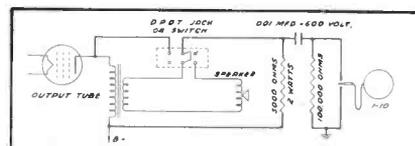


Fig. 2. Signal-tube output circuit for pillow speaker using a transformer shunted by 5000-ohm 2-watt resistor. (Courtesy Brush)

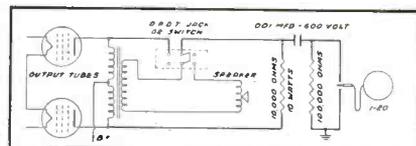


Fig. 3. Pushpull output arrangement for pillow speakers. (Courtesy Brush)

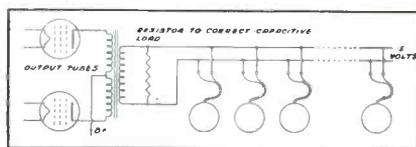
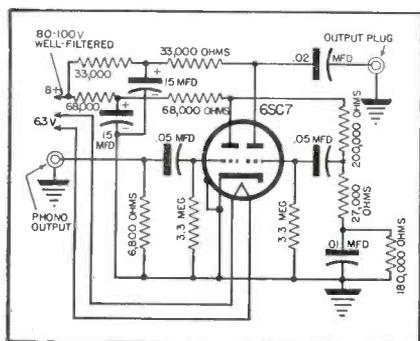


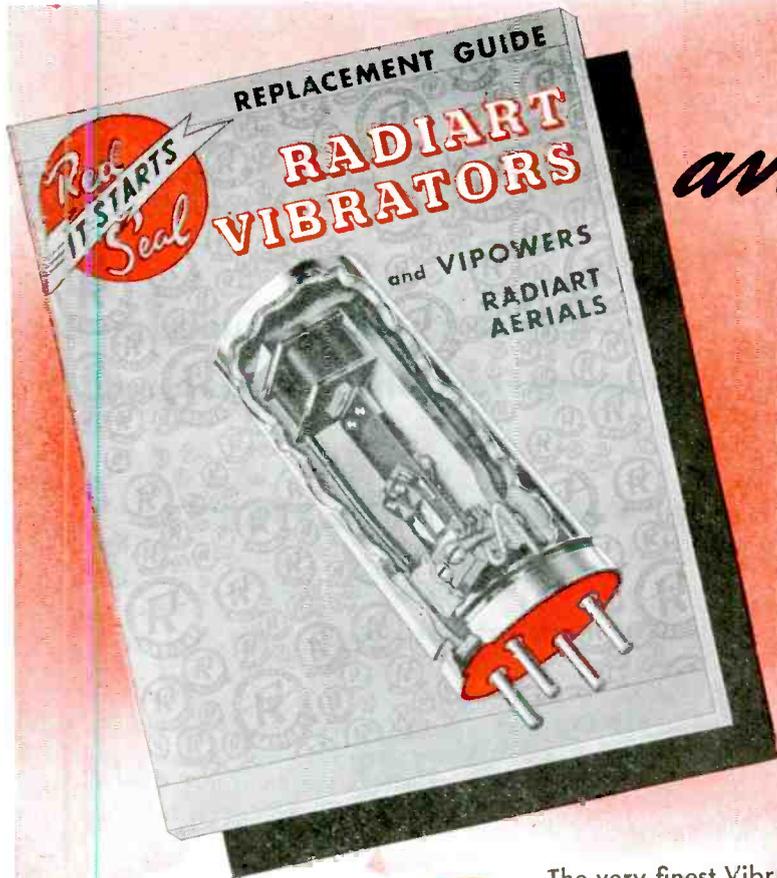
Fig. 4. Connection of quantity of pillow speakers to amplifier. (Courtesy Brush)

Fig. 5. Preamplifier unit designed for variable-reluctance pickup.



Fig. 6. Circuit of variable-reluctance pickup preamplifier. (Courtesy G.E.)





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# A NOMOGRAPH

## For Multi-Speaker Matching

Chart Provides Rapid Determination of Transformer Types Required to Operate Several Speakers at Different Power Levels From One or More Amplifiers

by RAYMOND E. LAFFERTY

Chief Engineer<sup>2</sup>

Radio Instrument Labs

IT IS OFTEN NECESSARY to operate several speakers at different power levels from one amplifier. This requires the use of coupling transformers with the proper turns ratio.

The turns ratio from primary to any one of the secondary windings depends upon two factors; ratio of primary to speaker impedance and ratio of primary to speaker power. The equation for the turns ratio is<sup>1</sup>

$$N_p/N_s = \sqrt{Z_p/Z_s \cdot P_p/P_s}$$

The ratio, provided by this equation, for any one of a group of secondary windings, will reflect from the secondary to the primary, an impedance greater than desired. This is true of each secondary winding. The total impedance reflected into the primary, however, is made up of all these reflected impedances taken in parallel which produces the correct match. To permit rapid application of the equation and use of the proper matching medium, the nomograph shown in Fig. 2 was constructed.

### Use of the Nomograph

Let us suppose we have a 45-watt amplifier, with 6L6s in push-pull in the power-amplifier stage and we wanted to operate four speakers, two of the trumpet type and two of the cone type. We find that the trumpet-type speakers have voice coil impedances of 16 ohms each and the cone speakers have voice coil impedances of 6 ohms. The speakers, rated at 5 watts each, are to operate at 35 watts (17.5 watts each), and be placed close to the microphones. The tubes have a primary impedance (plate to plate) of 3,800 ohms.

For simplicity, we can connect the two 16-ohm speakers in parallel and do the same with the smaller speakers. Our problem therefore is to match one 8-ohm load that takes 35 watts, and one 3-ohm load that requires 10 watts.

Now to use the nomograph, we lay

a straight-edge between 3,800 ohms on the  $Z_p$  scale and 8 ohms on the  $Z_s$  scale, and mark a reference point on *reference line A*. Then we lay a straight-edge from 45 watts on the  $P_p$  scale to 35 watts on  $P_s$  and mark a reference point on *reference line B*. The two reference points are connected with the straight-edge and we can read the primary to secondary turns ratio of the output transformer on the  $N_p/N_s$  scale. We find that the turns ratio for the two trumpet speakers connected

in parallel is 25. If the two speakers are connected to individual secondary windings the impedance ratio for the equation will be double, but the power ratio will halve. The over-all result is that the turns ratio remains the same regardless of the type of connection we choose.

Repeating these operations for the 3-ohm load we find that the ratio of  $N_p$  to  $N_s$  equals 75. This is the ratio if the two speakers are parallel connected to one winding or separately connected to two windings.

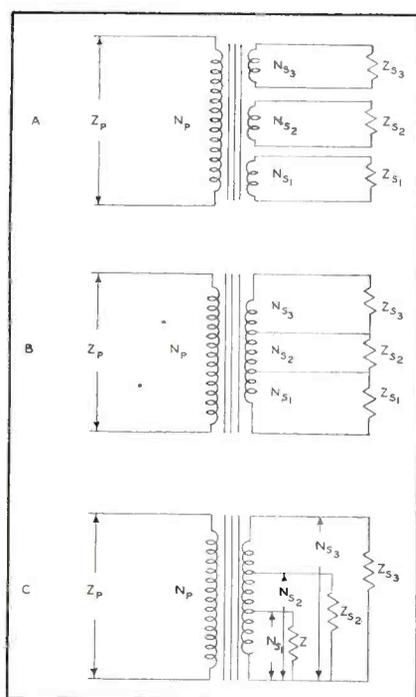
If the turns ratio of one-half of the primary to the full secondary is desired we must do one of two things: Use the primary plate-to-plate impedance with the nomograph and divide the final result by two; or use the impedance that is desired across one-half of the primary winding (this equals one-quarter of the plate-to-plate impedance) with the nomograph and read the turns ratio directly. Either method will yield the turns ratio for one-half of the primary winding to the full secondary winding.

### Appendix Converting Impedance Ratios to Turns Ratios

There are many types of universal output transformers rated in impedance ratios and not in turns ratios. It is therefore necessary to convert the impedance ratio to its equivalent turns ratio.

Two methods may be used; application of actual test voltages and mathematical computation. In the test method an audio signal generator and

Fig. 2. Three ways of connecting speakers to operate at different power levels. Circuit shown in A provides speaker isolation.



<sup>1</sup>F. Langford Smith, *The Radiotron Designer's Handbook*, pp. 207-209; Amalgamated Wireless Valve Company, Pty. Ltd., Sydney, Australia.

<sup>2</sup>Also Chief Engineer, WSLB.

(Continued on page 45)

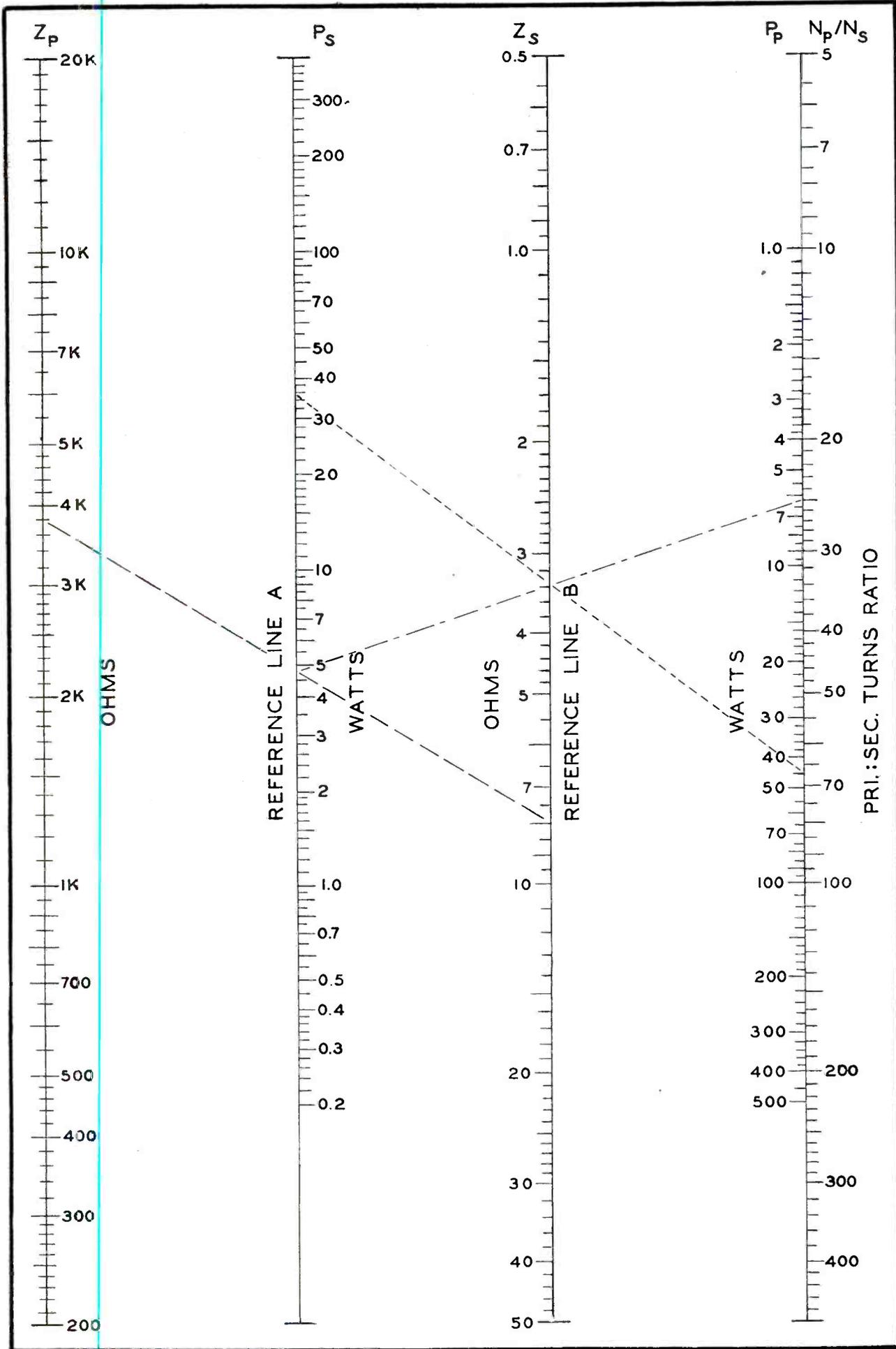


Fig. 1. The nomograph used to determine proper match for a multiple-speaker system when using speakers of various impedances and power ratings. In this nomograph  $Z_p$  represents the rated tube-load impedance in ohms.  $Z_s$ , or reference line  $B$ , is used for laying off the impedance of the speaker. The line drawn from  $Z_p$  to  $Z_s$  will intersect reference line  $A$  on  $P_s$ . The fourth graph line serves the double purpose of representing both the maximum rated circuit power output and turns ratio of output transformer. A line drawn from the circuit rated power output to reference line  $A$  or rated speaker output, will intersect the reference line  $B$ . The last line is then drawn from the intersection on reference lines  $A$  and  $B$  to where it crosses  $N_p/N_s$  or turns ratio.

# MERCHANDISING Sound

by **SIDNEY HARMAN**

*David Bogen Co., Inc.*

A LITTLE ENTERPRISE and imagination can take the Service Man a long way in the sound business.

All the old opportunities still exist, but they appear more often. In addition there are a large number of new and interesting applications of sound equipment and there are countless others that can be easily developed.

It's summer now and the fairs, festivals, hotels, camps and theatres are in the market to buy or rent good sound systems again. The sound man who actively seeks this business will get it. But the fairs and festivals are the old standbys, the ones for which competition will be keen and plentiful. There are other opportunities Service Men can make for themselves, opportunities which will result in substantial returns.

Nearly every man in service during the war came into contact with and developed respect for the value of sound equipment. Movies popularized inter-office communicating and public-address systems, and men and women in factories throughout the country worked to the accompaniment of sound system music. Today, most people know what an intercom or p-a system is. What many do not know, and what can be easily demonstrated is how sound equipment will serve them.

When a business man is shown how he can double and triple the efficiency of his organization at a relatively trifling cost, when a house-keeper can be shown she can eliminate the continual running up and down stairs through the day, when you sell anything that performs a vital useful function you're selling in terms that people understand. With sound equipment this can be done every time.

Finding a customer for sound equipment is difficult! Finding a customer for a specific application of sound equipment however, is easy and profitable. Your own community is quite a fertile area. Consider the types of

business you find, and analyze for yourself how an intercom or paging system will save that business money or increase its productivity. Decide exactly what equipment is required to do the job and go sell that business that equipment.

If you attempt to develop business on sound equipment without a plan—if, in other words, you just try to sell "sound equipment to business" instead of selling a specific system providing specific services to a specific business, you'll soon blunt your selling edge and you'll soon find that the returns are less than you like. Your ideas should be organized, target picked and hit with the correct selling arrow.

## **A Few Examples**

It's summer and cars are beginning to bulge the highways again. Tourists' courts will flash their competing neons and some smart sound man will figure that a "tourist court intercom system" with the master in the business office and a remote in each cabin will mean more customers and more business for the court that has it. He'll demonstrate that such a system will permit the tourist to call in his orders

*A 20-watt amplifier, featuring a controlled expander, designed for high-fidelity applications.*



for food, cigarettes and liquor without leaving the cabin. "When you make it easy to order, they'll order more and more often." He'll find other important applications for the system, and he'll remember basic features; for example, the system will have to be private. No guest wants any eavesdropping. The tourist court operator probably never thought of an intercom for his business. He'll think plenty when it's properly presented and demonstrated.

The efficiency of the local coal yards can be tremendously increased by use of a simple paging system. You can become a coal yard expert in fifteen minutes by discussing a typical yard's operation with one of the operators. You can learn one coal yard's language, and brother that can help a whale of a lot. If you know that a given yard may handle barley, egg, buckwheat or steam coal . . . if you know that the yard may load from docks or from a railroad siding . . . if you can talk to your prospect in terms of eliminating misunderstood hand signals and unheard instructions when a truck is on the scales . . . point out that your "coal yard system" will permit the operator to locate his men in a moment when they're waiting around the yard for trucks and that a chauffeur can be paged in the yard telling him to rush a special order or to change a load of stove to nut without wasting time . . . then you're talking his language . . . you're merchandising sound equipment and you're showing him how that sound equipment will mean dollars and cents to him. What chance has the fellow who asks the operator whether sound equipment can help him in the face

*(Continued on page 41)*

# TRIPLE-TEST ASSURES *Quality* IN GENERAL ELECTRIC RESISTORS

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- ★ STABILITY

What does triple-tested mean? It means that General Electric resistors have been subjected to the most rigid tests and inspection to make certain that they conform to high quality standards. Characteristics, endurance and stability have been checked in the laboratory and in the field, under actual operating conditions. These checks are assurance to you that General Electric resistors will stand up... will give greater customer satisfaction.

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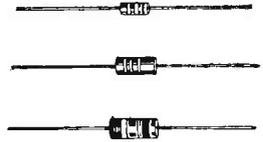
Be sure to stock the entire line of General Electric universal parts.

For complete information write: *General Electric Company, Electronics Department, Syracuse 1, N.Y.*

# GENERAL ELECTRIC

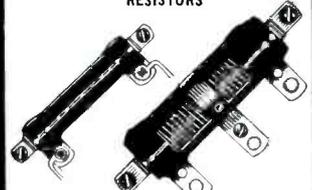
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1/2 watt, 1 watt, 2 watts

### POWER WIRE-WOUND RESISTORS



Fixed  
10, 20 watt

Adjustable  
10, 25, 50,  
100 watt

### TUBE-TYPE WIRE-WOUND RESISTORS



### COMPOSITION CONTROLS ATTACHABLE SWITCHES



### SMALL WIRE-WOUND CONTROLS



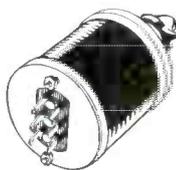
2 watt

### POWER RHEOSTATS

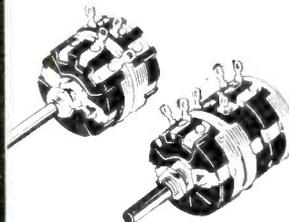


25 watt, 50 watt

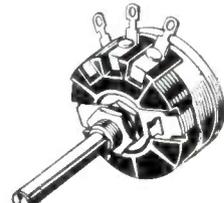
### CONSTANT IMPEDANCE ATTENUATORS



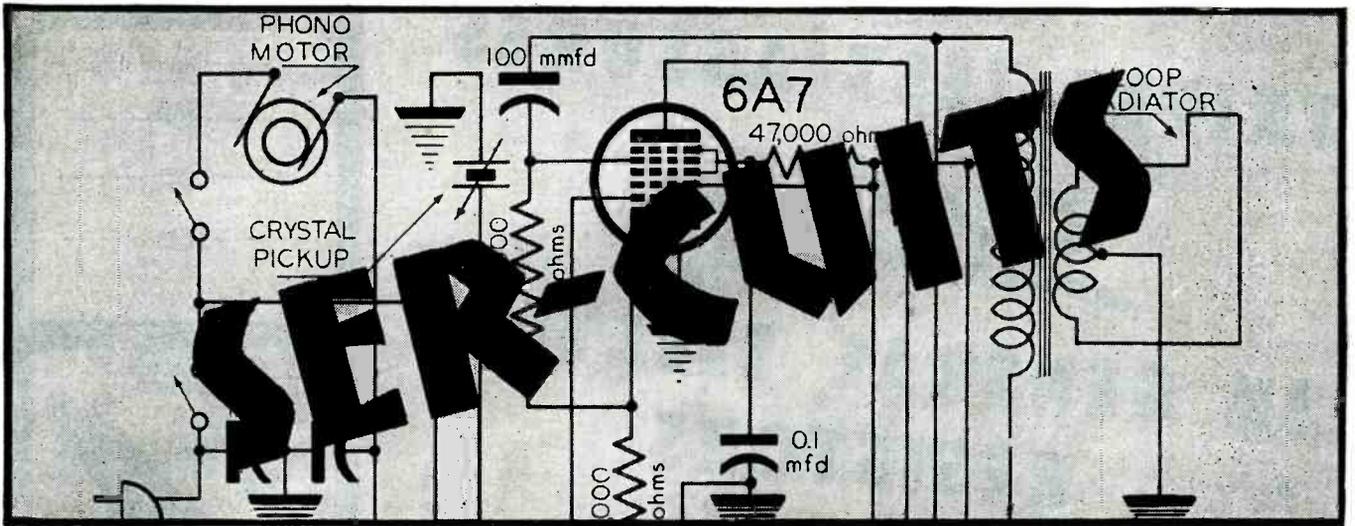
### WIRE-WOUND L-PADS AND T-PADS



### WIRE-WOUND CONTROLS



3 watts & 4 watts



# SERVICES

THE DESIGN OF A PHONO AMPLIFIER is determined primarily by the type of pickup used in conjunction with it. Other considerations entering into the design include the quality of reproduction desired and the power output, which to a great extent is dependent on cabinet size and price.

Crystal pickups are almost univer-

## PHONO AMPLIFIERS

sally used to drive the modern phono amplifier. The direct-voltage output of a crystal pickup will vary anywhere from .5 to 4 volts. This output voltage is a function of the intrinsic de-

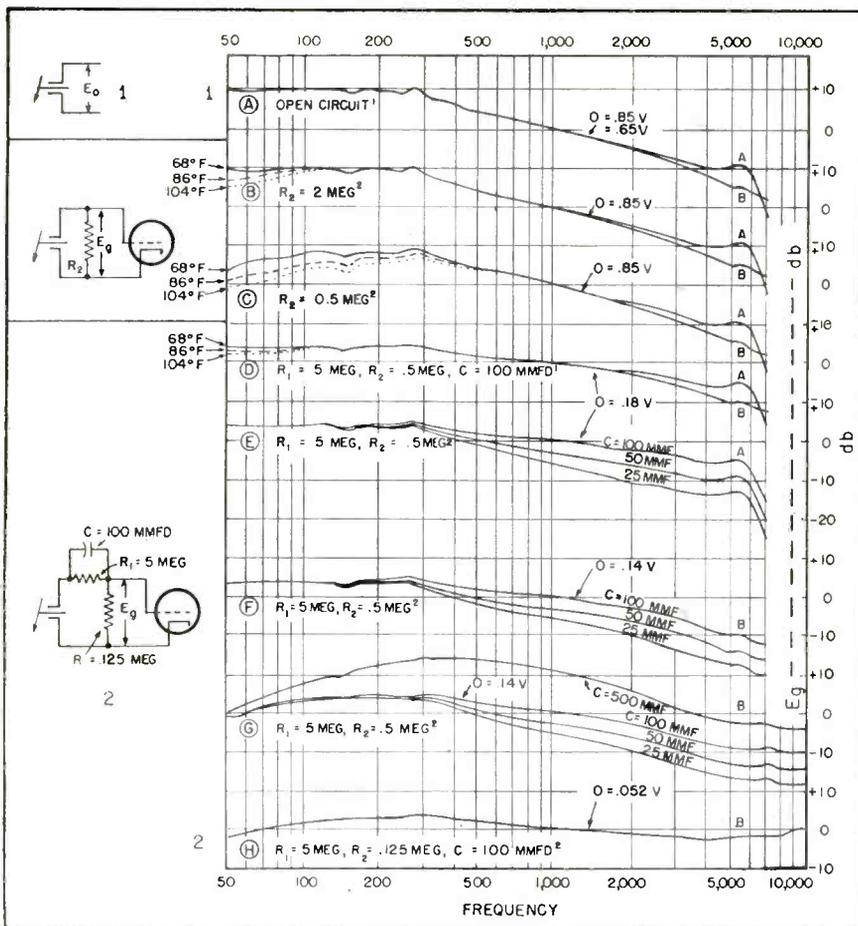
sign of the pickup, and is usually determined by means of an audio test record which duplicates the average voltages developed by records.

The input voltage to the first audio stage of the amplifier may be even lower than the crystal output due to the presence of a frequency correction filter which is sometimes inserted between the crystal and the amplifier proper.

This factor is effectively demonstrated in the response curves of Fig. 1, involving two crystal pickups.<sup>1</sup> Curve 1A represents the response of a pickup, measured directly across its terminals, unloaded. At 1,000 cycles, using a frequency test record,<sup>2</sup> the output was found to be .65 volt. Using this as a reference point, the output voltage of the pickup will vary from +10 db at 100 cycles to -17 db at 7,000 cycles.

Curve 2 in the same plot shows what happens to this curve when a corrective filter is installed. Here another type of test record<sup>3</sup> has been used. The reference point is still 1,000 cycles, but the output voltage is .052 volt. However, it will be noted that the overall response is now very flat, varying no more than  $\pm 3$  db over the same range. Therefore, the pickup and associated filter will exert a great influence on the gain characteristic of the amplifier. Other curves in the plot show the voltage output and response for various coupling networks. The necessity of making exact replacements of phono pickup units becomes quite obvious when these curves are studied. It will be noted that both equalizer and amplifier are designed to a specific pickup.

Fig. 1. Typical response curves for two types of pickups. The curves A were obtained with a pickup having a cut-off characteristic of between 6000 and 7000 cps. The B curves cover a pickup with a 50 to 10,000-cps range. It will be noted that the response curve of B in 1 has been considerably flattened at B in 2. This was done by a filter network which is identified as 2 in the drawing; a reduction in output voltage of from .65 to .052 volt resulted when this network was inserted. Shown, too, are the effects of temperature on the low-frequency response of the pickups. (Courtesy Astatic).



<sup>1</sup>Astatic FP-38 and FP-18.  
<sup>2</sup>Audiotone.  
<sup>3</sup>Columbia M-10603.

[An analysis of a group of amplifiers for high and low-voltage pickups will appear in July SERVICE.]

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# NEW PRODUCTS IN SOUND



## ST. LOUIS OUTDOOR MICROPHONES

An outdoor-type dynamic microphone, which it is claimed can be dropped successively without failure, has been developed by The St. Louis Microphone Co., Inc., 2726-28 Brentwood Blvd., St. Louis 17, Missouri.

All components in the mike can be replaced. Range is said to be 40-9,000 cycles. Uses an Alnico-V magnet. Variable impedance output adjustment to low, 200, 500 or high.

\* \* \*

## WRIGHT P-M SPEAKERS

Six sizes of p-m speakers are being produced by Wright, Inc., 2233 University Avenue, St. Paul 4, Minn.

Model NP-468 is a 4" p-m type with a voice-coil impedance of 4 ohms; power rating, 3 to 4 watts; .68-oz. Alnico V magnet.

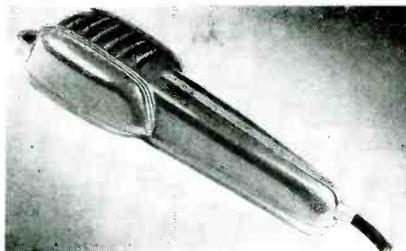
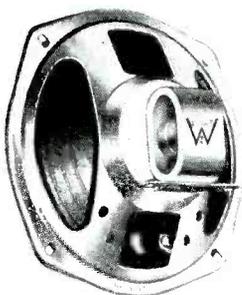
Model NP-535, 5" p-m, has a voice-coil impedance of 3.2 ohms; power rating 4 to 5 watts; 1-oz. Alnico V magnet.

Model NP-635, 6" p-m, with a voice-coil impedance of 3.2 ohms, has a power rating of 5 to 6 watts. Uses 1-oz. Alnico V magnet.

Model P-810, 8" p-m, has a voice-coil impedance of 5.7 ohms, power rating of 8 to 9 watts. Uses 10-oz. magnet.

Model P-1016, 10" p-m, uses a 16-oz. magnet; voice coil impedance, 5.7 ohms; power rating, 10 to 12 watts.

Model P-1221, 12" p-m, has a 21-oz. magnet; voice coil impedance, 5.7 ohms; power rating, 12 to 14 watts.



## TURNER HAND MICROPHONES

A hand microphone, model 20X, has been announced by The Turner Company, Cedar Rapids, Iowa.

Features a *metalseal* crystal which is said to withstand humidity conditions not tolerated by the ordinary crystal. Range is said to be 50-7000 cycles; effective output level, 54 db below 1 volt/dyne/sq.cm.

A high impedance unit, it can be used with any standard amplifier employing high impedance input.

\* \* \*

## ELECTRO-VOICE CARDYNE CARDIOID DYNAMIC MICROPHONES

Dynamic microphones featuring the *mechanophase* principle of unidirectivity, and the *acoustalloy* diaphragm, which are said to provide true cardioid unidirectional pickup and wide-angle pickup at front of microphone are being manufactured by Electro-Voice, Inc., Buchanan, Michigan.

Other features of microphones are said to be: Increased effective working distance from microphone; stops feedback; high output level (53 db below 1 volt/dyne/cm<sup>2</sup>); voltage developed by normal speech, 0024 volt; tiltable head.

Available in 50, 250, 500 ohms or high impedance.

Frequency response of 731 (Cardyne 11), said to be substantially flat from 30-12,000 cps. Frequency response of 726 (Cardyne 1), said to be substantially flat from 40-10,000 cps.

\* \* \*

## SCIENTIFIC RADIO Baffles

Ceiling type, spun-metal, speaker baffles for low and medium size ceilings, with a metal conical sound dispersing unit, have been announced by Scientific Radio and Television Co., 1531 Branch St., St. Louis 7, Mo.

Baffles are available in aluminum satin, polished copper and chrome finish. Models available for 8" or 12" speakers.



## AMPERITE STUDIO RIBBON MICROPHONES

A ribbon microphone, which it is said will not become boomy on close talking, has been developed by the Amperite Company, 561 Broadway, New York 12, N. Y.

Frequency range is said to be 40 to 14000 cps,  $\pm 3$  db; output —56 db.

Wide pick-up angle, 120° front and back; feedback said to be unusually low, since the microphone has no peaks.

Standard equipment includes a switch, which is optional, 25' cable and a cable connector.

\* \* \*

## AMERICAN MICROPHONE MOVING-COIL PHONOGRAPH REPRODUCERS

A moving-coil pickup cartridge using an Alnico V magnet has been developed by the American Microphone Co., 370 S. Fair Oaks Ave., Pasadena 2, Calif.

Stylus will track and operate normally at pressures as low as one-half ounce.

Mechanical stiffness of the voice coil assembly is said to be extremely low.

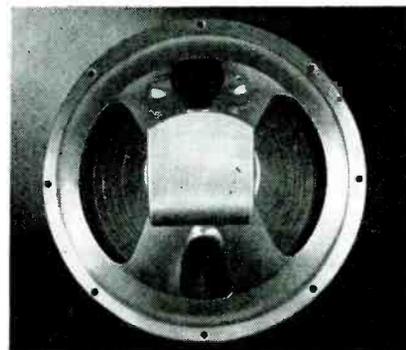
Impedance of the cartridge is 35 ohms and said to remain constant over entire audio frequency range.

\* \* \*

## QUAM 10-INCH SPEAKERS

A 10" p-m speaker featuring a patented U-shaped coil pot which is said to provide a perfect flux path, and the *adjust-a-cone* voice coil mounting, has been announced by the Quam-Nichols Company, 33rd Place and Cottage Grove Ave., Chicago 16, Illinois.

Quam *adjust-a-cone* speakers are of welded construction.



**UNIVERSAL MICROPHONE**

A cartridge-type carbon microphone, A174, has been announced by the Universal Microphone Co., Inglewood 2 California.

The A174, a newly styled version of the Universal W model, utilizes a single-button construction and is fully insulated. Impedance rating is 200 ohms. Output level is said to be 12 db below 6 milliwatts for 100-bar signal.



**UNIVERSITY PAGING SPEAKERS**

Industrial paging speakers of the reflex air column type with built-in hermetically sealed driver units are being manufactured by University Loudspeakers, Inc., 225 Varick St., New York 14, N. Y.

Models CR and RCR can handle 18 watts of input power. Models IB8 and IBR have a power handling capacity of 12 watts.

Model IB8, illustrated, has an impedance of 8 ohms, a dispersion of 90° and frequency of 300 to 6,000 cps.



**LANSING LOUDSPEAKERS**

A 15" p-m 20-watt speaker featuring a cone frame of cast aluminum, an aluminum diaphragm fastened to a 3" voice coil tube, and an Alnico V magnet is now being made by Lansing Sound, Incorporated, San Marcos, Calif.

Impedance, 15 ohms; resonant frequency, 55 cycles.

**W.E. DUAL SPEAKER**

A dual speaker system, the 757-A, that is said to cover the range of 60 to 15,000 cycles has been designed by the Bell Telephone Labs. and produced by Western Electric Co. Utilizes a 713-C speaker with an aluminum sectoral horn, as the high-frequency component. A 702-A

(Continued on page 36)



Alfred A. Ghirardi—the man who takes the headaches out of Radio-Electronic Servicing

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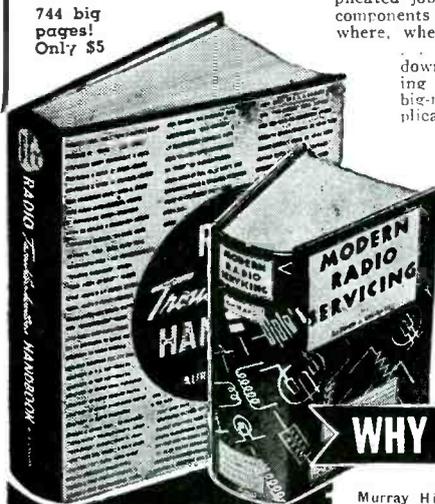
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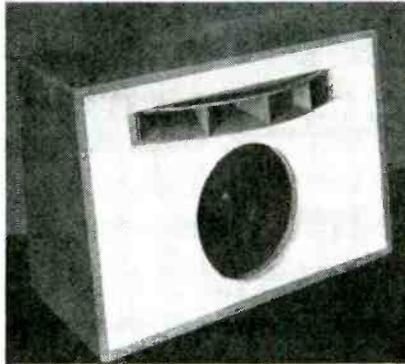
# ATLAS SOUND CORPORATION

1445 - 39th St., Brooklyn 18, N. Y.

## New Products

(Continued from page 35)

network and 700-A attenuator are used for dividing the audio frequency range for feeding the two loudspeakers.



\* \* \*

### GARRARD RECORD CHANGERS

Record changers, RC60, featuring adjustable speed control, swivel head with either crystal or magnetic pickup and 10" or 12" intermixing, are now available from the Garrard Sales Corporation, 315 Broadway, New York 7, N. Y.

Other features include automatic shut-off, and non-slip spindle. Magnetic pickup is of the moving iron type, with a needle pressure of 3/4 ounce.



\* \* \*

### NEWCOMB SCRATCH FILTER

A filter and equalizer, the LP-1, which is said to effectively reduce needle scratch to a minimum, has been announced by the Newcomb Audio Products Co. Wired between a crystal pickup and an amplifier. Has four steps of adjustment.



\* \* \*

### R-MC TRANSCRIPTION PLAYER

A transcription player, TP-16C, for transcription records up to 16", 78 or 33 1/3 rpm, is available from the Radio-

Music Corporation, East Port Chester, Connecticut.

Motor is constant-speed type. Drive wheel and idler have neoprene tires, precision ground for concentricity.

Switch output impedance, 30,250, and 500/600 ohms.

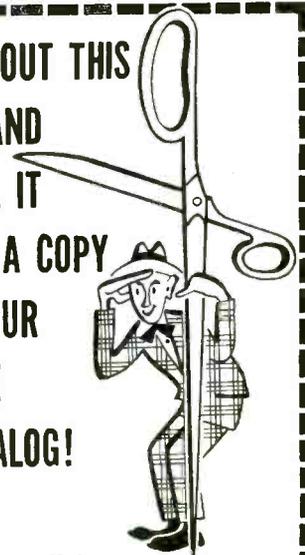


\* \* \*

### AMPLIFIER CORP. DIRECT-COUPLED AMPLIFIER

An amplifier featuring a signal self-balancing and current drift-correcting direct-coupled output circuit has been developed by the Amplifier Corp. of America, 398-3 Broadway, New York 12, N. Y. Response is said to be 20 to 20,000 cycles. + 1 db; develops 23 watts with less

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than 1% total distortion; overall gain, 96 db; hum and noise level, -40 vu. Balanced output terminals are provided for 4/8/16 and 500 ohms. In-between terminals provide the following additional output impedances: 1/2/6/10/12/83 100 125/150 and 166 ohms.

Filtered d-c, having less than .03% ripple, is applied to the heaters of the input tubes through a regulating-ballast resistor.



**KNIGHT 4-WATT PHONO AMPLIFIER**

A 4-watt phono-amplifier for record-playing purposes has been announced by the Allied Radio Corp., 833 W. Jackson Blvd., Chicago, Ill. Unit has an inverse feedback circuit. Operates with high-impedance crystal pickup.

Size, 4" wide, 5 1/4" long, and 4 3/4" high.

**CALLMASTER INTERCOM**

A 6-station intercom unit, CM-20, has been announced by the Lyman Electronic Corporation, 12 Cass Street, Springfield, Massachusetts.

Sub-stations can call at any time. Has 4" speaker.



**OPERADIO INTERCOM**

An intercom system, the Flexifone, with four basic units, executive master, official master, supervisor master and speaker station, is available from the

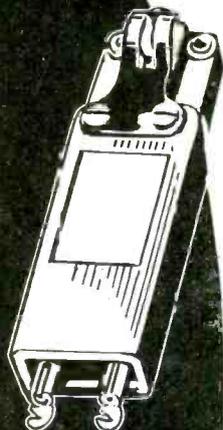
(Continued on page 45)



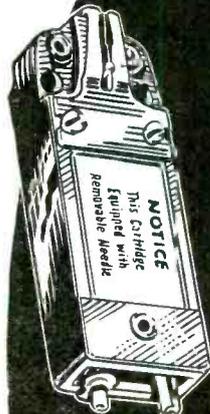
Cutaway view of Flexifone.

# TWO NEW ASTATIC PHONOGRAPH CARTRIDGES

**Employ Matched, Replaceable Needles for Finer Reproduction**



**MODEL NYLON I-J**



**MODEL "QT" (Quiet Talk)**

Many modern record players appearing on the market are equipped with these new MATCHED reproducer units... some with the Astatic Nylon Cartridge and Needle... some with the Model "QT" Cartridge and Needle. In each instance these cartridges employ MATCHED, REPLACEABLE Needles of the precious metal and sapphire-tipped types. These Needles are engineered to match the characteristics of their respective cartridges and are the ONLY Needles that can be used in making replacements.

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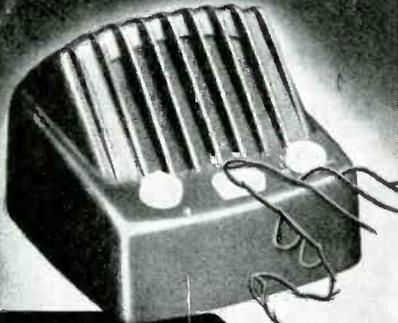
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#### RIDER MANUAL CONTEST

A letter-writing contest, in which cash and servicing-equipment prizes worth \$4,325 will be awarded, has been announced by John F. Rider, Publisher, Inc.

Prizes will be awarded for the best letters of one hundred words or less on why "Rider Manuals Mean Successful Servicing." There will be two hundred and twenty-four cash and servicing equipment prizes, the first of which will be five hundred dollars in cash. Jobbers designated by the first ten prize-winning Service Men will also receive cash awards. Nothing need be bought to enter the contest, which closes September 15, 1947.

Entries must be submitted on sheets supplied with the official entry blanks. These are available from radio parts jobbers, or from John F. Rider, Publisher, Inc., 404 Fourth Avenue, New York 16, N. Y.

Spelling, grammar and writing style will not be factors in judging the awards. The prize-winners will be selected on the basis of completeness, compactness and originality of expression demonstrating the value of Rider Manuals to the servicing industry.

\* \* \*

#### GENERAL CEMENT COUNTER-WIRE STRIPPER DISPLAY

A metal display which demonstrates the *Spcedex* wire stripper has been announced by General Cement Manufacturing Co., Rockford, Illinois.

Display is so designed that customers can use the stripper on the display.

Displays are available free and without obligation upon the purchase of wire strippers.

\* \* \*

#### BURLINGAME ASSOCIATES NAMED EASTERN AMPLIFIER REPS

Eastern Amplifier Corporation, 794 East 140th Street, New York 54, New York, has appointed Burlingame Associates Limited, 11 Park Place, New York 7, N. Y., as representatives for the New England states, Metropolitan New York,

New Jersey, Eastern Pennsylvania, Maryland, Delaware and District of Columbia.

Jack Grand and "Herb" Fletcher of Burlingame Associates will direct the jobber program for Eastern Amplifier.

\* \* \*

#### NEWS OF THE REPRESENTATIVES

Dean A. Lewis, 65 Ninth St., San Francisco, Calif., has joined the California chapter of the Representatives. The Los Angeles chapter reports the addition of Harold A. Kittleson, 623 Guaranty Bldg., Hollywood, Calif. and Arthur W. Philo, 470 E. Orange Grove Ave., Pasadena, Calif., as associates.

Walter J. Brauer, 15631 Lakewood Ave., Lakewood, Ohio is now with the Buckeye chapter; Alek K. Gianaras, 3624 W. North St., Chicago, Ill., has joined the Chicagoland chapter; Irving I. Kahn, 3324 Main St., Hartford, Conn., has become a member of the New England chapter; and V. Hutto, 255 Mathews Ave., N. E., Atlanta, Ga., has joined the Dixie chapter.

\* \* \*

#### NATIONAL WALSCO CONTEST WINNERS

Winners in the recent national WalSCO contest have been announced by Walter L. Schott, president of the Walter L. Schott Company.

Major winners and their suggestions are: Felix Januss, Los Angeles, California, first prize for submitting several valuable ideas, including a new type of speaker cone patch, a novel magnetic probe, etc.; Eugene M. Beck, West Los

**S.S.S.**

"Servicing by Signal Substitution"

Learn about this modern dynamic approach to radio servicing with ONLY BASIC TEST EQUIPMENT.

... Fully described in a 120 page book available from your Precision Distributor or factory at 35¢.

... Schools are invited to inquire regarding quantity orders from our Educational Division.

**PRECISION**  
APPARATUS COMPANY INC.  
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Manufacturers of Fine Test Equipment  
RADIO • TELEVISION • ELECTRICAL • LABORATORY

**ESICO**

REG. U. S. PAT. OFF.

Esico soldering irons and soldering appliances have been standard equipment in industrial plants thruout the country during the past twenty years.

They have served equally well in the Service Industry.

Available at All Good Distributors

**ELECTRIC SOLDERING IRON CO., INC.**  
3147 West Elm St., Deep River, Conn.

Angeles, second prize, for various ideas, including neon light device for checking turntable speeds, etc.; M. Saltzman, Jamaica, New York, third prize, for an automobile antenna installation tool idea; and Gene Kwartz, Newport, Oregon, for three suggestions covering automobile radio installation tools.

\* \* \*

**CUSHWAY NOW EXECUTIVE V-P OF WEBSTER-CHICAGO**

Charles P. Cushway has been elected executive vice president and a director of Webster-Chicago Corporation, 5610 Bloomingdale Avenue, Chicago 39, Illinois.

W. S. Hartford has been appointed general sales manager and will be in charge of all sales and merchandising activities.

E. R. Johnson, general comptroller, has also been named treasurer.

Norman Conrad is chief engineer of Webster-Chicago.



C. Cushway

\* \* \*

**RCA BOOKLET ON PHOTOTUBES, C-R AND SPECIAL TUBES**

A 16-page booklet "RCA Phototubes, Cathode-Ray Tubes, and Special Tubes" has been released by the tube department of RCA.

Booklet describes 113 tube types. Phototube section includes tube dimensional outlines as well as spectral-sensitivity curves.

Booklets, priced at 10 cents a copy, may be obtained from RCA tube distributors, or Commercial Engineering, Tube Department, Radio Corporation of America, Harrison, N. J.

\* \* \*

**PHOTOFACT FOLDERS WILL FEATURE SYLVANIA PRODUCTS**

Sylvania Electric has entered into a participation agreement with Howard W. Sams & Co., Inc., in connection with Photofact Folders and the Radio Servicing Institute.

Sylvania tubes will be mentioned in connection with servicing information supplied in the Photofact Folders. Test equipment including tube testers, polymer and oscilloscope will be employed in clinical service work in the Howard Sams Radio Servicing Institute.

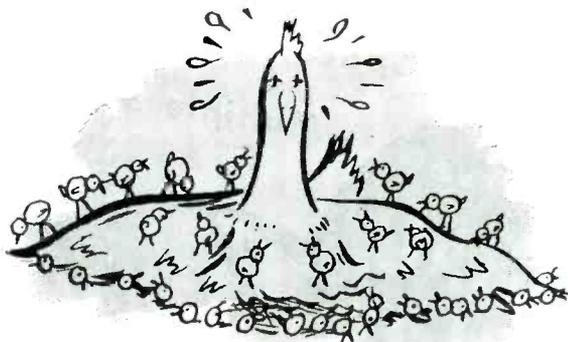
\* \* \*

**JOBBERS TO HANDLE PERMOFLUX SPEAKER LINE**

Permoflux Corp. will distribute their line of speakers, transformers, pickups and microphones to the jobber trade.

Two factory plants will serve the Eastern and Western territories; 4900 West Grand Avenue, Chicago, Illinois, and 236 South Verdugo Road, Glendale, California.

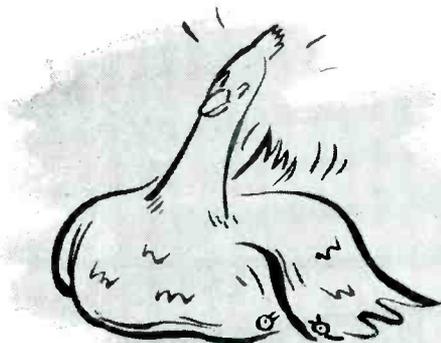
L. M. Heineman is president of Permoflux.



~~NOT 31~~



~~NOT 25~~



**BUT ONLY 13 MODELS**

**... of Electronic Vibrators provide exact replacement on all auto-radios**

● You'll have a smaller inventory investment, get more customer satisfaction... faster turnover—and bigger profits when you...

**SWITCH TO ELECTRONIC... THE SIMPLIFIED LINE**



A complete Vibrator Replacement Guide is available. It lists alphabetically every auto-radio model serviced by E-L Vibrators, and the proper E-L Vibrator Model Number.

**ELECTRONIC LABORATORIES, INC.**

**INDIANAPOLIS, INDIANA**

Minimum Space for  
Multiple Sales

Self-Serve  
**AERIAL  
DISPLAY** *Free!*

Model FD-5 Floor rack and display board is free—you pay only for the 29 aerials it contains.

Place this colorful new sales-builder in a traffic spot and watch it sell! Requiring only an investment of a 15-inch square of floor space, and very few dollars, this new self-serve floor display stores a complete stock of 25 fast-selling Ward Aerials. The handsome display board holds four more. Display is completely assembled, ready for instant use. List price of all 29 aerials, only \$166.75. Order your FD-5 display immediately.

THE WARD PRODUCTS CORPORATION

1523 E. 45th ST., CLEVELAND 3, OHIO

**WARD** *Aerials*

EXPORT DEPARTMENT: C. O. Brandes, Mgr., 4900 Euclid Ave., Cleveland 3, Ohio  
IN CANADA: Atlas Radio Corp., 560 King St. W., Toronto, Ontario, Canada

## 25-30 Watt Amplifier

(Continued from page 15)

work into nominal load impedances of 4, 8, 15, 60 and 250 ohms.

Any tap may be loaded with higher impedance, with a corresponding loss of power.

The minimum input level for rated power output of 250-ohm microphone inputs is  $-70$  db when  $0$  db = .001 watt and  $-78$  db when  $0$  db = .066 watt. High-impedance microphone inputs, 0.0035 volt rms; phonograph input (1), 0.0215 volt rms; and phonograph input (2), 0.215 volt rms.

Amplifiers have a rated power output of 25-30 watts at 7% total harmonic distortion with 117-volt line and plate taps in high-power position; 20-25 watts at 7% total harmonic distortion with 117-volt line and plate taps in low-power position.

### Noise Level

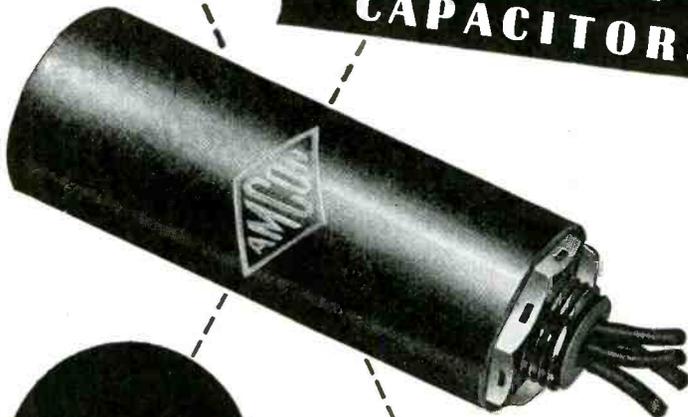
With microphone inputs and phonograph input 1, the noise level is  $-2$  db when  $0$  db = .001 watt and  $-10$  db when  $0$  db = .006 watt. At phono input 2, the level is  $-7$  db when  $0$  db = .001 watt and  $-15$  db when  $0$  db = .006 watt.

### Loudspeaker Connections

In connecting loudspeakers to the amplifier, the impedance of the group of speakers should be equal to or greater (never less) than the amplifier output impedance that is used. To determine the impedance of a group of identical speakers, the impedance of one speaker can be divided by the number of speakers connected in parallel.

When connecting two or more loudspeakers in the same vicinity, correct polarity in connections should be observed so that the speakers will operate in phase with each other. The cones of the various speakers must move simultaneously in the same direction. If they are not in phase, the sound output will be materially reduced, because the sound from one unit will cancel that of the other. A simple method of checking the phase of speakers is to connect a 1½-volt dry cell across the voice coil to determine polarity of winding. The cone will jump forward or backward, according to the battery polarity. Selecting the positive battery pole as a reference, all the voice coil leads which were connected to this pole for the same direction of cone deflection should be connected together. This places the loudspeakers in parallel.

**AMERICAN  
CAPACITORS**



All standard types,  
Write for the new  
Amcon catalog.

Amcon precision engineering  
means dependable, unflinching  
Capacitor performance.



**AMERICAN CONDENSER CO.**

4410 N. Ravenswood Ave., Chicago 40, Illinois

## Merchandising Sound

(Continued from page 30)

of that type of selling? After you've checked with one coal yard you can approach the others. When you can point to other installations that are paying their way, you've added a tremendously valuable selling tool.

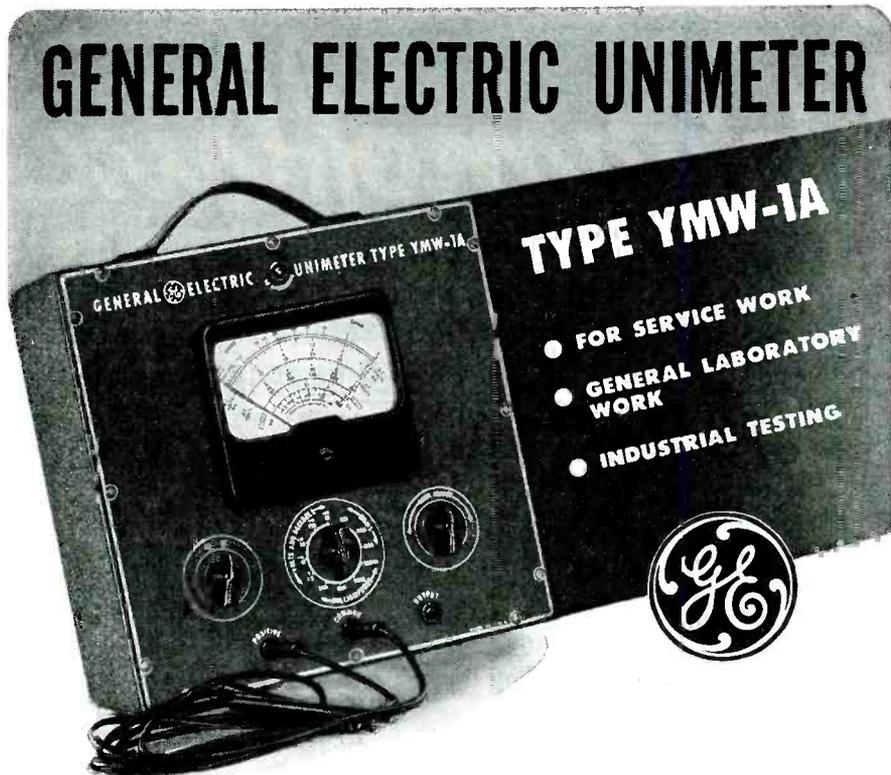
Remember that before you knock on the door you should have worked up the complete package, figured all the applications, and have a good idea of the price for the system installed and working.

There are more dramatic possibilities. Advertising in the air has been a growing business. Sky writing has its limitations, however, in terms of the message it can present. Advertising with sound from the sky is permissible in many sections of the country, and the effect is startling. You can work out an airplane sound system and you'll get an attentive audience from the enterprising sky operator.

Go to work on your own community. A little real merchandising will pay off!

Once you've decided whom to solicit and specifically what you want to sell him, some thought should be given to your presentation. Remember that you're not selling a completely mechanical piece of office equipment like an adding machine. Your package has a personality. What you sell the president of the local bank is a system of which he is a part, because his voice is the thing which makes it work. Right there, you have one of the keys to the sale of an intercom system. First make sure that the equipment you're selling will faithfully reproduce his voice. When you've shown him how to use it, let him talk with one of his key assistants. You can almost always get the assistant to compliment the "old man" on his performance, and once you do you're practically in. I've seen many a reluctant die-hard melt under the warm glow of appreciation for his excellent diction. I remember one large sale which was clinched when the salesman humorously cautioned the executive's aide not to compliment the boss too much or he'd lose him to the radio. There followed a half hour dissertation on the old man's college days when he was offered the job of news broadcaster by the local radio station, and then followed one of the nicest contracts that enterprising sound man ever landed.

A sound system is quite a wedge for intelligent and moderate flattery. Most business men like to think of them-



### ACCURATE

Rapid, correct measurements of ohms, volts, current and decibels. Meter and terminal resistance accurate to within  $\pm 2\%$ ; precision resistors accurate to within  $\pm 1\%$ .

### EASY TO READ

4 $\frac{1}{2}$ " meter with clear graduations shows readings at a glance.

### SIMPLE TO OPERATE

All functions available without

changing test leads, except 50 microamps and output meter capacitor. Single rotary selector switch controls all functions and ranges. Two position switch used to select AC or DC volt ranges.

### COMPLETELY PORTABLE

Weighs only nine pounds, gray wrinkle finish. Dimensions 10 $\frac{1}{4}$ " x 9 $\frac{3}{4}$ " x 4".

NEW FREE BOOKLET ON  
FM SERVICING AVAILABLE

For complete information, write: *General Electric Company,*  
*Electronics Department, Syracuse 1, New York.*

# GENERAL ELECTRIC

154-F5

selves as pretty capable mechanics. Know how your product operates. Know what its features are and how to demonstrate them. Learn to explain them simply and clearly, and when your customer checks you to make certain that he's got the operation of that busy signal feature straight, you can work wonders with an exclamation: "Why that's it exactly! That's precisely the way it works!"

Take the time to figure out where the need exists. Work out the equipment to answer that need correctly. Know your equipment well, what it

will do and how to set it up quickly for demonstration. Spend time in planning your demonstration and take maximum advantage of the dramatic values and the personality of sound equipment.

Don't ever underestimate the importance of good equipment. Price is important, but dependability is an absolute must. The fellow who installs equipment that stands up will be recommended to others. Sound equipment like almost nothing else is a continuous advertisement for itself. Make certain that the equipment you sell is thoroughly reliable.

# Permoflux SPEAKERS



**AN OLD NAME IN SPEAKERS**  
 FOR YEARS A MAJOR SUPPLIER TO THE INDUSTRY  
**A NEW HIGH IN PERFORMANCE\***

*Announces...* a COMPLETE JOBBER LINE of standard replacement and hi-fidelity de luxe loud speakers with both permanent and electro-magnet fields. These quality speakers, together with matching output transformers, embody the same skillfully engineered features as used in the units that PERMOFLUX now supplies to the radio set manufacturers.

\*A two-to-one preference for use by radio set manufacturers. Sound room laboratory tests show greater uniformity and frequency response than other comparable makes.

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**PERMOFLUX**

TWO COMPLETE FACTORIES TO SERVE YOU

**PERMOFLUX CORPORATION**

4900 WEST GRAND AVE., CHICAGO 39, ILLINOIS  
 236 SOUTH VERDUGO ROAD, GLENDALE 5, CALIFORNIA

PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS

*Built so You  
 Can Read it!*

**MULTIPLEX**  
 VOLT - OHM - MILLIAMMETER



This is your instrument for all day, every day use. The Multiplex Model 458 is a rugged, accurate, portable, bench-type V.O.M. built to high industrial standards by one of America's pioneer makers of test equipment.

**Multiplex Features:**

Big 5 1/2" d'Arsonval movement meter. 1000 ohms per volt. Multipliers accurate within 1%. Rotary range selector. Copper oxide rectifier for A.C. range accuracy. Priced remarkably low for **\$26.00**—NET an instrument of this quality—only.

See Your Jobber or Write for Bulletin 458

**CHICAGO INDUSTRIAL INSTRUMENT CO.**

536 West Elm Street

Chicago 10, Illinois

## Speakers

(Continued from page 24)

B-supply ripple and producing audible hum. This is a rare case, but if it occurs can be cured by brushing a coating of thin quick drying cement such as household cement, thinned with an equal amount of acetone to the edge convolutions of the cone. After the cement has hardened, the resonance will be found to be 10 to 30 per cent higher, providing cement of the proper consistency has been used.

Normally, the Service Man need not concern himself with the speaker resonance, but should it be necessary to measure it, it can be quite easily done. The equipment required is an audio signal generator capable of delivering at least one-quarter of a watt of output, or a signal generator which can be fed into a test amplifier or the receiver audio input terminals, and an a-c voltmeter or ammeter. Resonance is measured at one-quarter watt input to the voice coil at 400 cycles per second, speaker off baffle and held free in the air. The signal-generator frequency is lowered until the meter shows a sharp rise in voltage across the voice coil or a sharp decrease in current into the voice coil. The peak must be located accurately and then the signal generator frequency read. This is the primary cone resonance frequency.

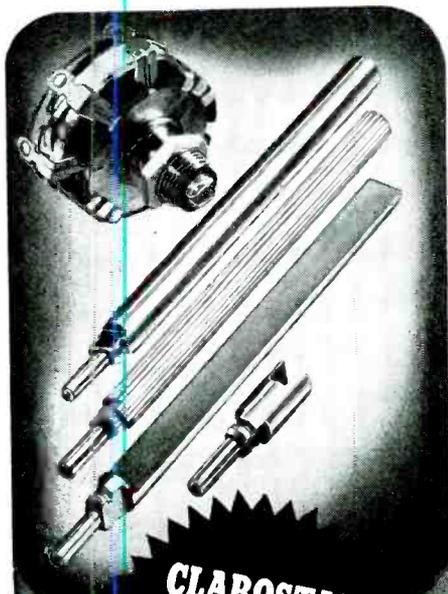
The Service Man should not attempt to adjust speaker resonance except as outlined and even this should be done only as a final measure. It is better to select speakers until one with the proper resonance is found. If this can not be done, it may be possible to correct feedback by slight modifications on component involved, or by mounting the loudspeaker on the baffle using soft rubber grommets. The grommets should be of sufficient thickness to space the speaker gasket 1/16" to 1/8" away from the baffle, and care must be taken to avoid compressing them when the mounting screws are tightened. This method will cure many troubles caused by acoustic feedback.

**Power-handling Capabilities**

A replacement speaker is always given a power rating by the manufacturer. This rating represents the maximum power the voice coil can handle safely, but because of the many frequencies a loudspeaker is required to handle, the cone or some other component may be the first to fail. Speakers using aluminum voice coils

**All Popular Ranges**

- Volts D. C. . . . . 0-5/10/50/100/500/2000
- Volts A. C. . . . . 0-12.5/25/125/250/1250
- Milliamperes D. C. . . . . 0-1/10/100
- Milliamperes A. C. . . . . 0-2.5/25/250
- Ohms Full Scale 1000/200,000/2,000,000
- Ohms Center Scale . . . . . 50/2250/22,500
- Output . . . . . -5 to +55 Decibels



**CLAROSTAT  
AD-A-SHAFT  
CONTROLS**

**NO WIGGLE  
NO WOBBLE  
NO TROUBLE**

★ Select that control for ohmage, taper, tap. Then select the required shaft—round, flat knurled, auto-radio, etc. They go together with a bang. Just a blow on the shaft and it's permanently fastened. No wiggle. No wobble. No coming out again. It's as rigid as the factory-riveted job.

That's what servicemen like about the new Clarostat Ad-A-Shaft. Mechanically, it's tops—fully matching the electrical perfection of the Clarostat control.

With each Ad-A-Shaft Control Series AM (Standard) or AT (Tapped) you select any type shaft you need. Minimum stock, maximum uses. You can now afford to have controls on hand. No need wasting time chasing down to the jobbers' each time. No tying up of real money. Here's the right control and right shaft right at hand.

Ask our jobber about the new Clarostat Ad-A-Shaft. By all means try it. You'll want it after that!



CLAROSTAT MFG. CO., Inc. · 285-7 N. 6th St., Brooklyn, N. Y.

carry higher power ratings due to their more stable characteristics but, to be safe, a speaker should be chosen with a power rating at least equal to the maximum power which it may be required to handle. A well designed and built speaker can handle amazing overloads for short times, but like any other electrical component a loud-speaker should not be operated above its rating for extended periods.

**Impedance Matching**

The impedance of a speaker is matched to the power output tube at only one frequency. Experience has shown that the proper frequency is approximately 400 cycles, or somewhat lower for large speakers. Above and below the matching frequency the voice coil impedance will change as much as eight- or ten-to-one. Nevertheless, the impedances should be fairly closely matched at 400 cycles by using a replacement speaker with approximately the same impedance as the replaced speaker. Variations of 20% or so will not be of great importance, and even variations of 50% or 75% will not seriously affect the set output. Amplifiers using inverse feedback are less critical to load impedance than those without it, but in all cases, the maximum power output will be available only with a proper impedance match. In general, voice coil impedance should be held to  $\pm 10\%$  to 20% of the manufacturer's specifications.

**Making Mechanical Changes on New Speakers**

Within reasonable limits, it is possible to do additional work on new loudspeakers to adapt them to specialized receiver designs. Such modifications might include drilling or drilling-and-tapping holes in metal parts, adding brackets, cutting off small pieces of the speaker frame, etc.

The main points to be avoided here are . . . (1), bending or distortion of the speaker frame; (2) allowing metal chips or filings to lodge in recesses between vibrating parts, thereby causing buzz or rattle; (3), damage to magnetic circuit; and (4), damage to cone or other moving component.

Before any work which may cause chips or filings is undertaken, all vents in the cone housing should be closed with masking tape, and a stiff piece of cardboard taped across the paper cone. After the work is done all

(Continued on page 44)



**Now—more on Miniatures  
to keep you up to date**



Another Cunningham technical aid . . . this handy reference bulletin gives you the data you want on RCA's 48 miniature tube types. Its classification chart, comparative-type and application information, electrical characteristics, and socket diagrams will keep you up to date on these tubes.

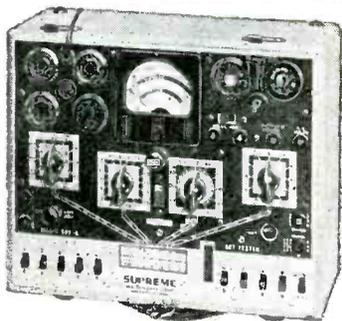
Authoritative technical data and Cunningham tubes\* keep you ahead of the field. GET BOTH FROM YOUR CUNNINGHAM DISTRIBUTOR.

For more service—TURN THE PAGE →

**Cunningham  
Electron Tubes**

A product of  
RADIO CORPORATION OF AMERICA  
Harrison, N. J.

# 3 WAYS TO BE AHEAD in Buying Test Equipment



Model 599-A Tube and Set Tester

- 1 BUY ACCURACY
- 2 BUY DEPENDABILITY
- 3 BUY SUPREME-ACY

Ask your nearest SUPREME Jobber for a demonstration of Model 599-A Tube and Set Tester (above), Model 561-AF & RF Oscillator, Model 546-A Oscilloscope, Model 592 Speed Tester. Ask to see the complete line of SUPREME equipment.



**SPECIFICATIONS**  
 DC Volts — 5 ranges 0/6/15/150/600/1500 volts. 1000 ohms per volt.  
 AC Volts — 3 ranges 0/15/150/600 volts.  
 DC Current — 3 ranges 0/6/60/600 milliamps.  
 Output Volts — 0/15/150/600 volts  
 Ohmmeter — 4 ranges 0/200/20,000 ohms and 0/2/20 megohms.

Condenser Checker—Ohmmeter provides fast method of checking leakage of both paper and electrolytic condensers.  
 Battery Tester — Tests most commonly used dry portable batteries of 1.5/4.5/6.0/45/90 volts. English reading "Replace-Good" scale.

Tube Testing — Circuit incorporates proven and modernized emission circuit. Checks for short, leakage, and noise tests between elements.  
 Power Supply—100-133 volts—50/60 cycles. Special voltages and frequencies on request.



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SUPREME INSTRUMENTS CORP., Greenwood, Miss., U.S.A.

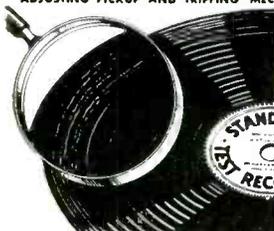
Export Department: THE AMERICAN STEEL EXPORT CO., Inc., 1347 Madison Ave., New York 17, N. Y., U.S.A.

## NUMBERS 4 and 5 OF THE WALSCO Hit Parade

THE SENSATIONAL, NEW, SCIENTIFIC

### WALSCO STANDARD TEST RECORD

FOR IMMEDIATE . . . ACCURATE . . . AUDIBLE ADJUSTMENT OF RECORD CHANGERS AND COIN OPERATED PHONOGRAPHS . . . SOLVES THE PROBLEM OF ADJUSTING PICKUP AND TRIPPING MECHANISM THROUGH



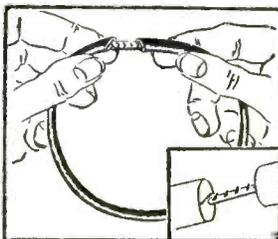
- Three Tone lead-in grooves permits immediate adjustment to proper set down position of the pick-up through audible means.
- Made to RMA and NAB standards.
- Record plays in less than 40 seconds.
- Audio tone at end of record indicates proper adjustment of tripping action.

The WALSCO Standard Test Record saves time and increases efficiency in the adjustment of record changers and coin operated phonographs. Write for full information.

**WALSCO products**  
 Help The Radio Man

WALTER L. SCHOTT CO. BEVERLY HILLS CALIF. CHICAGO 5, ILL.

### WALSCO UNIBELT THE UNIVERSAL DIAL DRIVE BELT CAN BE CUT TO FIT ANY DIAL DRIVE Will not Slip or Stretch



"UNIBELT" comes in 5-foot length spools and can be installed without taking dial mechanism apart. A real time and money saver. Eliminates the need for stocking numerous sizes of belts.

Free sample and literature. Write to Dept. 6C.

## Speakers

(Continued from page 43)

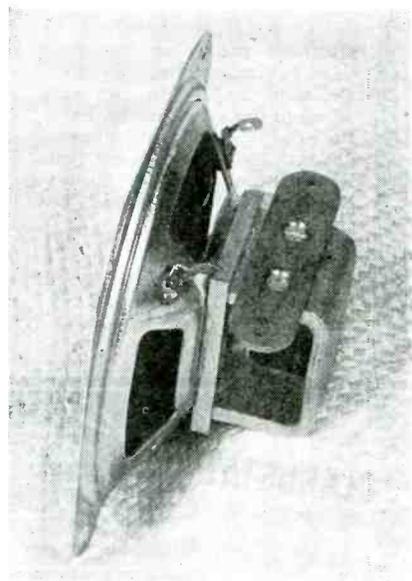
metal residue must be cleaned off the speaker before the tape is removed.

It will be noticed that in some receivers one side of the voice coil is grounded, either through a ground strap or by means of a grounded lug on one terminal. In all cases the original design should be followed when a speaker is replaced, using speakers with one grounded terminal when this type is removed and using a non-grounded speaker in the other case. This point can be very important.

In addition to the foregoing, failure to observe proper voice coil grounding can affect set operation. Along these lines, care should also be taken to see that polarity of voice coil connection is properly observed. If the non-grounded side of the transformer secondary is connected to the grounded speaker terminal, the set output will sometimes be shorted.

On speakers supplied with a terminal board having a strap running from one terminal to ground, the ground can be removed by carefully cutting both ends of the strap and discarding it. If a grounded lug type of terminal is used, it will not be possible to remove the ground without removing the lug and insulating it. It is best to choose a line of speakers using either terminal board type of construction or with neither lug grounded. In the latter case, if a ground is required, it can be easily made by means of a short lead soldered to the speaker frame.

Four-inch speaker with transformer mounting bracket.



Don't Miss the Feature Articles on . . .

F-M and TELEVISION RECEIVER servicing and maintenance scheduled to appear in July SERVICE.

Thousands of  
Satisfied  
Users!



**TRANSVISION**

**TELEVISION  
KIT... A High Quality  
TELEVISION RECEIVER**  
ready for Easy,  
Rapid Assembly  
Features the Brilliant  
LECTROVISION Picture Tube!

ENGINEERED  
BY  
TELEVISION  
SPECIALISTS



Easy-to-Assemble: No knowledge of television required. COMPLETE easy-to-follow INSTRUCTION SHEET gives you all the knowledge you need.

This Kit INCLUDES SOUND, all component parts, and the following:—

Specially designed Television Antenna... A \$30.00 Brilliant Lectrovision seven-inch Picture Tube, plus ALL other tubes... Pre-tuned R-F unit... Finished front panel... All solder, wire and 60 ft. of low loss lead-in cable.

Operates on 110V.; 50-60 cycles A.C. Price: complete with ALL tubes, \$159.50 (fair traded).

**IMMEDIATE DELIVERY!**

We believe that the comparative quality of this set is superior to other available sets. It has been acclaimed by major television schools.

**CABINET for  
TRANSVISION  
Television Kit**



Made of selected grain wood, with beautiful hand-rubbed walnut finish. Accessory Kit for Mounting included at No Extra Charge. Overall size: 17 $\frac{1}{2}$ " deep; 19 $\frac{1}{4}$ " wide; 15 $\frac{3}{8}$ " high.  
Price: \$29.95

**DEALERS!** Cash in on this Kit! Ideal for making your own Custom-Built Television Receiver. See your local distributor, or for further information write to:

**TRANSVISION, INC.** Dept. S  
385 North Ave., New Rochelle, N. Y.

## Speaker Matching

(Continued from page 29)

a v-t-v-m are required. The signal generator is connected to either the primary or secondary of the transformer under test, and a known voltage applied at 400 cps. This voltage can be determined by means of the v-t-v-m. The voltage across the secondary or primary (depending on which section the audio signal generator is connected) is then read. The turns ratio is then a function of the voltage ratios. These readings while subject to some error, are accurate enough for practical use. If the audio signal generator is capable of a large voltage output, say 100 volts, the work involved reduces itself to simply applying the 100 volts to the primary, and then reading the secondary voltages at the various taps.

### Use of Mathematics

If the test equipment is not available, but an impedance chart of the output transformer is handy, the turns ratio may be determined mathematically. For example, let us say that the impedance ratio of the transformer is 5,000 ohms primary to 25 ohms secondary. The turns ratio may then be determined by the following formula:

$$\text{Turns ratio} = \sqrt{Z_1/Z_2} = \sqrt{\frac{5000}{25}}$$

$$= \sqrt{200} = 14.14, \text{ or } 14.14 \text{ to } 1$$

## New Products

(Continued from page 37)

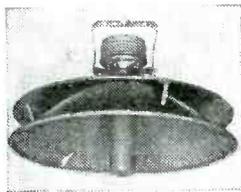
Operadio Manufacturing Co., St. Charles, Illinois.

\* \* \*

### ATLAS SOUND RADIAL REFLEX PROJECTORS

Radial driver-unit projectors featuring 360° coverage are being made by the Atlas Sound Corp., 1447 39th Street, Brooklyn, N. Y.

Two sizes are available: RC-48, suitable for musical reproduction, as well as



speech, and RC-36, adequate for speech.

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**Magnetic Recording**

(Continued from page 20)

three motors, one on each spool and one on the capstan.

**Wire Speeds**

Although the tendency in present designs is for a constant speed of 2 feet per second, there are one or two models which offer a choice of speeds. One of these has a double speed selection and the recording time is cut to about one-half hour, although the upper frequency limit is about doubled.

The more complete machines also include some means of showing the amount of wire used or time of recording on a loading at any instant. This feature permits for dubbing in or erasing.

Currently, there are three general classes of wire-recording units. One type includes a complete wire-recorder mechanism and electronic oscillator, amplifier and power supply, controls and switches and is of instantaneous-operating. Another type includes the wire-recorder mechanism, oscillator and controls complete, but not the amplifier. These types are designed for

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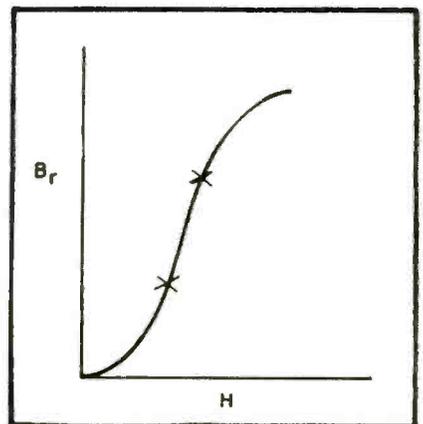
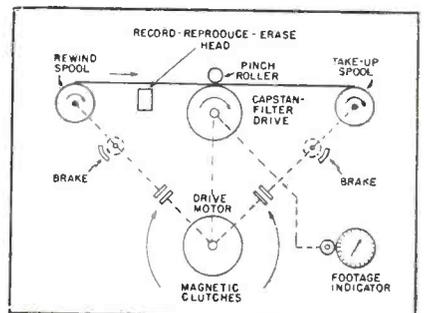


Fig. 2. Plot showing how supersonic bias effectively places magnetic variations, due to the signal, on the straight line (x...x) portion of the B-H characteristic of the recording wire.

Fig. 3. Mechanical schematic of a typical magnetic wire recorder.



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use with any standard audio amplifier, and cables are usually supplied, with directions for connecting. This is a very simple matter. Another type includes the wire recorder mechanism only. This is intended primarily for installation in receivers, radio-phonograph combinations, or simply in an electric phonograph, with oscillator amplifier and power supply built in.

### Operation of Electrical Portion of Wire Recorders

A standard 3-stage audio amplifier with a gain of about 90 db serves for both recording and reproduction. When reproducing, the record-reproduce winding of the head is switched to the amplifier input grid. The output of these heads at full signals on the wire is of the order of 1 to 2 millivolts, so that the high-impedance microphone input is used when a separate standard audio amplifier unit is required with the system. At the same time, the amplifier output is switched to a loudspeaker, or a headphone jack; thus a low impedance speaker tap is required on the output transformer. It is customary to use amplifiers with an output rating of from 5 to 10 watts. The erase and bias windings on the head are now used in reproducing, except when the erase winding is intentionally switched in to cut out a portion of the recording.

In recording, however, these windings are switched on, both being connected to the supersonic oscillator. These 30 to 40-kc oscillators are usually of the Hartley type, and a power supply must also be furnished in the latter case.

In any event the record-reproduce winding is switched to the amplifier output at the same time, and the loudspeaker is removed. This winding is connected to the plate of the output stage through a blocking capacitor and a resistance-capacity network. This network is necessary to boost the high frequencies so as to compensate for the normal loss of magnetizing flux in the head with increasing frequency. The microphone input jack is also reconnected to the input grid, as the recording head winding is removed from it.

When the recorder is started, the erasing gap removes any residual modulation (except where a switch is provided to cut this winding in or out at will to remove only portions of previous recording), and the amplified signal from the microphone (or other signal source) is fed to the record-  
(Continued on page 48)

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# Cunningham Electron Tubes

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# Magnetic Recording

(Continued from page 47)

ing winding, while the bias winding is also impressing supersonic modulation on the wire simultaneously.

The actual audio power required to drive the recording head to full modulation is small. However, depending upon the amount of equalization and the losses in the output network, and the sensitivity of different heads, the average audio power required from the amplifier varies between about  $\frac{1}{4}$  to 2 watts for different models.

The equalization required is usually split up between recording and reproducing circuits. In recording, the high frequencies are boosted an amount limited by the maximum undistorted possibilities of the various components. Some of this equalization is inherent in the head design and some is obtained in the electronic circuits. In reproducing, the low frequencies are boosted sufficiently to flatten out the frequency response as nearly as practicable over the range. By this means, the greatest possible signal-to-noise ratio is obtained. Values ranging between 30 to 50 db dynamic range over the noise level of clean wire are thus obtained depending on the model of recorder.

Recorders which are complete in themselves have the equalization incorporated in the system. One type, for instance, uses about 50 db electrical boost up to 3000 cycles for recording, while another has about 25 db inherent boost up to 1000 cycles in recording and about 20 db bass boost in reproducing. Those types requiring separate amplifiers are designed so that about 8 to 12 db bass boost (starting at 80 cycles and tapering off

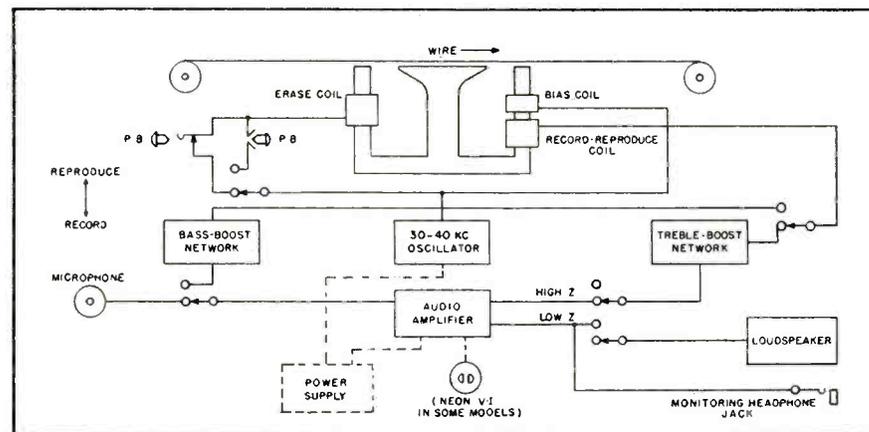


Fig. 4. Electrical circuit schematic of a typical wire recorder.

with increasing frequency) is required.

The frequency range of the present commercial wire recorders with 2 feet per second wire speed varies depending on the make. Those designed for speech only are substantially flat from 200 to 3000 cycles, some models providing a double speed step also, doubling the upper frequency limit, approximately, and halving the recording time. Other models cover the range from 80-100 cycles to 6000-8000 cycles.

The physical design of wire recorders varies from the types in which the wire spools, driving drum and record-reproduce head are placed on a vertical or sloped panel, to those in which this equipment is arranged on a flat panel. The controls may or may not be on the same panel.

Handling of the wire has been simplified in various ways in these machines. In one model, using small spools, the spools are supplied in pairs, one loaded, but with the wire already

attached to the other spool. It is only necessary to place the spools on their spindles and set the wire in the recording head. These heads are made with a groove in the magnetic material (Fig. 5) only slightly larger than the wire diameter at the bottom but tapering out toward the top to permit easy insertion of the wire. Thus the latter is surrounded on three sides by the magnetizing material effecting greatest magnetizing efficiency in operation. The ends of the slot are also tapered, so that knots in the wire will ride up over the slot without damage; in case the wire breaks, it is only necessary to join the ends with a square knot and clip off the free ends and no noticeable loss of the recorded material results.

In the type of machine using a large drum for the take-up spool, the end of the wire on the small magazine spool is furnished with a plastic leader. The wire is placed on the  $V$  groove of the recording head (and erase head, if separate), the plastic leader is pressed

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into the groove on the take-up spool, and the machine is ready to operate by simply turning on the proper controls. One model of this type, having the above mechanism mounted on a flat panel is also equipped so that the large take-up spool can be used as a phono-disc turntable. This large diameter spool also serves as the wire drive and mechanical filter, thus simplifying the design. This unit is particularly suitable for incorporating into receiver combinations.

### Record-Reproduce Windings

The record-reproduce windings usually have impedances in the neighborhood of 300 or 400 ohms at 400 cycles, utilizing around 3,000 or 4,000 turns of small gage wire such as No. 44 B&S. The erase winding is much smaller, possibly 15 to 25 turns of a larger gage such as No. 26 to No. 28 B&S, one type being 1½ ohms at 40 kc. Thus a relatively large current at low voltage is drawn from the oscillator. The bias winding is either a separate small coil connected to the supersonic oscillator or a few turns of the erase winding wound on the same leg as the record-reproduce coil. Hence, this winding is usually of only

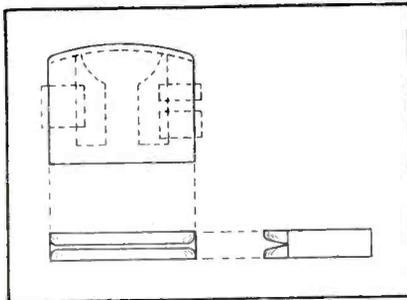


Fig. 5. V groove in the head, provided for easy insertion of the recording wire. Tapered ends of groove push knots up out of narrow passage.

a few microhenries inductance, and creates a much weaker supersonic magnetizing field than the erase winding.

Very fine magnetic records utilizing metallic-tape instead of wire have been built. Certain disadvantages in cost, bulkiness, and manipulation have rendered it unpopular with designers and manufacturers of commercial recorders for public use. The apparatus and method used in recording with metal tape is inherently the same as with wire except for the design changes required to handle a thin flat medium instead of a circular. The directions of magnetization also vary from that used with wire.

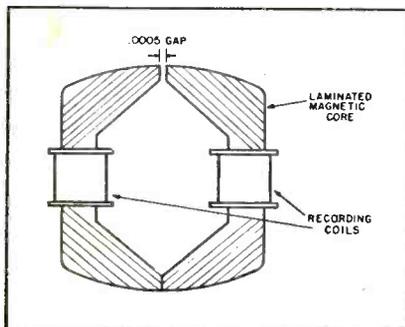
### Coated Magnetic Tape Recorders

The most recent development in recording media is the flat tape, both film and paper base, which is coated with a finely divided magnetic material. The tape offers several advantages over the wire, except that it is slightly more bulky to store. Wire has the advantage of furnishing, under some conditions, somewhat longer playing time for a given size of spool or reel.

Fundamentally, the wire and tape recording system is essentially the same. The additional bulkiness of the tape is partially offset by the fact that it can be run slower than wire. This

(Continued on page 50)

Fig. 6. Paper-tape recorder head. (Courtesy Brush)



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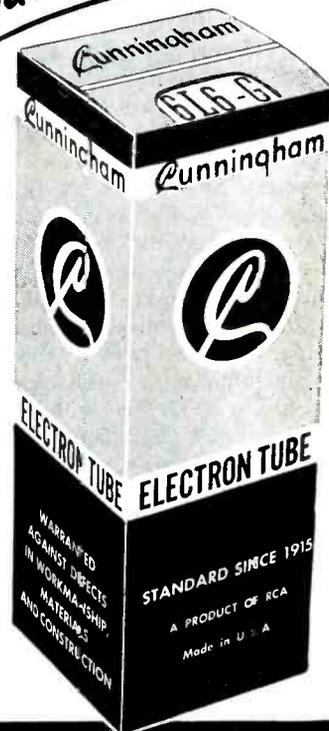


To believe that elaborate test equipment and the availability of service data eliminate the need by the serviceman for an up-to-date understanding of radio theory is tantamount to hanging one's hopes on a plume of smoke.

There was a time when the simplicity of receiver construction made maintenance and repair work a fairly easy task. Today, modern mass production methods, extended frequency ranges, and improved designs, have multiplied the complexity of radio servicing.

The serviceman who has an adequate technical background will have no difficulty in recognizing or understanding new circuit modifications. Without such knowledge, however, servicing must be a costly "trial and error" procedure, no matter how good and versatile the test apparatus. Servicing "know-how" is one of your most valuable assets—upon it rests the success of your business.

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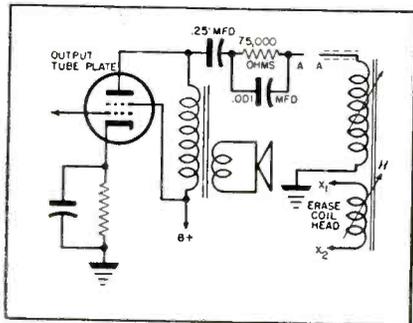


Fig. 7. How a wire recorder head can be wired into a receiver or amplifier output. The head must be disconnected from A after recording and connected to amplifier grid input for playback. (Courtesy Wirecorder)

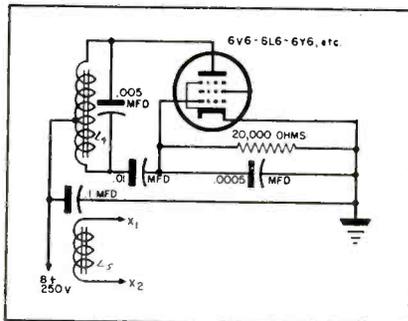


Fig. 9. High-frequency oscillator used in recorder.  $L_1$  usually consists of 450 turns of No. 28 Formex or enamel wire tapped at 150 turns from the start, and wound on a powdered iron coil  $\frac{3}{8}$ " by 1" long.  $L_2$  is a 23-turn, closely-wound coil of No. 20 wire, wound on top of  $L_1$ . The erasing coil leads of the head are connected to  $X_1$  and  $X_2$  during recording. The B+ from the oscillator and  $X_1$  are disconnected when playing back.

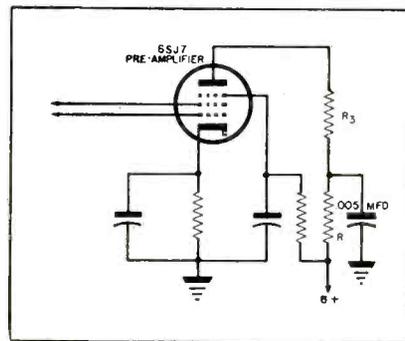


Fig. 8. Provided bass boost for a wire recorder. Usually 12 db of bass boost is used for recorded wire reproduction. (Courtesy Wirecorder)

## Magnetic Recording

(Continued from page 49)

material is made by combining either a magnetic iron oxide or certain metallic powders, of extremely fine particle size, with a binder, and coating the paper or film base. This coating is about  $\frac{1}{2}$  thousandth of an inch in thickness, and about  $\frac{1}{4}$ -inch wide. In one case, the coating is applied to paper base discs.

The design of paper-tape recording machines is very similar to wire recorder machine design, with the exception that the reels and other parts through which the tape rims must be made to accommodate the  $\frac{1}{4}$ " width. The tape speed is much lower than the wire speed. In a recorder of this type developed by Brush, using magnetic iron-oxide coated tape, good response to 5000 cycles, at a tape speed of only  $7\frac{1}{2}$  inch per second, has been obtained. With 7-inch diameter reels, one-half hour recording can be obtained. A capstan is used to drive the tape, with a rubber-tied idler touring the capstan flywheel, thus furnishing good mechanical filtering action. The recording head has a very small gap, about  $\frac{1}{2}$  thousandths of an inch, and about  $\frac{1}{4}$ " wide perpendicular to the tape move-

ment. The coil is divided into two parts, one on each leg, to reduce external magnetic flux pickup. Signal-to-noise ratios as high as 60 db have been obtained.

Brush has also developed a high-coercivity disc recorder using the same type coated media. The recording is made out to a diameter of  $8\frac{1}{2}$ " by guiding the recording head by means of a supplementary grooved disc placed on the center pin of the turntable. It is thus very similar to a disc phonograph arrangement. The recording is started inside from a  $5\frac{1}{2}$ " diameter. The sound track, in spiral form, is somewhat less than  $1/64$ " wide and the separation between tracks is a little over  $1/100$ ". With 20 rpm in rotation speed, a three-minute recording can be made.

Both the paper tape and disc are extremely tough, and will not break easily, due to the choice of the special paper base. The disc can be folded and unfolded (such as for mailing purposes) without appreciable effect on the recording. Both forms can be erased by the supersonic erasing method if desired, and recordings can be played 1000 times with no substantial loss in quality. The tape is

easily edited, and repaired; sections can be torn or clipped out and the ends joined by adhesive or scotch-type tape, with no noticeable effect from the splice-in reproduction.

Another kind of tape using powdered metal material has been developed by Indiana Steel Products Co., and termed Hyflux. This magnetic powder suspension has a very high coercive force. Measurements on solid specimens show  $H_c = 450$  to 500 and  $B_r = 4000$  to 5000. Recordings offering high audio frequencies have been made with this tape; the present recommended speed of tape is about 8" per second affording good recording to 6000 cycles. This tape is  $\frac{1}{4}$ " wide and .002" thick including the powdered metallic coating of .0005". It has a break load of 6 pounds, and substantial dimensional stability.

The general methods and equipment for recording and reproducing are the same as for other magnetic tape, but due to the different characteristics of Hyflux, the design details are somewhat different. The manufacturers recommend a flywheel-capstan drive with a 3" diameter steel flywheel  $\frac{3}{4}$ " thick. The capstan (flywheel hub) must be between  $\frac{3}{4}$ " and 1" diameter. A metal pressure wheel is used, and held in close contact with the capstan by a strong spring. This has

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To prevent interference and simplify alignment problems a combination record-reproduce head is used on Hyflux tape recorders. A satisfactory head used consists of a laminated magnetic ring with an air gap .0005" wide for higher frequency recording or .002" for ordinary speech recording, the length of the gap across the tape being 1/4". The tape rides on the gap, the laminated ring being made 1" o-d and 3/4" i-d, with the poles under the gap tapering, so that the flux will concentrate to the point of tape contact with the gap. The laminations are of mumetal, and are about .006" thick, never more than .012". The mumetal is annealed after being cut to shape.

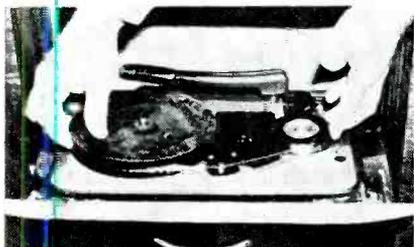
The high coercive force of Hyflux requires 1 1/2 to 2 watts of supersonic power in the recording head. This is based on a 15-to-20-ampere turn coil, taking 50 to 75 milliamperes of supersonic current, with a recording coil of 3 to 5 ampere turns and 10 to 15 milliamperes of audio current. The supersonic frequency used does not exceed 30 kc due to difficulty of obtaining these large powers at higher frequencies. Good erasing can also be obtained on Hyflux with permanent magnet erasing heads.

#### Tape Recording Advantages

Advantages of tape recording include, first, the low linear speed of the medium, required for good high frequency recording. This is chiefly due to the relatively high coercive force of the material or its resistance to demagnetization. This property also results in less demagnetizing effect between turns of a stored reel, and hence less deterioration of the recorded material with time. Second, the sound energy level on the tape is relatively high, requiring less electronic amplification between the head and the loudspeaker. One Hyflux recorder for instance, used only 30 db gain. The tape recorder mechanism presents no problem of winding the material evenly on the reels, hence no level-wind mechanism is required, as with wire recorders.

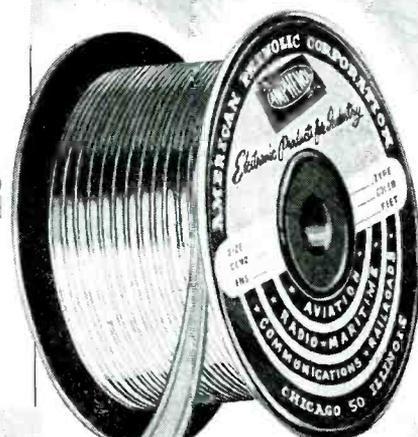
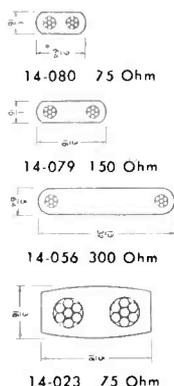
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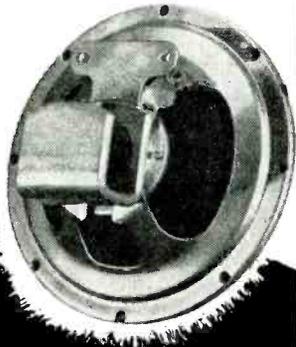
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## JOTS AND FLASHES

MANUFACTURERS REPORT that most receivers now coming off the line are of the f-m/a-m type. At the recent Music Show in Chicago practically every console was an a-m/f-m type. FCC reports that 215 f-m stations are now on the air, and 800 more have received conditional grants to proceed with construction. According to the FCC, over 500 communities in 47 states will have f-m service before the year is out. It is quite apparent, therefore, that f-m is rapidly becoming an important broadcast service, and Service Men will have to step lively and bear down on training themselves for those f-m calls. . . . The tv antenna apartment house problem has been temporarily solved in New York. One of the large realty companies has agreed to permit the temporary installation of television antennas of either the one or multiple-feed type, until master antenna systems have been developed. . . . The Galvin Mfg. Corp. will hereafter be known as Motorola, Inc. . . . A. F. Wild is now sales manager of television equipment in the G.E. transmitter division. . . . Andrew A. Foley has been named Philadelphia representative for the Astatic Corporation. . . . The St. Louis Microphone Co. has been incorporated under the laws of Missouri. They have moved to a new building at 2726-28 Brentwood Blvd., St. Louis 17, Mo. . . . A. E. Stevens, formerly with Hammarlund Mfg. Corp., is now sales manager of Radio Essentials, Inc., 152 MacQuesten Parkway, Mt. Vernon, N. Y. . . . Dade Distributors, Inc., 136 N.E. First Street, Miami 32, Florida, have been named Florida distributors for the Howard Radio Company, Chicago. . . . James D. McLean, former manager of sales of transmitters at G.E., has joined the Philco television station WPTZ, as commercial manager. . . . George L. Beers, assistant director of engineering of the RCA Victor Division, has received an honorary degree of Doctor of Science from Gettysburg College, Gettysburg, Pa. . . . J. J. Clune, formerly with National Union, has been appointed merchandise manager of Air King Products Co., Inc. . . . Bob Karet has resigned as sales manager of the Thordarson, Meissner and Radiart divisions of Maguire Industries, Inc., to enter the manufacturers' representative field. Mr. Karet will be affiliated with Ray R. Hutmacher (Salescrafters Inc.), 510 N. Dearborn Street, Chicago. . . . Charles Hampson is now sales manager for General Electronics, Inc., 1819 Broadway, N.Y.C. . . . A 44-page booklet describing components used in transmitters, receivers and electronic devices has been released by the Westinghouse Electric Corp. Copies of the booklet (B-3610) are available from Westinghouse, P. O. Box 868, Pittsburgh 30, Pa. . . . The Selenium Corp. of America are now located in a new building at 2160 E. Imperial Highway, El Segundo, Calif. . . . Littelfuse, Inc., 4757 Ravenswood Avenue, Chicago 40, Ill., have released a catalog, No. 9, describing a variety of fuses, fuse mountings and circuit indicators. . . . LeRoy W. Beier Co., 600 S. Michigan Avenue, Chicago, Ill., will represent Electro-Voice, Inc., in the state of Wisconsin, eastern Iowa and the northern two-thirds of the state of Illinois, except Chicago.

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