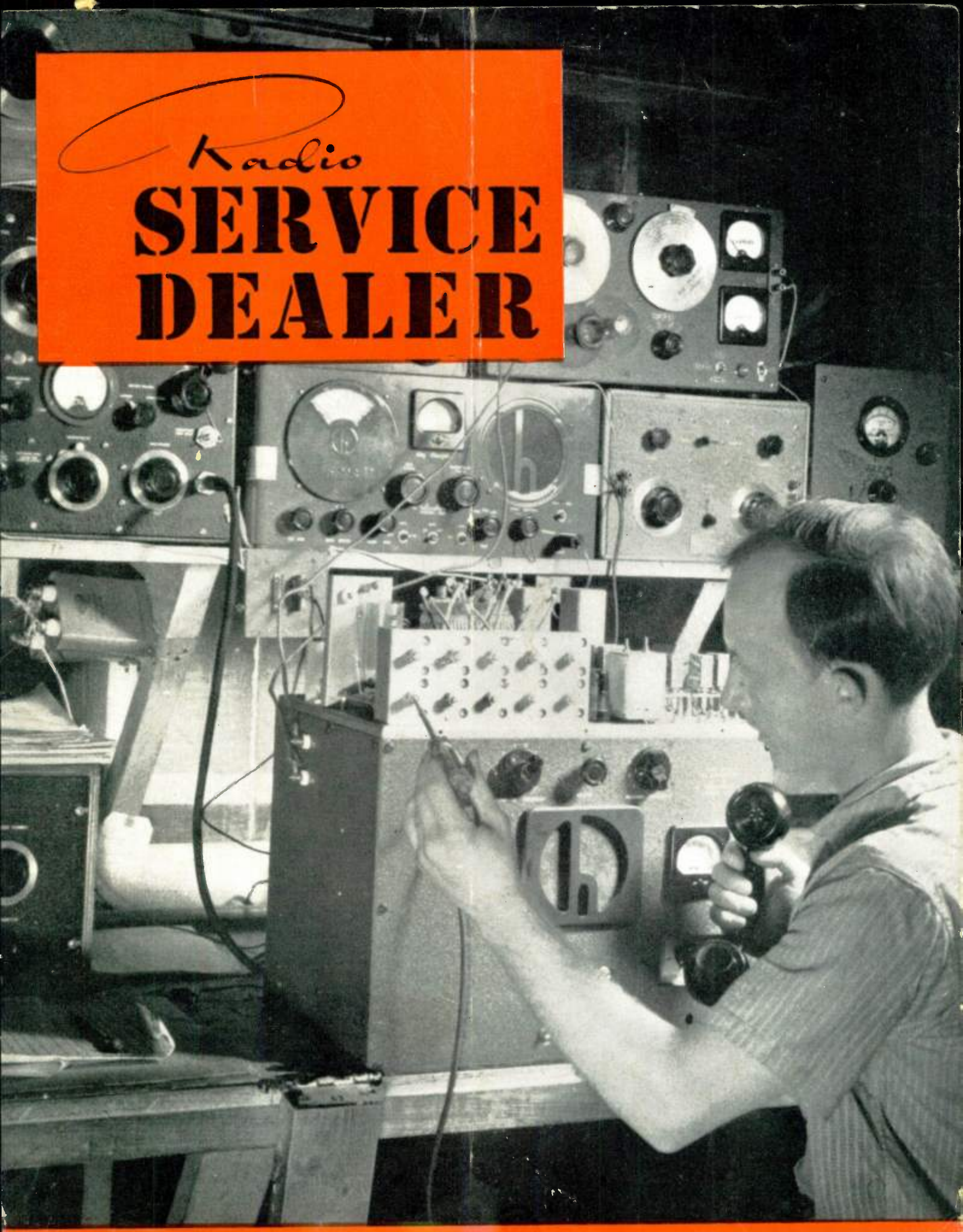
Radio SERVICE DEALER



(Radar, see page 6)

$2 PER YEAR **AUGUST 1943**

RADIO-ELECTRONIC MAINTENANCE

Every Page is a Spark Plug for Your Ingenuity

The Chapter Headings Tell the Story

1 Loud Speakers and Their Use
2 Superheterodyne First Detectors and Oscillators
3 Half-Wave and Voltage Doubler Power Supplies
4 Vibrators and Vibrator Power Supplies
5 Phono-Radio Service Data
6 Automatic Tuning
7 Frequency Modulation
8 Television
9 Capacitors
10 Practical Radio Noise Suppression
11 Vacuum Tube Volt Meters
12 Useful Servicing Information
13 Receiving Tube Characteristics

"Keep 'em listening," is the ambition of every radio serviceman, engineer, amateur and experimenter. Here is the book you need as ambition's assistant. The latest technical data is the biggest help you can get to overcome parts shortages through making the most of available materials; to solve the problems posed by faltering receiving sets.

The new MYE Technical Manual is the practical answer to every-day questions. Every page is a spark plug for your ingenuity. Theory is blended with practice in simple terms—easily applicable—up-to-the-minute—much of the data never before published.

Servicemen tell us it is exceptionally complete. "The buy of the year," says one . . . "Must be within reach on the bench," says another . . . "Can't get by one day without referring to it" . . . so it goes; summarized into one word, it is "indispensable."

408 pages, hard cloth covers, profusely and accurately illustrated. A real wartime helper. Your nearest Mallory distributor can supply you. Price $2.00, while the supply lasts.

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

P.R. MALLORY & CO. Inc.
MALLORY

Approved Precision Products

Radio SERVICE-DEALER

Registered U. S. Patent Office

MEMBER AUDIT BUREAU OF CIRCULATIONS

Vol. 4, No. 8 ★ August, 1943

CONTENTS

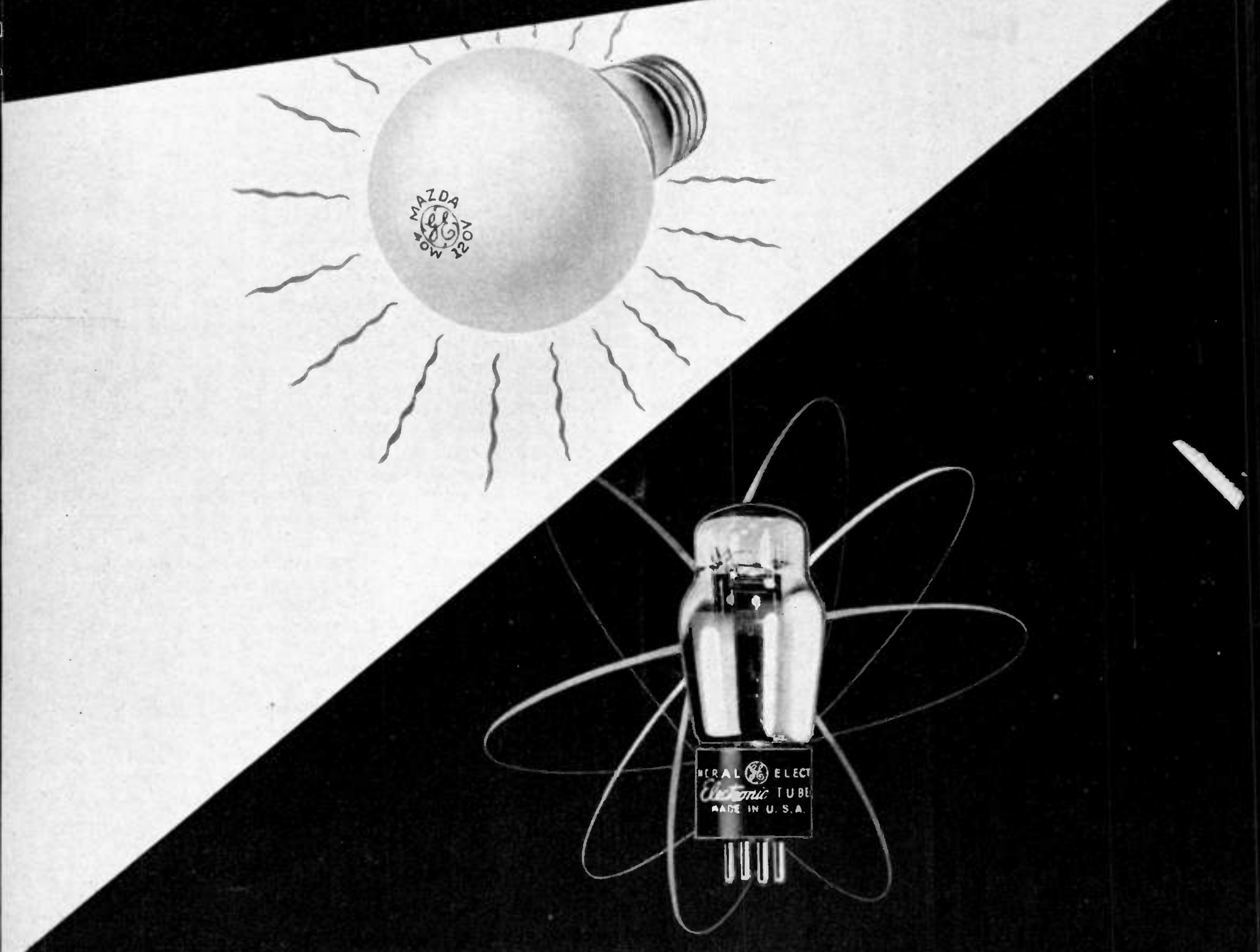
Executive & Editorial Offices
132 West 43rd St., N. Y., 18, N. Y.
Telephone CHickering 4-3278

★

★

RADIO SERVICE-DEALER, published monthly at 34 N. Crystal Street, East Stroudsburg, Pa., by the Cowan Publishing Corp. Executive and Editorial Offices at 132 W. 43rd Street, New York, 18, N. Y. Subscription rates—United States and Possessions, $2.00 for 1 year, $3.00 for 2 years; elsewhere $3.00 per year. Single copies 25c. Printed in U.S.A. Entered as Second Class Matter October 3, 1941, at the Post Office at East Stroudsburg, Pa., under the Act of March 3, 1879.

What have G-E Mazda Lamps and G-E Electronic Tubes in common?



THE General Electric Mazda Lamp and the General Electric Electronic Tube have a lot more in common than meets the eye!

But radio service men and service dealers should recognize the important similarities. Both lamp and tube bear the same G-E symbol that the public has long shown its respect for by buying countless millions of electric lamp bulbs for its homes, stores, farms, factories.

Both are durable. Both are efficient. Both bring a fair profit to the retailer. Both are as American as Chevrolets, Plymouths, Fords. Both give much more service than their cash value indicates.

The history and development of both are closely tied in with General Electric's history and development. Both are being widely and currently advertised to consumers through the nation's most effective advertising media.

As a result, the G-E Electronic Tube is earning the same complete consumer confidence now given to the famous G-E Mazda Lamp.

There is already an increased demand for G-E Electronic Tubes. And when peace is restored, General Electric Electronic Tubes will be in greater public demand for replacements than they ever were before. Insistent General Electric advertising and promotion are carefully planned to make them your fastest moving radio tubes. *Electronics Department, General Electric, Schenectady, New York.*

Tune in "THE WORLD TODAY" and hear the news direct from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over CBS. . . . On Sunday listen to "The Hour of Charm" at 10 P. M. E.W.T. over NBC.

GENERAL ELECTRIC

176-84

LEADER IN RADIO, TELEVISION, AND ELECTRONIC RESEARCH

editorial....

THE TELEVISION BATTLE AGAIN

• In the past decade the Radio Industry has enjoyed (sic) many verbal battles between various engineers or manufacturing factions on divers subjects. It could not be otherwise. To achieve progress there must be a divergence of opinion, a consolidation of ideas and the ultimate coordination of all useful and constructive criticisms so the new and proposed development might be brought into actual existence and then be given a trial.

Reminisce a bit and you'll find that television, frequency modulation, mystery controls, avc, and cathode-ray 'scopes, as respectively "invented," each had their proponents and derogators. As one might surmise, when any particular development achieved marked success, everyone seemed to jump on the band-wagon seeking a share of acclaim. To cite an example, take "Radar." Not long ago only a handful of men knew that such a development existed. Today it is almost impossible to find anyone in the radio industry who will admit that he wasn't either the actual inventor or a prime factor in the ultimate perfected use of the device.

Now we find the Industry all agog again. It seems that Mr. Ralph R. Beal, research director for Radio Corporation of America, stated on July 21st that, "within the shortest space of time required to re-convert the radio manufacturing industry from war to peace production . . . television receiving sets will be well within the range of the average pocketbook . . . television will provide a much more satisfactory entertainment medium than has been achieved . . . networks of relay stations, automatically monitored, will carry the sound and televised images to any desired distance . . . then the next normal development will be three-dimensional and color television." Just one week later Commander E. F. McDonald, Jr., president of Zenith Radio Corporation countered with his opinion to the effect that commercial television is still a long way off. That sounds logical, for the end of the war seems to be a long way off. Realize please that Mr. Beal clearly said that in his opinion television would hit with a bang quickly *after* the war's cessation. It is interesting to note that Paramount Pictures, Inc., which seems to have an interest in the Allen B. DuMont Laboratories, famous for their contributions to television, also wanted to express their opinion on television for on July 30th they released an optimistic report that now advertisers are offered time on the air for program planning and experimentation because, "television will be the greatest medium yet developed for the advertiser of trade-marked goods and packages, for he can tell his full story, also show his product." Amen!

It is our opinion that television is coming, will arrive with a bang and will go on to astounding success. All this will happen eventually, just when, no mortal can now guarantee. But the point we want to drive home is this—no factions in radio should quibble about television at this time. If quibble they must, why not wait a while until the war is over and production schedules are being planned. It's too silly, what with the shortage of paper and the lack of set production, to try to confuse the set-owning public (which is sore as hell) because it cannot even get tubes to keep its present midgets playing.

NEED FOR INSTRUMENT SERVICING

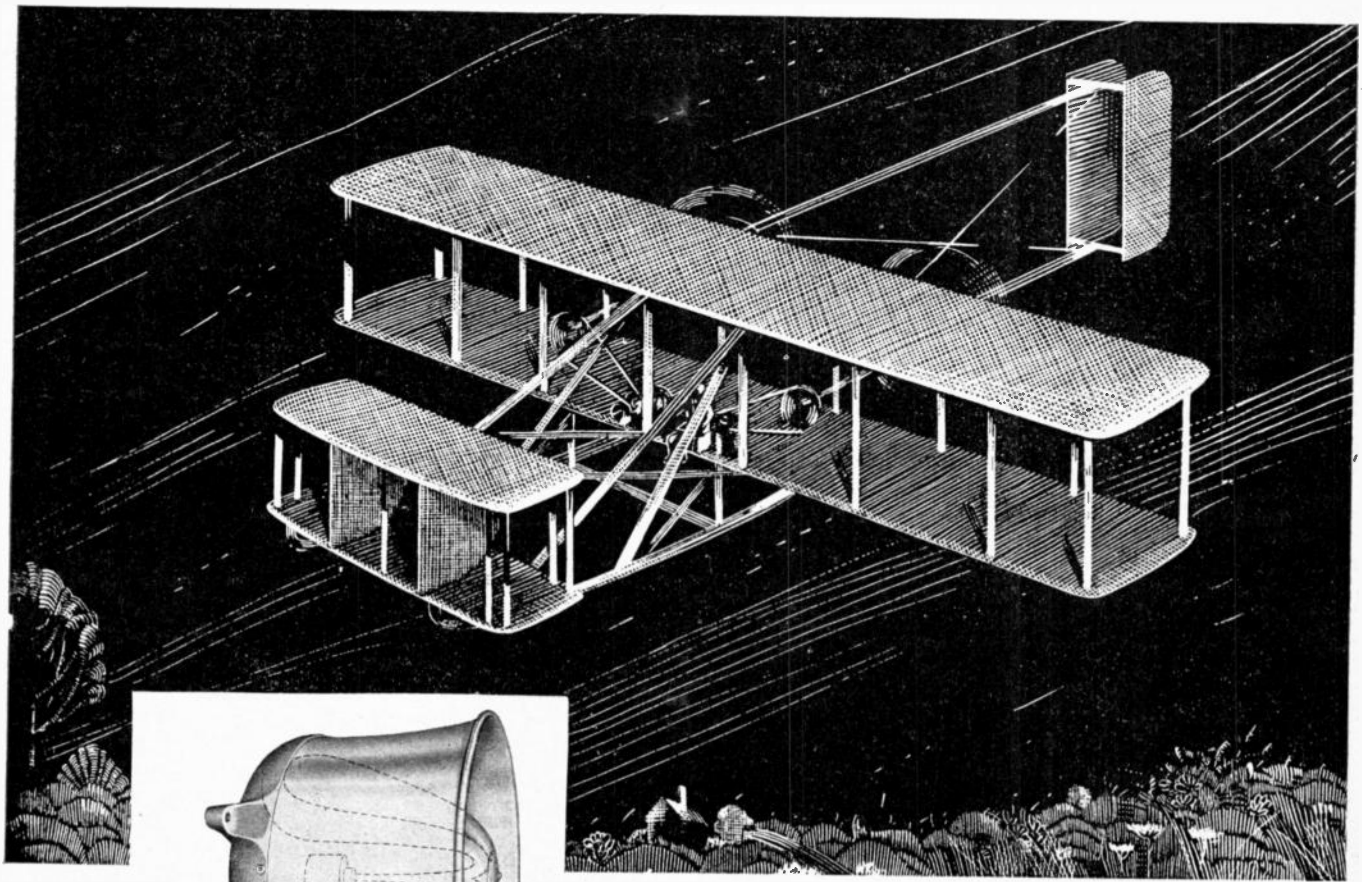
• From all parts of the country letters have come to us from well established radio servicing organizations who are handicapped because their test equipment has broken down and no instrument manufacturer will even answer inquiries as to where or how such test equipment can be repaired. Instrument makers are not intentionally neglecting their old service-dealer and jobber customers. Parts needed for repairing instruments are available only on the highest priority for which civilians simply do not quality. The amount of repair parts needed to keep America's test equipment in working order is infinitesimal so we have asked W.P.B. for special consideration. However, instrument firms are loaded to the hilt with war orders; they suffer from acute manpower and production facility shortages. It adds up to this—do the best you can to keep your instruments functioning and there's a bare possibility that we may soon be able to locate an instrument repair depot.

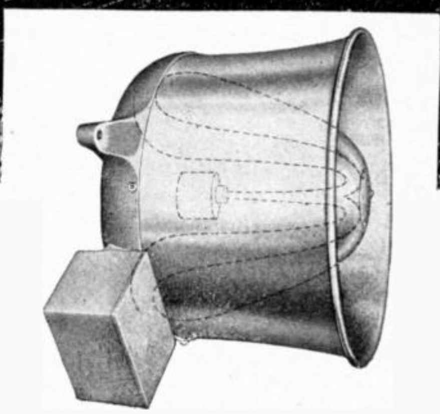
APPLIANCES FOR DEALERS

• Department stores started advertising food processors and dehydrators for sale a week ago. For a moment we thought we had been "scooped"—that a resumption of production of electrical appliances was under way. Our disillusionment was profound when we ascertained that these appliances are not electrical for they are merely wooden boxes that contain an incandescent lamp. Further research, and contact with Washington, now convinces us that no appliance containing any of the "scarce metals," such as steel, copper, nickel or aluminum —or "scarce materials" like plastics, fibre, etc., can be produced for civilian markets while the war lasts. We'll be fortunate if we get repair parts, let alone retail items.

Too Bad He Didn't Have RACONS

When airplanes were pioneered, and later being used in World War I, many pilots lost their lives. They had bad communications methods, couldn't land at night or "blind". In those days RACON was pioneering too—making loud-speakers. RACONS and planes have improved in twenty years. Now-a-days many types of RACON speakers and driving units are "flying high" aboard bombers, blimps, transports and naval vessels. They save lives. They were selected because they are most dependable and efficient.





Shown here is the RACON MARINE HORN Speaker used on many bombers and navy vessels. Approved by the U. S. Coast Guard, formerly the Bur. of Marine Inspection, Dept. of Commerce. Several sizes available. Stormproofed, of the reentrant type, suitable for indoor or outdoor use—may be used as both speaker and microphone.

You can obtain RACONS for every conceivable type of public-address or paging installation for industrial war plants, shipyards, training bases, etc. Write for complete details.

RACON ELECTRIC CO., 52 East 19th St., New York, N. Y.

RACON

RADIO MECHANICS

Part I

by John H. Potts

OF all the subjects which have been covered in books and publications devoted to radio, it is a curious fact that the mechanical aspects of radio servicing have been most neglected. Although every radio servicing job involves mechanical work, often the dismantling of the receiver and constructional alterations to accommodate substitute parts, information as to what constitutes best practice in making such alterations has been lacking. As a result, a goodly percentage of callbacks occurs because of poor mechanical fastenings, unsatisfactory soldering or improper selection of mechanical components.

We need not concern ourselves with troubles which occur purely from carelessness. If a chassis is returned to a customer with screws and lockwashers missing from the bottom cover, or if it is re-installed in the cabinet with only one or two bolts, or if the bolts are made only finger-tight—and these practices are only too common—it is not strange that unsatisfactory performance results. Nor is it strange that the inquisitive customer, who investigates and discovers such conditions, forms a poor opinion of the offending worker. But we are concerned with troubles which develop when an honest effort has been made to turn out a permanently satisfactory job.

It is perfectly possible, for example, to fasten a ground connection firmly to a shield or chassis, using a brass screw and lockwasher into an aluminum sheet or molding, and have this connection become thoroughly unsatisfactory due to *galvanic action* resulting from the interaction of the dissimilar metals. A poor electrical connection may develop because an improper type of solder is used—and we don't mean acid-core solder. We know that rubber shock mounts usually correct cases of microphonic howl, but sometimes they don't—what then? These are some of the points we are going to discuss.

Finishing Various Metals

The chassis in radio and electronic apparatus will ordinarily be made of steel, zinc or aluminum alloy, plated or otherwise treated to resist corrosion. Steel is often cadmium plated, a plating which provides excellent corrosion resistance. Zinc plating is also satisfactory, but is somewhat harder to apply. Occasionally chemical treatments are used, such as *bonderizing*, *parkerizing* or other forms of "phosphate coating" which afford some measure of protection, but are not as good as plated or painted finishes. If paints or lacquers are used, it is customary to apply a "priming coat" of zinc chromate, which improves corrosion resistance and forms a good base for the paint or lacquer. Bonderizing is also often applied to zinc.

Pure aluminum has high corrosion resistance, but is soft. For chassis, dural is generally used. Dural contains small percentages of copper, magnesium and manganese, the balance being aluminum. It is stronger than pure aluminum but does not have good corrosion resistance and therefore is generally finished with a protective coating of some sort. One much in use is called *anodizing*, by which a protective oxide coating is formed. This is very effective, but it must be remembered that this protective coating is an insulator, and when making ground connections to aluminum parts it is necessary to remove this coating to make certain a good electrical connection is obtained. Sometimes the blocks and supports for shields are so treated, and when this oxide is not removed poor shielding and noisy operation frequently result. High-purity aluminum often receives a sand-blast treatment to improve appearance. This may be followed by a coat of clear lacquer. The lacquer must of course be removed from points to which an electrical connection is to be made.

Difficulties often arise in making electrical connections with items of hardware, such as screws, nuts, flat washers and lockwashers. Such hardware requires the same sort of protective treatment as the chassis. Steel screws and nuts are frequently cadmium or nickel plated. Lockwashers of steel often receive a bonderized or parkerized finish, which produces a dark color giving a reasonable amount of corrosion resistance. Some platings react on lockwashers to render them brittle;

TABLE I
ELECTROMOTIVE SERIES

METAL	POTENTIAL (at 25°C) (Volts)
Magnesium	—2.34
Aluminum	—1 67
Zinc	—0.76
Chromium	—0 71
Iron	—0.44
Cadmium	—0.40
Nickel	—0.25
Tin	—0.14
Lead	—0.13
Hydrogen	0.00*
Copper	+0.34
Silver	+0.80
Palladium	+0.83
Mercury	+0.85
Platinum	+1.2
Gold	+1.42

**Chosen as an arbitrary reference point.*

Front Cover

WAR PRODUCTION TESTS

Before the war most radio servicemen were competent technicians. But radar and communications equipment now used by the military are so much more complex than civilian radio that men engaged in testing or repairing same must "know their stuff." Here is a production line tester using instruments familiar to most servicemen, making a step-by-step check.

RADAR MASS PRODUCTION

"RADAR" is the designation given to equipment and procedure for "(ra)dio—(d)etection—(a)nd (r)anging," in which radio and electronic facilities are employed to determine, by reflected radio impulses, the (1) distance, (2) angle of elevation, and (3) angle of azimuth of large bodies.

Post-war radar is slated to prevent collision between objects, such as boats, airplanes, or even automobiles; for radar functions in fog or pitch blackness—it is an all-seeing eye. The illustrations above show radar in mass production at General Electric Company plants.

this does not happen when chemical treatment by means of the bonderizing method is employed. Since very little surface is exposed in actual use, this method of treating washers of this type works out well.

Often brass screws and nuts are used without any protective treatment. Since brass has high corrosion resistance, this is generally satisfactory. However, in the presence of salt air, an oxide forms on brass which affects its appearance, although whether its utility is likewise affected depends upon the application. One point is especially important in this regard; brass screws should not be used in aluminum unless the brass is plated. It is preferable that nickel plating be used, although zinc is also applicable. The reason is that contact between dissimilar metals produces an electric potential which accelerates corrosion in the presence of damp air, particularly salt air. This effect is small unless the potential difference between the two dissimilar metals is greater than one volt.

Contact Potential by Galvanic Action

A table of the electrode potentials of various metals is shown in Table I. The potentials of each kind of metal are related to hydrogen, which is chosen as an arbitrary zero reference. Brass would have substantially the same potential as copper, about plus (+) 0.34-volt, while aluminum is minus (—) 1.67 volts. Thus, in combination, a resulting potential difference of about 2.01 volts occurs. When the brass is nickel plated, only the nickel, which has a potential of —0.25-volt, is in contact with the aluminum, so the potential difference is reduced to —1.42 volts. The best plating for the screw, from a potential standpoint, is zinc, which would reduce the potential difference below 1 volt. Nickel plating is far more common, though, and an assortment of nickel-plated brass screws of various types and sizes will be found quite handy for making connections in metals of all kinds. In steel, of course, there is no potential problem, because, unless we go to gold-plated screws—perish the thought—we can't get a potential difference of greater than one volt. Of course we wouldn't use either aluminum or magnesium because these metals are so soft, and therefore, quite unsuitable.

Stainless steel, which is steel with about 18% chromium and 8% nickel, as commonly used, requires no plating or lacquering. It usually receives only what is called a *passivation treatment*, which removes scale. This metal has high corrosion resistance and is only slightly magnetic.

Phosphor-bronze is widely used for lockwashers and has excellent corrosion resistance. It requires no plating or other treatment unless used in contact with aluminum and is particularly desirable when electrical contacts are involved because of its high conductivity. Such lockwashers can be obtained in either the non-interlinking type, most commonly used, or in the internal- or external-tooth Shakeproof variety. Shakeproof lockwashers are generally used where vibration problems are encountered, such as in auto-radio receivers, but are also used in more conventional applications. The internal-tooth type is more widely employed. This type bites into the panel and fastening nut to effect a secure assembly.

Phosphor-bronze or beryllium-copper, spring temper, is generally used for the springs in the spring-type knobs which have largely replaced set-screw types in commercial radio sets. Many knobs of this type possess decided grasshopper proclivities, insofar as the springs are concerned. Too often, when the knob is pulled off the control shaft, the spring hops out and departs to some undiscoverable or inaccessible spot and a replacement is required. These springs may be cut from thin sheet metal of the types specified and bent to shape. Bending must be carefully done to avoid breakage. Steel springs

The SPRAGUE TRADING POST

EXCHANGE—BUY—SELL

Your own ad run FREE!

The "Trading Post" is Sprague's way of helping radio servicemen obtain the parts and equipment they need, or dispose of the things they do not need during this period of wartime shortages. Send in your own ad today—to appear free of charge in this or one of the several other leading radio magazines on our list. Keep it short—WRITE CLEARLY—and confine it to radio items. "Emergency" ads will receive first attention. Address it to:

SPRAGUE PRODUCTS CO., Dept. RSD-38
North Adams, Mass.

EQUIPMENT FOR SALE — Hickok #18 signal generator; Supreme 3" scope; RCA Model 156 Tube Tester (factory revised); Superior X-Rayometer, v.o.m. up to 30 meg.; Simpson Model 325 (9" meter) counter tube tester; Triplett #1200A twin meter, 2000 ohms per volt analyzer; Stancor super pack 115 V.A.C. to 6 V. at 12.5 amps.; two G-E handy phone intercommunications, receivers model EM-43C. What am I offered? Harry Sklar, 146 Myrtle Ave., Jersey City (5), N. J.

WANTED—Voltohmmeter A.C.-D.C. volts, 1000 ohms resistance per volt. Urgently needed. Eldred Sherrill, Lapulpa, Okla. (General Delivery).

TEST EQUIPMENT WANTED—Tube tester, pocket size tester, bench tester, etc. Write giving price and details. Victor D. Letourneau, Jr., 179 Main St., Holyoke, Mass.

CONVERTER WANTED—32 to 110 volt, 300 to 500 watts. Give price and details. Milo W. C. Wilson, Bellefonte, Route #2, Pa.

WANTED FOR CASH—CB1-60 Solar condenser and capacity analyzer; 5 volt A.C. meter (Weston or Triplett); 5 amp. A.C. meter. Must be in A-1 condition. All replies answered. Wm. H. Zink, 618 N. Chester St., Baltimore (5), Md.

WANTED AT ONCE — Montgomery Ward portable phonograph with spring drive. Ray Hauser, P. O. Box 55, Litchfield, Ill.

TUBE TESTER WANTED—Will pay cash for Radio City 312-C tube tester, or Triplett model 1612 in good condition. J. B. Patrizi, 115 W. Sherman Ave., Newark, N. J.

C-R TUBE WANTED—Want cathode ray tube for Philco 022 'scope. #2152. Will pay cash. J. R. Jones Radio Service, Hamden, Ohio.

FOR SALE—4 ICA and 4 Bruno s-w coils; 140 mmfd. condensers; 300 tubes in sealed cartons (some open, but not used) — guaranteed test; power packs, 180 volts to 400 v. D.C. Priced low. Enclose stamp for detailed reply. W. F. Onder, Rt. 1, Box 389, Kimmswick, Mo.

SIGNAL GENERATOR WANTED — prefer American Model 4103. Also want volt-ohmmeter, Triplett model 666H. L. Dewey Cothian, Belton, S. C.

ACORN TUBES WANTED—955 and 954 Acorn types. Give details and price. Fox Radio Service, 435 S. 5th St., Richmond, Ind.

FOR SALE—One 10v. 5a. fila. transformer, 5000 v. insulation; one Stancor A-4406 driver transformer; two Taylor T-200's (new); two 866's; two 50's; also other used tubes; two .5 mfd. 1000 v. condensers; one 2 mfd. 1500 v. condenser; complete transmitter; audio amplifier 56-56-p.p. 2A3's; and A.C. pre-amp. 57-57. Write for details. S. H. Heil, 725 Folk St., Easton, Penna.

WANTED AT ONCE—Latest model tube tester, any std. make. E. E. Johnson, Shelter Island, N. Y.

FOR SALE — Brand new automatic record changer #8 made by General Industry Co. Will hold 10" or 12" records at one time. Has Astatic crystal pickup and built-in volume control. $36 cash, or will trade for an up-to-date tube tester or 'scope. E. E. Johnson, Shelter Island, N. Y.

SIGNAL GENERATOR WANTED — Any good make or model considered. State condition, frequencies covered and price. Cash sale—but needed immediately. Willis G. Jenkins, 408 Woodhams St., Plainwell, Mich.

WANTED—Sprague Tel-O-Mike, Solar capacity exammeter or capacity bridge model CB, CC, QBC, OCK; Cornell-Dublier BF50 or BN; Aerovox L.C. checker. Will pay cash or trade for any of these. State condition and lowest price. Anthony Pusateri, 1101 Fleming St., Coraopolis, Pa.

WANTED—1½V. 90V. A-B pack batteries. Also 1A7, 1A5, 1H5 and 1N5 tubes. Ellison's Radio Service, Centertown, Ky.

SIGNAL GENERATOR WANTED — RCA or Philco. Will trade late table model radio or pay cash. Service Radio Co., 3320 White Oak Drive, Houston, Texas.

RIDER MANUALS WANTED—Will pay cash for complete set. Give details and price. L. W. Bakewell, 434 W. Locust St., Springfield, Mo.

FOR SALE—100-watt R.F. unit, HK-24 final. Completely portable with self-contained 1000 volt power supply. Xtal oscillator, meter, relays. In 13x20x12 inch steel cabinet. Will give full output up to 30 megacycles. Ideal for schools engaged in radio instruction. E. F. Harris, 60 E. Norwich, Columbus (1), Ohio.

WANTED—Howard 435-A or 436-A receiver; also Howard 610 power pack. Morris Hagemeister, Manfred, N. Dak.

WANTED—Electric tube tester in good condition and not too old. Also 0-1 or 0-5 ma. meter. Will pay cash. Reginald H. Cox, Hoyt Station, Sunbury County, N. B., Canada.

WANTED — Chanalyst, 3" oscilloscope, Aerovox LC checker, Hickok or Jackson Signal Generator, tube tester, multimeter. First class equivalent quality acceptable. Dick's Radio Service, 4705 Delmar, St. Louis, Mo.

XMITTER PARTS TO SELL OR TRADE—Am offering wide variety of parts in normal used condition. These include resistors, modulation transformer, sockets, neutralizing condenser, r-f tuning condensers; fixed condensers; oil-filled condensers, etc. —all from a Western Electric 9-A low-level modulation 400-watt transmitter used in aircraft ground station service in 3000-6000 kc. band. Would like to trade for 24-A tubes, 27's, 45's, 80's, 117L7GT, or power pack Xfrms, or 0-1 ma. meter. Write for complete list. Gerald L. Cook, 12453 Maple St., Blue Island, Ill.

NEEDED AT ONCE—Late model oscilloscope (3"); also university LH horns with or without units. Cash waiting. Fred Allen, Brockton Sound Service, 449 Howard St., Brockton, Mass.

"EMERGENCY"—We need 75 each of the following tubes: 12SA7; 12SK7; 12SQ7; 50L6; 35Z5; 35Z3; 6SA7; 6SK7; 6SQ7; 1A7; 1N5; 1H5; 1A5, and 3Q5 as we have over 100 radios for service that cannot be returned to customers due to grave shortage of tubes in this district. Please write airmail how many you can ship—prices—condition, etc. Roy Davis Company, Orange Park, Fla.

SHOP EQUIPMENT WANTED—for new service business. Need new or used r-f signal generator, multimeter or tube checker and multimeter combined. Cash for any equipment I can use. Avery Lenty, 401 E. Church St., Salem, Illinois.

MANUAL FOR SALE—Rider's XIII (new) $10. Peter Grzywna, 106 N. Ferry St., Schenectady (5), N. Y.

NEEDED IMMEDIATELY — Test equipment in good condition; 12SA7, 12SK7, and 12SQ7 tubes, also Rider's manuals, any or all vols. Cash. Bob's Radio Shop, Box 179, Christiansburg, Ohio.

CASH WAITING — for Micro and 0 to 1 MA meters; testing instruments and oscilloscopes; overhead screw recording unit; 12, 35, and 50 volt tubes, etc. What have you? Rush price and complete information. Scott Radio Service, 163 Hanover St., Bridgeport (4), Conn.

FREE SERVICE DATA: *Making 18 "Victory Line" Capacitors do the work of 473!*

Vital materials **must** be conserved for war uses—and this means that servicemen are now faced with the problem of making a "Victory Line" assortment of 18 Capacitors do the work of the approximately 473 replacement types and sizes previously supplied for this work.

But servicemen will cooperate accordingly! They'll use 'em—and they'll make these 18 types fill the bill! What's more, they'll get all the help Sprague can give them in solving the headaches that are bound to arise.

WRITE TODAY for your free copy of the Sprague "VICTORY LINE" Folder. In addition to listing the 9 Atom Electrolytics and the 9 TC Tubulars now available under wartime restrictions, this contains helpful data for those applications where some real "juggling" must be involved to make replacements properly. It tells you, for instance, how to replace 600 volt Capacitors with available 450 volt types; how to use drys on wet electrolytic jobs, and much more.

It's a folder that will prove invaluable in your daily work and we want to make sure every serviceman has a copy.

Don't Miss It!

SPRAGUE PRODUCTS CO.
North Adams, Mass.

SPRAGUE CONDENSERS AND KOOLOHM RESISTORS

Obviously, Sprague cannot assume any responsibility, or guarantee goods, services, etc. which might be exchanged through the above advertisements.

SELENIUM INSTRUMENT RECTIFIERS ARE IN DEMAND

Now you, too, can share in profits on the newest developments in the electrical field by becoming a *Selenium Corporation of America* Distributor.

Of course, thousands of these quality selenium rectifiers are being used directly by instrument, radio and similar manufacturers — but our full capacity facilities allow us to take care of distributor needs, too.

IMMEDIATE DELIVERY

Advertisements like the samples shown are constantly appearing in important technical publications, such as

Electrical Engineering, Electronics, Electronic Industries, Electrical Equipment, Instruments, Industrial Equipment, News, I. R. E., Telephony, Aviation Equipment R. S. I., Telephone Engineer, etc.

(Note: Every ad directs customers to you by saying, "Available through your Electronic Parts Distributor")

Join progressive distributors who are looking for increased sales volume now and in the Electronic Age after the war. Learn the value of handling a line consistently ahead with the newest in electronics.

Experienced engineers in our nation-wide sales offices are always at your service. Write for more details on Emby Selenium rectifiers and photo cells.

SELENIUM CORPORATION of AMERICA
1800 West Pico Boulevard
Los Angeles 6, California

Eastern Office: 215-05 27th Ave., Bayside, L. I.
Canadian Division: J. R. Longstaffe, Ltd., 349 Carlaw, Toronto

are also used, but the other metals mentioned above are superior.

While most volume controls are now available with a flatted shaft so that a spring-type knob may be slipped on, shortages may make it necessary to file down the round shaft of a control designed for a set-screw type of knob. Many servicemen find difficulty in doing this sort of job. This becomes simple if the control is placed in a vise which holds the shaft stationary. The filing should be done in one direction only. Hold the file with both hands, one at each end and file away from you. Each file should have a wooden handle; they're cheap and permit easier and better work.

Tools

Most of us don't have enough screwdrivers. Damaged screw-head slots are the inevitable result. The proper screwdriver for a given screw is the one which *fits* the screw slot; if the spade is too short or too thin for the slot, or too thick, the screwdriver will skid or the screw slot will be marred—or both. The result is a poor mechanical job, and often when the screwdriver slips other parts are damaged too. In selecting screwdrivers pick out ones with spades which won't turn in the handle. Some wooden-handle types are satisfactory, but the types which employ handles of insulating material, with the spade molded in, are more suitable in radio work.

One of the most useful tools for the radio shop is a *taper reamer*. With this instrument it is possible to increase the size of any hole until it meets requirements. This is often necessary when substitutions of different parts are required. Usually a single taper reamer will not be sufficient, since a single size can cover only a limited range of hole diameters. But two reamers will meet most requirements, if so selected that the range of one overlaps that of the other.

Tapping

It is frequently necessary to tap holes in bakelite, aluminum, and other metals, and the selection of a tap drill of the proper size is a much-debated question, even among skilled machinists. Often we see tables of tap drill sizes which do not agree with each other. For example, for the common 6-32 screw, tap drills called for in various tables range all the way from #33 to #36. All of these will work, but each provides a different degree of thread engagement. If we have a deep tapped hole into which the screw will fit, it is not necessary for more than 50% of the depth of the thread to be engaged in order to provide sufficient strength. On the other hand, if we are tapping a relatively thin piece of metal so that only two or three threads of the screw will be engaged, a snug fit—75% to 90% of the thread depth—will be required for mechanical strength.

The tap drill size is also affected by the type of material to be tapped. For aluminum, copper, bakelite and other relatively soft materials, a relatively larger hole is required than for iron or steel. If the tap drill is too small and the material is soft, when using the tap the threads are likely to become ripped. As a result, although the theoretical thread engagement is increased over that which would result if a larger hole were drilled, from a practical standpoint it will be found that the resulting threads with the larger drill are more perfect so a better mechanical job is obtained.

A complete tabulation of screw sizes up to ¼-inch and the corresponding tap drills required for hard and soft materials is shown in Table II. The smaller recommended drill size is for hard metals, such as iron castings, and steel. The resulting hole, when tapped, will provide a thread engagement of about 75%. For the softer metals, such as aluminum, copper, zinc, and for bakelite, polystyrene and similar insulating materials, the larger size tap drill is recommended. This will provide from 50 to 60% thread engagement. The larger size may also be used for hard metals, provided the depth of the hole is at least 1½ times the diameter of the screw. The large number of threads will give adequate strength and there will be less likelihood of breaking the tap, because less force will be required to cut the thread in the hole.

TABLE II
TAP DRILL SIZES

SCREW SIZE No. and Pitch	Outside Dia. (Max.)	TAP DRILL A*	B**
0-80	.060	3/64	55
1-64	.073	53	52
1-72	.073	53	52
2-56	.086	50	48
2-64	.086	50	48
3-48	.099	47	45
3-56	.099	45	44
4-40	.112	43	41
4-48	.112	42	40
5-40	.125	38	36
5-44	.125	37	35
6-32	.138	36	33
6-40	.138	33	31
8-32	.164	29	27
8-36	.164	29	27
10-24	.190	25	21
10-32	.190	21	18
12-24	.216	16	12
12-28	.216	14	11
¼-20	.250	9	7

**Tap drill size for steel, iron and other hard metals (approx. 75% thread engagement).*

***Tap drill sizes for aluminum, magnesium, bakelite and other soft materials (approx. 50-60% thread engagement).*

Drilling

If you have an electric drill—and no radio shop is complete without one—you will find it pays to get high-speed steel drills. While the cheap carbon drills are fairly satisfactory for hand drills, where high speed is out of the question, in electric drills the heat developed from the rapid rotation of the drill draws the temper and the drill soon becomes useless. High-speed steel drills are made to withstand such heat.

For special work, such as drilling certain grades of stainless steel, even the conventional high-speed drills are not good enough. For such work cobalt steel drills or, best of all, tungsten-carbide tipped drills are essential. The latter are expensive.

Drilling is easier if the proper lubricant is used. For steel, lard oil is recommended; for malleable iron, petroleum oil; for very hard steel, turpentine; for aluminum, kerosene, and the drill should be rubbed with beeswax or tallow. Oil should not be used on hard rubber or fiber; cold water may be used on rubber or the material may be machined dry. Cast iron should be drilled dry also. Light oil may be used on brass or bronze, or a special paste or soluble oil compound.

Solders

We have mentioned solder as an item much used in radio servicing about which little has been published. For most of the operations involved in radio repair, "soft" solders, containing principally lead and tin, are used. They are called soft solders because they fuse, or melt, at relatively low temperatures. A "hard" solder fuses at high temperature. Silver solder, composed of copper, zinc or brass, and silver, is an example of a hard solder.

A good solder for radio work should contain a high percentage of tin to assure a strong connection and one which is electrically good. The solder should contain very little antimony, which is an impurity which

(Continued on page 24)

BASICS OF SOUND

by Ira Kamen

PART 2

IN the amplification and distribution of sound, there is no single "most important" element, for like the proverbial chain, a system of amplification is no stronger and of no greater fidelity than its weakest link.

Loud Speaker Limitations

Generally speaking, today's weak link in any system of amplification is the speaker, for in all truth, though much has been done in development and design and much progress has been made in increasing the power handling capacity and broadening the response of the speaker unit, loud speakers are still the one factor in sound equipment which most seriously limits true reproduction.

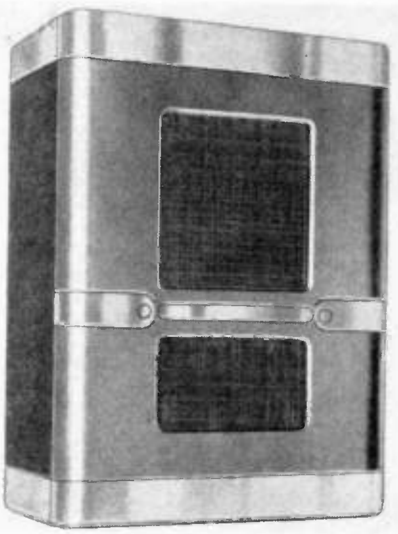
In order to achieve "true" reproduction of sound (music, voice and signals), the loudspeaker should theoretically be capable of reproducing frequencies from 30 to 15,000 cycles. In the reproduction of these frequencies, it is essential that for any given frequency, the amplitude of vibration of the air must be directly proportional to the current and for any given current input the amplitude must be independent of frequency. Loudspeakers are made in many diverse forms in order to satisfy these requirements, and in order to satisfy varying requirements of efficiency and power handling capacity. The loudspeakers in widest use today are of two general types: (a) Cone type speakers employing moving coil driver units and (b) Metal type exponential trumpets.

Regardless of the specific type of loudspeaker, it can be generally said that it consists of three main parts: (a) the driver unit which translates the varying audio currents and voltages into mechanical vibrations, (b) the coupling unit which comples the driver unit to air and which by its mechanical variations causes the movement of air molecules, and (c) the baffle or trumpet which controls the frequency response.

Moving Coil Speakers

The most widely employed driver unit is the moving coil type in which a light coil of wire called the voice coil is suspended and moves back and forth in the annular magnetic field between two concentric magnetic poles.

When a potential is applied to the coil the resulting current creates a magnetic flux in and around the coil at right angles to the flux of the magnet. This action of the two fields produces a force which causes the voice coil to move, the direction and force of movement being determined by the direction and magnitude of the current which is flowing.



Peri-dynamic loudspeaker with Jensen Bass Reflex principle speaker enclosed; suitable for home entertainment, auditorium and public address applications where quality is paramount.

The magnet may be of the permanent or of the electro-magnetic type. The coil around the electromagnet is commonly referred to as the field coil and may be polarized by a 110 volt d.c. source, by batteries, a copper oxide rectifier or a rectified a.c. supply. Quite often, the filter choke in an amplifier rectifier circuit is employed to obtain the necessary d.c. field.

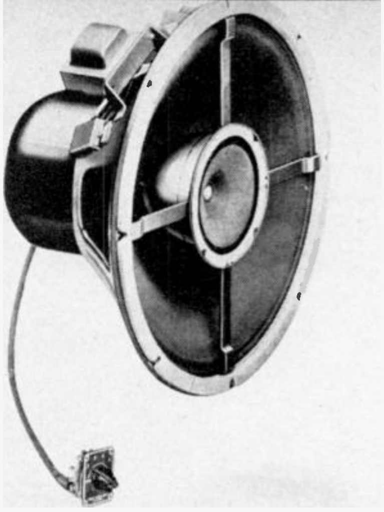
Humbucking coils, or shading rings, are frequently used in electromagnetic speaker circuits to reduce hum. The humbucking coil is so located in the dynamic unit that it produces an E M F which prevents any change in magnitude or direction of the stationary d.c. field.

The shading ring is composed of copper rings mounted on the field coil, and acts as a shorted turn to any a.c. which may be present in the d.c. field.

A Design of Paper Diaphragms

The popular cone type speaker consists of a moving coil type driver of the permanent magnet or electrodynamic types described above to which a paper diaphragm of conical shape is directly connected. The cone is generally ribbed and this ribbing serves a most important function. It permits free action at high frequencies for at low frequencies the cone acts as a plunger and the whole cone vibrates whereas at high frequencies only the center portion of the cone vibrates.

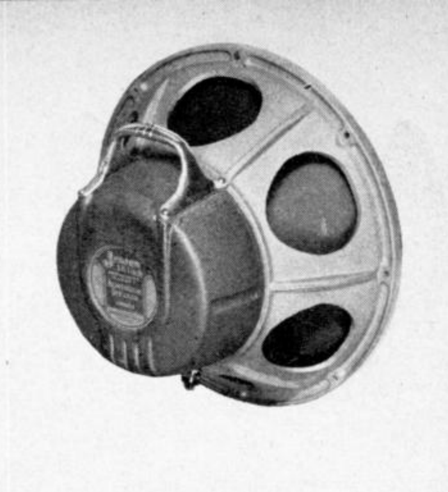
Use of a neon stroboscope to "stop" the movement of the cone will demonstrate this fact, and as a matter of fact, the neon stroboscope is often used to determine which portion of the cone should be ribbed. When "stopping" the movement of the cone it will be seen that only a portion of the cone moves at high frequencies and by ribbing that section and thereby facilitating move-



Coaxial loudspeaker for extended-range such as with F.M. receivers. Operates at relatively low level where quality of performance, rather than power of output is required. Has built-in frequency dividing network. The remote-controlled high-frequency attenuator shows at lower left.

Projector with driver unit and stand. Used for general sound reenforcement work where principle requirement is good speech reproduction. Horn is the re-entrant type.

Above photos courtesy of Jensen Radio Mfg. Co.



Auditorium speakers are general purpose units, respected for high quality reproduction. Recommended for use where source is free from distortion. Particularly good for voice reproduction although bass response has not been sacrificed.

ment, the load of that portion of the cone which does not move is removed. The frequency at which the speaker is resonant and far most efficient, is dependent upon the ribbing.

Speaker Output Efficiency

Cone speakers of the moving coil type are of extremely low efficiency. The average 8" speakers are 5% to 7% efficient at best. Efficiency is simply the ratio of the useful acoustic energy output to the signal energy input. For example, a speaker with an efficiency of 5% would provide ½ watt of sound energy when fed with 10 watts of electrical energy. "Absolute" efficiency is the ratio of the useful acoustic energy output of the loudspeaker to the signal energy an ideal load would absorb from the source signal. Absolute efficiency is, of course, the more true picture of efficiency since it considers the particular speaker's ability or inability to absorb energy from the source. Manufacturers sometimes claim higher efficiencies than the ratio of energy absorbed by ideal load to useful output would reveal. These higher ratings result from the inclusion of all diaphragm, air, hysteresis and eddy current losses, which can hardly be considered "useful" energy under truly scientific standards. In this connection it is advisable that the prospective user of a speaker be conversant with the types of measurements made by manufacturers so that an effective evaluation of the specifications can be made, and a careful judgment be exercised.

Sound Output Curves

Sound output curves are usually made by measuring the output at the point of axis. When loudspeakers are under actual working conditions, however, the high frequency response depends upon the room conditions, the number and type of reflecting surfaces, the listener's proximity to these surfaces, the listener's position in relation to the speaker, etc. In this connection it is always most advisable to make reference to polar curves, such as was illustrated as *Fig. 1 in Part* . of this article. These are curves obtained from a series of response curves taken at a number of angles off the axis. The frequency response at anl angle off the axis can be read directly from the polar curve.

For example, it can be seen that at 30° off the axis, the 1000 cycle response has fallen 50% and at 60° it has fallen approximately 90%. This is, of course, an example only of a hypothetical speaker, but it amply demonstrates the curve value.

Phase Cancellation Baffles

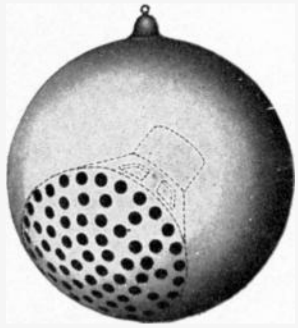
The low frequency response is dependent, to a very large degree, on the type of baffle employed. Since low frequencies tend to diffuse, they radiate from the front of the cone to the rear, and there phase relationship results in cancellation of the low frequencies. To prevent this cancellation, a baffle is provided to extend the effective sound path from the front to the rear of the cone. A good practical method for calculatingthe required size of a baffle in order to achieve a desired bass (low frequency) response is shown in the formula:

Baffle length in feet = ½ wavelength of the lowest frequency to be reproduced without cancellation.

The formula for wavelength is, of course:

$$\text{Wavelength in feet} = \frac{\text{velocity}}{\text{frequency}}$$

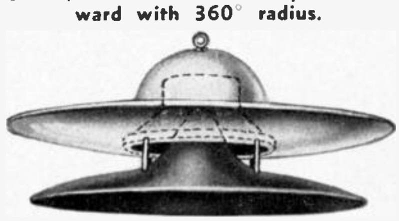
Let us assume that the lowest frequency desired is 100 cycles. At



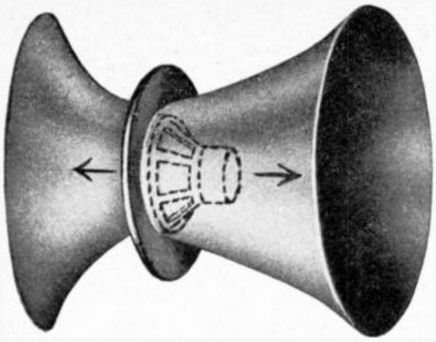
Ball Cone Speaker for use where directional sound is required and where the standard type of cone projections clash with surrounding furnishings. Projects beam at 45° angle.

Racon Paging Horn—Extremely efficient 2-foot trumpet for use where highly concentrated sound is required to override high noise level. Uses a P-M driving unit.

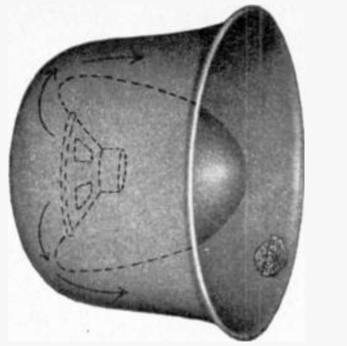
Radial Horn Speaker — a re-entrant type employing sound-reflection to foreshorten length of horn for given length of sound travel. Distributes sound, with even intensity, downward with 360° radius.



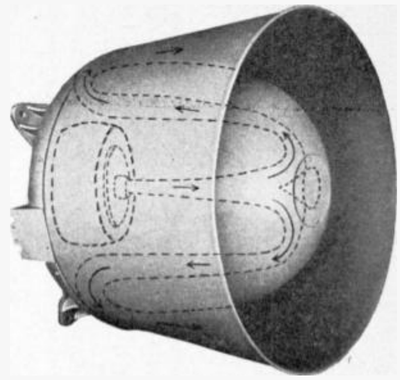
Radial Cone Speaker—a non-re-entrant type of loudspeaker affording 360° distribution. Decorative, excellent for low-ceilinged rooms.



2-way Cone Projector—a dual-direction loudspeaker, with sound projection in directions 180° apart. Both front and back waves of cone "motor" are utilized.



Marine Cone Speaker. This re-entrant type of loudspeaker is recommended for use under all weather, humidity or temperature conditions. The center-piece is of non-resonant material; horn of heavy gauge aluminum.



Marine Horn Speaker. This double re-entrant type, driven by a permanent magnet unit, handles up to 50 watts; can be used as mike and speaker.

0° C. the velocity of sound in dry air is approximately 1080 feet per second and the wavelength is:

$$W = \frac{1080}{100}$$

$$W = 10.8$$

The baffle length (BL = ½W) would therefore be 5.4 feet. This is the length in feet from the front of the cone to the rear, or in other words, it is the width of the baffle when the low cut-off is to be 100 cycles.

It is evident that loudspeakers which are mechanically vibrating systems having mass and spring forces, must vibrate most easily at some one frequency.

Some manufacturers offer tweeter combinations (small 3 or 4 inch speakers resonant from 3000 to 5000 cycles) in combination with woofers which are the larger 12 or 14 inch speakers, resonant at some lower frequency.

To eliminate the effects of mechanical resonance damping is necessary and this can be accomplished in a number of ways. In the next article the damping of resonant frequencies through constant voltage inverse feedback in the power amplifier will be carefully examined.

Exponential Horns and Trumpets

The most popular type of loudspeaker for outdoor use today is the metal, weatherproof exponential trumpet, employing a moving coil driver. The basic principle of this type of trumpet or horn is that the cross section area varies as an exponent of the length. Thus for every foot of length, the cross section area may double. If the throat of such a 4-foot trumpet were 2 square inches, the cross section area (the bell) at four feet would be 32 square inches. The ratio of expansion varies with different manufacturers of exponential trumpets. Some increase at a higher, others at a lower rate than the example.

The low frequency cut off of the exponential trumpet is a function of the taper or rate of expansion. The lower the rate of expansion, the lower the cut off frequency. If the cross section area of a given trumpet in length the low frequency cut off doubles with an increase of 8 inches will be approximately 115 cycles. Should the cross section area double with an increase of 4 inches in length, the cut off frequency would be 230 cycles.

The actual length of the horn is a determining factor in the elimination of mechanical resonance, rattling and vibration. If the diameter of the mouth or bell is approximately 1/4 to 1/5 of the wavelength corresponding to the cut off frequency, resonance will be reduced to a minimum.

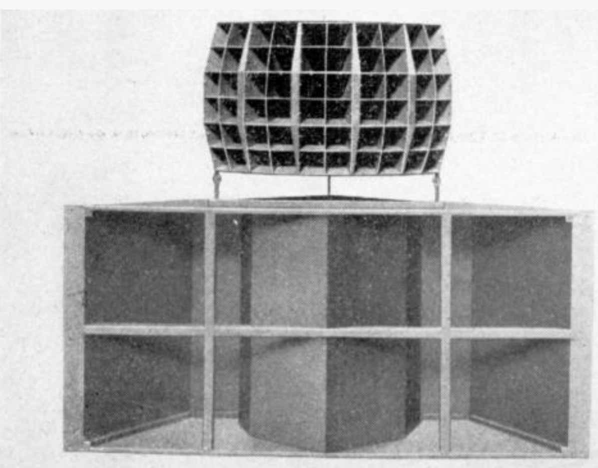
It is apparent, since cut off is a function of the exponential rate of expansion and resonance and response is a function of the length, that these two conditions must be considered jointly in the design or evaluation of the horn.

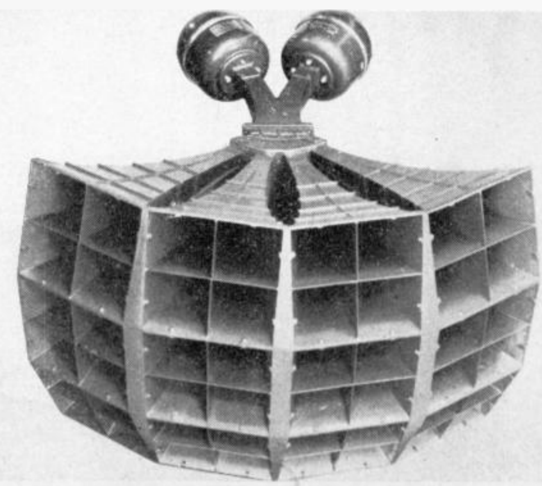
The principal advantages of the exponential trumpet over the older types of horn are its wider response, the more efficient coupling of the driver and air, the reduced distortion and the elimination of resonance. By this elimination, acoustic feedback conditions are reduced—resulting in broader applications and less troublesome installations.

Choosing Speaker Size

To obtain a cut off as low as 115 cycles with a minimum of resonance and distortion, it can be seen that the exponential trumpet would of necessity be quite long. For example, if it is desired to employ a horn with a cutoff at 115 cycles in conjunction with a driver unit having a ½ inch diameter opening, the related

Below—LEFT. A complete high-fidelity system. Used in theatres, and auditoriums like Madison Square Garden. Usually employed in multiples. RIGHT—a multi-cellular horn with 2 driver units. Used alone for voice reproduction only, or in a 2-way system to reproduce frequencies above 400 c.p.s. In latter case, extensive use is in high fidelity installations, such as auditoria, etc.





wavelength would be:

$$\frac{1080}{115} = 9.4 \text{ feet}$$

Dividing the wavelength by 4.5 to obtain the required diameter of the bell results in 2.1 feet or 25 inches. The area of the bell (πr^2) is 490.62 sq. in., the area of the throat is .2 square inches. With the first increase of 8 inches in length, the cross section area is .4 square inches. With the second increase of 8″ in length, the cross section area becomes 8 square inches. The third 8″ length increase results in a cross section area of 16 inches and so forth until a cross section area of 490.62 square inches is achieved. This can be determined as 108 inches in length . . . a nine foot trumpet.

Many methods for reducing the overall length of the exponential trumpet have been employed. Coiled, folded and divided trumpets were most common until a short few

A 9-unit Aeroplane Horn Speaker. A trumpet recommended for high-intensity, directional sound projection (up to 3 miles, ground). Weatherproof. Bell 30″ diameter, 54″ over-all length.

years ago when the reflex (or re-entrant) trumpet was developed. The reflex is an exponential horn, folded in upon itself in such manner that the acoustic chamber is reflexed and the overall length is greatly reduced while maintaining the acoustic length. A typical reflex trumpet of current manufacture compresses an acoustic length of 6 feet into an overall length of twenty-six inches.

The driver units employed with the exponential trumpets are moving coil dynamic units of special construction. They are extremely efficient compared with cone type units. Where a cone speaker employing the old type projector may be 10% to 15% efficient, the current reflexed exponentials are 30% to 50% efficient.

Speaker Transformers

In any amplifying system, the output and line matching transformers are of vital importance in relation to the speakers.

A good method for selecting an output transformer for transferring the power from the output stage to the line is to make certain that the inductive reactance ($X_L = 2\pi fL$) of the primary winding, when the secondary is unloaded, is at least five times the reflected load—at the lowest frequency to be amplified. The reflected load is obtained from the formula: $Z_{RL} = N^2 Z_{SL}$ where Z_{RL} is the reflected load, N^2 is the transformer turns ratio squared and Z_{SL} is the proper load on the secondary winding.

If X_L is lower than the value determined by the above procedure a loss of low frequency response will result. It is conceivable that such a condition might be desirable in some cases. This would be so when it is desired to deliberately attenuate a low frequency resonant speaker.

Transformer losses also affect the accuracy of the formula, $Z_{RL} = N^2 Z_{SL}$. If the resistance of the secondary winding is relatively high with respect to the secondary load, the value of Z_{RL} will be higher than calculated. Transformer magnetic core losses cause the reflected impedance to decrease from the calculated value. (Note:—The next article in this series will deal in detail with the relationship between the amplifier power stage and the output transformer.)

Multiple Speaker Problems

Amplifier systems generally involve the use of a number of speakers, each requiring different amounts of driving power, and in many cases, the speakers are located at considerable distances from the amplifier. When speaker lines are of short runs, it is satisfactory to run them at voice long lines must be run, and doing so at so low an impedance would result in power loss in the line. Running high-impedance lines would, of course, result in appreciable attenuation of high frequencies due to capacity effects of the line.

The best procedure is to run lines in the order of 200 to 600 ohms, and to use line-matching transformers at the speakers to properly load the line and to obtain the desired driving power in the various speakers. Practically all commercial amplifiers today employ output transformers with multi-tapped secondaries providing lines of 2, 4, 8, 15, 250, 500 and 1000 ohms to permit various arrangements of speaker circuits and practically all amplifiers are designed with inverse feedback circuits to provide good regulation, when speaker loads are varied.

In order to select the correct line matching transformer to transfer

(Continued on page 25)

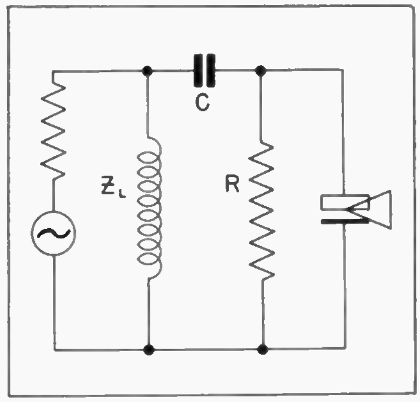


Fig. 1. Output Stage Employing Crystal Speaker—C prevents DC from effecting the crystal. Its capacitive reactance should be small enough at lowest frequency to be amplified, so there will be no a.c. drop across it.

Auditorium Horn Speaker—not re-entrant but a continuous horn 7 ft. long, in a space 21½ inches by 26½ inches by 23½ inches.

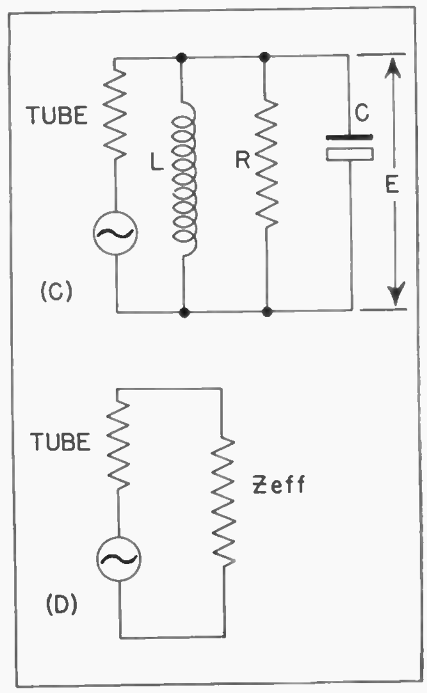


Fig. 2. Effective Circuits of Output Stage. Crystal has characteristics of condenser (C) L and C are sometimes resonated to improve crystal output at point of low efficiency.
Load on output tube (Zeff) varies with frequency; can be calculated by measuring L and C and computing Zeff including R.

TECHNICAL SERVICE PORTFOLIO

SECTION XXXII

OUTPUT INDICATORS

AND THEIR APPLICATIONS

★ Many of us are inclined to think of output indicators as being only those devices which we hook across some portion of the power output stage for aligning purposes. Modern output indicators appear in a wide variety of types and perform a number of functions in addition to their application in aligning. There are output indicators which connect into r-f and i-f sections of receivers under test, where they serve to indicate signal levels, or changes in signal levels, and thus help to localize the causes of fading, intermittent operation or noise, and other irregular manifestations in radio receiver performance. Apart from the radio servicing field, with which we are primarily concerned, various types of output indicators are also used in p.a. work, broadcasting and allied branches of radio.

Often devices which bear other names are employed as output indicators. Thus a vacuum-tube voltmeter may be used as an output indicator; so likewise the copper-oxide rectifier meter which forms the basis of many volt-ohmmeters. More modern output indicators are the r-f and a-f channels of the Chanalyst and other signal-tracing instruments. The tuning indicator tube used in many receivers serves as an excellent output indicator. The fundamental difference between a device which is purely an output indicator and other devices which may be used for the same purpose but which bear other names is that the output indicator, as such, needs to show only changes in signal strength—it need not be calibrated in volts, decibels, or any other units.

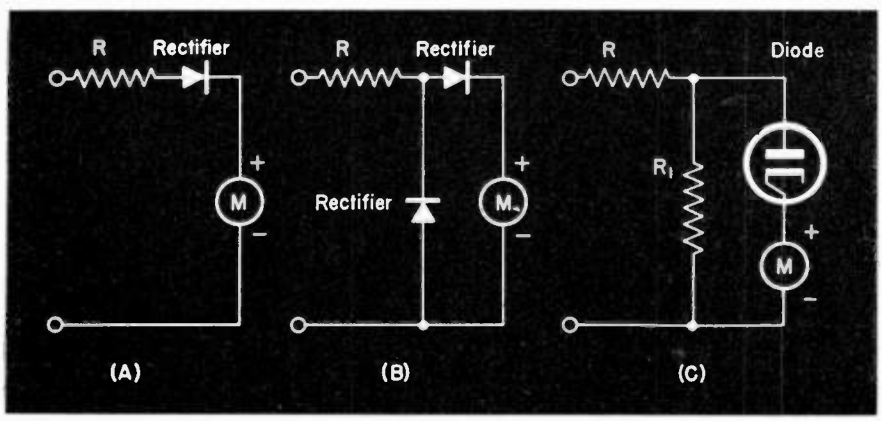


Fig. 1. In (A) is shown the simplest form of half-wave rectifier circuit. This circuit cannot be used when the circuit to which it is connected contains a blocking condenser. In (B) this limitation is overcome and improved rectification is secured. The diode circuit (C) is simple and efficient.

Rectifying the Signal

Because all output indicators function on signals while most indicating devices operate on d.c., it follows that some means of rectifying the signal is generally required. When the output indicator takes the form of a small lamp or neon bulb, of course no rectifier is required. But such indicators, which rely upon variations in brilliance to show relative signal levels, are not as satisfactory as other types. More often the indicating device is a d-c meter or a "magic eye" and, for such, a rectifier is required. The simplest type of rectifier circuit is the half-wave arrangement. Various circuits of this type are shown in *Fig. 1.*

In *Fig. 1A*, the rectifier may be a copper-oxide or crystal of the carborundum or silicon variety. The latter are seldom used. The rectifier functions because it passes current better in one direction than in the other. In a good rectifier, the resistance in the conducting direction will be from 25 to 50 times that in the reverse direction. Thus more current will pass through the meter in one direction than in the other and the pointer will deflect accordingly.

Low Resistance Section Checks

Because a closed metallic circuit is necessary for a d-c meter to show an indication, the circuit of *Fig. 1A* will not operate if a blocking condenser is used, as would normally be required when hooking up to the output tube plate for aligning purposes in order to prevent the high d-c voltage from likewise providing a reading. This circuit may only be used across such elements as power transformer secondaries, voice coils, and other parts which have low d-c resistance. When connected across a high resistance, the resistance adds to that already present in the output indicator circuit and thus reduces the meter reading.

The circuit of *Fig. 1B* is an improvement in that better rectification is obtained. In the forward direction current passes through the series rectifier and the meter; in the reverse direction the shunt rectifier forms a low-resistance path for most of the current and thus provides a better effective ratio of rectification. This is especially the case when the meter resistance is high compared to that of the rectifier in the conducting direction. Such a circuit is necessary when the series resistance is high. Under such conditions the ratio of the current flowing through the rectifier in the conducting direction to that flowing in the non-conducting direction is very small, because the change in resistance of the rectifier between the conducting and non-conducting directions causes but a small variation in total circuit resistance. Since a large ratio of change in circuit resistance between the non-conducting and conducting directions is necessary for good rectification, such as is provided by *Fig. 1B*—in which the resistor *R* is not effectively a part of the rectifier network — better operation is secured. Further, operation with a blocking condenser is possible.

In the half-wave circuit of *Fig. 1C*, some of the limitations of the preceding circuits are overcome. Because, unlike the copper-oxide rectifier, the diode has almost infinite resistance in the non-conducting direction, there is no need for the shunt rectifier, shown in *Fig. 1B*, to provide better rectification. By substituting a resistor *R1* in shunt with the diode, a return path for the rectified current is provided and the circuit may be used with a blocking condenser in series. This adapts it to output indicator applications where connections to points at high d-c potential are required.

Full Wave Circuits

The theoretical maximum indication provided by a d-c meter used with a perfect rectifier is 0.45 of the r.m.s. value of the voltage under test, assuming a sine waveform is present. Since the average copper-oxide meter rectifier is only about 80 to 82% efficient, the resulting indication is reduced to approximately 36% of the r.m.s. value when a half-wave rectifier is employed. By using full-wave circuits, as shown in *Fig. 2*, the resulting meter deflection for a given applied vo'tage is doubled. And, if diodes instead of copper-oxide rectifiers are emp'oyed, even greater efficiency results because of the greater rectification efficiency of the tube type of rectifier. However, the difference in efficiency is not sufficiently great to compensate for the far greater convenience and compactness provided by the copper-oxide type of rectifier, particularly in the applications under discussion.

In circuits where rectifiers are present, the need for a rectifier as a part of the output indicator circuit is obviated—we can use the rectifier already present in the circuit under test. This condition is met by the avc network which is generally present in modern receivers. Here the avc diode serves as the rectifier for th avc voltage. and anv suitable output indicator may be hooked across the avc system to show changes in avc voltage. Because the resistors in the avc network are generally very high in value, it is not practical to connect any but the most sensitive meters directly in the avc circuit, in order to indicate changes in avc voltages. However, it is possible to use an electronic voltmeter across such circuits; in fact, this instrument is practically ideal for the purpose.

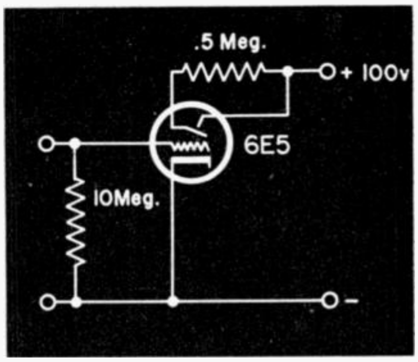


Fig. 3. The simple indicator tube circuit illustrated serves as an excellent output indicator when connected across an avc circuit and ground.

Tuning Indicators

The simplest output indicator device for use in avc networks is the tuning indicator shown in *Fig. 3*. This is adaptable to aligning and testing operations in precisely the same manner that it functions in its more common application as a tuning indicator. Instead of indicating when various stations are tuned in properly, in this application it is used to show when each circuit in the r-f, oscillator and i-f section of the receiver is properly tuned. This is done by connecting the indi-

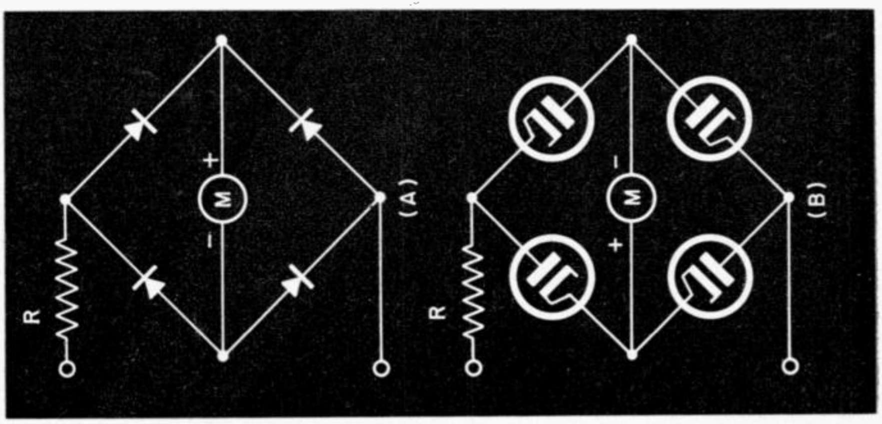


Fig. 2. The standard bridge-type rectifier circuit shown in (A) gives twice the sensitivity of the half-wave circuits shown in Fig. 1. Diode rectifiers may also be employed, as shown in (B), with excellent results.

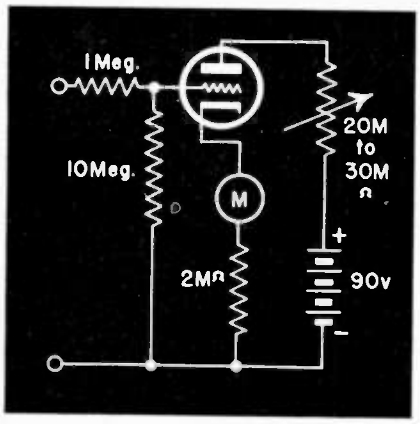


Fig. 4. This is a simplified version of an electronic voltmeter which can be hooked into any avc circuit for aligning purposes.

cator circuit input across any portion of the avc system, and ground, and then each circuit is adjusted in turn until maximum closure of the eye is obtained. The signal level is kept only sufficiently great as to provide an indication on the eye tube. Other operations in peaking the circuits are performed in precisely the same manner as in aligning with an audio output meter. The test signal need not be modulated; this is an advantage because many signal generators show a double peak on the signal when modulated, making proper alignment difficult.

The Electronic Voltmeter

In *Fig. 4* is the circuit of a typical electronic voltmeter, simplified to act as an output indicator. The 0-1 ma meter in the cathode circuit normally gives about half-scale deflection with no applied input voltage. When connected across a circuit in such polarity that the grid of the electronic voltmeter is made more negative with respect to ground, the meter reading decreases; if more positive, it increases. Thus, when connecting across ground and the high side of an avc bus in a receiver, the meter will deflect in a negative direction because the avc voltage is always negative. This type of indicator is more sensitive than an electronic eye and provides an ideal means of indicating proper alignment of circuits in a receiver.

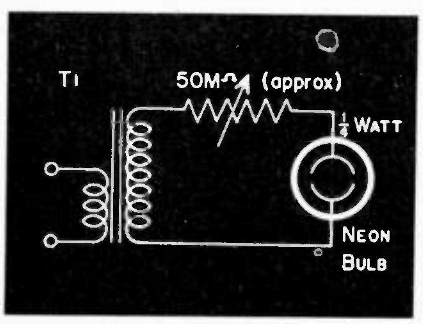


Fig. 5. A neon bulb and an old output transformer form the basis for this output indicator. The rheostat is adjusted until the neon tube just glows when a signal is fed to the receiver being aligned. Connection is made across the receiver voice coil.

There are times when a simple device is required for aligning which will not tie up any critical strategic materials, such as meters, rectifiers of the copper-oxide variety, or vacuum tubes. One instrument which meets these requirements is shown in schematic form in *Fig. 5*. The transformer, *T1*, may be any discarded output transformer whose windings are intact. The secondary is used as the primary for this application, and connects across the speaker voice coil of the receiver to be aligned. Across the normal plate winding of the transformer is connected a ¼-watt neon bulb. The transformer serves as a means of stepping up the signal voltage across the speaker voice coil to a value sufficient to actuate the neon tube. The adjustable rheostat in series with the neon bulb serves as a means of limiting the current through the bulb and of adjusting the brilliance while the receiver circuits are being pulled into alignment.

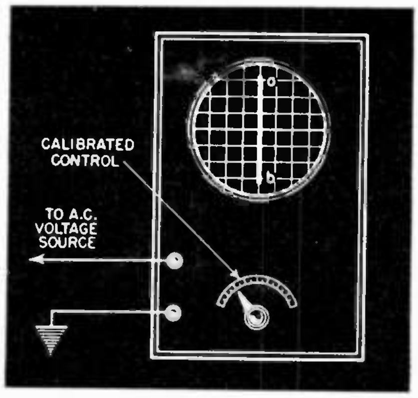


Fig. 6. The cathode-ray oscilloscope is an ideal output indicator. The vertical amplifier is connected to the circuit (preferably from grid to ground of an audio stage). The height of the image (A-B) increases as the tuned circuits are brought into alignment.

The C-R Oscilloscope

The output indicator de luxe is of course the cathode-ray oscilloscope. This is the only instrument which provides at once an indication of the waveform and amplitude of the signal wave. Although a 'scope is not calibrated to indicate the actual value of the voltage under test, this may be determined if desired by feeding various known voltages to the 'scope and calibrating the gain control in the manner indicated in the diagram, *Fig. 6*.

In broadcast studios, and often in p.a. systems, some means of monitoring the sound output level is required. The VU meter shown in schematic form in *Fig. 7* is one which is often employed in communication apparatus. The potentiometers *R2*, *R3* and *R4* are arranged in a constant-impedance network so that the load on the circuit to which the VU meter is connected remains constant. This is necessary in order that adjustment of the signal level fed to the meter will not change the volume level in the line to which it is connected. This is important because otherwise changes in the adjustment of the measuring device, such as switching from one scale to another, would cause a change in the volume level in the line.

For P.A. Use

In p.a. systems, less elaborate volume level indicators are satisfactory. Practically any of the copper-oxide voltmeters serves the purpose satisfactorily, though it is better to use a full-wave rectifier type. The half-wave rectifier lops off a portion of the positive half of the signal when connected across a high-impedance circuit, often causing noticeable distortion. The v-t voltmeter type of indicator is ideal for this sort of service because it places negligible load on the circuit under test.

The practice of monitoring r-f as well as a-f signal levels has developed during the past few years, as a result of the general adoption of signal-tracing instruments. Such instruments may be connected to r-f or i-f sections of intermittently operating receivers and will provide an instantaneous indication of any change in signal level in the circuit under test. This is particularly de-

$1.00 PAID FOR SHOP NOTES

Write up any "kinks" or "tricks-of-the-trade" in radio servicing that you have discovered. We will pay $1 in Defense Stamps for such previously unpublished "SHOP NOTES" found acceptable. Send your data to "Shop Notes Editor," RADIO SERVICE-DEALER, 132 W. 43rd St., New York City. Unused manuscripts cannot be returned unless accompanied with stamped and addressed return envelope.

sirable in many forms of intermittent troubles where the slight electrical disturbance resulting from the connecting of a lead or the touching of a test prod to the receiver is sufficient to restore operation, often for a considerable period. By continuously monitoring r-f, i-f, avc and audio circuits, a glance at each of the monitoring units when the set under test "cuts out" tells where the signal level has changed and thus provides a guide to the analysis and localization of the trouble.

A Simplified R-F/I-F Indicator

A simplified version of an r-f or i-f indicating device, along the lines of that used in some signal tracing instruments, is shown in *Fig. 8*. As

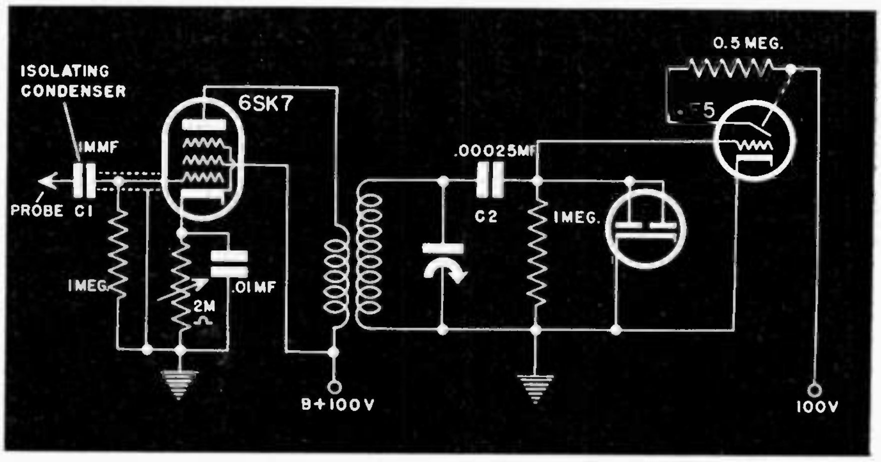


Fig. 8. The simplified RF-IF channel shown may be used for monitoring purposes in either r-f or i-f circuits when testing intermittents.

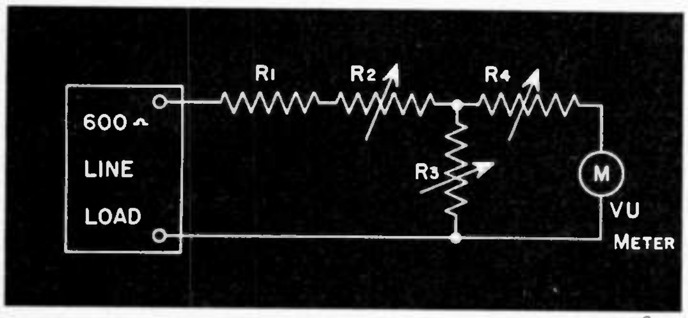


Fig. 7. For broadcast and p.a. work, the VU meter can be connected across an audio line and the level adjusted without disturbing the circuit, because of the constant-impedence network employed.

shown, this consists of a single-stage r-f amplifier feeding a diode detector and indicator tube. Connection to the receiver circuit is made through an isolating condenser, generally formed by simply spacing a terminal a fraction of an inch from the internal conductor of a shielded cable. The resulting capacity between the probe tip and the cable wire is very small—of the order of 1 mmf., so that the detuning effect on the circuit to which the probe is connected is negligible. This feature is obtained at the sacrifice of sensitivity, since only a small portion (about 1/100th or less) of the signal voltage at the prod reaches the grid of the amplifier tube. As a result, the signal in the circuit under test must be pretty strong, or there must be considerable amplification of the signal in the signal tracing instrument, if a satisfactory indication is to be obtained. In the circuit shown in *Fig. 8*, the signal stage amplifier will provide sufficient gain to check a signal level in i-f stages, but will not be enough to detect any but the most powerful r-f signals. In commercial signal tracing instruments, a three-stage high-gain amplifier is generally used, permitting closure of the indicator eye for signal levels of about 5 millivolts. A range of operation of from 90 to 1600 kc is obtained, in three frequency bands. The sensitivity of the amplifier is controlled by means of a rheostat, as shown, in the cathode circuit.

Checking Audio Stages

For audio stages, and for use as an indicator in p.a. systems and the like, the indicating device shown in schematic form in *Fig. 9* is recommended. This is along the lines of the audio channels used in signal-tracing apparatus. Here the audio signal is fed directly to the 6SQ7 high-mu triode amplifier, thence to the rectifier diodes of the same tube. The resulting rectified voltage is applied to the 6E5 indicator-eye grid. This type of audio channel is sufficiently sensitive to provide full closure of the channel eye for an input signal of approximately 0.1 volt, rms. Connection is made directly to the circuit under test, since there is no need for the small probe condenser in a-f circuits because such circuits are not tuned.

Let us consider some typical applications where several output indicators are used to detect intermittent noise, fading, or inconsistent operation. We know that any effort to check the receiver in the usual manner as soon as the trouble appears is likely to cause the set to commence performing normally, a

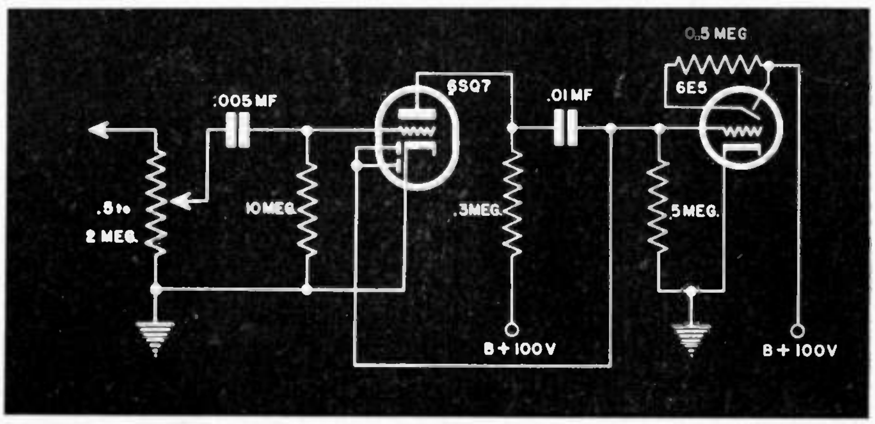


Fig. 9. This AF channel circuit, used in signal tracers, may be used either for aligning or monitoring purposes. It is a valuable adjunct for checking intermittents.

condition which may last for hours or even days before the trouble again shows up. When we have several instruments connected into key circuits, however, the danger of upsetting the circuits by the minute shock excitation induced when a test prod is touched to a critical point is at once eliminated.

For example, in the typical receiver circuit of *Fig. 10*, the numbered points in the circuit represent places where output indicators, or voltmeters (in some instances), may be connected to monitor the receiver performance. Thus, if we couple loosely to the receiver loop a lead from our test oscillator and thereby feed a signal into the receiver at *point 1*, we should be able to pick up the same signal at the various other points numbered on the diagram. After passing through the r-f amplifier, the signal will be stronger at *point 12* than at *point 1*. Because of the conversion gain contributed by the 12SA7, the signal level at *point 7* will be much greater than at *point 2*. At *point 3*, the signal will have substantially the same strength as at *point 7*. At *point 8*, there will be the gain of the i-f stage to amplify further the i-f signal. At *point 4*, there will be little i-f signal present, because it will have been bypassed by *C10*—this point is used to check the avc voltage. At *point 9*, the audio voltage is initially checked, and appears again, much amplified, at *points 10* and *5*, to which any audio

This country needs servicemen for servicemen, with the parts situation as it is.

★

output indicator of the high impedance type may be connected. For the purpose of checking intermittent performance, the loudspeaker itself serves as a perfectly good indicator of conditions in the output stage, and thereby obviates the need for an instrument to monitor this stage.

It is not necessary to connect an indicator at each of the enumerated points, although the more indicators which are connected in to the circuits the more closely the trouble may be localized when it appears. Let us assume that we connect an r-f indicator, such as that illustrated in *Fig. 8*, to *point 3*. Here it will indicate the signal level after the signal has been amplified by the r-f stage and the converter. If any trouble appears in the receiver which affects the operation of this small section of the receiver, the indicator will register this change. For example, if the cause of intermittent operation were an intermittent coupling condenser *C13*—not at all improbable, by the way, as most of us realize—the output signal level indicated by the speaker would drop, but the signal level at *point 3*, where we have our indicator hooked on, would remain the same. Thus we know at once that none of the circuits ahead of the point to which we are connected is, under such circumstances, at fault.

Checking the Power Source

Suppose, though, the trouble were an intermittently operating electrolytic in the power supply circuit. Because the power supply is common to the r-f, i-f and a-f circuits, any trouble which originates in it will be reflected in sub-normal performance of every section of the receiver. Then it would not make any difference how many indicators we had connected along the signal-carrying circuits—we could never localize the cause. But if, in addition, we hook

(Continued on page 26)

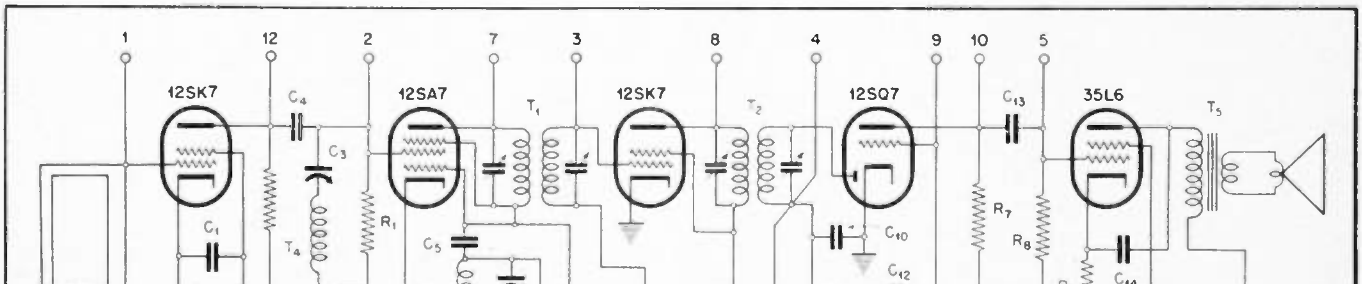


Fig. 10. In this typical receiver circuit, points of connection when monitoring intermittents are numbered. The return connection is made to the receiver chassis. Selection of test points is discussed in the text.

RADIO SERVICE ENGINEERING

Part 2 • by Harold Davis •

This is the second in a series of articles in which Mr. Davis illustrates how fundamental radio formulas may be applied to everyday radio service problems.

DUE to the difficulty in obtaining replacement tubes, the importance of being able to calculate the resistance and "wattage" (watts power) of filament dropping resistors is accentuated. Few of the 12-volt series of tubes are available, making it necessary to substitute similar types of the 6-volt line. As these tubes are almost invariably in a series-connected filament circuit, and because the 12-volt tube group draws only half the current of the 6-volt types, substitution of them constitutes quite a problem.

The first consideration is that current flowing in a series circuit is the same in all portions. Accordingly, a 6-volt tube drawing 0.300-amp. cannot be placed in a circuit with 12-volt tubes drawing only 0.150-amp. That is they cannot be employed without a little circuit tinkering.

Practical Examples

Most of the small sets using 12-volt tubes utilize the common 5-tube circuit, consisting of a converter, i.f., and 2nd-detector—1st audio, all 12-volt types. The other two tubes are usually a 35L6 and a 35Z5, both with 35-volt heaters. All these tubes draw 0.150-amp.

We will assume that the 12SQ7 is defective, and that it is to be replaced with a 6SQ7 drawing 0.300-amp. It will be necessary to raise the entire network to one drawing 0.300-amp. This can be done by connecting the other two 12-volt tubes in parallel, after which the two 35-volt tubes are connected in parallel. This doubles the current drain but cuts the voltage drop in half. The total drop is now 35 plus 12 plus 6 or 53 volts (*Fig. 1*), leaving 62 (115 — 53 = 62) volts to be dropped with a resistance line cord. The value of this cord can be found by substituting in the formula,

R = (E/I)
R = (62/0.300)
R = (620/3) multiply both figures by 10 to remove decimal
R = 206 ohms, approx.

A standard 200-ohm cord would be satisfactory.

(Note. — The author has chosen 115 V. as the line potential, in his formulas, rather than the generally accepted value of 117 volts. The serviceman, however, should make certain of his line voltage before applying these formulas. Also, the more convenient figures of 6 V. and 12 V., for heater ratings, have been utilized, and help simplify calculations. In practice, however, the actual ratings of 6.3 V. and 12.6 V., respectively, must be used.—*Editor*)

Should the set have four 12-volt tubes, the solution would be to change two of them to 6-volt types, connecting the other two in parallel as well as the 35-volt output and rectifier tubes.

Should one of the 35-volt tubes require replacement, the procedure would be to change both of them to the 25-volt types (25Z5 and 43) in series operation. The heaters of two of the 12-volt tubes must be paralleled to raise the current drain and the third must be replaced with a 6-volt 0.300-amp. type. This will raise the entire network to a 0.300-amp. circuit with a voltage drop of 25 plus 25 plus 12 plus 6 or 68 volts. This will leave 43 volts to be dropped across the line cord (115 — 68, see *Fig. 2*). The value of this resistance line cord can be found by formula as above and will be approx. 143 ohms.

In this case provision for pilot lights must be made, as they are

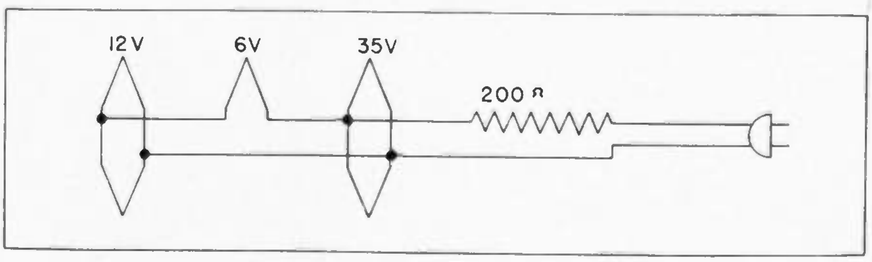


Fig. 1. When a 12-volt tube is replaced by a 6-volt tube, a 200-ohm resistor is required to achieve a 62 volt drop. The method of computing the resistor value is described in the text.

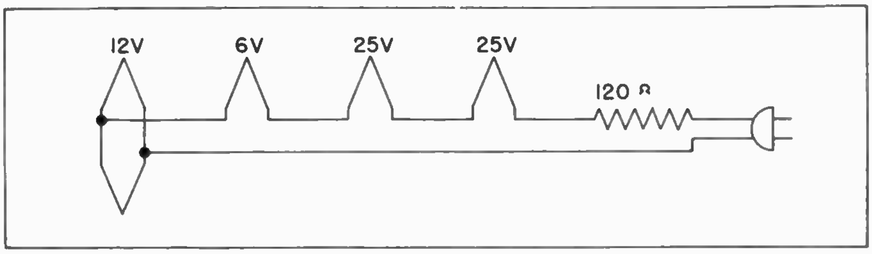


Fig. 2. Two 25-volt tubes are sometimes used to substitute for one drawing 35 volts. In revising the circuit the proper voltage drop must be computed to compensate for the different values.

usually operated from a tap on the 35Z5. If two brown-bead lamps are used in series, a very convenient way of connecting them is to leave the three 12-volt tubes in the set, connect two in parallel and connect the two pilot lamps across the third (*Fig. 3*).

The total heater drop is now 75.2 volts, and the line cord resistance would figure approximately 135 ohms, which is a standard-value cord.

Should no provision for pilot lamps be necessary the third 12-volt tube could still be used and the current drain raised by connecting a shunt resistor across the heater, the value of which can be found by the formula,

$R = E/I$

where E is the 12.6 V. heater and I is 0.150-amp. heater current.

$R = 12.6/0.15$

$R = 1260/15$

$R = 84$ ohms.

The formula for this shunt resistor where the answer is not obvious is,

$$\text{Heater shunt resistor} = \frac{\text{Heater Voltage}}{\text{Current desired} - \text{Heater current.}}$$

Example: To raise the current drain on a 70L7GT from 0.150- to 0.300-amp., so as to replace a 32L7GT, would require a shunt resistor across the heaters of,

$$\text{Shunt} = \frac{70}{0.300 - 0.150} = \frac{70}{0.150} = 465 \text{ ohms}$$

Substitution of tubes will often upset pilot lamp circuits, and it will be well for the serviceman to learn to design circuits to replace these. There are several simple ways of lighting pilot lamps. If the lamp draws the same current as the tubes, it may be used in series with them. The brown-bead lamps draw 0.150-amp. and the blue beads 0.250. Substitution in the above formula will give the resistor value required across this lamp in order to use it in series with 0.300-amp. tubes. In this case the resistor value will be 120 ohms.

The watts rating of this resistor can be found from the formula,

$W = I^2R$ (I in amperes)

$W = 0.05 \times 0.05 \times 120$ (The current drain through the resistor is only 0.05-amp.)

$W = 0.0025 \times 120 = .3$-watt

or, if the decimal is to be removed, the following formula,

$$W = \frac{I^2R}{1{,}000{,}000} \text{ (I in milliamperes)}$$

$$W = \frac{50 \times 50 \times 120}{1{,}000{,}000} = \frac{300{,}000}{1{,}000{,}000} = 0.3\text{-watt}$$

Connecting pilot lamps in series with tube heaters is not good practice because the lamps heat quicker than the tube heaters and will "flare up" when the set is first turned on. This surge causes short lamp life,

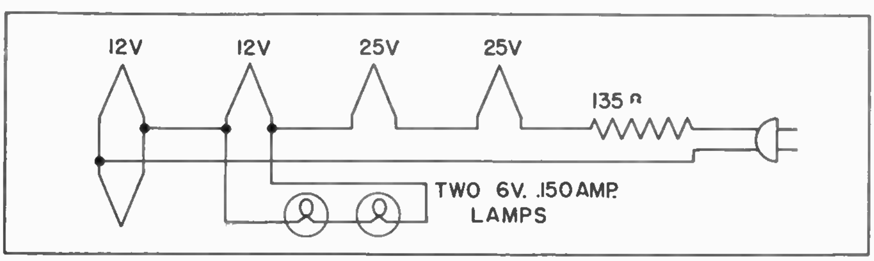


Fig. 3. Pilot lamps act as resistors. In this particular circuit 2 are used in series to draw the equivalent current of a 12-volt tube which has been omitted in modifying the circuit.

and when the lamp burns out, the filament circuit is broken.

A better way is to insert a resistor in series with the filaments and shunt the pilot lamp across it. The size of this resistor can be found by substituting in the following formula:

$R = E/I$, where E is the lamp voltage and I is the current drain of the series circuit.

To light two brown-bead, 0.150-amp. lamps connected in series would require a drop of 12 volts. This could be developed across a resistor of 40 ohms connected in series in a 0.300-amp. network, calculated as follows:

$R = 12/0.300$

$R = 120/3$

$R = 40$ ohms.

The lamps will not burn to full brilliancy, but will be satisfactory and will last much longer.

The voltage drop across the lamps when connected in series with the filaments, and the resistor when used to develop the voltage for the lamps, must be taken into consideration when calculating the size of the line cord.

The rating of the resistor in the above case is 3.6 watts, found by substituting in the formula, $W = I^2R$.

The ohms value of this resistor can always be up as much as 50% because the effective resistance is lowered by the shunt load of the lamp.

Condensers and Capacity

In general, the radio serviceman is required only to replace condensers of known characteristics. In some cases, however, he may be required to calculate capacity values and capacitative reactance.

The basic formula for finding capacitative reactance is:

$$Xc = \frac{1}{6.28 \times f \times c} \text{ where,}$$

Xc = reactance

f = frequency being used in *cycles*

c = size of condenser in *farads*.

To substitute everyday radio problems with this formula is difficult because we always work either with the microfarad (one-millionth of a farad), or the micromicrofarad (one-millionth of a microfarad).

If the circuit operates at radio frequency, the frequency will be expressed in kilocycles (a thousand cycles).

Fortunately, we have available formulas for finding Xc that permit the use of microfarads and kilocycles directly. They are as follows:

$$Xc = \frac{159{,}000}{f \times c}, \text{ where,}$$

f = frequency in cycles
c = capacity in *microfarads*.

This is an ideal formula for working with audio frequencies. If the frequency is in kilocycles the following formula is better:

$$Xc = \frac{159}{f \times c}, \text{ where}$$

f = frequency in kilocycles
c = capacity in microfarads.

When the reactance (capacitative) of a condenser at a given frequency has been found, the figure may be substituted directly in Ohm's Law formulas as though it were resistance.

The most popular transposition of the above formula is the one which permits solving for C. It is,

$$C = \frac{159{,}000}{f \times Xc}, \text{ where,}$$

f = frequency in cycles
Xc = capacitative reactance of the desired condenser.

With the exception of tuning condensers, those encountered by the serviceman have one function: to pass only alternating current. All coupling, bypass, bias, and decoupling condensers perform this function. The size of these condensers may not be critical, and variations up to nearly 10 times recommended values may in some cases be tolerated.

The minimum size of a coupling condenser has been reached when excessive low-frequency attenuation is encountered. This figure is arrived at by the acoustical limitations of the speaker and baffle. For example, it is of little use to pass frequencies below 150 cycles to a loudspeaker that will not reproduce them, and to do so simply uses up an appreciable amount of the output tube's power capability, for which nothing useful is received in return.

Coupling condensers which are larger than necessary can also cause momentary blocking.

Following is a table showing the proper capacity value to be used with a series of popular-size grid resistors, for *high-fidelity reproduction.*

Grid Resistor	Xc
10,000	5,000
50,000	25,000
100,000	50,000
250,000	125,000
500,000	250,000
1,000,000	500,000

From this it can be seen that for high-fidelity reproduction the capacitative reactance of the coupling condenser should be approx. one-half the resistance of the grid resistor. High fidelity is based on the assumption that the reproduction of all frequencies from 12.5 to 10,000 cycles-per-second is the same. Few circuits are required to reproduce frequencies as low as 12.5 cycles, and accordingly coupling condensers having smaller capacity values (and greater reactance) can be used.

To determine what value of condenser would be used with a 500,000-ohm grid resistor, the formula given above could be transposed to solve for capacity instead of reactance. The reactance given in the table is substituted in the formula as follows:

$$C = \frac{159{,}000}{f \times Xc}$$

$$C = \frac{159{,}000}{12.5 \times 250{,}000}$$

$$C = \frac{159}{12.5 \times 250} \text{ or 0.05-mf.}$$

As previously stated, this value is for high fidelity only. Should the coupling condenser be for a small set capable of passing no frequencies lower than 100 cycles, the size of the condenser would be found as follows:

$$C = \frac{159{,}000}{100 \times 250{,}000}$$

$$C = \frac{159}{100 \times 250}$$

$$C = \frac{159}{25{,}000} \text{ or 0.006-mf. (approx.)}$$

Following the same procedure, coupling condensers for use with any size grid resistor and to pass any desired frequencies can be found.

Bypass Condensers

Condensers placed in shunt with bias resistors should be much lower in reactance at the lowest frequency expected to be passed, than the resistance of the resistor. In other words, the lower the bias resistor value, the higher must be the bias condenser capacity. A triode requiring a low-value bias resistor will require a high-value condenser in shunt to it. Reactance varies with frequency and capacity.

Suppose a pair of 6F6s in push-pull are biased by a 200-ohm resistor. What size condenser should be used as a bypass if frequencies of 50 cycles and above are to be transmitted to the speaker?

Assuming a condenser whose reactance is 1/5 that of the resistor, is satisfactory, we must find the value of a condenser whose reactance at 50 cycles is 40 ohms.

$$C = \frac{159{,}000}{50 \times 40}$$

$$C = \frac{159{,}000}{2{,}000}$$

$$C = \frac{159}{2}$$

C = 75 mf., approx.

Actually, a 50-mf. condenser is commonly used, as the frequency most manufacturers "shoot at" is seldom as low as 50 cycles.

Bypass condensers should be many times lower in reactance than the circuits they bypass. Most bypass condensers, other than those in cathode circuits, are used in r.f. circuits where the frequency is expressed in kilocycles, and to find these values the formula used is,

$$C = \frac{159}{F \times Xc}$$

The reactance of a condenser at radio frequencies is surprisingly low. The reactance of a 0.1-mf. unit at 550 kc., the lowest broadcast frequency is,

$$Xc = \frac{159}{550 \times .1}$$

$$Xc = \frac{159}{55} = 2.8 \text{ ohms, approx.}$$

Solving for Frequency

Another transposition of the reactance formula permits the serviceman to check the manufacturer of well-designed sets and see what minimum frequency the instrument will pass.

This formula solves for frequency as follows:

A receiver using a 250,000-ohm grid resistor and a 0.005-mf. coupling condenser was designed to transmit evenly, frequencies as low

"My assistant is just a little new at this business!"

$$F = \frac{159{,}000}{C \times Xc}$$

$$F = \frac{159{,}000}{.005 \times 125{,}000}$$

$$F = \frac{159{,}000}{.625} = 250 \text{ cycles, approx.}$$

The figure 125,000 is obtained from the table showing Xc values for given grid resistors.

It might be well to mention that in all problems given in this series, the "low frequency" mentioned is not to be taken as absolutely the lowest frequency the set will pass. It means the lowest frequency that can be passed before attenuation begins. However, these formulas are figured on a basis of only 1 db. loss at that particular low frequency, and attenuation much greater than this is permissible without seriously affecting the reproduction of the set. Low-frequency attenuation is greatly compensated for in most sets by the tone control.

Inductance

There are very few problems relating to inductance that are practical for the radio serviceman. Even if he knew the required inductance of an r.f. coil it would be far too complicated to attempt to interpret this figure in terms of number of turns, or any other simple term that we could put to work (Do our readers agree with Mr. Davis's opinion? — *Editor*). An R.F. coil is not marked in terms of inductance (chokes excepted) or number of turns. An i.f. coil is marked simply for the band it is to cover. They are carefully engineered with far too many factors involved to permit any simple formula for their calculation.

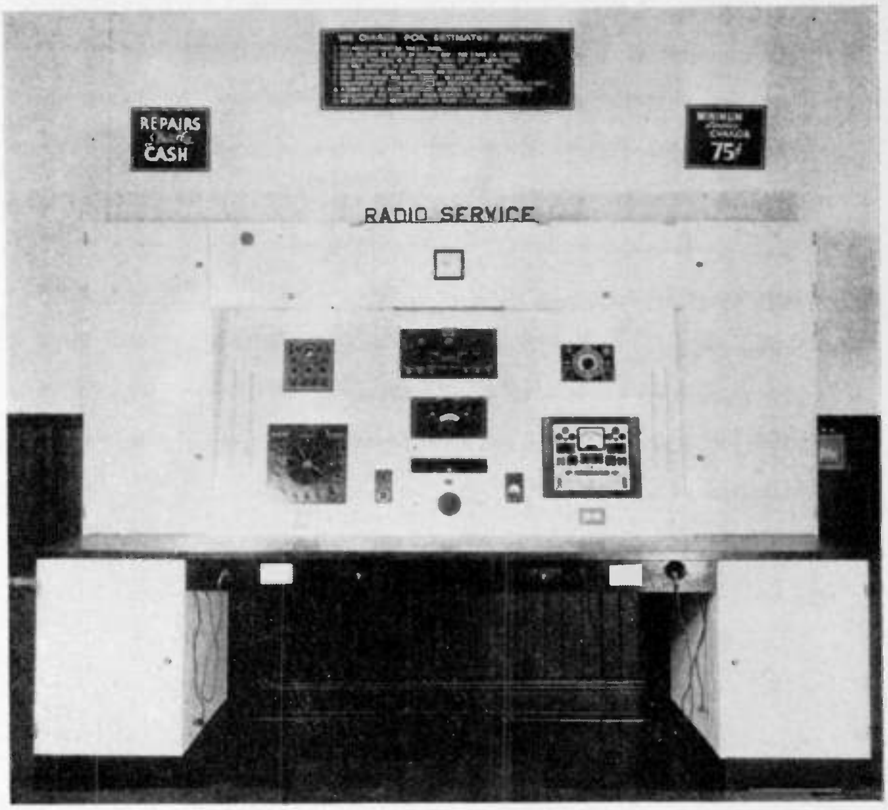
However, this article would not be complete without at least touching on the subject.

The formula for inductive reactance is,

$X_L = 2\pi FL$, where
X_L = inductive reactance
2π = 6.28 (a factor)
f = frequency in cycles
L = inductance in henries

As can be seen, the inductive reactance varies directly with frequency or inductance. Inductive reactance can be substituted directly in Ohm's Law the same as capacitative reactance. The difference between the two is that current through a condenser leads the voltage by 90 degrees, while through an inductance it lags the voltage by 90 degrees. Accordingly the use of inductance and capacity in the proper

(Continued on page 26)



NEW BENCH SET-UP

HAS UTILITY AND APPEAL

From Q. Jenia, proprietor of Range Electric & Radio Co., Virginia, Minn., comes an interesting photograph of the new service bench now installed and being used at capacity.

Says Mr. Jenia, "If told about it, some other servicemen may want to lineup something similar." He continues, "You will notice that our equipment is on a sloping panel, with a fluorescent fixture in the canopy under the clock. The equipment consists of a one-inch oscillograph, below it, a universal speaker; top center, oscillator and wobbulator; below that, a point-to-point tester; and immediately under the tester, there is a little drawer which houses a signal tracer and unit with the amplifier speaker just below it. On each side of this unit you will see a meter type output indicator on the right, and on the left a neon type output indicator; a capacity analyzer on the upper right hand side with an up-to-the-minute tube tester just below it.

"The two chrome bars you see on each side of the panel we use as a decoration, also as an aerial and ground connection. In the upper cabinets is housed a complete set of Rider manuals. The upper side cabinets house complete stocks of radio repair parts; the lower side cabinets house our heavier equipment such as electric drill, etc. If you will notice, on the front bench apron there are two round openings with drain tile directly in back, a convenient place for soldering irons when they are hot.

'This work bench was built with the idea in mind of conserving time. All equipment is centrally located so that two men can work conveniently without being in each other's way."

Thank you, Mr. Jenia. ED.

KEN-RAD STIMULATES PRODUCTION

Weekly awards for suggestions tending to increase production, eliminate waste, and promote a greater intensity in the war effort are given to employees of The Ken-Rad Tube & Lamp Corporation, Owensboro, Kentucky. Originators of accepted suggestions receive cash awards of from $2 to $25.

ANOTHER "E" STAR

Last month the Army-Navy award for continued excellence of production — a white star added to the "E" flag — was presented to the Emporium plants of Sylvania Electric Products, Inc., in token of 6 months of high-quality, high-quantity output of precision electronic devices for the armed forces.

Shop Notes

Data presented as "Shop Notes", contributed by service-dealers as a result of practical experience, is carefully considered before acceptance. We believe it correct but we assume no responsibility as to results.

Card 1

PHILCO MODEL 38-4

(Gain Data)

Tune receiver, Sig. Anal. and Sig. Gen. to 600 kc. Tune receiver for *peak* on Analyzer's indicator. Tuning condenser must be rocked for peak on all tests except for oscillator.

Ant.	through .01 mfd.	Condenser	1.0		600 KC
6K7G	RF amp.	grid	29.0		600 KC
6K7B		plate	82.0		600 KC
6A8G	osc. mod.	grid	27.0		600 KC
6A8G		plate	200.0	osc. freq.	1070 KC
6A8G		plate	540.0	IF freq.	470 KC
6K7G	IF amp.	grid	100.0		470 KC
		plate	8700.0		470 KC
6J5G	det.	grid	3500.0		470 KC
6J5G	AF amp.	plate	23.0	400 cps.	
6F6G	PPamp. plate to	plate	140.0	400 cps.	
AVC	at last IF return		12.5	volts DC	

Submitted by Robert Boudreaux

Card 2

ZENITH MODEL 9S262

(Gain Data)

Tune receiver, Sig. Anal. and Sig. Gen. to 600 kc. Receiver must be tuned for *dip* on indicator, and sensitivity control set on "distance" position. Rock tuning conds. for *dip* on all tests except oscillator.

Ant.	through .0002 mfd.	condenser	1.0		600 KC
6K7G	RF amp.	grid	4.8		600 KC
6K7G		plate	29.0		600 KC
6L7G	Mixer	grid	4.8		600 KC
6L7G		plate	240.0	osc. freq.	1056 KC
6L7G		plate	180.0	IF freq.	456 KC
6K7G	IF amp.	grid	100.0		456 KC
6K7G		plate	5550.0		456 KC
6H6G	diode	plate	2500.0		456 KC
6F5G	1st AF	plate	48.0	volt 400 cps.	
6F6G	output	grid	45.0		
6F6G		plate	125.0		
AVC	at diode return		13.0		

Submitted by Robert Boudreaux

Card 3

PHILCO MODEL 39-7

(Gain Data)

Tune receiver, Sig. Gen. and Sig. Anal. to 600 kc. Receiver must be tuned for *dip* on indicator, and sensitivity control set on "distance" position. Rock tuning conds. for *dip* on all tests except oscillator.

Ant.	through .0002 mfd.	condenser	1.0		600 KC
6A7	ocs. mod.	grid	4.5		600 KC
6A7		plate	100.0	osc. freq.	1070 KC
6A7		plate	84.0		470 KC
78	IF amp.	grid	13.0		470 KC
78		plate	700.0		470 KC
75	diode	plate	570.0		470 KC
75	triode	plate	10.0	volt 400 cps.	
41	output	grid	9.0		
41		plate	80.0		
AVC	at vol. cont.		5.0	volt DC	

Submitted by Robert Boudreax

Card 4

ZENITH 4K-600 (Chassis 4B01)

(Dead Receiver)

Frequently this model receiver will not operate after new tubes and batteries are installed. Check to see whether the old batteries have corroded the chassis, components or tube sockets as this is generally the cause of complaint. To remedy, apply carbon tetrachloride and then carefully sandpaper the battery contact points to remove all signs of corrosion. Do not use emery cloth.

Card 5

AIRLINE MODEL 5B17

(Gain Data)

Tune receiver, Sig. Anal. and Sig. Gen. to 600 kc. Receiver must be tuned for *dip* on indicator, and sensitivity control set on "distance" position. Rock tuning conds. for *dip* on all tests except oscillator.

Ant.	through .0002 mfd,	condenser	1.0		1000 KC
1A7GT	osc. mod.	grid	6.3		1000 KC
1A7GT		plate	93.0	osc. freq.	1456 KC
1A7GT		plate	25.0	IF freq.	456 KC
1N5GT	1st IF amp.	grid	5.0		456 KC
1N5GT		plate	55.0		456 KC
1N5GT	2nd	grid	44.0		456 KC
1N5GT		plate	2500.0		456 KC
1H5GT	diode	plate	1000.0		456 KC
1H5GT	triode	plate	11.0	400 cps.	
1A5GT	output	grid	9.0		
1A5GT		plate	65.0		
AVC	at diode return		4.2	DC	

Submitted by Robert Boudreaux

Card 6

ZENITH 6D410-411-413-414-425-426-427-446-455

(Whistle)

A high-pitched whistle is sometimes encountered in these bakelite chassis models. It is caused by an open circuit in condenser C3, mounted on the condenser gang. To remedy, replace the defective part with an 0.1 mfd, 200-volt condenser, Zenith part 22-190.

Another cause of audio oscillation and howl in these models is due to coupling between the audio output plate circuit and the diode load bypass condenser. To remedy, simply dress the 35L6 plate load (green wire) away from the diode load bypass condenser C6.

Card 7

SALVAGING TRANSFORMER WIRE

When replacing I.F. transformers save the old transformer's wire for potential future use. Boil the old unit in a mixture of bees wax and paraffin or bees wax alone for about 15 minutes. This cleans the wire. Then rewind it on fresh spool.

Submitted by J. E. Simmons

Card 8

SUBSTITUTES FOR G2,2S - G4,4S AND 2S/4S TUBES

Old Majestics used these tube types. If replacements cannot be obtained, change the socket and wire in a 117Z6. Results will be better than when original tubes were used.

Submitted by J. E. Simmons

Radio Mechanics

(*Continued from page 9*)

causes unsatisfactory adhesion to the metallic surfaces to which the solder is applied and which also inhibits smooth flowing of the solder. Zinc has a similar effect upon the flow of the solder, as does aluminum. Sometimes phosphorus is added, in very small quantities, to improve the flowing qualities of the solder.

Most solders used for radio are either the 50-50 or 60-40 variety. These figures refer to the relative percentages of tin and lead, in the order named. The solder containing 60% tin is most desirable because of its lower me'ting point. Still better is an alloy containing 66% and 34% lead. This has a slightly lower melting point and somewhat greater hardness, resulting in a better mechanical, as well as electrical, connection. The solders containing high percentages of lead and lower percentages of tin are largely used by plumbers for sweating joints, and are not desirable for radio work. For tinning wires, cable ends, etc., it is necessary to use pure tin for satisfactory results and this is the custom among all wire manufacturers.

A tabulation of lead-tin alloys used for soldering is shown in Table III.

TABLE III—LEAD-TIN ALLOYS FOR SOLDERING

PERCENTAGE Tin	PERCENTAGE Lead	HARDNESS (Brinell)	MELTING POINT (°F.)
0	100	3.9	619
10	90	10.1	577
20	80	12.1	532
30	70	14.5	491
40	60	15.8	446
50	50	15.0	401
60	40	14.6	368
66	34	16.7	356
70	30	15.8	365
80	20	15.2	388
90	10	13.3	419
100	0	4.1	450

Note that the melting point of the alloy of lead and tin is generally lower than that of either of the metals used individually; also note that the hardness and strength are greatly increased when these metals are alloyed.

For radio connections a resin flux is imperative. Most of the pastes on the market contain acid and will eventually cause corrosion, no matter how carefully the joint is cleaned after soldering. Even resin is, strictly speaking, somewhat corrosive. If it weren't, it wouldn't work. For the purpose of any flux is simply to clean the joint and to prevent oxides forming during the soldering process. To clean, the resin must be able to cut into any film which may be present on the metallic surfaces, and it is not possible to do this without, at the same time, affecting to some slight degree the underlying metallic surface. High-grade workmanship requires that each soldered joint using resin or other flux be cleaned with alcohol (*wood* alcohol, preferably—*Ed.*) after soldering and, to prevent any possible action of salt air on the junction of the dissimilar metals, it is desirable to cover the entire joint with a clear lacquer.

In Part II we plan to discuss, among other things, applications of silver soldering and similar operations in radio work.

NEXT MONTH

We will present Part 1 of a series of articles, by F. L. Sprayberry, which will simply and clearly describe a method of completely testing radio receivers without the use of meters.—ED.

BASICS OF SOUND

(Continued from page 13)

the desired speaker driving power from the line to the speaker, the following simple formula may be employed:

$$Z_{RL} = Z_L \left(\frac{p}{P} \right)$$

where Z_{RL} is the correct value of the reflected load on the primary of the matching transformer when the secondary is loaded with the specified voice coil impedance, Z_L is the impedance of the line (i.e., the value of the load necessary for most efficient transfer of power from the output transformer), P is the full rated output of the amplifier, and p is the desired driving power. Let us assume a 100-watt amplifier, from which it is desired to feed 10 watts into a given speaker.

If a 500-ohm line is to be run, the formula becomes:

$$Z_{RL} = 500 \left(\frac{100}{10} \right) = 5000 \text{ ohms}$$

Commercial line-matching transformers are available with tapped primaries, and most manufacturers employ labels which indicate the different values of the taps for different secondary loads. These transformers are constructed for various power-handling capacities.

360° radial cone projector, capable of variable angular forward projection, adjustable by means of movable acoustic disperser of non-resonant material.

Crystal Speakers

Another speaker which will shortly become very practical and will probably enjoy a wide popularity is the crystal type. This is a voltage-operated device requiring extremely little power. The circuit is shown as *Fig. 1*. Crystal speaker engineers are rapidly improving the response of the speakers which are naturally high pitched. See *Figs. 1* and *2*.

The Rochelle salts crystal transforms the electrical forces applied across the crystal by virtue of the signal voltages into mechanical energy which is the resultant sound power. This is the well known piezoelectric effect.

Output Indicators

(Continued from page 18)

on a voltmeter at the high "B" output of the power supply *(point 11)*, then any change in the output voltage of the power supply would be indicated by a change in meter reading. To be sure, the meter reading would also be affected should we have an intermittent short in any circuit connected to the power supply. But it would provide a fundamental indication that trouble was present in the voltage supply to the various stages, and would thus eliminate many of the components, such as coils, trimmers, etc., because the operation—or lack of it—of such items does not ordinarily affect the voltages.

Monitoring the AVC

A convenient point to monitor is the avc system, at *point 4*. In the absence of any r-f monitoring devices such as we have described, a simple magic eye connected at this point will serve as an excellent means of monitoring the entire r-f and i-f network. Any change in the monitored avc voltage, will indicate immediately that the trouble is of such nature that the r-f and i-f stages are affected. Of course, this is not a very definite localization of the trouble, but in combination with a voltmeter at the B plus point and the loudspeaker at the final stage output, we can, by a process of elimination, localize the trouble to one section of the receiver. For instance, if the voltmeter remains unchanged while the avc voltage decreases, we know that the trouble is in some component of the r-f, converter, or i-f section—or in one of the avc filter condensers—likewise not an uncommon trouble. If the avc voltage suddenly increases, this is most likely due to some defect in one of the components of the avc network, such as an intermittent resistor or condenser, whereby the avc bias voltage is not transmitted to one or more of the controlled tubes, so that the gain suddenly rises.

★

Radio Service Engineering

(Continued from page 22)

proportions will neutralize this effect, correcting the power factor.

The inductive reactance of a 30-henry choke at 60 cycles can be found as follows,

$X_L = 6.28 \times F \times L$
$X_L = 6.28 \times 60 \times 30$
$X_L = 6.28 \times 1800$
$X_L = 6.28 \times 18 = 11{,}200$ ohms.

At 25 cycles, this same choke would have a reactance of only

$X_L = 6.28 \times 25 \times 30$
$X_L = 6.28 \times 750$
$X_L = 4{,}710$ ohms.

While Xc, capacitative reactance, decreases with an increase in frequency, X_L, inductive reactance, increases. The reactance of a 100-millihenry choke at 1,000 kc is,

$X_L = 6.28 \times .1 \times 1{,}000{,}000$ (A millihenry is 1/1,000-henry. To convert millihenries to henries, point off three places to the left. Also kilocycles must be converted to cycles by multiplying by 1,000.)
$X_L = 6.28 \times 100{,}000$
$X_L = 628 \times 1{,}000 = 628{,}000$ ohms.

Should inductance be expressed in microhenries (one-millionth of a henry), and the frequency in megacycles, both figures may be used without reducing them to units.

The inductive reactance of a 200-microhenry choke at 1,000 kc is,

$X_L = 6.28 \times 1 \times 200$ (1,000 kc. = 1 megacycle)

$X_L = 6.28 \times 200$

$X_L = 628 \times 2 = 1{,}256$ ohms.

Combining Resistance and Inductive and Capacitative Reactance

When a circuit contains resistance and capacity or inductance, it is necessary to combine the two or three into a common unit in order to substitute the total reactance in the Ohm's Law formulas. This combined unit is called *impedance*. The formula for it is,

$Z = \sqrt{R^2 (Xc - X_L)^2}$, where

Z = Inductance

R = Resistance

Xc = Capacitative reactance as found in previous formulas

X_L = Inductive reactance as found previously.

This formula reflects the previous statement that Xc has a tendency to neutralize X_L and vice versa.

If either Xc or X_L is not present, the formula for impedance is,

$Z = \sqrt{R^2 + Xc^2}$, or

$Z = \sqrt{R^2 + X_L^2}$

As with Xc and X_L, Z may be substituted in Ohm's Law formulas.

The use of these formulas in radio service work is very limited and for that reason no details of their solution will be given. If the use of a sliderule has been mastered, these formulas are very simple.

★

BARRELS OF BLOOD

Radio is successfully waging its own brand of war, against the Axis, on the home front. The above photograph graphically illustrates the amount of blood already pledged by the people of one radio company alone, Crosley Radio Corp., Cincinnati, O.; and shows three of the reasons why Crosley's manpower shortage isn't too aggravated: Vera Mae Shulten, Eleanor Anderson and Eileen Cahall (left to right, perhaps—the company's publicity manager didn't state which).

"RADIARETTES" LEARN BASIC FACTS

According to David Grimes, vice-president in charge of engineering for Philco Corp., the company through its engineering and production departments is providing full scholarships (with pay) at Temple University to 60 high school and parochial school graduates from the Philadelphia area who, upon completion of the course, will be known as "Radiarettes" and serve as assistants to junior and senior engineers of the corporation.

This program has been entered upon in the belief that the average girl graduating from high school is, first of all, capable of learning the basic facts of radio; and, secondly, she is anxious to do her part in this all-out fight for victory.

Classes began June 15th, at Temple University and for a period of 50 weeks, 40 hours a week, to study mathematics, elementary electricity, radio, television, radio laboratory technique, electrical drafting, industrial orientation and production processes. At graduation the trainees will receive college credits for courses in science and mathematics.

The training program will continue regardless of the outcome of the war and, even if peace comes before the course is completed, all trainees will be given an opportunity to complete their studies.

Radio
SERVICE - DEALER
Group Subscribers Save UP TO 50%

Money-Saving Group Subscription Rate Now Offered "RSD" Readers

★ Most articles published in RADIO SERVICE-DEALER have important reference value for years. A complete file of "RSD" is an asset and time-saver. Our special Group Subscription Rate affords cash savings and helps every radio technician, or man engaged in allied fields, to start and keep his own individual file.

★ The more in a group the bigger the savings. 6 men in a group save $1.00 each; 4 men groups save $.75 per man. Present "RSD" subscribers may participate in or form a group with co-workers, or even competitors. Still active subscriptions are automatically extended 1 year. Start a Group today! The timely and exclusive technical data appearing in future issues of "RSD" will make this the best investment you ever made. The special Group Rate offer may be withdrawn at any time—so hurry.

RADIO SERVICE-DEALER is a member of the Audit Bureau of Circulations and has a larger paid circulation amongst the nation's leading independent radio servicing orgnizations and dealers who operate service departments than any other trade paper devoted to radio-electronic maintenance.

TEAR OUT—MAIL TODAY

RADIO SERVICE-DEALER MAGAZINE
132 W. 43rd St., New York 18, N. Y.

Please enter 1 year subscription orders for the names given below. Our remittance is enclosed.

	In U.S.A. & Territ.	*Canadian & Foreign*
☐ One 1-year subscription	$2.00	$3.00
☐ Two 1-year subscriptions	$3.50	$5.50
☐ Three 1-year subscriptions	$4.50	$7.50
☐ Four 1-year subscriptions	$5.00	$9.00
☐ Five 1-year subscriptions	$5.50	$10.00

Groups of 6 or more U. S. subscriptions will be accepted for $1.00 each, Canadian & Foreign at $1.50 each.

PRINT SUBSCRIBERS' NAMES CAREFULLY

Name . . . .
Address . . . .
Title or Position . . . .
(**Check whether Owner ☐ Service Manager ☐ Employee ☐**
State whether a New Subscriber ☐ or Renewal Order ☐)

Name . . . .
Address . . . .
Title or Position . . . .
(**Check whether Owner ☐ Service Manager ☐ Employee ☐**
State whether a New Subscriber ☐ or Renewal Order ☐)

Name . . . .
Address . . . .
Title or Position . . . .
(**Check whether Owner ☐ Service Manager ☐ Employee ☐**
State whether a New Subscriber ☐ or Renewal Order ☐)

Name . . . .
Address . . . .
Title or Position . . . .
(**Check whether Owner ☐ Service Manager ☐ Employee ☐**
State whether a New Subscriber ☐ or Renewal Order ☐)

Name . . . .
Address . . . .
Title or Position . . . .
(**Check whether Owner ☐ Service Manager ☐ Employee ☐**
State whether a New Subscriber ☐ or Renewal Order ☐)

Name . . . .
Address . . . .
Title or Position . . . .
(**Check whether Owner ☐ Service Manager ☐ Employee ☐**
State whether a New Subscriber ☐ or Renewal Order ☐)

NOTE: If you do not wish to tear this order blank out, just print or type the information on a single sheet of paper, following the style given. Each subscriber's occupation must be clearly described.

PHILCO'S POST-WAR PLANS

In a statement on Philco's post-war plans, vice-president T. A. Kennally included the following highlights:

"For Philco Corporation, the most important job at the present time is to help win the war," he said, but added, "The scientific research now going on to meet the needs of the war emergency, the precision standards required for government equipment, and the continuing strength of the distributor-dealer organization should all combine to help Philco make the most of post-war opportunities."

Remarking that the market for home and automobile radio receiving sets, radio-phonographs, refrigerators and air conditioners at the end of the war will be of unprecedented proportions, he said there is good reason to believe also that soon after the war, television will begin to realize its high promise.

"The technical accomplishments prior to Pearl Harbor demonstrate that television network operation is already practical, and undoubtedly much of the recent work in the field of electronics will directly or indirectly contribute to the further improvement of the art. This means that it will be possible in a short time through radio links to provide the best television entertainment for millions of people, and should stimulate the demand for television receivers. Starting slowly at first, and then gathering momentum, this business within a few years should be far greater in dollar volume than radio ever was," he pointed out.

Following is another merchandising angle disclosed by Mr. Kennally: "It is a definite part of Philco's post-war planning to have a radar and communications division which will serve the Army and Navy, and stand ready to be of all possible assistance in connection with their production and service requirements on present radar and radio equipment as well as in connection with the development of new products. This division will also be prepared to handle all requests for peace-time applications of radar and electronics equipment that the government approves. *In the post-war period every plane and every ship will undoubtedly be required to carry radar equipment in the interests of safety.* (The italics are ours.—Ed.)

"Radar should do more than any other development of recent years to make civilian flying safe and dependable. Through this new division, Philco will be prepared to contribute to and benefit from this development," he concluded.

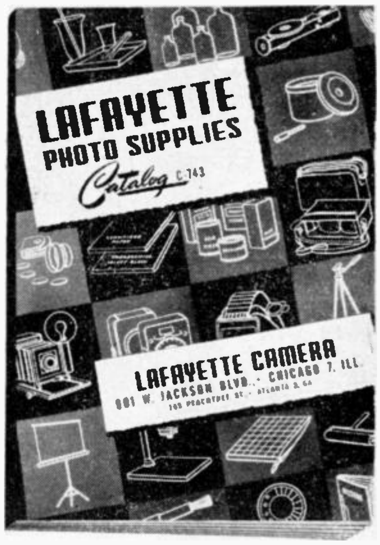
★

NEW UNIVERSAL MIKE REP.

Harry Gerber, of the Gerber Sales Co., Boston, Mass., has been appointed New England factory representative for the Universal Microphone Co., Inglewood, Cal.

PHOTO SUPPLIES STILL AVAILABLE!

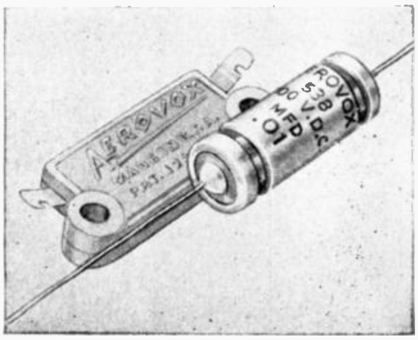
Many hard-to-get items such as exposure meters, flash guns, enlargers and printers, movie screens and projectors are still available. These and many other items are listed in the new



1943 LAFAYETTE CAMERA Supply Catalog No. C743. Write early for copies of this catalog as the supply is limited. Address Lafayette Camera Corp., 901 W. Jackson Blvd., Chicago 7, Ill. and 265 Peachtree St., Atlanta 3, Ga.

MICA-CONDENSER ALTERNATES

Ultra-small oil-impregnated, oil-filled condensers for use in assemblies where both space and weight are at absolute minimum, were announced, last month, by Aerovox Corp., New Bedford, Mass. Originally designed as metal-cased alternates for mica condensers (and the larger, ordinary paper types), these Type 38 "oil tubulars" are now being used for newly-designed equipment.



Metal case is capped by double-rubber-bakelite terminal insulator assembly, and units are available with both pigtail terminals insulated or with one terminal grounded to the case. Normally supplied without outer sleeve but can be had with insulating jacket adding 1/16-in. to diameter and length Sizes: 1 and 1 13/16 in. long x 5/16- and 7/16-in. dia. Castor (Hyvol) or mineral oil impregnant and fill. Ratings: 300 to 800 v., d.c.w. Capacities from 0.001- to 0.01-mf.

★

LAFAYETTE EXPANDS

The Schools Division of Lafayette Radio Corp., established to give consultation service to all schools and colleges on radio training programs and engineering problems in radio, electronice and physics, has been enlarged and expanded under Arthur J. Rattray.

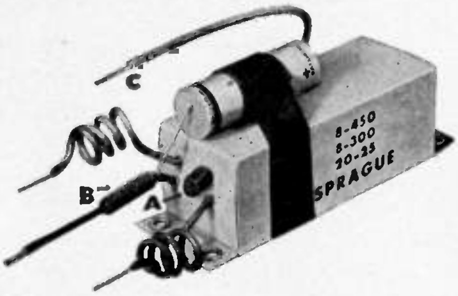
A. J. RATTRAY

Lafayette engineers, through the Schools Division, offer advice in planning training courses and in designing electronic equipment for special applications. A timely new brochure on radio training kits is now offered—free for the asking—as well as schematic diagrams, radio parts catalog, etc.

CORRECTION—THOSE GREMLINS DID IT!

One of those hard-to-catch typographic errors that make life miserable for printers and advertising men did a "gremlin" job on a Sprague Condenser advertisement appearing in this publication, June issue.

This advertisement contained the accompanying illustration demonstrating how a Sprague UT-8 8mfd. 450 volt Atom Midget dry electrolytic could be used to replace the 8 mfd. 450 volt section of a 3-section condenser rated at 8 mfd. 450 v., 8 mfd., 300 v., and 20 mfd. 25 v. So far, well and good—but the trouble



came when our little pet gremlin mixed up the "B" and "C" portions of the accompanying directions. Actually, they should read as follows:

(A) Cut lead to defective section and tape end.

(B) Connect cathode (—) side of Atom to common minus lead of multi-section condenser.

(C) Connect cut circuit lead to positive (+) side of Atom.

By following this procedure, you'll find that it is seldom necessary to replace an entire multi-section condenser simply because one section has gone bad. Most defective sections can be replaced by using a Sprague Atom of the proper capacity and voltage in the manner illustrated. The Atom can either be fastened by tape to the multi-section container, or simply held in place by means of its sturdy wire leads.

★

RADIO WIRE

Radio jobbers may obtain relief in connection with frozen stocks of copper wire mill products which cannot be sold in accordance with C.M.P. Regulation #4. (Should authorization be granted, copper wire sold under such authorization cannot be replaced in stock.)

Application should be made to the War Production Board on Form #PD-470 (WPB-1161), listing the products by amounts, sizes and types.

★

BUY MORE WAR BONDS

POST-WAR RADIO—G.E. VERSION

In the field of post-war broadcasting, General Electric engineers expect the replacement by f.m. stations of many low-powered a.m. stations which are now handicapped by interference and inadequate signal strength. This probably will mean higher power and more clear channels for the remaining a.m. stations, according to statements by Paul A. Chamberlain of the company's electronics department.

Television broadcasting is expected to develop rapidly after the war, along with f.m. radio broadcasting. Manufacturing experience gained in the production of electronic equipment for war will undoubtedly result in lower-priced television receivers after the war and this, plus public demand, should accelerate the expansion of television service.

After the war, the company expects to continue to build all types of transmitters—f.m., a.m., television—together with auxiliary equipment.

Ad Index

TOMORROW, Mr. Distributor, *you* may be selling devices like this one that saved Mary's hand from injury. And *you*, Mr. Serviceman, may be called upon to service the equipment.

A great electronic future is opening up before you. A future in which RCA Electron Tubes will be put to work on a multitude of peaceful, industrial fronts—to perform countless new services—do many things better, faster, more cheaply, and more safely than was ever before possible.

Many of these tubes are well known to you as radio tubes. The operation of the equipment will often depend primarily on circuits and parts familiar to you in your radio experience.

Remember *The Magic Brain of All Electronic Equipment Is a Tube—and the Fountain-Head of Modern Tube Development Is RCA.*

RCA

RCA ELECTRON TUBES

RCA Victor Division • RADIO CORPORATION OF AMERICA • Camden, N. J.

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

ASK ABOUT... RCA INDUSTRIAL MUSIC SERVICE

They who are fighting under every climatic condition know the superior performance qualities of RAYTHEON tubes . . . their unfailing response even under war-time rigid requirements.

They will not forget that RAYTHEON tubes in war even surpassed their peace-time records for long life, trouble-free operation and high quality performance.

The RAYTHEON trade mark will be a familiar name to the thousands of servicemen and dealers when they come back to their peace-time work . . . they will not forget that RAYTHEON tubes unfailingly performed their duty in every emergency.

Raytheon Production Corporation

Newton, Mass.

Los Angeles • New York • Chicago • Atlanta

POWER TUBE DIVISION

RADAR DIVISION

EQUIPMENT DIVISION

SMALL TUBE DIVISION

Four "E" Awards

DEVOTED TO RESEARCH AND THE MANUFACTURE OF TUBES FOR THE NEW ERA OF ELECTRONICS