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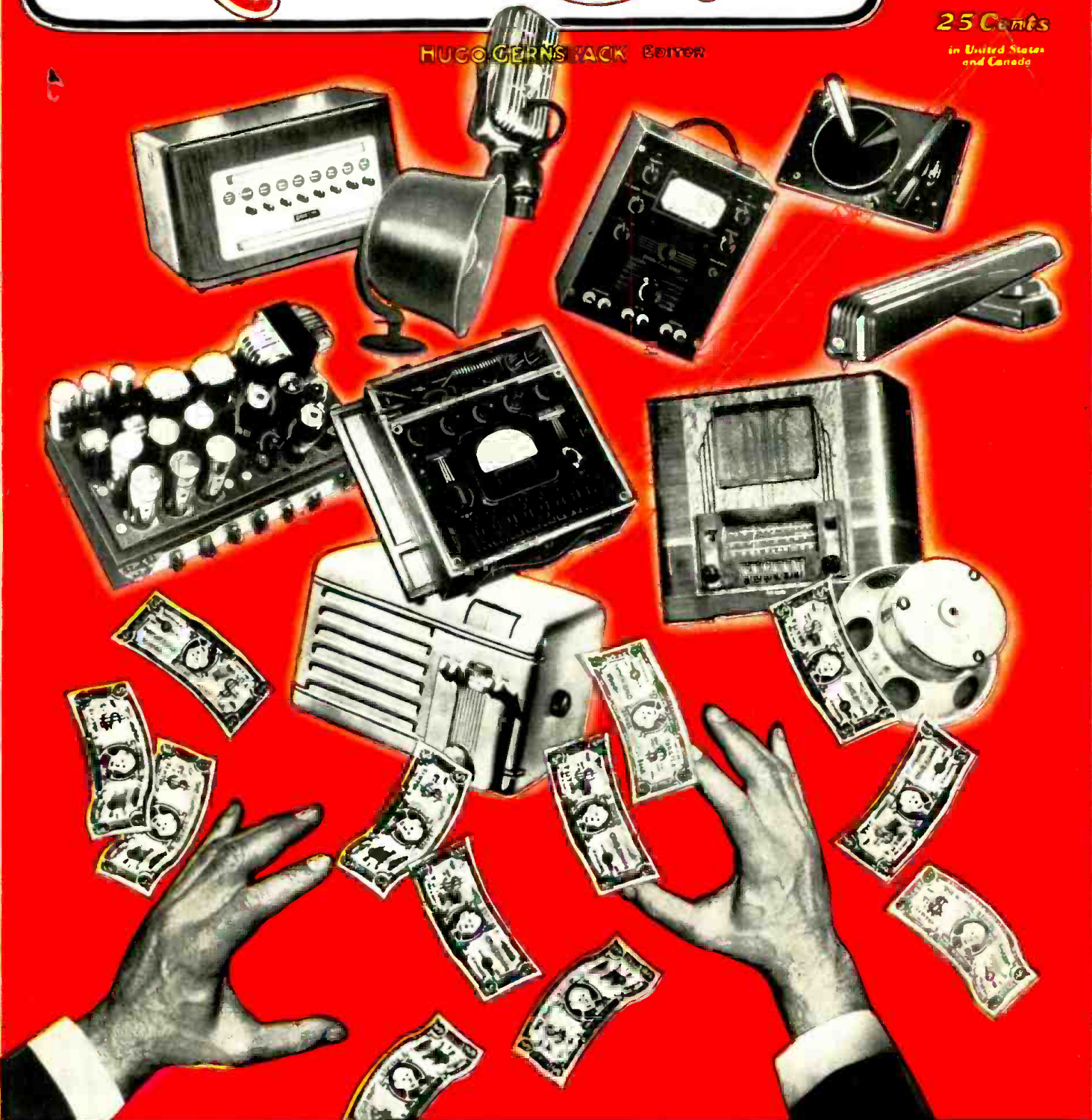
Radio-Craft

June

25 Cents

in United States
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HUGO GERNSTÄCK Editor



New! Money - Making "Modernizing Demonstrator" — Beginners' 1 - Tube Set
Sideline Money for Service Men — Automatic Spectrum Control Add - On Unit

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Here Is the Content of the 1938 RADIO REFERENCE ANNUAL

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This particular section of the 1938 RADIO REFERENCE ANNUAL contains a description of a number of important, as well as interesting receivers. They are as follows: A Simplified Converter; A Farm Battery Receiver; An Executive's A.C.-D.C. Desk Set; Handy Book-End Novel Receiver. Other receivers described are: Crystal Set, Portable Battery Receiver, and several others. Each receiver is described accurately, complete with constructional data and list of parts required.

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This chapter is devoted to Radio service instruments in general. Special emphasis is given to a number of the more essential instruments—they are: Service Oscillators, Mixer Circuits, V.T. Voltmeters and an Interference Eliminator.

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Radio Service Men who prefer to build their own equipment will find all the construction details necessary for building the following: Condenser Analyzer, Midget Oscilloscope with 1" and 2" tubes; Service Audio Oscillator.

GENERAL INTEREST ARTICLES

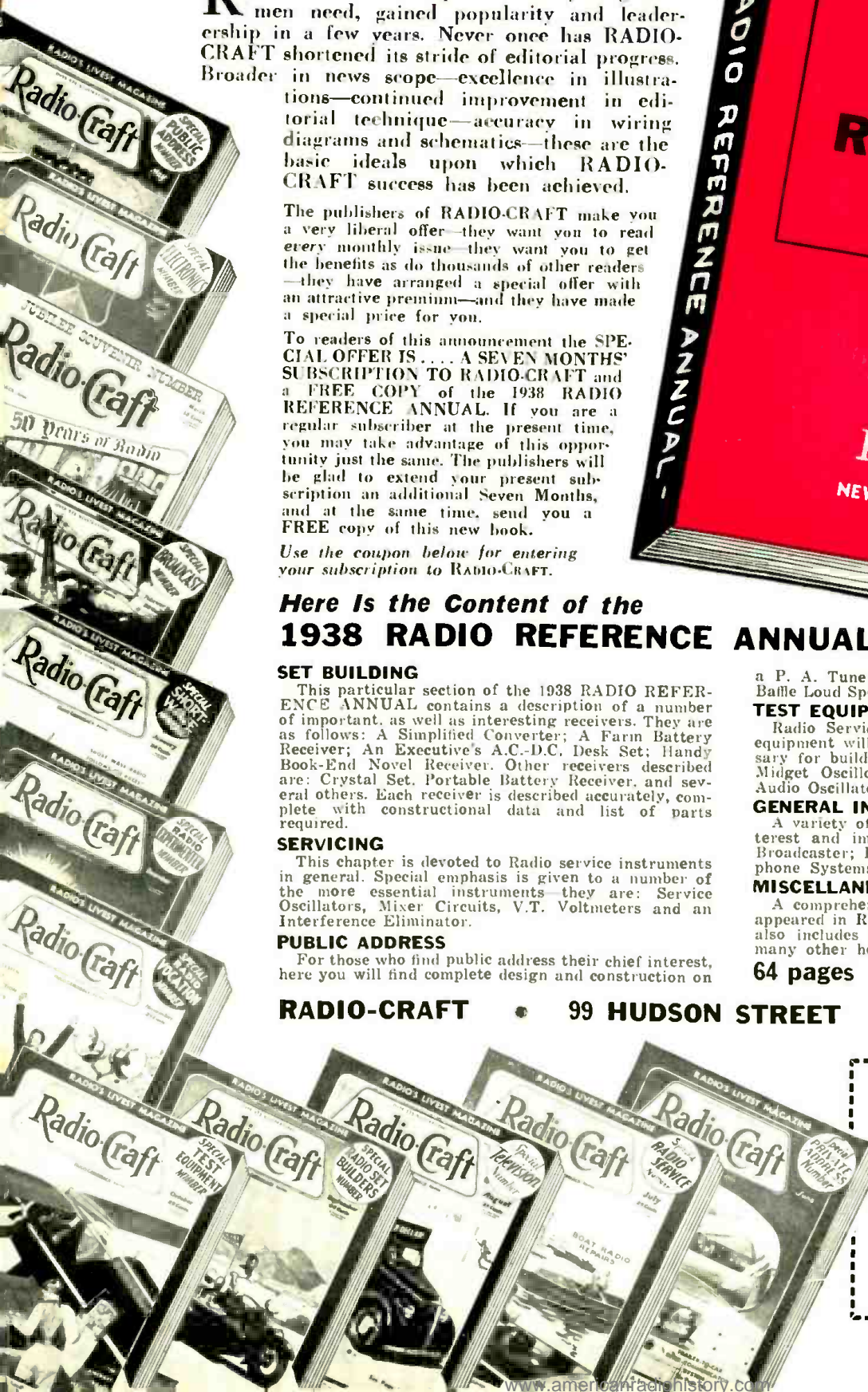
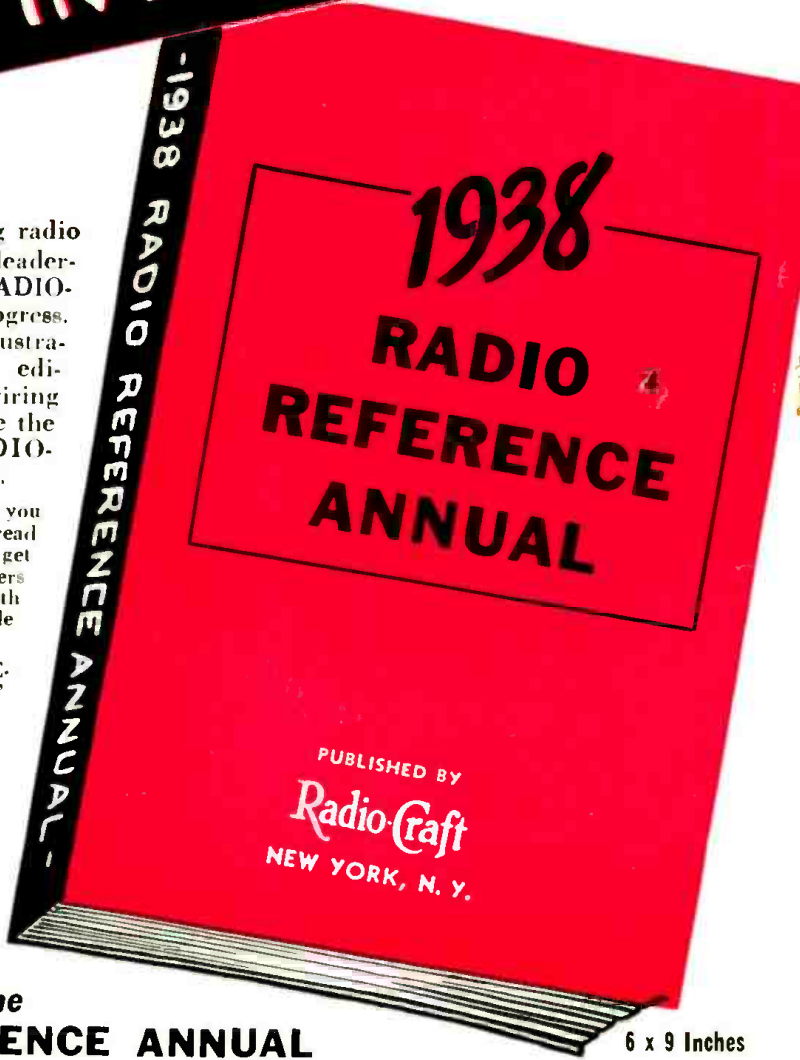
A variety of topics have been selected for their interest and importance. These subjects cover—Home Broadcaster; Remote Set Tuning; Carrier-Type Interphone Systems and a number of others.

MISCELLANEOUS

A comprehensive index of important articles which appeared in RADIO-CRAFT during 1937. This section also includes data on recently developed tubes and many other helpful hints and suggestions.

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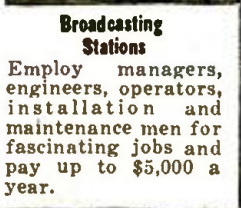
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Do you want to make more money? Radio offers you many opportunities for well-paying spare time and full time jobs. You don't have to know anything about Radio or electricity, give up your present job, leave home or spend a lot of money to become a Radio Expert trained to "cash in" on coming Television opportunities.

Many Radio Experts Make \$30, \$50, \$75 a Week

Radio broadcasting stations employ engineers, operators, station managers and pay up to \$5,000 a year. Spare time Radio set servicing pays many \$200 to \$500 a year—full time jobs with Radio jobbers, manufacturers, dealers, as much as \$30, \$50, \$75 a week. Many Radio Experts operate their own full time or part time radio sales and service businesses. Radio manufacturers and jobbers employ testers, inspectors, foremen, engineers, servicemen, paying up to \$6,000 a year. Radio operators on ships get good pay, see the world besides. Automobile, police, aviation, commercial Radio and loud speaker systems are newer fields offering good opportunities now and for the future. Television promises to open many good jobs soon. Men I trained have good jobs in these branches of Radio. Read their letters in "Rich Rewards in Radio." Mail the coupon.

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Radio already gives jobs to more than 300,000 people. In 1937 Radio enjoyed one of its most prosperous years. Nearly \$500,000,000 worth of sets, tubes and parts were sold. Over 5,000,000 home Radios were sold—25,000,000 homes (4 out of 5 in the U. S.) now have one or more sets. Over 1,800,000 auto Radios were sold - 5,000,000 cars now have Radios. Every year millions of sets go out of date, are replaced with newer models. Every year millions of dollars are spent on transmitting equipment, Television developments, etc. The \$30, \$50, \$75 a week jobs have grown from a few hundred 20 years ago to thousands today. And Radio is still a young industry—developing fast.

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IN JULY RADIO-CRAFT'S ANNUAL SERVICE NUMBER

Do not miss the forthcoming issue of *Radio-Craft* in which the Service Man will find an exceptionally large number of practical articles of importance to the craft. New devices which Service Men will find to be money-makers also will be illustrated and described.

Public Address and Electronics are additional fields which will be well represented by important contributions. Set builders and P.A. specialists will be interested in the article, "How to Make a High-Fidelity Tuner."

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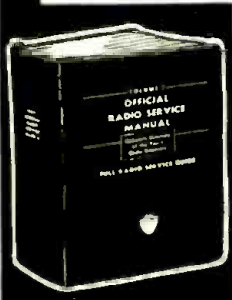
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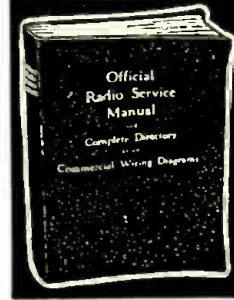
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★ 1933 MANUAL ★
This 700-page Manual, with over 2,000 illustrations, contains page after page of operating notes—schematics showing location of parts on chassis—values of I.F. peaks, resistors and condensers. A complete section on construction of various types of test equipment, plus money-making ideas for radio men. Includes auto-radio installation and servicing. Size—9 x 12 inches; flexible, looseleaf covers.
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★ 1932 MANUAL ★
This Manual contains a full radio service guide of 1931-32 receivers. With over 1,000 pages and over 2,000 illustrations, it features a step-by-step analysis in servicing a receiver—chart showing operation of vacuum tubes—schematic diagrams with color coding indicated—commercial short-wave receivers and adapters and servicing public address equipment. Size—9 x 12 inches; flexible, looseleaf covers.
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Editorial Offices: 99 Hudson St., New York, N. Y.

HUGO GERNSBACK, Editor

Vol. IX, No. 12, June, 1938

MONEY IN RADIO

An Editorial by HUGO GERNSBACK

EVER since the inception of radio, there have been many opportunities to make money in it, in one way or another. As radio grew up and divided itself into dozens of branches, these opportunities multiplied themselves; and notwithstanding the opinion of professional pessimists there are today more opportunities for making money in radio than there ever were.

In this article, I will not touch upon the obvious nor upon the radio industry as a whole, because manufacturers of radio sets on a large scale or the broadcast industry on a similarly huge scale need not be discussed here, as these branches really belong in the industrial end of radio.

On the other hand, what the average reader wants to know is, how can he make money in radio today without a large capital investment; and believe it or not, the woods are still full of radio dollars in one way or another, which are waiting to be plucked by those who know where to go for the harvest.

Even the oft-lamented custom-built radio sets are still making money for those who care to build them and know where to sell them. There are still thousands of people throughout the length and breadth of the land, who are interested in specialized radio sets of one kind or another to fit special conditions in their homes and elsewhere. Such radio sets still sell for good money, by those who care to build them. Just to mention a few special jobs that have come under my personal observation during the past two months: A well-to-do physician was in the market for a special phonograph record-changing radio combination. The requirements were such that no ready-made set could fill the specifications. In the physician's home was a certain space where he wished to fit this phonograph-radio and he was willing to pay as high as \$600 for the job. He eventually found someone to build the set for him.

A certain establishment required a special radio set coupled with a Public Address system whereby as many as 75 dynamic speakers could be thrown into the circuit at one time, with an elaborate switching system so that as many as 4 different programs could be sent over the lines. This of course really meant 4 radio sets in one, with a distributing board and other technical accessories. A local firm finally built the set at a very handsome figure.

A banker, during a recent kidnapping scare, was in the market for a special amplifying system whereby sensitive microphones were to be connected in such a manner that any unusual noise from the children's room would be instantly transmitted to the master bedroom where the banker slept. He insisted that the system must be built in such a manner that only a certain loud noise or speaking sounds or an outcry from the children would put the set into in-

stantaneous operation. The set was built in due time and also at a good price. So much for special, built-to-order radio sets and amplifiers, but this of course does not exhaust the list; as a matter of fact it does not even scratch the surface.

Wide-awake Service Men and radiotricians are making money in their respective fields, but often "fill in" on special jobs, depending upon their own ingenuity and personal getup in contacting the right people. In any city you can hardly walk a single block without finding some radio opportunities, where a little investigation often shows that radio equipment of some kind can be used. One man in the East specializes in placing concealed microphones in the lobbies of theatres, so that the manager can overhear the comments made by the patrons as they leave. Of course the patrons never know that they are being listened-in on, but this often gives valuable information to the theatre owner or manager. Another man in the West specializes in radio ore locators, and has built up quite a business in this odd radio branch. He builds his machines to order and they are all expensive models, too. Another application of the principles of "Private Address" (a term coined, last year, by the writer), incorporated in items mentioned above, has especial significance for the Service Man-Dealer; credit for the scheme goes to a Service Man-Dealer in Plainfield, N. J. The idea is to utilize an overhead loudspeaker in a talk-back circuit; prospective customers who stop to admire and comment upon a particular set model in the shop window suddenly are amazed to hear, instead of the incidental music (supplied by an automatic phonograph or a radio set), a few well-chosen remarks concerning the features, etc., of the set in question! It's a sure attention-getter.

Another young and ambitious Service Man who had a good deal of time on his hands hit upon the idea of specializing in sharpening the tuning of radio sets in his community. In practically all cases, standard radio sets, particularly those of the non-superheterodyne variety, in use for a number of years, are usually found to tune broad. There is often cross-talk on some of the channels and certain stations can hardly be brought in with good volume at all. By means of a simple wavetrap that this young man constructed himself and which he fitted into existent radio sets, poor receiving conditions could be overcome in practically all instances. This Service Man disarmed his prospects by stating that they did not have to pay a cent unless he could improve the receiving condition of the prospect's set by at least 50%. He charged \$2 for the wavetrap which cost him only about 50c to make, and in this manner gained many valuable customers. He is still at it and making money. The woods are full of radio opportunities—if you go after them.

THE RADIO MONTH



H. M., King Farouk, opens Cairo Radio Conference. (His Highness is wearing a striped tie.)



(Photo—Radio Press Service)

An Egyptian stamp perpetuates the Cairo Radio Conference at which representatives of all nations are settling international radio problems.

1,200 KILOWATTS TO BLANKET S. A.!

SOUTH AMERICAN reception of short-wave broadcasts from the United States will be greatly improved by General Electric's use of an effective carrier power of 1,200 kilowatts—*more than twice the power of any existing long-wave unit!*—for short-wave station W2XAD; together with a \$120,000 a year special series of programs for foreign listeners only, established by the National Broadcasting Company. This increase in power strength, together with the program facilities of General Electric and N.B.C., will provide complete coverage of all parts of South America when used with 2 new F.C.C.-granted W2XAD frequencies.

The new set-up will give Central and South American neighbors a short-wave service second to none. Because of the

expert programming facilities of the General Electric and National Broadcasting organizations, the new service should not even be excelled by any of the heavily government-subsidized stations of Europe.

The 2 frequencies that will be used at night for broadcasting to Latin America are the present W2XAF frequency of 9,530 kilocycles and the new 9,550-kilocycle frequency of W2XAD. In the morning, Central and South America will be reached by the new 21,500-kilocycle frequency, and later in the afternoon by the frequency of 15,330 kilocycles (W2XAD, which also sends to Europe in the afternoon programs received there in the evening).

Newest addition to the undeclared wars that are today's vogue is a modest battle of the air waves. Combatting Italy's Arabic-language 39-minute broadcasts from Bari, B.B.C. counters with a 15-minute Arabic-language broadcast from London, according to a *Reuters* (Rome) report last month.

But while Great Britain still has its mouth open, and getting warmed up to its counter-propaganda program via the short-waves, Italy attempts to shout down the Lion with announcements that a counter-counter-propaganda is planned via a powerful station soon to be erected at Addis Ababa! Beginning in 1939 plans are to transmit in Arabic, Amharic and Galla. All of which makes Il Duce two languages up on Johnny.

World Telecommunications Conference attendee E. K. Cohan, CBS's able engineering director, has completed arrangements at Cairo for directional short-wave transmissions to Egypt via W2XE; at home, chief engineer B. Chamberlain has OK'd the N. Y. set-up.

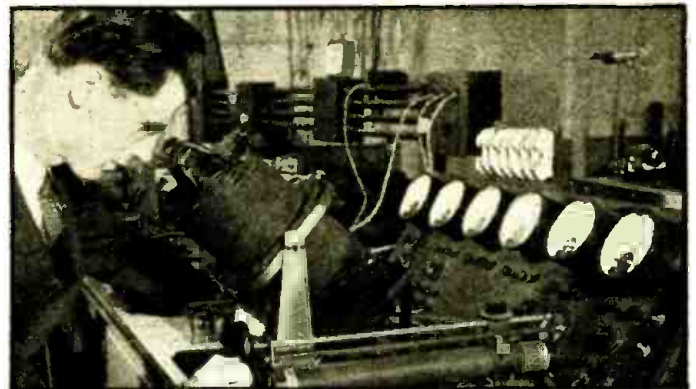
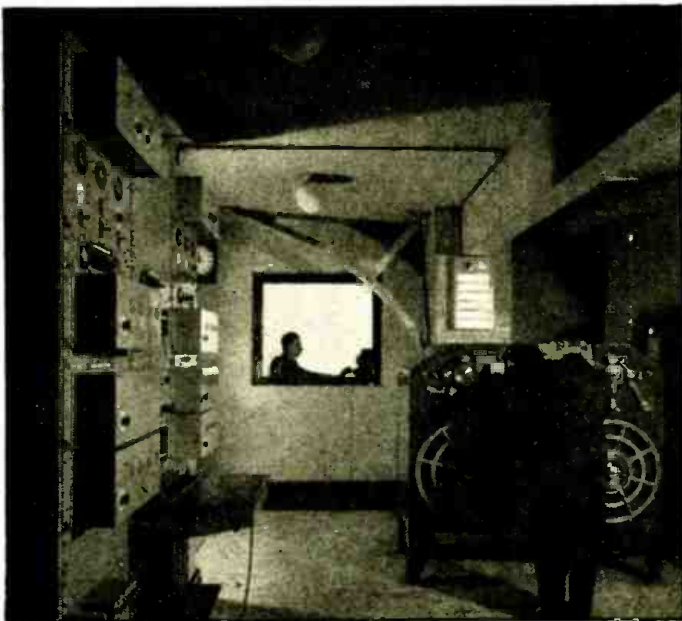
ADD COLUMBIA U. S.-W. PROPAGANDA

THAT international S.-W. propaganda has caught the attention of institutions of higher learning was evidenced, last month, when President Nicholas Murray Butler of Columbia University discussed the appointment of a committee to study radio and to formulate University policy. Said President Butler. "The hourly international short-wave broadcasts by the several governments of the world present a worldwide problem in education. This activity is a challenge to the ingenuity and to the resourcefulness of all institutions functioning in the field of liberty." My!, my!

Typical music and stories about traditional customs and present-day circumstances of the countries of South and Central America, broadcast in 5 languages throughout Europe, Africa and Latin-America, inaugurated a new series, "The New World Salutes the Old," over Station W3XAL, of the NBC International Division, last month.

While prepared especially for other sections of the world, the programs also will be broadcast twice a week on W3XAL's South American directional beam, once in Spanish and once in Portuguese, under the title of "Folk Songs and Customs of the Americas." Why?—because of the interest of South and Central American countries in their neighbors' music and story. (Are you listenin', world?)

John S. Young, World's Fair radio mogul, announced, last month, that short-wave stations W2XAD and W2XAF will have permanent wires from Schenectady to the Fair grounds.



Above.—An RCA technician investigates magnetron oscillator phenomena. This device utilizes a negative resistance characteristic to produce high-power oscillation at 300 to 600 megacycles. This region of $\frac{3}{4}$ to $\frac{1}{2}$ -meter is an almost inexhaustible region of service channels. Problem is to be able to properly modulate these extremely high frequencies; outstanding characteristics are the high directivity and amazing efficiency of these frequencies.

Left.—B.B.C.'s recording room in the auxiliary studio at Maida Vale is seen to include latest magnetic-type tape recorder. Putting voice frequencies on magnetizable steel tape has almost reached the status of a fine art in England. Such tape machines are also utilized for temporary recording of short-wave pick-ups which then may be put on the air, at broadcast wavelengths, at leisure. Technician at lower-right is manipulating the magnetic-tape recorder-reproducer.

IN REVIEW

RCA/NBC 18th ANNUAL REPORT

THE 18th annual report of RCA was released last month to nearly a quarter-million stockholders.

Money-Making.—It showed a net profit for the year 1937 of about \$9,000,000 (based on a profit margin of 8 per cent); up 46% over 1936. The Corp.'s activities, in communications, broadcasting, manufacturing and radio research, grossed 112 millions. Sales of radio-phono combinations upped 50%!

Broadcasting.—The same report gives NBC's network 143 stations—an increase of 41. Also announced was organization of the N.B.C. Symphony Orchestra, first full-size full-time symphonyorch by and for the U.S. air waves.

Short-wave Propaganda.—Of special significance was the development, on a 16-hours-per-day schedule, and expansion of S.-W. broadcasting to foreign countries to foster international goodwill. Programs are in English, French, German, Italian, Spanish and Portuguese languages, sent to Europe and Latin-America. In 1936 programs totaled 184; in '37 there was a veritable barrage of 3,179 such programs.

Television.—This report concludes mention of television with the following comment: "Our experiments with television in the past 18 months improved the system by increasing its capabilities and efficiency, thus enabling it to move closer to the inauguration of a television service for the American home." To satisfy the television expectations of more than 130 million people,

Radio is now such a vast and diversified art it becomes necessary for *Radio-Craft* to present a survey of important general-interest monthly developments.

spread over more than 3 million square miles, is no mean task.

Facsimile.—Comments, in the report, on *facsimile* are a bit more optimistic: "The facsimile transmission by radio of type matter, pictures and other visual material is another achievement of laboratory research. *Now there is active preparation for employing such a system for the transmission of news bulletins and pictorial information from established broadcasting stations to homes in their service areas.*" (Italics are *Radio-Craft's.*) "Plans are being developed for 'field tests' of such a service, and the RCA is providing equipment specially designed for this use by broadcasting stations."

BROADCASTING, ET AL.

STATION WLW at Cincinnati, world's most powerful station with 500 kilowatts actually in the antenna, will be (on the basis of some 3 years' experience) the principal witness for super-power at F.C. Commission's hearing this month on the applications of 15 other stations which want to garner the coverage and hence the shekels they envision in going to 500 kw. (Cheer up! We may even yet hear a high-fidelity program on the broadcast band!)

Sheer outstanding genius, we call it! Stumped by boxing club's ban on airing of boxing at Oakland Auditorium, KLS sportscaster "Speed" Riley "takes recording machine to ringside, spouts description onto disk, including between-round interviews with celebs, and at



Compare the coverage afforded by General Electric's new short-wave stations beamed on Brazil and Argentina, with Germany's beam.

final gong rushes back to station with police escort and spins disks before auditorium empties," according to an item, streamlined as quoted, in *Radio Daily* last month.

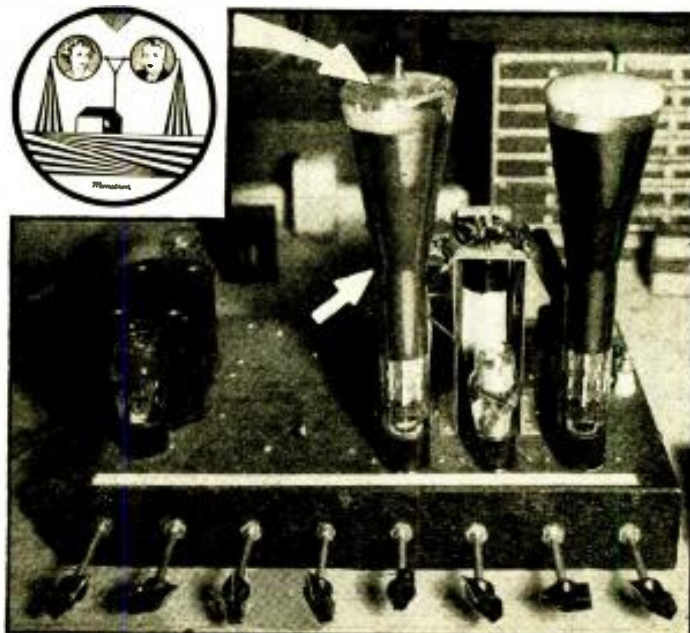
A "clipping bureau of the air," with 25 customer-concerns to date, now affords 24-hour service in discing programs. Charges: \$200 per month (daily report and weekly summary). Air programs thus sound-recorded include all the wordage on the death of John D. Rockefeller!

An interesting commentary by a Mr. Magnay, last month, to England's Postmaster General, Major Tryon, brought up the interesting question of: when is an SOS not an SOS?

Mr. Magnay asked the Postmaster General if he was aware that naval and merchant shipping interests resented the misuse of the signal of distress at sea, SOS, by the British Broadcasting Corporation and other commentators, including newspapers; and whether he would ask the B.B.C. to substitute another designation for its urgent
(Continued on page 838)



Above.—Last month's issue of *Radio Vente* carries an illustration of a medal now in preparation by P.T.T. (Post Office, Telegraph and Telephone). Girard, an artist whose works are well known, is using television as the theme for his engraving; but France, wanting television, chafes at getting only a medal.



Right.—One of television servicing's first pieces of test apparatus. The "Monotron" cathode-ray tube (arrow) contains an actual picture which is scanned, with the associated equipment shown, and reproduced as a television image on the other or "Vidotron" cathode-ray tube. The design (insert) printed on the metallic disc in the end of the Monotron tube is an ideal test pattern due to the shading from solid black to gray, and the angular formation of the design components. This item for television Service Men was developed by M. P. Wilder, of National Union Radio Corp.

SERVICE MEN!—HERE'S A NEW MONEY-MAKER! THIS "MODERNIZING

Most Service Men fail to see the golden opportunities for added sales presented by daily contact with their customers. The author's approach to this situation is based on ordinary servicing ability and sound sales psychology, which should be given "a try".



Fig. A. A Howard converter, connected to a G.E. console's antenna and ground posts, helps sell a pushbutton-tuning modernizing job.

MR. STUART TELLS YOU—

1. How a "Modernizing Demonstrator" may be used to boost your income by demonstrating to your customers, RIGHT IN THEIR OWN HOMES, how you can add to their sets radio's newest features!
2. How to convert an inexpensive radio set into a "Modernizing Demonstrator."
3. How to utilize a modern, medium-price set as a "Modernizing Demonstrator."

THE wide-awake Service Man can earn more money if he has the mind to. The only requirements are: ability to recognize an opportunity, willingness to take advantage of it and tactfulness in its execution. The opportunities to which I refer lie in the field of sales. No one will deny the fact that to make a sale is to earn money. The problem, however, is how to make the sale; and that's where the "Demonstrator"—a modern idea—makes its début.

WHAT AND WHOM TO SELL

But let us digress a moment in order to discuss the question of *what* and *whom* the Service Man can sell.

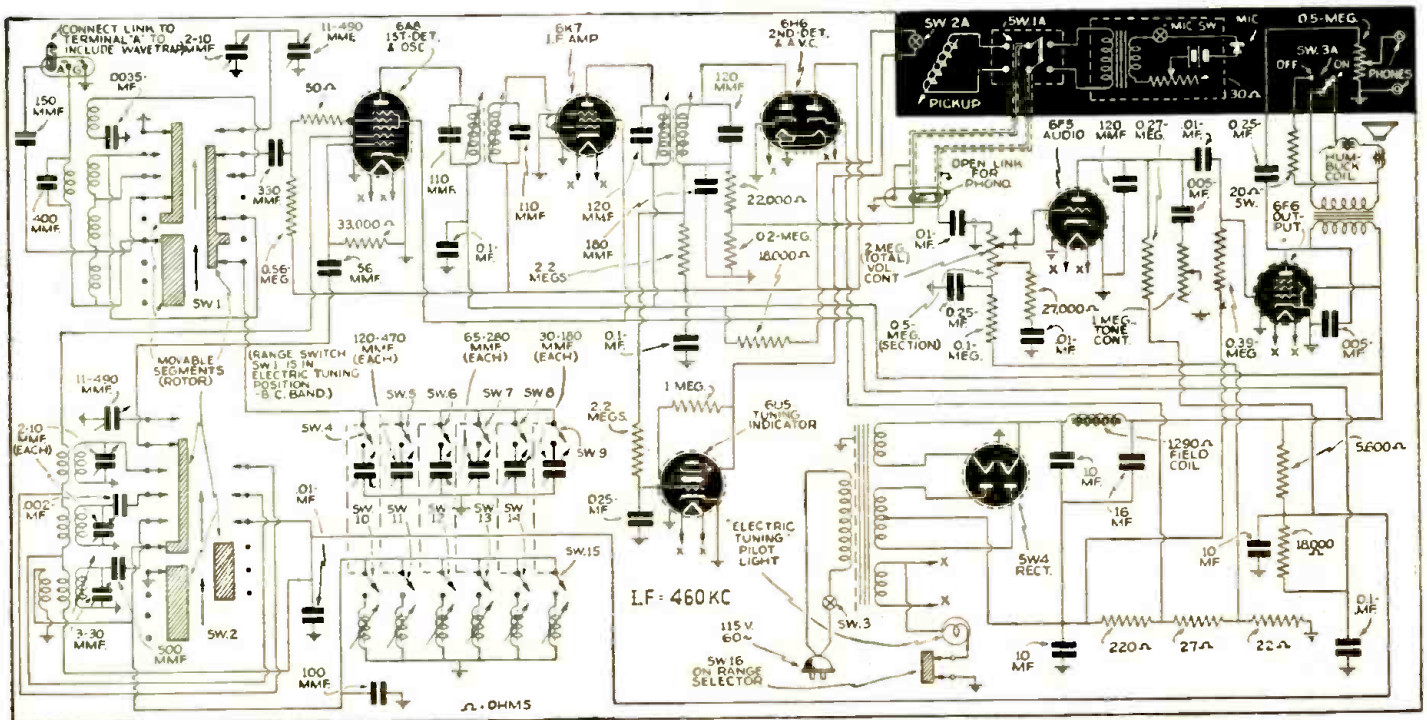
There are, in this country, over 30,000,000 sets in use which do not have visual tuning indicators or pushbutton tuning systems; hence there are more than 30,000,000 opportunities to earn money by adding these devices;—divided amongst the reputed 100,000 Service Men, leaves 3,000 opportunities per Service Man! There, then, is your potential business . . . your increased business and that represents only 2 salable items. How about the host of other devices which can be added in order to bring these many sets up to date?

Whom to sell? . . . The people who call you to service their sets! It's for people like these—Mr. Average Set

Owner—that manufacturers have designed those visual tuning indicator adapters, and the many other add-on units. All these items *must* be salable, else they would not have been manufactured!—and you, Mr. Service Man, are the logical person to make the sale! . . . and thereby earn more money!

A salesman in any other field of endeavor generally considers the "battle" half won if the housewife merely permits him to enter the home. Yet you, Mr. Service Man, are actually *invited* into the house—merely to "fix the radio," of course; but don't forget that every person who owns a 6-months-old (or older) radio set is a potential customer for a modernizing job. (I say "6 months old" because Radio moves so rapidly these days that a set purchased 6 months ago is almost always superseded by later models incorporating new circuit features).

Then there are those other devices which can easily be sold;—those, such as *phonograph pickups* and *microphones* which give added entertainment to the family and zest to the party; *short-wave converters* to receive those increasingly popular foreign programs; *wave-traps* to clear the "air" of interfering stations; *noise filters* to prevent the electric refrigerator and oil burner from "hashing" the program. These are all salable items . . . all potential money for you, Mr. Service Man.



DEMONSTRATOR" HELPS SELL YOUR CUSTOMER

ALLAN STUART

WHAT IS THE "MODERNIZING DEMONSTRATOR"?

Returning to the "Modernizing Demonstrator" let us see what this instrument is and what useful claim it has to existence.

The "Demonstrator" is neither complex nor ingenious. However, so far as the author knows, it is the fruition of an original idea. By merely jiggling the proper switches on a switch box, it can be made to instantly demonstrate radio's newest magic.

For instance, you can show, in a second, the advantages of *pushbutton tuning* as compared with manual tuning, and *visual tuning* as compared with tuning by ear. Also, if the prospect has a phonograph, it can be made to demonstrate *electrical reproduction of records*. For the hard-of-hearing or for the late-sitter-upper it will demonstrate the advantages of *headphone reception*. You could talk yourself blue in the face to a prospect on the entertainment value of having a *home-broadcast microphone* attached to his (or her) set, without getting very far, but plug a mike into the "Demonstrator" and let her hear her own voice boom from the loud-speaker! . . . bingo! . . . a sale is made. *It works like magic!* (Note to Service Man: Don't forget to turn up the volume control. That's part of the psychology! She then hears her voice as others would hear it:—loud, commanding).

BANISH "SALES FRIGHT"

Now don't let the word "sales" frighten you. The task is really simpler than the word might imply. In fact, with the aid of the "Demonstrator" things will actually sell themselves, with little or no help from you (and in many cases, in spite of you).

Which reminds me of a valedictory speech I once heard: "Never worry too much about your patients," said the professor to a graduating class of medical students, "because, 5 percent will die *no matter* what you do, 5 percent will get better *because* of what you do, and 90 percent will recover *in spite* of you."

And so it is with this "Demonstrator." A small number of sales will not materialize because the lady (or man) of the house would not have bought the item *under any circumstances* (apparently not having any need of it); some of the sales *will* materialize because of your direct efforts (since the prospect was "on the fence" and you won him over); and by far the great majority of the sales would be consummated immediately upon a demonstration. Why? . . . Because most of them are *eager* to buy these attachments, having heard of them at one time or another, or seen them operate at a friend's or neighbor's house. And suppose they have never seen or heard of them before; just let them hear

(Continued on page 824)

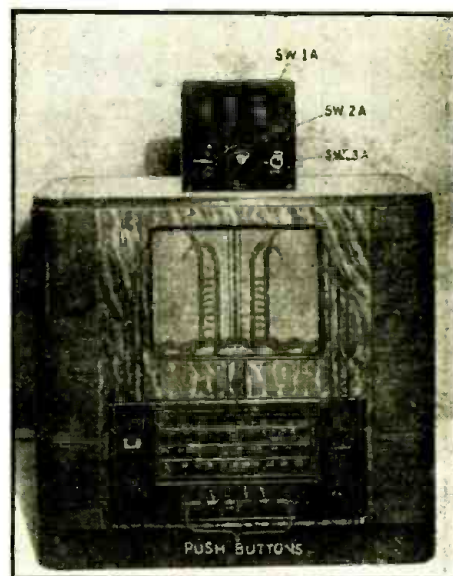
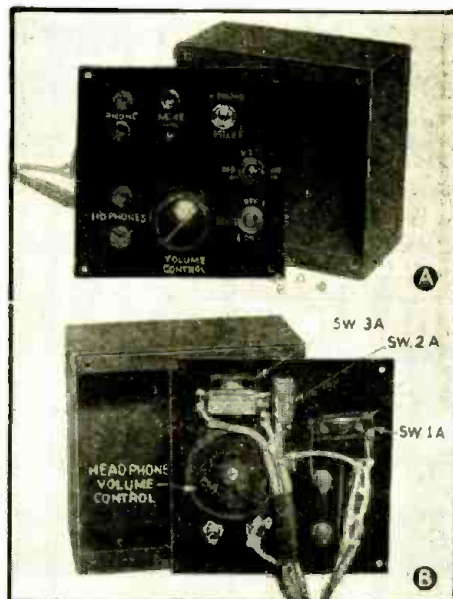


Fig. B. The "Modernizing Demonstrator" set.



Front (A) and rear (B) views of switch box.

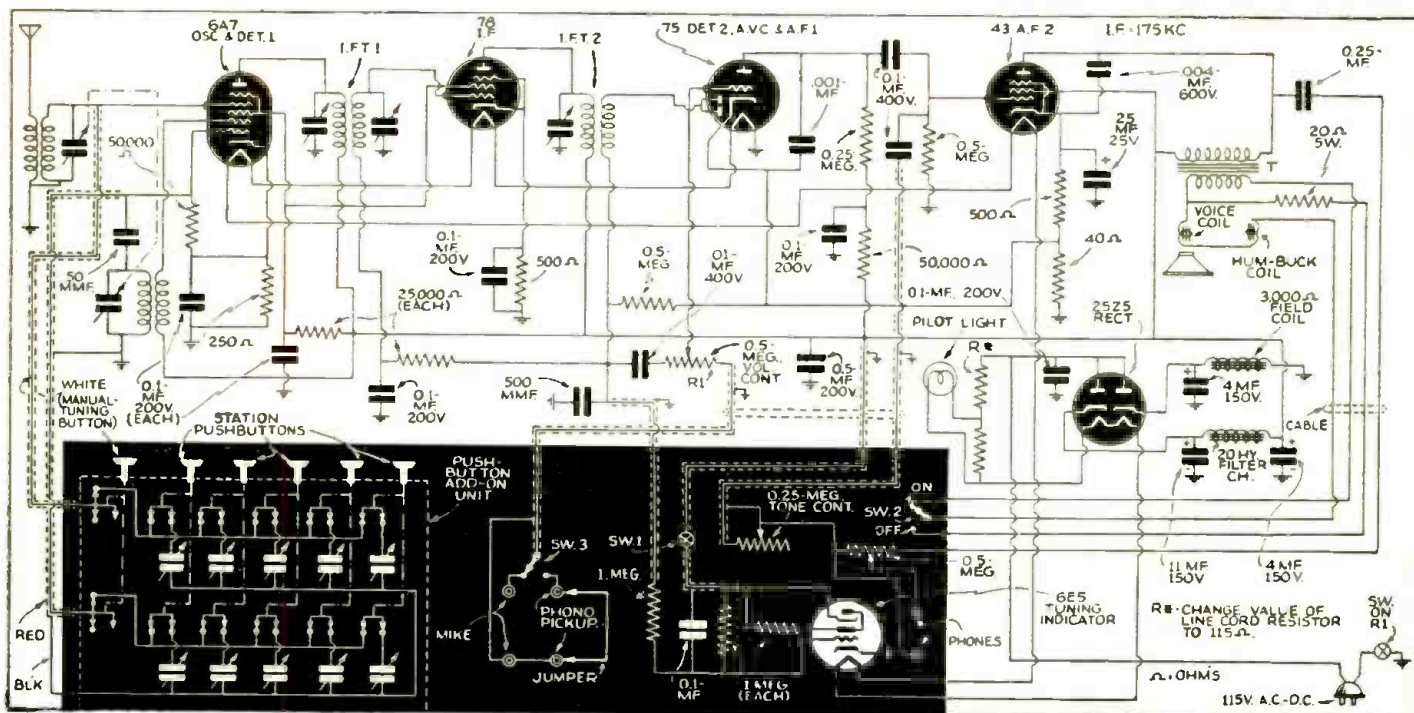


Fig. 2. An inexpensive midget set, recircuited (black inset) to include the facilities of the "Modernizing Demonstrator."

Suggest these ideas to your customers—

- Short-Wave Aerial
- Short-Wave Converter
- Short-Wave Preselector
- Beat-Frequency Oscillator
- Headphone Connection
- External-Speaker Posts
- Automatic Volume Expansion
- Pushbutton Tuning
- Noise-Elimination Service

SIDELINE MONEY

The author of this article originated the "Operating Notes" idea so widely copied. **BERTRAM**

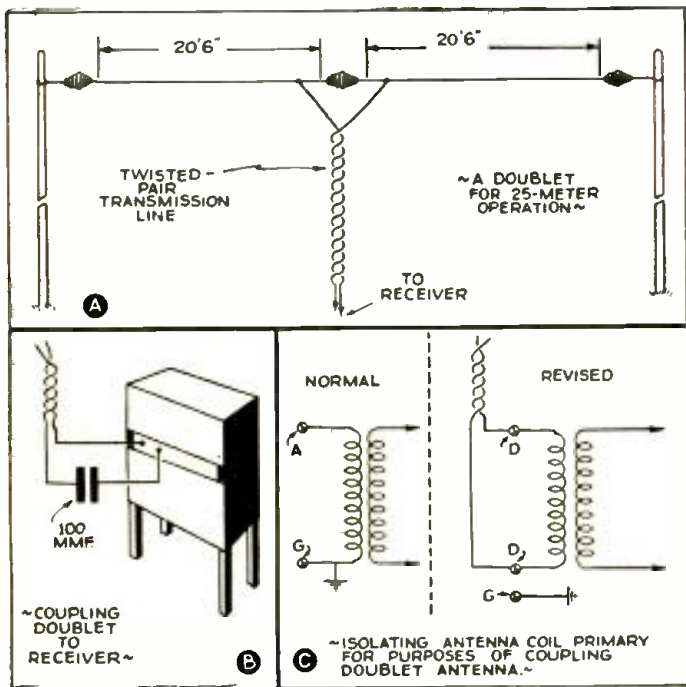


Fig. 1. Antenna items that offer added profits.

COUNTLESS plans and ideas have been formulated and advanced time and again to increase the earnings of radio Service Men, all predicated upon the proposition that the income of a radio Service Man is not, and should not be, limited to radio repair and service work.

There are many related "sidelines", which offer lucrative possibilities and provide a means of supplementing regular earnings, available to Service Men. There can be no doubt that radio servicing is a business which concerns itself with "selling" personal service. Most customers employ the services of radio Service Men because of faith in the ability of that individual, either resulting from recommendation, previous experience or contact, or the fact that the individual is established in the community. By rendering reliable and expert radio work, customers and clients are convinced of the fact that the radio Service Man is a good technician and "knows his business." With this won confidence, it is only a matter of determining what they may need or want and suggesting what they should buy.

Many customers have some "pet hobby," "whim," or particular requirement with regard to radio or associated equipment. In the course of rendering service, a few casual but directed questions will soon disclose the nature of these requirements. Some customers enjoy short-wave reception, while others are interested in the excellent tonal quality of their receiver. By catering to these whims and hobbies, and satisfying individual needs, a profitable "sideline" business may be developed which will yield dividends not only from a standpoint of financial return but that of further and more firmly establishing the radio Service Man in his business.

In setting forth these sideline opportunities, an effort has been made wherever possible to include the most satisfactory methods of accomplishing the best job.

SHORT-WAVE POSSIBILITIES

Thousands of all-wave and short-wave receivers have been sold in recent years for which an efficient and more satis-

factory antenna system for short-wave reception may be installed. Many set-owners are really interested in good or better short-wave operation, and the suggestion that a marked improvement in reception of short-wave signals will result from a good antenna system seldom fails to elicit this interest. The Service Man may then proceed to "sell the customer a bill of goods."

There are many types of short-wave aeriels available today, some good, others better, and some useless, and selection may prove to be a big problem. It is best, by far, to employ a short-wave antenna system, ready tailored for the purpose, of a reputable manufacturer whose claims for the product are modest and not over-estimated. These antenna kits, usually of the doublet type, comprise rolls of aerial and transmission line, cut to size and soldered, with the necessary transformers or devices to match the antenna circuit of the receiver.

The most important consideration when installing these or any antenna system is that of erecting the aerial proper, high and clear of surrounding objects through the use of poles or masts and insulators. Each job should be a custom-built installation to fit the peculiar and individual needs of the occasion. The best and most expensive antenna kit hastily and carelessly erected, without attention to minor details, will prove to be far less productive of good results than the regular inverted-L type aerial installation. Through proper installation of these manufactured antenna kits, most of which have noise-reducing qualities when the flat-top is erected in a noise-free zone, the improvement in short-wave reception is manifest and should satisfy the most exacting customer.

Where price is a consideration, a simple doublet antenna, easily and quickly installed, may be utilized to accomplish an improvement in short-wave reception. The doublet antenna is nothing more or less than an antenna divided exactly in half by means of insulators, and is so called because it is most efficient in receiving signals whose wavelength is double the total length of the aerial in meters. In other words, a doublet antenna with sections of 20.5 ft.

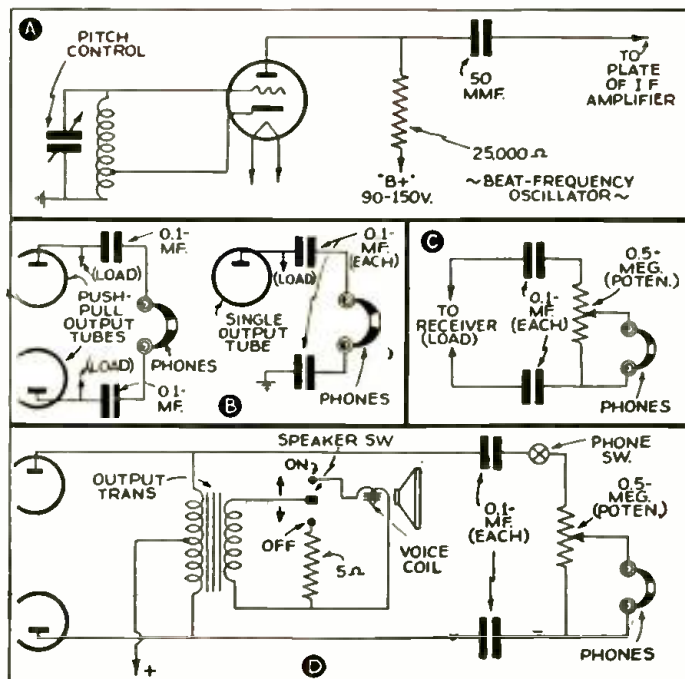


Fig. 2. Headphone and loudspeaker connections added.

FOR SERVICE MEN

Some more easily salable ideas—

M. FREED

Mr. Freed, whose servicing articles date from '29, outlines many profitable ideas.

- Rewiring for High-Fidelity
- Tone Control
- Bass Booster
- Phono Record Player
- Phonograph Oscillator
- Tuning Indicators
- Rental-Amplifier Service
- Wired-Radio Call Systems

will receive short-wave signals in the 25-meter band most efficiently. A twisted-pair transmission line is employed as the lead-in, connected to the inside ends of each aerial as shown in Fig. 1A. The problem of coupling the transmission line to the receiver now arises. Perhaps the simplest and most widely employed method is that shown in Fig. 1B, in which a 100 mmf. mica condenser is connected into the ground leg of the transmission line. Another means of coupling the transmission line to the receiver consists of employing the primary winding of the antenna coil by isolating this winding from the set as shown in Fig. 1C.

Since a doublet antenna possesses directional qualities, and receives best those desired signals emanating at right-angles to its length, it should be erected to secure every advantage of this fact. The aerial may be installed so that it points toward the known source of some external interference such as a high-tension wire or a trolley line, so as to improve the signal-to-noise ratio of weak signals.

MORE \$\$\$ IN SHORT WAVES

Many receivers of ancient vintage which formerly cost a sizeable sum are being operated by set-owners who, because of economic or for sentimental reasons, are unable or refuse to purchase an all-wave modern receiver. For these persons, *short-wave converters* and *adapters* are available. The former, operable in a few seconds, connect to the set's antenna and ground posts; the latter require slightly rewiring the set to obtain operation. Set-owners often may be sold on S.-W. if the educational and entertainment value of the programs is described to them. This appeal, plus the comparatively small investment required in view of utilizing the existing antenna system and radio receiver, often results in an order for either a converter or an adapter.

S.-W. converters and adapters are made in 2 types, those with a self-contained power supply and others which secure operating potentials from the receiver to which they are connected. Converters with built-in power supply are preferable since they are more easily connected and place no additional load or stress upon the receiver. The combina-

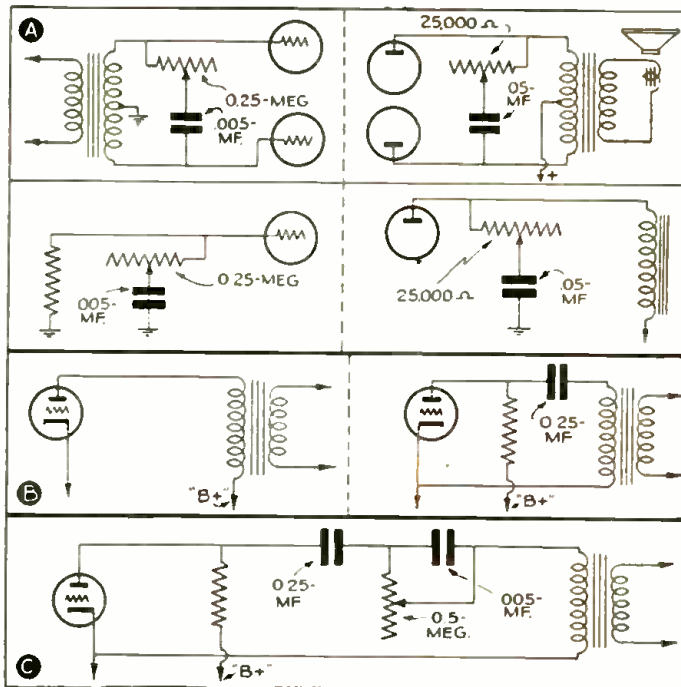


Fig. 4. Adding treble and bass tone controls.

tion of a good short-wave converter coupled to a good broadcast receiver of any type is far better than an inexpensive, poorly-constructed all-wave receiver. A sale of a short-wave converter can generally be made by demonstrating the device upon making a service call.

As a further aid to those who possess good all-wave receivers and appropriate antenna systems, any one of several *preselectors*, available in open market, may be readily suggested to improve considerably performance on the short-wave bands. The better preselectors, equipped with 2 tuned R.F. stages one of which is usually regenerative, self-powered, and easily tuned, are especially applicable to the thousands of all-wave receivers which lack an R.F. stage. Well designed preselectors have much to offer in improving reception on short-wave bands and should appeal to many set-owners, in view of the increased sensitivity and selectivity, and reduction in image-frequency interference.

Another aid to short-wave tuning which is easily sold to short-wave enthusiasts is the *beat-frequency oscillator* (or B.F.O.). This device consists of only a few readily obtainable components, and may be connected directly into the receiver with little trouble. To demonstrate the ease with which short-wave stations may be tuned-in or found if a beat-frequency oscillator is employed, couple a signal generator to the control-grid lead of the I.F. tube with a few turns of insulated wire. Adjust the generator to deliver an *unmodulated* R.F. signal at the frequency to which the I.F. amplifier of the receiver is tuned. As the receiver dial is tuned, the presence of a station will be apparent by "whistles" heard in the reproducer. By tuning between the "whistles," the correct setting is determined; the generator may then be switched off to obtain only the station.

Although easily constructed and mounted upon the chassis of the receiver, it is recommended that a complete B.F.O. unit be secured from any coil manufacturer or supply house. These units are relatively inexpensive and may be obtained in almost any frequency rating to match the frequency of the I.F. amplifier in any receiver. The oscillator

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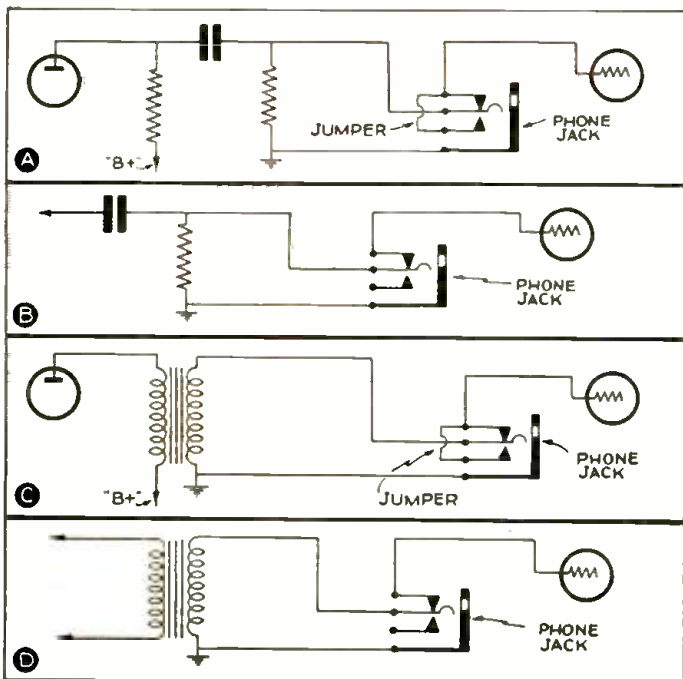


Fig. 3. More phone circuits for your customers.



HOME RADIO DIATHERMY— A GROWING FIELD

Here is a streamlined story, paced in modern tempo, that carries the reader completely through radiotherapy; the author traces the progress from the time of d'Arsonval (1890), forward. The article treats of Short-Wave Diathermy in such way as to acquaint the radio man with a working knowledge which will enable him to intelligently discuss the subject with sales or service customers.

MICHAEL LOONAN

Left.—Portable and shock-proof, 1-tube, 15-meter, 200-W. generator.
Lower-right.—This 16-meter, 275-W. generator has 2 power tubes and rectifiers; and surgery outlet.

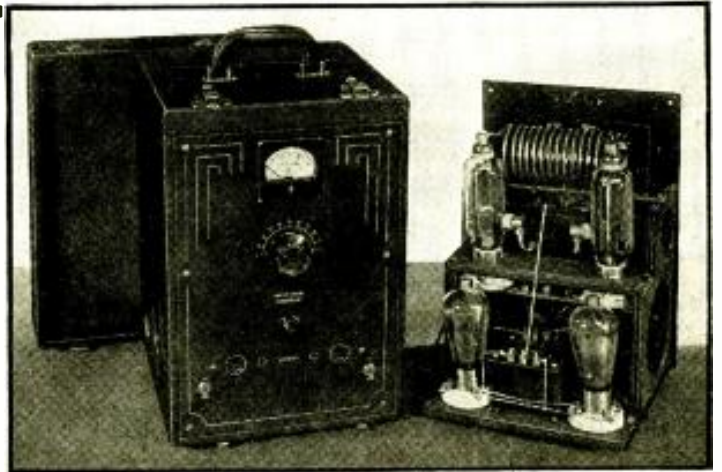
MEDICAL MEN owe as much to Physicists and Engineers as they do to members of their own profession for the striking advances that have been made in Radiotherapy.

A BRIEF HISTORY

Let's go back to 1890 when Professor Arsene d'Arsonval, the eminent physicist, saw possibilities in the apparatus that another physicist, Hertz, had devised to prove the existence of the waves we now use in Radio.

And then came Dr. Willis R. Whitney, another physicist with the fever machine of today, which is nothing more or less than a short-wave wireless set. Out of Radio came Short-Wave Diathermy. Whitney knew more about physics than did the medical men. He had seen eggs cooked in the

(Continued on page 828)



SIDELINE MONEY FOR SERVICE MEN

(Continued from preceding page)

may be mounted in any position in the receiver cabinet and connected to the chassis with leads or adapters supplied for the purpose to secure power. A switch connected into the plate supply of the B.F.O. tube may be mounted into the side of the cabinet so that the oscillator may be turned off conveniently.

For those desirous of constructing the B.F.O. upon the chassis of the receiver, the schematic diagram shown at Fig. 2A may be followed. Any tube like the type 56 or 76 is employed, depending upon whether the B.F.O. is employed with a receiver using 2.5 volt or 6.3 volt tubes.

HEADPHONES AND SPEAKER CONNECTIONS

A frequent request made by owners of radio receivers is for an external connection for headphones or an additional

speaker. This request is easily and completely satisfied with only few required parts and a minimum of effort. Many Service Men make a practice of checking a receiver after repair with phones, in the presence of the customer, solely for the purpose of demonstrating the phones. For the short-wave and DX fan connections for phones prove to be a blessing to his family and neighbors, and enable fishing for short-wave and DX stations without inconveniencing any member of the household.

Some member of almost every family is hard-of-hearing, and a headphone connection for his or her use serves to good advantage for the entire family.

Headphone terminals may be provided on any receiver either through the use of tube adapters obtainable at any supply house, or by wiring directly into the receiver. Probably

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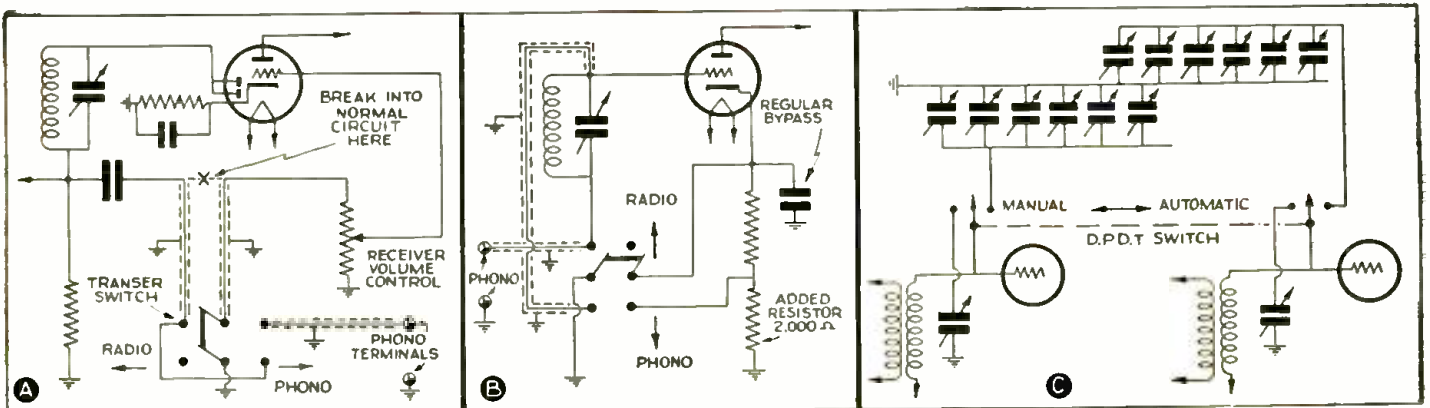


Fig. 5. Suggest these phono-radio and pushbutton-tuning circuit facilities to your customers.

SOUND SPECIALISTS!— CASH-IN ON THIS "A.S.C." ADD-ON UNIT

A critical discussion describing a new technique and a new Audio Spectrum Control Unit which enables you to improve the performance of any sound system!

A. C. SHANEY

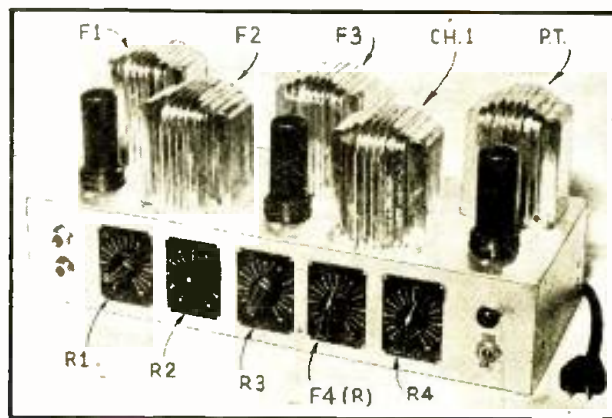


Fig. A. The Audio Spectrum Control "add-on unit." Note the shielded band-pass units.

ANYONE who has read Mr. Hugo Gernsback's editorial on "Public Address Deficiencies" (see *Radio-Craft*, May 1938, page 725) cannot help but come to the conclusion that a chaotic condition exists in the Public Address field; a condition brought about mainly by lack of knowledge, by inexperience, and gullibility.

WHO IS TO BLAME?

Only lack of knowledge can cause a Service Man, engaged in P.A. rental and sales, to set up a system incapable of clear articulation of the human voice. Only inexperience can cause an otherwise competent laboratory technician to install a system characterized by annoying echoes and double sound effects—and only gullibility can cause such a deficient system to be sold to an unsuspecting prospect!

Unfortunately, the blame for existing public address deficiencies cannot be pinned on any one source. Everybody is to blame, including the microphone manufacturer, the amplifier designer, the loudspeaker engineer, the installation technician, and the operator. (Author's Note—We expect a flood of indignant letters from some readers. Nevertheless, it is the very recognition and elimination of these existing deficiencies that will put money into the pockets of sound specialists.)

THE HIDDEN CAUSES

A detailed discussion covering all of the causes and cures for P.A. defi-

ciencies known to exist, would more than fill this entire volume. Suffice it to say, however, that the basic causes are all conditions which prevent the realistic reproduction of sound in exact accordance with the original sound source. The most important academic causes which prevent the attainment of this ideal can be found in the following 4 types of distortion:

(1) *Frequency distortion* (which is produced when all audio frequencies are reproduced unequally well); (2) *amplitude distortion* (which occurs when a given increase in the volume of sound at the microphone does not cause a proportionate increase in the sound output of the loudspeaker); (3) *phase distortion* (which is noticed when some audio frequencies travel faster than others and arrive ahead of their fundamentals and sub-harmonics); (4) *directional distortion* (which is produced when a recreated sound appears to come from some direction other than the one from which you would naturally expect to hear it).

THE CURE-ALL?

As can be expected, there is no single piece of equipment that will cure all forms of undesirable distortion, but a careful study of actual field conditions disclosed an almost unbelievable situation. Before delving into this "find" let us briefly review some attempted "cure-alls."

Most of the early equipment used for

P.A. and allied work (radio amplifiers, sound-on-film recording, broadcasting pick-up and modulating equipment, etc.), was characterized by considerable frequency distortion. In fact, this distortion was so pronounced, that it soon attracted the attention of many progressive engineers. The result was a mad scramble towards a new era. An era of "high fidelity" which was finally adopted and defined by the Federal Communications Commission (covering a permissible 5 db. variation). Not content, however, engineers strove to approach a straight-line-frequency response (within ½-db. or less) as the ultimate in all microphone, amplifier, and speaker design.

A sad discovery was made the first time a high-fidelity microphone was connected to a high-fidelity amplifier and fed into a high-fidelity speaker. While reproduction was good, it was not natural. Other causes of distortion were then carefully checked, and strange as it may seem, it was found that some form of amplitude distortion was actually desirable!

In fact, experiments along these lines soon produced "volume expansion" (which is nothing more than positive amplitude distortion) as well as "volume compression" (a form of negative amplitude distortion). Precautions for the elimination of phase distortion (to which the ear is practically insensitive) and directional distortion did not seem to produce natural reproduction of music and clear articulation of the human voice. Naturally, the cycle of investigation returned to frequency distortion and we ask ourselves today, "Why shouldn't a high-fidelity microphone, plus a high-fidelity amplifier and a high-fidelity speaker, sound natural?"

A NEW ERA—AWAY FROM FLAT FREQUENCY RESPONSE

The engineer who first added a Music-Voice switch to his radio set probably had the correct answer. Strange as it may seem, the frequency response of the amplifier with the switch in the "voice" position was far from flat. In fact, it actually accentuated all voice frequencies and suppressed otherwise desirable low tones. This statement is not to be construed as favoring manu-

(Continued on page 834)

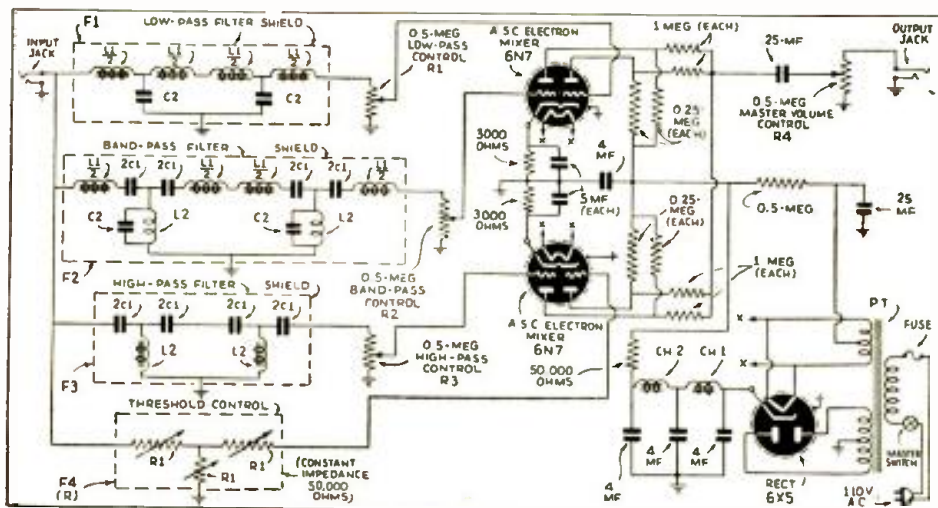


Fig. 1. Schematic diagram of the "A.S.C." add-on unit. The 3 audio filter units are well shielded.

SERVICING PUSHBUTTON

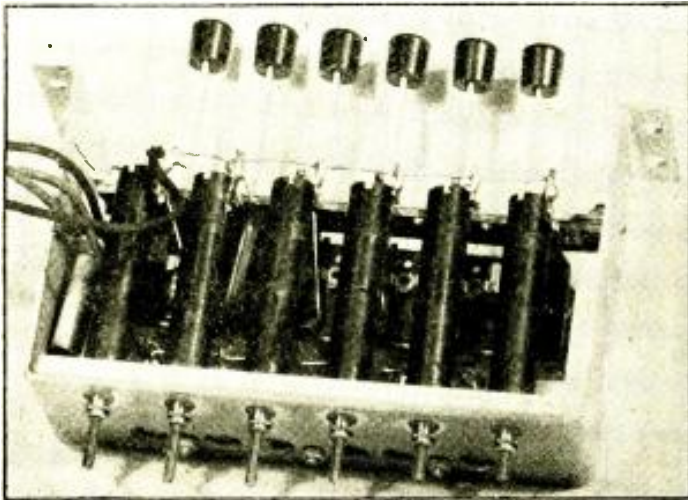


Fig. A. RCA-Victor model 86T6 coil and pushbutton switch assembly.

First part of this installment describes the 5 outstanding types of trimmer-tuned push-button tuning systems; and the basic procedure for setting-up each of these 5 systems. Second part describes the location and correction of the faults in the above systems. Third part describes 3 outstanding types of motor-tuned pushbutton tuning systems; and the basic procedure for setting-up each of these 3 systems.

Fourth part describes the location and correction of the faults in the above systems.

PART I CHARLES SICURANZA

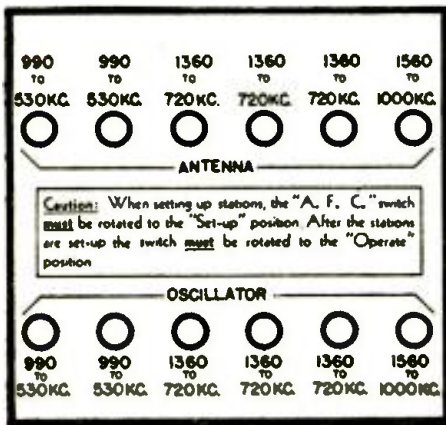


Fig. 1. Stromberg-Carlson models 235 and 245.

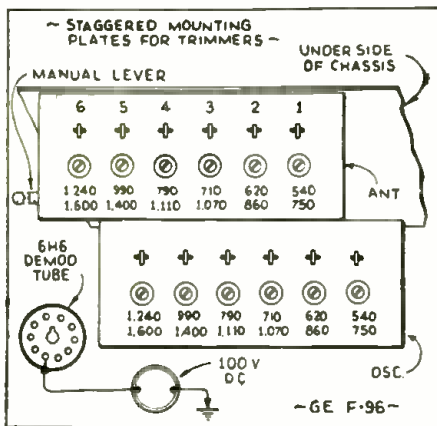


Fig. 2. General Electric model F-96.

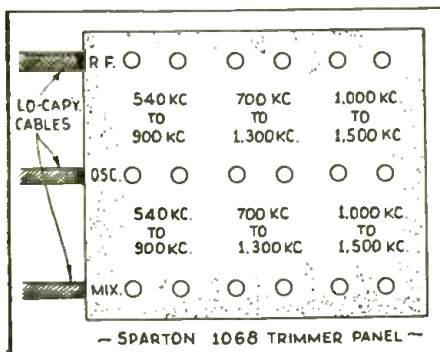


Fig. 3. Sparton model 1068 panel.

“FOR the convenience of the customer”, is the phrase which best describes the reason behind all the hectic activity on the part of radio manufacturers, to supply the phenomenal public demand for “button-tuning” sets.

When these sets were first shown, a few months back, most Service Men took one look and said, “H’m-m-m, more headaches.” And in a way they were right, because some of the sets shown were mechanical marvels, or monstrosities, depending on how much the Service Men knew about things mechanical.

Most of the really good Service Men of my acquaintance rallied to this new challenge by “tangling their hooks” into every brand new button-tuned job they could lay their hands on.

After which, they would calmly dismember the system, analyze the contents, re-assemble it again, and purr contentedly, *IF* it worked again. All of which adds up to this: *these sets are here to stay and they will provide a source of income to Service Men for years to come.*

Logically, now is the time to learn all about these systems, while they are still relatively simple, because you can bet they will become more and more complicated, later on.

NEW VS. OLD SYSTEMS

While it is quite true we have had button- and remote-tuning in past years, nevertheless these were never fully successful because of customer dissatisfaction over a period of years’ service.

It remained for two truly outstanding developments in modern radio to make button-tuning “click” and these are (a) the automatic disengaging latch switch and (b) A.F.C. Whereas in the old systems you would wear a dent in your finger holding the button pressed down, now you merely stab the button in, and that’s all, thanks to the latch. Further, when the old system had finally churned to a stop (usually about 3 or 4 kilocycles off-resonance), you would have to finish tuning-in the set by hand. We have no more of that, thanks to A.F.C.

There are 3 classes of button-tuning, namely: (1) mechanical, (2) motor-driven, and (3) tuned-trimmer types. The servicing methods are different for each class and may vary for subdivisions of each.

SETTING UP THE STATIONS

In the majority of instances, a Service Man will be called upon to set up the stations initially for the dealer, or reset to some favorite station which the customer wants.

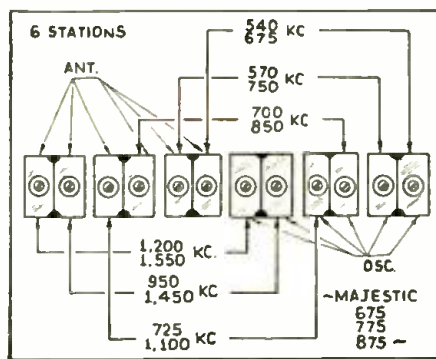


Fig. 4. Majestic models 675, 775 and 875.

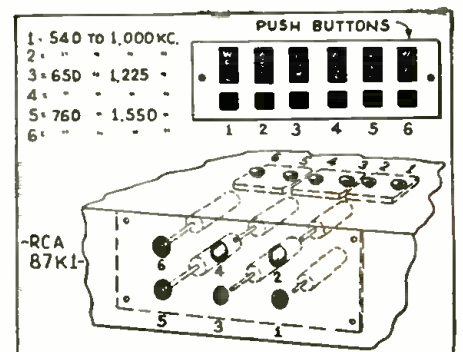


Fig. 5. RCA-Victor model 87K1.

TUNING SYSTEMS

Here is a working treatise, on pushbutton tuning, for the practical Service Man. Says Mr. Sicuranza: "These sets are here to stay and they will provide a source of income to Service Men for years to come."

The Tuned-Trimmed Types. The setting up procedure differs for each class and we will take up the tuned-trimmer type first. In the first place, you will find that these sets are equipped with a switch to disconnect the variable condenser when button-tuning is desired. In the second place, practically all these sets with one or two exceptions, do not make use of an R.F. stage on button-tuning.

In other words, even if the set has an R.F. stage between antenna and mixer grid, it is cut out on button-tuning to eliminate the additional trimmers, wiring and so forth. In the third place, none of these sets has more than 6 buttons (stations) to set up, which means there are 12 trimmers to adjust; 1 antenna and 1 oscillator trimmer for each station. One exception is the Sparton model which has 6 additional trimmers for the R.F. stage in use with button-tuning.

Regardless of make, all these sets come equipped with sheets, on which practically all U.S. station call letters are printed within little squares. The desired station tabs are cut out with a razor blade at the time of setting up. These tabs are inserted in proper order over each button as it is set up. This usually requires removal of the escutcheon plate which covers the latch frame.

One important point to remember is that the trimmers are designed to cover only a limited frequency span. For this reason the buttons are usually numbered, from 1 to 6, and number 1 is always the largest capacity and should, therefore, be adjusted somewhere above 700 kc. You could not, for example, adjust this trimmer to a frequency of 1,400 kc. simply because, even with its leaves wide open, its minimum capacity would be too large for 1,400 kc. The same rule applies to trimmer number 6 which has very little capacity even when tightly closed.

The next important point is that, unless the desired station is on the air, a

signal generator will have to be used to supply the exact frequency required. A generalized procedure to follow would be to tune-in the desired station manually on the dial, the station corresponding to number 1 button somewhere between 700 and 550 kc. Then switch over to button-tuning by means of the switch provided, and don't forget to press-in number 1 button. The next step is to turn the number 1 oscillator trimmer in or out, until the desired station is heard. After trimming the oscillator for maximum signal, adjust antenna trimmer number 1 for greatest volume and clarity.

The same procedure is used in setting up the remaining stations in numerical order, first by tuning-in manually, then switching over and pressing the corresponding button. To check the accuracy of the trimmer adjustment, tune-in the station manually, press-in the corresponding button and then snap the switch from manual to button-tuning.

There should be no drop in volume or change in tone if the trimmers are properly adjusted.

To avoid long leads the trimmers are mounted as closely as possible to the latch switch contacts. The main antenna and oscillator leads coming from the Manual-Button switch are usually enclosed in low-capacity shielded cables. A small metal box encloses the trimmers and wiring as shown in Figs 1, 2, and 3. Notice that the range span of each trimmer is printed under the trimmer screw hole. Figure 1 shows the arrangement used in the Stromberg-Carlson models 235 and 245.

Figure 2 shows the arrangement used in the General Electric F-96 model. This is a special job in one respect, that is, there are 7 buttons, one of which is marked "Manual". When hand tuning is desired the "Manual" button is pressed in and the variable condenser is then connected. Pressing any one of the other 6 buttons releases the "Man-

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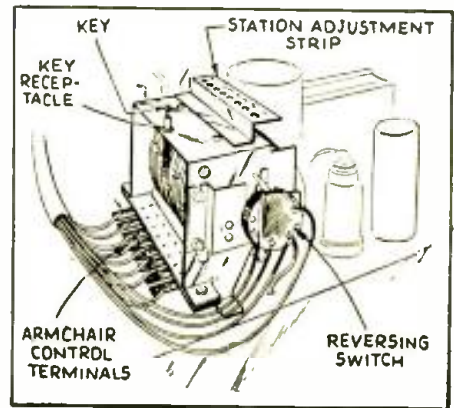


Fig. 6. RCA-Victor disc drum assembly.

NEXT MONTH—

Mechanical-tuned pushbutton tuning systems, their setting-up data, and faults and their correction, will be discussed in the concluding Part II. Both Parts are based on practical experience with many types of pushbutton-tuned receivers; and an analysis of practically every make on the market.

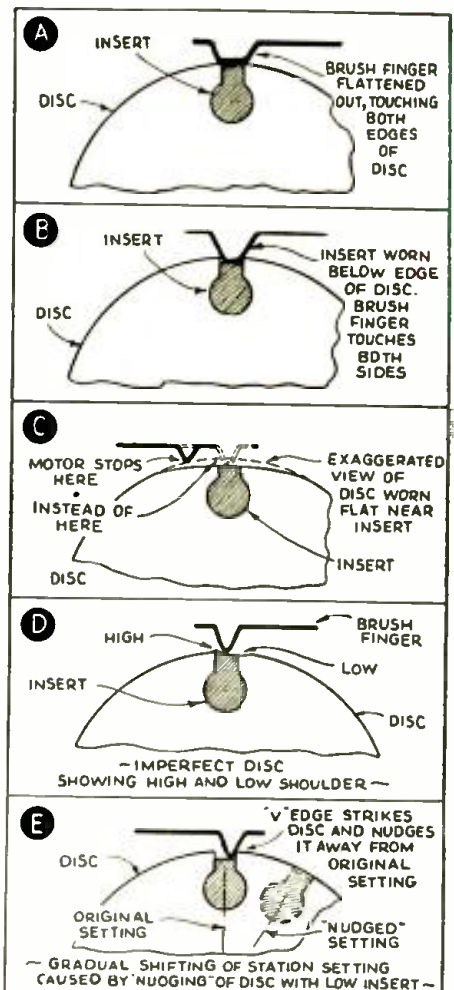


Fig. 8. Details of a pushbutton-tuning unit.

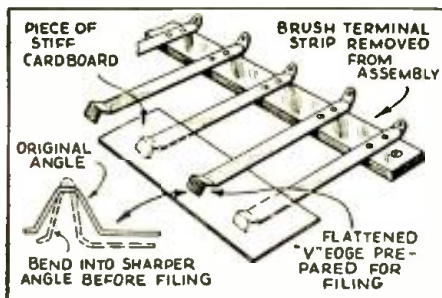


Fig. 9. Use an "ignition" file.

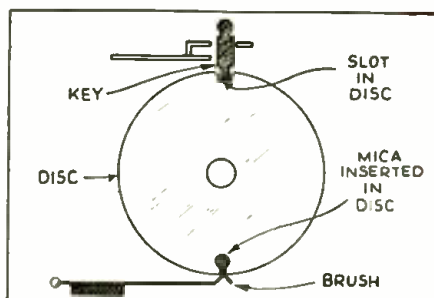


Fig. 7. Key aligns disc and brush; RCA 811K, etc.

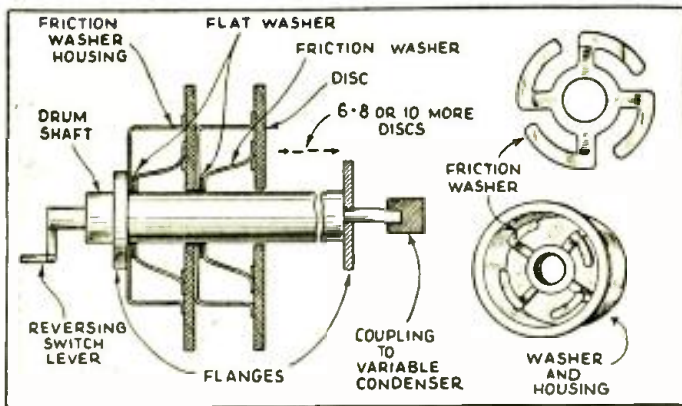


Fig. 10. Close-up of drum shaft, etc. (RCA, Crosley, Majestic, etc.)

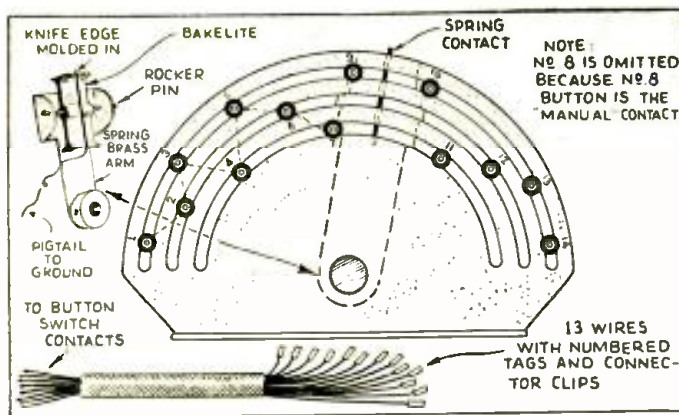


Fig. 11. General Electric motor-tuning sector.

(Continued from preceding page)
 ual" button, thereby automatically cutting the variable condenser out of circuit and instantly tuning-in the station corresponding to the button which was pressed in. The trimmers are mounted on staggered mounting plates which are located on the underside of the chassis. When the trimmers are to be set up, the strip of metal or fibre board at the rear of the chassis must be removed in order to get at the trimmers.

Figure 3 shows the Sparton 1068 trimmer arrangement. Note that 6 additional trimmers are used to tune the R.F. stage, making a total of 18 adjustments, or 3 for each station. Be sure to trim the oscillator first (center row), the mixer next (bottom row), and the antenna last (top row). A "push-pull" knob switch is provided on the front panel to switch from manual to button-tuning. On button-tuning a light shows through a green disc marked "Selectronne".

Figure 4 shows a simple and effective arrangement as used on the Majestic models 675, 775 and 875. Six dual trimmers are mounted directly on the latch button frame. Viewed from the rear, the 6 trimmers on the left side tune the antenna while the 6 trimmers on the right side tune the oscillator. A printed card at the rear of the cabinet shows the trimmer span. A small knob at the bottom center of the front panel enables the user to switch from button to manual tuning.

Figure 5 is a sketch of the RCA-Victor model 87K1 in which 6 small, separate oscillator coils are used for button-tuning. Each of these coils has an adjustable magnetite plug for tuning within the specified range. Three dual trimmers are used to tune the single antenna coil. Photo A shows coil and switch assembly of model 86T6.

The numbers at the back edge of the chassis are for the oscillator adjustments, while those on top are for the antenna. As usual, number 1 is for the lowest frequency stations and number 6 is for the highest frequency.

These 5 examples should be sufficient to acquaint you with the general procedure of setting up stations on the tuned-trimmer type of set.

LOCATING AND CORRECTING FAULTS IN TRIMMER-TUNED SETS

Button Pressed In, No Reception. (1)

May be caused by broken contact on button latch. (2) Shorted plates in trimmer condenser. (3) Broken lead to trimmer or latch contact. (4) Trimmer capacity too small or too large for particular station desired. (5) Defective oscillator coil. (6) Defective antenna coil. (7) Defect in Manual-Button Switch.

Button Pressed In, Poor Reception. (1) May be caused by incorrect setting of oscillator trimmer capacity. (2) Incorrect setting of antenna trimmer. (3) High-resistance contact in oscillator or antenna button circuit, including Manual-Button changeover switch. (4) Two settings of oscillator trimmer will tune in the desired station. Be sure to use the setting which gives maximum volume.

Unwanted station heard when high-frequency station is tuned-in on button. (1) May be due to close proximity to powerful station. (2) Poor image rejectivity of set. (3) Desired station tuned to image-frequency of unwanted station. (4) Code interference rides in with desired station. (5) Adjacent-channel station is heard in background.

Suggested Remedies for Above: (1) Reduce antenna pick-up by series condenser method or by wavetrap adjusted to remove unwanted station. (2) Cannot be helped, because of insufficient R.F. selectivity when using 2-gang condensers. (3) and (4) Use wavetrap to eliminate both. (5) Usually cannot be helped, but try peaking I.F. channel sharply.

In addition to the faults enumerated above, which are, strictly speaking, due to button-tuning defects, there will be occasions when other parts of the set are at fault. One instance is that encountered in sets using A.F.C., which have become misaligned for some reason, so that on manual tuning (without A.F.C.) the station comes in at the correct setting, while on button-tuning (with A.F.C. automatically cut in), the station will come in at the wrong setting, or actually detuned.

Another example of an unusual trouble may be found when 2 trimmer circuits are shorted together in parallel accidentally (on button-tuning). In this case it will be found impossible to tune in the desired station on each of the 2 buttons.

This just about covers the general troubles encountered in trimmer-tuned sets. Specific instances of unusual cases or constantly recurring cases will be dealt with later on.

MOTOR-TUNING TYPES

In contrast to trimmer-tuned sets, motor tuning requires a fractional-horsepower motor, a disc drum, a brush assembly, a special winding on the power transformer and the necessary number of button latch switches.

The modern motor-tuning systems are in many ways similar to the system used several years ago. The similarity ceases at the dial drive arrangement, which in modern sets, must accommodate as many as 7 different wave bands.

It is the writer's belief, that when trouble comes, it will be due to the dial system, rather than the motor drive.

1ST EXAMPLE

Setting up the stations on motor systems is, in general, simpler than setting up trimmer-tuned sets. We will take 3 different sets as examples, the first one being the RCA 811K. Models 813K and 816K also use the same drive system as the 811K.

Figure 6 shows a rear view of the selector drum. Note the station adjustment strip which has 8 small holes, numbered from 1 to 8. To the left is seen the key receptacle and key. This key has a flat milled end which fits the slot at the edge of each disc. The slot in each disc is exactly opposite to the mica insert at the edge of each disc.

Figure 7 shows the appearance of one disc with the key in the slot and the brush at rest on the mica insert. Eight of these discs are used and 8 brush fingers bear against the discs. At the extreme rear of the drum housing is mounted the switch which reverses the direction of motor travel at the instant the variable condenser becomes fully meshed or fully unmeshed.

The drive motor obtains its power from the special winding on the power transformer, through the button switch, by way of the brush contacts on the drum discs, which are grounded to the chassis. Power to the motor is disconnected when the knob marked "Manual-Remote-Electric" is turned to "Manual."

(Continued on page 832)

THE "BEGINNERS' SPECIAL!" —A SIMPLE 1-TUBE SET WITH PUSHBUTTON TUNING

This set is indeed a treat for the newcomer to radio! Its circuit and method of tuning combine simplicity with modernity in a compact, battery-operated, easy-to-build 1-tube set;—so go to it!

H. G. McENTEE

THE little receiver illustrated in Figs. A and B may be used for a variety of purposes, but its greatest appeal will probably be to the beginner. It may easily be made in an evening's work and those of little or no experience will find it very simple to build and use.

The receiver is just the thing for those with poor eyesight since each station is tuned-in by pushing a single button, there being no dials or complicated controls to twiddle. This fact also makes the receiver invaluable for hospital, invalid or child use.

The heart of the receiver is one of the new pushbutton tuning units which is designed for use with a superheterodyne receiver employing 2 tuned circuits. In the present instance the "A" or antenna set of condensers tunes in the station, while the "O" or oscillator set controls regeneration. An extra button is provided on these tuning units to enable connection to an ordinary variable condenser gang. This switch knob and the leads to it are not required in our small receiver.

THE SINGLE, "TWIN-TRIODE" TUBE

A single tube, in this case a 1J6G, is used. This tube is a *twin-triode* and serves as both regenerative detector and audio amplifier. The old 19-type tube is very similar and may be used where the disadvantage of its higher filament drain is important. Both tubes are of the same size, the 1J6G having an octal base, while the 19 has a 6-prong base.

The panel and chassis are made of aluminum. The size is not important, but the set described had a panel 7 ins. square before it was bent. The bend enables the tuning buttons to be operated with more ease, but care must be taken when mounting the pushbutton unit to see that all the tuning condensers on the rear of the unit may be easily reached. If the tube and shield can are not placed properly some of the holes cannot be reached.

The coil is one intended for use as an antenna coupling unit and as such has only 2 windings. We use the secondary as it was intended. The primary then must be used as a tickler. This latter coil has a great many turns and must be altered for our use. Simply remove 100 of these turns. The primary coil, by the way, is the one at the bottom end of the form and it measures about 1/8-in. in width and the same in depth.

The units must be connected exactly as shown in the diagrams, Fig. 1. Note:—This includes connections to coil which must be made just as marked. The designations on the coils are those shown on the manufacturer's slip which is packed with each coil.

TUNING THE PUSHBUTTON TUNER

After all connections are made and *carefully checked*, the set must be tuned. A long, Service Man's insulated screwdriver is needed for this process. Depress a button and tune in the desired stations by turning the "A" screw corresponding to that button. The volume may be brought up by adjusting the associated "O" screw which will control regeneration. Both screws for each button must be so adjusted, but once set, will remain so indefinitely. (The comparatively broad tuning we of course obtain from a set of such abbreviated design makes it unnecessary to invoke the automatic tuning-in characteristic of *automatic frequency*

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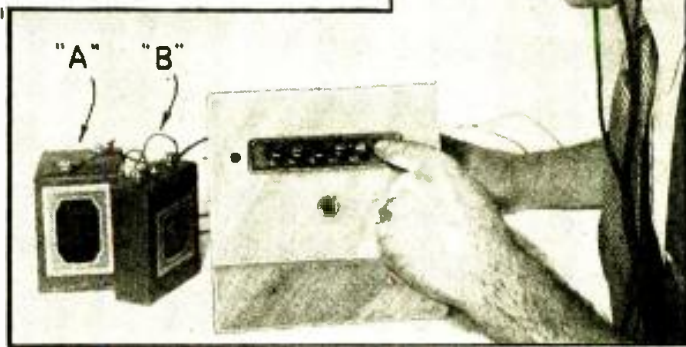


Fig. A. Press a button and there's your station!

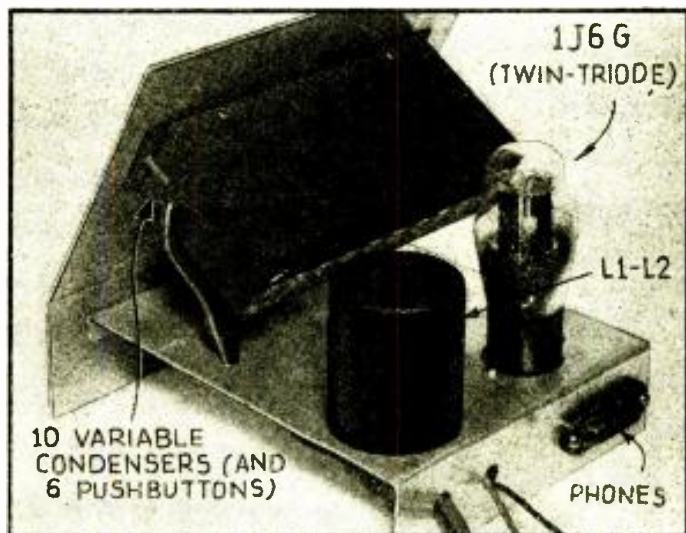


Fig. B. Rear view of the set. Simple, is it not?

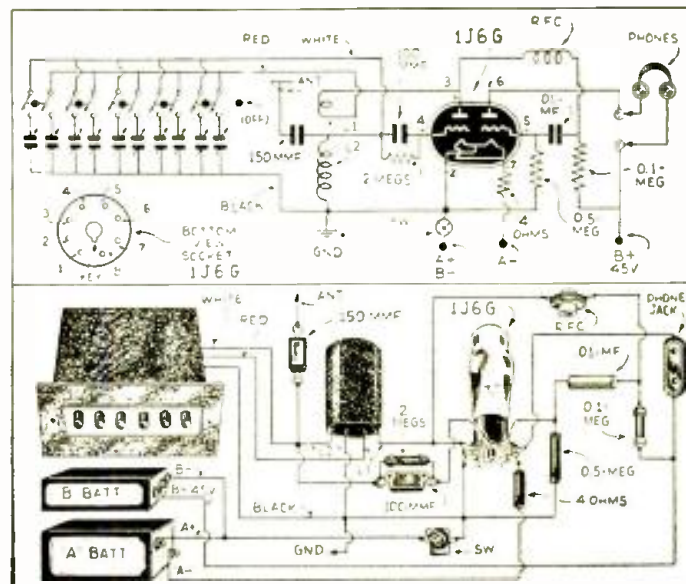
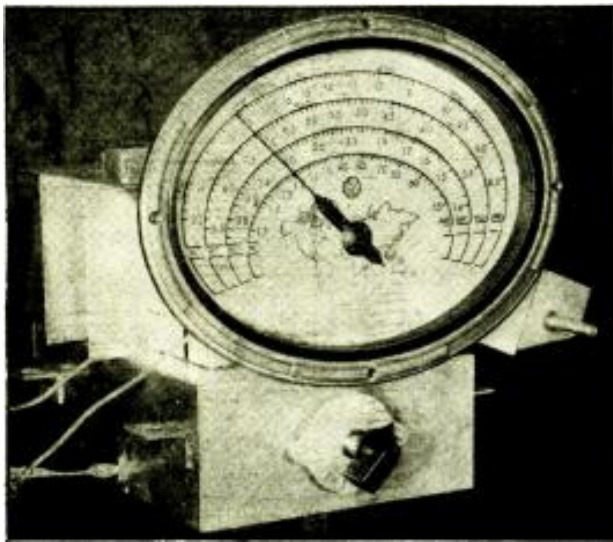


Fig. 1. The schematic (upper) and the pictorial (lower) diagram of the Pushbutton 1-Tube Set.



IT'S EASY TO BUILD THIS "BROWNING 83" 4-BAND SUPERHET.

Preceding installments outlined fundamental design features of this 10-tube set; concluding, Part III details its construction, test and alignment. Service Men and set builders are here offered a radio set incorporating all the best features for DX reception. HERE IS THE BEST SET OF 1938!

GLENN H. BROWNING

IN THE last issue of *Radio-Craft* the writer gave the technical information and performance curves on a 4-band superheterodyne kit receiver designed fundamentally for the amateur, experimenter and DX fan. (Also, *Service Men* are "missing a bet" if they pass up the opportunity, offered by the "Browning 83," of suggesting this receiver to their customers as a replacement of their older, out-moded radio set. There's "good money" in this idea. —Editor)

The heart of the "Browning 83" is a tuning catacomb which is completely wired, aligned, and tracked for an intermediate frequency of 456 kc. Figure 6 gives a complete pictorial diagram of the receiver. (See page 803.)

MOUNTING THE COMPONENTS

It is advisable to mount all tube sockets, shield bases, the power transformer, and I.F. transformers before any wiring is done. The receiver is laid out for either metal or glass tubes with octal-bases. If glass-type tubes are used tube shields must be employed. The same mounting screws hold the tube sockets which mount on the underside

of the chassis and the tube shield bases which mount on the top of the chassis. It is important to have the tube socket contacts in such positions as to make the leads carrying the radio-frequency currents as short as possible. In mounting the I.F. transformers, be sure that the adjusting screws on the face of I.F.T.1 face the rear of the chassis while those of I.F.T.2 face the side of the chassis. It will be noted that several extra holes have been included in the chassis. These are provided for the addition of various circuits—which experimenters may wish to add to the receiver—such as noise-suppression circuits, a beat-frequency oscillator, and a 2-stage I.F. amplifier, according to the individual's desire.

In mounting condensers, be sure to observe the proper polarity as indicated in Figs. 1 and 6. (Figure 1 is the schematic diagram which appeared in the 2 preceding installments.) This is especially important in the case of electrolytic condensers which will fail immediately if connected with wrong polarity.

So that the completely wired receiver may be most conveniently checked or serviced, it is advantageous to employ various colors in wiring the various portions of the circuit. For instance, red wire may be used for all leads which carry the full "B"-plus voltage of 230 volts. Brown wire may be employed for screen-grid leads which are at a potential of about 100 volts above the chassis. Green may be employed for control-grid leads, blue for plate leads, while black may be used for all connections to ground as well as for filament wiring.

Other circuits which do not fall under the above classifications may be wired with any desired colors so they may be easily distinguished. The leads on resistors and condensers as supplied may be a great deal longer than necessary. These should be cut to the correct length before installation. It is always advisable to keep all leads as short as convenient. It is advisable to do the wiring in the following order: Wire all filament, power supply, etc., then add the resistors and then the condensers. (See Fig. 6.) Temporarily chassis-mount the volume controls, and do all possible wiring, before mounting tuner.

There are 4 extra holes for controls, etc., drilled in the front of the chassis. However, there are no extra holes in the panel. These holes have been placed in the chassis for the convenience of the experimenter in adding extra front-panel controls. Thus, if a beat-frequency oscillator is used, an off-and-on switch may be installed readily.

A phone jack or a phonograph pickup jack may be incorporated easily. Also a stand-by switch may be desired, or a control for a noise-suppression circuit.

MOUNTING THE TUNER

The tuner is mounted on 8 soft-rubber grommets and held to and insulated from the main chassis by means of 4 machine screws, 4 insulating washers, and 4 metal washers. If the tuner is properly mounted, it will be entirely insulated from the main chassis as far as the mounting is concerned. The tuner is grounded to the main chassis by the low-resistance, tinned, copper braid connected to the tuner. This should be securely soldered to the chassis or to a ground soldering lug.

The leads from the doublet antenna should not pass over the bottom of the tuner chassis but should be run along the side; otherwise coupling may be obtained between these leads and the coils located in the tuner. The connections from the 100 mmf. and 0.002-mf. condensers to the oscillator coils should be made by means of rigid leads, as short as possible. These leads must be covered with spaghetti so that they cannot touch the tuner chassis or the base of the cabinet in which the receiver may be mounted.

MOUNTING THE DIAL AND PANEL

The large dial is attached to the tuner chassis by means of 2 self-tapping screws. The slots in the mounting bracket allow for adjusting the dial parallel to the tuner. Two set-screws in the hub of the dial fasten it to the shaft of the main tuning condensers. Before the screws are finally tightened, be sure that the condenser gang may be turned throughout its full range by means of the dial tuning shaft. So that the receiver will check the frequencies indicated on the dial, the pointer should

(Continued on page 804)

TABLE OF VOLTAGES AND CURRENTS

	Tube	Voltage*	Voltage**	Current (Ma.)
6K7 R.F.	Plus B	230.	230.	
	Plate	230.	230.	
	S.-G.	90.	90.	
	Cath.	2.3	.8	
	Ip Isg			4.7 1.1
6A8 Pentagrid Converter	Plate	227.	227.	
	S.-G.	90.	90.	
	Cath.	2.6	2.6	
	Ip Isg Iag			3.0 3.5 4.0
6K7 I.F.	Plate	225.	225.	
	S.-G.	90.	90.	
	Cath.	2.9	2.4	
	Ip Isg			4.7 1.0
6K5 Audio Amplifier	Plate	160.	120.	
	Cath.	1.75	1.3	
	Ip			.7
6C5 Phase Inverter	Plate †Bias	200.	180.	
	Ip	6.	1.	
				1.3
6F6's Output	Plate	225.	225.	
	S.-G.	230.	230.	
	Cath.	14.	14.	
	Ig Icq			25. 6.

*Using an infinite-resistance voltmeter.

**1000 ohms/volt meter.

†Control-grid to cathode.

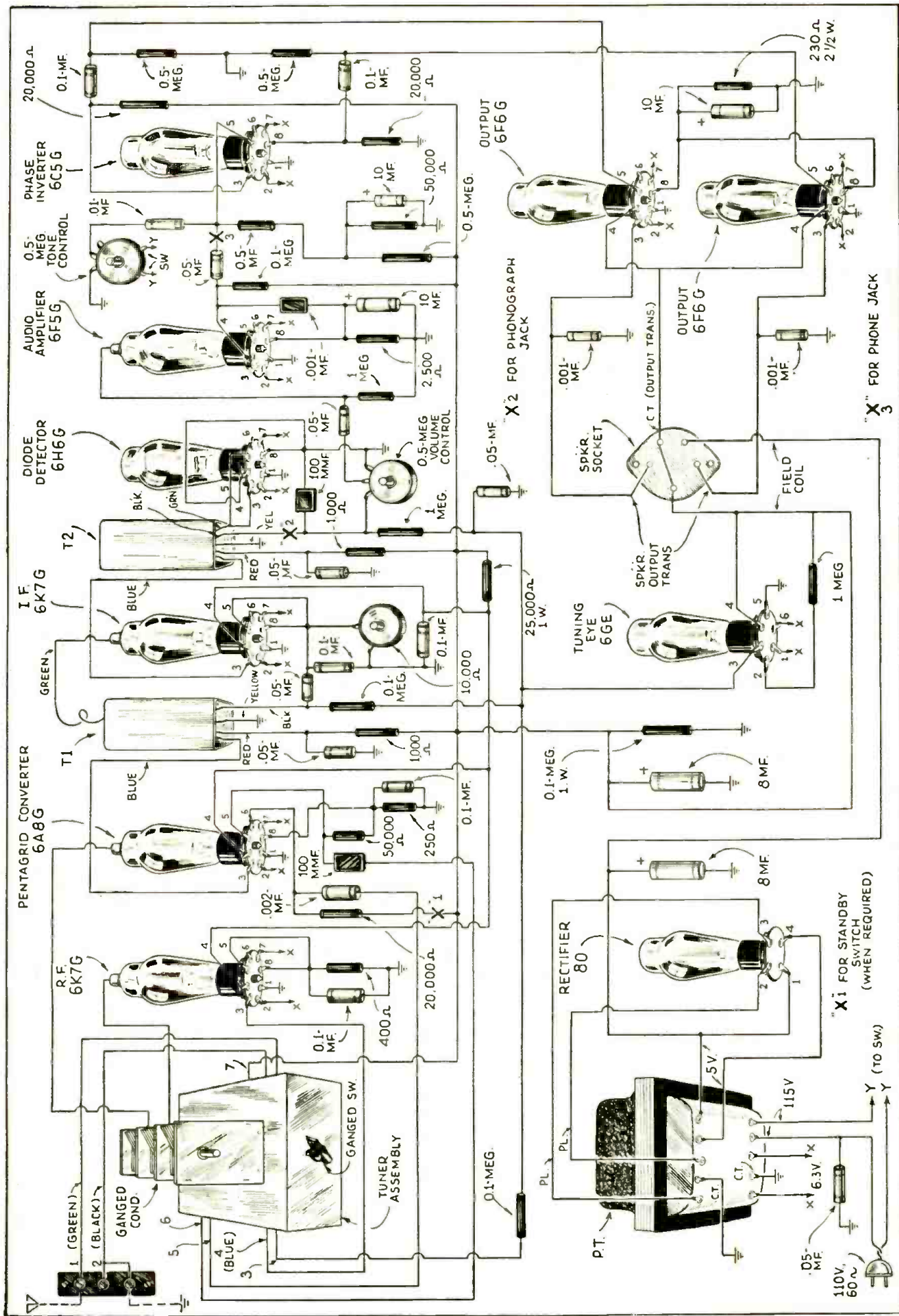
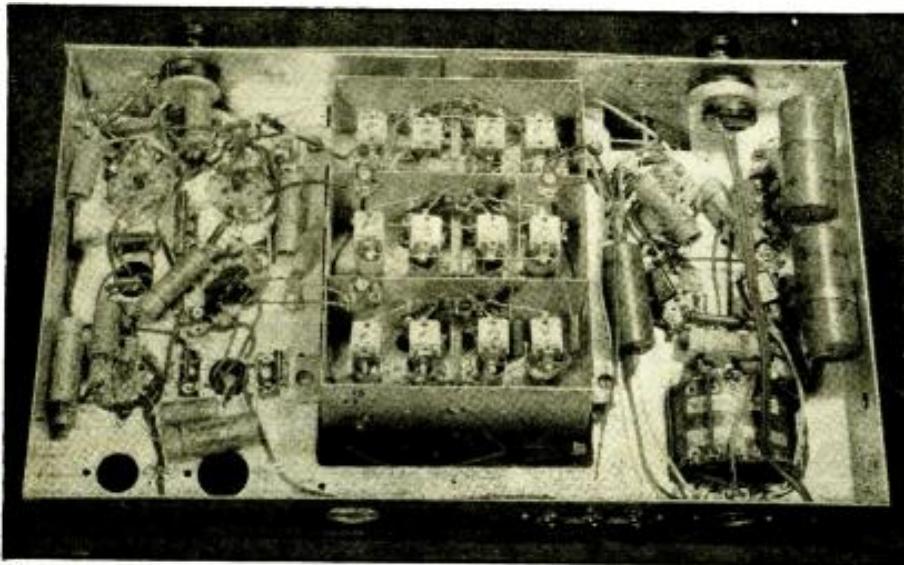


Fig. 6. Pictorial wiring diagram of the "Browning 83" 10-tube, 4-band, superheterodyne receiver. The I.F. is 456 kc. The "tuning eye" is a 6G5.



Underside view of the complete chassis. In the center are located the aligning condensers of the tuner.

(Continued from page 802)

be set at the line marked BAND with the condenser plates fully in-mesh (maximum capacity). The pointer may be moved on its shaft slightly to make this adjustment. The dial should be mounted on the tuner and the pointer properly set before the front panel is put in place.

When the dial has been mounted on the tuner chassis and the pointer adjusted to its correct position, the panel, upon which has been mounted the dial escutcheon, can be fastened to the main chassis. The panel is held in place by means of the lock-nuts which secure the volume control and tone control potentiometers. Care should be taken that when the panel is in place the dial on the tuner does not touch the front-panel escutcheon; otherwise chassis currents will be set up which may cause noisy reception (as on the H.-F. bands).

CHECKING WIRING AND FINAL ADJUSTMENTS

After the wiring has been completed, the experimenter should check the wiring with the schematic wiring diagram (Fig. 1) which has appeared in previous articles. (This will usually locate faulty connections more easily than checking against the sectionalized diagrams supplied with the tuner.)

When the wiring of the receiver has been carefully checked, it is ready for trial operation and should, when the antenna and ground are connected and the set turned on, bring in signals. Be sure to plug-in the loudspeaker before turning on the set; otherwise abnormal voltage will be thrust on one of the filter condensers. If no signals are received with a reasonable length of antenna, the wiring of the set should be further checked before changing alignment of either the I.F. transformers or the trimming or padding condensers in the tuner itself. The set should bring in signals before attempting final alignment.

I.F. ALIGNMENT (WITHOUT A SIGNAL GENERATOR)

In all alignment procedure it is advisable to use a small insulated screw-

driver for making adjustments, thus minimizing body capacities.

The I.F. transformers have been carefully aligned at the laboratory to the intermediate frequency of 456 kc. However, lead and tube capacities will materially affect the tuned circuits connected to the grid and plate circuits of the tubes. Therefore, it is necessary to make slight adjustments on the 4 tuned circuits connected to the control-grids and plates of the tubes.

The link circuit of each transformer, however, is unaffected by lead and tube capacities and acts as a key for the alignment of the I.F. transformers at the correct intermediate frequency. (If the receiver were not aligned at the correct intermediate frequency, the tracking of the tuner would be impaired and the received frequencies would not check with the dial calibration.) The link circuit in both I.F.T.1 and I.F.T.2 is adjusted by means of the center screw. **DO NOT CHANGE THIS ADJUSTMENT** except as described hereafter.

To make adjustments, proceed as follows:

- (1) Connect antenna to antenna binding post.
- (2) Turn on receiver. (Tone control should be set at its maximum counter-clockwise position without turning off the set.)
- (3) Turn both audio and I.F. volume controls to the point of maximum response. (Rotate clockwise as far as possible.)
- (4) Set band-selector switch on band 4. (Broadcast band.)
- (5) Adjust tuning condensers so as to receive a relatively weak signal.
- (6) Adjust the top and bottom screws on I.F.T.2 for maximum signal response.
- (7) In case the adjustment procedure in (6) results in a very loud signal, tune-in a weaker station and adjust the top and bottom screws on I.F.T.1 for maximum signal.
- (8) Remove antenna.

(Continued on page 826)

HIGHLIGHTS OF THE "BROWNING 83"

Complete 4-band tuner assembled, wired, prealigned; range, 0.54- to 22 megacycles (13.6 to 555 meters);

Large, high-ratio, vernier, megacycle dial;

High signal-to-noise ratio;

Diode detection; A.V.C.; 10 tubes; visual tuning indicator;

Triple-tuned I.F. circuits with variable gain controllable from front of panel;

Push-pull 6F6 output with phase inversion; High-quality speaker to match receiver;

Added chassis holes provide for: noise-suppression circuit, phono pickup, headphone jack, stand-by switch, beat-frequency oscillator, and a 2-stage I.F. oscillator.

LIST OF PARTS (Parts Nos. refer to Fig 1, Parts I and II.)

- One Browning tuner, model No. 1;
- One Browning dial and escutcheon;
- One Browning band-switch escutcheon;
- One Browning bakelite antenna strip;
- One Browning drilled black crinkle panel;
- One Browning drilled cadmium-plated chassis;
- One Browning I.F. trans., 456 kc., I.F.T.1;
- One Browning I.F. trans., 456 kc., I.F.T.2;
- Five Browning 7 x 22 in. pictorial wiring diagrams and instructions;
- *One power and filament transformer with static shield;
- One Browning special etched and engraved panel;
- One I.R.C. resistor, 230 ohms, 2.5 W., R25;
- One I.R.C. resistor, 250 ohms, 0.5-W., R4;
- One I.R.C. resistor, 400 ohms, 0.5-W., R2;
- One I.R.C. resistor, 0.5-W., R27;
- Two I.R.C. resistors, 1,000 ohms, 0.5-W., R5, R9;
- Two I.R.C. resistors, 50,000 ohms, 0.5-W., R13, R21;
- One I.R.C. resistor, 20,000 ohms, 0.5-W., R3;
- Two I.R.C. resistors, 20,000 ohms, 0.5-W. (5% tolerance), R20, R22;
- One I.R.C. resistor, 25,000 ohms, 1.0 W., R26;
- One I.R.C. resistor, 50,000 ohms, 0.5-W., R7;
- Three I.R.C. resistors, 0.1-meg., 0.5-W., R1, R6, R14;
- One I.R.C. resistor, 0.1-meg., 1.0-W., R16;
- Four I.R.C. resistors, 0.5-meg., 0.5-W., R18, R19, R23, R24;
- Three I.R.C. resistors, 1. meg. 0.5-W., R10, R12, R17;
- *One paper cond., 0.01-mf., 400 V., C11;
- *Seven paper condensers, 0.05-mf., 600 V., C5, C6, C8, C12, C15, C23, C24;
- *Six paper condensers, 0.1-mf., 400 V., C1, C4, C7, C17, C18, C22;
- *Two tubular electrolytic condensers, with clamp, 475 V. working, 600 V. peak., 8 mf., C13, C14;
- *Three tubular electrolytic condensers, 50 V. working, 75 V. peak, 10 mf., C10, C16, C19;
- *One mica condenser, 0.002-mf., C2;
- *Two mica condensers, 100-mmf., C3, C9;
- *Three mica condensers, 0.001-mf., C20, C21, C25;
- One Centralab resistor, 500 ohms fixed, 10,000 ohms variable potenti., right-hand taper, R8;
- One Centralab variable potenti. resistor, 0.5-meg., left-hand taper, R11;
- One Centralab variable potenti. resistor, 0.5-meg., right-hand taper, with A.C. switch, R15;
- One Wright-DeCoster loudspeaker (special for "Browning 83"), BL 1100, 1,200-ohm field;
- Two RCA type 6K7 tubes;
- One RCA type 6A8 tube;
- One RCA type 6H6 tube;
- One RCA type 6F5 tube;
- One RCA type 6C5 tube;
- Two RCA type 6F6 tubes;
- One RCA type 80 tube;
- One RCA type 6G5 tube;
- (Glass-hulb equivalent types, as shown in Fig. 6, may be used.)
- *Eleven wafer sockets for tubes and loudspeaker.

*Most Radio mail order houses can supply this item if properly identified as to title of article, issue (month) of Radio-Craft and year.

NEW AMPLIFIER HAS ADJUSTABLE FREQUENCY CHARACTERISTICS

Some high-fidelity purists shiver at mention of a "tone-control"; but, it's useful!

THE problem confronting installation organizations has always been one of obtaining the proper type of reproduction—that is, the Public Address system should do only one thing. It should increase the sound intensity but in no way alter the character of the sound.

It is relatively easy at the present time to obtain P.A. equipment, starting in from the microphone on through the amplifier, to and including the loudspeakers and various accessories, that has a high order of faithfully reproducing, at an increased volume, the sounds or the program entering the microphone.

We have, however, generally speaking, one portion of our system which is ordinarily fixed and that is the enclosure in which the installation is to be made. Generally it is difficult to obtain the proper type of acoustic treatment in the halls, churches, theatres, etc., ordinarily encountered. Consequently, we find that although the reproducing equipment is of a high order, the tone emanating from the loudspeakers is frequently unnatural, or at least so sounds to the listener.

(Continued on page 842)

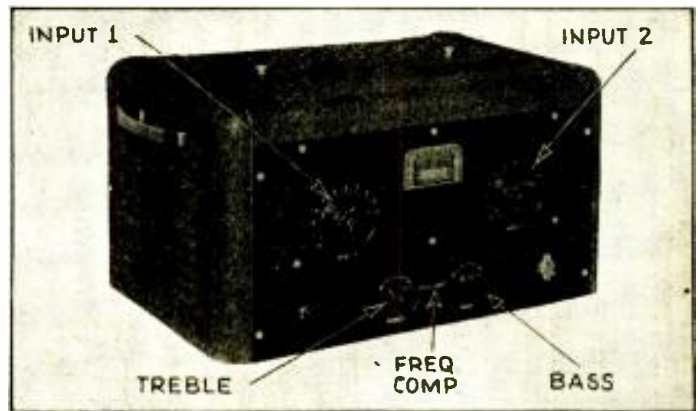


Fig. A. This amplifier permits compensating acoustic conditions.

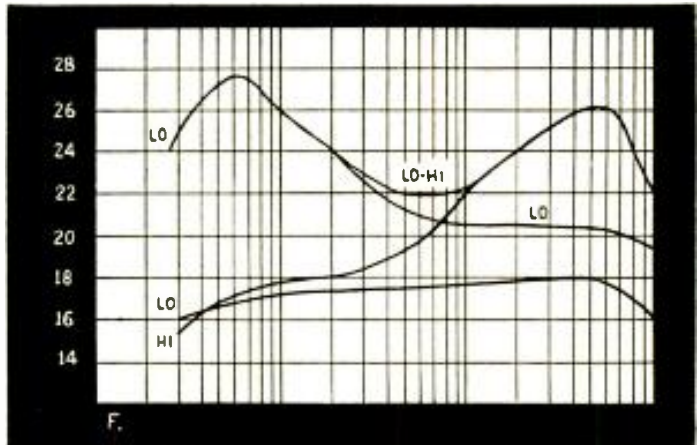


Fig. 1. "NO" curve is with both tone controls in off position; "HI" curve is with Treble Tone Control full-on; "LO" curve is with Bass Tone Control full-on; "LO-HI" is with both tone controls full-on. "F" indicates frequency.

A 'SCOPE THAT SPEEDS RADIO SERVICING

By placing special emphasis on design specifications of a 3-inch oscilloscope to achieve fast performance in service work, at comparatively low cost, the Service Man now has available an instrument that should help increase his profits.

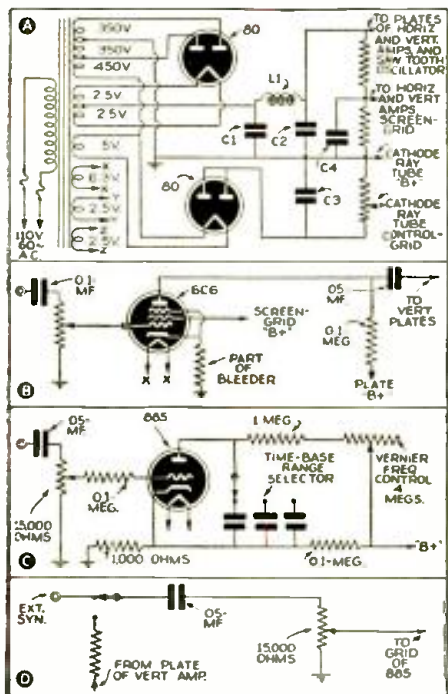


Fig. 1. A—basic rectifier circuit; B—basic wide-frequency-range amplifier; C—basic linear time base; D—extremely simple, effective synchronizing circuit.

SAMUEL C. MILBOURNE

MOST Service Men are delaying the purchase of cathode-ray oscilloscopes for one or more of 3 reasons: (1) They are afraid that the equipment will be so complicated that they can not learn to operate it; (2) they have to be shown that it has enough use around the shop to at least pay for itself; and, (3) they haven't a hundred dollars to spend on this unit.

When cathode-ray oscilloscopes were first introduced, they sold for around \$100 and were rather complicated to use. Many time-saving operations were not developed at that date nor was the Service Man given a clear picture as to just what he could expect from his 'scope.

Many educational lectures and much literature on 'scopes have rolled under the bridge and the Service Man is slowly awakening to the amazing possibilities for 'scope use in not only speeding up his present service work, but in servicing radio equipment more satisfactorily. He is finding out that, with the service-type oscilloscope he has a powerful "third" eye which will allow

(Continued on page 836)



Fig. A. The complete 3-in. 'scope.

NEW CIRCUITS IN MODERN RADIO RECEIVERS

The details of the modern radio receiver circuits that make them "different" from previous designs are illustrated and described each month by a well-known technician.

F. L. SPRAYBERRY No. 9

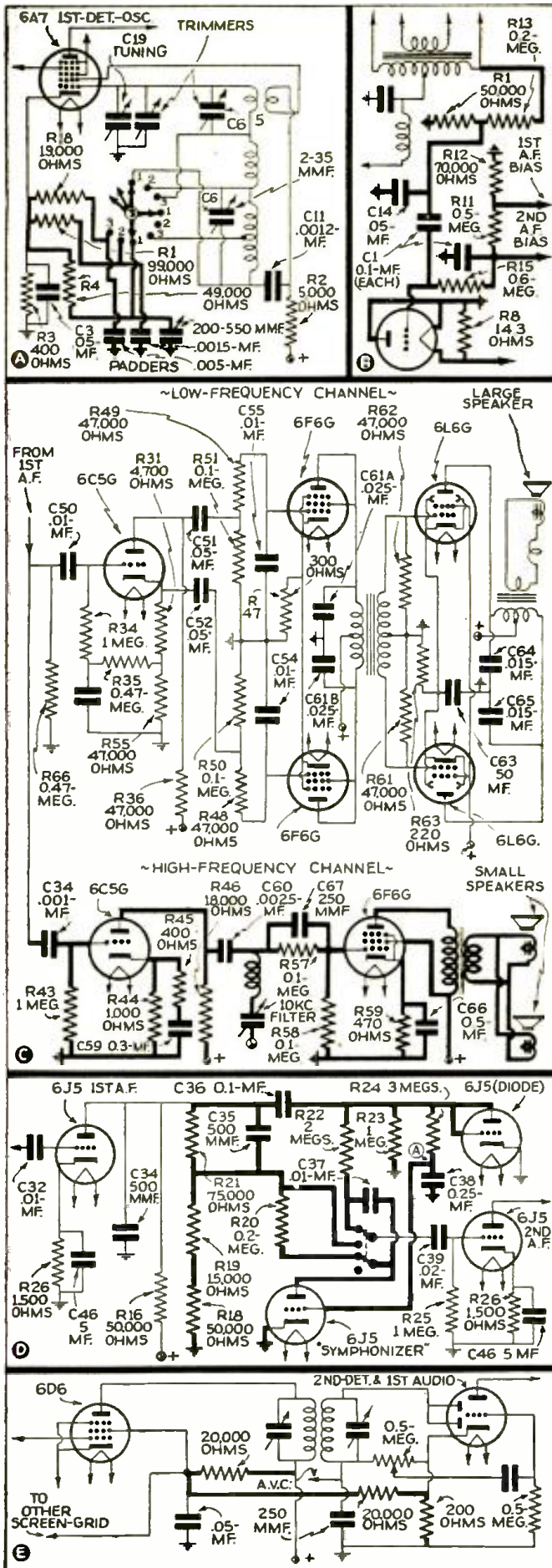


Fig. 1. Heavy lines in the circuits accentuate the points discussed in the text.

(1) ALL-BAND OSCILLATOR STABILITY

Zenith Models 6B-107, 6B-129, 6B-164. *Stable performance of the oscillator in every band is acquired in the new Zenith line (chassis 5635 and 5707) by using a separate grid leak for each band.*

As shown in Fig. 1A, the padding condensers serve as grid condensers and the band switch for the oscillator-grid coils connects the proper grid leak resistor in the circuit for each band. At higher frequencies, even with the same amount of feedback, there would be more rectified grid current which would bias the tube higher and make it more critical in operation—more likely to stop oscillation. However, if we lower the grid leak value, the bias may be made the same for high frequencies as for low frequencies, making the plate current the same in any band.

(2) SEPARATE "C"-BIAS IN BATTERY SET

Climax Radio and Television Co. Model 6PV. *For improved power efficiency an independent bias supply is used in this receiver not limited to the battery voltage and not wasting plate current at the expense of short vibrator life.*

The auxiliary bias circuit (see Fig. 1B) takes about 20% of the peak power output high voltage at the junction of the divider R13—R1, partially filters it by C14, and through C1 feeds it into the control-grid of a 30 tube, the plate and cathode of which are grounded. The high-resistance divider R15—R11—R12 selects the proper negative voltages for the 1st and 2nd A.F. amplifiers. The load on the vibrator is negligible while the bias voltages are adequate and could be somewhat greater if needed at the same efficiency.

(3) SEPARATE H.F. AND L.F. AUDIO CHANNELS

Sparton Model 1867. *Separate high- and low-frequency channels in the A.F. section of the receiver give full realization of high-fidelity.*

As in Fig. 1C immediately following the 1st audio output, the signal circuit takes 2 paths; one, through an amplifier designed to fulfill all of the low-frequency requirements of the signal, and the other to fulfill all of the high-frequency requirements. The signals come together again only as sound waves as separate speakers are used. As the high-frequency section carries frequencies considerably above 10 kc. it is provided with a 10 kc. band elimination filter to bypass any heterodyne between adjacent station carriers.

(4) SYMPHONIZER VOLUME EXPANDER

Emerson Model AB-184. *"Symphonizer" volume expander uses tube as one section of an automatic signal voltage divider when switched in the circuit for operation.*

From Fig. 1D it will be noted that a very small signal induced through C36 from the 1st A.F. amplifier will form a very low negative voltage at A or at the 6J5 symphonizer grid. As no other bias is used on this tube its plate current will be relatively large and its plate resistance compared to R20 will be low. Thus only a small portion of the total signal across R20 and the tube is available at the plate of the 6J5 symphonizer. This reaches the second A.F. grid through C37 and C39. As the signal strength increases, the

(Continued on page 821)

APPLICATIONS OF A LOW-COST VOLT-OHM-MILLIAMMETER

Electrical household appliances as well as radio apparatus can be easily and accurately tested with this simple inexpensive unit.

MILTON REINER

SO many different factors affect the earnings (actual and potential) of the average person, that it would be absurd to give any arbitrary advice that would apply to everyone. Of course the *potential capacity for money-making* is increased by acquiring more knowledge and experience. And this is achieved in turn by study, work, reading, observation and experimentation;—so let us profit by using every opportunity available in this direction.

Be alert to *all* avenues that might yield some revenue and which are ordinarily overlooked in the run of radio service business. This includes the repair of electrical appliances, repair and installation of inter-communicating systems, annunciator, bell and electronic devices. List the various applications of drycell and storage batteries in your community or neighborhood and then make an active effort to service or repair such applications.

There is a growing demand for repair work on electrical toys and many a household appliance job is merely the repair of the line cord. The essential equipment needed is small and consists of a few inexpensive tools and a simple, low-cost testing instrument of some kind. With these facts in mind the Multitester *illustrated and described herewith* was designed. It meets the comprehensive requirements consistent with commercial accuracy.

The one instrument that is most widely used by radio Service Men generally as well as by electrical repair men is a Multitester or combination volt-ohm-milliammeter. The

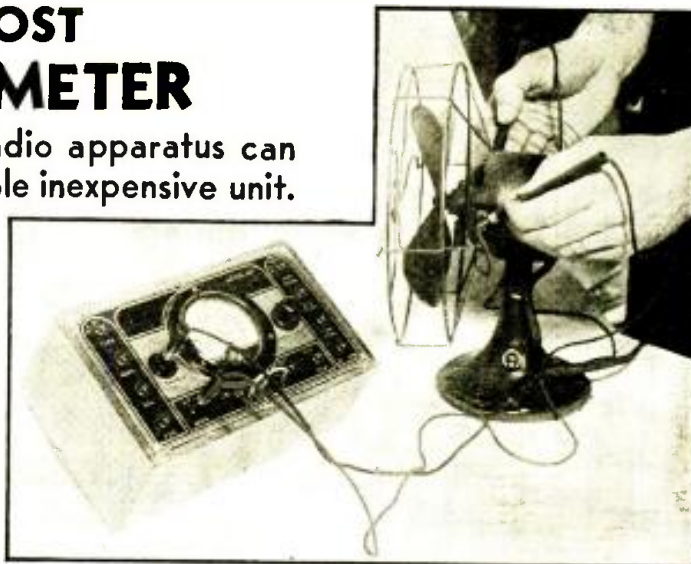


Fig. A. The low-cost helps the radio man get a little "side" money.

requirements in range, sensitivity, accuracy, quality and appearance will vary considerably with highly specialized applications but these instances are relatively few and the instrument built and described by the writer will suit the needs of the vast majority of Service Men or about 90 per cent of them.

SUITABLE METER CHARACTERISTICS

Particular emphasis has been put on economy without sacrificing quality or appearance. The cost (less than \$10) is well within the reach of the beginner or the repairman who is pressed for economy.

(Continued on page 837)

OPPORTUNITIES IN OUTDOOR P.A.

A new speaker, radically designed for outdoor public address installations, is a powerful stimulant for increased sales of outdoor Public Address systems.

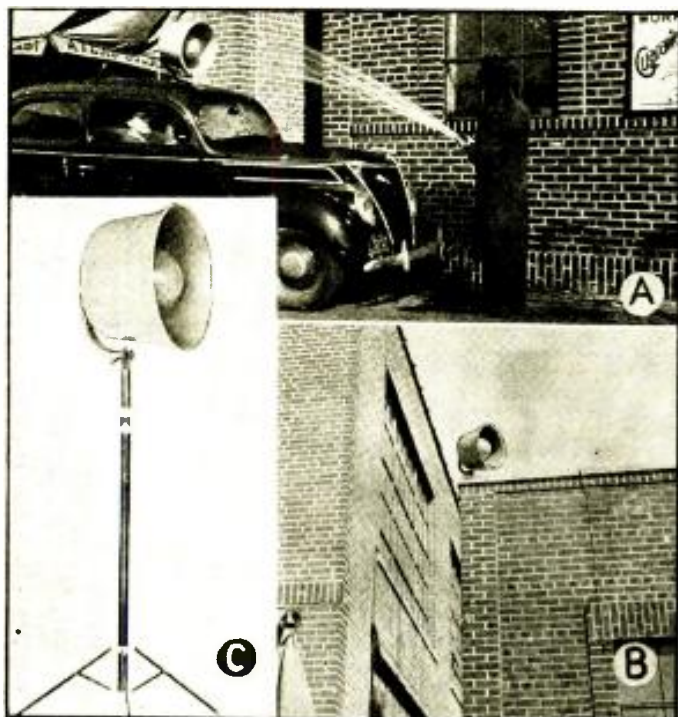


Fig. A. As shown in A, pumping water directly into the speaker does not affect its operation in the least. This demonstration sells the speaker on sight. In B, the speaker is shown permanently installed. The stand mounting in C, is excellently utilized in temporary outdoor installations.

R. C. REINHARDT

PUBLIC ADDRESS men are not taking full advantage of the possibilities of outdoor sound equipment installations. There are numerous installations which remain undone because of the lack of activity of men in the business who neglect this type of installation, and which sometimes proves the most remunerative and profitable.

For years, many good sound contractors have been shying away from the installation of outdoor P.A. systems, because of the lack of a good weatherproof speaker which was durable, efficient, and moderately priced. There is a constant need for a speaker which could stand a driving rain, and an average of 3 years of outdoor service.

LIMITATIONS OF VARIOUS LOUDSPEAKER TYPES

Trumpet-type units are effective, but the price of horns and units often prohibits the sale of a P.A. installation.

Another difficulty which presents itself is the fact that cone speakers are not only exposed to weather, but also to mechanical difficulties such as the damaging of a cone by accident or by the work of vandals.

Another important factor which thwarted a good sound prospect was the necessity of a multiple lineup of speakers to insure proper coverage of the given area. The cost of the speakers was so great that the installation was often lost.

A new marine-type speaker unit using cone speakers of 8-in. and 12-in. sizes has been introduced which will solve all these problems for the P.A. man.

PROFIT-MAKING APPLICATIONS

This speaker horn will enable sound contractors to contact

(Continued on page 845)

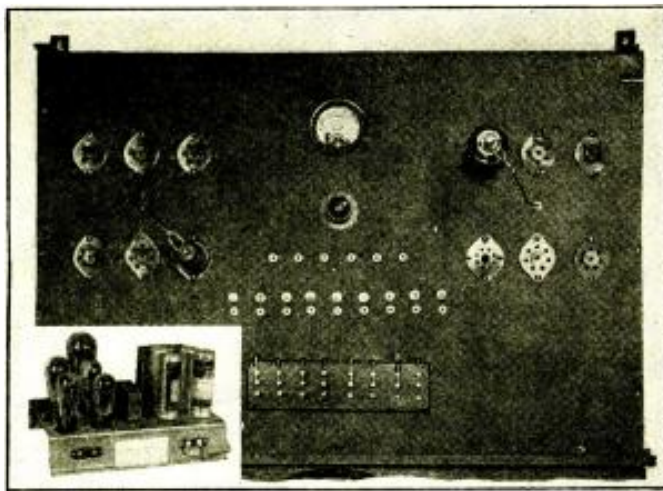


Fig. C. Close-up of the panel layout and, in the inset, the amplifier.

LIST OF PARTS

- One I.R.C. type DHA resistor, 20,000 ohms, 10 W. (minimum dissipation rating);
- One I.R.C. resistor, 7 megohms, 1 W.;
- One I.R.C. resistor, 0.5-meg., 1 W.;
- One I.R.C. resistor, 0.25-meg., 1 W.;
- One Centralab resistor, 0.1-meg., 1 W.;
- One Centralab resistor, 50,000 ohms, 1 W.;
- Two Centralab resistors, 10,000 ohms, 1 W.;
- One Centralab resistor, 400 ohms, 1 W.;
- Two Cornell-Dubilier type EB or EY dual electrolytic condensers, 4 mf., 450 to 525 V., or 4 single 4 mf. units;
- Two Cornell-Dubilier type DT paper condensers, 0.25-mf., 600 V.;
- Two Cornell-Dubilier type DT condensers, 0.1- to 0.25-mf., 600 V.;
- One Aerovox type 604 paper condenser, 0.1-mf., 600 V.;
- One Aerovox type 601 paper condenser, 0.01-mf., 600 V.;
- One Aerovox type 1150 0.01-mf. for V.-T. V.M.;
- One Aerovox type 1467 mica condenser, 0.001-mf.;
- One Thordarson type T-7542 power supply transformer having 600 V. C.-T. at 60 ma. and two 2.5 filament taps. (This should be preferably of the shielded-case type and it is recommended that it also have an electrostatic internal shield construction.)
- One Thordarson A.F. transformer, type A or F, 3 or 3½ to 1 ratio (preferably shielded type);
- †One output transformer if not already attached with speaker. Primary impedance to match 47-tube output, secondary suitable to type of speaker employed;
- †Two filter chokes, 10 to 30 hys., 40 ma., preferably shielded type;
- One National 5-pin isolantite socket for V.-T. V.M.;
- †Four 5-pin wafer-type sockets;
- One Readrite type 55 or 65 D.C. meter, 0 to 20 ma.;
- Identification pins. The numerical indication buttons as used for socket pin or tube electrode identification are brass thumb of the type commonly employed for numbering window screens. These are available at 5 & 10 cent stores or may be obtained from Montgomery Ward & Co. in numbers from 1 to 25 for 5 cents per set (cat. order No. 84B4562), plus postage;
- †Switches. Our constructions utilized small S.P.D.T. knife switches (see text);
- Sub-panel or chassis base. No particular specific size can be adopted due to fact that it may be desirable to include this unit in the tube tester case or immediately underneath it. However, the size is immaterial and component mountings may be arranged for convenience or cascade sequence wiring.
- †Most Radio mail order houses can supply this item if properly identified as to title of article, issue (month) of *Radio-Craft* and year.

A HOME-MADE INFINITE-RESISTANCE TUBE CHECKER

Designed by a Service Man, this checker has infinite resistance, making accuracy possible, and gives both visual and audible indications of various tube defects. It can be used for any type of tube now sold.

PART II LOUIS F. B. CARINI

LAST month the writer described how this practical tube tester had been found to meet all the requirements of daily service work. As the schematic circuit, Fig. 1, shown in Part I indicates, the set-up may utilize certain existing types of equipment, and lends itself particularly well to shop use.

USE OF THE VACUUM-TUBE VOLTMETER

The heart of this tube checker is the vacuum-tube voltmeter; our version of an excellent time-proven circuit which we have employed for years in determining leakage and in making resistance tests. Ordinarily, this is a unique incorporation in instruments of this nature; it is, nevertheless, the most necessary accessory for attaining the intended purpose of the checker.

Inasmuch as short testing is essentially a check for a poor or intermittent-conductive electrical path, a versatile means of resistance indication presents itself as the most appropriate form of determining the degree of loss present in a given circuit. With this, it is possible to determine the electrodes that are shorting as well as the disclosure of noise origination within a tube under observation. It provides a very efficient method of measuring resistance values upward to 300 megohms and so encompasses the entire range in which we might expect to find the most remote indications of a short. It is such high-resistance shorts that are common in radio tubes and the cause of much trouble.

For practical purposes it is the ideal infinite-resistance indicator inasmuch as it is generally more sensitive at high values than at the lower values. Also for this reason, plug-in jacks have been provided to the input of the V.-T. V.M. and a means of varying the meter range through the selection of various resistors in circuit with the grid, so as to enable one to make high leakage tests. This is particularly suitable for use as a high-range ohmmeter in testing the effective leakage of electrolytic condensers. In this system our chief means of leakage indication, is, of course, the milliammeter and not the amplifier output. Hence the latter is unused.

VACUUM-TUBE VOLTMETER FUNCTION

When the tube employed in the vacuum-tube voltmeter circuit is placed in operation, the liberation of electrons from the cathode will cause the negative grid voltage to rise and attain a value where conditions approaching total plate current cut-off may result. During this action, the grid was "free" and if we now close the grid circuit by inserting a resistance value between the grid and the negative return side of the filament or cathode, we note a definite rise in plate current, indicated as a given value on the plate milliammeter. According to the sensitivity of the Ip indicating device, the output current might be read for various degrees of "freeness" of the grid.

Thus, by inserting different values of resistance, it is possible to obtain a variety of plate current values, each of which is representative of a given resistance. In this manner it is possible to calibrate a chart of resistance values from plate current readings. Hence, when an unknown resistance is inserted across the input terminals, a new current will be noted, which is used as an index of the unknown resistance value. It is this method of resistance

indication that enables us to determine the degree of leakage within a tube whose particular "short" may represent many megohms of resistance not at all discernible in any other type of checker. Likewise the same method permits us to check leakages of electrolytic condensers and to measure the resistance of resistors whose range our ordinary ohmmeters do not attain.

Theoretically speaking, if the input to the vacuum-tube voltmeter is "free" or open there would still be some effective resistance present which would actually close it. A very sensitive plate current indicator would disclose this, assuming, of course, that other circuit conditions were appropriate. This "stray" resistance is always present as a virtue of the tube itself, and may therefore be regarded as an idiosyncrasy of practically all conventional tubes. The introduction of this infinite resistance occurs at the press of the glass envelope where the grid lead comes into proximity to the cathode or filament leads. This leakage is further increased at the base of the tube as well as the socket, both of which are composed of phenolic compositions which, together with the resistance offered at the glass press, approach a value of possibly a half-thousand megohms. Such losses, although ordinarily regarded as infinitesimal, become important factors in the selection and operation of a vacuum-tube voltmeter to be used in the determination of ultra-high resistances.

It becomes obvious that such inherent resistance can materially influence the function of such an instrument. For these reasons it is necessary to employ a tube of good design, construction and stability of operation. This applies equally to the selection of the switches, and for minimum leakage we use small knife switches. Our experience with apparatus wherein jack and toggle S.P.D.T. compact switches have been used has not been gratifying. Due to the unusual sensitivity to high resistances, high humidity has very pronounced effects upon the leakage losses in the dielectric insulation employed in the small-size switches. This has manifested itself in erratic operation of the circuit and it introduces an inherent hum which increases the level of noise in the amplifier output when it remains idle. This is most undesirable, inasmuch as it throws off our acoustical sense of balance of the checker's output as well as exaggerates the degree of noise indication. Stability of operation is to be desired for the sake of repetitive indicating constancy even though this may be interpreted only in arbitrary values.

CONSTRUCTION OF THE V.-T. V.M. SECTION

Some degree of care is necessary in the design and assembly of the vacuum-tube voltmeter. Due to its sensitivity to high-resistance indications, it is important to employ excellent insulation throughout, and standards of ultra-high-frequency practices may well be utilized to advantage here. Wiring should be executed with busbar or high-tension cable for best results, although pushback wire has been used with success. Various types of tubes may also be employed such as the 955, 01A, 26, 27, and 56. We have found the 56 the most desirable and

(Continued on page 827)

FIRST PRIZE.....\$10.00
 SECOND PRIZE.....5.00
 THIRD PRIZE.....5.00

Honorable Mention

EXPERIMENTERS: Three cash prizes will be awarded for time- and money-saving ideas. Honorable mention will be given for all other published items. Send in your best "kinks"!

SHORT-CUTS IN RADIO

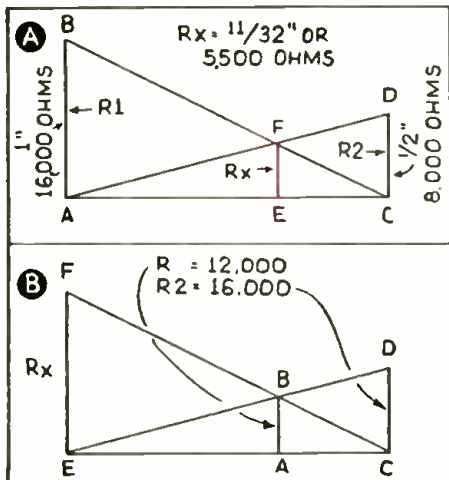


Fig. 1. Simple calculation of parallel resistance.

FIRST PRIZE—\$10

A GRAPHIC METHOD OF FINDING PARALLEL RESISTANCE. Time is money, so this time-saver is a moneymaker, when no resistance chart is handy and the resultant resistance of parallel resistors must be computed. It avoids the confusing "reciprocals of reciprocals" which must be used in computing values by means of the formula.

From any 2 points on a horizontal line, erect the perpendiculars, AB and CD (see Fig. 1A), proportional to the respective known resistances, R1 and R2, using any convenient scale such as, 1000 ohms to each 1/16th of an inch, etc. Join AD and BC. From F, the point where AD and BC intersect, drop a perpendicular (FE) to AC. The length of this perpendicular, FE, represents the total resistance (Rx) desired to the same scale. If more than 2 resistors are to be used in parallel, take any 2 and work out as before. Then apply the same method again, using the result of the first 2 with the next, and so on.

If the required resistance is known and you have none of the right value, you can select from your stock those which, in combination, will fill your need, by using the following method, shown in Fig. 1B.

On a horizontal straight line erect AB representing the required value (for example, 12,000 ohms, R; the scale might be, as above, 1/16-inch per 1,000 ohms). If you have, among others, a 16,000-ohm resistor (R2), erect the perpendicular CD to the same scale. Run a straight line from D through B to a point, E, on the horizontal line, and erect a perpendicular there. Then run a line from C through B to this perpendicular, intersecting it at a point, F.

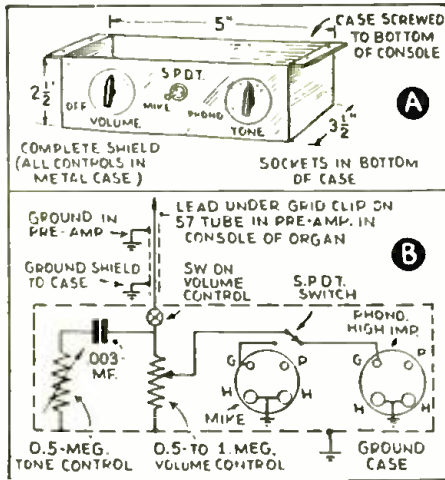


Fig. 2. Puts phono or mike on electric organ.

Measuring EF, you will find that you require an additional resistor of approximately 54,000 ohms.

AL ROBINSON,
Niagara Falls, Ont., Canada.

SECOND PRIZE—\$5

SIMPLE CONTROL UNIT. Figure 2 shows a microphone and phonograph control box. I have about 8 of these units in operation at present on electric organs being used in roller skating rinks here in the middle west. The microphone can be turned on and used to announce skaters, and not affect the playing of the organ, while for afternoon skating, they use the phono pickup.

There is nothing very complicated about the control box, but it works so well that I received a long-distance phone call from the manufacturers of the electric organ asking for information on the unit. The engineer told me that two customers insisted on having these units with their organs. Only crystal mikes having a gain of -65 db. or more can be used with this system.

FLOYD A. ZENBER

THIRD PRIZE—\$5

S.P.D.T. "CAPACITY SWITCH." I have made what I call a "capacity switch" for use in switching, noiselessly, from one antenna to another, or switching the antenna from one stage to another, as ordinary contact switches were unsatisfactory. It also has several other uses. The only part needed to make it is an old tuning condenser with a stator block that can be split, such as the Zenith, Cardwell, etc. The stator is split as shown in Fig. 3. The rotor plates are then cut with a hacksaw, and

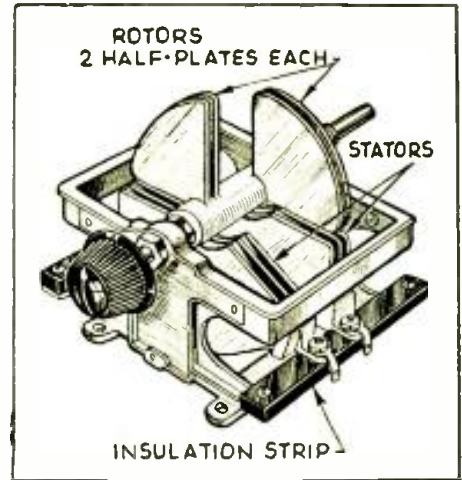


Fig. 3. Antenna switch works by capacity variation.

the segments broken away, leaving a rotor having 2 segments with 2 plates each. Re-assemble, and it is ready for use.

Fix a stop so that when shaft is turned to right, one set of plates will be in mesh, and when turned to the left, the other set will be meshed. The capacity can be lowered by removing or cutting down the plates.

VERNON O. BOLLES

HONORABLE MENTION

HOME-MADE ILLUMINATED VERNIER DIAL. A highly efficient vernier illuminated dial can be made from an RCA vernier drive, Part No. 6675. The complete assembly of parts is illustrated in Fig. 4.

Secure a piece of light-gauge celluloid and shape it as shown in Fig. D. Make a mark with a needle or other sharp-pointed instrument in the center of the celluloid strip to form a "hair line." Glue strip to the outer shaft of the RCA drive as indicated. With a jig-saw or other suitable tool make a semicircular slot in panel. The dial markings are drawn on transparent paper or tracing cloth and pasted on the back of panel. The dial markings can be drawn 0 to 100 or in kc. if you know the exact position of the variable condenser for the various frequencies.

A miniature base socket, radio type, can be soldered on at the shaft as shown so that the light will always be directly in back of "hair line" indicator.

This vernier dial can be built for about 25c. yet, it will surpass in service and smoothness of operation, dials costing about 6 times that amount.

LOUIS B. SKLAR

(Continued on page 843)



Fig. A. Homemade illuminated vernier dial.

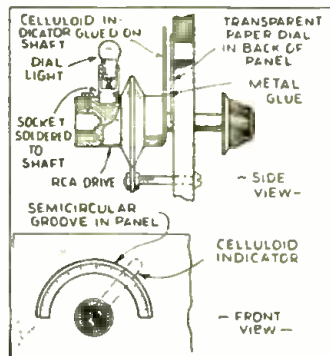


Fig. 4. Sketch of the dial shown in Fig. A (left.)

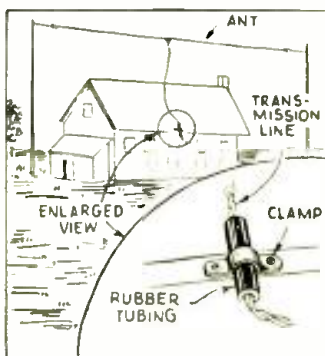


Fig. 5. Non-breaking lead-in.

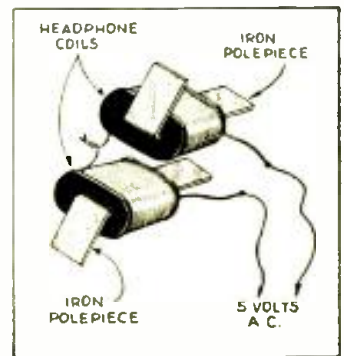


Fig. 6. Phone poles demagnetized.

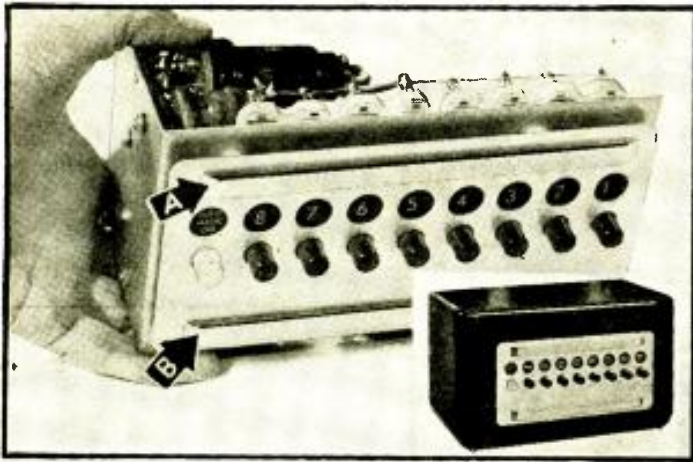


Fig. A. Decorative strips conceal antenna (A) and oscillator (B) trimmers.

THERE is a good chance for the Service Man to pick up a few extra dollars by modernizing receivers which, while still capable of performing well, lack some of the more desirable modern features. One such feature, now in great demand, is Pushbutton Tuning—and it is far more easily added to existing receivers than is commonly believed! One such unit, in fact, is of the "converter" type, and so needs only be connected to the Antenna and Ground posts of the receiver to which it is being added.

THE SELF-POWERED PUSHBUTTON "CONVERTER"

A circuit diagram of this unit is given in Fig. 1A. As indicated, the unit is self-powered; it may be placed atop the set with which it is used, or may be installed at some position remote from the receiver.

It is housed in an attractive ebony cabinet only 9½ by 5¼ by 5¼ inches, the brushed silver-finish panel of which mounts 8 station selector buttons and an additional button

SERVICE MEN!—ADD THIS PUSHBUTTON-TUNING CONVERTER TO ANY RADIO SET

This "converter," which connects to any set's antenna and ground, affords pushbutton tuning in a jiffy; an "adapter," also diagrammed, requires connecting to the set's converter-tube plate.

(the white one, in Fig. A) for putting the automatic tuning into and out of the circuit. The receiving antenna is connected to this converter instead of to the radio receiver.

The heart of the converter is a 6A7 tube used as a mixer and oscillator, its output being 540 kc., to which the receiver must be tuned when the automatic tuner is in use. The second tube in this set, a type 1V, is the rectifier for the power supply circuit.

Each of the 8 pushbuttons controls a pair of trimmer condensers (covered by decorative metal strips), which are set by means of a screwdriver to tune the desired stations, and may then be left set. As the only connections are made externally to the receiver, there is no chance of misaligning.

The complete converter is pictured in Fig. A. It can be used on any set which tunes to 540 kc. (which most sets do), irrespective of circuit design.

(Continued on page 829)

READERS' DEPARTMENT

Readers are invited to make this page their meeting place for the interchange of ideas and a frank discussion of problems and experiences, particularly those which affect the Service Man.

STEWART, BRITISH COLUMBIA

Gentlemen:—

I have been a newsstand reader of your magazine for 2½ years now and this is the first time that I have availed myself of the opportunity of writing to you in order to put in my word of appreciation for the splendid magazine that your editorial staff puts on the market month after month.

It was not until a few days ago that the real value of your periodical made itself felt. Isolated as we are up here in the northern part of British Columbia and the only means of communication with more populous parts by means of steamer calling here twice a week it really is a comforting thought that one may fall back on *Radio-Craft* when in need of a reference work on the more up to date phases of radio.

Naturally, the radio art does not play such a large part in our every day lives as it does in the more thickly populated districts, but one in my position must necessarily keep himself well informed on the ever changing radio industry, and I find that your magazine fills in with just the right kind of information.

I do not know whether you have the

figures that were issued in the monthly bulletin issued by the R.M.S. to its members, but just in case you have not you might be interested.

A questionnaire circulated by the R.M.S. among Canadian members brought to light that of the 360 members who answered the question concerning what magazines they read, *Radio-Craft* headed the list with 252, the next widely read magazine had a following totaling 211.

JOS. J. BOUZEK

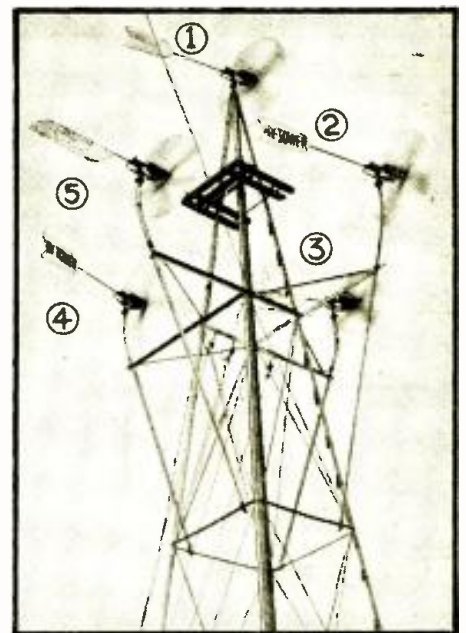
Thanks very much, "J. J.," for bringing this bit of statistical data to our attention; and thanks, too, for your kind comments concerning *Radio-Craft*.

LYNBROOK, N. Y.

Gentlemen:—

In the August 1937 and subsequent issues of *Radio-Craft* appeared a series of articles entitled, "How to Make the *Radio-Craft* Super-DeLuxe 30-Tube Set," in which it was stated that details of a phonograph chassis would be included; but the March, 1938, Jubilee Number contained the concluding Part,

(Continued on page 826)



(Photo—Parris Dunn Corp.)

Service Men will be interested to note the new-type bracket supporting wind-electric chargers 2, 3, 4 and 5; bracket is recommended for farmers' windmills. Central unit No. 1 tops the 60-ft. mast. How about suggesting to rural groups a "community" wind-electric power tower?

ANALYSES of RADIO RECEIVER SYMPTOMS

OPERATING NOTES

SERVICE MEN: Illustrate, wherever convenient, your Operating Notes on characteristic faults of given sets. Space rates will be paid.

Philco Model 610. This receiver has the unusual trouble of a badly distorted and wobbly signal. The distorted signal leads one to believe immediately that either the coupling condenser between the volume control rotor and the control-grid of the type 75 tube, or the condenser between the plate of this tube and the control-grid of the type 42 output tube, is open-circuited. The trouble is usually in the coupling condenser between the plate of the 75 tube and the control-grid of the 42 tube (Fig. 1), but in checking it, be careful to take it out of the circuit and replace with a new 0.015-mf. or 0.02-mf., 600-volt condenser. This condenser becomes leaky so just bridging it with a new condenser will not remedy the trouble.

When the receiver is first turned on the signals come in with about normal volume only to gradually weaken and finally become fluttery. This trouble can be traced to the secondary winding of the last I.F. transformer (Fig. 2), which affects the automatic volume control action of the receiver. Replacing the transformer will cure the fluttering signals.

Philco Model 20. The usual complaint with this receiver is that of circuit oscillation at high volume especially on the high-kilocycle end of the dial. It will generally be found that the oscillation grows stronger as the dial is turned from the low- to high-kilocycle end of the dial.

The usual recommended cure for this trouble is that of cleaning the rotor contacts of the variable gang condensers and running a pig-tail lead from the rotor to the chassis of the receiver. I tried this and found that it improved reception only slightly. All the parts of the receiver were found to be in good condition. Finally I connected a 0.01-mf. 600-volt paper condenser (Fig. 3), between the terminal of the power transformer to which the powerline cord is attached and the chassis. The trouble disappeared. On some receivers a larger capacity is needed. This can only be determined by experimenting with different values. (This procedure will also, many times, remove hum—if trouble of this type should be encountered.—Editor)

Philco Model 60. Some receivers of this model came out with the I.F. stage using a cathode resistor and condenser separate from those used by the detector-oscillator tube. A common trouble with these receivers is a loud hum tending toward oscillation. The trouble usually appears only at long intermittent periods and any attempt to test the parts in the set will cause

the defective condenser to heal. The trouble is with the condenser used to bypass the cathode resistor of the 7N-type I.F. tube (Fig. 4). Try disconnecting one lead of this condenser and listening to the resulting sound in the loudspeaker of the receiver. It will be found to be the same as that of the noise complained of if that condenser is the defective part. This condenser usually open-circuits.

Philco Model 45. The owner of this receiver complained of weak reception. A complete checking of all voltages of the set showed no great deviation. All the condensers and coils test correct. The only place where there was any slight difference between the correct voltage and the actual voltage of the tube was on the control-grid of the type 6A7 detector-oscillator tube. This was only about 0.3-volt off. At first I suspected the A.V.C. circuit but found that that circuit was operating correctly. A test oscillator, connected to the control-grid of the 6A7 tube with the grid clip removed, gave a normal signal output in the loudspeaker. While checking the circuit connected to the grid of the 6A7 tube I placed the test prods of my voltmeter between the cathode of this tube and the opposite end of the antenna coil from the grid connection of the tube. Immediately the set functioned properly. I discovered that the total resistance of the meter was between 50,000 and 60,000 ohms. So, placing a resistor of 50,000 ohms value between these 2 points brought back reception to normal (Fig. 5). This is only a temporary repair and can be used on all similar circuits.

Sparton 467 B. Circuit oscillation and a sudden drop in volume experienced in this particular model can be traced to a 50,000-ohm resistor on the 6A7 tube. (See Fig. 6.) Replacement offered the solution of this complaint.

Sparton 47 K. Low volume and cutting out on this model can, in most cases, be traced to a defective 6F7 used as a combination I.F. and 2d-detector. Replacement of this tube. I have found, readily clears up the trouble in this small model.

A thin or rasping tone which would seem to be lack of bias, can generally be traced to a poor voice coil connection. Resolder at once.

Sparton 057. Noise and poor reception on this model was the complaint. Considerable time was spent, and the trouble finally ended by resoldering center terminal of volume control in spite of the fact the connection seemed to be OK.

HERBERT H. DAVIS,
London, Ont., Canada.

Stromberg-Carlson Models 145, 150, 160 and 180. When putting chassis back in 145, 150, 160 and 180 receivers, be sure that the metal grommets in the rubber cushions at the top of the dial plate, which is held to the cabinet by wood-screws, are in place. If they are not in place, there is some chance of the screws being driven too far into the cabinet and possibly going

(Continued on page #46)

A CORRECTION

The offer of "free condensers" made in a Stewart-Warner Operating Note, published in the February issue of *Radio-Craft*, is not applicable to the general public, but only to distributors and dealers who have such sets in stock or in work, and are experiencing the trouble described. Unless you are in that class, please do not attempt to secure a free condenser.

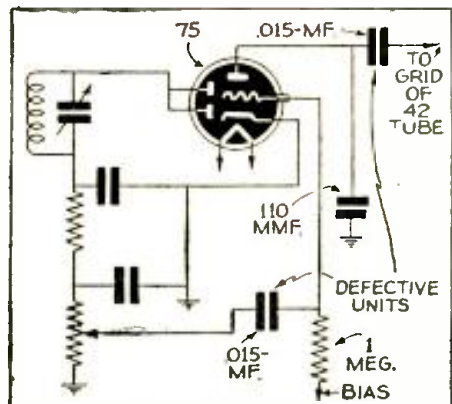


Fig. 1. Defective coupling condensers cause distortion.

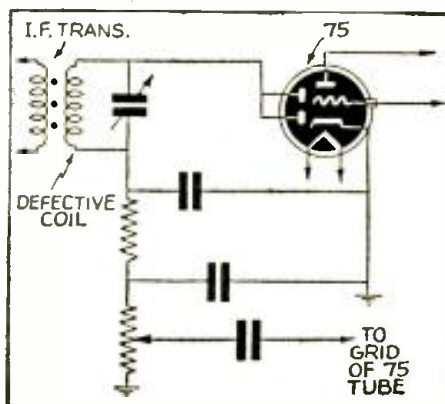


Fig. 2. "Flutter" traced to I.F. transformer winding.

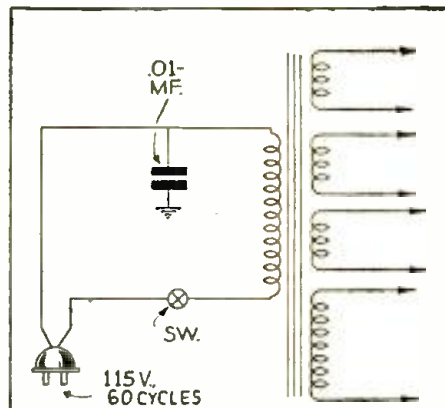


Fig. 3. Line condenser to stop circuit oscillation.

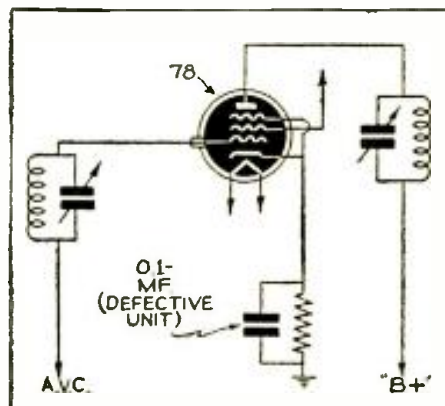


Fig. 4. "Bad" electrolytic causes severe hum.

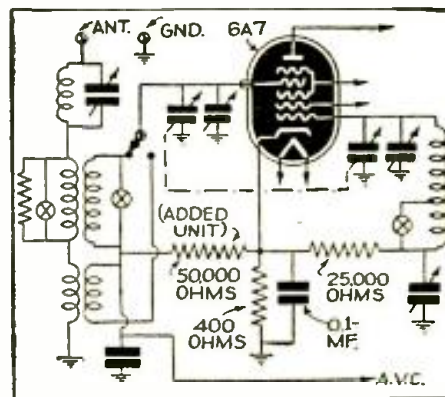


Fig. 5. Resistor added, strengthens signal response.

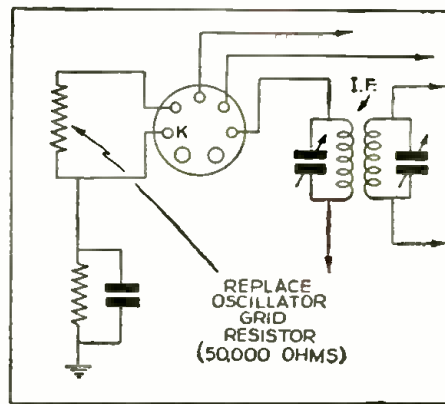


Fig. 6. Trouble from defective grid resistor.

SLIDERULES!— FOR PUBLIC ADDRESS AND SERVICE WORK

Progressive radio men will find in this 2-Part article something new and useful. The old adage that "Time is Money" holds special significance for specialists in sound and radio design and service work, and these men will find the Radio Sliderules real time-savers and, hence, money-makers.

APPLICATION TO SPREAD-BAND CIRCUIT ALIGNMENT

PART II

LAST MONTH the Public Address angle of the RCA radio sliderule was discussed; in that Part, the line of demarcation between the sections of the sliderule may be determined, in Fig. 1, by close inspection—the fine lines "heavy up" a bit where Scale B meets Scale A on one side and Scale C meets Scale D on the other (Scales B and C being on one middle, sliding strip).

In this concluding Part, the line of demarcation on the reverse side is considerably more evident; in Fig. 2, which shows this Radio Servicing side of the RCA sliderule, the demarcation is exactly at the ends of the 10 short lines of Scale B, as will be noted by referring to the numbers 15 and 1500 (Scale B is the one which slides).

Accurate alignment and dial calibration of the high-frequency bands of multi-wave receivers is often somewhat of a problem for the Service Man because the short-wave bands of most test oscillators do not possess the accuracy of calibration required.

This is especially true in the case of the *spread-band* receivers. In this latter case, accurate calibration requires the establishing of input signals whose frequencies can be determined with a very high degree of accuracy. The short-wave bands of most test oscillators cannot be accurately calibrated by the Service Man with the facilities he has at his disposal, and he must therefore resort to some method which does not involve the use of fundamental high-frequency outputs from the test oscillator.

A method has been developed, as will be explained, which utilizes the harmonics of the signal obtained from the standard-broadcast band of the test oscillator. It provides a method for accurately determining the frequency of the fundamental signal voltage from the test oscillator, and a method for identifying the harmonic to which the receiver may be tuned. This method requires no equipment other than standard test oscillator and the output indicator which would be used for conventional alignment work. The application, however, can be greatly simplified by the use of the *alignment* section of the RCA-type radio sliderule as explained in the text which follows.

ZERO-BEAT METHOD OF OSCILLATOR CALIBRATION

See Fig. 3. All American commercial broadcast stations may be considered as standards of frequency because they must maintain their carrier frequency within plus or minus 50 cycles of their assigned frequency, and these broadcast stations, therefore, may be used to calibrate test oscillators by the zero-beat method.

To calibrate a test oscillator, connect an antenna to the receiver, couple the output of the test oscillator loosely to the antenna lead and tune-in a broadcast station of known frequency. Adjust the test oscillator to approximately the same frequency and vary the tuning of the test oscillator until zero-difference frequency is obtained between the test-oscillator output and the incoming signal. Make a notation of the test-oscillator calibration, i.e., whether the dial reading is 2 kc. high, or 6 kc. low, or whatever the case may be.

Care should be taken that the *difference frequency* heard is a result of combining the incoming signal and the test-oscillator fundamental signal and not a beat between a signal of the test oscillator and harmonics of the hetero-

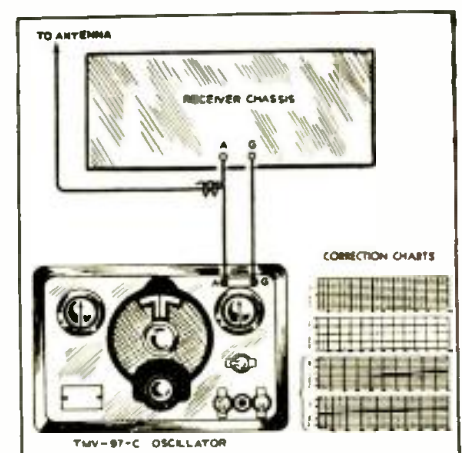


Fig. 3. Zero-beat method of oscillator calibration. (1) Couple oscillator output loosely to antenna lead. Tune receiver to a broadcast station of known frequency. (2) Tune oscillator to approximate broadcast signal frequency, and adjust oscillator carefully for zero-difference frequency (zero beat). (3) Read oscillator dial setting and note correction, i.e., mark reading, 5 kc. high or 8 kc. low, on correction chart.



Fig. 2. Reverse side of RCA 9 7/8 x 1 3/4-in. sliderule.

dyne oscillator of the receiver. This may be established by tuning the test oscillator to obtain a difference frequency of 200 or 300 cycles that is quite audible and then varying the tuning of the receiver. If there is a change in the frequency of the beat note, it is quite obvious that the test oscillator is not beating against the incoming signal but instead, the test-oscillator signal is beating against some frequency generated by the heterodyne oscillator of the receiver. *No change in frequency occurs with a variation in tuning if the beat frequency is the result of combining signals at the receiver input.*

The test oscillator may also be calibrated by use of harmonics generated by an RCA piezoelectric calibrator, which calibrator has 2 modes of operation. Since one fundamental frequency of oscillation is 100 kc., harmonics can be obtained every 100 kc. throughout the broadcast band.

When the broadcast band of the test oscillator has been accurately calibrated by one of these methods, it is then possible to utilize harmonics such as the 10th, 15th, 20th, etc., for high-frequency alignment and dial calibration work, and the results will reflect a much higher degree of accuracy than could be obtained if the high-frequency fundamental output of the test oscillator were used.

DIAL CALIBRATION PROCEDURE

See Fig. 4. When utilizing harmonics, it is necessary, first of all, to be able to identify the number of the harmonic in order to establish the frequency of the signal being used. It is impractical to count the harmonics because none of the receiver tuning bands covers all of the frequencies required to do this. One excellent, simple method of identifying the harmonic number is as follows:

Tune the test oscillator until one of its B.C.-band-signal harmonics is received. Change the frequency of the test oscillator and note the nearest setting where another signal is received without changing the receiver tuning, that is, change the frequency of the test oscillator until another signal is picked up by the receiver. The numbers of the harmonics and the frequency of the tuning corresponding to that particular dial setting may then be established by use of the receiver-alignment portion of the Radio Sliderule, as will be described.

It should be kept in mind that the calibration of the broadcast band of the test oscillator must be accurate, for it is obvious that whatever the percentage of error in the calibration may be, the error in kilocycles (but not in percent) increases in proportion to the harmonic number, thus an error of 2 kc. in the standard-broadcast range will be equal to 20 kc. at the 10th harmonic. Offhand, this does not seem serious, but 20 kc. would be represented by approximately $\frac{3}{4}$ -in. on one make of spread-band dial. The Service Man therefore should calibrate the broadcast band

(Continued on page 822)

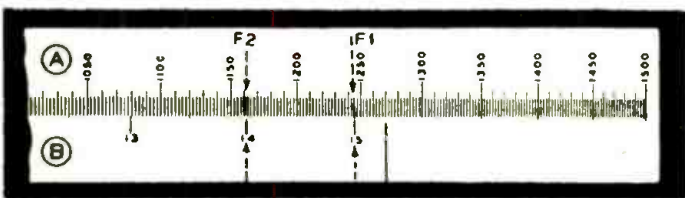


Fig. 4. Dial calibration procedure. With receiver dial set, vary adjustment of test osc. until 2 different signals are received; say, F1 = 1,245 kc., and F2 = 1,162 kc. Slide rule until 2 harmonic numbers coincide, for example—1,245 and 1,162. If $1,245 \times 14 = 1,162 \times 15$ frequency of dial calibration is established.



Fig. 5. Aligning high-frequency bands. Example: (Assume alignment desired at 14.2 mc.) (1) Divide 14.2 mc. by some usable harmonic number say 13. $14.2 \text{ mc.} \div 13 = 1,093 \text{ kc.}$ (2) Add one unit to harmonic number $13 + 1 = 14$. (3) Slide scale "B" until 14 coincides with 1,093 kc., and 13 coincides with 1,015 kc. (4) Adjust high-frequency trimmers until a signal is received at 14.2 mc. dial setting when osc. is alternately tuned to 1,015 kc. and 1,093 kc.

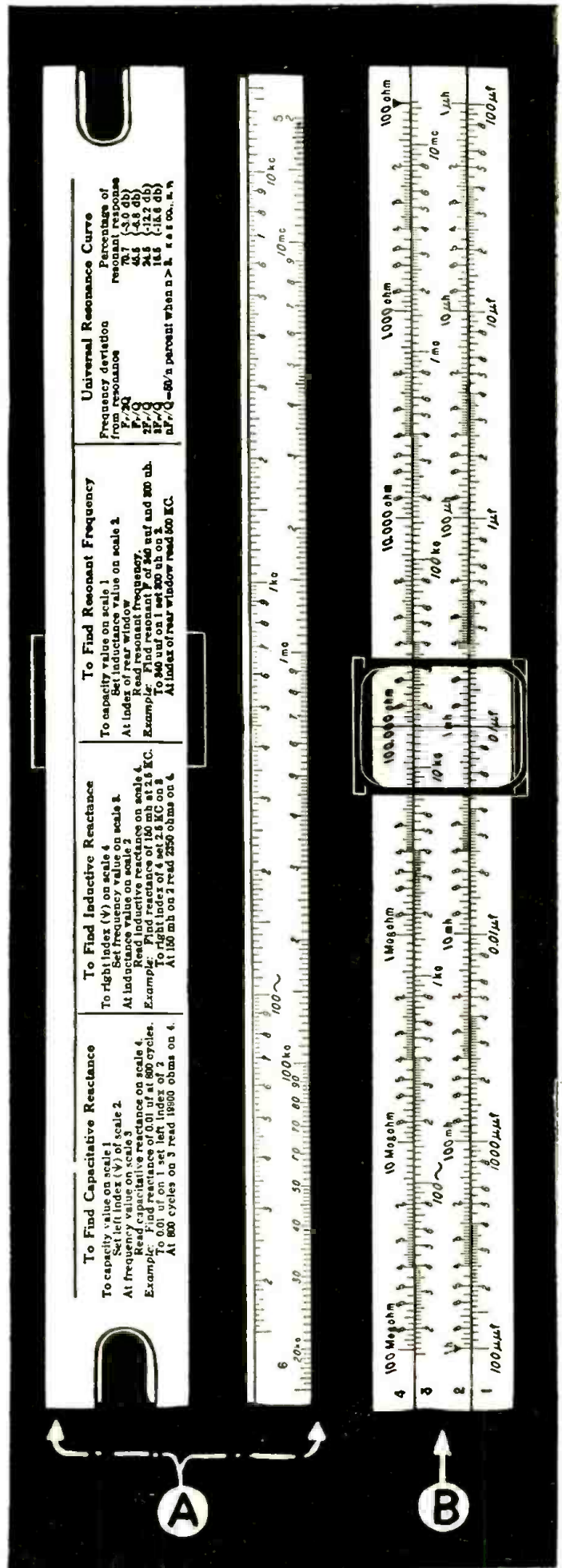


Fig. 7. National Union sliderule. Actual size is $1\frac{1}{8}$ by $10\frac{1}{8}$ ins. long.

PHONO PICKUPS

Part I of this enlightening story dealt with the theoretical considerations in the construction and use of pickups. Concluding, Part II treats of the practical problems encountered in their operation. A new crystal-sapphire pickup is also described.

CLIFFORD E. DENTON

PART II

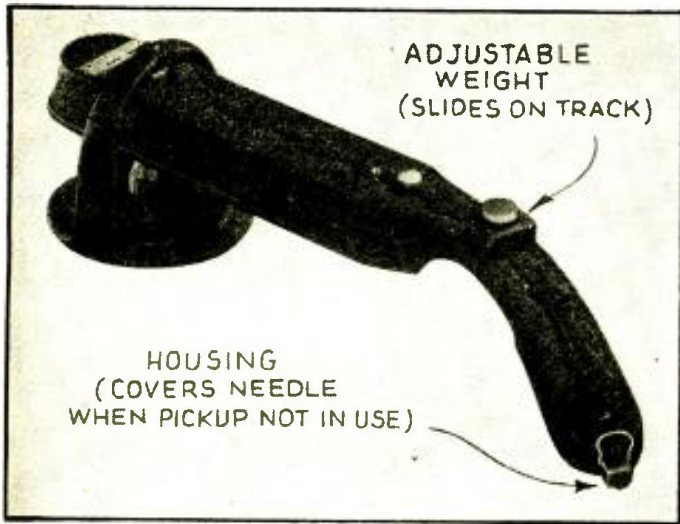


Fig. E. Photo of new Brush "transcription type" crystal pickup.

It had been the author's intention to devote this second section of "Phono Pickups on Parade" to the practical problems encountered in operation and installation. However, some space must be devoted to the presentation of a new "crystal" development so that our story will be complete.

This new pickup, shown photographically in Fig. E, features (a) wide frequency range, (b) low needle pressure and (c) a sapphire stylus. Two models are being produced. One for the reproduction of *lateral-cut* recordings and the other for *vertical-cut* records. The wide-spread use of the lateral-cut record makes this model more suitable for description at the present time.

CONSTANT AMPLITUDE AND VELOCITY RECORDING

Modern records (lateral cut) are cut at *constant amplitude* up to 250 cycles, and from there on up are cut at *constant velocity*. At frequencies above 250 cycles the amplitude of stylus motion decreases as the frequency increases. Curve 1 of Fig. 13A shows amplitude vs. frequency. The amplitude below 250 cycles has a constant value of 1/1,000-inch. Double swing doubles this figure or 2/1,000-inch. Curve 2 of Fig. 13A indicates that the force required to overcome stylus and arm inertia will vary directly with frequency, above 250 cycles; and will be proportional to the frequency squared, below this frequency.

Curve 3 of Fig. 13A shows the restoring force plotted against frequency. Here the restoring force which tends to bring the stylus to the center or "free" position is greater below 250 cycles than the force due to the inertia of the arm and stylus at 10,000 cycles. By designing the crystal unit so that the force required for maximum deflection was

slightly greater than the inertia of the stylus and arm it was possible to obtain a greater degree of freedom from stylus stiffness.

The damping force is proportional to velocity and is considered as pure friction. This is constant, above 250 cycles, as shown in curve 4 of Fig. 13A.

The curve, 5 of Fig. 13A, shows the pressure of the record groove on the stylus point plotted against frequency. At 2,000 cycles the force of inertia equalizes the restoring force. Thus, the force exerted on the stylus is that which is necessary to overcome the damping force. This frequency, 2,000 cycles, is also the natural period of the pickup when the stylus is not in contact with the record. This checks with curves 2 and 3 which intersect at 2,000 cycles. At other frequencies curve 5 is equal to the difference between curve 2 and curve 3 plus damping friction curve 4.

NATURAL PERIODS OF COMPONENT ELEMENTS

The *natural period of the crystal* is around 14,000 cycles, the *natural period of the assembly* is placed around 5 cycles, while the *natural period of the stylus* (when not in contact with the record) is 2,000 cycles.

The record groove limits the swinging of the stylus at 2,000 cycles, thus preventing accentuation at this frequency.

The high natural period of the crystal permits a flat frequency response to 10,000 cycles; and the low natural period of the pickup minimizes the effect of any mechanical or acoustic impulses (that would affect the ordinary pickup) having a natural period within the audible range.

A sapphire stylus having a diameter of 25/1,000-in. is used and if given reasonable care will last for years. The sapphire was selected for its low frictional characteristics, resistance to wear and smooth surface.

The frequency response can be varied, as indicated in Figs. 13B, C, D and E, by proper selection of filter and input circuits.

The output level is low so that it can be fed into microphone circuits; which may or may not be an advantage. The writer believes that this pickup will be excellent for use with volume expanders of the type using the 6L7 with the separate expander amplifier.

A cross-sectional drawing of the cartridge unit, of the pickup pictured in Fig. E, is shown in Fig. 12. The construction is simple in form and compact, and follows the present trend in crystal cartridge design which has resulted in improved performance and stability of operation.

Having "paraded" the pickups it's about time to cover some of the problems encountered in the building and operation of these devices and their associated components.

PROPER PLACEMENT OF THE PICKUP

Placing the pickup is simple, though many consider that it is necessary to be a surveyor to do it. Remember, all *measurements for pickup mounting are made from the center of the turntable*; or the center of the motor spindle, since these points are identical, of course.

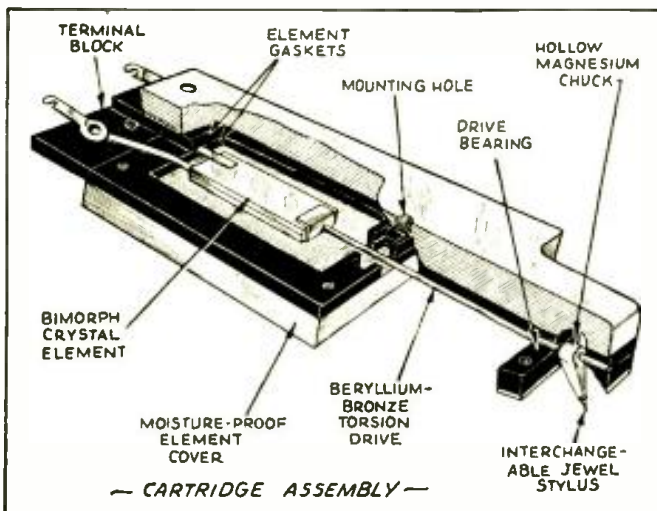


Fig. 12. Phantom view of the new Brush unit's "cartridge."

ON PARADE

So far as *Radio-Craft* is aware, no book or previously-published magazine article contains all the important information, on phono pickups and their use, Mr. Denton here presents to the practicing sound specialist.

Having determined the proper placement of the turntable on the board carefully mark a point which will indicate the center of the spindle. From this point draw a circle with a radius equal to the distance indicated in the instruction sheet which every manufacturer of pickups supplies. The layout is complete except for the mounting of the pickup some point along the circle that will afford the utmost in convenience for operation. See Fig. 13F1. The small crosses on the outer circle indicate a few of the possible points of mounting. If you have made the measurements very carefully and followed the manufacturer's specifications as to the length of the radius it will be impossible to make a mistake, no matter where you mount the pickup, on the circle.

In case you do not know the proper radius or do not have the instruction sheet, write to the manufacturer because an improperly placed pickup will increase record wear and raise the scratch level (acoustically speaking).

MOUNTING THE MOTOR

Most of the phonograph motors on the market today have a horizontal shaft which drives the vertical spindle through a worm-gear. In operation the motor will vibrate and this vibration is transmitted through the drive spindle to the turntable and through the motor frame to the motor-board. Thus, high-impedance pickups with good bass response will reproduce these vibrations along with the signal. As long as the signal is great enough to over-ride the noise created by the motor vibration everything is all right. Low-level passages permit this noise to come through, and the reproduction is marred in an annoying way.

Motors are mounted on the motor-board by means of springs or rubber bushings; this minimizes the vibrations transmitted from the motor frame to the pickup arm through the board. However, those vibrations transmitted through the drive spindle are carried by the turntable directly to the pickup stylus. Therefore the motor should be mounted in such a way in relation to the pickup that the transmitted vibration is kept at a minimum.

Figure 13F2 shows how to position the motor and pickup for minimum vibration pickup. This simple method has worked very well on different types of motor-boards and while it cannot be a perfect cure, it surely helps.

After determining the spindle point and the pickup mounting point, draw or scribe lines *a* and *g* so that they form a 90° angle, as shown. Continue line *a* until it intersects circle *r*. Draw a line through the spindle point and the point of intersection of *a* and *r* as shown. This new line should parallel the horizontal shaft of the motor. Actual tests may prove that a slightly different angle may be best due to differences in motor-board size, material, method of motor mounting and the condition of the motor bearings. From an examination of Fig. 13F2 it will be noted that the path of the stylus should parallel the motor shaft line as closely as possible. This "rule of the thumb" method of motor layout cannot be considered perfect but offers a sane, logical method of motor placement that is superior to the hit and miss system so often employed.

The effect of motor vibration, turntable wobble, pickup mounting and bearing chatter is easily noted in practice but is difficult of solution on paper.

VIBRATION INSULATION OF PICKUPS

Pickups having high output levels and good bass response are susceptible to the reproduction of motor rumble, (Continued on page 834)

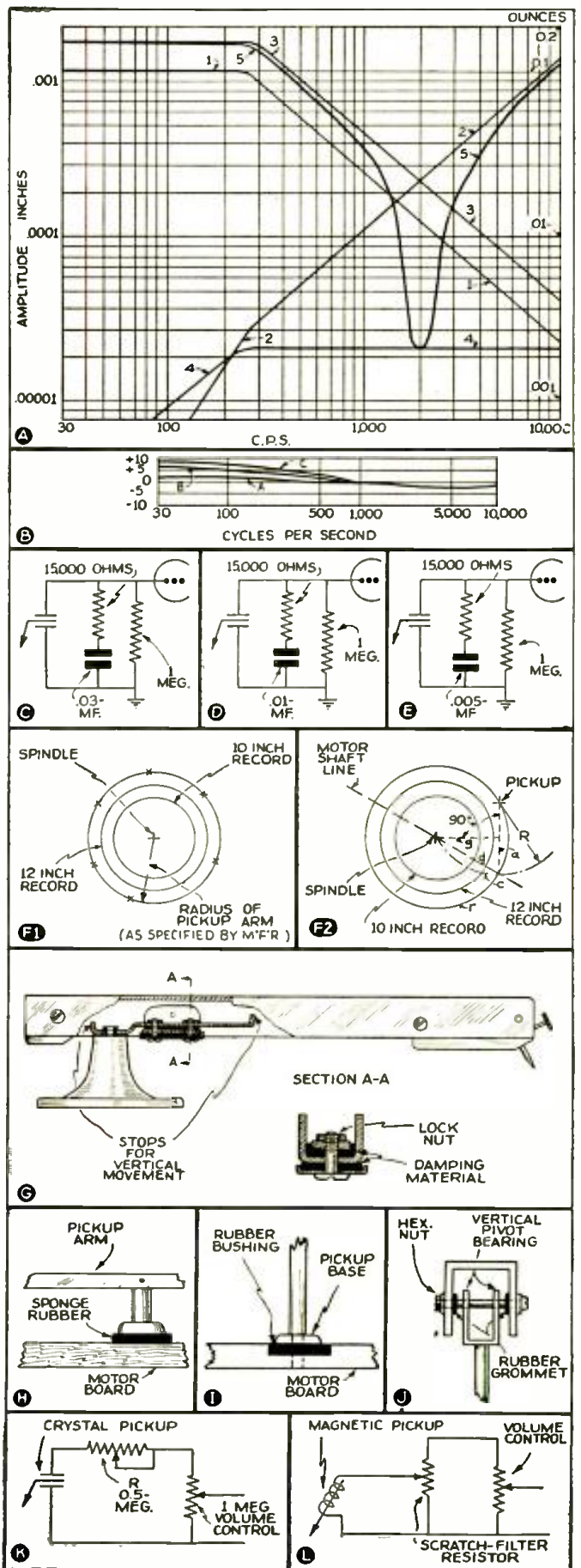


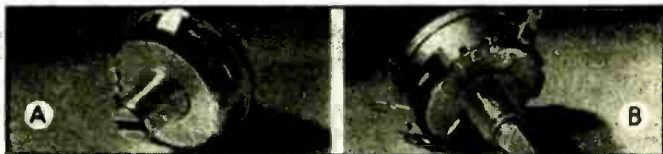
Fig. 13. Response curves and respective circuits; checking motor-board; at G, Astatic's "axial" cushion; then follow anti-vibration mountings; and finally, crystal and magnetic pickup scratch filters. The accompanying discussion concerning the latter is especially revealing.

THE LATEST RADIO EQUIPMENT

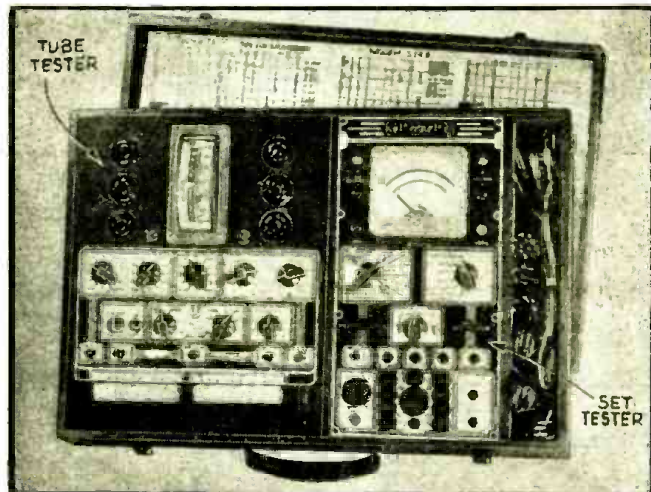
Technicians utilize this department to keep posted on the newer and better ways of doing things in Radio, Electronics, and Public Address.



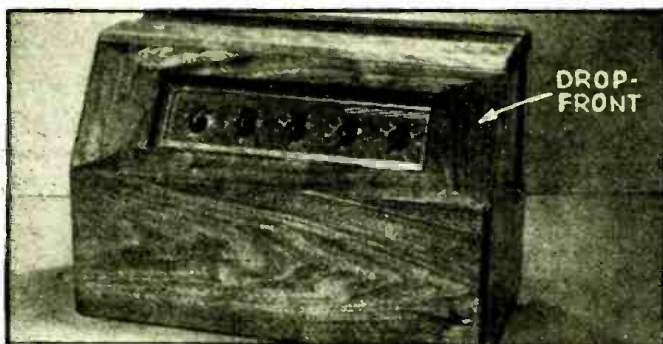
An easily salable car-radio antenna. (1596)



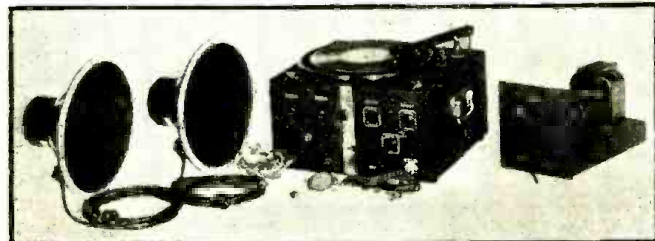
Variable resistors, smaller than ever. (1597)



Complete service-instrument set-up. (1598)



Something "different" in amplifiers. (1599)



New P.A. unit has many money-making uses. (1600)

HORIZONTALLY-EXTENSIBLE CAR-RADIO ANTENNA (1596)

THIS "Zephyr" model of car-radio antenna is often salable where other, less decorative car-top models cannot be sold. In addition to having a decorative "prow," the antenna may be extended horizontally to suit urban or rural reception. Length, telescoped, 20 ins.; extended, 36 ins.

MIDGET-SIZE CONTROL RESISTORS (1597)

(Clarostat Mfg. Co.)

AT A is shown the screwdriver-adjustable type, and at B the regular knob-controlled style, in a new line of ultra-small potentiometers. The "Ad-A-Switch" feature, of a snap-on switch, is available. The line includes all standard resistance values of (a) tapped controls (for diode-bias and tone-compensating circuits), and (b) car-radio controls. The case diameter of both types is only $1\frac{1}{8}$ ins.

COMBINATION TESTER (1598)

THIS instrument combines a complete tube tester with a wide-range set analyzer to make one of the most complete pieces of radio servicing equipment available. The tube tester is of the highly-efficient dynamic mutual conductance type. It tests the elements separately in multi-element tubes; checks gas content on meter; detects both short and open elements; and tests for shorts, hot or cold. Reads "Good, Doubtful, and Bad," as well as indicating mutual conductance in micromhos.

The set analyzer section has a built-in multi-selector with a complete set of leads and adapters for socket analyses. Its zero-current voltmeter gives readings in infinite ohms/volt D.C., equivalent to millions of ohms/volt. Also reads capacity of mica, paper and electrolytic condensers.

Ranges cover every present need and many future requirements: D.C. volts at infinite ohms/volt; A.C. and D.C. volts at 1,000 ohms/volt, D.C. microamperes, D.C. milliamperes, ohms, microfarads, output, decibels and henries. Batteries operate all except the highest ranges of ohms and capacity meter, which operate from built-in power supply. The instrument has 2 long-scale meters.

NEW-STYLE AUDIO AMPLIFIERS (1599)

(Thordarson Electric Mfg. Co.)

SOMETHING new in power amplifier design to intrigue the sound specialist is here illustrated. Outstanding features include: protected controls, illuminated and window-visibility dials, inverse feedback, multiple inputs with individual controls, and universal output impedance (plug-in selected). Power range: 8 to 60 watts. Carrying case available.

25-W. BEAM POWER MOBILE P.A. SYSTEM (1600)

THIS combination mobile public address system has been designed specially to give the sound man a unit extremely rugged, compact and "ready to go" in almost every instance where a temporary installation is required. It may be used for 110 V. A.C. or 6 V. D.C. by a simple interchange of packs.

Uses beam power tubes. Electronically mixes 1 microphone and 1 phonograph. Includes latest dual diaphragm crystal microphone of the hand-type but also can be used with various other types. Includes two 12-in. permanent-magnet speakers especially designed for public-address work. High-grade phono motor. "Economizer" control for battery supply. Heaviest duty type generator. Fused. Can be used in conjunction with radio set by using an available radio matching unit.

"HOOEY" CONTROL (1601)

HERE'S a sideline item which should enable the radio Service Man to annex a few occasional extra dollars. If the customer rants about excessively long advertising blurbs from some certain station, show him how this "Hush-tone" pushbutton device may be connected so as to open-circuit the speaker, during lengthy periods of undesired portions of a program, without getting out of one's chair. Extension cord, terminating in a pear pushbutton, releases and rolls up like a window shade.

Cable length is about 16 ft. To install, cut the set's voice coil wires and connect in the Hush-tone's 2 leads. Distinctly a Service Man's item; should be a good sideline money-maker.

TRANSCRIPTION REPRODUCER AND RECORD PLAYER (1602)

(Allied Radio Corp.)

A VERSATILE, compact portable phono unit for the sound man for A.C.-D.C. operation is illustrated. All 8-, 10- or 12-in. recordings as well as 16-in. transcriptions may be reproduced at 33 $\frac{1}{3}$ or 78 r.p.m.; power output is 4 W. Includes crystal pickup, scratch

Name and address of any manufacturer will be sent on receipt of self-addressed, stamped envelope. Kindly give (number) in above description of device.

filter, tone control and 8-in. permanent-magnet dynamic loudspeaker. Case measures 19½ x 11¼ x 14 ins. high.

DIAL-LESS MIDGET SET (1603)

(RCA Mfg. Co., RCA-Victor Division)

PUSHBUTTONS, 6 of them, solve the problem of tuning-in stations, in the little set here shown. It measures only 8 x 8 x 6 ins. deep; there are 4 tubes in this model 94X-1 A.C.-D.C. receiver; has built-in antenna; output is 1½ W. Entire set sells for less than \$20; a fine item for the Service Man to recommend to invalids, etc., since there's no tuning dial to try a person's patience.

ULTRA-SMALL DRY ELECTROLYTICS (1604)

(Solar Mfg. Corp.)

THE trade name "Minicap" is used to distinguish this new line of dry electrolytics from preceding, larger types. They are hermetically sealed into metal cans; 23 stock sizes, in 4 different working voltages (from 100 V. to 450 V.), simplifying servicing. Electrical characteristics are said to be equal to, or better than those of the older, larger equivalent types.

These condensers range in diameter from about ⅝-in. to 1 1/16 ins.

PLASTICS-CABINET RADIO SET (1605)

HERE is a 5-tube A.C.-D.C. radio set, with ivory- (illustrated) or walnut-finish molded plastic cabinet, that has a so-called "Wonder Tone" grille which is claimed to "blend high and low audio frequencies, giving 'studio reception' evenly distributed throughout the room." At any rate, set has beam power output, and extended-range (broadcast and police) tuning.

"MECHANICAL" PUSHBUTTON TUNER (1606)

A DIECAST frame mounts 6 or more pushbuttons (as necessary) as a single, amazingly simple assembly. May be used in all types of home and car-radio sets. Pushing a button partially turns a main drive shaft on which is mounted a pulley, which must be suitably geared to the standard tuning-condenser gang. After setting-up a station—simply accomplished by



High-grade phono unit. (1602)

means of a screwdriver—the action is exact and without perceptible lost-motion. An item for manufacturers.

A.C.-D.C. PHONO-RADIO (1607)

(Wholesale Radio Service Co.)

SERVICE MEN should find it easy to occasionally interest certain of their customers, who exhibit the usual vacation-lust, in the useful entertainment device here shown. Extended tuning range of the radio set incorporated in this device covers 176 to 545 meters; the output tube of this 4-tube T.R.F. set is a 43. The phono section "plays" up to 12-in. records, at 78 r.p.m., via a magnetic pickup of high quality.

TELEVISION DEFLECTING YOKE AND TRANSFORMERS (1608)

TWO NEW cathode-ray accessories of interest to the television experimenter have been introduced by a transformer manufacturer.

Deflecting Yoke. The first of these is the deflecting yoke shown at A. It is designed for use with cathode-ray tubes of the electro-magnetic deflection type.

Special care is taken in the winding and placement of coils in this yoke to reduce to a minimum any distortion which may occur due to unbalanced magnetic flux or non-uniform fields. By means of proper construction, coupling between high- and low-frequency coils has been re-



No dial to turn! Just jab buttons! (1603)



Dry electrolytics get smaller and smaller. (1604)



Newest small set. (1605)



Mechanical button-tuner. (1606)



Vacationists' phono-radio. (1607)

duced to a negligible value. An internal shield is effective in reducing the effects of external fields on the image to be projected.

More than ample deflection with negligible distortion is obtained from the type T-700 yoke on 9-inch tubes at a plate voltage of 6,000.

The low-frequency coils are so constructed that a low-impedance line may be run to them from the output transformers (see B). This helps to minimize pick-up and eliminate coupling condensers.

Sweep Circuit Output Transformer. The second item, the new high-frequency sweep output transformer shown at B, is wound with low-capacity coils in order to effectively pass the higher harmonics of 13,200 cycles necessary for the production of a linear deflection.

POLICE ADAPTER FOR CAR-RADIOSETS (1609)

(ABC Radio Laboratories)

HERE is a broadly-resonant short-wave converter which transfers signals in the 1,500 to 2,600 kc. frequency range, to the broadcast frequency range of 600 to 700 kc. Tuning is accomplished in the car set and not in the converter. Two metal tubes provide R.F. amplification and conversion.

(Circuit is shown, to illustrate applicability, on page 846.)

WORLD'S SMALLEST ELECTROLYTIC? (1610)

(Cornell-Dubilier Electric Corp.)

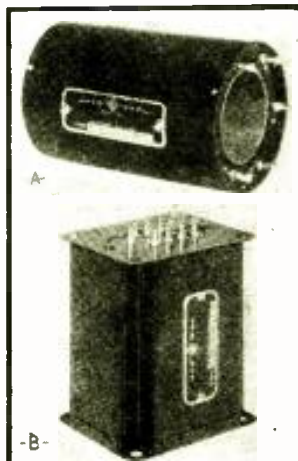
A SIMPLE reply to the question, "How does the condenser manufacturer make the new 'Beaver' dry electrolytic so tiny?" might be answered this way: A new method of treating electrolytic foils, and known as the *etched-foil process*, results in greater capacity per unit area; makes possible a 16 mf., 150 V. unit only 1¼ ins. long!

Actually, however, there are other considerations involved, and the details are most interesting.

All electrolytic condensers, compared to other types, have high capacity per unit of volume. The aluminum electrode's oxide film is very thin (approx. 10 to the -5 centimeters), and the dielectric constant of this aluminum oxide (which insulates the aluminum electrode



A "quiet" pushbutton. (1601)



Left.—Experimenters' television components. At A, C.-R. tube yoke; B, sweep transformer. (1608)



Above.—This adapter transfers police signals into your car-radio set. (1609)

STEWART-WARNER R-182 (RECEIVER MODELS 1821 to 1829)

7-tube superhet.; A.V.C.; pushbutton tuning; 3 bands (Broadcast, Police, Short-wave); 4.25 watts output.

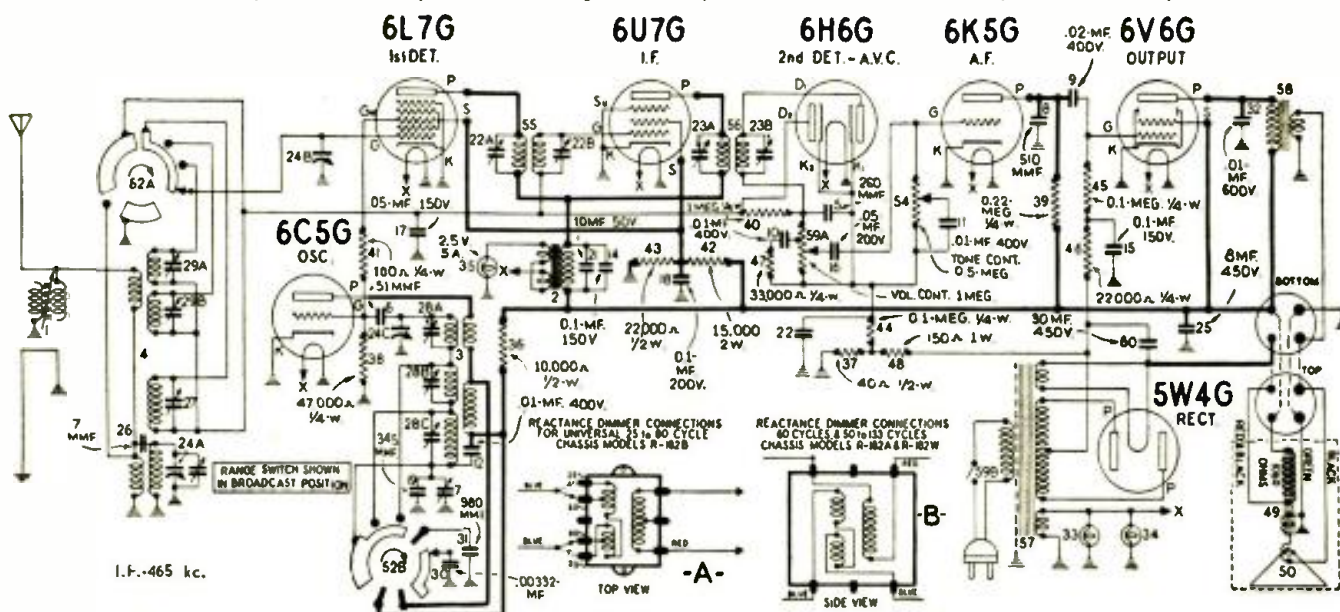


Fig. 1. Schematic diagram of circuit. Connections for reactivity dimmer for various models shown in inset.



Fig. A. Stewart-Warner Model 1822.

PHONOGRAM CONNECTIONS FOR MODEL 182-W

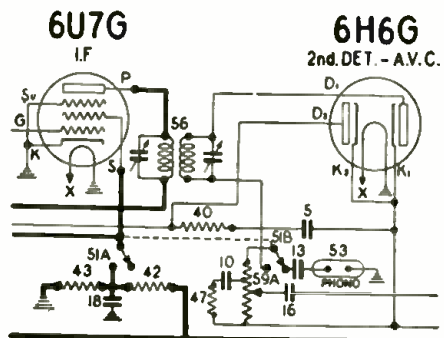


Fig. 2. Phono connection.

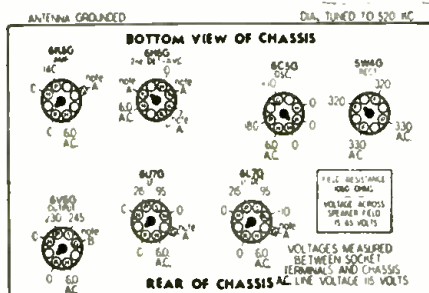


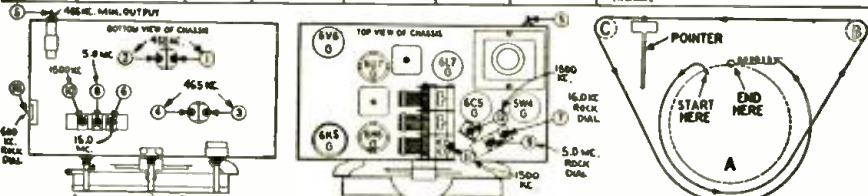
Fig. 3. SOCKET VOLTAGES. Important:— Use a high-resistance (1,000 ohms/volt) meter. NOTE A:— Bias for control-grids of 6L7G, 6U7G, and diode plates of 6H6G is —2.5 volts measured across resistor No. 37. NOTE B:— Bias for control-grid of 6V6G is —1.25 volts measured across resistors No. 37 and 48.

ALIGNMENT EQUIPMENT & PROCEDURE

- For alignment, an output meter and an accurately calibrated signal generator with a tuning range from 400 KC. to 15 MC. are required.
1. Connect the output meter across the voice coil or between the plate of the 6V6 tube and ground, depending on the type of meter. (The more sensitive type should be connected across the voice coil.)
 2. Connect the ground lead of the signal generator to the chassis of the receiver.
 3. Turn the volume control to the maximum volume position and keep it in this position throughout the entire alignment procedure.
 4. With the gang condenser in full mesh set the pointer on the last scale division on the low frequency end of the dial. This may be accomplished by releasing the clip on the pointer slider; where it attaches to the dial cord.

IMPORTANT:—THE BROADCAST BAND MUST BE ALIGNED AFTER THE SHORT-WAVE BAND AND POLICE BAND.

DIPPER AMT. IN BENCH WITH 810 OHM	CONNECTION OF SIG. GENERATOR TO RECEIVER	SIGNAL GENERATOR FREQUENCY	RANGE SWITCH POSITION	RECEIVER DIAL SETTING	TRIMMER NUMBER	TRIMMER DESCRIPTION	TYPE OF ADJUSTMENT
.1 HPD CONDENSER	CONTROL GRID OF 6L7G TUBE	400 KC.	BROADCAST (Clockwise)	AMT POINT WHERE IT DOES NOT AFFECT THE SIGNAL	1-2	1ST I.F.	ADJUST FOR MAX. OUTPUT. THEN REPEAT ADJUSTMENT.
					3-4	2ND I.F.	
400 OHM CARBON RESISTOR	ANTENNA TERMINAL	400 KC.	BROADCAST (Clockwise)	AMT POINT WHERE IT DOES NOT AFFECT THE SIGNAL	5	WAVE TRAP	ADJUST FOR MAXIMUM OUTPUT USING A STRONG GENERATOR SIGNAL.
400 OHM CARBON RESISTOR	ANTENNA TERMINAL	16 KC.	SHORT-WAVE (Counter-clockwise)	16 KC.	6	SHORT-WAVE OSCILLATOR	ADJUST TO BRING IN SIGNAL. CHECK TO SEE IF PROPER PEAK HAS OBTAINED BY TUNING IN DIAL AT APPROX. 16.1 KC. IF IMAGE DOES NOT APPEAR REALIGN AT 16 KC. WITH TRIMMER SCREW PARTIALY OUT. RECHECK IMAGE.
400 OHM CARBON RESISTOR	ANTENNA TERMINAL	16 KC.	SHORT-WAVE (Counter-clockwise)	TUNE TO 16 KC. GENERATOR SIGNAL	7	SHORT-WAVE ANTENNA	ADJUST FOR MAXIMUM OUTPUT. TRY TO INCREASE OUTPUT BY DETUNING TRIMMER AND RETURNING RECEIVER DIAL UNTIL MAXIMUM OUTPUT IS OBTAINED.
400 OHM CARBON RESISTOR	ANTENNA TERMINAL	5.0 KC.	POLICE (Center)	5.0 KC.	8	POLICE OSCILLATOR	ADJUST TO BRING IN SIGNAL. CHECK TO SEE IF PROPER PEAK HAS OBTAINED BY TUNING IN DIAL AT APPROX. 5.1 KC. IF IMAGE DOES NOT APPEAR REALIGN AT 5.0 KC. WITH TRIMMER SCREW PARTIALY OUT. RECHECK IMAGE.
400 OHM CARBON RESISTOR	ANTENNA TERMINAL	5.0 KC.	POLICE (Center)	TUNE TO 5.0 KC. GENERATOR SIGNAL	9	POLICE ANTENNA	ADJUST FOR MAXIMUM OUTPUT. TRY TO INCREASE OUTPUT BY DETUNING TRIMMER AND RETURNING RECEIVER DIAL UNTIL MAXIMUM OUTPUT IS OBTAINED.
400 OHM CARBON RESISTOR	ANTENNA TERMINAL	1500 KC.	BROADCAST (Clockwise)	1500 KC.	10	BROADCAST OSCILLATOR (Stunt)	ADJUST TRIMMER TO BRING IN SIGNAL.
400 OHM CARBON RESISTOR	ANTENNA TERMINAL	1500 KC.	BROADCAST (Clockwise)	TUNE TO 1500 KC. GEN. SIG.	11	ANTENNA	ADJUST FOR MAXIMUM OUTPUT.
					12	DETECTOR	
400 OHM CARBON RESISTOR	ANTENNA TERMINAL	600 KC.	BROADCAST (Clockwise)	TUNE TO 600 KC. GENERATOR SIGNAL	13	BROADCAST OSCILLATOR (Series Pad)	ADJUST FOR MAXIMUM OUTPUT. TRY TO INCREASE OUTPUT BY DETUNING TRIMMER AND RETURNING RECEIVER DIAL UNTIL MAXIMUM OUTPUT IS OBTAINED.



HOW TO REPLACE THE DIAL CORD

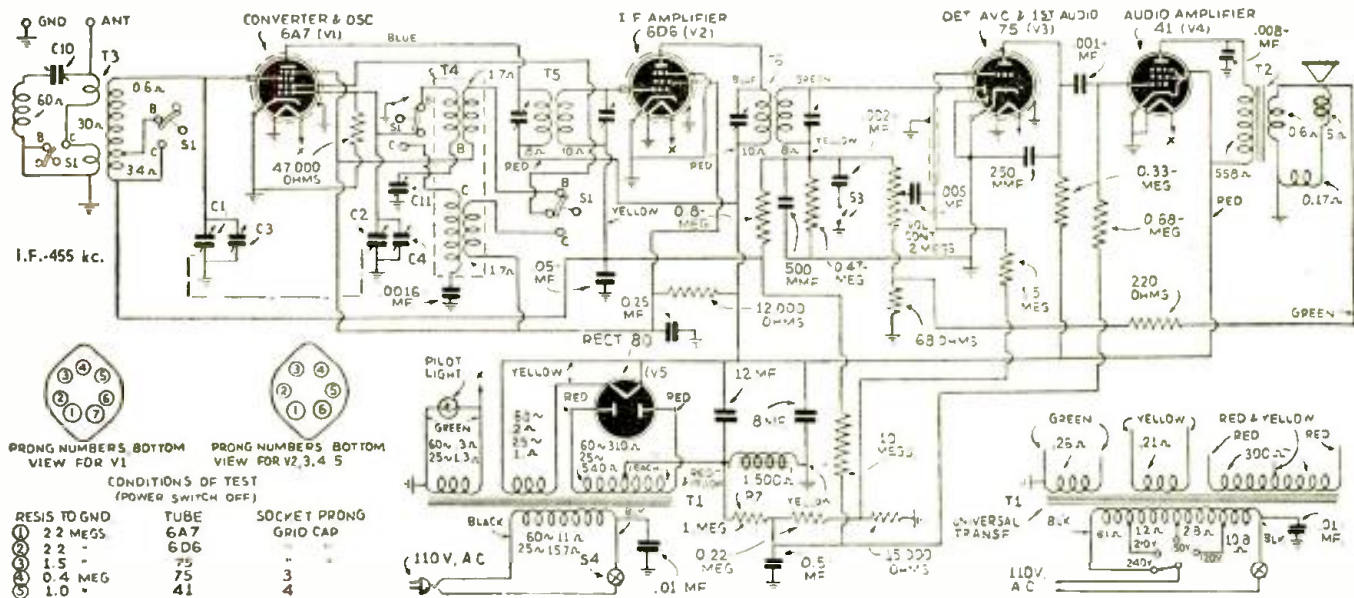
Before attempting to replace the dial cord, fully mesh the gang condenser. The holes in drum A should be in the top position as shown in the diagram above.

The pointer drive cord should be 33 inches or more in length. Place one end of the cord through the left hole in drum; then knot the end. Run the free end of the cord down

around the drum and up to pulley B. Continue over pulley B to pulley C, then down to drum A. Bring the cord up around drum D. Tie the cord to the end of the tension spring so that the spring will be extended to about 1 1/4 inches, when hooked to the slot in the drum. Now place the pointer on its track so that it points to the last scale division on the low-frequency end of the dial, then clip it to the cord.

GENERAL ELECTRIC MODEL F-51

5-tube A.C. superhet.; 2 bands (540-1,720 kc. & 2,200-7,000 kc.); A.V.C.; 2-point tone control; undistorted output 2.3 watts (max. 3.5 watts).



A signal from the antenna is coupled by the antenna transformer to the control-grid on the 6A7 oscillator and converter tube. After conversion to 455 kc. the signal is amplified at this frequency by the intermediate frequency amplifier which employs 2 double-tuned I.F. transformers.

The diode part of the 75 tube is used as a detector and provides the A.V.C. voltage. The 75 tube is resistance-coupled to the 41 pentode amplifier output tube. Minimum bias is supplied for all tubes by the voltage drop over the resistor R.7.

Negative feedback is used to improve tone. In this circuit voltage is fed back from the voice coil circuit to a tap on the volume control. This feedback voltage is out of phase with the input voltage to the audio amplifier. The resulting degeneration reduces distortion arising in the audio amplifier and extends the tune range.

ALIGNMENT PROCEDURE

Alignment Frequencies

I.F., 455 kc.; Broadcast, 1,500 and 580 kc.

I.F. Alignment

Connect an output meter across the voice coil. Set the volume control for maximum.

Set the test oscillator to 455 kc. and connect one test oscillator output lead to the receiver chassis and the other through a .05-mf. condenser to the control-grid of the 6A7. Do not remove the grid lead from the 6A7 as this would remove the minimum bias from this tube. Keep the test oscillator output as low as possible to give a readable output. The 4 I.F. trimmers, see Fig. 1, should be adjusted in the following sequence for maximum output.

- (1) Secondary trimmer (C-9) on 2nd I.F. transformer
- (2) Primary trimmer (C-8)

- (3) Secondary trimmer (C-7) on 1st I.F. transformer
- (4) Primary trimmer (C-6)

Wavetrap Alignment

Leave the test oscillator set to 455 kc. and connect one output lead to the receiver chassis and the other through a 250-mmf. condenser in series with 100 ohms to the receiver antenna lead. Adjust C10 for minimum output.

R.F. Alignment

Use the same dummy antenna (250 mmf. and 400 ohms). With 1,500 kc. input, and the band switch on the broadcast position, adjust oscillator trimmer C4 and antenna trimmer C3 for maximum output. Next with 580 kc. input adjust the broadcast padder C11 for maximum output while rocking the gang condenser in the vicinity of 580 kc. Repeat the adjustments at 1,500 kc. No adjustment is required on the short-wave band.

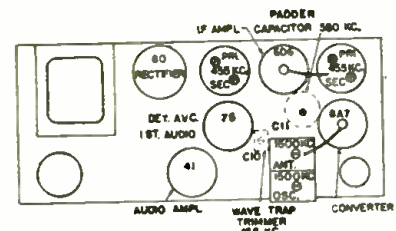
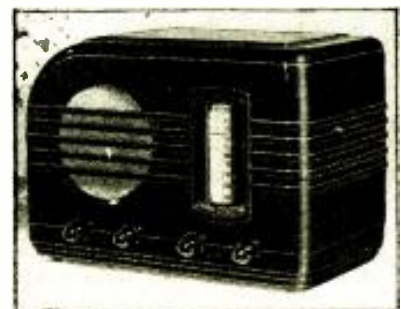


Fig. 1. Trimmer location.



G.E. Model F-51.

SOCKET VOLTAGES

Tube No.	Plate to Ground Volts D.C.	Screen-Grid to Ground Volts D.C.	Cathode to Ground Volts D.C.	Cathode Current M A.	Heater Volts A.C.
6A7	Oscillator	105	0	14.8	6.3
	Converter	230	0		
6D6	1st I.F. Amp.	105	0	10	6.3
75	Det. A.V.C.	100*	0	.16	6.3
	1st audio	215	0		
41	Output	230	0	29	6.3
80	Rectifier	300/600 R.M.S.	315 to 'B--'	54	

A.C. line voltage 120. No signal input. 1000 ohms/volt meter. Dial pointer at 530 kc. (*Measured on 500-volt scale.)

SERVICING QUESTIONS & ANSWERS

Service Men may write, requesting answers to specific service questions. Address inquiries to Service Editor. For questions answered by mail, a service fee of 25c per question is made. Only questions of wide interest can be published. In view of the "rush" character of most service calls an effort is made to maintain 48-hour service on mail inquiries. Let us help you solve your service problems.

VOLUME CONTROL INEFFECTIVE

(52) John Kiba, Lundale, W. Va.
(Q.) An Airline Radio set using 12 tubes is giving me trouble. This radio set "plays," but very weakly. The volume control seems to have no effect whatsoever. I have put in a new control and this did not help a bit.
(A.) Your problem may be overcome by checking for an open 0.05-mf. audio coupling condenser. This receiver uses a separate 56 tube as an A.V.C. rectifier and still another 56 as an A.V.C. amplifier. However, to make doubly sure that these tubes are functioning, substitute them with some tested pair, for if they are at fault in any way the R.F. and I.F. returns may be affected so much as to render them inoperative, causing weak reception. With the antenna shorted to ground, the voltage reading of the cathode to control-grid should be 17 volts on the A.V.C. amplifier socket, and none on the A.V.C. rectifier.

SQUEALING AT ALL SETTINGS

(53) Dave's Refrigerator and Radio Service, Oconto Falls, Wis.
(Q.) I have a Philco model 65 radio set in my shop for service, and I am having difficulty with it. This set howls, squeals and groans no matter what frequency it's tuned into. All voltages in the set are correct and I've tried aligning and checked all parts. I have tried replacing all resistors and condensers with the exception of

the filter condensers. I replaced the volume control also without correcting the trouble. Shielding was also tried without success.

(A.) It is imperative with this model receiver, to make sure that the R.F. stages are properly shielded. Another cause for this same complaint can usually be traced to either the grid or plate leads of the R.F. stages running parallel with, or in close proximity to each other. On some of these receivers a shield was added over the R.F. coil on the bottom of the chassis. Therefore if there is none in your set, it may be advisable to include this in order to stabilize it.

HUM IN MIDGET SET

(54) Joseph Sylvester, Saratoga Springs, N. Y.
(Q.) I have a 5-tube A.C.-D.C. Lang set, the voltage reading on the plates of nearly all the tubes is about 20 volts including the rectifier. The tubes used are: 6C6, 43, 6D6, 6A7, and 12Z3. By shorting the filter choke the voltages may be brought to normal but the A.C. hum does not permit stations to be heard. The rectifier current at this point is 60 ma., while before shorting it was 12 ma.

(A.) You can obtain a higher plate voltage reading on all the tubes simply by adding an 8 mf. electrolytic condenser to the filter network. In all A.C.-D.C. midgets, when the plate voltage drops below normal, it is primarily due to the filter condensers' capacities dropping below normal and reducing the effective power.

OVERHEATING AND HIGH-VOLUME DISTORTION

(55) B. R. Babin, Duplessis, La.
(Q.) Concerning a Crosley radio set model 655, I have difficulty with distortion, especially on high volume. There is not enough volume, and the power transformer gets so hot I can't hold my hand on it.

(A.) It seems that the lack of power can be traced to a poor 5Z4 rectifier, or a weak 6F6 power output tube. The reason for the power transformer getting too hot may be due to one of the filter condensers drawing current, thereby reducing the voltage, and this incidentally will cause distortion and low volume. Check the output voltage to determine a faulty filter condenser and replace it.

INTERMITTENT RECEPTION

(56) B. R. Munday, Godenich, Ont., Can.
(Q.) The reception on a Philco model 112A is very intermittent. Sometimes this set will be very mushy and distorted, and then again it will play fine. Can you help me with this problem?

(A.) The intermittent reception on your Philco model 112A receiver can usually be traced to poor soldering on the lugs of I.F. transformers. However, if this condition is not remedied with the above, check for either an open oscillator
(Continued on page 842)



FREE — A 1-year subscription to RADIO-CRAFT to each person who submits a WITTIQUIZ that in the opinion of the Editors is suitable for publication in RADIO-CRAFT. Read the following WITTIQUIZZES; can you spot the correct answers? Now send in YOUR idea of one or more good WITTIQUIZZES based on some term used in radio, and win an award. (Contest rules at end of dept.)

(65) A blocking condenser is used to—
(a) Hold a radio chassis rigid while shipping. (b) Keep out undesired stations. (c) Prevent direct current from passing. (d) Prevent condenser plates turning too far.

(66) The term "push-pull" in radio means—
(a) An accordion-like device which pulls in R.F. signals and pushes out A.F. signals. (b) A combination Receiver and Transmitter. (c) That a dynamic speaker with a moving voice coil must be used with the set. (d) An amplification system in which two amplifier tubes work in parallel. (e) An amplification system in which 2 tubes work 180 degrees out-of-phase.

(67) A cat-whisker is a—
(a) Tickler for a regenerative circuit. (b) Hair on cat's face. (c) Device used to clean the dust from between condenser plates. (d) Part of a crystal detector.

J. N. CLAPP

(68) Any radioman knows that a getter is—
(a) A person who gets things from wrecked ships. (b) A new type of radio circuit. (c) A chemical used to flash out the remaining gases in vacuum tubes after the air has been pumped out.

(69) Feedback is—
(a) A substitute for a fullback in football. (b) A disturbance in radio receivers caused by inductive or capacitive back-coupling from one stage to another. (c) A disturbance of the stomach resulting in retching.

HORLUF JENSEN

(70) The tickler coil is—
(a) A coil in the older type sets used to tickle the various parts to keep them sensitive. (b) A coil wound in such a way as to have self-induction of great strength. (c) A coil in the plate circuits which causes regeneration by transferring energy to the grid circuit.

(71) A wavetrapp is—
(a) A device used by sailors to keep the ship's deck dry. (b) A valve controlling the amount of waves going into the receiver via the antenna. (c) A circuit which can be tuned to eliminate any undesirable station.

OLIVER KALMAN

(72) The experts say that skin effect is—
(a) That familiar tickling feeling which you get when you happen to put your hand across a 110 volt A.C. line. (b) The effect on reception when you touch the grid cap of a receiver's tube with your finger. (c) The tendency of a current to flow near the surface of a conductor when the current alternates at high frequency.

(73) An accumulator is—
(a) A device which stores up electrical energy, such as a condenser or storage battery. (b) An amateur who is always buying up more radio parts. (c) An electromagnetic gadget used for picking up small nuts and bolts from the bottom of your junk box.

(74) A triode is—
(a) A 3-element vacuum tube. (b) A tube with only 3 base prongs. (c) A type of vacuum

tube which gives 3 times as much amplification as any other type of tube. (d) A home-made short-wave receiver using only 3 tubes.

G. E. IRONS,
Vancouver, B. C., Can.

(75) A high-pass filter is—
(a) A unit designed to cut out low frequencies and permit high frequencies to pass through. (b) A fence whose height prohibits short people from climbing over it. (c) A provision of the Federal Communications Act assigning only the high frequencies for amateur use so that less interference will filter into the broadcast receivers. (d) A filter unit that steps up the voltage as it smoothes out the irregularities in plate current. (e) A new type of telephone transmitter that kills all germs that flow through the wires with the electrons.

MORRIS GISSER

(76) Is an intermediate frequency—
(a) A frequency a new amateur may use till the F.C.C. finds a channel for him? (b) A deviation from 60 cycles? (c) A frequency to which the I.F. transformers in a superhet. are tuned? (d) Frequent fading occurring in the immediate vicinity?

(77) Is a pickup—
(a) A beautiful blonde? (b) A tool to pick up nuts or screws that drop into the chassis? (c) An instrument to convert mechanical impulses from a phonograph record to electrical? (d) A Service Man who picks up the tools after quitting time?

(Continued on page 844)

**THE "BEGINNERS' SPECIAL"!
A SIMPLE I-TUBE SET WITH
PUSHBUTTON TUNING**

(Continued from page 801)

control, to maintain resonance over a considerable length of time.—Editor)

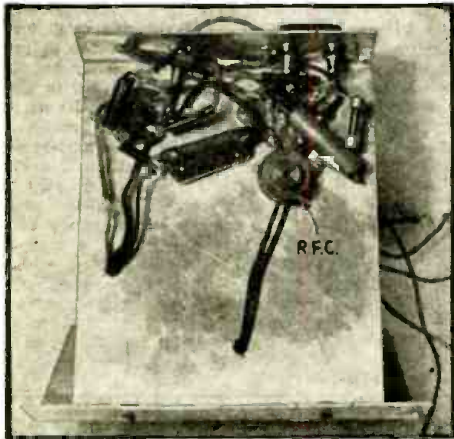
The set may be used with any antenna but one of medium length is preferable. The length required depends upon the distance from the stations for which the receiver is to be set.

This little receiver will give very good volume for headphone use and works well with only 22½-V. "B" battery although 45 V. is more efficient.

LIST OF PARTS

- One Automatic Devices Manufacturers' tuning button unit;
- One Meissner coil, No. 6862;
- *One R.F. choke, 30 mhy.;
- One Raytheon type 1J6G tube;
- One Aerovox mica condenser, 150 mmf.;
- One Aerovox mica condenser, 100 mmf.;
- One Aerovox paper condenser, 0.01-mf.;
- One I.R.C. resistor, ½-W., 0.5-meg.;
- One I.R.C. resistor, ½-W., 2 megs.;
- One I.R.C. resistor, ½-W., 10,000 ohms;
- *One wire-wound resistor, 4 ohms;
- *One octal wafer socket;
- *One S.P.S.T. toggle switch;
- *One jack for phone tips;
- *Aluminum, wire, etc.

*Most Radio mail order houses can supply this item if properly identified as to title of article, issue (month) of Radio-Craft and year.



Under-chassis view of the "Pushbutton I".

**NEW CIRCUITS IN
MODERN RADIO RECEIVERS**

(Continued from page 806)

bias on the 6J5 symphonizer at A is increased by added rectification of the 6J5 used as a diode and the plate resistance of the 6J5 symphonizer begins to compare with R20 and exceeds it, thus increasing greatly the portion of the signal which is used. Finally with a very strong signal the symphonizer bias is driven to cut off value and all of the available signal is used, as the tube section of the signal divider no longer drops the signal through R20.

**(5) STABILIZER SYSTEM CONTROLS
DEGENERATION**

H. H. Horn Radio Mfg. Co. Model 518. Degeneration in the 1st audio stage of radio receivers is minimized, in this new circuit, by a voltage divider stabilizer system to include the 1st audio cathode resistor.

Instead of the bias voltage for the 2nd-detector—1st audio, type 75 tube being derived entirely from the cathode current of the triode section, it is derived from a much larger current in a smaller cathode resistor dropped from the plate and screen-grid supply (see Fig. 1E). The variation of the total cathode current with the signal with this system is negligible and the possibility of the 1st audio bias changing inversely to the signal applied (degeneration) is greatly minimized in this circuit.

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Joseph Rapten, Jr.

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Chas. Koerber.

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**SLIDERULES!—FOR PUBLIC ADDRESS
AND SERVICE WORK**

(Continued from page 813)

of the test oscillator against broadcast-band signals quite often if he desires to align spread-band circuits and high-frequency bands of the conventional type with a high degree of accuracy.

For a specific example, assume that a check against the accuracy of the calibration at a dial setting of 15.1 megacycles is desired. Set the receiver dial to 15.1 mc. Vary the tuning of the test oscillator until a harmonic of a signal from its broadcast-frequency band is received. Supposing this happens with an oscillator-dial setting corresponding to 1,078 kc. Then readjust the test oscillator above or below 1,078 kc. until a second signal is received (be careful not to pass over a signal). If it is below 1,078 kc., the second signal should be received when the test oscillator is set to 1,006 kc.

The Radio side of the RCA sliderule, as shown in Fig. 2, has 2 scales which have logarithmic proportions. The upper scale divisions are marked in kilocycles from 600 kc. to 1,500 kc. corresponding to readings of the test-oscillator dial between 600 kc. to 1,500 kc. The lower scale divisions are marked in units 6 to 15 representing the harmonic numbers. Adjust the sliderule until 2 adjacent "Harmonic numbers" on the lower scale coincide with these 2 figures. For example chosen, 14 and 15 will coincide with the "kilocycle" scale division 1,006 kc. and 1,078 kc., respectively. Cross-multiplying 14 x 1,078 kc., and 15 x 1,006 kc., results in products equalling 15.1 megacycles. This establishes the fact that the 14th harmonic of 1,078 kc. and the 15th harmonic of 1,006 kc., both of which are of the same frequency (15.1 mc.), are both being received at the point on the dial marked 15.1 megacycles. Thus the dial calibration at that particular point of the high-frequency band of the receiver is accurate.

For another example: Assume that the 15 mc. short-wave band of a receiver is out of calibration and it is desired to determine the amount and direction of misalignment.

Adjust the test oscillator until a signal is received at some point on the receiver 15 mc. high-frequency band. Note the reading of the test-oscillator dial and in this case assume that it is 1.170 kc. Readjust test oscillator until a second signal is received. As an example, this second signal might be 1.087 kc. Make a note of these 2 figures.

Slide the "Harmonic number" scale of the sliderule until 2 adjacent harmonic units coincide with the above readings. When this is accomplished, there will appear below 1,087 kc. on the "kilocycle" scale the figure 13, and below 1.170 kc. the figure 14. Cross-multiplying these figures, 1,087 kc. x 14, and 1,170 kc. x 13 we find the product to be 15.21 mc. in each case. From this, the degree of misalignment may be established. If, for instance, the dial reading indicates that the receiver is tuned to 15.3 mc., and a check as outlined indicates that it is actually tuned to 15.21 mc., then it is evident that the dial calibration at that point is off 15.3 mc.—15.21 mc. or 90 kc.

ALIGNING HIGH-FREQUENCY BANDS

See Fig. 5. The first step in the alignment of the high-frequency bands of a receiver by the harmonic method is to establish a frequency having a harmonic smaller than the 15th which will fall within the band to be aligned. For example, if a receiver is to be aligned at a dial setting of 15.1 mc., the first step would be to divide 15.1 mc. by 12, 13, or 14. If we divide by 14, the answer will be 1,078 kc., and it is apparent then that the 14th harmonic of a 1,078-kc. signal will be 15.1 mc.

With the Receiver-Alignment portion of the sliderule it is necessary to establish one such frequency. Then add 1 unit to the harmonic number 14 making the harmonic number 15. Slide "Harmonic number" scale until 15 coincides with 1,078 on the "kilocycle" scale. Number 14 will now coincide with 1,006 on the kilocycle scale. This establishes the second frequency necessary as a check to make certain you are receiving the 14th harmonic of 1,078 kc. during the alignment procedure. This second frequency will of course be the 15th harmonic of 1,006 kc.

Turn on and adjust the test oscillator to 1,078 kc. and set receiver dial to 15.1 mc. If a signal is received, it is possible that the receiver

is properly aligned but a check will be necessary in order to determine that you are receiving the 14th harmonic of 1,078 kc. Therefore, readjust the test oscillator to the second frequency indicated on the kilocycle scale, which is 1,006 kc. If a signal is not received at this second test-oscillator setting, it is evident that the receiver is incorrectly aligned and that the signal received with the test oscillator set to 1,078 kc. was one other than the 14th harmonic of 1,078 kc.

Readjust the test oscillator to 1,078 kc. and adjust the high-frequency oscillator trimmer, or magnetite core, until another signal is received. Then check again by retuning the test oscillator to the second frequency (1,006 kc.). If the second signal is received, it is a positive indication that the signals received when the test oscillator is tuned to 1,078 kc. and again to 1,006 kc. are the 14th and 15th harmonics respectively of signals of these frequencies. Either of these two signals can then be used to complete the alignment procedure as outlined in the service instructions for that particular receiver.

**APPLICATION OF THE RADIO SLIDERULE
WHEN USING THE MODEL 150 TEST
OSCILLATOR**

See Fig. 6. In order to use the Receiver-Alignment portion of the sliderule when using the Model 150 Test Oscillator, it is necessary to insert an open-circuit phone plug into the "external modulation" jack thereby eliminating the 800-kc. fixed-oscillator signal, so there will be present in the output, only the fundamental and harmonic signals of the variable oscillator. As the dial is calibrated in terms of the difference frequency on the 4 lower-frequency bands, it will now be necessary to add 800 kc. to the dial reading to establish the fundamental output frequency. In calibrating or using the broadcast band, it will be necessary to turn the test-oscillator range-selector switch to position No. 1. For example, with the range-selector switch turned to position No. 1 and the test-oscillator dial reading 206.6 kc., the output frequency will actually be 1,006.6 kc. If the oscillator tuning dial were set to 278.6 the actual output would be 1,078.6 kc.

Taking the previous example with the receiver set to the high-frequency band at 15.1 mc., adjusting the test-oscillator dial to 260 kc. will

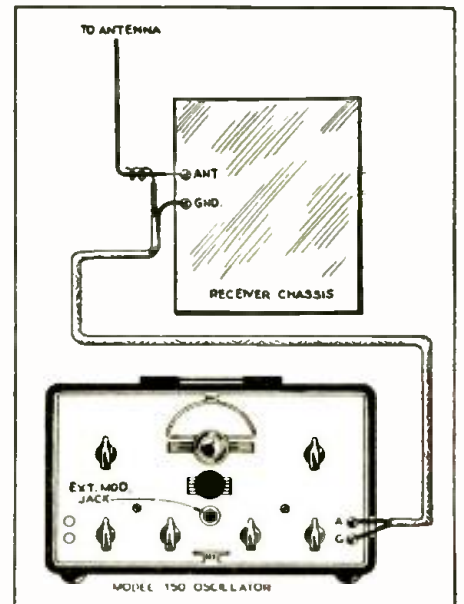


Fig. 6. APPLICATION OF RCA MODEL 150 TEST OSCILLATOR TO SLIDERULE PROCEDURE. (1) Insert open-circuit (dummy) phone plug in "ext. mod." jack, eliminating function of fixed 800 kc. oscillator. (2) Reason. Broadcast range of oscillator is calibrated in difference freq. (difference between variable and 800 kc. fixed oscillator). Harmonics of 800 kc. fixed oscillator are undesired for sliderule applications. (3) Dial calibration for broadcast range will now be 800 kc. Lower. (4) Example:—If use of 1,060 kc. output is desired, set oscillator dial to 260 kc. (1,060 - 800 = 260).

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result in the reception of the 15th harmonic of the 1,006-kc. signal and readjusting the test oscillator so the dial reads 278 kc. will result in the reception of the 14th harmonic of the 1,078-kc. output signal.

Make a note of these numbers and set the sliderule until the units of the "Harmonic number" scale coincide with 1,006 kc. and 1,078 kc. It will be observed that 1,006 kc. will appear directly over 14, while 1,078 kc. will appear directly over 15. Cross-multiplying 15 x 1,006 kc. and 14 x 1,078 kc. both equal 15.1 megacycles, thus indicating that the receiver is properly aligned to 15.1 megacycles.

When using the Model 150 Test Oscillator, the dummy phone plug inserted in the "external modulation" jack results in the elimination of audio modulation and it becomes necessary to use the Magic Eye or some A.V.C. indicator.

NATIONAL UNION'S SLIDERULE

The National Union Radio Slide Rule, a well-built wooden affair, and made by the foremost manufacturer of sliderules, is reproduced in Fig. 7. It may be used in a manner generally similar to that described for the RCA rule in the preceding installment. Great care will have to be taken, however, if this reproduced rule is mounted, for some settings on the front afford readings on the back, and unless each part is maintained in accurate relationship to all the other parts, inaccuracies will result. (Scale 2-3 slides between 1 and 4.)

PURPOSE

This sliderule is designed to permit the rapid determination of:

- (1) *Capacitive reactance* when capacity and frequency are known.
- (2) *Inductive reactance* when inductance and frequency are known.
- (3) *Resonant frequency* when capacity and inductance are known.

As a corollary in each case above, the determination of the unknown quantity, when any 2 of the 3 quantities are known, may be readily accomplished.

Conventional sliderule solutions of these problems have in general 2 drawbacks; namely, the necessity for several settings to find the answer, and no provision for determining the decimal place in the final answer. This sliderule has been designed to overcome these limitations, providing as it does the answer to problems with only 1 setting of the slide and the position of the decimal place automatically indicated.

The range of scales has been chosen so as to include by far the major portion of values in which the average radio engineer is interested. These ranges are:

- Scale 1—Capacity—100 mmf. to 100 mf.
- Scale 2—Inductance—1 microhy. to 1 hy.
- Scale 3—Frequency—16 cycles to 16 megacycles.
- Scale 4—Reactance—100 ohms to 100 megohms.
- Scale 5—Resonant Frequency—16 cycles to 16 kc.
- Scale 6—Resonant Frequency—16 kc. to 16 megacycles.

Four of the scales appear on the front of the rule properly identified by numbers at the left. Scales 5 and 6 are on the reverse side of the slide.

ACCURACY

The percentage accuracy of a sliderule is approximately proportional to the length of its scales. A sliderule having 10-in. scales gives a result accurate to approximately 1/10 of one per cent. Total scale length of this radio rule is 10 ins. with this length divided into 6 cycles or decades, thus giving an effective scale length of slightly over 1 1/2 ins., with a resulting accuracy of approximately 3/4 of 1 per cent. This degree of accuracy is adequate, in view of the fact that knowledge of circuit constants is infrequently better than to an accuracy of 1 per cent. In the infrequent cases, where a very high degree of accuracy is required, this rule will be found extremely helpful as a check on the figures obtained by more laborious means.

HOW TO USE

Scale 1—lower scale on body. The numbers slope to the right, serving as a constant reminder that the scale is to be read from left to right.

Scale 2—lower scale on front of slide. The numbers slope to the left as a reminder that the scale is to be read from right to left. At the 1-henry mark on Scale 2 is an arrow to be referred to as the left index.

Scale 3—upper scale on front of slide. Frequency divisions progress to the right.

Scale 4—upper scale on body. At the 100-ohm mark on Scale 4 is an arrow referred to as the right index.

To find the reactance of a known capacity at a known frequency:

- (1) To known capacity value on Scale 1 set left index of Scale 2.
- (2) At known frequency on Scale 3 read reactance on Scale 4.

Example: Find reactance of 0.01-mf. at 800 cycles.

- (1) To 0.01-mf. on Scale 1 set left index Scale 2.
- (2) At 800 cycles on Scale 3 read 19,900 ohms on Scale 4.

To find reactance of a known inductance at a known frequency:

- (1) To right index on Scale 4 set known frequency on Scale 3.
- (2) At known inductance value on Scale 2 read reactance on Scale 4.

Example: Find reactance of 150 mhy. at 2.5 kc.

- (1) To right index on Scale 4 set 2.5 kc. on Scale 3.
- (2) At 150 mhy. on Scale 2 read 2,350 ohms on Scale 4.

RESONANCE

Scales 5 and 6, on the back of the slide and visible through the rear windows, are used in conjunction with Scales 1 and 2 for the solution of resonant frequency problems. It will be noted that when the slide is extended to the right only Scale 5 is visible in the window; and, conversely, when the slide is extended to the left only Scale 6 is visible. This arrangement automatically avoids confusion in selecting the proper frequency scale.

To find resonant frequency for a known value of capacity and inductance:

- (1) To capacity value on Scale 1 set inductance value on Scale 2.
- (2) At index of rear window read resonant frequency.

Example: Find the resonant frequency of 340 micro-microfarads and 300 microhenries.

- (1) To 340 mmf. on Scale 1 set 300 mhy. on Scale 2.
- (2) At index of rear window read 500 kc.

UNIVERSAL RESONANCE CURVE

The Universal Resonance Curve is convenient in calculating the ratio of response of a tuned circuit at frequencies small amounts off-resonance. Data, in tabular or curve form, for the Universal Resonance Curve is not usually at hand. On the back of the National Union's Radio Sliderule has been printed a short table of Universal Resonance Curve Data.

Knowing the Q of a circuit, the response at frequencies near resonance is:

Frequency deviation from resonance	Percentage of resonant response
Fr/2Q	70.7 (- 3.0 db)
Fr/Q	45.5 (- 6.8 db)
2Fr/Q	24.5 (-12.2 db)
3Fr/Q	16.5 (-15.6 db)

Where Fr is the frequency of resonance:

Example: Assume a circuit resonant at 1000 KC and having a Q of 80. From the table Fr/2Q is the frequency deviation from resonance at which the response will be 70.7% of the response at resonance:

Fr = 1000 KC 1000 KC
 ————— = 6.25 KC off resonance
 Q = 80 2 x 80

For frequency deviation greater than 3Fr/Q the percent response, to a good approximation, is inversely proportional to the fractional deviation.

nFr/Q = 50/n percent when n > 3.
 Radio men find these new sliderules are repaying their comparatively slight cost in a short time due to the tremendous amount of time they save, in the aggregate, in making essential calculations. Of course, the trick is all in using the rules a short time until the use of them becomes second-nature.

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List Price \$24.50 complete with Transformer.



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THIS "MODERNIZING DEMONSTRATOR" HELPS "SELL" YOUR CUSTOMER

(Continued from page 793)

their own voices or their favorite records come ringing from the loudspeaker with great volume and depth! It does something to them . . . they are immediately enthused . . . and you're in a few extra dollars.

BUILDING THE DEMONSTRATOR—2 PLANS

In building the "Modernizing Demonstrator," one of two courses may be pursued . . . depending upon the health of the individual exchequer. They are:

(1) Obtain an inexpensive superhet. midget receiver, one with fairly good tone quality, and add to it all the latest gadgets plus the switches which control them;—or

(2) Obtain a modern table model receiver which already has these latest refinements incorporated. It is then merely necessary to add several switches and the "Demonstrator" is ready.

Now the first plan has two advantages, namely, it is relatively inexpensive; and (like the prospect's), is an old set, modernized. Its disadvantages, serious ones, are its relatively poor appearance and tone, and being a home-built job it is not likely to perform as efficiently as the devices built and engineered into the modern receiver.

THE "MODERN SET" DEMONSTRATOR

The author chose to follow plan No. 2. The set used, as Fig. B shows, is an RCA-Victor model 87T1. It seemed to be the least expensive on the market for our purpose. The set already incorporates the following refinements which would have had to have been added if the set in plan No. 1 were used: Pushbutton tuning with provisions for changing to ordinary manual tuning when desired; "magic eye" visual tuning indicator; tone control; and a terminal strip for connecting a phonograph pickup. This same strip can be used for connecting a carbon mike (in conjunction with its battery and transformer) into the circuit.

The only additions to the set necessary to transform it into a "Modernizing Demonstrator" is a switch box or panel containing 2 pin-jacks each for mike and phono pickup inputs together with a S.P.-D.T. toggle switch to change from one to the other; another toggle switch (single circuit) to cut the visual tuning tube in and out of the circuit; 2 tip-jacks, a S.P.-S.T. toggle switch and a volume control for the headphone connection. In the schematic diagram of the receiver (see Fig. 1) the switch box and its connections are shown in the black inset.

THE "MIDGET SET" DEMONSTRATOR

For those Service Men who, for reasons of their own, choose to follow plan No. 1, the diagram of Fig. 2 is printed. It is the circuit of a typical midget receiver of the better type. Here too the black inset shows the added circuits and their connections. In Fig. 3 is a suggested panel layout for the various components.

These components are symmetrically mounted on the front panel of a small home-built wood cabinet so as to present a respectable appearance. Connections to the visual tuning indicator are made through a shielded 4-wire cable, the shield acting as the ground conductor. The push-button tuning unit has 5 leads. Two of these (those connecting to the oscillator and R.F. circuits of the receiver, respectively), should be

replaced with low-capacity leads (such as ignition cable), and shielded. In addition to these precautions they should also be made as short as possible. The tone control requires but a single shielded lead and the phone and mike connections a 2-conductor shielded cable.

APPROACHING THE PROSPECT

So much for the "Demonstrator." Now a few words concerning the method of approaching the prospect. It is difficult for one person to list all the various avenues of approach, since the circumstances surrounding each case are different. However there are a few general "Don'ts" which might apply in all cases.

The best way to lose a sale is to spread your wares and start talking. Don't forget that you were called to repair a set and not to sell merchandise or additional service work. It is best to let the prospect approach you.

How? . . . Very simple!

When you go on a service call always take along an extra "set" . . . the "Modernizing Demonstrator" . . . so that the party might not be without the entertainment to which he (or she) is accustomed, regardless of whether you have to leave the set there overnight or merely play it while you are working on the receiver.

KEEP AN EAR "PEELED" FOR CONVERSATION

While fixing their set, keep your ears opened for an opportunity to unobtrusively start a conversation relevant to some word dropped here and there or overheard concerning such subjects as: hard-of-hearing, baby crying, new neighbor's set, Magic Eye, etc., etc. That is your cue.

For the "hard-of-hearing" prospect you can sell a *headphone adapter* plus the price of installation. For the "baby crying" prospect possibly you can sell the mother the idea of having a microphone hung over the baby's crib and connected to the radio set, and constituting a *radio mike*, so that she could hear the slightest cry or noise from the remote room of the child. Plug your microphone into the "Demonstrator" and turn up the volume considerably. Let her hear how easy it is for her own voice to come booming from the speaker. Then let her that the job merely implies lengthening the micro-



(Photo—Philco)

Even manufacturers use the "demonstrator" ideal! Here's how one big manufacturer gives a high-fidelity set the acid test—and boosts sales! A "signal generator" (atop set) does the trick; a complete range of audio notes (from very low to very high), fed into the set, is faithfully reproduced.

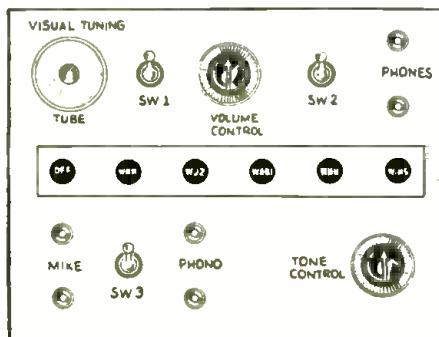


Fig. 3. The author's suggested layout of the "addon" components and switches . . . for plan No. 1.

Please Say That You Saw It in RADIO-CRAFT

phone cable. Or perhaps you can sell her (despite the fact that you are unable to demonstrate it) an *interphone system*, functioning entirely independent of the radio set, to constantly guard the baby even while she is listening to her favorite programs on the radio. And so it goes! As already mentioned, much depends upon the Service Man's ability to recognize an opportunity.

Very often the lady (or man) of the house will start the conversation by remarking about the "wonderful tone quality of the set" (the "Demonstrator" which is always left playing during the service call). There is another cue! Keep the conversation going by pointing out (in an informal, colloquial manner) the advantages obtainable with a *modern set*, and how easy and *inexpensive* it is to have all these advantages applied to her present receiver.

Press one of the electric-tuning buttons on the "Demonstrator" and watch her face light up with surprise . . . a sure sign that the sale is half won. At this point, while she is all "pepped" up about it, bring out a pushbutton tuning converter (see Fig. A) and demonstrate how pushbutton tuning can, within the short space of 5 minutes, be attached to her *own* receiver. Let her press the buttons (which have been pre-set for the most popular local stations) and see for herself how almost magically the stations are instantly tuned in and out at will. That clinches the sale! . . . and you are in a few more dollars. The same thing holds true for phono pickups and the host of other attachments which are on the market, each of which, when applied to an old set, brings it several degrees closer to modernity.

It's true that in order to follow the above suggestions the Service Man has to carry, in addition to his tools and the "Modernizing Demonstrator," such devices as the pushbutton tuning converter mentioned above, a phono pickup, microphone, short-wave converter, several wave-traps, a variety of noise filters, etc. But what of it? To earn more money, one must work harder; and carrying all this equipment around is part of "working harder."

Of course it is not necessary to actually bring



Free (almost) electricity! Here is a typical installation of a wind-driven charger, sold and set up by a Service Man. Aside from furnishing power for the owner's 6-volt radio receiver and charging the storage batteries of his car and tractor when they become run down, it furnishes electricity for 14 bulbs (6-V.) used to give illumination in the house, barn, garage, tool-shed and chicken coops.

Service Men should tie-up with their local dealers in selling these units. Manufacturers, realizing the vastness of this field, are cooperating wholeheartedly with farm-radio dealers to educate the rural populace concerning the advantages of these devices, thereby stimulating sales. One manufacturer (of *Pin-charger machines*) even went to the expense of putting out a trio of 60-second trailer films on the use of 6-volt radio sets. These films are available, it is said, to farm-radio dealers in all parts of the United States. The films feature the pleasure of "big city" radio reception for 50¢ a year power operating cost, stressing further the elimination of "B" batteries and expensive re-charging.

all this material into the customer's house. Only your tools and the "Demonstrator" need to be brought in. The balance can remain in your car, or if your workshop happens to be close by, you needn't take the material along with you at all. Your chances of consummating a sale would not be weakened one iota if, in the course of a conversation with your client, you excuse yourself for 2 or 3 minutes in order to get the device which is the subject of the conversation.

If the conversation has swung around to the subject of *high-fidelity*, perhaps because of the increased tone quality that usually becomes apparent, when the "Modernizing Demonstrator" is used or perhaps a noise-filter has been added to the set-owner's radio receiver, you have the cue to talk-up the use of a *separate loud-speaker*. You can tell your audience how easy it is to connect a second, or even a third, or fourth, loud-speaker to his set in almost the same way you connected the headphones you previously demonstrated to him. Another and more modern approach, recently made more convenient by the advent of several ingenious housings, is to suggest that they retain their old radio set, but install the reproducer in a special housing in order to obtain better tone quality; and, in some cases, added volume.

With this in mind it may be profitable to have on hand an acoustical labyrinth, or the more recent "Bi-Fonic" type of acoustical housing, in order to be able to demonstrate these items while the customer is in a favorable frame of mind. In passing, it may be well to note that if the "Bi-Fonic" type of sound reproducer is elected to fill the bill to demonstrate improved tone quality and volume, it will be wise to take along a plate of bakelite or other plastic material, as wide as the reproducer and about 18 ins. deep. Placed on a rug, and directly against the base-front of the housing, it serves to prevent low frequencies being absorbed by a carpet.

SPECIAL OPPORTUNITIES FOR RURAL SERVICE MEN

Rural Service Men, in addition to the many salable devices mentioned above, have the additional opportunity of selling *wind-electric chargers*. Today many farmers are lighting their homes, milking their cows, refrigerating their food and operating stokers with current generated cheaply and reliably by the wind. Many other farmers, however, are unaware of even the existence of these efficient wind-driven electric chargers. Of course these devices cannot be demonstrated on the spot, but by carrying manufacturers' literature with you it becomes an easy matter to explain how inexpensively and simply a wind-electric charger system can be installed and operated. Another item for the rural Service Man is the gas or kerosene-burning refrigerator. Tie up with a local dealer. He will be more than willing to have you represent him while making service calls. The gasoline-electric power plant is another A-1 "bet," for supplying radio and electric equipment power, where it is inconvenient to install wind-driven apparatus.


The "Modernizing Demonstrator" is a very potent factor in selling devices intended to improve old radio receivers. When sold, however, there still remains the task of mounting and wiring the particular device into the customer's set. This information, however, is the subject matter for another article which appears in this issue.

Incidentally, the pushbutton tuning converter mentioned above is about the most popular and therefore most salable item at the present time. It is therefore completely described and diagrammed in another article in this issue. (Also, a pushbutton tuning adapter, of the same make, is diagrammed in the same article. Note, however, that the adapter requires making connections inside the customer's set, and hence, although less expensive as to unit cost, is more costly as to labor.—Editor)


LIST OF PARTS

- One RCA-Victor model 87T1 receiver;
- Six pin-jacks (in colored pairs);
- Two S.P.D.T. toggle switches;
- One single-circuit toggle switch;
- One 0.5-meg. potentiometer;
- One metal box measuring 5 ins. sq. x 3 3/4 ins. deep (or any other size to suit the individual);
- One 1/16 in. thick bakelite panel for the above box.

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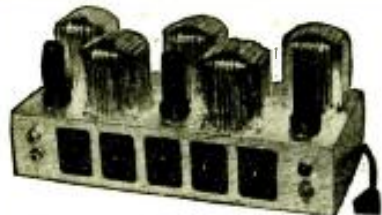
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IT'S EASY TO BUILD THIS "BROWNING 83" 4-BAND SUPERHET.

(Continued from page 804)

If the I.F. amplifier has been adjusted by the above procedure to nearly its most sensitive position, a hiss should be heard with the antenna disconnected.

- (9) Set the tuning condensers so that no station is heard.
- (10) Readjust the top and bottom screws on I.F.T.1 for maximum hiss.
- (11) Readjust the top and bottom screws on I.F.T.1 for maximum hiss.

The I.F. transformers should now be properly aligned at 456 kc. If the experimenter is experienced in making adjustments on I.F. amplifiers, the link circuits may be *very slightly* adjusted for maximum hiss. As before indicated, these link circuits are adjusted by means of the center screws in I.F.T.1 and I.F.T.2.

If the wiring has been carefully done and the leads made short, the I.F. amplifier circuit should not oscillate when the I.F. GAIN control is fully advanced.

FINAL TUNER ADJUSTMENTS (WITHOUT A SIGNAL GENERATOR)

With the antenna disconnected and the receiver turned on (volume controls at maximum, tone control turned counter-clockwise as far as possible without turning off receiver) make the following adjustments:

- (1) Set the band-selector switch on band 4.
- (2) Turn the pointer to approximately 1.4 mc. (If a station is received at 1.4 mc., adjust the tuning condenser slightly above this value to a position where no signal is heard.)
- (3) Refer to the illustration supplied with tuner assembly for the position of the antenna and R.F. trimmers for band 4.
- (4) By means of an insulated screwdriver, adjust the trimming condenser on the antenna coil of band 4 for maximum hiss.
- (5) Adjust the trimming condenser on the R.F. coil of band 4 for maximum hiss.
- (6) Turn band-selector switch to band 3.
- (7) Adjust antenna and R.F. trimmers for maximum hiss with tuning condensers set for a frequency of approximately 3.6 mc.
- (8) Turn band-selector switch to band 2.
- (9) Set pointer at about 8.0 mc. and adjust antenna and R.F. trimmers for maximum hiss.

It is difficult to adjust band No. 1 for maximum hiss; therefore the adjustments for this band will be treated separately.

- (10) Set band-selector switch on band 4.
- (11) Turn pointer to approximately 0.6-mc.
- (12) Adjust padding condenser on band 4 for maximum hiss. (This padder is adjusted with an insulated screwdriver through the hole provided in the rear of the chassis, the band 4 padder being adjusted by means of the bottom right-hand screw as viewed with tuner in its normal position.)
- (13) Turn band-selector switch to band 3.
- (14) Set dial pointer between 1.6 and 1.5 mc.
- (15) Adjust padder on band 3 for maximum hiss. (This padder is adjusted by means of the screw placed slightly to the left and higher on the rear of the tuner chassis.)

The padders on the other 2 bands are of relatively large value and are not adjustable. Very stable fixed mica condensers have been used for these padders. It is always advisable, after the padding condensers have been adjusted as described above, to again check the adjustments on the trimmers since these adjustments may have been very slightly altered. In other words, after having adjusted the padders, go back and check the trimmers as previously described. All of the above adjustments are made on noise, and noise alone. If a station is tuned in during the process, detune so that no broadcast is heard.

ADJUSTING BAND 1 TRIMMERS (WITHOUT A SIGNAL GENERATOR)

With a very short antenna connected, and the volume controls turned to maximum, proceed as follows: (Refer, once again, to the illustration supplied with the tuner assembly, in order to quickly locate the trimmers mentioned below.)

- (1) Set band-selector switch on Band 1.
- (2) Tune-in a broadcast station or other signal between about 15 or 16 mc., the weaker the signal the better.
- (3) Adjust the trimmer condensers on the antenna and R.F. stages for maximum signal strength.

On Band 1 there is a possibility of adjusting the trimmers to the image frequency instead of the true frequency. It may be found that there are 2 signal maxima obtained when the antenna or R.F. trimmers are adjusted. The correct setting for these trimmers is that setting which gives a maximum response when the adjusting screws are advanced in a clockwise direction by a greater amount (greater capacity).

It will be noted, in the alignment instructions, that the trimming condensers on the oscillator coils have not been altered. This adjustment changes the frequency to which the set tunes with the tank condensers in any fixed position.

ANTENNA INSTALLATION

If DX reception is desired, a good antenna installation is essential. The "Browning 83" has provision for a doublet antenna and if the receiver is being operated in a noisy locality, it is advisable to use a suitable noise-reducing antenna system comprising an antenna properly placed as far as possible from the interference sources and a lead-in so designed that it does not pick up either interference or signal. Since man-made static is usually carried by conductors, such as electrical wires or metallic structures, and radiated from these only a relatively short distance, it is advisable to locate the pick-up system of the noise-reducing antenna as far as possible from metallic structures. Usually, interference radiation from a metallic structure will be very weak at a distance of about 50 feet. If the receiver is located in a relatively quiet neighborhood as regards man-made interference, an L- or T-type antenna of 30 or 40 feet total length will be entirely suitable.

It may or may not be advisable to employ a ground connection with the "Browning 83." Sometimes connecting the ground binding post on the receiver to radiators, water pipes, etc., increases rather than decreases interference due to man-made static. This can be determined by experimentation.

Sometimes less interference is encountered if a filter is placed at the outlet of the 110-volt circuit. All precautions possible have been made to keep interference from the lighting circuit out of the receiver. For this reason a condenser has been put across the 110-volt line and an electrostatically shielded power transformer is employed. However, if there is a great amount of interference coming in over the power line circuit, some of this interference may be radiated by even the few inches of 110-volt lead before it is eliminated by the radio frequency bypass condenser. In such cases, a filter at the 110-volt outlet will reduce this interference.

This concludes the description of the "Browning 83" receiver. *Radio-Craft* recommends this set to Service Men and set-builders as a superlative instrument incorporating all the modern refinements essential to efficient reception of DX broadcast and short-wave stations. This radio set will come as a welcome relief to DX listeners who have been disappointed in the performance of less-modern all-wave receivers; the noise-free performance of this set as compared to earlier types in which the *signal-to-noise ratio* had not been given paramount consideration will be a revelation.

READERS' DEPARTMENT

(Continued from page 810)

without a description of the phono chassis having appeared. Do you plan to run this information in a forthcoming issue?

FRANK A. HUBBARD

Since provision was made on Chassis No. 3 for connecting a phono pickup, any type of mike or a low-gain preamplifier, it was felt that a description of Chassis No. 5 (the phono section) would be superfluous.

Further, adding a volume expansion circuit, according to the original plan, it was later felt would lead the builders into serious difficulties (from an operating standpoint).

Please Say That You Saw It in RADIO-CRAFT

A HOME-MADE INFINITE-RESISTANCE TUBE CHECKER

(Continued from page 808)

suitable to our application in view of its all-electric operation with 2.5-volt heater line.

As per the schematic (Fig. 1, Part 1), it will be noted that there are only two input terminals to which all connections to the tube sockets are made. A flexible grid lead is provided from a central location about these sockets as it serves as common connection to the control-grid cap of these tubes. Pin-jacks are also provided, to which test leads may be attached when it is desired to check the leakage of electrolytic condensers or the resistance of high-value resistors.

It should be noted that the S.P.D.T. switches are in the "off" position when they are up or in contact with the top terminal line circuit to the plate. Switching means as provided for one socket are shown in the diagram. Note that one individually manipulated switch is provided for each electrode of a tube. A set of 9 switches will be found adequate means of controlling the leads to the set of sockets used. Here all 4-prong tubes will be checked in one 4-hole socket and so on for 5-, 6-, 7-, and octal-prong combinations.

In checking tubes, the 7-megohm resistor in the grid circuit should be employed; the other resistances are used when checking condenser leakage and unknown values of high resistance. For the latter the milliammeter scale may readily be calibrated by using known resistance standards or interpreting these values from respective scale numerals. Scale deflection limit can be controlled by the correct selection of the proper resistance. The variable resistor R2 is adjustable to permit setting the scale when checking tubes.

OPERATION OF THE NOISE-AND-SHORT CHECKER

As previously mentioned, all tubes checked for noise and shorts must be cold; with the exception of the check for heater-to-cathode short, when the tube should be preheated. The heater is then checked against the cathode.

Assuming that the V.-T. V.M. and amplifier are now in operation, the milliammeter should be adjusted to zero, being certain that the switches are all "off" and that the 7-megohm resistor is in the grid circuit. A low hum may be audible, which is permissible; but it should not be of so high a level as to be distracting. After inserting a tube in the proper socket provided and by first depressing one switch lever, the one electrode in which circuit this switch is inserted will be checked against all the other tube elements together and across the voltmeter-ohmmeter. Successively the remaining switches are manipulated, respectively and in sequence, until an abnormally loud noise emanates from the speaker. This is an indication of current leakage and upon further observation it will be noted that the milliammeter supports this fact by a scale deflection registering the amount of resistance present. Tapping the tube will give further evidence of the nature of the short as indicated simultaneously by both speaker and meter needle.

Hence, it may be seen that this affords a very flexible system of testing tubes. It permits the operator to segregate and isolate each independent electrode of a tube and analyze its behavior with respect to the rest, regardless of how large this number may be. A good tube will check without any indication of noise or meter deflection.

THE AUDIO AMPLIFIER

For the practical as well as the psychological effect, an audio amplifier is necessary to amplify the output of the V.-T. V.M. in order to better assist in the interpretation of the condition of the tube. Noisy tubes are caused by vibrations of loose elements within the tube which, when applied to this circuit, have the effect of varying and altering the interelectrode capacity of the tube to a sufficient degree to cause instability of the input to the V.-T. V.M. This is of course detected by the V.-T. voltmeter and is passed on to the amplifier where it undergoes amplification and manifests itself as abnormal, erratic, or spasmodic reproduction.

The circuit utilized is of conventional design and quite suitable for this purpose. A number of various types of circuits have been tried and tested but this one was chosen because of the commonly used tubes it employs. Either



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WESTON Radio Instruments

a magnetic or dynamic reproducer may be used, but we have found that the former type delivers sufficient output for the purpose. It is suggested that a 6-inch speaker of good construction be employed—preferably one of the high-frequency-reproduction type which will accentuate the noise frequencies to good advantage. An additional output indicator in the form of a 2E5 "eye" may be added for visual observation if desired. This would provide a suitable mute or indicator for the benefit of near-leaf customers.

THE POWER SUPPLY

The dual unit power supply was designed as a means of providing sufficient reserve potential for the heavy drain imposed. It also supplies separate plate voltages, thus tending to minimize and maintain a low noise level by eliminating common conductive coupling paths between the vacuum-tube voltmeter and the amplifier. Although the 27 supplies sufficient potential, it is possible to employ 80's in the same manner. Good-quality filter condensers are important; and transformers and chokes should be mounted so as to prevent coupling with each other. The use of condensers in the primary circuit of the power transformer for bypassing and eliminating 60-cycle-frequency modulation is essential and, in stubborn instances, R.F. chokes may be of assistance.

Wiring. Common push-back hookup wire may be employed in wiring the audio amplifier and rectifier sections; however, we recommend the use of a good conductor in wiring the V.-T. voltmeter and particularly the test panel, otherwise cabling cannot be practiced without anticipating residual hum. We have steadfastly recommended ignition cable having thick insulation for anti-capacity efficiency. The use of busbar is also practical for a true instrument-like appearance, but must be kept well apart to defeat capacity effects. Of course, all low-frequency A.C. filament wiring must be twisted and must be kept away from the V.-T. V.M.

SUMMARY

Our experience from the use and production of this tube checker has demonstrated its

versatility and thoroughness of applicability to everyday tube problems and having thus recognized these unusual qualities and advantages not possessed by any other checker, the author recommends its use to fellow radio technicians who have from their experience learned to appreciate the things that this apparatus will accomplish.

It provides one of the most certain forms and perhaps the most reliable and undisputed method of determining the exact condition of any and all types of vacuum tubes when employed in conjunction with a good transconductance or emission tester. Its systems of indication are simple enough for the layman to easily understand without difficult interpretations of graphs and arithmetical calculation. Given these simple means of explanation it shows tubes up without doubt so that it becomes the most conclusive form of tube seller available.

All of the components employed are of standard manufacture and should not warrant discrimination to insure satisfactory operation if the other construction and wiring details are closely followed. Careful filtering and shielding are important as well as the correct placement of the chokes and transformers, which should be mounted with core axes at right-angles to each other. More serious as a source of trouble, from our experience, has been the presence of poor insulation. Non-hygroscopic dielectrics are essential for year-round operation, and for this reason this checker will not operate properly in tropical or humid countries. We would further suggest that isolantite sockets be employed in lieu of the bakelite type as shown in the photograph.

IN JULY RADIO-CRAFT—

The forthcoming issue of *Radio-Craft* will contain the schematic circuit, list of parts, and complete details for making a modern high-fidelity tuner. Don't miss this article, you set builders, P.A. specialists, and Service Men!

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HOME RADIO DIATHERMY—A GROWING FIELD

(Continued from page 796)

field of a short-wave set—cooked though the outer atmosphere was at normal temperature. If a properly designed set could do that, why could it not also heat the body internally? The temperature could be controlled—something impossible to do by any other means. This led to the development of Short-Wave Diathermy which has definitely taken its rightful place in the medical field.

But another of the wonderful achievements of modern science has been the development of a home-model short-wave diathermy unit that operates automatically, safely and efficiently.

Many suffering from ailments that will respond to short-wave diathermy applications are confined to their homes and cannot conveniently travel outside the home for these applications. Also, there are many living in communities where ready accessibility to short-wave diathermy is lacking. It is to these people, especially, that the portable Short-Wave device is a blessing.

Hippocrates, the "father of Medicine" is credited with having said, in effect some 2,300 years ago—

"Give me the power to create fever and I will be able to cure disease."

But it was not until the very eve of the World War that Hippocrates' prophecy was fulfilled—and it was a "radio accident" some years later that finally established today's Short-Wave Diathermy. In a research laboratory, in 1929, a physicist found some of his assistants developing fever of unknown origin while at work. He traced this to their experiments with short-wave broadcasting apparatus.

Fever, authorities point out, is used not merely to kill by heat the germs of certain diseases, but also to help the body rally its defensive forces against disease—As they explain: "The fever increases the number of white 'police' cells in the blood which fight invading germs—and peps them up to redoubled activity. It also speeds up blood circulation, sometimes as much as 400 per cent. This gives the tissues which are 'fighting for their life' an increased supply of blood, and at the same time carries off poisonous by-products more speedily."

THE MODERN WAY TO COMBAT PAIN

The oldest known diseases of mankind are rheumatism and arthritis. They occur more frequently than any other chronic maladies. They have been the cause of intense suffering since time immemorial. This was the scourge in early Egyptian, Greek and Roman days, mentioned in history.

In temperate zones, such as the United States, rheumatism and arthritis are very common and are particularly evidenced in people over 50. Life is made almost unendurable for these sufferers. Although infants of 10 months may contract it, it is especially observed in adults, usually over 30 years of age.

The sufferer is faced with a future that is far from pleasant. He becomes distressed and in many cases incapacitated. He suffers excruciating pain and becomes more or less crippled.

SHORT-WAVES RULE HUMAN ILLS

Short-Wave Diathermy is still in its infancy. About 5 years ago this business was in the embryonic stage. A crudely assembled spark oscillator was offered to the public and this was the forerunner of the present-day short-wave generator.

Just as ultra-violet and infra-red finally came out of the hospital and physician's office and into the home, now, too, Short-Wave Diathermy simplified and easy to apply, and just as potent, comes into the home.

Short-wave diathermy's extraordinary powers in relieving the anguish of *arthritis, neuritis, rheumatism, sciatica, lumbago* and kindred ailments, are well established.

When sun-lamps and other modalities of heat made their bow, the doctor and physio-therapist were the only ones to use it in their practice. Today, every drug store, hardware store and department store offers sun-lamps for sale. The lowest fee for an individual application of "Short-Wave" is \$3.00. Usually a series of treatments is required and it becomes too expensive for the masses. With a portable in the home, at a price within the reach of all, every sufferer can avail himself of this wonderful treatment.

I should like to stress the fact that short-

wave therapy has long passed the experimental stage. It is an accepted method by the entire medical profession, throughout the entire world. Current periodicals, the world over, have and still are extolling the virtues of short-wave energy, in treatment of an enormous variety of ailments. The public at large is quickly becoming short-wave conscious and the time is ripe to invade this great potential field—the home. Every family becomes a prospective buyer.

THE MODERN SHORT-WAVE UNIT

Short-wave diathermy portables are designed to meet every conceivable requirement for the most simple, practical and convenient application in the home. The remarkable simplicity of operation, the deep penetration and the automatic timing device are in strong contrast with the older methods of strapping on metal electrodes with their potential spark burns and the uncertain results due to their inability to deliver deep heat.

THE PHYSIOLOGIC ACTION OF SHORT-WAVE DIATHERMY

Short-wave diathermy penetrates deep into the tissues of the flesh and into the bone, causing heat units that set up an excessive accumulation of blood. This action, known as *hyperemia* increases local nutrition—produces beneficial chemical changes in the body—and causes the white blood corpuscles to destroy any microbes which may be present.

By producing hyperemia through the use of short-wave diathermy you are simply aiding nature in using the natural curative powers of the body which may reside in the blood. This influence on the circulatory function causes the vast capillary net-work of the skin to be completely filled with blood—thus relieving congestion of the liver, stomach, spleen and other internal parts.

Daily repetition of short-wave diathermy tends to restore normal conditions gradually. The circulation becomes more and more active and the amount of blood in the over-burdened internal organs is diminished as the vital resistance of the tissues is increased—the digestive secretions resume their normal functioning, and the liver, adrenals, lymphatic glands and other poison-destroying organs are again effective.

EFFECTS OF SHORT-WAVE HEAT

In addition to alleviating pain and stimulating the blood supply in the area between the electrodes, these short-wave impulses dilate the arteries and blood vessels, increase oxidation and nutrition, and hurry the elimination of toxic poison and waste materials. The heat produced by short-waves has a sedative effect and induces sleep.

Many of us will recall that heat held a prominent place among Grandmother's remedies. For stomach ache we were compelled to drink hot water and hug a heated dinner plate. Heated soapstones, bricks, flatirons, and jars filled with hot water, were packed around us when we had a chill, or placed along the spine when it ached. Hot water was the remedy par excellence for infections of all sorts—boils, wounds, abscesses, etc.

The trail blazed by our grandmothers, as now applied by modern methods for alleviating pains, aches, inflammations and congestions, has broadened. Short-wave diathermy has brought hope to thousands suffering from arthritis and other rheumatic ailments. Only short-wave diathermy's ultra-modern radio-waves bringing their soothing power to the relief of pain can convey heat through the skin and pass it to any particular part of the body deep down to the very center of an aching muscle, sinew or bone, down into the tortured rheumatic joint itself. Grandmother's methods attempted to do what short-wave diathermy actually accomplishes.

Short-wave diathermy has won high laurels in the medical world. It is used by leading hospitals and physicians.

Short-wave diathermy is at the place the Radio Industry was 20 years ago. The product is more or less standardized and those who applied intelligence are today making progress at a rate comparable to the pioneers of the now firmly established Radio manufacturers.

The big money in this business lies in installing equipment in the home. This should be

(Continued on following page)

Please Say That You Saw It in RADIO-CRAFT

SERVICE MEN!—ADD THIS PUSHBUTTON-TUNING CONVERTER TO ANY RADIO SET

(Continued from page 810)

THE SET-POWERED PUSHBUTTON "ADAPTER"

Figure 1B shows the circuit of another type of pushbutton tuner, suited to installation in superheterodyne receivers only. It is a single-tube job, drawing its power supply from the set to which it is connected. Its one tube, a 6A8, acts as oscillator and mixer, its output being

"tune" the trimmers and thereby setup the desired 8 stations. The lower row of trimmers adjust the oscillator circuit and the upper row, the antenna circuit. The former are adjusted first, until the station is heard. Then the antenna trimmer is adjusted for maximum strength and clarity.

Names of manufacturers will be supplied upon receipt of a stamped and self-addressed envelope.

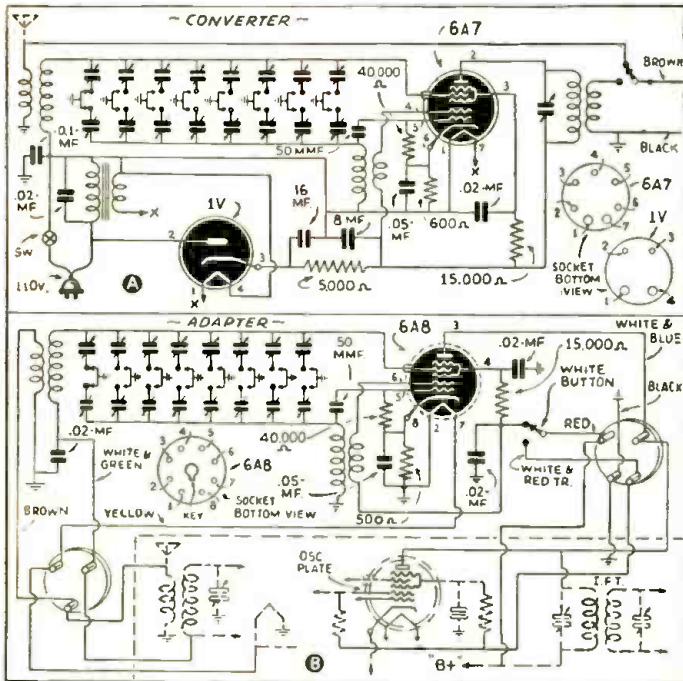


Fig. 1. At left you see 2 diagrams of importance to Service Men.

At A is shown the pushbutton-tuning converter. It connects to the antenna and ground posts of the radio set and is self-powered; hence, it does not require wiring into the radio set with which it is associated.

At B is shown the pushbutton-tuning adapter. It connects into, and derives its power from, the associated radio set.

fed directly to the plate circuit of the mixer tube in the receiver with which it is used.

With this unit, connections must be made to antenna, ground, mixer plate, positive "B," heater circuit, R.F. grid-return (A.V.C. circuit), and to an opened cathode circuit.

The panel layout of this converter is similar to the one previously described, and the means of setting up the stations is the same. On the front panel are two decorative metal strips, which when pried off, reveal holes through which an insulated screwdriver may be inserted to

HOME RADIO DIATHERMY—A GROWING FIELD

(Continued from preceding page)

notably interesting to radio dealers and radio Service Men. The home user is the highest customer—no one is better fitted to install these units in the home than the Radio dealer.

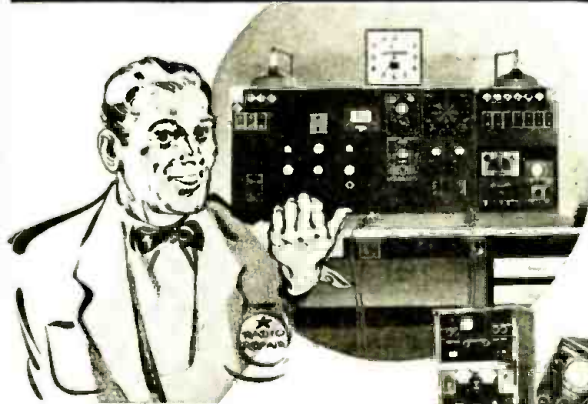
The home market should eventually be, and I believe will be, the greatest market for short-wave diathermy, in the future. It will bring more pleasurable hours free from pain and year round comfort to sufferers. I believe the day will shortly be here when all but the very poorest will own a Portable Short-Wave Diathermy unit instead of going to hospitals or doctors. A unit in the home is cheaper, more convenient, and fills a want long felt by the sufferers who cannot afford large fees.

People will demand the comfort and relief from pain that short-wave diathermy provides. This assures a waiting demand for this type of equipment. It is not a periodic business because suffering knows no season. Sales are continuously active.

In conclusion let me point out that those men who possess the vision to recognize the vast opportunities of this business should profit handsomely—provided they don't let the grass grow under their feet.

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SIDELINE MONEY FOR SERVICE MEN

(Continued from page 796)

the most convenient and most popular method of accomplishing this is shown at Fig. 2B. Good paper condensers of high working voltage and low leakage are preferable. The use of higher capacities than those shown is not recommended. Where a volume control for the headphones is desired, employ a 0.5-megohm potentiometer connected as shown at Fig. 2C. Incidentally, these same terminals may be used for external connection of a magnetic speaker, which may be placed several hundred feet from the receiver, provided parallel rather than twisted lines are employed.

In some instances, it may be desired to cut in either the headphones or receiver reproducer, or both together. This is done through the use of toggle or knife switches mounted conveniently on the receiver cabinet, connected as shown in Fig. 2D. It should be noted that a 3-ohm resistor is employed to shunt the output transformer secondary when the voice coil circuit is opened. For control of an external speaker, a similar circuit is followed.

There are other methods employed to connect headphones to receivers. Some Service Men choose to cut in the phones before the output stage. Through the use of jacks, suitably wired, it is possible to cut in the headphones with the output stage in or out of the circuit. With the output stage out of the circuit, the speaker is silenced. In resistance-capacity coupled audio stages, the phones are connected directly across the grid resistor as shown in Fig. 3A. When the jumper is omitted, as at Fig. 3B, the speaker is silenced as the phones are plugged in. In receivers where transformer-coupled audio stages are employed, connect the phone jack as shown in Fig. 3C. To permit phone operation without loudspeaker, use diagram in Fig. 3D. A volume control may be incorporated, in any case, simply by adding a 0.5-megohm potentiometer.

FIDELITY IMPROVEMENT

Few set-owners resist the suggestion that a very decided improvement in the tone of their receiver is possible at a small investment. By slight changes in component values and through the use of later, improved-type tubes, the fidelity of many receivers is greatly enhanced.

For example, greater volume and more than double the undistorted power output is achieved when 2A3 tubes are substituted for the type 45 tube. In most instances, it is necessary to change the bias resistor value to secure the correct grid voltage. The only precaution to observe is the fact that since the plate current of the 2A3 tubes is higher, the available D.C. output voltage of the receiver may fall considerably. By shunting the input filter condenser of the power unit with additional capacity, this decrease in plate current is generally overcome.

Receivers without tone control are easily improved. Many Service Men carry a small box in which a variable resistance and fixed condenser are conveniently applied to the output tubes by means of adapters slipped under the tubes, to demonstrate to set owners the value of tone control in reducing high-frequency response and to minimize static interference. For a permanent job, the variable resistor is mounted in the front or side of the receiver cabinet; or, where the line switch for the receiver is a separate control, employ a tone control switch for the purpose.

The most common methods of applying tone control consist of variable resistances connected in series with a fixed condenser across the grids or plates of a push-pull output stage or from the grid or plate to ground of an audio or single tube output stage. This is shown in Fig. 4A.

There are so many receivers being operated today in which the bass response is either lacking, or over-emphasized, resulting in inferior or boomy reproduction. By providing some means of overcoming this deficiency, a well-meaning and profitable service may be rendered. To improve bass response in receivers without sacrificing high-frequency reproduction entails only simple additions or changes.

In transformer-coupled audio stages, bass reproduction is easily enhanced. A conventional transformer-coupled stage is shown to the left of Fig. 4B. By adding a 50,000 ohm resistor in the case of a triode amplifier or a 0.25-megohm resistor in the case of a screen-grid type, and a 0.25-mf. paper condenser as shown in Fig. 4C, bass reproduction is fortified considerably. Bass-response control is rendered simply by the addition of a 0.005-mf. condenser and 0.5-megohm

potentiometer as shown in Fig. 4C. Manipulation of the potentiometer varies bass response.

When reproduction is boomy and too bassy in transformer-coupled receivers, employ the circuit shown in Fig. 4B, but substitute a 0.005-mf. or 0.01-mf. for the 0.25-mf. coupling condenser shown in the diagram. Trial with different capacities will soon determine the correct condenser to employ.

By increasing the capacity of the coupling condenser in resistance-capacity coupled stages, bass response may be augmented. Should treble reproduction be affected by the increase in coupling condenser, it may be necessary to employ a higher value of grid leak, although this latter change may introduce motor-boating. To reduce bass response in resistance-capacity coupled stages requires only that a lower capacity coupling condenser be utilized.

RECORD PLAYER POSSIBILITIES

Much may be said with respect to the many opportunities afforded to radio Service Men by the increasing popularity of records and record-players. In hundreds of homes, old-style spring-wound phonographs with their countless costly records stand forgotten. The phonographs are never used because by comparison with their radio set, the deficiencies are all too readily disclosed.

With little ingenuity and through the use of an electric phonograph motor and turntable, and electric pickup, these old phonographs may be completely modernized to the delight of the owner and profit of the Service Man. Mechanical details are left to the individual.

The many inexpensive but efficient record players offered to the public today by different manufacturers are easily salable and make possible another profitable sideline.

Although terminals and facilities for connecting phonograph pickups are provided on many radio receivers, it will be found necessary upon many occasions to remove the receiver chassis and make certain changes and additions for pickup connection. The best portion of the receiver circuit to connect the phono pickup will depend, of course, upon the particular circuit arrangement of the receiver. Various methods of making phonograph connections will be shown here. In all cases, a double-pole, double-throw toggle or knife switch is employed for the phono-

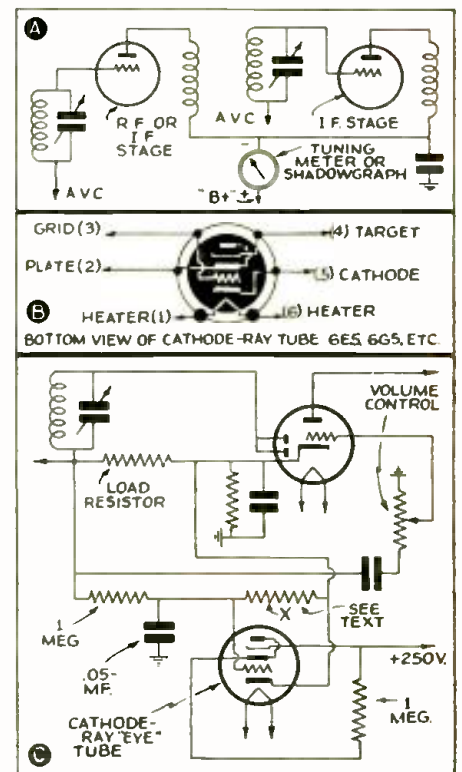


Fig. 1. A shadowgraph or tuning meter is attached to a superhet, as shown in A. Section B gives the socket connections for a visual tuning tube; and C, its circuit connections.

Please Say That You Saw It in RADIO-CRAFT

radio transfer switch, and provision is made to satisfactorily prevent radio interference during phono operation. Use shielded leads wherever indicated upon the diagram for best results and keep all leads as short as possible.

With those receivers diode detection and A.V.C., the volume control is usually in the audio circuit. The pickup is connected across the volume control as shown in Fig. 5A.

In receivers where a power detector is found, the pickup is connected as shown in Fig. 5B. As can be seen, the secondary circuit is open-circuited in the phono position and the secondary winding is short-circuited to prevent radio interference. The second pole of the D.P.D.T. switch connects into the cathode circuit only the lower value resistor which has been added to the cathode circuit so that the tube will operate linearly.

The situation may arise where insufficient gain is provided by the audio stages of the receiver for satisfactory operation of a magnetic pickup. In these cases, the entire amplification of the receiver may be utilized to secure the requisite gain for the pickup, by means of a *phonograph oscillator*. This device is an unmodulated R.F. oscillator, tuned to some broadcast frequency, and derives its operating voltages either from a built-in power supply or from the receiver with which it is used.

The phonograph pickup is so connected as to modulate the R.F. output of the oscillator. By connecting the phono oscillator to the antenna and ground posts of any receiver and tuning the receiver to the oscillator output frequency, record reproduction is secured. Phonograph oscillators of all descriptions are available or are readily constructed. They provide a means of quickly connecting and demonstrating phonograph pickup operation without the necessity of disturbing any part of the receiver circuit.

For those discriminating owners of radio-phonograph combination receivers, desirous of receiving all that is possible from their instruments, *automatic volume expansion* should be described. It has been the experience of many Service Men that when the salient features of volume expansion are properly explained to set-owners, and that this important development may be made part of their present instrument, the idea and device is often sold with little trouble.

Automatic volume expansion may be added to any good receiver by connecting the expander unit into the audio circuit. Volume expanders with built-in power supply are compact but efficient, and are marketed by several manufacturers as separate units, ready to operate providing proper connections are made to the receiver.

PUSHBUTTON TUNING

Pushbutton tuning is setting the pace in radio receivers this past season. Every customer is a prospect for a pushbutton installation. By means of *pushbutton kits*, available for 2-, 3- and 4-gang condenser receivers, any T.R.F. or super-heterodyne receiver may be modernized at comparatively little expense. As a sideline bet, this item is a "natural" and the idea should be easy to sell.

Installation of the pushbutton kits is simple since all necessary hardware is supplied. A double-pole, double-throw switch of the low-loss wave-band type is required to effect the changeover to manual or automatic tuning. After mounting the pushbutton assembly into the front panel of receiver cabinet, connect the switch and pushbutton kit to the receiver as shown in Fig. 5C. The changeover switch is pictured as a knife switch merely for simplicity and convenience. The gang condenser stators are disconnected from the tuning coils and connected to the changeover switch. Keep all leads to the switch as short and direct as possible. A 2-gang pushbutton assembly is pictured. Only 3 leads to the assembly are necessary.

NOISE ELIMINATION POSSIBILITIES

The reduction and elimination of noisy radio reception as caused by man-made static has developed into a huge and profitable enterprise for those radio Service Men who have devoted proper study and sufficient application to the problem. There is much that every Service Man can do to realize on this phase of radio servicing, and set-owners are willing to pay for this *noise-filtering service*.

Radio receivers operated in restaurants, barber shops and beauty salons, shoe repair shops, tailor shops and business offices, are unduly noisy

either all or part of the time because of the interference created by the electrical equipment in these establishments. The application of any one of the simple capacitive or capacitance-inductive type filters directly to the device in question, speedily ends the trouble.

In homes, such filters may be applied to vacuum cleaners, electric razors, food mixers, electric fans, door bells and oil burners. The correct type filter for any filtering purpose is manufactured by many reputable concerns and may be obtained from local supply houses.

Where the interfering device cannot be located or is inaccessible, and it has been determined that the interference is reaching the receiver via the antenna, necessary precautions may be taken to minimize or eliminate the interference with the proper installation of a good noise-reducing antenna system. The subject of noise-reducing antennas is inexhaustible and beyond the scope of this article. Readers are referred to many excellent articles previously published in *Radio-Craft*.

TUNING INDICATORS

The accurate tuning so essential to receivers incorporating A.V.C., is often difficult and confusing to hundreds of persons unfamiliar and unskilled in the process. Equipped with one of various *tuning indicators*, correct tuning of these receivers becomes a simple and fascinating game to young and old.

Tuning indicators most commonly employed are the "tuning meter," the "shadowgraph," and the small cathode tube, which RCA has termed the "Magic Eye." The mounting of these devices upon the front panel of the receiver cabinet requires some measure of mechanical ability on the part of the radio Service Man with wood-chisel and augur bit. Carefully planned and laid out, however, it is only the work of a few minutes. All come equipped with mounting bracket and escutcheon and present no real problem.

The tuning meter and shadowgraph, observing polarity, are connected into the plate supply circuit of one or more A.V.C.-controlled stages as shown in Fig. 6A. Where necessary, a better deflection may be obtained by shunting the meter or shadowgraph with a carbon resistor whose value may be from 500 to 2,000 ohms. The pilot light leads are connected to the filament or heater terminals of a convenient amplifier tube socket.

Anyone of the small cathode-ray tubes such as the 6E5, 6G5, 6U5 and 6T5 may be employed as a tuning indicator. For receivers with 2.5 volt tubes, a type 2E5 is readily obtained. The tube, whose bottom socket view is seen at Fig. 6B, by means of its socket and leads is connected into the A.V.C. circuit of the receiver as shown in Fig. 6C. A diode-type detector is illustrated since this is most common. The value of the resistor X is dependent upon the individual circuit of the receiver and is employed only to prevent overlap of the shaded angle of the "eye" tube. The value of X is determined by tuning-in a strong signal and trying different resistance values until the shadow angle is nearly zero or the eye is closed. This limiting resistor value generally falls between 0.1-megohm and 2 megohms.

PUBLIC ADDRESS POSSIBILITIES


Volumes have been written to date and ream upon ream used to describe the possibilities in Public Address and the rich rewards in this field. From all indications, most radio Service Men have failed to enjoy this bonanza, partly from lack of enterprise, but largely from unfair competition. However, there is money to be earned with Public Address and associated equipment.

First there is the *rental-amplifier service*. By renting out small amplifiers for use at dances, club meetings and parties, church socials and bingo parties, sideline dividends are possible. Knowledge of these social functions is obtained in advance through newspaper publicity, store window advertisements and street placards. Offering the use of an amplifier at a nominal cost to the entertainment committee of these enterprises should do much to secure some of this business.

Employ inexpensive, small and sturdy amplifiers, those that may be easily set up and operated, and that can be left without fear of over-abuse. An undistorted power output of 4 or 5 watts is always sufficient at functions of this nature. A permanent-magnet type of dynamic speaker, and a diaphragm-type crystal or in-

(Continued on page 835)

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8C. (B) Gummy deposit such as vaseline or dust, etc. on the edge of the disc. (C) Disc shaft hole worn eccentric with respect to edges. (D) Binding of clutch friction washer within disc assembly. (E) Insufficient tension on brush finger. (F) Binding of any moving part at or near the point where the dial pointer is supposed to stop.

Undershooting when pointer moves to left—overshooting when pointer moves to right, and vice versa. This is a peculiarly annoying trouble caused mainly by an imperfect disc—that is, a disc having a high shoulder on one side of the insert, and a low shoulder on the other side. See Fig. 8D.

Gradual shifting of original station setting—this is a rather unusual trouble and happens only when the insert sinks below the edges of the metal disc. Each time the disc turns towards the V-edge of the brush finger, the impact of the disc shoulder causes the disc to shift a very small fraction of an inch. Eventually, the station will be detuned from its original setting. See Fig. 8E.

Possible remedies for these various defects are given in numerical order, as follows: (1) metallic particles ground into edge of insert are easily removed by lightly scraping with a razor blade. Be careful not to nick or burr the metal edges of the disc. Put a speck of vaseline on the insert when the particles have been removed.

(2) Flattened V-edges on brush fingers can be restored by filing carefully after removing the brush terminal strip from the drum housing. See Fig. 9. If all the V-edges on the strip are badly worn, it would be advisable to install a new brush terminal strip. (3) Overshooting because of a low insert requires that the metal shoulders be very carefully filed to slope down towards the insert. This can sometimes be done without dismantling the set. However, in cases where this remedy fails, it will be necessary to install a new disc—or a complete stack, if the manufacturer will not supply single discs.

(4) Undershooting which is not caused by gummy dirt on the disc, is most often caused by an "out of round" condition, as previously explained. The best remedy is replacement of the disc, or stack. If a gummy streak is responsible for the trouble, it can be cured by washing off the dirt with a toothbrush dipped in carbon tetrachloride, or alcohol. A very thin film of white vaseline should then be applied to the circumference of the disc.

Other causes, such as binding of the disc friction washer may be cured by squirting 2 or 3 drops of rust solvent between the disc plate and washer cup from above, allowing the solvent to seep in and loosen the washer. Too much solvent will cause slipping of the disc. When binding is caused by some other part of the mechanism it is best to track down the cause by hand tuning.

Right or left overshooting and undershooting caused by defective disc—requires that the high shoulder be removed by careful filing. It is advisable to file just a few strokes at a time. Try the system each time to see how close to the station setting the pointer hesitates. The first time that the pointer does not overshoot its setting, stop filing. Finish off with steel wool and vaseline.

We have, so far, covered the most common troubles encountered in the motor-tuned sets using disc drums. For other, and unusual troubles we will have to refer to specific cases later on. In the meantime, to appease the curiosity of Service Men not acquainted with the "innards" of disc drum assemblies, we show a sectional view of a typical stack, consisting of a series of cups and discs clamped together by spring action against the shaft flanges. (See Fig. 10.) When the drum shaft is turned, all the discs turn with it, but any single disc can be stopped from turning without affecting the others.

3rd Example

The 3rd example of motor tuning is the General Electric, F107 model, which uses an entirely different mechanical layout, although electrically similar to the 2 previous examples. Instead of using a disc drum, these receivers make use of a 3-slot sector and a control board with 16 pushbuttons. See Fig. 11. This sector is mounted at the rear edge of the chassis and is linked to the variable condenser shaft through the scanning arm contactor and reversing switch.

In operation, this arm sweeps over 13 stud screws and the motor current is interrupted when the relay is energized. This happens only when the grounded scanning arm contacts with

any one of the 13 pushbutton circuits that is closed (station button pressed in). When the "Manual" button is pressed in, the motor circuit is broken and hand tuning can be employed. Pressing any of the other 15 buttons closes the motor circuit which will rotate the gang condenser to the stud corresponding to the button which was pressed in. To turn this set off, just press the button marked "Off," which opens the primary of the power transformer. To turn the set on, just press any one of the other 15 buttons, thus releasing the OFF button which in turn closes the primary.

One button is marked "SCAN" and is used mainly to tune rapidly from one end of the dial to the other. If this button is left pressed in, the motor will never stop turning until the button is released, thus breaking the "SCAN" circuit.

Setting up the stations involves the following steps: First, remove the 13 wires clipped onto the stud screws on the sector. These wires have little metal or paper tags which are numbered, from 1 to 14. Number 8 is omitted because No. 8 button is the "MANUAL" button and does not terminate at the sector.

The second step is to loosen the lock nut on each stud screw so that each screw can be easily moved along the slot. Next, push in the "Manual" button, which will turn the set on. Turn the Range knob to the Broadcast band and tune accurately to the lowest frequency station, such as WMCA. The A.F.C. should be turned off during the setting up operations.

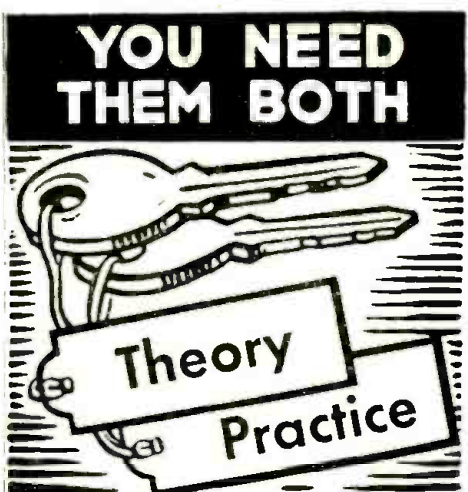
Looking at the back of the set you will see that the scanning arm is almost horizontal and points to the left. Now slide the stud marked No. 1 in Fig. 11, until the stud face pushes the spring contact back, then tighten the stud lock nut with your fingers. Do not use pliers or excessive force as you may crack the sector. Out of the cable of 13 wires, select the wire which is tagged No. 1 and push the clip onto the stud screw No. 1. This station is now set up. To check the adjustment, press in No. 1 button on the control panel. This will release the "Manual" button and if the adjustment is properly made, nothing will happen.

If the adjustment is off a little, then the motor will move until the scanning arm contacts the stud. In such a case, press in the "Manual" button, retune accurately to the station and shift the stud a little until the adjustment is exact. In the same manner the remaining studs may be adjusted to the desired stations. As will be seen in Fig. 11, the stud screws are staggered from one slot to the next and should be adjusted in that general order. As each stud is set up, the corresponding numbered wire should be attached, to avoid confusion. The tabs come on a perforated sheet and it is easy to press them out and insert into the recess of the pushbutton heads. After which, little celluloid covers are snapped into each button to prevent marring the tab underneath.

The arm swings back and forth from right to left and is mechanically linked to the variable condenser. The spring contact is an insulated block, in the face of which is embedded a knife-edged blade. This blade is grounded to chassis at all times. The 13 screws are insulated from the sector and whenever the knife-edged blade touches one of these 13 screws the relay circuit acts to open the motor circuit at the screw contact corresponding to the button pressed in, thus stopping the motor at the point desired. Pressing any of the other buttons closes the motor circuit and repeats the above action.

Service details on the G.E. system will be given in Part II. In addition, we will take up mechanical systems of button-tuning.

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SOUND SPECIALISTS!— CASH-IN ON THIS "A.S.C." ADD-ON UNIT

(Continued from page 797)

facturers of amplifiers and accessories with decided frequency distortion.

PSYCHOLOGICAL FACTORS GOVERNING INTELLIGIBILITY

A brief examination of the physiological factors influencing hearing will clearly reveal the desirability of getting away from "flat-frequency" equipment.

A study of the field of audition will disclose the interesting fact that the ear has a threshold of audibility which is far from flat. In fact, there is a variation of 90 db. between the threshold of audibility at maximum sensitivity (2,000-cycle tone) as compared to a point of minimum sensitivity (20 cycles). An actual study of curves (which have appeared in *Radio-Craft*) showing the field of audition will clearly indicate the advisability of varying the frequency response of an amplifier system so as to attain maximum intelligibility, and pleasing results. To further complicate this seemingly simple situation, the fact remains that the physiological processes involved in hearing varies between people. In other words, what might sound pleasant to one person may sound far from ideal to another. (Read "How Do We Hear?" in May and June *Radio-Craft*, 1936.—Editor)

A simple experiment to prove this point was conducted in our laboratories, wherein an Audio Spectrum Control Amplifier (utilizing 5 audio band controls) was placed at the disposal of a representative group of listeners. Each was asked to adjust the various controls for the most pleasant results, and as expected, *no two persons adjusted the controls alike for the same type of recording.* Based on this "find," additional experiments were conducted and the following, almost unbelievable, conclusion was reached: **Frequency distortion is desirable when properly applied.**

A NEW AUDIO SPECTRUM CONTROL UNIT

To meet this condition, the Audio Spectrum Control Unit (Fig. A) was constructed and inserted between microphone and amplifier. By manipulating the various controls, it was a relatively simple matter to remove the characteristic boominess of velocity microphones. On the other hand, diaphragm-type crystal microphones were made to sound like velocity units. In fact, the unusual amount of control in varying the response of the completed P.A. system suggested the idea of using this unit as a basis for improvement of all P.A. systems which were not characterized by directional distortion or objectionable echoes and double sound effects (these latter conditions can only be remedied by re-allocating loudspeakers).

Like any other technical "tool," it is necessary to know how to handle the Audio Spectrum Control Unit in order to attain any desired results. In reproduction of voice, wherein it is desired to transmit maximum intelligibility, it has actually been proven that the lower frequencies which carry most of the speech energy, contribute very little to intelligibility. On the other hand, the high frequencies attain very little speech energy but contribute greatly to articulation. In fact, those frequencies above 1,000 cycles account for 85% of speech intelligibility. Frequencies below 1,000 cycles are characterized by a 42% intelligibility.

Work done by communications engineers in developing telephone equipment definitely proves that the range from 500 to 2,000 cycles includes the frequency components of speech which are most important to articulation. It is therefore apparent that to improve the voice production

of any P.A. system, boosting of these frequencies will add considerably to intelligibility.

On the other hand, for the reproduction of music, it is usually desirable to boost the low and high ends of the Audio Spectrum. The amount of boosting varies with the level of the reproduced sound.

It undoubtedly has been noted by sound specialists that, at low volumes, a peculiar effect is noticed wherein music loses its "body" and seems deficient in low frequencies. This effect is due to the variable frequency response of the ear to tones of different intensity. Former attempts to correct this condition evolved the "tone-compensated volume control." Naturally, its original design pre-determined the amount of compensation available, disregarding local acoustic conditions.

Upon manipulation of the Audio Spectrum Control Unit, so that the low frequencies are raised in an inverse ratio to the relative sensitivity of the ear in going from normal volume to the volume at which the music is to be reproduced, a compensation results which makes up for the different sensitivity of the ear at lower volumes. Naturally, varying compensations may be made to suit individual requirements.

Should your prospect be "tone deaf," over-accenuation of the high frequencies will produce an unusually pleasant sensation to him. It is a simple demonstration of this type which can not but help sell the A.S.C. unit to any owner of a P.A. system.

If voice announcements are to be made, accentuation of the central band will greatly improve intelligibility, regardless of the type of the microphone, speakers, or amplifier employed. In fact, a simple demonstration of this type invariably results in a sale.

For the music lover, the insertion of the "A.S.C." unit between the phono pickup and the amplifier will so vary the frequency response of any system, that it will be relatively simple for the most inexperienced operator to adjust the controls for the most pleasing effects regardless of the quality of the original recording or the frequency response of the P.A. system.

HOW IT WORKS

A complete discussion covering the operation of this unit (as incorporated into a complete amplifier) was covered in the December, 1937 issue of *Radio-Craft*. The most important feature of this unit is the addition of low, high, or middle frequencies to any sound pick-up or reproducing device. These frequencies may be added in any pre-determined band so that overtones and sub-harmonics are amplified equally well.

In order to minimize inductive hum pick-up, anti-hum construction is employed in the power transformer and chokes. It will be noted that the heaters of the 6N7 tubes are raised to a voltage higher than their plates, so as to avoid the possibility of heater-to-plate emission.

The "A.S.C." unit will add approximately 21 db. to the gain of any existing amplifier. It will therefore enable the use of higher quality microphones with older type equipment without necessitating any changes in the amplifier circuit proper. The unit is available with optional low-impedance input and output transformers to match any existing type equipment.

The author will be pleased to answer any questions relative to this Audio Spectrum Control Unit.

(For further information, on the theory and principle of Audio Spectrum Control, see the article, "Introducing—'Audio Spectrum Control' ", in the Dec. 1937 issue of *Radio-Craft*.)

PHONO PICKUPS ON PARADE

(Continued from page 815)

mechanical feedback from the loudspeaker if located in the same case, as well as acoustic feedback from the speaker if they are placed close together.

To minimize the effect of the mechanical and acoustic feedback it is necessary to use some type of mounting which will dampen the vibrations of the motor-board at the base or the axis of the pickup.

Direct acoustic feedback can be eliminated by playing the record in an enclosed space which will prevent the sound waves from the speaker

from striking the pickup arm and setting it into vibration. Most of the new record player units are so constructed as to size that the records can be played with the top cover down. This licks the direct acoustic feedback problem but it does not follow that the record can be played to the best advantage if direct mechanical-vibration coupling exists between the speaker and the pickup.

Figure 1311 shows a simple way to reduce mechanical feedback between motor-board and the pickup arm. Make sure that the rubber used

Please Say That You Saw It in RADIO-CRAFT

is soft and that the rivets or screws used to fasten the rubber to the pickup base do not touch either the motor-board or the screws used to fasten the rubber to the motor-board.

If the use of the rubber pad lifts the pickup so that the correct stylus playing angle cannot be maintained then it is best to countersink the motor-board (Fig. 131) to the required depth. Make sure that the rubber is free from strain. Cut the hole so that it is not necessary to compress the rubber. Remember, rubber when compressed loses its efficiency for the purpose, and if you crimp or compress it unduly no advantage will be gained.

Figure 13J shows how small rubber grommets can be used with pickups having arms of the "U"-channel type as an axial cushioning. This is very effective and involves no changes of the motor-board.

A commercial application of the "axial cushioning" principle is shown in Fig. 13G. The improvement in reproduction due to the use of cushioning in one form or another is marked in effect and will be found in all good pickups and record reproducing equipment.

SCRATCH FILTERS?

Before going into *scratch filters* let us ask a few questions.

(1) Do we have wide frequency range, low harmonic distortion in our amplifiers?

(2) Is the speaker system used by the record-playing addict, "good" above 4,000 cycles?

(3) Don't we want the best pickup that can be bought, with good high-frequency response?

The answer to the 3 questions is, *Yes!*

Since this is so, why does the average player of records immediately reach for a "scratch filter"? Because, a *scratch filter cannot and does not filter the scratch without filtering an important part of the signal.*

If you want the design dope on high-pass, low-pass or band-pass filters then refer to any one of the many texts available on the subject.

If you want a cheap, simple scratch filter,

simply connect a 0.5-meg. resistor in series with the output of a crystal pickup, as shown in Fig. 13K, and you will have an apparent freedom from scratch without too great a loss of highs. It is useful to make control R of Fig. 13K variable so that one can vary the effect of the series resistance on the crystal. The effect of this method of frequency response control can be noted by reference to the curves in the first Part which appeared in the preceding (May) issue.

For magnetic pickups shunt the output with a resistance having an ohmic value equal to or less than the impedance of the winding. It is best that this resistance be variable so that the effect can be controlled over a reasonable range. See Fig. 13L for details. The value of resistance for the control of volume should be 20 times the rated impedance of the pickup.

The solution of the scratch problem lies NOT in the direction of filters but in the proper selection of records, needles, pickup placement, etc.

If the record has a high abrasive content or is badly worn get rid of it or accept the scratch level as inevitable. Do not buy records with high scratch levels. If you want a particular selection wait until you can obtain a copy with a minimum of scratch.

Use the best needles that you can buy. Cacti needles and shadow-graphed half-tone steel are the best. Do not use a needle more than once. Needles are cheaper than records.

Make sure that the stylus is held at the proper playing angle.

Be accurate in laying out the motor-board; particularly, the proper placement of the pickup.

Keep your records in cases or covers and carefully wipe them off with a soft cloth or brush before and after playing.

Use as light a stylus pressure as possible on the record without permitting the arm to jump the groove on loud passages.

This concludes our present story, "Phono Pickups on Parade." Any questions? Any suggestions as to additional ground on this subject you'd like to have covered, by the writer, in a subsequent article?

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SIDELINE MONEY FOR SERVICE MEN

(Continued from page 831)

expensive dynamic microphone serve best in these cases.

An unsatisfied market for *call systems* of the plug-in "wireless" ("wired radio") type is proving a bonanza to all radio Service Men interested and with ambition to go out and get this business. These units are obtained now in 1- to 5-way sets without the need for any interconnecting wires. They may be connected to outlets in adjoining buildings if necessary with as good results.

These call systems fill a long-felt want in restaurants, parts supply houses, department stores and long business lofts, since each and all sets may be moved and plugged-in anywhere at anytime. To mothers with babies, these wireless call systems are especially attractive. Instead of climbing stairs countless times during the course of an evening after baby is in bed, to see to the wants and comforts of baby, a wireless call set is plugged in near baby's bed and another set connected near mother downstairs. Any cough, call or disturbance on the part of baby is immediately heard by mother.

(The author here concludes his article; having covered practically the entire gamut of radio activities through which the radio Service Man may most readily turn his hand to an extra bit of cash. Just how successful *Radio-Craft* readers are in capitalizing the many suggestions outlined in this article will depend almost entirely upon the individual and his local conditions; Mr. Freed has found every one of these ideas commercially practicable. Undoubtedly, some of our more advanced readers will be tempted to say, "Oh, I know that circuit." or, "Oh, that's an old idea"; but remember, this article covers considerable technical territory, and a few of these money-makers may be new to you, or, at least, may have slipped your memory. The main purpose of this article, however, is to impress upon Service Men the desirability of keeping a weathereye open for "sidemoney" service work; coincidentally, the basic diagrams given above will meet most of the circuit requirements of these "special" jobs.—Editor)

THIS POCKET VOLT-OHM- MILLIAMMETER DOES ALL YOUR D.C. TESTING

Ask Your Jobber to Show
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● Model 735 has a Triplett D'Arsonval type precision instrument with easily readable scales. Ranges are 15-150-750 volts at 1000 ohms per volt; 1½-15-150 M.A.; ½-1000 low ohms; 0-100,000 high ohms at 1½ volts. Provisions for external batteries for higher resistance measurements. Has selector switch for all ranges and individual zero adjustment for resistance measurements. Now with silver and black etched panel.

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Included

Please Say That You Saw It in RADIO-CRAFT

A 'SCOPE THAT SPEEDS RADIO SERVICING

(Continued from page 805)

him to see what is happening in the equipment under test.

THE SCREEN-SIZE PROBLEM

To combat the price bugaboo, 'scope manufacturers introduced the 1-in.-screen 'scope which through savings in the cost of materials, lowered the selling price of this type 'scope to around \$50. At the time, Supreme engineers were experimenting with the 1-in. tube, but decided against issuing such a unit because they felt that it would not be satisfactory due to the small screen area of the 1-in. tube which was only 1/9th the area of the 3-in. tube! (This item was the subject of an interesting article in a past issue of *Radio-Craft*.—Editor)

Instead, they announced a 2-in. cathode-ray unit which gave 4 times the screen area of the 1-in. tube and 4/9ths the area of a 3-in. tube. The general price range of 2 of these units placed them, in one case as reasonable in price as the 1-in. units and, in the other case, considerably less than 1-in. units.

This advance in 'scope economy was "topped" recently when these same engineers announced a 3-in. tube (known as model 546 cathode-ray oscilloscope), (Fig. A), which answers the requirements of (1) simplicity, (2) flexibility, and (3) price, to a remarkable degree; and combines all the previous functions with a newer operation speed and comfort.

CIRCUIT FEATURES

Power Supply. The model 546 uses a cathode-ray tube with a 3-in. screen and the complete unit is operated from the A.C. line by 2 power supplies. One rectifier uses an 80-type tube in a half-wave rectifier circuit to supply the proper operating potentials for the cathode-ray tube. The other utilizes an 80-type tube in a full-wave rectifier circuit to supply the proper operating potentials for the 2 amplifiers and the sawtooth linear oscillator. By this method, interaction between circuits is eliminated. (See Fig. 1A.)

Amplifiers. The model 546 has 2 separate signal amplifiers, one associated with the Horizontal set of deflecting plates, the other associated with the Vertical set of deflecting plates. Each amplifier utilizes a 6C6-type tube, the Horizontal amplifier having a gain of 40 and the Vertical amplifier having a gain of 70, with both amplifiers having a flat line frequency response of from 20 to 90,000 cycles, and an input resistance of

approximately 0.5-meg. with an input capacity of about 20 micromicrofarads. Each amplifier has a separate gain control which is graduated so that comparative tests may be made, if desired. (See Fig. 1B.) Using the amplifiers, the sensitivity of the Horizontal deflecting plates is 0.48-volt r.m.s.; and for the Vertical deflecting plates, 0.52-volt r.m.s. per inch deflection.

Oscillator. The sawtooth or linear sweep oscillator employs an 885 gaseous discharge tube. This circuit is designed to insure a maximum of linearity over its entire range (15 to 30,000 cycles) by the use of the proper value current limiting resistors. Six ranges are given and the approximate frequency limits of each is inscribed on the panel for ease of operation. There is sufficient frequency overlap between ranges to obtain satisfactory synchronization at any point between 15 and 30,000 cycles. Besides these 6 ranges, there is a vernier frequency adjuster which allows the operator to get just the proper frequency. (See Fig. 1C.)

Synchronizer. A very fast-acting synchronizing circuit is included which literally "snaps" the image into place. This eliminates all "image wandering." Means are also incorporated for using the internal linear sweep or some external sweep source and synchronization can be obtained either between the internal linear sweep and the incoming signal or an external source. (See Fig. 1D.)

INSTRUMENT CONNECTIONS

The incoming signal under study may be applied directly to either set of deflecting plates or through either amplifier. The output of the sawtooth oscillator can be applied to the horizontal deflecting plates, through the Horizontal amplifier, when a linear time base is desired. Provision is also made for application of D.C. potentials direct to the deflecting plates. (See Fig. 2, which shows the complete circuit of the model 546 oscilloscope.)

All connections may be made by means of pin-jacks on the front of the panel, resulting in fast operation. Six tubes are used, one 3-inch cathode-ray tube, one type 885 sawtooth oscillator tube, two type 6C6 amplifiers, and two type 80 rectifiers.

The 546 has both vertical and horizontal Spot Centering Controls on the panel, an Intensity and a Focus control, Synchronizing control, Linear Sweep range selector, Fine Frequency

adjuster as well as Horizontal and Vertical Gain controls.

Another important point is the overall size and weight of the instrument, the size being but 11½" x 7¼" x 13½" and weighing less than 20 lbs.

This unit in conjunction with an instrument such as the Supreme model 580 or 581 Signal Generator (having a means for frequency modulation) can be used for the complete visual alignment of radio receivers, including the determination of band width and selectivity in I.F. stages. It is also applicable to a wide variety of practical service tests such as the analysis of distortion, hum and intermittents in radio receivers and P.A. amplifiers. Also for analysis of waveforms, frequency measurements, phase measurements, measurements of tube dynamic characteristics, hysteresis, overload, etc. It can be used as an A.C. Peak Voltmeter, for transmitter modulation measurement and adjustment as well as a host of other uses.

As a result, it is felt that this instrument model 546 is a practical, compact, fast, easily operated, completely flexible instrument and that it has been made available within the price range of almost every Service Man's pocketbook. There is, now, no reason for Service Men blindly attempting repairs and alignment of radio equipment when it is so easy and profitable to use cathode-ray oscilloscopic equipment.

This article has been prepared from data supplied by courtesy of Supreme Instruments Corp.

RADIO TECHNOCRACY?

Another venerable theatrical institution, the call-boy, has been sacrificed to the machine-age with the installation of an intercommunicating system—first on record for back-stage use in a theatre—for the "Brother Rat" company now entering the 8th week of its run at the Locust Theatre, Philadelphia, according to Philco.

The master unit of the system was placed behind the "Brother Rat" set for the stage manager of the company. The remote speaking units were placed in dressing-rooms on the 1st, 2nd, 3rd and 4th floors and another unit was placed in the box-office, connecting that point directly with back-stage. This set-up permits simultaneous or individual calls to, or conversation with, occupants of dressing-rooms on all floors.

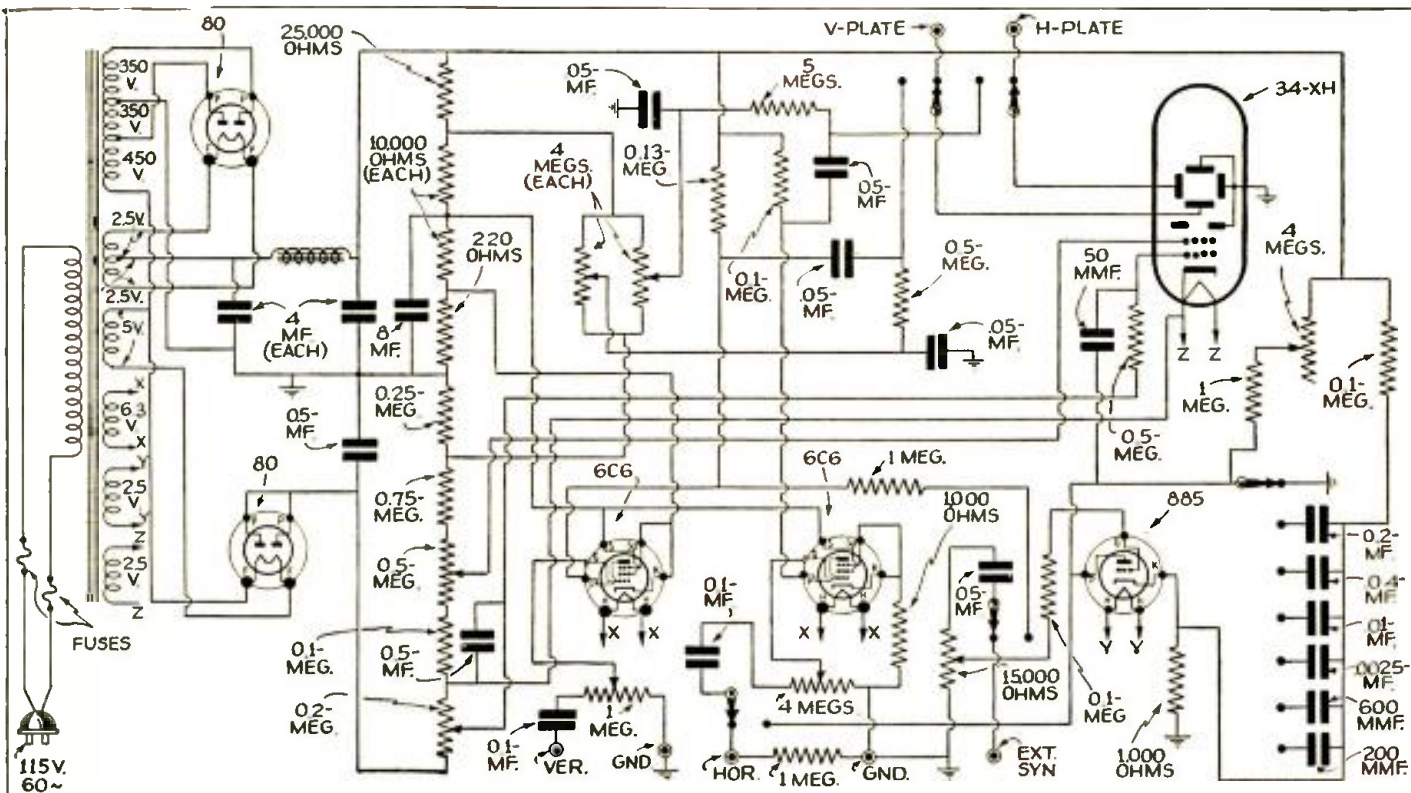


Fig. 2. Schematic circuit of the complete oscilloscope, utilizing a type 34-XH or 3-inch cathode-ray tube. Circuit details are shown in Fig. 1.

APPLICATIONS OF A LOW-COST VOLT-OHM-MILLIAMMETER

(Continued from page 807)

In spite of the low cost, a large, bakelite-case d'Arsonval meter is used. The large dial and long scales provide easy reading and there is sufficient room for 4 independent sets of scales: (1) High Ohms; (2) Volts and Milliampers, A. C. and D.C.; (3) Low Ohms; (4) Decibels. The low-ohm scale is tinted red so as to be in contrast with the other scales in black. The sensitivity is sufficient for most voltage measurements although there are a few occasions when it is desirable to use a high-cost, highly-sensitive movement but this instrument is not intended to take the place of such testers. The meter has the standard accuracy guarantee of within 2%.

GENERAL USES OF INDIVIDUAL RANGES

The D.C. voltages usually encountered are such that the high range of 750 gives ample coverage. The other ranges of 300, 30 and 7.5 volts give good readings for the plate and grid voltages that are most commonly met in practice. All of the voltage multipliers are connected in series so as to keep the individual resistor watts at a minimum. The common jack is the negative for all ranges.

The A.C. voltage multipliers are also in series and they connect to the meter through a copper-oxide rectifier. The rectifier has splendid linear characteristics and will indicate with commercial accuracy on all ranges, with the exception of the lower portion of the 3-volt range; that is below 1 volt. For accuracy, a correction curve is supplied with the instrument, although it will be a rare instance that will require the measurement of a fraction of a volt A.C. at high accuracy in the general application of the tester. The high range of 300 is good for line voltages as well as for measuring the voltage across half the winding of power transformers. The 30-volt A.C. range is just right for filament voltages of 12.6-15-25 and 30 volts and will take care of the wide range of the higher-voltage class of toy transformers.

The low A.C. voltage ranges are fine for testing various filament supplies and for output measurements. If the output voltage to be measured includes D.C.; it will be necessary to apply the voltage through a 1-mf. condenser so as to block the D.C. voltages which would otherwise damage the rectifier. The 3-volt scale should give excellent indications for the majority of output measurements and for very high outputs the 7.5 volt range would be suitable. (For ordinary service work only relative output indications have any significance and the absolute values can be entirely disregarded.)

The decibel scale. The indications can however

be read on the decibel scale and after proper corrections are made for any mis-match of impedance, the output can be determined in db.

The low-ohm scale of the instrument is particularly useful and permits accurate very low resistance measurements which cannot be made on even the highly expensive instruments. The first 4 divisions of this range read 0.02-ohm each and the center of the scale is only 3 ohms! Resistance of voice coils, shorted turns on transformers, high-resistance joints, contact resistance of various types of switches can easily be measured here. Just the other day it was puzzling to find the cause of considerable inaccuracy in the measurements of an expensive, fine tester. Using the low-ohm range of the Multitester showed that there was a 0.1-ohm resistance in the switch contact that was in the shunt circuit of the tester. Such additional small resistance in the normally low-resistance shunt circuit would cause an appreciable error. A new switch was installed and the fine tester was again in accurate working condition. It seemed sort of ironical to require a low-price tester in order to repair a fine expensive instrument, but that's our story and we can prove it.

Economy is affected by switching the connections of 2 flexible leads on the low-ohm range. This is a very simple operation and requires only 3 seconds as the leads are already attached to the tester. These leads also serve as an unusual feature enabling the ohmmeter circuit to be balanced on all 3 ranges without the use of test probes, which must be inserted and short-circuited in all conventional testers.

Medium-ohm and high-ohm ranges. Two ranges, one of 10,000 ohms and a high range of 100,000 ohms, are also provided for making resistance measurements within these limits. These ranges also serve for general continuity tests. Of course the ohmmeter ranges can be extended by adding additional batteries and resistors externally. The zero-adjust control is wire-wound and functions smoothly on all ranges. It is a double-section tapered winding.

Current ranges. Current may be measured on 2 ranges of 3 and 30 milliamperes, D.C. For the high range the flexible lead is used for making the shunt connection. Symmetrical layout gives an attractive appearance as well as convenience for use. The tester is furnished complete with self-contained 2½-volt unit-cell batteries (flash-light types) and these are inexpensive to renew. Normal life of the batteries should be about 1 year. Weight, 32 ozs.; size 8½" x 5" x 3½".

This article has been prepared from data supplied by courtesy of Radio City Products Co.

UNIQUE TRAILER PUBLIC ADDRESS SYSTEM



(Photo and story—A. V. Liu (Chiang))

"The most powerful public address system ever put on" is what Walter Church, San Diego, California, claims for his unique system which can be clearly heard for a distance of 6 miles! The huge loudspeaker horns cost \$500. Built just for advertising purposes, at a cost of \$3,000, this swanky system is loaned free for broadcasting public events or for use at charity programs.

It is mounted on an airplane fuselage the same as is used by United Airlines, and is painted white with black lettering, which combines to give it an unusual and attractive appearance wherever it goes . . . on the streets, highways, and at all kinds of public gatherings. Its advertising value is of inestimable value to Mr. Church.

This address system is in such demand that it is often engaged several months in advance. It presents P.A. programs at the famous Ford Bowl in Balboa Park, for San Diego State College football games, etc.

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For a Genuine

THRILL!

BUILD THE BROWNING 83



THE HIT SET OF 1938

For the Discriminating professional—for the amateur experimenter—the new Browning 83 fills the bill. Here is a kit set which can be constructed and aligned with nothing more than a soldering iron, a pair of pliers, and a screw driver. The completed job is a high quality receiver whose performance will amaze you.

DID YOU KNOW?

- THAT the Browning 83 four-band kit receiver can be operated from a 6 volt storage battery by means of a Mallory Vibrapak?
- THAT the same Wright DeCoster speaker is employed as with the a-c. job?
- THAT the 83 makes an ideal vacation receiver because of its low noise level and high sensitivity on both broadcast and short wave bands?
- THAT the 83 can be converted from battery to a-c. operation at a minute's notice?
- THAT the 83 can readily be installed in your present fine console?
- THAT the 83 chassis is so constructed that additional circuit features such as noise suppression, volume expansion, beat frequency oscillator, etc. may readily be incorporated by the experimenter.

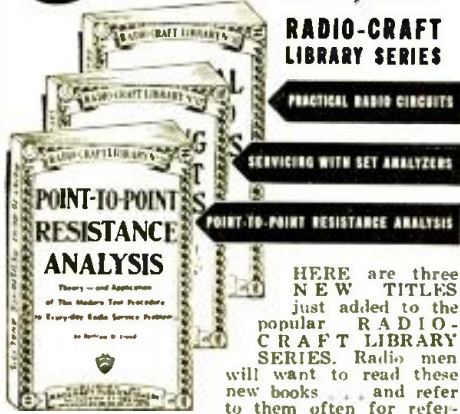
FEATURES

1. Extremely high signal-to-noise ratio essential for DX reception.
2. Band pass IF amplifier provides adequate selectivity without "clipping" side bands.
3. The four band BL-1 Tuner covers continuous frequency spectrum from .54 to 22 mc.
4. Generous overlap on all bands prevents skips and dead spots.
5. Sensitivity less than 1 microvolt on all bands.
6. High fidelity audio system provides genuine program enjoyment.
7. Visual tuning indicator.
8. A.V.C.—Manual control of both IF and audio gain.

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No. 16

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THE RADIO MONTH IN REVIEW

(Continued from page 791)

messages to relatives of sick persons?

Major Tryon replied: "I am not aware of any resentment against the use by the British Broadcasting Corporation of the designation SOS for urgent broadcast messages to relatives of sick persons. I am informed by the Corporation that such messages have been so designated since 1924 without complaint from any quarter. I understand that by international agreement 'M'aiders' and not 'SOS' is used by ships and aircraft for spoken signals of distress. I see no adequate reason for asking the B.B.C. to alter their present practice." (So there!)

According to Sid Shalit, one of the best radio commentators in the dailies, the "subject matter dished out over the major networks is as feeble as a leg in the grave. Federal control would be the banana peel under the other leg." A *Sunday News* editorial tackles the subject from another angle—and more strongly; to wit: "Unless the radio public, the newspapers and the radio chains and stations get out and fight this thing, government censorship of radio will creep upon us. And censorship of the press will follow. The radio people, incidentally, have up to now shown the courage of jellyfish in this matter. They had better change that; had better stand up and fight political interference with them, or political interference will gradually throttle them. Dr. George Gallup, sampler of public opinion, claims to have found that 59% of the people are against government censorship of radio, while 41% favor it. Those 41% are surely asking for it—it being a radio controlled by prissy little bureaucrats in Washington, with the American radio's present pep and beauty and interest removed, and most of the air time given over to stale, dry and insidious political propaganda." All of which is apropos of the efforts, last month, of certain misguided politicians to put radio broadcasting too much under the thumb of government.

This flurry of activity among legislators looking for new fields to conquer in their spare moments included projected legislation to tax broadcasters; and program "advisory" plans which smell suspiciously of a blue-law censorship odor. Representative J. J. Boylan (New York) proposed to the House a broadcast station tax based on watts-power used, to raise 5 to 7 millions, which F.C. Commission Chairman McNinch (who previously took the Mae West-Charlie McCarthy broadcast hue and cry very much to heart) approved, according to a Washington, D. C., report. Senator Clyde Herring (Idaho), after hearing Boris Karloff's rendition of Poe's "The Evil Eye," came to the rescue of neurotic children with a bill proposing government "control" of programs; strange to relate, big broadcasters look with favor on this and similar ideas as a means of getting into line, recalcitrant, smaller broadcasters who exhibit little regard for the content of their script. Assemblyman Arthur Doran's bill, introduced in the Albany (N. Y.) Assembly, was nipped in the bud. Bill promised to put N. Y. radio corps. under Public Service Commission control, and subject them to additional taxes. But a similar bill, proposed by Senator McCall, is pending.

Strange as it may seem, representatives of the world of music, radio, theatre, and advertising, education and other fields, have at last agreed to get together in a 2-day conference in the first cooperative effort to explore and analyze the factors and trends in American recreation and entertainment "which influence and shape the cultural life of the nation." First general session was held last month at Columbia U. We hope this conference doesn't pull a "League of Nations," but instead, really does accomplish something.

"International Radio," a section in the entertainment world's magazine *Variety*, states that objections by radio set owners, to shelling out their hard-earned cash for the annual radio license fee of the Canadian Broadcasting Corporation, on the grounds of static, interference from local power or tramway (train and trolley) companies, and lack of service, were overruled as "immaterial." Perhaps existence of the Canadian government's efficient, free system of interference location and elimination, described in recent issues of *Radio-Craft*, had something to do with the decision.

Incidentally, C.B.C. doesn't know whether it's coming or going—and is afraid it's the latter, since Canada's Court of Appeals has ruled that C.B.C. is not a dept. of the Federal Government's Civil Service. A subsequent ruling by the

Supreme Court that C.B.C. is a private corp. would call into question C.B.C.'s right to charge the \$2 license tax; and to license and regulate competitors!!

TELEVISION AND FACSIMILE

WE get an inkling of Philco's ideas regarding the introduction of television in the home from remarks last month by Sayre M. Ramsdell, vice-president of the Company.

Says Ramsdell: "The public introduction of television is still quite a way off. However, there are indications that it may be introduced prematurely" (italics *Radio-Craft's*) "because of the impatience of one company or another now working on television to be first in the field. I say prematurely from the point of view of television broadcasting and not of receiving sets. At present, the maximum range of a television program is about 25 or 30 miles. By the time television is likely to be offered to the public in what I call a premature state, the range may very well be 50 miles.

"That is why television will have very little effect with the farmer. There must be station-for television, and as no network systems will be possible at the start, the cost of broadcasting will be tremendous. The cost of building even a moderate number of stations would take millions of dollars alone. All this cost will have to be borne by the television industry because there will be no commercial value in a station until there is further development in coverage."

Ramsdell further points out that it will be logical to build these stations in the greatest concentrations of population—the big cities—to cover as many people as possible within a circumscribed area. This would leave the large farming districts without coverage until such time as broadcasting could blanket the country without meaning financial suicide to the broadcaster. He concludes:

"Maybe the farmer is lucky. When he is properly covered by visual broadcasting, television will have recovered from its first growing pains



(Photo—Don N. Wright)

ARSENALTOWN'S WHBF STAFF HAS ZIP. This picture shows the interior of the transmitter room of Radio Station WHBF, Rock Island, Ill., after a \$40,000 fire destroyed the transmitter building atop the roof of the 5-story Harms hotel in Rock Island, Ill. The fire originated in the hotel attic and ate its way through the roof to the transmitter building, where the engineer on duty discovered it, at 9:20 p.m., and gave the alarm that probably saved the 70 hotel guests from possible injury and loss of effects. Working through the night, engineers had WHBF back on the air with a new transmitter, by 5 p.m. the next day! Officers from the U.S. Arsenal, hard by, viewed the record-breaking achievement with an eye to its military significance as to speed in setting up a "replacement" radio station.

Please Say That You Saw It in RADIO-CRAFT

and he will have missed them. Those growing pains may be pretty painful—to the public as well as to the industry."

According to a published *Reynolds* (London) report last month there exists a gentleman's agreement between the British Post Office, the British Broadcasting Corporation and the Radio Manufacturers' Association, which, however commendable, at least offers one effective solution of television receiver obsolescence. According to this report the Post Office guarantees not to change television standards, so that sets bought now will not become obsolete during that period. In continuing, the report discusses practicabilities and discards "wired-radio" or "carrier" television, as we call it; and just so you won't know what it's all about they refer to this system of transmission as "lay on" television.

One of the biggest problems facing television and its general use in the home can be solved, paradoxically, only by the automobile manufacturers. So the Radio Club of America was told at its meeting in New York City last month by A. F. Murray, engineer in charge of television research for Philco.

Murray explained that the effect of a passing auto in the proximity of a television set is a blurring of the picture on the screen. The interference causes thousands of tiny white specks to make their appearance, producing the semblance of a raging snowstorm.

If there were an automobile parked nearby with the motor running, television image-reception would be impossible, Murray declares. *Television engineers have not found any means of coping with the situation up to the present, he says!*

Yet, he points out, there is a solution but the television engineers will have to look to the automobile producers for it. When and if television becomes prevalent in the home, the use of suppressors on automobiles will effectively eliminate auto interference with television reception.

Only the car manufacturers themselves can equip every auto with suppressors. Will they do it? Murray thinks they will when the time comes. In the meantime, he declares, it places television in the position of being dependent for a good measure of its future success upon another, entirely unrelated industry.

Radio-Craft points out that many states have legislation against the operation of devices that cause man-made interference to radio reception. Despite this handwriting on the wall, automobile manufacturers blithely continue to manufacture a device that, at least in connection with television receivers, is an interference transmitter of the most pernicious sort; and helps delay commercial (home) television! Today, 4½ million trucks and 25½ million passenger cars constitute a mobile source of man-made static interference with television that is unequalled; only a small proportion of this number of cars has been serviced to mitigate interference to broadcast reception by car-radio sets. Incidentally, the use of suppressors is, at best, only a makeshift solution of the problem.

When will car makers wake up to the necessity of shielding the entire ignition system (putting it in conduit would help) to prevent the radiation of short-wave interference which at the present time is ruining experimental (laboratory field test) television reception?

IMAGES AND PICTURES

STICKING to its promise, to help the radio amateur get into television, RCA last month announced the availability of several essential television (image-reception) components. How soon will the amateurs be introduced, via the parts route, to the lots cheaper activity of experimental facsimile (picture-reception) reception? An R.M.A. meeting is scheduled for this Spring to settle on facsimile standards, now that television standards have been temporarily taken care of. This step, upon which merchandizing programs are contingent, is pending upon F.C.C. approval of transmission standards, the latter being a key to setting up regular service facilities in lieu of the present experimental status.

According to *Radio Daily*, last month, F.C.C. granted Finch Telecommunications Laboratories, Inc., permission for experimental broadcasting of sound and facsimile on 35.6 megacycles with 1-kw. power.

A.T.&T.'s 1937 STEWARDSHIP

A.T.&T.'s annual report for 1937, released last month, calls attention to the addition of new short-wave radio telephone circuits, one linking

New York and London and the other San Francisco and Honolulu. The circuit to Honolulu introduces the new *single-sideband* system, through which it is anticipated that economies will be made both in the use of radio frequencies and in the amounts of power required to operate the circuits. One of the existing circuits to London was also converted to single-sideband operation.

Of special significance is the announcement concerning a coast-to-coast system of the sort popularly called "wired radio" and which A.T.&T. calls *carrier telephony*. We quote: "To meet the increasing volume of transcontinental telephone conversations and to give added safety and stability to the coast-to-coast service, a 4th transcontinental telephone route was completed during 1937 to Los Angeles. While initially the new line provides facilities for 16 additional telephone circuits between the Atlantic and Pacific seaboard, it has been so constructed as to allow for the application of the recently-developed broad-band carrier systems which, when added to the existing facilities, will yield a total of 16 telephone circuits for each pair of wires. Installation of terminal and repeater equipment for the first of the new systems is planned to begin in 1938. Completely equipped with wide-band carrier systems, the 8 wires of the new line can be made to yield 64 telephone circuits."

Another outstandingly significant item points out that over 300 vessels now connect by radio-telephone with 8 Bell System and connecting radio stations on the Atlantic and Pacific coasts and on the Great Lakes. These boats include tugs, yachts and fishing vessels as well as freighters. We predict that the busy business man will soon be able to telephone by radio, just as he does now by wire from his office, from nearly every ferryboat afloat.

SHORT WAVES—AND SUCH

FROM widely divergent points in the East come reports of consternation in the ranks of the lawbreakers. According to *A.P.*, Camden, (N. J.), police became incensed last month at the success with which miscreants, by listening to police radio broadcasts were able to successfully scurry from the scene. Police Chief Officer Colsey ordered: (1) hereafter all police radio orders will be in code; (2) the authorities will confiscate "bootleg" short-wave sets caught picking up their calls. (Wanted: an automatic switch which will turn your car set off, if it's tuned to one of the police bands, whenever John Law comes within ear-shot; even when he's in plain-clothes!)

From Buffalo, N. Y., came another *A.P.* report, last month, that described the activities of federal authorities to punish the operators of a nation-wide short-wave system which enabled bettors to place bets on horse-races which had already been run.

The system: "The racketeers placed a man at the race track with an ultra-high-frequency transmitter to watch the race and transmit the results to a confederate outside before the official results were posted. The outside man transmitted the results over the shortwave band throughout the country in a code that could be quickly unscrambled. In that way the racketeers were able to receive results first and place large bets before the bookmakers themselves knew the race was over." Federal operatives nabbed their men in New Orleans.

Short-wave radio saved the day, last month, when Sir Hubert Wilkins reported to the *New York Times* concerning radio experiences during a 19½-hour search in Aklavik, N.W.T., for Soviet flier S. Levanevsky and his companions lost last August. Said Sir Wilkins, "Both our radio aids to navigation—the radio direction finder apparatus in the plane and our radio compass—were ineffective. However, our short-wave radio was functioning and our radio operator was able to keep us informed of the conditions on the ground."

Scheduled broadcasting on ultra-shortwaves started last month! General Electric's new ultra-shortwave radio transmitter, erected on top of the state office building in Albany, N. Y., has officially inaugurated its broadcast schedule. This new station, known by the call letters of W2XOY, operates on a frequency of 41 megacycles or 7.31 meters with a power output of 150 watts. It is on the air 4 times each week. All programs originate in General Electric's short-wave studios in Schenectady and are carried by a special wire line to the Albany transmitter.

Signals on this ultra-S.W. band are supposed to travel in straight lines, the same as light
(Continued on following page)

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THE RADIO MONTH IN REVIEW

(Continued from preceding page)

waves, to be heard within a distance of 20 or 25 miles from the point of origin. However, in one of the early tests about 2 months ago a report was received from an amateur in Phoenix, Arizona, more than 2,000 miles distant, telling of receiving the station!

The Federal Communications Commission quashed plans of Press Wireless and RCA Communications last month when they denied special applications in connection with respective stations WCH and W6X1. Request was for temporary authority to operate a new special experimental station for the purpose of determining practicability of ultra-high-frequency for maintaining reliable communications when lower frequencies are adversely affected and rendered unreliable by atmospheric conditions prevailing during periods of solar disturbances.

HAM RADIOP NEWS

OUR good friend, the A.R.R.L., calls attention to interesting considerations in connection with the International DX Competition of March 5 to March 13 (radio telegraphy), and March 17 to 27 (radio telephony). In this contest the radio amateurs of nearly 100 countries vie with one another. Of what practical use is this competition? Ah! therein lies the story.

The DX Competition, although ostensibly providing an exciting contest for the radio amateur interested in long-distance communication, is actually much more than just a thrilling competition. It is a proving ground for amateur equipment and operators, since shortcomings in both come to light under the stress of the con-

test that might otherwise remain hidden. New antenna systems and revised transmitting and receiving equipment are given the acid test under the gruelling conditions of almost continuous operation.

An A.P. report of last month has a Binghamton, N. Y., ham operator bringing across 6,000 miles the historical associations of 148 years ago. It was then that mutineers of the good ship (?) *Bounty* parked on Pitcairn Island; last month F. W. Wolfinger of Binghamton claimed to be the first American to contact Andrew Young—a direct descendant of Fletcher Christian, sailing master of the *Bounty*, who led the mutiny—via Pitcairn's new station VRA. The pay-off came when Lindley Granville on P.I., who had installed the P.I. set a few days previously, talked to his mother in Providence, R. I., through the simple expedient of having the radio reception telephoned from Binghamton!

A newspaper report from *Science Service*, informs us that 3 chosen radio amateurs generated lifting the isolation of Los Angeles, last month, under emergency measures provided-for by recently perfected A.R.R.L. emergency coordination plans.

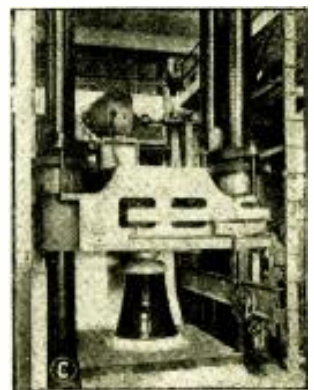
Under these plans they prepare a listing of self-powered stations capable of bridging flooded waters. They arrange that the most experienced operators will handle the greatest volume of traffic; rule stations off the air where there is crowding in the emergency; and, form links with the Red Cross, the nation, State and civil authorities. They also set up liaison services with other radio agencies; man key stations on 8-hour shifts; and, route messages requiring accurate

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A HALF-MILLION POUNDS OF STEEL RISES HIGHER THAN WASHINGTON MONUMENT. Completion of WGY's (Schenectady, N. Y.) new 625-foot vertical antenna, last month, gave General Electric's 50,000-watt "voice" sufficient strength to effect a 40% increase in service area. The spire, painted in alternate stripes of orange and white, is topped by a 1,000-watt flasher aviation beacon; constantly glowing lights (automatically turned-on by means of photo-electric cells upon the approach of darkness!) are spotted at different levels. The completed tower (A) passed through important transitional stages. For instance, in order to test the ground upon which the concrete mounting block was to be placed, pigiron was piled onto the spot until a pressure of 8,000 lbs./sq.ft. was exerted, and ground-settling measurements made for a month; yet, the actual tower exerts a pressure of only 3,000 lbs./sq.ft. In order to insulate the "live" tower from this concrete block a hollow porcelain shell is used (as shown in B). A U.S. Bureau of Standards hydraulic testing machine was used to determine the strength of this shell; at about 2 million lbs. pressure (4 times normal) a duplicate test-shell exploded with a cannon-like crack (C and D).

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record over radiotelegraph channels, and discussions among separate officers through the radiotelephone bands.

"ROCK" RADIO

FROM Gibraltar, world's most strongly fortified garrison and naval base, came information via the U. S. Department of Commerce, last month, that its 22,000 population has exhibited a "comparatively large" interest in radio sets. Per capita figure: 84 sets per thousand. However for a colony with an area of only about 2-1/6 square miles their radio sets cause plenty grief. For instance, the "Levanter," a denae gulf mass which overhangs the Rock, affects transformers; however, a pitch-compound protective covering helps, no end. More headaches include warped cabinets due to excessive summer heat; and a 75- and 76-cycle power supply although most of the 60-cycle sets appear to operate successfully on either the 75- or 76-cycle supply. Gibraltar, incidentally, is a "no-amateur's land" with not one ham transmitter "known to be operating in Gibraltar," according to the D. of C.

INVENTION AND DEVELOPMENT

ACCORDING to an A.P. report, last month, from Gary, Ind., 2 radio engineers have contributed to automotive safety a most important radio invention. Claims for the invention: a red light will flash on the dashboard and the auto-radio set will blare a warning of trains approaching grade crossings. Designed to work in autos that are within the danger zone when a train approaches a crossing, the device signals the auto at the same time that it starts the usual crossing red lights and bells. (The "Radio Garage-Door Opener," described in a past issue of *Radio-Craft*, could be applied [in principle], easily and inexpensively, to this new and humanitarian service.)

Airplane radio loop antennas netted Franklin, Redpath and Morgan, T.W.A. engineers, \$250 and a bronze plaque, last month, when these items—one useful and the other decorative—were awarded to them by an aviation magazine. These engineers did such a fine job in the development of a directional radio antenna for the guidance of storm-plagued airmen that the Federal Bureau of Air Commerce subsequently made it compulsory for all interstate airlines to use similar equipment! Nice going, fellers.

A nation-wide power survey completed last month by Philco shows that there has been a decided increase in voltage to the consumer throughout the country. Not more than a few years ago, the average voltage fed by power companies to homes was 110. The average voltage now, as demonstrated by the survey, is almost 120 with an increasing tendency to reach that figure! It was discovered that generally there is not more than a 5-V. variation in power supply to the home, and that the average voltage is 117, with a trend to 120.

Engineers of the company are utilizing the findings of this survey by working on a change of design for transformers to allow for extremes in present voltage variation and to meet future voltage increase which is indicated by the trend. (Keep your eye on the ball, Mr. Service Man!)

When is a tube not a tube? A definition of what constitutes a radio "tube" has been agreed upon by a special committee of the R.M.A. Tube Division of which Meade Brunet of Harrison, N. J., was chairman. The proposed tube definition would exclude the ballast resistor type. The recommended definition, following meetings of the special committee and also the R.M.A. vacuum tube and broadcast receivers committee, is now being considered by the entire R.M.A. Tube Division, and will be acted upon finally by the R.M.A. Board of Directors to constitute an industry definition covering advertising and merchandising practices.

Now that that's settled, the knock-down and drag-out fight between "tube" and "valve" should be a diverting international set-to.

Reported R.M.A. last month: "Ballast, or resistor, tubes and also cathode-ray tuning-eye tubes are exempt from the federal 5 per cent excise tax, when sold separately from a chassis or receiving set, according to an informal ruling secured by the R.M.A. from Internal Revenue Bureau headquarters at Washington.

"Regarding the ballast or resistor type of 'tube', so far as the excise tax law is concerned it is not regarded as a 'tube'. It is a resistance

unit or voltage regulator, in the opinion of Internal Revenue Bureau officials, who are of the opinion that a tube must consist of at least 3 elements in the modern receiving set to perform the functions of a tube and be subject to excise taxation."

According to this tentative classification in which a tube must "consist of at least 3 elements" it would seem that diodes, as for instance the metal 6H6, however much the radio man considers them to be tubes and purchases them as such, actually are not tubes. Maybe we'll have to fall back on the outmoded "valve" to identify them? (Hi!; maybe Johnny Bull has the right idea after all!)

From Geneva came a report last month, from the International Broadcasting Union, that radio receiving sets throughout the world totaled 69,700,000 at the end of 1937, compared to 63,450,000 at the end of 1936.

First extensive labor study of the radio industry conducted by the Department of Labor since 1926-'27 was announced last month by the Radio Manufacturers Association in reporting scheduled completion within a fortnight, of a government report on working conditions as well as wage scales of about 25,000 radio factory workers. Whether this will mean any more dollars in the jeans of radio men only time will tell.

Average income of male workers of radio receiving factories was 69.6c per hour, and 50.4c hourly for female workers. Among employees of parts and accessory manufacturers the average hourly earnings for male employees was 54.5c and 41.8c for female workers. The industry average, however, for all workers in the radio industry, according to the latest official report, for December 1937, was 63c per hour.

Radio workers' wages compare favorably with those of other comparable industries. Following are the last December average hourly earnings in other industries: jewelry, 61.3c; clocks and watches, 58.5c; stamped and enameled ware, 61.8c; cutlery, 61.2c; lighting equipment, 67.5c; electrical machinery and apparatus, 74.8c, and the highly paid automobile industry average of 90.5c.

According to a report by the Electrical Division of the Department of Commerce, last month, wind-electric chargers are much in demand, in the Philippine Islands, for charging batteries for radio sets. The 6-V. unit with 10-ft. tower is the most popular unit. "It's an ill wind. . ."

New evidence that we live in a topsy-turvy world was presented when a radio meteorograph sent aloft at Fairbanks, Alaska, last month, by Washington, D. C., weathermen revealed amazing information concerning temperatures in the sub-Arctic region. In fact, a person at the 26,260-ft. level of the robot at top-flight, if consigned to the "lower region" would have found a temperature of 13 below zero at ground level, as compared to 74 degrees above, at the 9-mile height!

OUR SWAP DEPARTMENT

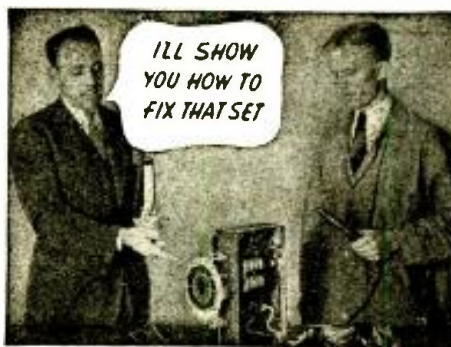
A CLIPPING from an unidentified newspaper sent to *Radio-Craft*, last month, tells how a Mayfield, Ky., patrolman exhibited the proclivities of a Yankee trader. He had a 10-cent pocket knife which he traded for a slightly better knife, which he traded for an old watch, which he traded for a radio set, and so forth and so forth for about a 100 swaps. He can't remember all of them, but he now has a used car which he values at \$200. He figures his net profit at \$199.90, not counting his time as worth anything because "trading is just fun."

MISCELLANEOUS

Radio beams have long guided airplanes. They now assume the mammoth task of guiding ferry boats. Place: across the Straits of Mackinac; reason: fog—and the Graham Shoals. This spring, 5 boats in the service there are to be fitted with 2-way radiophones.

Barkers at the 1939 Golden Gate Fair may bark their loudest, but may not use P.A. systems to augment their stridulencies.

In Australia, a man who lived next to a race track could not see the races because of the fence. So he built a tower upon which he and his friends might sit, happy and ticketless, watching the ponies perambulate. When he rented space on the tower to the B.H.C., race track officials sued to stop him. They lost.



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THE HERTZ FUND—AN OPEN LETTER TO THE RADIO FIELD

RADIO at last has an opportunity to pay at least a small part of the debt it owes to one who, giving unsparingly of his genius, contributed most to the art when least was known about the transmission of thought by means of electromagnetic energy.

Hertz, whom we honor by conferring upon this energy the designation *Hertzian waves*, passed away, in 1894, at the untimely age of 37 without ever having known the inspiration he gave to Marconi and subsequent searchers.

The posthumous presentation of a manuscript—dated 1888 and dealing with Dr. Hertz's research in the electromagnetic phenomena upon which radio is founded—to Prof. Bjerknes of Oslo, Norway, who gave it to the Academy of

Science (founded by His Holiness, Pope Pius, who sent to Dr. Hertz's widow a "generous money grant"), has disclosed a most regrettable situation.

A Jew, though from Aryan stock, his widow and two daughters are Protestants. Today, his widow and children live in Cambridge, Eng., having lost through Nazi activities both their home at Bonn and the modest pension upon which they had lived; the family is, in fact, in straitened circumstances.

Radio-Craft suggests, therefore, that all organizations and individuals in the radio field contribute toward a Hertz Fund to be put in trust, for the lifetime of Mrs. Hertz, for the use of the widow and her two daughters.

Please Say That You Saw It in RADIO-CRAFT

SERVICING QUESTIONS & ANSWERS

(Continued from page 820)

coupling condenser (110-mmf. mica unit), or an open oscillator plate resistor (13,000-ohm carbon unit).

OSCILLATION AT HIGH FREQUENCIES

(57) G. A. Younghein, Mitchell, Neb.
(Q.) I have a Majestic model 90-B, which operates well from 550 to 1,000 kc. At higher frequencies, oscillation sets in. Tubes are perfect. All condensers check OK as do all resistors. Neutralizing and alignment do not help. The rheostat on the gang condenser is OK. Oscillation can be started by tuning the dial slightly or by adjustment of the other two controls, with the tubes in the 1st, 2nd and 3rd R.F. stages removed.

This leads me to believe that the trouble is in the 4th R.F. stage. Will you please help me?

(A.) Although the symptoms mentioned in your letter do point to trouble in the 4th R.F. stage, actually, the oscillation is due to poor connection to the condenser gang rotor (caused by corroded rotor contacts). This difficulty may be overcome by cleaning the spring wipers and the spring washer and contact surfaces on the dial drive assembly. First remove the dial to get at the spring washer.

INTERMITTENT RECEPTION

(58) H. Dobson, Thorntown, Ind.
(Q.) A Philco model 90-A, with single 47 in output stage, has been serviced for the complaint of "intermittent reception." Turning off and on any light in the house will bring the set "back to life" for a short time. Everything checks OK. Is there some way you can help me clear the trouble?

(A.) The most common difficulty encountered with the Philco 90-A is that of open-circuiting condensers. In this model, as well as many other early Philco receivers, bypass and coupling condensers are bakelite-encased. The stiff pigtail leads emerging through eyelets to the lugs on the bakelite case often snap, either at the lug or within the case, due to vibration or other causes.

The offending unit may be easily located through the use of an insulated prod, while the receiver is set up for operation. Gently move each condenser pigtail lead. Usually the audio coupling condenser is at fault.

NEW AMPLIFIER HAS ADJUSTABLE FREQUENCY CHARACTERISTICS

(Continued from page 805)

This is, ordinarily speaking, caused by the fact that an auditorium can be regarded as a resonant chamber with all of the complex sound patterns that can be set up in an enclosure of this type.

The most common trouble that we encounter is an excessive amount of low-frequency response, which makes the reproduction sound boomy and unnatural.

Sound men in the past have frequently undertaken the job of altering the response characteristics of their equipment to accommodate it to the specific installation. Generally, however, these alterations are expensive and take time, although the results that can be obtained with the proper type of frequency compensation are well worth the effort.

To reduce this problem, however, to the most simple form, the type 2A-30 amplifier, shown in Fig. A, has been developed. It has an adjustable frequency characteristic—either the bass- or the high-frequency end can be accentuated or attenuated at will, with the result that a new standard of performance can be set by installation organizations for the quality of the work that they are doing.

The frequency compensation obtainable in this 30-watt amplifier is clearly shown in Fig. 1. Two input controls permit the use of 2 low-level microphones such as crystal or velocity.

This article has been prepared from data supplied by courtesy of The Webster Co. (Webster-Chicago).

SHORT-CUTS IN RADIO

(Continued from page 809)

HONORABLE MENTION

RUBBER TUBE STOPS LEAD-IN BREAKS. In installing all-wave antennas I find that the transmission line always breaks where it is fastened to the building by nail-on knobs. This is caused by the wind swaying the lead-in wire. To overcome this I slip a piece of heavy rubber tubing over the transmission line and fasten this to the building with a Romex clamp or a (t.) strip, as shown in Fig. 5. This tubing should be about 18 inches long. This causes the transmission line to bend over a spread of several inches instead of on the one spot where it always breaks when such protection is not used.

JOHN MEDNANSKY

HONORABLE MENTION

DEMAGNETIZING PHONE POLES. Headphones that give a low signal and appear worn-out often may be rejuvenated by removing the coils from the phone (the magnet may be removed instead) and connecting 5 volts of A. C. across the coils for about 5 minutes. This eliminates residual magnetism in the polepieces. Headphones "treated" in this manner have outperformed previously more sensitive ones. Figure 6 indicates how this is done.

LAWRENCE B. JOHNSON

HONORABLE MENTION

COMPACT TEST ADAPTER. This little unit is made, as Fig. 7 shows, by reassembling a standard cube-tap. In drilling out the rivets holding the receptacle springs to the plug prongs, the hole is made large enough to admit a fibre bushing around the small screw used to reassemble the parts as shown in the self-ex-

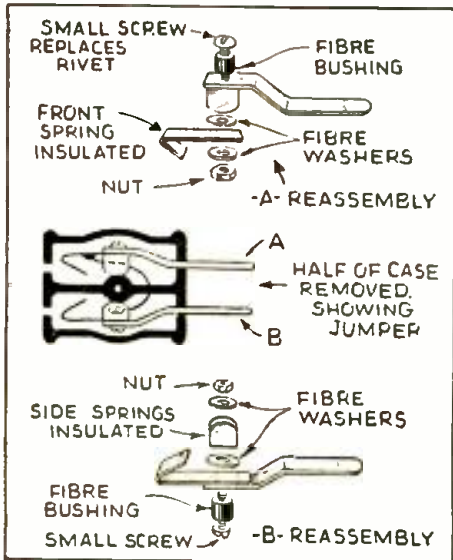


Fig. 7. Convenient test-lamp unit.

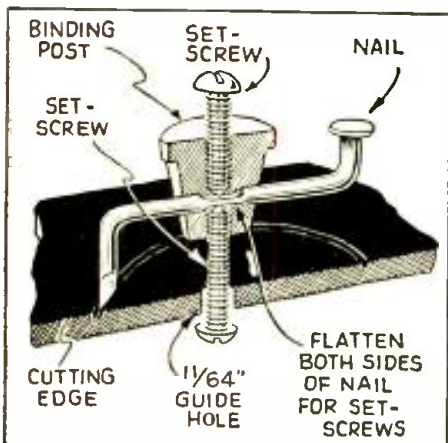


Fig. 8. Improved fly-cutter.

planatory diagram. The front spring of A is insulated from the rest, as are the side springs of B. The connection between these 2 insulated springs, as in the diagram with the cover removed, completes a unit in which the side receptacles are in parallel with each other and in series with the front. Complete the equipment by adding a plug-in adapter with screw-in socket, a plug base, plug fuse, and test prods leading from a plug.

A list of applications would entail considerable space, so a few are mentioned and the rest left to the creation of the reader. A continuity tester is had by putting the adapter with a lamp into the front receptacle and the test prods in the side, or vice-versa, with the whole plugged into the 110-volt service. To use the lamp in series with the line as a current limiting device, when working on a shorted appliance or radio set, plug radio receiver in front and lamp in side. When the short is remedied shunt the lamp by joining the prods on the other side or replace the lamp with a fuse. Disconnected from the "110," with the lamp and prods in the sides, it can be used as for checking circuits other than those with standard plug connections. When fused, 110-volt flexible leads are needed, plug in adapter with a fuse on one side and the leads on front. When the writer does low-voltage testing—as on doorbells and auto systems—he uses a low-voltage lamp and drycell in place of the 110-V. supply. By fastening a plug receptacle on the battery, it makes an ideal portable set-up to use where "110" is not available.

W. B. SANFORD

HONORABLE MENTION

INEXPENSIVE, ADJUSTABLE HOLE-CUTTER. Desiring to mount some test meters of different sizes on an instrument panel, the cutter shown in Fig. 8 was devised out of junk box parts. It is inexpensive, yet remarkably efficient, if used with a little care for most panels, except metal.

The body part is an old binding post used upside down. The cutting tool—any rod, such as a nail, that will go through hole in binding post—then bent at a right-angle and sharpened with a file to a cutting edge; it should also be flattened slightly where set screws clamp it to keep it from turning over. The other end may be bent up to secure a better hand-hold.

Center-punch and drill a 1/64-in. guide hole at center of desired hole, as a guide for the short bottom set-screw. Adjust the cutter to the radius of the required hole and start the cut. After cutting about half through the panel, turn it over and cut the other side thus making a clean-cut hole without torn edges.

ALVIN E. JOHNSTON

NEW EDUCATIONAL PLAN FOR SERVICE MEN

Last month, National Radio Institute announced that they had completed a special course, in radio theory and practice for Service Men, to be made available to the members of a well-known manufacturer's service organization (membership at present is said to total about 27,000 Service Men).

The Course is intended for men who are now actively engaged in service work. Consequently, many of the features in the ordinary radio course are unnecessary to the man who is already working in radio service, and these have been eliminated. Further information concerning this course, and the equipment, certificate and other benefits that go with it, are contained in the free booklet, "How to Make and Keep Radio Servicing Profitable," obtainable from "N.R.I." or *Radio-Craft*.

In addition to the interesting outline of the radio course, which this booklet contains, there are several pages containing actual technical material of interest to most Service Men. For instance, an N.R.I. "Easy Calculating Chart" affords a convenient means for converting voltage, current, resistance and power into various convenient and related figures merely by using a straightedge.

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Power supply operates directly from 110 volt, 60 cycle lines. Requires three 6K7, one 6H6, one 6F8G and one 5Z4 Tubes.

By all means, see the Meissner P.A. Tuner Kit at your jobbers today. And write direct for more information.



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111 Belmont Ave., Mt. Carmel, Ill.

AN IMPORTANT ANNOUNCEMENT which tells about five NEW books which have been added to the RADIO-CRAFT LIBRARY SERIES appears on Page 838 of this issue.

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SPACE in this department is not sold. It is intended solely for the benefit of our readers, who wish to exchange radios, parts, phonographs, cameras, bicycles, sporting goods, books, magazines, etc., without profit. Since we receive no money for these announcements, we cannot accept responsibility for any statements made by the readers. Use these columns freely. Only one advertisement will be accepted from any reader for any one issue. All transactions MUST be above board. Remember you are using the U. S. mail in all

these transactions and therefore you are bound by the U. S. Postal Laws. Describe everything you offer accurately and without exaggeration. Treat your fellow men the way you wish to be treated.

NO ADVERTISEMENT TO EXCEED 35 WORDS, INCLUDING NAME AND ADDRESS

We welcome suggestions that will help to make this department interesting and profitable to RADIO-CRAFT readers. Copy should reach us not later than May 5th for the July, 1938 issue.

WANTED: FAMOUS HEADLINES from newspapers, old or new. Will offer radio parts. State what you want. A. Seldman, % Sleser, 54 Willett St., New York City.

WANTED: 4" x 5" FOLDING plate camera with plate holders, or 4" x 5" Eastman folding Kodak with plate back and holders. Good condition. Give diaphragm scale numbers. Will trade good radio. Edw. Seymour, 49 Manning Ave., No. Plainfield, N. J.

WANTED: ISSUES OF THE PROCEEDINGS prior to 1920. Offer photographic and miscellaneous other supplies. Doane Bernard, Room 1104, 99 Hudson Street, New York City.

WILL SWAP LOFTIN-WHITE amplifier with tubes, excellent condition for portable electric drill or other tools. Allan Stuart, 1627 Ponsi St., Fort Lee, N. J.

WILL SWAP COMPLETE SET OF golf clubs, all steel shafted, including 3 woods and following irons, No. 2, 5, 7, 9, and putter, with bag, for any standard 1937-8 auto-radio set. N. Gray, 160-22 97th St., Howard Beach, L. I., N. Y.

WANTED: RADIO PARTS vintage of 1920—earlier, want Murdock crystal and loose coupler set. Want any type of coherer. Exchange radio or photographic parts, or what you want. H. D. Tilletson, 40 Manning Ave., No. Plainfield, N. J.

10-WATT AMPLIFIER 4-STAGE. Thoradson transformers (3) P.P. 50's output Shure D. H. mike, floor stand 12" speaker. Wanted: Test equipment, osc. tube tester or what have you. Ronald Oberholzer, 1253 Swede St., Norristown, Penna.

ELECTRIC AUTOMATIC DICK mimeograph; R.F. milliammeters; noiseless portable typewriter like new; other items. Want photographic range finder, Weston exposure meter, or what have you? Write before shipping. Elchberg, 782 West End Ave., New York, N. Y.

WILL SWAP A BRAND NEW 16 MM cinegraph projector for a large quantity of stamps, or a collection. Smitty's Radio Shop, 830 East 163 St., New York City.

WILL TRADE MICHIGAN STATE auto school course; Lincoln Engineering School Radio Engineering Course, also their electrical engineering course, Farmer Burns wrestling course. Want typewriter, Rider manuals, 16 mm projector. A. H. Jackson, Philpot, Kentucky.

WILL SWAP COMPLETE SELLING course of National Salesmen's Training Association, consisting of 16 brand new text books (value \$50). Want movie camera of equal value, in absolutely perfect condition. Or what have you? B. N. Lantz, 232 West 67 St., New York City.

EXCHANGE HAMMOND 161A heavy-duty auto R transformer, (\$3.00 new). Pryse, Canboro, Ont., Canada.

WANTED 16 MM PROJECTORS and equipment. Have General Electric Auto Radio and 4, 5, and 6 tube midjet radios in perfect condition. Abe Fisch, 1129 Tinton Avenue, New York City.

READRITE ANALYZER—710-A. Will trade for signal generator or service manuals. Leroy Ellis, 219 No. 11 Street, Richmond, Indiana.

WILL TRADE 28 LESSON CARTOONIST course, over 600 illustrations, for a 4 or 5 tube loud-speaker radio with or without cabinet. Send postcard to me and describe radio. Address Charles Deibel, Canfield, Ohio.

TRADE LINOTYPE KEYBOARD and Bennett's course, candid cameras. Want 8 mm camera or projector. I. Hukill, 1184 West Broad St., Columbus, Ohio.

THORADSON OSCILLOSCOPE—new—complete—trade for real good high gain P.A. amplifier of 30 watts output or more. At least two high gain inputs desired. State make and model. Edgar Iye, Blooming Prairie, Minn.

WANTED: ANY TYPE TEST equipment, ham equipment, anything in radio. Will swap for anything you need. David Oehlson, 69 West 23 St., Chattanooga, Tenn.

WILL SWAP COLLECTION OF radio manufacturers old catalogs and circulars for radio parts. What have you? B. Sunshine, 4408 10th Ave., Brooklyn, N. Y.

HAVE 250 WATT AC-60 CYCLE fan belt drive generator. Also 700 watt AC unit. Both ball bearing and guaranteed. Want generators, band saw, press, etc. Bench saw, AC motor. J. L. Orsien, Kennan, Wisc.

HAVE PRACTICALLY NEW Readrite 554A oscillator and 575 output meter, model 430 tube tester, with Triplett meters. Want Rider manuals, record player, motor, pickup, tubes, parts. Zachry Radio, Ashdown, Ark.

TREASURE FINDERS: WANT TO exchange ideas, hookups, etc., on metal locators. B. Deuchler, No. 5, So. Omaha, Nebr.

WILL TRADE SET OF 8 RIDER'S manuals, test equipment, 150 Raytheon tubes in sealed cartons and radio parts for any movie camera, projector or movie equipment. Irving Olson, 362 Wooster Ave., Akron, Ohio.

WILL SWAP 1922 ETC. RADIO News magazines, radio and electrical courses for what have you. Super Radio Service Co., 138 Vine St., Plymouth, Pa.

SIGNAL GENERATOR COILS. Small compact universal wound, 95-930 kilocycle. Will swap. E. J. Kujala, 62 Bruce St., Galt, Ont., Canada.

SWAP: WESTON DIRECT-READING ohmmeter Model No. 1 No. 43503, 0 to 2 1/2, 0 to 25 and 25 to 50 ohms, all full scale, for any three complete Rider manuals. L. R. Kinney, 826 N. Tuxedo Street, Indianapolis, Ind.

WANTED MEISSNER TUNING unit No. 7512, in exchange for an R.C.A. Piezo-Electric callibrator. Joseph Jordan, 25 W. Chicago Ave., Chicago, Ill.

WILL TRADE R.C.A. MAGNETIC pick-up model UP 741, slightly damaged. Good working order; Champion drill press with 1/2 chuck; 5-in. magnetic speaker. What have you. Luldi D. Mizkace, 89 Elm St., West Newton, Mass.

WANTED: 16 MM MOVIE CAMERA in swap with a Good Holmer small size piano accordion. It has 8 bass buttons and 23 the others. Little use. Write to Henry Bollmann, 10 Adrian Ave., New York, N. Y.

HAVE SEVEN VOLUME SET, accountancy and Business Management, books, leatherbound and in now condition. Also United States stamps. Want Rider's or Gernsback manuals, oscillator or tube tester. Wm. Scott, Davis, W. Va.

COMPLETE 5x8 PRINTING press, type, NRI radio course, Readrite analyzer 710. Quantity radio materials, send list and enclose card for reply. Make offer. Want manuals, meters, equipment. Edward Turner, Box 767, Hoboken, New Jersey.

WHAT HAVE YOU TO OFFER for a Midas combination camera and projector, electric motor driven, plus leather case. Brand new, used only once. H. N. Messel, 1627 Ponsi St., W. Fort Lee, N. J.

GOOD VIOLIN WITH TWO bows. Cost \$30. Will include four instruction books and sheet music. Will swap for testing equipment or portable battery radio. Ray Brockway, 402 Pond St., Muscatine, Iowa.

RADIO WITTIQUIZ

(Continued from page 820)

(78) You should know that a ribbon mike is—
(a) A micrometer for measuring ribbon.
(b) An instrument to convert sound into electrical impulses, consisting of a ribbon suspended between pole-pieces. (c) A microphone tied with ribbons.

(79) An electric eye is—
(a) A substitute for a glass eye. (b) An eye with batteries to see in the dark. (c) A cathode-ray tuning tube. (d) A photoelectric cell.

E. H. MICHAELSEN

(80) Any radio operator knows a fader is—
(a) The German pronunciations of "father."
(b) A radio set that fades. (c) A volume control which will allow one signal to be gradually removed and another gradually to be put into the circuit.

(81) Radio Service Men and experimenters know an Edison cell is—
(a) A tube. (b) A cell invented by Edison to keep maniacs in. (c) A type of accumulator employing an alkali electrolyte. (d) A type of primary cell employing a paste electrolyte.

(82) We all know a barretter is—
(a) A measuring device. (b) A thermal detector. (c) A bar of magnetized steel. (d) A new type of hat.

(83) All radio men know a swinging choke is—
(a) A noose. (b) A special iron-core choke, where, because of core saturation, the inductance changes with the average current. (c) A transformer used as choke and transformer alternated. (d) A choke which can be used or eliminated.

(84) They also know an undamped wave is—
(a) A dry spell. (b) A radio wave sent out during dry atmospheric conditions. (c) A continuous wave. (d) An unmodulated wave.

F. L. HOEWLICH

ANSWERS

(65c) (66e) (67d) (68c) (69b) (70c) (71c)
(72c) (73a) (74a) (75a) (76c) (77c) (78b)
(79d) (80c) (81c) (82b) (83b) (84d)

CONTEST RULES

(1) An award of a 1-year subscription to *Radio-Craft* will be given to each person who submits one or more WITTIQUIZZES that the Editors consider suitable for publication in *Radio-Craft*.

(2) WITTIQUIZZES should preferably be typed; use only one side of paper.

(3) Submit as many WITTIQUIZZES as you care to—the more you submit the more chance you have of winning—but each should be good.

(4) Each WITTIQUIZ must incorporate humorous elements, and must be based on some term used in radio, public address or electronics. Each WITTIQUIZ may have 4 "answers," only 1 of which of course will be correct; and, only 1 of which is non-radio.

(5) All answers must be grouped, by question number and correct-answer letter, on a separate sheet of paper.

(6) All contributions become the property of *Radio-Craft*. No contributions can be returned.

(7) This contest is not open to *Radio-Craft* employees or their relatives.

(8) The contest for a given month closes on the 15th of the 3rd month preceding magazine-issue date. (For instance, contributions to August, 1938, *Radio-Craft*, on the newsstands about July 1, must be received at *Radio-Craft* editorial offices not later than May 15, 1938.)

ELEMENTARY MATHEMATICS

For the Technician and Craftsman

CONTENTS OF BOOK

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Please Say That You Saw It in RADIO-CRAFT

OPPORTUNITIES IN OUTDOOR PUBLIC ADDRESS

(Continued from page 807)

lumber yards, stadiums, freight yards, fairs, and amusement parks, with the assurance that the speaker will stand up in the face of all adverse weather conditions.

As the photograph (Fig. A) suggests, a garden hose can be played into the mouth of the horn without disturbing the operation of the speaker or affecting its efficiency! The water cannot reach the cone because the speaker is mounted in an inverted position; which is a revolutionary step in the design of loudspeaker horns. (See Fig. 1 for cross-sectional view of the speaker.)

The marine-type horn is very effective because of its excellent distribution properties. The horn has a 120° angle of distribution immediately in front of the bell. For long-distance sound projection, advantage is taken of a center beam effect which appears to have greater carrying qualities and at a higher sound pressure than the immediate sound output at the bell.

This allows for a system to be operated at higher levels without the possibility of microphone feedback. There is very little danger of feedback even when the microphone is close by the horn itself.

Four of the horns using regular 12-in. permanent-magnet speakers are capable of handling a crowd of 10,000 people in an open stadium, when the horns are mounted in a circular cluster and are driven at 10 watts apiece.

There are various methods in which the speak-

er can be mounted. A bracket is provided for mounting on walls, sound cars, buildings, and towers. A floor stand is also provided so that the speaker can easily be moved around at will.

The horn is constructed of heavy gauge aluminum and steel spinings. All iron parts are electro-chemically treated to prevent corrosion and disintegration. The entire unit is also protected from rattle and resonance because of the thorough heavy construction.

Aside from the advantages mentioned we may observe the advantages offered by the "marine" horn for sound truck use. There is no need to overstress the abuse which a horn receives by being constantly dismounted and remounted on the roof of a sound car.

Sound truck operators now have a horn which can be permanent-mounted on a truck, and which can be left and used in the rain.

IDEAL FOR FIRE AND POLICE USE

Use of the "marine" horn in the rain is important also for use by local police and fire departments. The horn is able to withstand the torrents of water usually thrown about in fire-fighting. (As shown, last month, in "R.C."—Editor.) The horn is also absolutely weatherproof when driven around in the rain by police safety patrol cars.

The speaker will also be an important selling point in the replacement of present speakers which are not absolutely storm-proof. Present P.A. owners will welcome a speaker like this which they can substitute for present unprotected speakers.

This speaker is valuable when used in outdoor call systems. The speaker is very efficient for "talk-back" in all types of inter-communication systems where speakers must be mounted outdoors. This "talk-back" feature can easily be incorporated in many outdoor installations. (As illustrated, last month, in *Radio-Craft*.—Editor)

This message is not intended as a pep talk, but may be considered as a reminder. It seems that after a winter of P.A. inactivity the sound man must again be reminded of the profits P.A. work has to offer.

P.A. selling requires good equipment and good selling methods. The potential sales ability of a man cannot be improved greatly, but the type of equipment he handles, can. It pays, therefore, for the sound man to scrutinize every new P.A. development, and make the best of it in the terms of cash.

This article has been prepared from data supplied by courtesy of Atlas Sound Corp.

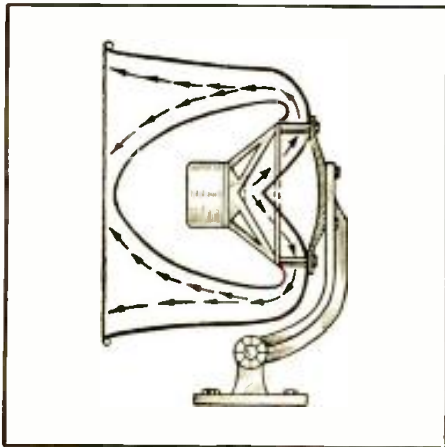


Fig. 1. Cross-section of weather-proof speaker.

THE LATEST RADIO EQUIPMENT

(Continued from page 817)

from the electrolyte) is high (approx. 10). Perfecting this and other characteristics has resulted in ultra-compactness.

The unusual diminutiveness of the Beaver or type BR unit here shown—since it well illustrates the present acme of compactness obtainable—results from an engineering development in the etching of anodic materials. The BR-type condenser claims title as the world's smallest electrolytic unit.

New methods of etching have been developed wherein the effective anode surface area has not only been increased to a greater extent, but wherein no corrosive alkali or acids are used in the etching process. The accepted standard etched-foil ratio, of the increase in capacity for a given cubic contents, has been 3:1. The new etching method has stepped-up this ratio from

8:1 to 30:1, depending upon the voltage and type of current (rectified A.C. or pure D.C.).

By employing newly-developed electrolytes, the Cornell-Dubilier Beavers are extremely stable and free from tendencies toward corrosion of the anodic film during active as well as idle shelf life. Special impregnation methods have also been developed which permit the electrolyte to be forced into the condenser winding at enormous pressure. Such a method insures complete saturation of the separator metal and penetration of the etched-foil surfaces. This makes for capacity stability over long periods of time.

(It has been known for some time that several metals, such as aluminum, tantalum, niobium, magnesium, zirconium and titanium can be coated with an insulating oxide film by electrochemical means. By introducing the metal into a suitable electrolyte, aluminum in an aqueous solution of boric acid and sodium borate, and passing a current through it.)

The Beaver unit is externally insulated in an aluminum tube. The end of the tube is hermetically sealed against rubber-capped bakelite washers. There is no metal other than high-purity aluminum inside this sealed structure. Because no sealing compound is employed, no sealing compound can contaminate or dilute the electrolyte even though the condenser is operated in a relatively high ambient (surrounding) temperature. Also, no electrolyte can drip or leak from the structure. The radiation of any internally-generated heat is also facilitated by the absence of any sealing compound.

(Continued on following page)



Ultra-midget etched-foil condenser. (1610)

In that Metropolitan store on the Calle Rivadavia 869 Mr. Francisco Fernicola, the proprietor, is enthusiastic for he writes:

"They ask for them . . . these servicemen and amateurs . . . and come back again and again for other Centralab parts . . . Naturally I must agree with them that they are the best."



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permanent resistors, switches . . . perform their miracles in myriad languages in all parts of the globe. Manufacturers, servicemen, and amateurs everywhere . . . SPECIFY CENTRALAB.



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Health is the keynote of all activities at Hot Springs where thousands have found the Fountain of Youth, regaining pep and vigor through the curative thermal waters of the internationally famous spa. Under government supervision, drinking and bathing in these mineral springs afford relief to sufferers from high blood pressure, neuritis, rheumatism and other disorders. At the same time the joys of an outdoor vacation, riding, hiking, hunting, are readily available.

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H. Grady Manning, Pres. C. Emmett Karston, Mgr.

OPERATING NOTES

(Continued from page 811)

through the front. If the grommets are in place and the screw is not turned too hard, there is no danger of this.

Stromberg-Carlson High Fidelity Receivers. From time to time Service Men complain that "the High-Fidelity control detunes the receiver," or that "tuning can be sharpened appreciably after adjusting for High Fidelity." This indicates lack of attention to the Instruction Books accompanying each receiver, which specifically state that:

"On the broadcast band, a High-Fidelity Stromberg-Carlson radio should *always* be tuned with the fidelity control set for Standard Fidelity. *Never* re-tune the set after advancing to the High-Fidelity position."

The change in tuning meter swing or in the shadow on the Tri-Focal Eye tube, noticed when adjusting from Standard to High Fidelity, indicates a broadening of the sidebands to give a wider frequency response. If the operator re-tunes the radio after adjusting to high fidelity—or if he then tunes in another station without returning to standard fidelity—the receiver will invariably be tuned to one or another slight off-resonance peak, resulting in distortion.

Instruct prospects and customers as to the proper method of tuning a high-fidelity radio set.

The standard-fidelity position on Stromberg-Carlson models employing the Big Bronze Dial is indicated by half-red and half-white showing in the Fidelity-Tone Control aperture and a small white dot appearing on the red side. At "low-fidelity" condition, the tone control is fully operated.

For short-wave reception, the above instructions do not apply. Turn the High-Fidelity control so that the red part of the indicator covers approximately three-quarters of the aperture. This provides maximum sensitivity on the short-wave ranges and at the same time spreads the tuning a little for easier locating of short-wave stations.

STROMBERG-CARLSON, Solder Nuggets.

FREE POSTCARDS MAY BE HAD UPON WRITING TO THE PUBLISHERS

These postcards make it easy to answer advertisements which appear in RADIO-CRAFT, without cutting valuable data which you may wish to save.

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68 PAGES

THE LATEST RADIO EQUIPMENT

(Continued from preceding page)

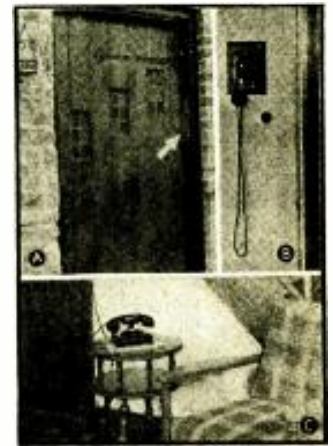
HEARING-AID MONEY-MAKER (1611)

(The Webster Company—Webster—Chicago)

SIMPLIFIED and improved aids for the hard-of-hearing, for use in churches, auditoriums, theatres, schools, etc., have just been introduced. Since an amplifier is incorporated in the design, Service Men can now recommend the system for connection to a theatre's sound-on-film equipment, because headphone-cord shorts will not interrupt the movie program. As illustrated, the patron individually controls volume at his respective jack-box (encircled at bottom of photo).



New crystal microphone, amplifier and earphone hearing aid. (1611)



(A) Plate covers doorjamb mike and speaker; (B, C) indoor units. (1612)

"DOORPHONE" IS SERVICE ITEM (1612)

WIDEAWAKE Service Men will have no difficulty selling this new Doormaster microphone-and-loudspeaker communicator when quoting on apartment-house group radio installations. Useful indoors or out.

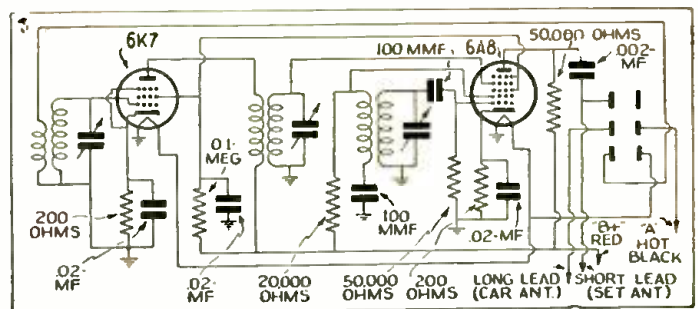


Diagram of "police adapter" described on page 817. (1609)

Please Say That You Saw It in RADIO-CRAFT

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

NEW "BI-FONIC" LOUDSPEAKER HOUSING LATEST MONEY-MAKER (1613)

(Bi-Fonic Reproducer Labs.)

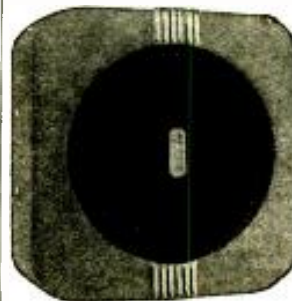
UNLIKE all previous types of labyrinths, etc., which were designed to eliminate the back-wave from the reproducer, this new "Bi-Fonic" housing actually utilizes the loudspeaker's back-wave! Result? Better frequency response at both the low and the high ends of the audio-frequency range; PLUS INCREASED VOLUME, utilizing the same reproducer! *Radio-Craft* editors witnessed a demonstration, of a midget set's loudspeaker in one of these housings, in which the midget set "out-highfidelitied" a much larger set costing several times as much.

Service Men can do a nice business on this item, if they'll recommend it to midget-set owners who do not want to invest in another and better radio set. Equally good prospects are radio set owners who want an auxiliary loudspeaker set-up.

Public Address specialists will find that a demonstration will sell the Bi-Fonic housing, and a suitable loudspeaker, to club owners, broadcast studios (for use as a monitor speaker), schools, restaurants, dance halls, etc.

AN AUTOMOBILE SPEAKER that has proven its worth for...

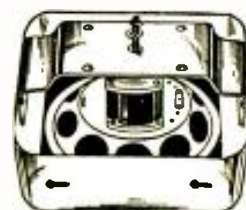
- Efficiency • Durability
- Attractiveness



Model VN8L

The cabinet is made of steel yet having a soft suede finish, delightful to the eye and in harmony with today's car interior.

The well known Nokoil Reproducer in this model VN8L will actually bring the performance of an old automobile radio up to and past that of many being sold today.



The steel cabinet is arranged with a single stud mounting so that it carries the whole weight of the speaker. This eliminates the necessity of fastening the stud in the pole piece of the speaker which often throws it off center.

Write for complete information. Wright-DeCoster Distributors are always anxious to cooperate.

WRIGHT-DECOSTER, INC.

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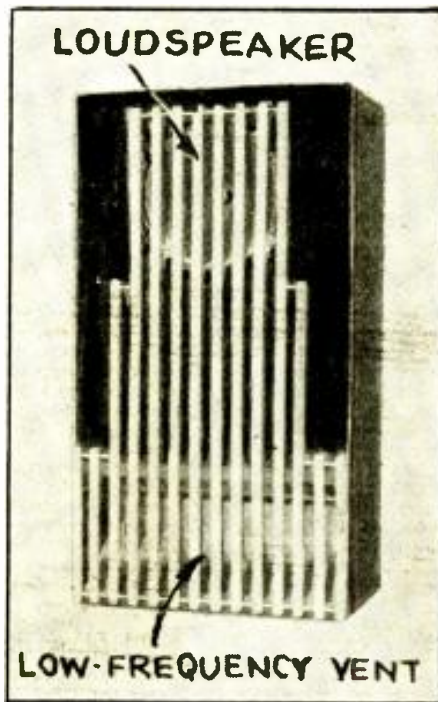
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PLUG-IN NOISE FILTER (1614)
(Sprague Products Co.)

ELECTRIC razors, fractional horsepower motors and other numerous domestic devices, output noise which is picked up by many radio sets. This interference may be effectively filtered out by means of the unit illustrated. It plugs into the wall receptacle (and holds there tightly), and into it in turn is plugged the offending device (or the radio set).

LOUDSPEAKER



LOW-FREQUENCY VENT

Above. — Reflecting, instead of absorbing, surfaces help achieve higher fidelity and greater volume. (1613)



Left. — Newest noise-filter measures only 2 x 1 7/16 ins. dia. Holds in wall outlet even better than most devices it filters. (1614)



Everything you need in radio. It's all in this new RADOLEK RADIO PROFIT GUIDE. Every repair part for every receiver. Newest radio receivers. Test instruments. Technical books. Special equipment. Leading standard brands. Every item guaranteed. It must be right or we make it right. And everything under one roof. You get what you want promptly, and exactly what you want. Radolek's immense stock, plus Radolek's efficient organization, insures you fastest service. 25,000 service men depend on this service and benefit by Radolek's Radio Profit Guide. It will help you make more money.

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RADIOOBSERVATIONS 'ROUND HOME

Three boys were arrested in Brooklyn last month for possession of a radio receiver which they were carrying down street to a "sick aunt"; they were carrying \$13 in small change, too, so a detective took them in and accused them of robbing a store. In Birmingham, Ala., a colored man who was robbing a radio store turned on a light—as he thought—it was a call box, and the police made him see the light. And in Chicago, Mayor Kelly last month had an ordinance passed to require burglar alarms on all fire escapes. A good chance to sell PE cells.

Short-wave radio sets in garages aid tow-cars, placed near garage doors, just as fire-trucks are in fire stations, to make quick get-away—in the "tow-car racket"; by which wreckers, racing to the scene of an automobile accident, not only violate speed laws but victimize persons involved in accidents (by charging exorbitant fees, etc.). Providence, R. I., police reported, last month, to the Int'l Assoc. of Chiefs of Police, according to *The American City*. In one instance, as many as 6 tow-cars at an accident blocked the highway and impeded the investigation!

Announcers of the American Legion Parade broadcast in New York last month wore headphones. Chief Controller Schechter thus gave each his cue when to come in to the program, and when to dry up—as the parade rolled by.

Learning a lesson from the floods that this Spring crippled radio service ("Radio and P.A. as a Flood Aid," *Radio-Craft*, April and May, 1937), every Pennsylvania airport maintaining regularly-scheduled flights and all radio transmission stations used for navigation purposes, according to reports last month, must maintain at all times an auxiliary source of electric current sufficient to keep the lights and radio equipment functioning for an emergency period of 12 hours. "High time every state enforced such a ruling," we might remark; it now remains for the Quaker State to enforce the order.

BOOK REVIEWS

FUNDAMENTALS OF RADIO, by Frederick Emmons Terman (1938). Published by McGraw-Hill Book Co., Inc. Size, 6 x 9 ins., cloth covers, 458 pages, 278 illustrations. Price \$3.75.

Professor Terman has a reputation for producing worthwhile technical books and his "Fundamentals of Radio", prepared in collaboration with Lt. F. W. MacDonald, U.S.N., upholds this reputation.

The chief prerequisite for study of the material in this book is an elementary understanding of alternating-current circuits, and in particular the conceptions associated with the terms loading, impedance, reactance, etc. A knowledge of complex quantities is not necessary.

The purpose of "Fundamentals of Radio" is to present the basic principles of radio and radio communication in a form suitable for use in an introductory radio course. This book is essentially an abridged version of the author's "Radio Engineering." It presents the subject with the same organization, the same viewpoint, and the same style, but the treatment is simplified. The length of the text has been nearly halved, and the problems have been increased in number and made primarily of a classroom type.

Chapter headings follow: The Fundamental Components of a Radio System; Circuit Elements; Resonant Circuits and Circuit Analysis; Fundamental Properties of Vacuum Tubes; Vacuum-Tube Amplifiers; Power Amplifiers; Vacuum-Tube Oscillators; Modulation; Vacuum-Tube Detectors; Sources of Power for Operating Vacuum Tubes; Radio Transmitters; Radio Receivers; Propagation of Radio Waves; Antennas; Radio Aids to Navigation; Television; Acoustics; Appendix; Index.

EXPERIMENTAL RADIO, by R. R. Ramsey (4th Edition, 1937). Published by Ramsey Publishing Co. Size, 6 x 9 ins., cloth covers, 196 pages, 167 illustrations. Price \$2.75.

This 4th Edition of "Experimental Radio" further simplifies and expands the scope of experiments presented in the preceding editions. A student who conscientiously follows the experimental presentations in Mr. Ramsey's book will have a more thorough understanding of First Principles of radio than would be the case if he would read the same amount of material in any other book that has so far come to the attention of this reviewer.

Only elementary arithmetic is employed and students just entering high school should have no difficulty in assimilating the entire contents of this highly educational book. We also recommend "Experimental Radio" to Service Men who are a bit hazy on their knowledge of the super-heterodyne action; and to sound men who want to brush up on basic principles of attenuators and characteristic impedance.

The book includes 132 experiments and a listing of laboratory apparatus required. These experiments cover the following outstanding fields of investigation: inductance, resistance, capacity, vacuum-tube theory, circuit phenomena, R.F. and A.F. amplifiers, P.A. and commercial broadcasting, and radio telegraphy and telephony.

RADIO SERVICING—Short-Cuts and Money-Making Ideas, by M. N. Beitman (1937). Published by Supreme Publications. Size, 8 1/2 x 11 ins., paper covers, 18 pages, illustrated. Price 50c.

Here is a book that contains practically nothing new. Its value lies almost exclusively in such merit as it may have as a compilation of certain radio fundamentals that might be new to the beginner in radio servicing.

HOW TO PASS RADIO LICENSE EXAMINATIONS, by Charles E. Drew (New 1938 Edition). Published by John Wiley & Sons, Inc. Size, 6 1/2 x 9 1/2 ins., stiff paper covers, 201 pages, 73 illustrations. Price \$2.00.

This up-to-date version of an old standby will be welcomed by everyone who contemplates taking a government license examination as a commercial radio, telegraph or radio telephone operator. Completely revised and re-written, this new edition of How to Pass will prove highly informative even to those students and operators who found the preceding editions helpful in obtaining a commercial "ticket".

QUESTIONS AND ANSWERS HANDBOOK (Revised Edition, 1937). Published by Allied Radio Corporation. Size 8 1/2 x 11 ins., 81 pages, paper covered, contains over 3,000 questions and answers. Price, 95c.

"Questions and Answers Handbook" for Service Men includes 19 sections, each covering a complete phase of radio servicing. Among the subjects discussed are: basic theory, superhetero. auto-radio, P.A., etc. This book offers an authoritative and comprehensive survey of every aspect of the subject. If you consider you really "know your oats," about servicing, give yourself a quiz via this book. It contains valuable data gathered, over a period of 2 years, from leading service texts, laboratories, schools, and Service Men in the field.

WIRELESS ENGINEERING, by L. S. Palmer (1937). Published by Longmans, Green and Co. Size, 6 x 8 1/2 ins., cloth covers, 544 pages, 353 illustrations. Price \$7.50 (21/-net, England).

The recent advances in wireless engineering have necessitated a thoroughly revised and enlarged edition of this well-known text-book (first published, in 1928). It deals with every branch of radio and recent advances in this science, such as short- and microwave technique, the mechanisms of wave propagation through the ionosphere, the use of quartz oscillators, copper-oxide rectifiers, distortionless loudspeakers, voice-operated radio land-line links and high-frequency feeder lines, and modern valve manufacturing processes.

DEAD — DR. OTHO FULTON



Dr. Otho Fulton, pioneer in facsimile, died on Monday, Feb. 28, at the home of friends in New York City, at the age of 70. Dr. Fulton (here shown demonstrating an early model of his Fultograph), a British subject, had been in America 8 years perfecting the radio and wire facsimile system he had originated many years previously; and had demonstrated a distance of 11,000 miles over the London-Sydney radio beam, about 10 years ago. (See "Announcing—Electrolytic Pictures via An Improved System," *Radio-Craft*, June 1935.)

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The New Model 1100-S

D.C. VOLT-OHM MILLIAMMETER



A sensationally low priced new pocket-size volt-ohm milliammeter. Features a 3" d'Arsonval type 0-1 meter, accurate within 2%; precision resistors. No external batteries necessary. Neat aluminum etched panel.

SPECIFICATIONS

0-5 volts D.C.	0-5 ma. D.C.
0-50 volts D.C.	0-50 ma. D.C.
0-500 volts D.C.	0-100 ma. D.C.
0-1000 volts D.C.	0-500 ma. D.C.
0-5000 ohms	0-500,000 ohms

Model 1100-S supplied with batteries, test leads and instructions. Size 6 1/2" x 3 1/2" x 2 1/4"; shipping weight 4 1/2 lbs. . . . Our net price

\$5⁸⁵

The New Model 1110-S

AC-DC VOLT-OHM MILLIAMMETER



A Midget in Size . . . a Giant in Performance! Here, without doubt, is the lowest priced, full-service instrument ever offered. Permits every possible measurement with absolute accuracy and simplicity of operation. 2% accurate 3 1/2" d'Arsonval type 0-1 meter. Precision resistors. Attractive etched panel. Housed in a modern striped fabricoid case.

SPECIFICATIONS

0-1.5 volts D.C.	0-1 ma. D.C.	0-15 volts A.C.
0-15 volts D.C.	0-10 ma. D.C.	0-40 volts A.C.
0-25 volts D.C.	0-100 ma. D.C.	0-75 volts A.C.
0-75 volts D.C.	0-500 ma. D.C.	0-200 volts A.C.
0-500 volts D.C.	0-500 ohms	0-1200 volts A.C.
0-500 ohms	0-500,000 ohms, low ohms read to 1 ohm	

Model 1110-S supplied complete with batteries, test leads and instructions. Size 8 1/2" x 5" x 3 1/4". Shipping weight, 5 1/2 pounds. Our net price

\$7⁸⁵

The New Model 1120-S

OSCILLATOR

Truly the greatest value ever offered! An All-wave, direct-reading Oscillator in portable size. Compares favorably with instruments selling at three times its price! Housed in a black crystalline cabinet with carrying handle.



SPECIFICATIONS

- Covers 110 kc. to 22 mc.; all on fundamentals, with ranges selected by front panel band switch, and frequencies in these ranges by dial manipulation.
 - Dial is direct reading in French letters, with band switch settings identified both by letters (A, B, C, D, E) and by frequencies, with the corresponding identifications on the dial scale.
 - R.F. and A.F. outputs obtainable independently.
 - Accuracy 1 per cent on I.F. and broadcast bands, 2 per cent on the short waves.
 - Separate posts for testing shorts, opens and leakages, including the leakages of electrolytic and other condensers. Thus even very high resistance circuits may be tested for continuity.
 - Planetary turn-easy drive, with 4-1 vernier.
 - Operates on 90-120 volts A.C. or D.C. Moreover A.C. may be of any commercial frequency, 25, 40, 50, 60 cycles, etc.
- Model 1120-S supplied complete with tubes, leads and instructions. Shipping weight 8 pounds. Size 10" x 7" x 4 1/2". Our net price

\$8⁸⁵

The New Model 1150-S

SUPER ALLMETER



A genuine achievement! For accurate and rapid measurements. Note the following features: • A.C. and D.C. Volts • A.C. and D.C. currents • Resistance • Capacity • Inductance • Decibels • Watts. Utilizes the new large 4 1/2" square d'Arsonval type 0-1 milliammeter at 1,000 ohms per volt, accuracy within 2%. Precision resistors. Housed in sturdy, attractive, black case with sloping panel for rapid and precise measurements. Removable cover and carrying handle for portable or counter use.

COMPLETE A.C. and D.C. VOLTAGE and CURRENT RANGES

D.C. Voltage:—0-15, 0-150, 0-750 volts D.C.
A.C. Voltage:—0-15, 0-150, 0-750 volts A.C.
D.C. Current:—0-1, 0-17, 0-150, 0-750 ma. D.C.
A.C. Current:—0-15, 0-150, 0-750 ma. A.C.

2 RESISTANCE RANGES

0-500 ohms 0-5 megohms

HIGH AND LOW CAPACITY SCALES

.0005 to 1 mfd. and .05 to 200 mfd.

3 DECIBEL RANGES

-10 to +10, -10 to +30, -10 to +50

INDUCTANCE: 1 to 700 Henries

Watts: Based on 6 mw. at 0 D.B. in 5000 ohms (0.00001 to 600)

Model 1150-S supplied complete with test leads, tabular charts and instructions. Size 10" x 7 1/4" x 4 1/2". Shipping weight 9 pounds. Our net price

\$11⁸⁵

Model 1150-A Portable carrying cover, 75c additional

The New Model 1160-S

SET TESTER

Combining the Super Allmeter and Tube Tester



A complete testing laboratory all in one unit! Combines Superior models 1140-S and 1150-S. For specifications read the description of both these models, herewith. Comes housed in sturdy, black case with sloping panel for rapid and simple measurements. Complete with test leads, tabular charts, instructions and tabular data for every known receiving type tube, including all major transmitting types. Size 11 1/4" x 9 1/4" x 2 1/2"; shipping weight 18 pounds. . . . Our net price

\$17⁸⁵

Model 1160A-S for Portable Cover, add 95c

The New Model 1140-S TUBE TESTER

A really modern tube tester conforming to all standards of good engineering practice. Utilizes a 2" d'Arsonval type meter with calibrated scale. Furnished in a sturdy black case with sloping panel for easy operation. Removable cover and carrying handle for counter or portable use.



SPECIFICATIONS

- Tests all 4, 5, 6, 7, 7L, and metal base tubes, including diodes.
 - Tests by the well established emission test method for tube quality, directly read on the GOOD ? BAD scale of the meter.
 - Afford separate neon test for leakage and shorts between elements.
 - All services performed by the use of only five controls at maximum, and many tests do not require working all the controls.
 - Supplied with instructions and reference table so that the filament voltage and emission measuring controls may be properly set for the unnumbered long list of tubes, which includes all tubes commonly encountered in servicing.
 - Work on 90-120 volts A.C. 60 cycle A.C.
- Model 1140-S comes complete with instructions and tabular data for every known receiving type of tube as well as many transmitting types. Shipping weight 16 pounds, size 10" x 7 1/4" x 4 1/2". Our net price

\$10⁸⁵

Model 1140-A with Portable cover . . . 75c additional

The New Model 1130-S

SIGNAL GENERATOR



With Audio Frequencies

It is with the greatest pride that we announce this new Model 1130-S Signal Generator. We predict it will be a great success and meet with the approval of the severest critic. Price considered, it's the finest instrument on the market today. Note the features listed below and judge for yourself! Comes housed in a grey, crystalline shielded cabinet with recessed name plates.

SPECIFICATIONS

- Combination R.F. and Audio Signal Generator. R.F. 100 kc. to 100 mc. A.F.—100-7500 cycles. All direct readings, all by front panel switching.
 - R.F. and A.F. output independently obtainable alone or with A.F. (any frequency) Modulating R.F.
 - Accuracy is within 1% on I.F. and Broadcast bands; 2% on higher frequencies.
 - Audio frequencies in 5 bands: 100, 400, 1000, 5000, and 7500 cycles.
 - Grant amplitude full vision, direct-reading dial.
 - Condenser and other leakages tested to 100 meg. ohms.
 - All serviced on 90-120 volts A.C. or 110 any frequency.
- Model 1130-S comes complete with tubes, test leads, carrying handle, instructions. Size 12" x 7" x 6 1/2". Shipping weight 15 pounds. Our net price

\$11⁸⁵

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E. D. Carter of Bethany, Ohio, writes: "I spent two years in college and have investigated other training in radio and the allied arts, and I have yet to find anything nearly so comprehensive as the A.T.I. training in television, which includes all any practical man needs to know about radio. I have earned an average of \$2,500 per year since studying with Mr. Sanabria doing television and telephone work."

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Already commercial in England, Television Engineering will be the next high salaried profession. Will you be ready to cash in with this new industry? Leaders of radio recognized their opportunity some fifteen years ago, and they as engineers have since earned millions! Now the future of television is assured. Are you going to make it *your* opportunity for success? Trained men will make from \$2,500 to \$20,000 per year.

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