RADIO'S LIVEST MAGAZINE

A GERNSBACK PUBLICATION

February
25 Cents

Radio-Craft

FOR THE

SERVICE MAN - DEALER - RADIOTRICIAN

HUGO GERNSBACK Editor

Radio Generates Health Fever

See Page 466

Service Men's Notes | World's Largest Speaker | A Unique Superhet

The Dynatron Oscillator | A Slide-Wire Bridge | Radio Craftsmen's Kinks

WHOLESALE PRICES

1931 FEATURE RADIO VALUES LOWEST WHOLESALE PRICES

MODERN UP-TO-THE MINUTE RADIO AT TREMENDOUS PRICE REDUCTIONS

Now, as never before, are you able to buy real radio values at astoundingly low prices. Never before in our many years of experience in radio merchandising, have we been able to offer such real values—on such quality radio merchandise as you will find presented in this catalog. No matter what your radio requirements may be, you will find them offered in this large 168 page catalog in large variety. Dealers—set builders, and radio enthusiasts of every nature should have a copy of this remarkable catalog.

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If you have planned on buying a new radio set—or if you contemplate replacing your old receiver with one of the new screen grid types, send for this catalog immediately. It will show you the way to substantial savings. Prices are down to a new all time record. In the large assortment of receivers shown, you will find just what you have been looking for—sets, accessories, kits or parts at lowest prices.

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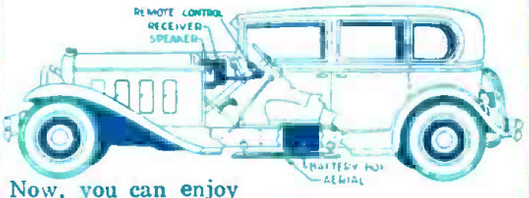
Here you are offered one of the season's most popular types of receivers. Housed in a beautiful walnut midget cabinet, complete with five tube chassis and speaker, it is an outstanding value at the low price quoted.

NEW AUTO RADIO



Now, you can enjoy your favorite radio programs as you drive. This new Roamer Auto radio blazes a new trail in its approach to perfection in circuit design.

$100.00 RETAIL
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Music as You Drive

No need to miss your favorite program while you drive. Sporting events, news flashes, symphony, dance or opera—all are available to you with this new Roamer Auto Radio. Concealed installation with remote control. R. C. A. licensed chassis. Universal brackets simplify installation in any car. Its many special features make it an outstanding value.

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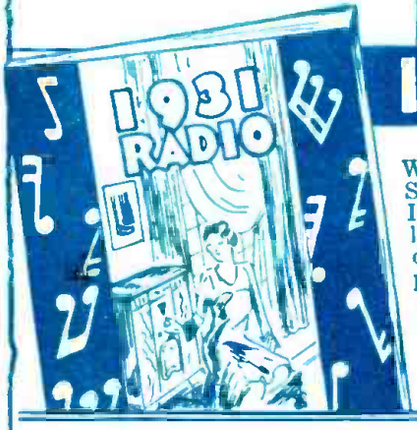

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EVERYTHING NEW IN RADIO

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Mail Coupon for *No-Cost* Training Offer

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Gentlemen: Send me details of your No-Cost Training Offer and information on how to make real money in Radio *quick*.

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Radio-Craft

FOR THE SERVICE MAN-DEALER-RADIOTRICIAN

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Editor Service Dept.

C. P. MASON,
Associate Editor

VOLUME II
NUMBER 8

Contents of This Issue

FEBRUARY
1931

In Forthcoming Issues

THE BAND-SELECTOR AND ITS APPLICATIONS, by C. H. W. Nason. One of the striking features which distinguishes the modern radio receiver, from one of a couple or three years ago, is the band-selector made necessary by its high amplification and the high power of modern broadcast stations. This article will deal with the theory and practice of band-selector design.

TWO-VOLT TUBES AND THEIR USE. The new '30, '31 and '32 tubes have given the battery-operated set a renewed lease of life; a new storage battery is available for these, and powerful, sensitive sets can be operated economically. The subject will be covered in several articles.

HOW TO MAKE A MIDGET SET, by H. G. Cisin. Details for the construction of one of these powerful little electric sets, now all the vogue.

A D.C.-A.C. CONVERTER, by R. W. Osland. No subject has elicited more inquiry than the operation of A.C. sets from D.C. light-lines. Those served by the latter will find this constructional article interesting, and probably profitable.

AN EXTRAORDINARY RECEIVER. If you had a free hand, regardless of expense, to build a radio set for range and quality, what would you construct? A great museum commissioned such a receiver as a permanent working exhibit; its unusual circuit will be shown.

RADIO-CRAFT is published monthly, on the fifth of the month preceding that of date; its subscription price is $2.50 per year. (In Canada and foreign countries, $3.00 a year to cover additional postage.) Entered at the postoffice at Mt. Morris, Ill., as second-class matter under the act of March 3, 1879. Trademarks and copyrights by permission of Gernsback Publications, Inc., 98 Park Place, New York City.

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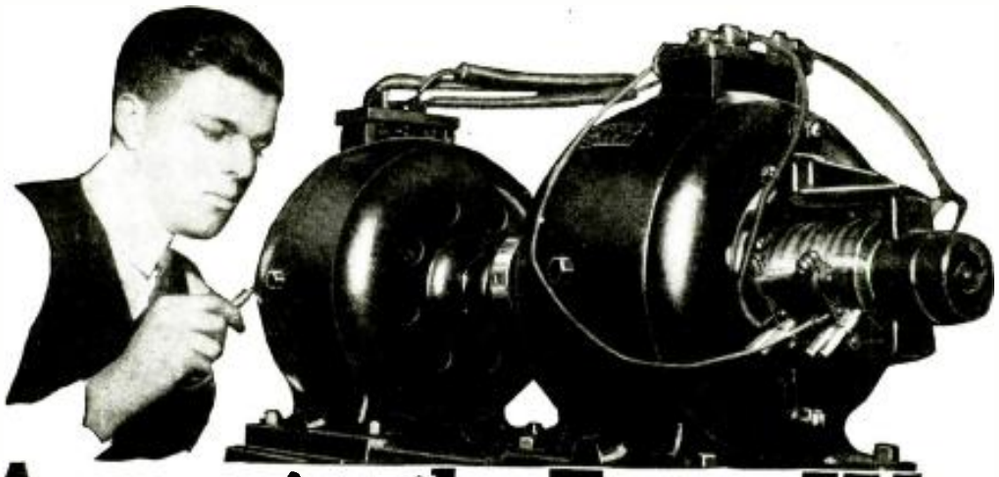

Amazingly Easy Way to get into ELECTRICITY

Don't spend your life waiting for $5 raises in a dull, hopeless job. Now . . . and forever . . . say good-bye to 25 and 35 dollars a week. Let me show you how to qualify for jobs leading to salaries of $50, $60 and up, a week, in Electricity —NOT by correspondence, but by an amazing way to teach, RIGHT HERE IN THE GREAT COYNE SHOPS. You become a practical expert in 90 days! Getting into Electricity is far easier than you imagine!

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By Actual Work—in the Great Shops of Coyne

Lack of experience—age, or advanced education bars no one I don't care if you don't know an armature from an air brake—I don't expect you to! I don't care if you're 16 years old or 48—it makes no difference! Don't let lack of money stop you. Most of the men at Coyne have no more money than you have.

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Here are a few of hundreds of positions open to Coyne-trained men. Our free employment bureau gives you lifetime employment service.

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An Important Message

to the owners of the

OFFICIAL RADIO SERVICE MANUAL

NOW!

SUPPLEMENT No. 1 to the OFFICIAL RADIO SERVICE MANUAL is ready for distribution—

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The first Supplement to the Manual brings that useful book right up-to-the-minute with the diagrams and schematic circuits of the latest radio models which have been placed on the market during the past few months, as well as with new information of sets for 1929 and 1930.

With each set of Supplements a new index is supplied. The pages are numbered to enable one to include the new additions in their logical places in the original OFFICIAL RADIO SERVICE MANUAL.

Every owner of the OFFICIAL RADIO SERVICE MANUAL will be sure to be up-to-date in radio if he becomes a subscriber to the Supplements. The cost—only $3.50 a year—is trifling, when it is considered that it is our intention to publish enough Supplements during 1931 to make the present SERVICE MANUAL more than twice the size it is now!

Some of the features in the first Supplement

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Voltage and current readings of over 120 sets.
Resistor and condenser values are included with the circuits.

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If you are one who has not yet recognized the importance of owning a copy of the OFFICIAL RADIO SERVICE MANUAL, turn to page 487 in this issue and learn more about this valuable book.

Future issues of the Supplements will be ready at the following dates:

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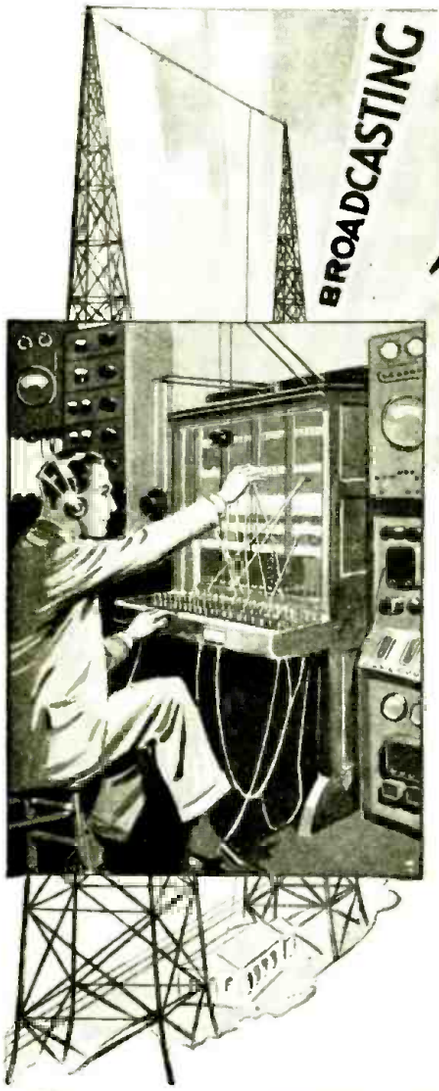

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Don't spend your life slaving away in some dull, hopeless job! Don't be satisfied to work for a mere $20 or $30 a week. Let me show you how to make **real money in Radio—the fastest-growing, biggest money-making game on earth!**

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Paying $60, $70 and on up to $200 a Week

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You learn ALL branches of Radio at Coyne—**in 8 short, pleasant weeks**—NOT BY CORRESPONDENCE, but by actual work on actual Radio, Television and Sound equipment. We don't waste time on useless theory. We give you just the **practical training you will need—in 8 weeks' time.**

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Coyne is NOT a Correspondence School. We don't teach you from books or lessons. We train you on the greatest outlay of Radio, Television and Sound equipment in any school—on scores of modern Radio Receivers, huge Broadcasting equipment, the very latest Television apparatus, Talking Picture and Sound Reproduction equipment, Code Practice equipment, etc. You don't need advanced education or previous experience. We give you—right here in the Coyne Shops—all the actual practice and experience you'll need.

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And now Television is on the way! Soon there'll be a demand for THOUSANDS of TELEVISION EXPERTS! The man who learns Television NOW can make a FORTUNE in this great new field. Get in on the ground-floor of this amazing new Radio development! Learn Television at COYNE on the very latest, newest Television equipment.

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"My earnings in Radio are many times greater than I ever expected they would be when I enrolled. They seldom fall under $100 a week. If your course cost four or five times more I would still consider it a good investment."

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Jumped from $35 to $100 a week

"Before I entered Radio I was making $35 a week. Last week I earned $110 servicing and selling Radios. I owe my success to N. R. I. You started me off on the right foot."

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$500 extra in 6 months

"In looking over my records I find I made $500 from January to May in my spare time. My best week brought me $107. I have only one regret regarding your course—I should have taken it long ago."

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Indianapolis, Ind.

If you are earning a penny less than $50 a week, send for my book of information on the opportunities in Radio. It is free. Clip the coupon NOW. Why be satisfied with $25, $30 or $40 a week for longer than the short time it takes to get ready for Radio.

Radio's growth opening hundreds of $50, $75, $100 a week jobs every year

In about ten years Radio has grown from a $2,000,000 to a $1,000,000,000 industry. Over 300,000 jobs have been created. Hundreds more are being opened every year by its continued growth. Men and young men with the right training—the kind of training I give you—are needed continually.

You have many jobs to choose from

Broadcasting stations use engineers, operators, station managers and pay $1,800 to $5,000 a year. Manufacturers continually need testers, inspectors, foremen, engineers, service men, buyers, for jobs paying up to $15,000 a year. Shipping companies use hundreds of Radio operators, give them world wide travel at practically no expense and a salary of $85 to $200 a month. Dealers and jobbers employ service men, salesmen, buyers, managers, and pay $30 to $100 a week. There are many other opportunities too. My book tells you about them.

So many opportunities many N. R. I. men make $5 to $25 a week while learning

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Radio principles as used in Talking Movies, Television and home Television experiments, Wired Radio, Radio's use in Aviation, are all given. I am so sure that I can train you satisfactorily that I will agree in writing to refund every penny of your tuition if you are not satisfied with my Lessons and Instruction Service upon completing.

64-page book of information FREE

Get your copy today. It tells you where Radio's good jobs are, what they pay, tells you about my course, what others who have taken it are doing and making. Find out what Radio offers you, without the slightest obligation. ACT NOW.

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National Radio Institute Dept., 1-BX
Washington, D. C.

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You can build over 100 circuits with these outfits. You build and experiment with the circuits used in Crosley, Atwater - Kent, Eveready, Majestic, Zenith, and other popular sets. You learn how these sets work, why they work, how to make them work. This makes learning at home easy, fascinating, practical.

Back view of 5 tube Screen Grid A. C. tuned Radio frequency set—only one of many circuits you can build with my outfits.

I am doubling and tripling the salaries of many in one year and less Find out about this quick way to BIGGER PAY

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FEBRUARY
1931
VOL. II—No. 8

Radio-Craft
FOR THE SERVICE MAN · DEALER · RADIOTRICIAN
"Takes the Resistance Out of Radio"

HUGO GERNSBACK
Editor

Editorial Offices, 96-98 Park Place, New York, N. Y.

Radio Service Replacements

By Hugo Gernsback

OBSERVERS of economics have often been struck by the fact, and have frequently pointed out, that the radio business in many ways has paralleled the automobile business. There is an excellent chance that this truism will continue in the future almost indefinitely, and that the parallel will even be closer than it is today.

It has been possible for a long time, in the automobile industry, to buy replacement parts of almost any description, for practically all cars. By this statement, it is not meant that the parts supplied must originate from the company which originally built the car. In the automobile industry, just as in the radio industry, there are a good many so-called "orphans"; that is to say, cars which continue on the road for many years after the companies that originally made them went out of business.

Then we also have the condition that automobile manufacturers change their models almost every year and, if you wish to get a part several years afterwards for a discontinued model, there is a good chance that the company no longer carries such parts.

Soon after the advent of the automobile, there sprang into being numerous firms which made it their business to supply almost any part for any car; and quite a sizable replacement industry has been built up, during the course of the past twenty years, in this particular field.

A similar development has now occurred in radio, where a sizable industry, which might be called the Service Replacement Industry, has come to life during the past two years; and this business, by the way, is advancing rapidly.

Particularly in the radio field, we have reached the point where a tremendous number of "orphan" radio sets are scattered all over the country. The original radio set manufacturers have gone out of business, and it would be today quite impossible to service such sets efficiently if it were not for the replacement industry.

Thanks to the latter, it is now possible to buy almost any important replacement parts (such as volume controls, voltage dividers, condenser blocks, filters, transformers, etc.), all of which have been designed to take the place of similar items, exactly as they were put out originally by the set manufacturer. Not only have these parts the exact electrical characteristics, but, in practically all cases, the exact physical size and shape is followed by the replacement industry. And it may be said, in passing, that most of the replacement parts sold nowadays are superior to the original article. The reason for this is obvious: when a set manufacturer contracts for ten or fifty thousand condenser blocks or power transformers, the saving of one or two cents on each becomes quite an item. And, for that reason, in the past quality has often been sacrificed for quantity; with the inevitable result that certain parts, such as condenser blocks and transformers, give out first in such sets. The Service Man who replaces a part must be assured that the components which he buys are first-class and will not bring him to grief in a short time after he has installed them. Therefore, a matter of five or ten cents is not of consequence to him, and he is willing to pay a fair price if he gets a quality article. This is just what the radio service replacement industry supplies him today.

Of course, the big set manufacturers supply the Service Man with replacement parts for their standard sets; they have been doing so right along and probably will continue doing so indefinitely. The trouble with some of the large set manufacturers today, however, is that, because of some curious mental twist, they do not recognize the independent Service Man, and consider him as an interloper into their business.

It is true that, perhaps two years ago, many radio Service Men were little better than set butchers; but this condition has long passed, and the Service Man of today performs a most important economic function in the scheme of the radio industry.

Nevertheless, some of the largest set manufacturers still refuse to recognize independent Service Men, and offer as their excuse that "we employ our own men who are better trained to take care of servicing our sets." This assertion may be taken with a huge dose of salt. It is true that, in the more important centers, the big set manufacturer takes care of his sets directly; but, where his sets are in use in smaller communities and at considerable distances from the large cities, such a situation does not obtain. It is hardly possible that there is a single set manufacturer in the country who can service each and every one of his sets, no matter where it it located.

So we have the curious result, that the Service Man cannot buy replacements for certain well-known sets from the set manufacturer; and he must fall back (fortunately for him—and for the set manufacturer, too) on the replacement industry. It is fortunate for the set manufacturer, because his set gets servicing in spite of him; the customer is satisfied while the Service Man makes a legitimate profit.

Under present economic conditions, the Service Man and the radio replacement industry are rendering a big service to the country; because it has been observed frequently that the owner of a radio set which he cannot have repaired will go without a radio rather than buy a brand new one, even though he can trade in the old set. We believe it is far better that an old set should be reconditioned and put into shape, so that the set owner is satisfied for the time being, than that he should learn to go without a radio and, eventually, be lost to the entire radio trade. This situation is not so impossible, as some might think, for it has happened too often with many disgusted set owners; and it is about time for the radio industry to wake up to this condition.

Service Men's Department

This department is about the Service Man, for the Service Man, and largely by the Service Man. Its contributors are practical men, and we invite every Service Man in the country to tell about his own experiences of all kinds.

Edited by JOHN F. RIDER

TELEVISION AND THE SERVICE MAN

By John F. Rider

THE purpose of this material is not to herald the advent of television. While it is true that television is not yet a practical reality, it has made certain definite strides toward its exit from the laboratory. We find much comment (adverse, of course), about the modern forms of television reception and, in particular, the use of the scanning disc. Whether or not it will be necessary to improvise new methods of television transmission and reception, is not a matter of importance now. The fact of significance is that certain stations are broadcasting moving pictures, of elementary character, at the time of this writing, and more and more popular interest is being displayed in such operation. In this connection, the writer of these lines has been daily and nightly observing the transmission of one local station and, intermittently, the transmissions of three other stations, two of which are more than 200 miles distant.

The exploitation of the experimental nature of television has been due, not to the character of the transmitted image, but to the fact that sufficient coverage has not been available with any one transmitter. All indications point to improvements in this direction; so much so that we take this opportunity to say that 1931 will show a tremendous increase in the interest displayed in television reception. Without a doubt, reception will at first be limited practically to centres in the proximity of the transmitters; this means large cities, but reports show that satisfactory signal intensity is available at many points a good distance from the transmitter.

It is not a far-fetched statement to say that changes may be made upon the audio amplifiers, now employed in radio receivers, to accommodate these systems to television as well as conventional speech and music reception. We have heard much technical comment pertaining to the tremendous width of the band required for the attainment of a satisfactory image. The radio world at large —at least the men who are experimentally inclined—will not wait until a perfect image is available. Strange as it may seem, many broadcast listeners are now discussing the possibility of television and are reluctant in the purchase of new radio equipment on that account. Recognizing the condition—that the equipment required for television involves apparatus independent of the receiver—it is very likely that manufacturers of radio receivers will develop their receivers for television reception and thus make necessary the later acquisition of nothing more than supplementary revolving mechanisms.

MR. JOHN F. RIDER, who passes upon all the material submitted for publication here, in the Service Men's Department, is a radio engineer of the first rank who has devoted much energy to the popularization of technical knowledge. None excel him in the art of making difficulties clear; he is a practical instructor, and the author of books known by all Service Men as useful guides. Letters, stories, requests and suggestions for this department may be addressed to him in care of RADIO-CRAFT.

This comment relating to television reception includes the possibility of a change in receiver design to accommodate the short as well as the broadcast waves. Just what the future holds in store, no one knows, but we feel certain that any one who in the past has listened to the police alarms, transmitted upon short waves by the police departments of the various cities in this country, cannot help but realize that at some time or other there will be a much closer alliance between such transmissions and reception by private individuals, as well as the cruisers of these respective police departments.

What with the continued rebroadcasting of foreign programs by local stations in the United States, much time will not elapse before the appetite of our Mr. Public is whetted to the point where he will not be satisfied with rebroadcasting. He will want to hear the signal direct from the origin; this means short-wave reception.

All of the above comment pertains to the reception of variable-frequency-modulated signals. This necessity distinguishes the receiver from the conventional short-wave system developed primarily for continuous-wave reception. It means that the broadcast receiver of today will of necessity cover the short-wave band. Whether this coverage will be secured by means of plug-in coils, or variable inductances, is not yet known; but one fact is glaring. The extension of the carrier-frequency spectrum of the future broadcast receiver will without a doubt include the television band; because such extension offers very definite sales features.

Some of the complications normally present in tuned-radio-frequency short-wave receivers are being ironed out during the development of similar systems for use in airplanes. These receivers are intended for the reception of modulated signals and, as such, resemble the modern broadcast-receiving system. The findings will be of immense aid when the time arrives—and it is not far distant—to produce a multi-wave broadcast receiver.

Returning once more to television reception, such receivers will give an impetus to that field. They will reduce the cost of the equipment necessary on the part of the listener. Whether or not this idea is in accord with the ideas of some of the representative men in the industry cannot be determined; but, according to reports, it is receiving more than casual attention. As a point of interest, there is current a rumor, though we do not know just how accurate it may be, that television reception and transmission fostered by one organization is scheduled to start some time in April, 1931.

Considered from the Service Man's angle, television presents an interesting field for study and experiment. There is no gainsaying the fact that, when television receivers are produced and television transmission becomes more general, service work will take on a new slant; new because of the introduction of items entirely foreign to the present-day receiver. In this connection we have but one warning to voice: do not under any condition imagine television to be so far off it may be dropped from the mind. He who thinks along such lines is very apt to be sadly disillusioned, when he finds himself out of the swim.

The subject of television is not of interest solely because it is a new form of entertainment. In one respect, it is an absolute necessity, as a stimulant to the entire industry. Short-wave reception, no matter how it may be exploited, will at all times be beset by one form of sales resistance due to the association of short waves with code transmission, and the fact that the reception of speech and music is not yet as steady as that available upon the normal broadcast band. Unless the minds of the industry can conceive something radically new to stimulate the business, television remains the only possible item which will introduce new life. Considered from the angle of new business,

(*Continued on page* 492)

Operating Notes for Service Men

Much of the knack of servicing comes from familiarity with certain receiver models. An old-timer communicates his professional experiences for the benefit of the craft.

By BERTRAM M. FREED

"MIDGET" sets have been on the market but a short time, and their peculiarities are now being learned. The "DeWald" D.C. midget receiver uses the new '32 and '31 two-volt tubes. If the ground wire should short to the metal chassis at any point, this set will become inoperative through the failure of the filament circuit; which will be caused by the "blowing" of the 6-volt pilot lamp. With this set, it will be a good policy to insert a condenser (about 0.1-mf.) in series with the ground lead, and tape this well; so that no short can occur.

Oscillation on the higher frequencies in the Philco "Baby Grand," another midget, is caused by either a poor '24 detector, or the lack of alignment of the compensating condensers, located alongside the first and second stators of the tuning gang.

Radiolas

In the Radiola "41 A.C.," microphonic howl and a low audio howl may be caused by a defective or open by-pass condenser, located and connected across the secondary terminals of the first audio transformer. The remedy, of course, is replacement; and the proper RCA replacement unit should be used, if possible.

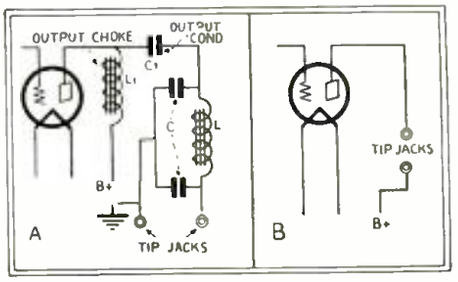


Fig. 1

A set with an output filter must have it cut out to use an external dynamic incorporating a transformer.

When Radiola "44 A.C." and "46 A.C." receivers have been returned for repair because of low plate voltages—or none—do not fail to look for a grounded coupling reactor in the detector plate circuit. This component is an audio choke located in a small brown housing beneath the tuning chassis, from which it is insulated only by a thin coating of pitch. Heat and other causes may loosen the coil, and allow it to short to the chassis. A remedy is to loosen the container and insert some insulating material between choke and chassis.

Some Service Men are replacing the '71A in the Radiola "60" and "62" models with a '45 amplifier. Although the writer does not recommend this change (since it often entails rebalancing the stages, to compensate the changes in plate and cathode voltages) it may be made by those who are desirous of obtaining the increased output. The green wires running from the chassis should be disconnected from their terminals on the power pack, and replaced on those to which the heavy blue leads run—one green to each blue. This will place the filament of the power tube in parallel with the remainder of the tubes in the set.

The biasing resistor unit of the receiver is located on one of the walls of the chassis beneath the tuner; it has four sections, of which the furthest from the volume control requires our attention. The '71A received 38 to 40 volts bias at 180 volts; but the '45 will require 30 to 34 at this plate voltage. To provide this, the 400-ohm sector of the resistor, mentioned above, must be shunted with another of the same value,

(*Continued on page* 490)

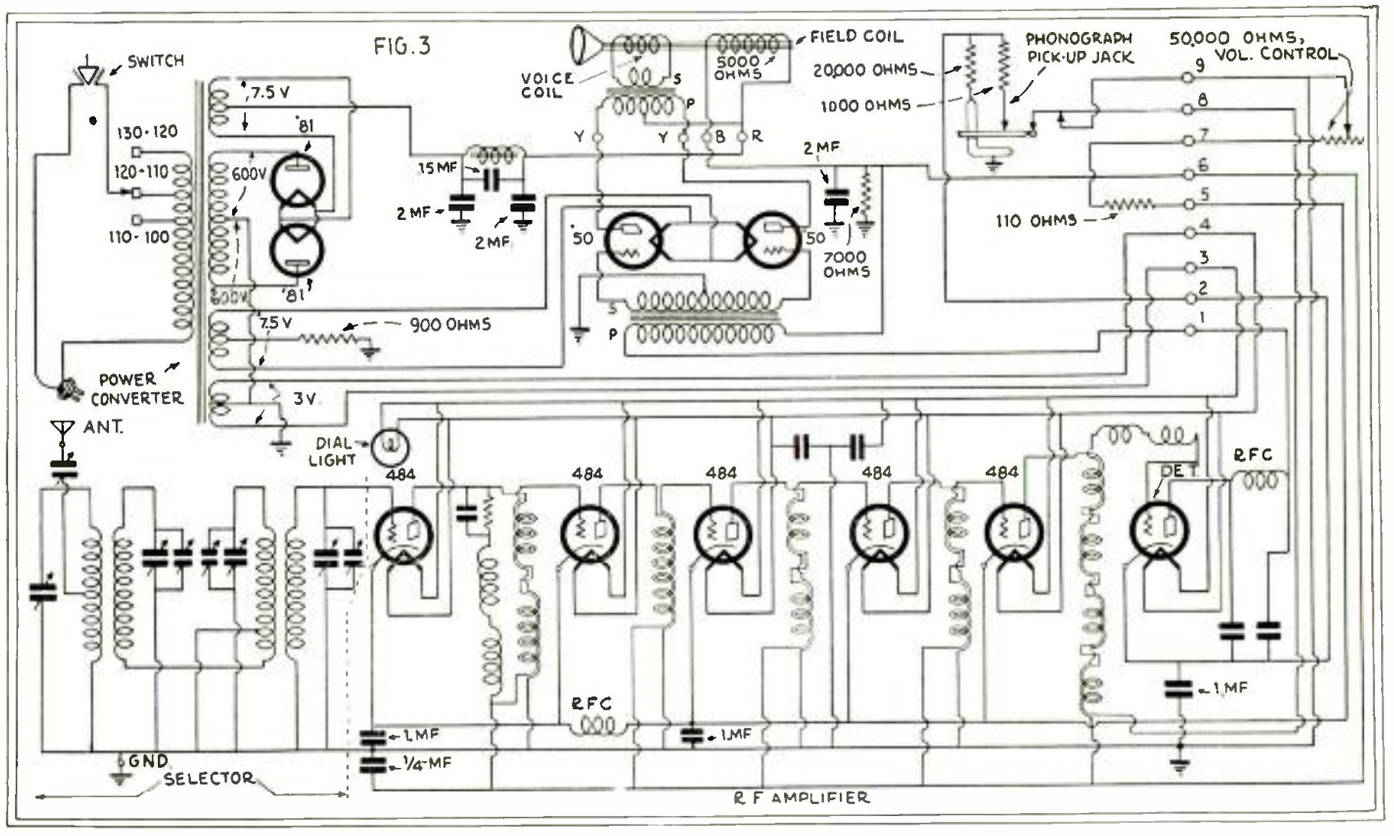


Fig. 3

The circuit of the Sparton "Model 301 Equasonne" A.C. set, with power pack and amplifier; the D.C. model appeared in Data Sheet No. 13 (March, 1930 Radio-Craft). Attention is called to the connections of the field coil; reversing which lowers '45 voltages and volume.

Leaves from Service Men's Note Books

The "Meat" of what our professionals have learned by their own practical experiences of many years

By RADIO-CRAFT READERS

INTERFERENCE PROBLEMS

By J. E. Deines

A CUSTOMER complained that, every time she pulled out the drawers of a certain dresser, her radio developed loud pops and groans; and she wanted it fixed.

On examining the dresser, we saw two small lamps; one with a good bulb and the other burnt-out. The latter proved to be the cause of the trouble; one of the small strands of the flexible cord was touching the metal shell of the lamp. Correcting this cured the trouble.

Any reader who is doubtful of this possibility may try touching the "hot" side of the electric line with a screwdriver, or other metal object, when a sensitive set is in operation.

Again, we had a complaint recently from the owner of a Philco, which would play nicely for a while and then double its volume with a severe popping noise. When the volume control was turned down to correct this, the program would fade out completely.

Removing the ground connection caused a great increase in volume and also in background noise; suggesting the trouble. On examination, it was found that the man who installed the lightning arrester had been in too great a hurry; he had left the ground connection loose, so that the slightest movement in the wire would vary the contact. A few turns with the pliers made everything rosy.

A SEMI-BAND PASS FILTER FOR THE BROAD TUNING RECEIVER

By R. William Tanner

MANY times the Service Man is confronted with the problem of increasing the selectivity of a receiver and, particularly, of one which was manufactured a year or more ago, when distance was the main qualification of a set. He, generally, either cuts down the length of the antenna system or installs a small-capacity condenser in the antenna lead. Both of these methods increase the selectivity but reduce the strength of signals as well.

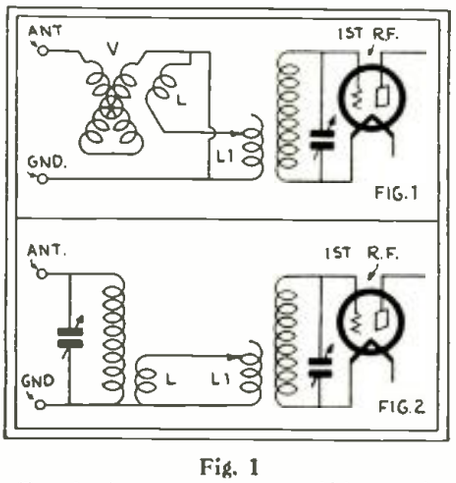


Fig. 1

Two band-pass arrangements which may be applied to give selectivity to a receiver.

It was at a time when the writer was working as a Service Man that he devised a rather unique means of increasing selectivity and at the same time, improving the quality. This was applied in the form of a semi-band pass filter. No tiresome mathematics are required to determine inductance and capacity values. The only parts needed are a few feet of No. 26 to 20 cotton-covered wire, a small battery clip, and one of the old style variometers (200 to 600-meter types).

Referring to Fig. 1, it will be seen that the variometer is connected in series with the antenna and ground. A coil L, coupled to the grounded end of the variometer, and another coil L1 coupled to the filament end of the first R.F. transformer, compose a link circuit through which the antenna currents are applied to the grid of the R.F. or detector tube, whichever the case may be. L consists of 6 turns, fastened in place in any manner which comes to mind. L1 should have 10 turns, tapped every turn down to 3 (less than three turns will result in poor quality due to clipping of side bands). This is what the clip is needed for; to vary the number of turns in order to secure a satisfactory band-pass action. Before L1 is wound, the regular primary or antenna coil (if one is used) should be removed, to eliminate the loss which would result from the "dead" coil being in close inductive relation to the grid coil.

In operation, the number of turns in L1 is decreased until selectivity is at its best with a good quality of reproduction; always remembering that, the more turns in circuit, the less will be the selectivity and the better the quality; and vice versa. If no shielding is employed in the receiver, the band-pass effect will not be very pronounced.

If a variometer is not available, a coil and a variable condenser similar to those used in the receiver may be employed; this arrangement is depicted in Fig. 2. A variometer is recommended; as then the tuning is not so critical as with a coil and condenser. However, when tuning, either may be set at minimum and, after the signal has been regularly tuned in, varied for best results.

"DATA TABS" FOR RADIO-CRAFT

By H. R. Wallin

THE Service Man, who often refers to this magazine for data for information on certain subjects, will find the data tabs described here, just the thing. They obviate the mutilation of the magazine and loss of time hunting for the subject through the indexes.

The tabs are made of small strips of heavy paper or light cardboard or, preferably, from the linen tags used for checking trunks. The data are typewritten on the strips or printed in with pen and ink; and the ends are pasted on the edges of pages supplying the information.

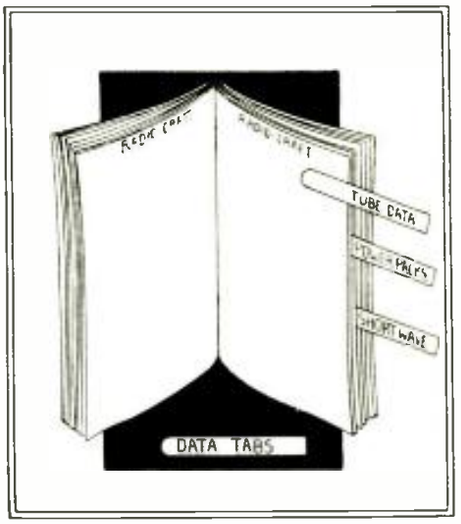


Fig. 2

A convenient method of indexing a magazine file for ready reference to useful data.

The tabs are pasted down the full length of the magazine so that all of them are visible, as in an indexed book. Should a large number of pages be tagged in this manner, the various tabs may be colored; as for instance, all tube data on red tabs, power-packs on white tabs, etc., etc.

SALVAGING FILTER CONDENSERS

By J. Pristash

SOME Service Men who write in these columns recommend a hammer and cold chisel to salvage parts within sealed cans, and ruin lots of good condensers. I don't even turn in the faulty blocks on new ones; as it is a simple matter to repair them at home, besides saving time in some cases and keeping the good will of your customers.

I use a gallon paint can about half full of seal (taken from packs that I wrecked before I used this system). Put this bucket on a hot plate and don't use much heat. When the seal is hot, lower with pliers the pack that you are going to thaw out, into the hot seal. Leave it in there about half an hour or more. When the block is thoroughly thawed out, lift out with a pair of pliers, and pour out the hot seal. In some cases it runs out through the numerous cracks. When emptying the can, be careful not to dump out the parts. You will find that there is practically no seal left on the chokes, condensers, etc.; but do not handle condensers while warm, because of the likelihood of pulling the leads out, which will render the condensers useless. This applies to the condensers with brass strips for leads.

This way most Service Men can use parts on hand which have been almost a loss because of their size, etc.; as a rule you will find plenty of room in these cans. In some cases, where the bias bypass condensers are located in these cans you can replace them with a larger condenser (hum being the limiting factor). This way you have another booster for your service; most owners will notice the difference in tone, and appreciate the change.

In sealing up the repaired block, do not pour to the top in one coat, because of bubbles which will come to the top. A neater job will result if the first coat is allowed to cool off before the final coat is poured. The hollow spots that will form in the top, by the shrinking of the seal, can be filled up with hot seal; and the surface finished with the flame of a torch; that is, if the Service Man wants a neat "factory" job.

You can not injure the chokes and condensers; the temperature can not rise high enough to burn them because of the low melting point.

I am a charter member of RADIO-CRAFT, and enjoy it very much.

MODERNIZING VOLUME CONTROL

By Henry C. Mills

A FEW notes may be of use to some other Service Men, who have some of the battery-type sets still on their list. The type of set I am using as an illustration is the Crosley "Model 601," which in my experience, has been the most frequent offender in this respect; namely: varying or fluctuating volume, when operating on local stations.

The volume control of this set is a rheostat, regulating the filaments of the three R.F. tubes. When located within a few miles of a broadcast station, it is necessary to keep these filaments at such a low temperature, that the tubes are operating at the critical point where slight changes in the filament voltage cause quite a large change in the filament emission; with the result that the volume increases and decreases, with even slight fluctuations of the filament current, in a greatly amplified form.

The remedy, of course, is to operate these filaments at a temperature above this critical point; but, unless the volume can be controlled in some other manner, this results in undesirable loudness. The following method has proved very satisfactory; though it results in a slightly increased drain on the "A" battery, the improved operation of the set more than offsets this disadvantage.

Disconnect the filament rheostat, and connect the filament wires directly to the fixed resistor in series with this rheostat; this gives the R.F. tubes slightly less than 5 volts. Remove the rheostat and mount in its place, a 0-500,000-ohm potentiometer (Centralab, or other non-inductive type). It will probably be necessary to take the shaft out of the rheostat, and substitute it for the regular shaft of the potentiometer; since this set requires a long shaft to extend through the cabinet panel. Connect the aerial to the center arm, and the grid and ground to the others; use shielded wire at least for the grid connection (ordinary armored automobile wire works very well). The R.F. choke used in this set may be removed if desired; but, while this results in a slightly increased sensitivity, it also has a tendency to cause oscillation, when the volume is advanced to its most sensitive point.

(*Continued on page* 493)

The Service Man's Open Forum

His Opinions on Conditions and Practices in the Radio Business

IMPRESSING THE CUSTOMER

Editor, RADIO-CRAFT:

We have found that, as a rule, it is not a very good policy, psychologically speaking, to refer to service mannals in the presence of the prospective customer. The majority, not having any fundamental knowledge of the radio, do not take into consideration that there are hundreds of different circuits.

In the matter of resistors alone, it is an impossibility to have indexed in one's mind the different values used in all the modern sets. It is, therefore, a good policy for students to study several of the most popular circuit diagrams, and make a mental picture of the sets using resistors in the different stages for voltage drops.

It is taken for granted that every radio Service Man realizes the use of a good set analyzer is an absolute necessity in the servicing of modern radio; for he can not get to first base without one.

Good personal appearance, with the ability to meet the public, is one of the greatest helps to the Service Man. In the course of inspection a number of seemingly foolish questions are to be expected. With a little patience, all these questions can be answered to the satisfaction of the customer.

I will illustrate a few experiences of my own which will cause much laughter to the novice but not to the old-timers who, like myself, are sure to overlook some of the more simple faults at one time or another.

A Radiola "44" which would only bring in a few strong locals, beside excess oscillations, had been attended previously by two "Service Men." Since some of these do not know where to find the neutralizing condensers on these models, it was my supposition that the set was out of balance. On sliding the chassis out, it was found to be impossible to stabilize the set! As we all know, the antenna and ground leads are taped and, upon disconnecting, there was found to be no continuity. *An open antenna lead!!* This is one example of overlooking one of the simpler faults.

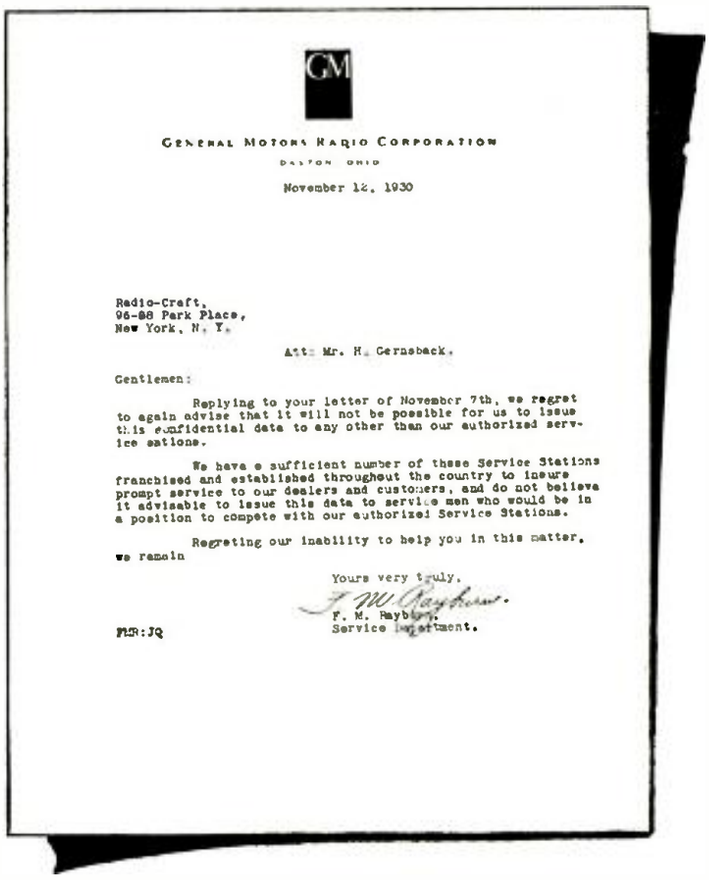
Another call was made on a Majestic. After the usual questioning it was found that one Service Man had reported, as the trouble, an open primary in the power transformer. Upon snapping the switch and looking into the set, it was found that none of the tubes would light. Upon following the lead to the receptacle (which in this case was a key socket of a mantel torchiere) and turning the key the customary hum was heard and in a few minutes the signal came through.

Later, inquiry disclosed that one of the roomers, not knowing where to find the switch and wishing to shut off the set, had snapped it off at the socket.

It was evident that the other Service

(*Continued on page* 495)

Service Men often wonder why the essential details for servicing a certain set are not available through RADIO-CRAFT *or the Official Radio Service Manual. Here is one reason. Incidentally, we might compare this letter with the attitude of an English manufacturer, as told in "Across the Water," on pages 495-496 of this issue.*



GENERAL MOTORS RADIO CORPORATION
DAYTON OHIO

November 12, 1930

Radio-Craft,
96-98 Park Place,
New York, N. Y.

Attn: Mr. H. Gernsback.

Gentlemen:

Replying to your letter of November 7th, we regret to again advise that it will not be possible for us to issue this confidential data to any other than our authorized service stations.

We have a sufficient number of these Service Stations franchised and established throughout the country to insure prompt service to our dealers and customers, and do not believe it advisable to issue this data to service men who would be in a position to compete with our authorized Service Stations.

Regreting our inability to help you in this matter, we remain

Yours very truly,

F. M. Raybern,
Service Department.

FMR:JQ

MAJESTIC "MODELS 50," "51" AND "52" SUPERHETERODYNE RECEIVER

The "Model 50" chassis is used in the "Model 52" Majestic superheterodyne; removing the legs from the small cabinet, thus making a radio set of the mantel type, results in the "Model 51" receiver. This circuit is one of the latest developments of the Grigsby-Grunow Company, Chicago, Ill.

Referring to the diagram, the following parts values will apply: (C1, C2, C3, ganged variable condensers); (C5, C6, C8, C9, C10, C11, C12, C13, are built into the receiver assembly as circuit-aligning units); C4, C7, C17, C18, .001-mf.; C14, C15, C21, C22, C23, C28, 0.15-mf.; C16, C19, C24, 1.0 mf.; C20, .04-mf.; C25, 3 mf., C26, 2 mf.; C27, .09-mf.

The resistors have the following ohmic values: R1, 10,000; R2, 100,000; R3, 12,500; R4, 500; R5, 35,000; R6, 25,000; R7, 800; R8, 60; R9, 2,680; R10, 4,170; R11, 4,030; R12, 645; R13, 116.

Filter choke Ch1 has a resistance of 330 ohms; the field coil is filter choke Ch2, 1,000 ohms. A 3.2-volt pilot light is used at V9. The volume control is a double unit; the ganged resistors R1, R12.

Lack of plate voltage on the second detector may be reported in some instances; probably due to an open resistor (R6).

Condenser C8 is the antenna compensator.

Operating current values are as follows: Filament potentials, V1, V2, V3, V4, V5, V6, V7, 2.35 volts; V8, 4.8 volts. Plate potentials, V1, V2, 180 volts; V3, 256 volts; V4, 225 volts; V5, 90 volts; V6, V7, 250 volts; V8, 358 volts. Plate currents, V1, V5, 3 ma.; V2, 0.8-ma.; V3, 4 ma.; V4, 0.5-ma.; V6, V7, 25 ma.; V8, 40 ma. Control-grid potentials, V1, V3, 3 volts; V2, 8 volts; V4, 20 volts; V6, V7, 37.5 volts (on analyzer, the grids may read about 1.75 volts; to get true reading, measure from filaments to ground). Screen-grid potentials, V1, V2, V3, 90 volts. (Cathode potentials, same as control-grids.)

Following are the correct (manufacturer's) code numbers for the Majestic tubes recommended for the receiver: V1, V2, V3, "G-24;" V4, "G-27;" V6, V7, "G-45;" V8, "G-80." V5 is a "427" de Forest tube.

Where the line potential exceeds 118 volts, it will be necessary to use a line-voltage regulator; there is available a special unit which is recommended in such instances. It is designed with three outlets marked "110," "120," and "130" volts, rating the corresponding inputs.

It is extremely important that an accurately-calibrated oscillator be used to supply the 175 kc. frequency required for aligning the receiver; and that the procedure be followed accurately.

To align the intermediate-frequency oscillator, connect the output of the I.F. oscillator to the grid of first detector V2. Tune the oscillator to a frequency of 175 kc., and align the plate circuit of V2, the grid and plate circuits of V3, and the grid circuit of V4 for maximum deflection of a milliammeter or thermogalvanometer connected (in place of the dynamic reproducer's voice-coil) across the output secondary terminals of the output transformer T2. This alignment should be done with great caution, inasmuch as it materially affects the entire selectivity of the receiver.

If the I.F. circuits are so far out of alignment that no signal can be heard, it may be necessary to put the oscillator output (which should be adjustable) on the grid of V3 and roughly align the second half of the I.F. stage, first; then proceed with the remainder of the steps indicated above. The four aligning condensers are located on the rear of the chassis about midway down the right-hand side; from left to right (facing the receiver from the rear) their order is: C10, C11, C12, C13.

The procedure to follow in aligning the R.F. circuits is given below. The locations of the small circuit-aligning condensers are as follows: C5 (aligning condenser balancing the minimum capacity of the oscillator tuning condenser C3 to the minimum capacities of the band-selector tuning condensers C1, C2-C9), is accessible from the bottom side of the chassis, and is located next to the end of the gang condenser on which the cable drive is mounted; C6 ("tracking" condenser, shaping the tuning graph of the oscillator to accurately match that of the band-selector), is accessible from the rear side of the chassis through a hole in the R.F. base assembly, and just to the right of the power transformer; C8, the first antenna alignment condenser, is accessible from the back of the chassis, just slightly upward and to the right of the antenna and ground binding posts; C9, the second antenna or band-selector alignment condenser, is accessible from the bottom of the chassis and is located through the center hole of the chassis base.

Tune in a station at approximately 1,280 kc. and align the oscillator and antenna or band-selector condensers C5, C8, C9. Next, tune in a 600-kc. signal and adjust the tracking condenser C6, while slightly rocking the tuning condenser knob from side to side, until maximum signal strength is obtained. (as indicated on the output meter). The third step is to set the main tuning dial to exactly 1,500 kc. and tune in, by means of the oscillator aligning condenser C5, a 1,500-kc. signal. It now will be necessary to readjust condensers C8 and C9. At this point, the dial reading should be checked by tuning in a broadcast station with a known frequency higher than 1,000 kc.; and then the dial strip is to be slipped to the correct setting with respect to the index of the dial escutcheon. As a final check, test the receiver for sensitivity and selectivity; and, if necessary, repeat the operation until satisfactory results are obtained.

Note that in some cases maximum output may appear to fall at either the maximum or the minimum capacity setting of the oscillator tracking condenser C6. A simple check to determine whether this is actually the maximum output is as follows: after obtaining the best setting of C6, try a slight readjustment of C9. If this readjustment results in nothing more than slight improvement, the adjustment of C6 is satisfactory.

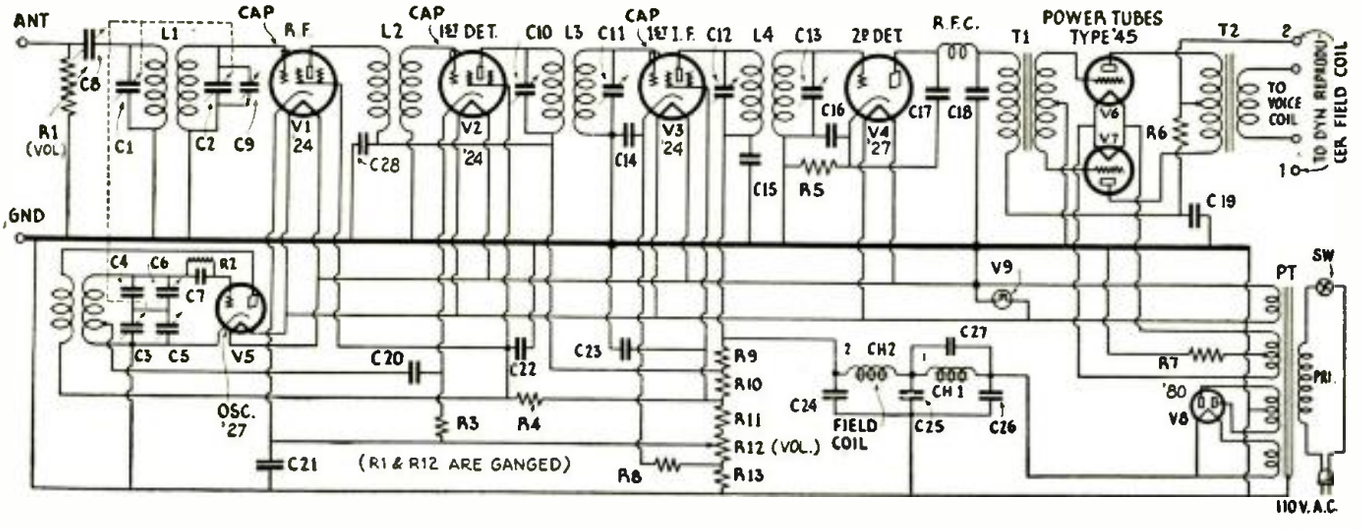
Resistor R6 is located at the right of the connecting terminals, inside the can above the power transformer; it is below and between the sockets of the power tubes.

Resistor R1 varies the signal input to the R.F. amplifier tube V1. The other half of the volume control (R12) controls the biasing voltage on the R.F. amplifier V1 and the first detector, V2.

Condenser C8 is adjustable through a hole in the rear of the chassis. When the installation of the receiver is complete, a station between 1,000 and 1,400 kc. should be tuned in, and the volume control adjusted to low volume. Then adjust C8 until maximum volume is obtained. Further adjustment of this condenser will not be necessary unless the length or position of the antenna is changed.

The manufacturers advise that *under no conditions* should an attempt be made to use a ground connection on the antenna binding post.

A tuned filter choke-and-condenser system (Ch1, C27) is used to reduce the hum level to a minimum. For this reason, a replacement condenser of exactly the right capacity must be used, if it becomes necessary to change condenser C27; otherwise, the absorption circuit (Ch1, C27) will not resonate at the correct frequency.



The Majestic "Model 50" chassis is the most compact of the A.C.-operated superheterodynes yet produced, being adaptable to even a midget cabinet. It has a single stage (screen-grid) of intermediate-frequency amplification, working at 175 kc. The tuning is single-dial; the R.F. stage's tuning condenser being ganged with that of the oscillator.

KENNEDY "MODEL 826B" COMBINATION RECEIVER

With the "Model 826B" broadcast receiver, the Colin B. Kennedy Co., South Bend, Ind., pioneers the field of mass-produced "combination-wave" radio receivers. The long-wave chassis, covering the regular broadcast band (and a bit more), tunes from about 195 to 550 meters, and is "Model 26;" the short-wave chassis, "Model 34," tunes over three wave-length bands of 15-25, 25-50 and 50-100 meters, each band being switch-selected. The two chasses, in a "Model 826" cabinet, comprise the Kennedy "Model 826B" receiver; the latest diagram of connections appears below. The receiver has a tone-control (R8-C17).

The parts used in the short-wave chassis are distinguished by the letter S in the following lists.

Condenser C1S, .00016-mf.; C2S, midget condenser of small capacity (built-in); C3S, C5S, C6S, C11S, C13S, C14S, ¼-mf.; C4S, C8S, .0001-mf.; C7S, 2 mf.; C9S, .0005-mf.; C10S, .06 mf.; C12S, .002-mf.

Resistor R1S, 2 megs.; R2S, ½-meg.; R3S, 500 ohms; R4S, 1,500 ohms; R5S R12S, 25,000 ohms; R6S, R7S, R8S, R10S R11S, 50,000 ohms; R9S, 10,000 ohms. The color code of these resistors is as follows: Yellow, 50,000 ohms; red, 1,500 ohms; red (large) 2 megs.; grey, 25,000 ohms; brown, 500,000 ohms; black (flexible, covered resistor) 500 ohms. The volume and regeneration control is potentiometer R9S. Unit RFC 1S is a wire-wound resistor of 1,000 ohms acting as an R.F. choke. Component 2S is an R.F. choke consisting of 50 turns of No. 30 enamelled wire, spaced .005-in., on a spool 0.3-in. in diameter. R.F. chokes RFC 2S, RFC 3S, and RFC 4S are of the standard 1,000-turn type. A.F. choke AFC 5 is an audio transformer with primary and secondary in series (aiding).

The "Model 26" chassis is composed of the following units: Condensers C1, C2 C3, C4 are the tuning condensers (ganged); C5, C6, C7, C8, C9, C10, C11, C12, C13, 0.25-mf.; C14, 1.0-mf.; C15, C16, .0005-mf. C17, .04-mf.; C18, C19, C20, 8-mf. (electrolytic); C21, .06-mf.; C22, .0001-mf.

The resistors have the following values R1, R7, 10,000 ohms; R2, R8, R12, 50,000 ohms; R3, 25,000 ohms; R4, R11, 5,000 ohms; R5, R6, 3,000 ohms; R9, 750 ohms R10, 20 ohms (center-tapped); R13, 0.5-meg.; R14, 1,500 ohms. Color code (biasing resistors): green, 3,000 ohms; blue, 5,000 ohms; grey, 10,000 ohms; yellow, 50,000 ohms; brown, 0.5-meg.; red, 1,500 ohms.

The tubes in chasses 26 and 34 test as follows (line potential, 120 V.): Filamen potentials, V1S, V2S, V3S, V1, V2, V3 V4, V5, 2.3 volts; V6, V7, 2.3 volts; V8 4.8 volts. Plate potentials; V1S, V1, V2, V3, 160 volts; V2S, 140 volts; V3S, 55 volts; V4, 125 volts; V5, 155 volts; V6, V7, 230 volts. Control-grid bias, V1S, 1.1 volts; V3S, 5 volts; V1, V2, V3, 3.5 volts; V4, 10 volts; V5, 9 volts; V6, V7, 45 volts. Screen-grid potentials; V1S, 70 volts; V2S, (volume control at maximum) 30 volts; V3S, 160 volts; V1, V2, V3, 85 volts. Detector V2S is of the grid-leak-and-condenser type; tube V4 is a power detector. Screen-grid tube V3S is connected as an oscillator of the "dynatron" type, (requiring no grid circuit inductance), working at the fixed frequency of approximately 1550 kc. (about 196 meters).

Switches Sw1 and Sw2 (for change-over between long- and short-wave units) are ganged. The power pack and long-wave chasses are connected by a 5-wire cable terminating in plugs; to this cable is connected a 4-wire cable for the short-wave chassis.

The cable color codes are as follows: 5-wire cable; 1, large black; 2, large white; 3, red; 4, black; 5, yellow. In the 4-wire cable, on the contrary, they are: 1, black; 2, white; 3, small black; 4, red.

Facing the unit, the shielded coil at the left, toward the rear, is the 50-100 meter coil; shielded coil at right front corner, 25-50 meters; unshielded coil in center of base, 15-25 meters.

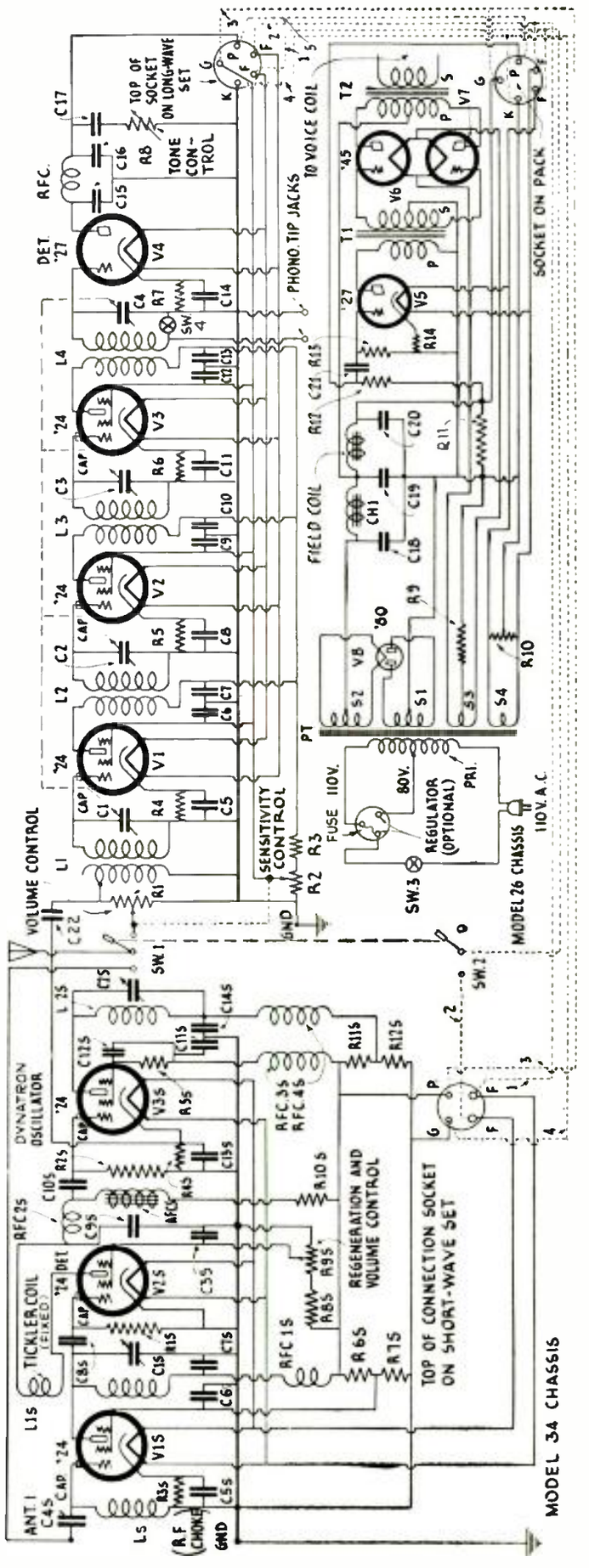
The midget condenser C2S tunes the oscillator in the neighborhood of 1500 kc., and compensates for variation in internal tub capacities.

The following modifications for increasing the sensitivity of the "Model 826B" receiver are recommended only to the experienced Service Man, and are to be applied with care: Change C13S to .04-mf., and shunt the old 0.25-mf. unit across C14S. Replace C22 by a .002-mf. unit. The shielding of the oscillator output wire must be grounded to the chassis. A good ground connection must be used for the combination set. Tube variations will be more evident in a set of this nature and, for best results, it is advisable to try several of each type;

All shielding must be fastened tightly The shielded coil at the rear center of the base is 1.2S; midget condenser C2S is on its shield top.

Referring now to the "Model 26" chassis, the dynamic reproducer field coil has a resistance of 2250 ohms. Note that all wiring must remain in the original positions. Phonograph pick-up switch Sw4 is part of R1-R2. Abnormal hum with chassis inverted is natural, and due to the disturbance of the electrolytic condensers; otherwise, exceptional hum (in normal position) often may be corrected by interchanging the connections of the electrolytic condenser sections.

Test for circuit oscillation only with chassis right-side up and with base-plate screwed on. If one R.F. coil becomes defective, change the set of four (otherwise, volume and selectivity may not be satisfactory). The line fuse is in a plug which is to be removed if the regulator tube is used. Excessive circuit oscillation may be to open or high-resistance R3 (graphite).



Favorite Testing Equipment of Service Men

And methods for its use to the best advantage in and out of the shop

A DYNATRON SERVICE OSCILLATOR

By Dale Pollack

THE modulated radio frequency oscillator is a useful adjunct to any Service Man's kit, with which he can perform a variety of vital tests on broadcast receivers. It is simplicity in itself for a technician to line up a ganged tuning condenser—if he carries his own station with him.

Have you ever attempted to balance four or five tuned circuits with nothing but your ear to help you? It is a nerve-straining task. No Service Man who has been called to repair a receiver and, after working over it for a time without finding anything amiss, is suddenly startled with this from the loud speaker: "We regret that, owing to an 'SOS,' this station has been silent for the past two hours"—would ever want to be without an oscillator again. There is nothing more embarrassing than to have the owner for whom you are servicing a set present at a time like this.

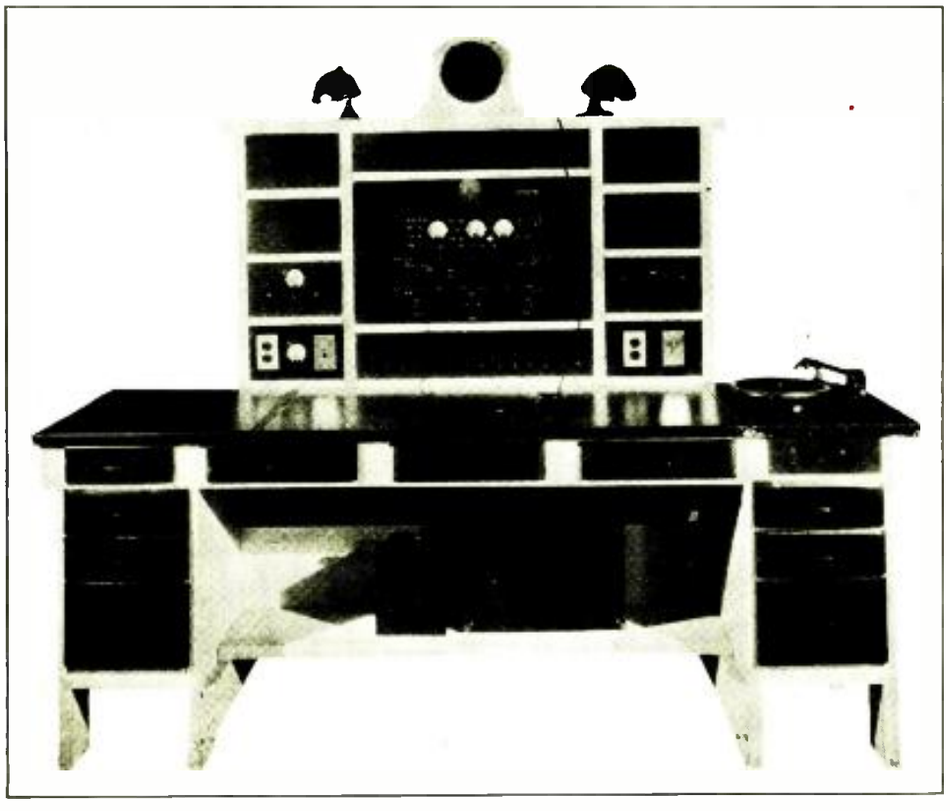
But the Service Man who carries an oscillator with him can easily supply his own signal to the set and thus really determine whether it is inoperative.

Unfortunately, however, most oscillators used at present comprise the elements of a young broadcast transmitter. Two vacuum tubes are required: an R.F. oscillator, and an A.F. oscillator to modulate it and thus make the signal audible. Such a device, with its associated batteries or power equipment, is a somewhat complicated piece of apparatus—worthy of a laboratory, perhaps, but rather unwieldy for a Service Man to carry.

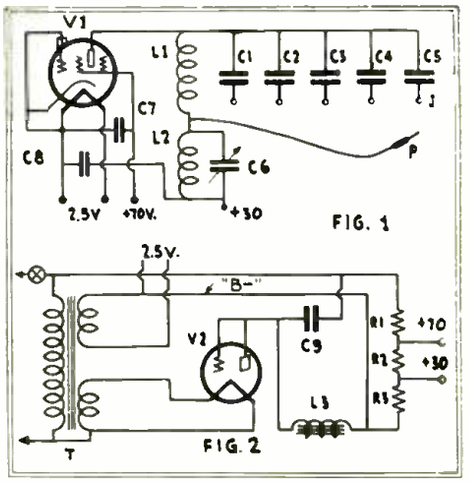
Another type of oscillator employs a buzzer to modulate the R.F. current. This disadvantage of this method is that, although it eliminates the modulating vacuum tube, the buzzer must be very carefully packed in a bulky, cotton-filled box to prevent any noise from reaching the ears of the operator directly from the buzzer.

Otherwise, since the volume control must be set near minimum when a set is being adjusted, the sound of the buzzer will overshadow that from the set and preclude the possibility of making accurate adjustments on a device so critical as a tuning condenser.

In addition, both of the above modulating systems suffer in that the modulating pitch is fixed. The vacuum-tube modulator, if of the common type, utilizes two inductances in the oscillatory circuit. Two capacities must be changed to vary the audio frequency, yet keep the percentage of modulation constant. The same is true of the R.F. oscillator. The tuning condenser, since it tunes only part of the oscillatory circuit, also varies the output of the oscillator. Hence, to make sensitivity tests on a broadcast receiver over the entire band



This attractive test bench was constructed by Virden Mabry, of the Mabry Radio Shop, Beaumont, Texas, from second-hand lumber in his spare time. Its elaborate equipment includes: center, a Supreme laboratory test panel and Diagnometer; left, ohmmeter and panel for reading current input to a set; right, antenna and line receptacles and an R.F. oscillator with phonograph pickup for its modulation. Below, portable testing equipment. The battery supply comes into the lowest center panel. How many shops can show as attractive and complete an arrangement?



Above, the simple circuit of a dynatron oscillator using a '24 tube; below, its power supply. The whole is light and easily carried with a service kit.

of frequencies either a correction factor (which will be inaccurate in all probability) must be introduced for each frequency, or a calibrated R.F. voltage divider must be shunted across the output. All this is a complicated procedure, unsuited to a Service Man's needs.

A "Kink" of the '24 Tube

Fig. 1 is the diagram of an extremely simple Service Man's oscillator which has none of the disadvantages of the above types. Inspection of the diagram will show that it is not of the ordinary kind. It is well known among engineers, but little known elsewhere, that screen-grid tubes possess a very strong "dynatron" characteristic: that is, one where the plate-voltage-plate current graph is negative over a part of the curve; or, in other words, where the curve points down instead of up as usual. Increasing the plate voltage decreases the plate current over this range.

The tube which most strongly exhibits this negative-resistance characteristic is the type '24. It has been shown that, if a resonant circuit is introduced into a tube operating over the negative portion of its curve, it will oscillate at the resonant frequency. This is the principle utilized here.

However, the tube, instead of oscillating at one frequency, is made to oscillate at both radio and audio frequencies, one being superimposed on the other in the output. Since only one coil is used for each frequency, changing any of the constants is very easily accomplished without affecting the remainder of the circuit. The values of parts listed will give an R.F. range from 500 kc. to 1500 kc., and an audible range approximately from 200 to 5,000 cycles per second. This enables the entire broadcast band to be conveniently covered.

The output at the various frequencies will be much more uniform than that from most "tickler" oscillators. The resistance and losses of the oscillating circuits should be as low as possible, however, or the tube will not oscillate at the audio frequency.

Fig. 2 shows a very simple power supply for the oscillator. The transformer has

only two secondary windings—2.5 volts for the '24's filament and 5 volts for the '01A used as a rectifier. The filter is of the simplest sort.

Method of Use

The operation of the oscillator is very simple. Apply the proper voltages either from the power supply or from batteries (one cell of a storage battery may be used for the '24 filament) and connect the antenna post of the instrument to that of the receiver. Set the oscillator condensers at convenient values—say 1000 kc. and 500 cycles; tune the receiver to 1000 kc., and the 500-cycle note should be heard.

The oscillator must, of course, be tested and calibrated beforehand on a set whose characteristics are known; using broadcast stations for the R.F. standard, and a musically-inclined ear for the audio standard. For this purpose the A.F. calibration need be only an approximation.

Condensers in a tuned radio-frequency amplifier may be easily lined up. Tune the oscillator to 550 kc., plug your set analyzer into the output tube's socket, place the tube in the analyzer, and set it to read plate current. Then adjust each trimming condenser, starting with the first stage, to get the maximum deflection of the meter. After all the condensers have been adjusted satisfactorily, check your adjustment at 1500 kc. and 1000 kc. If the condensers do not balance at these frequencies, strike a mean between the trimmer settings; favoring the lower frequencies, as most receivers are least sensitive here.

Service Men should find this unit an indispensible addition to their outfits.

Parts Required

L1—Pair of headphones, which serve as the A.F. inductance;
L2—R.F. coil, about 200 microhenries, such as the secondary of a R.F. transformer, used in receivers to couple two tubes together;
L3—Small "B" eliminator choke, of any convenient value;
C1, C2, C3, C4, C5—Tuning condensers for the A.F. range, .0005-, .002-, .005-, .02, and .05-mf. Other values may be interpolated, if desired, for finer adjustment of the audio frequency;
C6—Variable condenser, .00035-mf.;
C7, C8, C9—Filter and by-pass condensers, 1 to 2 mf. each;
R1, R3—Two 3,000-ohm, 10-watt resistors;
R2—One 4,000-ohm, 10-watt resistor;
T—Transformer; one secondary winding, 2.5 volts at 1.75 amperes; the other 5 volts at 0.25 ampere;
V1—One '24-type tube;
V2—One '01A-type tube;
S—Switch.
P and J—Midget plug and jacks, or rotary switch, as preferred.

INEXPENSIVE MODULATED OSCILLATORS

By James H. Mills

THE oscillator shown in Fig. 3 at A is the best to use if a 110-volt A. C. line is available; it is easier to take on your service trips because it doesn't require any batteries. That shown at B is a good one to use where A. C. power lines are not available.

In the first design (A), the coil L1 consists of about 100 turns of No. 22 enameled wire wound on a 1¾-inch tube with a tap at the 50th turn. The coil L2 consists of 100 turns of No. 28 enameled wire wound on a 1¼-inch tube. These windings should be placed at right angles to each other. The condenser C has a capacity of .0004-mf. The fixed condenser C1 has a capacity of .001-mf., and should have an A.C. working-voltage rating of at least 150. A 201A type tube is used at S and a 110-volt 25-watt lamp.

In circuit B, the coil L1 consists of 100 turns of No. 28 enameled wire, wound on a 1¼-inch tube, with a tap at the 50th turn; the variable capacity has a maximum of .0005-mf.

Two output meters to use with the above oscillators are shown at C and D. Both are good; that of D is the cheapest to build.

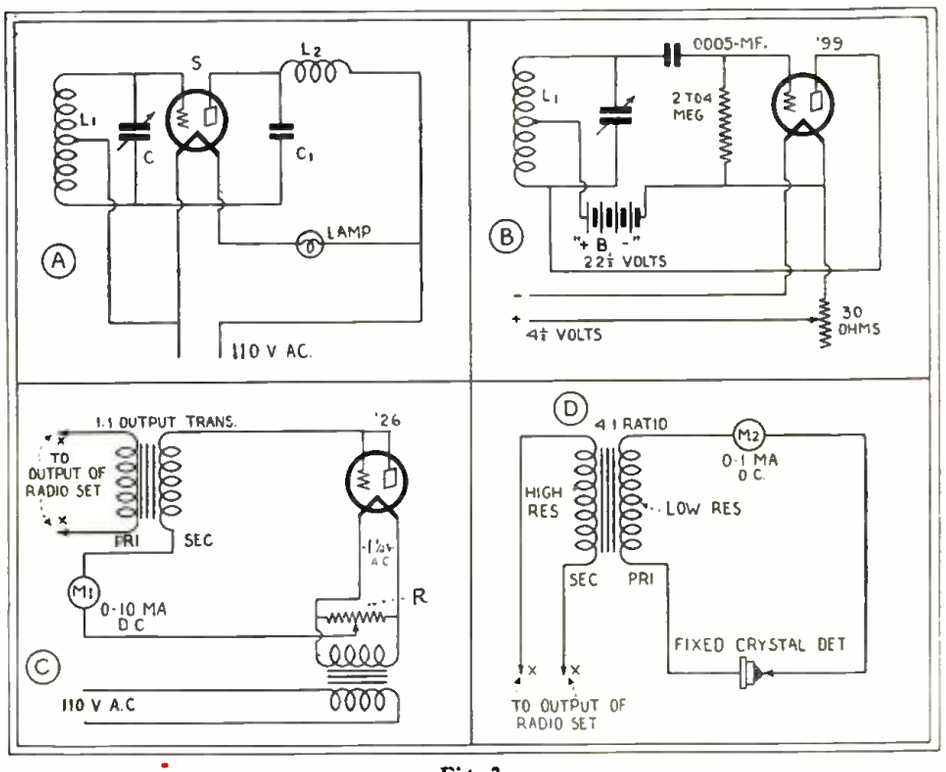


Fig. 3

Upper left, an oscillator operating directly from the light line; B, a battery-operated type. The former takes the 60-cycle hum; the note of the latter is given by the leak-condenser combination at a suitable pitch. The output meter of C is convenient; but that of D is both lighter and less expensive.

IMPROVING OLD TESTING EQUIPMENT

By Henry Burwen

IF you have an old type tube tester, it can probably be easily adapted to test the modern tubes. I have a Hoyt tester, made several years ago for testing battery tubes, and did a little experimenting with it recently. A few slight additions have made it possible to test nearly all types of tubes with it.

The operation of this tester is such that one meter gives three readings. First, the rheostat is turned up until proper filament voltage for the tube is shown on one scale; then, when one button is pressed, the pointer drops back to read plate milliamps on another scale. With this button still down, a second is pressed, which ties grid and plate together; and the pointer goes up to give space current reading. Current is supplied by a 6-volt storage battery and a 22½-volt "B" battery.

Modernizing the Tube Tester

First, I procured a "Na-Ald" adapter having four legs and five holes; this permits placing 5-prong tubes in the socket. I found, while endeavoring to get a reading on 27's with this adapter, that the rheostat would not carry the load and would start to burn. Accordingly, I procured a Carter 10-ohm rheostat having a capacity of 2.2 amps; one side of this I connected externally to the "A" binding post of the tester, the other side to the external "A—" terminal of the socket. The rheostat is simply laid on the bench and attached by the flexible wires.

The effect of this is to connect the new rheostat in parallel with the old; when

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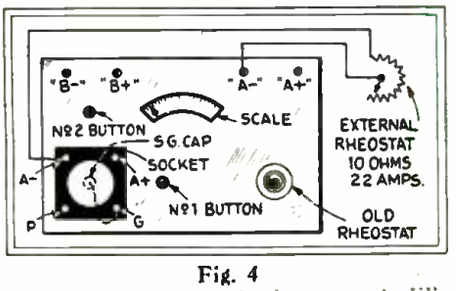


Fig. 4

The added rheostat and adapter permit UY tubes to be tested with an old-style unit.

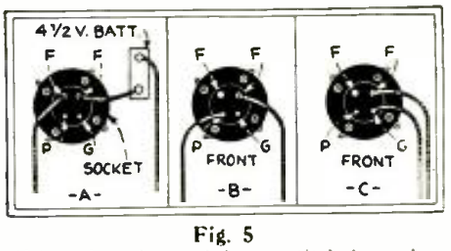
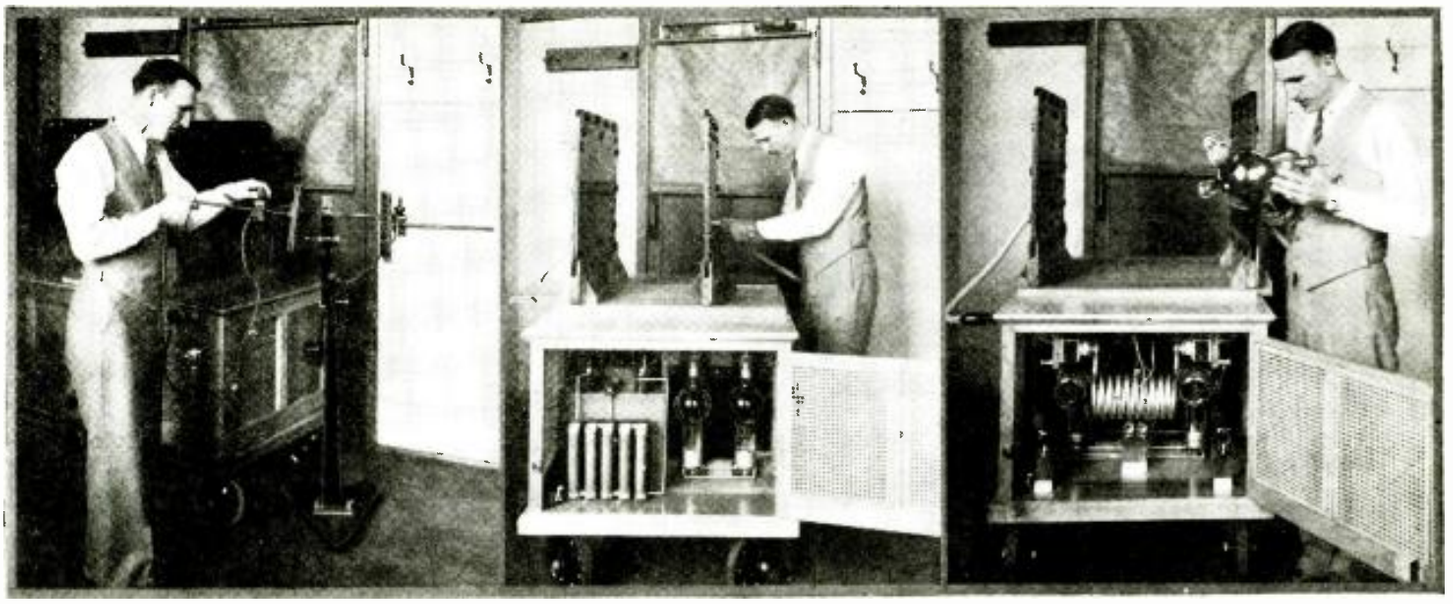


Fig. 5

Using the adapter holes as tip-jacks makes external connections easy on a low-priced analyzer.



At the left, a smaller "condenser" attached to a portable stand; and used with the generator for a localized heating effect. Center, an end view of the apparatus, with the rectifier open. The condenser plates are close together here. Right, the radio-frequency coils of the generator; and one of the "PR-861" tubes in the operator's hands. The lead to the sliding plate is clearly visible. (Photos by courtesy of General Electric Co.)

How Radio Generates a "Health Fever"

SINCE the dawn of medical science, and until a very recent date, though physicians distinguished between "malignant" and "benignant" fevers, they certainly did not intend to recommend the latter as desirable for their patients. To "break the fever" was the purpose of treatment.

As the nature of disease became better known, in the latter part of the nineteenth century, it began to be realized that most of the symptoms formerly attributed to the disease are caused rather by the regulatory mechanism of the body, organizing itself on a war basis for the expulsion of an invader. Of late, it has become understood that fever is not a disease, but a method of carrying on the campaign against disease. As a defending army—to make a suggestion which is not intended for an exact parallel—will lay waste its own fields and burn its own cities to make the position of the enemy untenable, so the human body throws off the check which keeps it at normal temperatures; and heats itself several degrees hotter for the purpose of weakening the intruding bacteria.

This discovery was to suggest to doctors, a few years ago, that very deep-seated diseases, against which medicines seemed of little avail, might be combatted by causing the body to become feverish. The most feasible method of doing so seemed to be to introduce the germs of another, and less dangerous disease, which is notable for being accompanied by feverish conditions. Thus two unhealthy conditions would be caused to cancel out each other.

Some three years ago, however, a very interesting and spectacular effect was discovered by radio experimenters, working on a powerful short-wave generator. Radio is not felt, as such, by any human sense; but, in the field of a six-kilowatt, six-meter transmitter, men became feverish. This condition was not a sickness, but a heating of the body, caused by its electrical resistance to the invisible, imperceptible waves. Inanimate objects, other than insulators, became hot; an apple held on a rod close to the transmitter could be baked, and sausages could be mysteriously cooked.

Consideration of these matters led to the idea that, perhaps these waves could be used for medical purposes. *Diathermy* has long been known; this consists of passing an electric current through a portion of the body, thereby warming its path. However, this method tends to create certain reactions, which limits its use to feeble current; and a high voltage can not be safely applied in this manner.

In the case of a radio wave, however, only the natural electric forces of the body are set into agitation within it; and therefore it is safe to put the patient into an area of great magnetic intensity—one in which, for instance, it would be uncomfortable to wear a ring, because of the heating of the metal.

A Generator for the Medical Laboratory

In pursuance of this idea, such equipment has been produced and placed at the disposal of a number of medical research workers. That illustrated on the cover of this magazine, and at the head of this page, was constructed by the General Electric Co. for experimental purposes. It is not, as yet, generally available to the medical profession; though it may be presumed that such treatment will in a few years be standard in specific cases. It requires, however, highly-skilled operators; since it is, in fact, a very powerful ultra-short-wave radio station, even though its use is confined to a single room.

The heart of the oscillating circuit, which works between 22 and 30 meters (ten to fourteen million kilocycles) is found in two 500-watt vacuum tubes, of a special type known as the "PR-861." This is a screen-grid pliotron; the electrodes are brought out to separate stems to reduce internal capacities. The filament is thoriated tungsten in a double spiral; the plate has six wings for the dissipation of heat. The screen-grid has two external leads. The electrical supply is obained from two hot-cathode, half-wave mercury-vapor rectifiers, which are fed from the 7,000-volt secondary of a transformer, and apply 3000 volts to the plate of each oscillator. The power transformer's primary is provided with an auto-transformer winding to insure constant input.

The output of the oscillator is fed into a condenser of small capacity, though large proportions, in the field of which the patient is placed. The plates, on which the 3,000-volt alternating output of the oscillator is impressed, are of ⅛-inch aluminum, 28 x 18 inches each; and each is covered with hard-rubber plates, ¼-inch thick, to insulate them against a conductive short circuit, or arcing, should any person approach them too nearly.

It is well-known, if not too generally appreciated, that a condenser is essentially, not the plates, but the insulating material between the plates. The plates are merely the flattened ends of leads to give a conductive contact to the surface of the insulator or dielectric. The charge of the condenser is kept in the dielectric, as demonstrated nearly two hundred years ago by Franklin; the value of the charge which it will receive—that is to say, the capacity—is determined by the amount of electricity which the dielectric will absorb and restore to the circuit.

For instance, the lowest capacity is found when only dry, motionless air separates the plates. The electrons, forced by the charge away from the plates, penetrate no further into the air than into vacuum; except as a few of them are taken up and carried by molecules of air. If, on the other hand, oil or glass separates the plates, a great many more electrons can be forced into the insulator; and the capacity of the condenser

(*Continued on page* 497)

Eliminating Interference in Airplane Radio

How the difficult problem of making plane-to-ground conversation reliable was solved by engineers

By ROBERT H. FREEMAN

THE keynote of effective radio-telephone communication between planes in flight and ground stations is the proper silencing (electrically) of the ignition, engine, and moving metal parts in the airplane, as the communication engineers discovered when they set about to develop an aircraft radio-phone installation for the San Francisco-Oakland-Chicago and San Diego-Seattle mail-passenger airways operated by the Boeing companies.

Proper shielding and bonding of the airplane presents the greatest difficulty in the installation of the equipment so that effective operation is possible. Because of the necessarily low powers of the transmitters on the ground, the receivers on the plane must be unusually sensitive to obtain reliable communication. The gain of the receivers must be of the order of 120 decibels; and therefore the interference problem is indeed serious by reason of the enormous gain.

It was found that the ignition system had to be covered with metal to lower disturbances to a point where they no longer interfered with the reception of voice signals. Standard shielding equipment either did not shield at the 5660- and 3142-kilocycle frequencies (52.97 and 95.42 meters) employed, or it did not have the necessary durability to stand up under the many hours of flight required from the air mail planes. Therefore it was necessary to evolve a harness which would eliminate effectively the interference from the ignition system.

Considering that high voltages (of the order of 15 to 18 kilovolts) are employed, the problem of shielding the spark plugs was difficult. After many weeks of experiment, a shielding was developed that would stand up mechanically, though light in weight, and would in no way affect the operation of the engine. The plug itself represents but a slight change from the regular spark plug commonly used by air transport operators; the difference is in the design of the jamb nut which holds the

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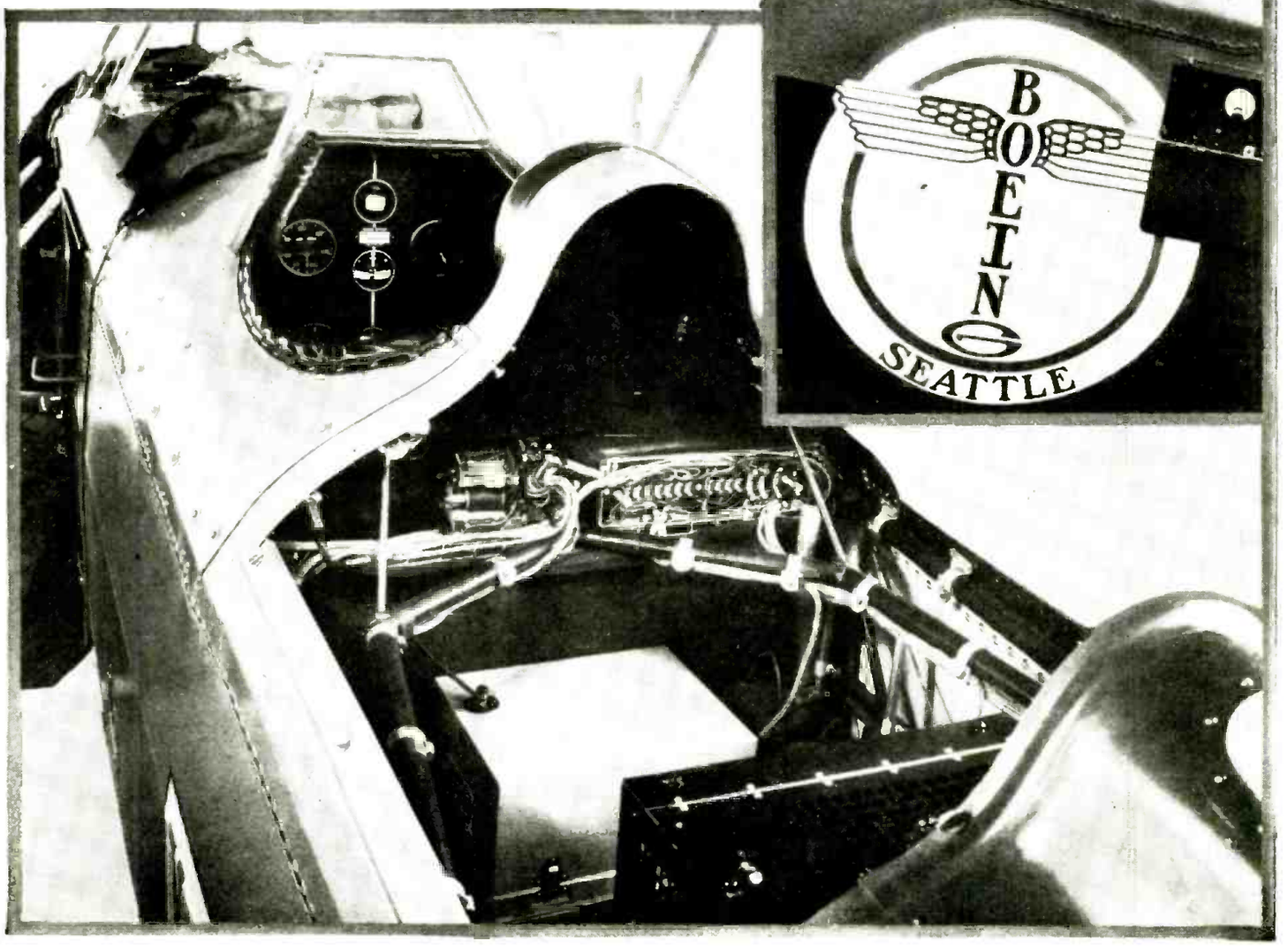


At the right, the side of a mail-passenger plane, showing the small door beside the second compartment, through which the station operator tunes the set before a flight is commenced. Directly behind this rises a streamlined dural antenna mast. Below, a view of the compartment, showing the receiver and transmitter, with their shielded cabling. (Photos courtesy Boeing System.)

The World's Largest Loud Speaker, and Other Late Devices

Fig. A (top)

The giant loud speaker, or "Riesenblatthaller," hoisted to a mast on the top of a research laboratory at Siemensstadt, in the suburbs of Berlin (Germany) from whence it was heard all over the city.

Fig. B (below)

A closer view of the giant speaker, here shown with a baffle to bring out the lower notes and make the sound more directional. The coils of the unit may be seen clearly; they are like the leads of a power station, rather than of an ordinary public-address system.

Fig. E (bottom left)

Mr. 'Rastus Robot, the most lifelike of mechanical men, conducting a conversation with S. M. Kintner, assistant vice-president of the Westinghouse Co., Mr. Robot needs some prompting, it is true; that is given by the flashlight in his interlocutor's right hand, which controls the "sound-on-film" conversation previously rehearsed.

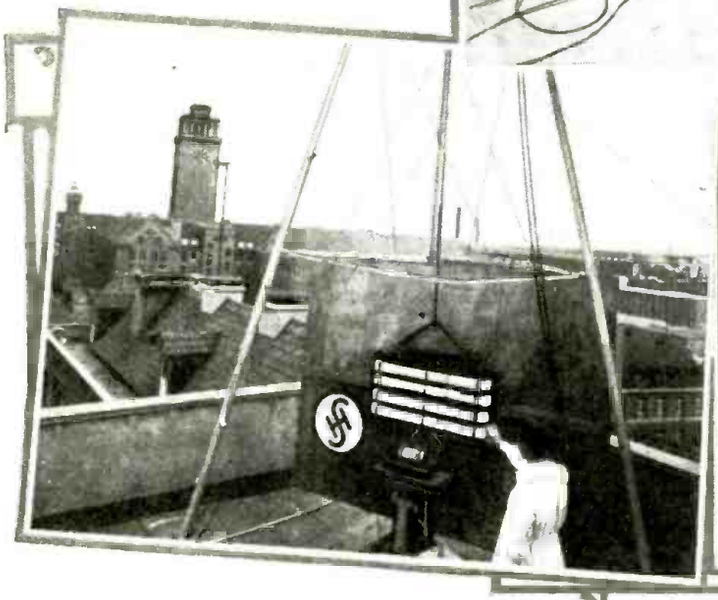
The big reproducer at the left has been heard over a radius of some twenty kilometers, or thirteen miles. People on the streets, hearing radio from an invisible source, were greatly surprised and unable to imagine the cause of the strange music and speech. (Photos Siemens & Halske Company)

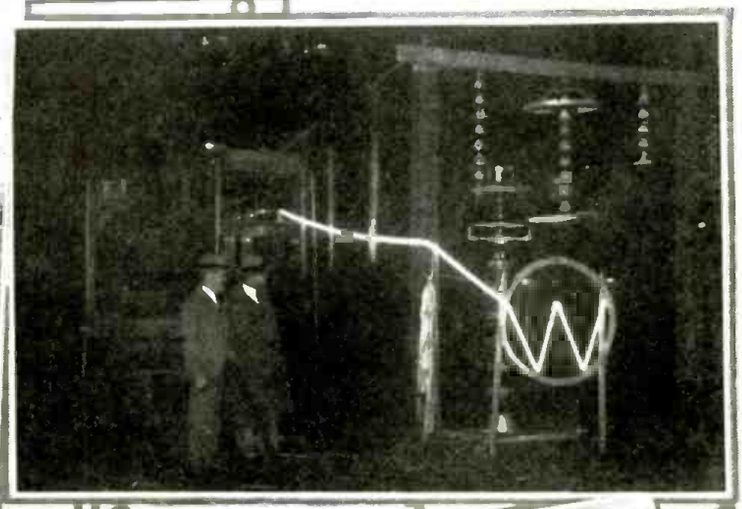
Fig. G (below)

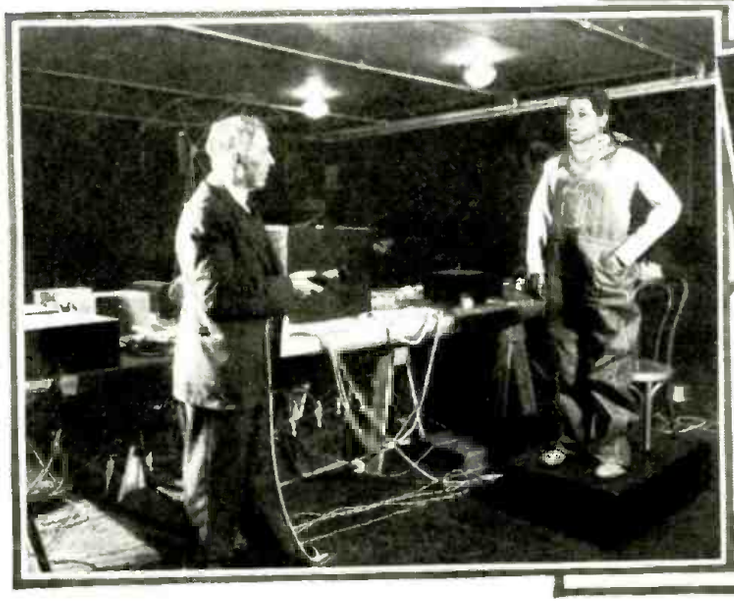
Here is a bolt of artificial lightning, at close range. The big truck in the background carries an assembly of very high-voltage condensers, from which a million-volt potential was suddenly released into a fine wire, the disruption of which caused the flash shown here. Messrs. W. G. Roman and J. J. Torok, transmission engineers, are here playing the role of Jupiter Tonans.

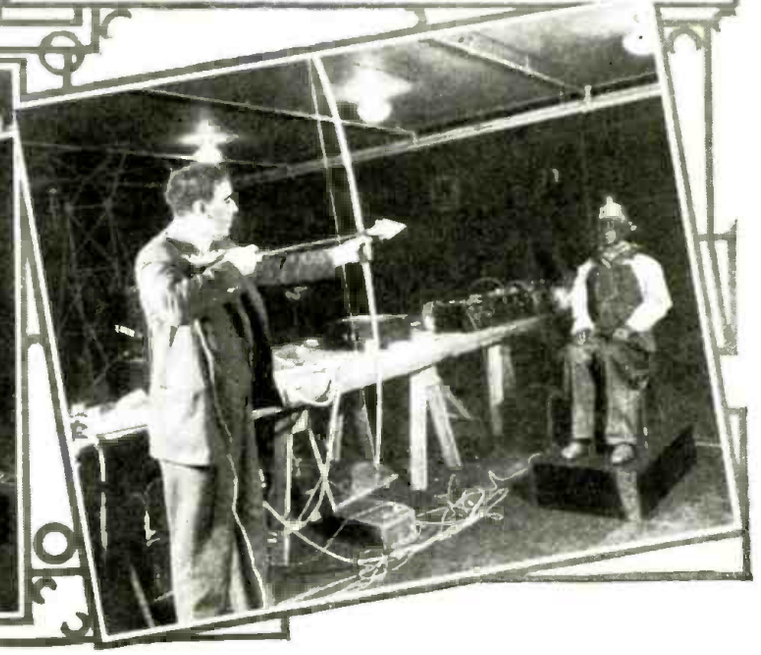
Fig. F (bottom right)

Here we have 'Rastus playing the role of the junior Wilhelm Tell. He has a rather strained air; and the shot will bring him to his feet with an exclamation of dismay. However, the shot will be made, not with the arrow itself, but with a beam of light. (Photos Westinghouse Electric & Mfg. Co.)









"O FOR a blast of that dread horn,
On Fontarabian echoes borne,
That to King Charles did come,
When Roland brave and Olivier,
And every paladin and peer,
On Roncesvalles died!"

So Sir Walter Scott turned into modern verse one of the tallest tales of the Age of Chivalry—a period, be it known, when men were men and the telling of tales was the only skyscraping industry.

Count Roland and the rear guard of the Frankish army, so runs the epic, were ambushed in the pass of Roncesvalles, in the Pyrenees mountains, some time in the latter eighth century. Roland was called upon to blow his horn "Olifant," a mammoth thing of ivory and gold, to bring to their aid the main body of the army under the command of King Charles the Great (Charlemagne). He refused, however, until he found his small detachment destroyed, and himself mortally wounded. Then, seizing Olifant, with his last breath he blew such a blast that the horn was shattered; birds around fell dead out of the air; and Charlemagne, thirty miles away, heard the sound and turned back.

For ten centuries this Bunyanesque legend has remained as an example of what the unrestrained and picturesque imagination can do. We may not call it science fiction, for it contained no science; yet, today, the wild imagination of the author of *La Chanson de Roland* has been overtaken by science.

The illustrations on this page show the details of the most powerful loud speaker yet constructed; the proportions of which may be seen from Figs. A and B, on the preceding page, which were taken near Berlin; where this speaker, mounted upon a factory tower, amazed the people of the German metropolis, miles away, by sudden and powerful radio reproduction in their midst from an unknown source.

Dr. Lee de Forest

EARLIEST RADIO-RECORDING

1224 Wall Street,
Los Angeles, California.

Mr. Hugo Gernsback,
Editor, RADIO-CRAFT,
96 Park Place,
New York, N. Y.

Dear Mr. Gernsback:—

Have just read with much interest Mr. Washburne's article on "Home Recording of Radio Programs and Speech" in the December issue of RADIO-CRAFT. The statement is there made that Charles E. Apgar, called the "pioneer home-recorder," recorded his first radio transmission press in October, 1913.

In the cause of historical accuracy it may be interesting to your readers to know that in the summer of 1912, at the Palo Alto laboratory of the Federal Telegraph Company, in conjunction with the late Charles V. Logwood, I recorded press telegraph messages regularly from San Francisco, using a two-stage audion amplifier and Poulsen telegraphone.

(*Continued on page* 489)

The sound of this Gargantuan reproducer can be heard over fifteen miles, and we may imagine that, if a suitably huge exponential horn were created for it, it might carry even further. Furthermore, the purity of the reproduction and its freedom from metallic resonance is said to be unprecedented.

The instrument is of a pattern which the makers—the Siemens & Halske Co.—call "Blatthaller," indicating a reproducer whose diaphragm is a leaf or sheet of metal. It is of the electrodynamic type, the field having an intensity of 22,000 gausses; and the voice coils are attached to diaphragms which are corrugated to insure their vibration as a whole. The metal is aluminum, 1/16-inch thick.

The speaker unit illustrated weighs more than five hundred pounds. It is quadruple, having four individual diaphragms; since a larger diaphragm would be subject to vibration in sections. The voice coils of the units are of cables, rather than wires; since they must carry a current of 120 amperes. Two hundred watts of energy are put into the air by this speaker—a thousand times the power of an ordinary, room-size speaker. The piston action of the diaphragm reaches a stroke of an inch, and the vibration of the air can be felt more than fifty yards away; in fact, it is so tremendous that some of the operators around the reproducer were severely affected and made ill by the tests.

"A very active part will be taken by this novel salesman," the makers anticipate, "in the field of advertising." It is their plan to demonstrate its power to cover all Berlin from a balloon. We may conceive the implications in American terms: the city of New York has lately forbidden the operation of outdoor loud speakers for commercial purposes; but such a titanic horn, erected on the Palisades of New Jersey, could cover Manhattan with its voice, and Manhattan—between elevated trains, riveting, etc.—would have to listen.

Mr. 'Rastus Robot

During the electrical and radio exhibitions of the past season, the increasing perfection of those mechanical servants, now popularly called "robots," has been the most spectacular feature. One of the finest yet produced, for human appearance and versatility, is "'Rastus," who is illustrated on the opposite page. He has the powers of speech, of using his hands, of rising and sitting—although, to date, the complicated maneuvers of walking seem to have been a little too much for biped automatons.

(*Continued on page* 509)

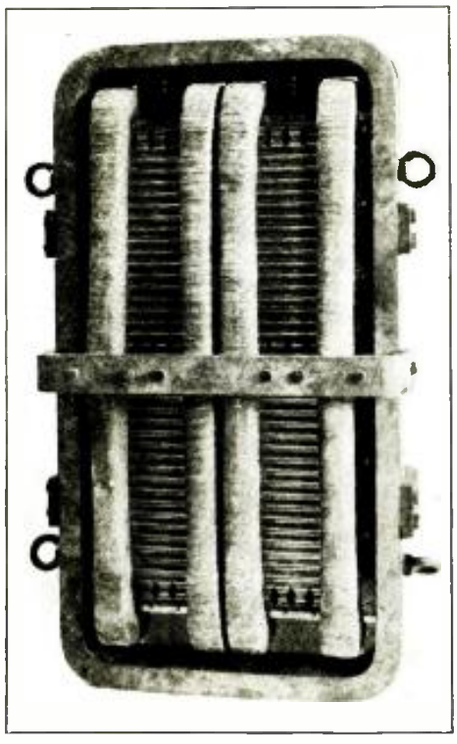


Fig. C

Suspended in the frame of the speaker are the field coils; through them we see the corrugated diaphragm, which is made in four sections, to swing back and forth.

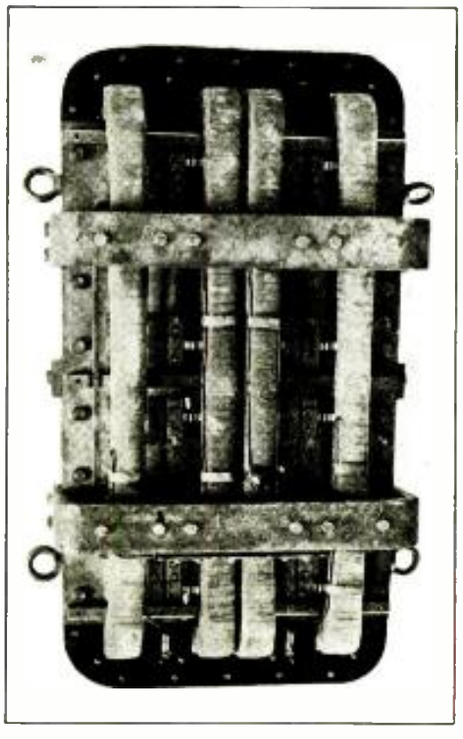


Fig. D

The rear view of the giant speaker, which shows the strength of its bracing, and the voice coils, which are attached to the aluminum diaphragm. This is the largest of a family of electrodynamic speakers working on the same principle.

New Radio Devices for Shop and Home

In this department are reviewed commercial products of most recent interest. Manufacturers are requested to submit descriptions of forthcoming developments.

SHORT- AND LONG-WAVE BROADCAST RECEIVER

WE have become so accustomed to descriptions of home-built receivers, incorporating in one cabinet apparatus designed to cover wavelengths between 15 and 550 meters, for the reception of experimental television signals and code messages, as well as broadcast programs, that we had become almost hardened to the lack of a manufactured receiver incorporating such a design.

Now, however, we realize how attractive, convenient and efficient a job is possible in an electric set of this nature made on a commercial production basis—the "Model 826-B" made by Colin B. Kennedy Corp.; a phantom view of the chassis is given in Fig. B. The short-wave tuner is at the upper left; lower left, the power pack; upper right, the long-wave broadcast tuner. The upper left knob (on the side of the cabinet) tunes the short-wave tuner; below that is the waveband switch. The front knob is a volume-and-regeneration control. The knob on the upper right side of the cabinet is the regular tuning control; below that is a volume-and-sensitivity control; while on the front of the chassis is the off-on switch.

The waveband switch on the short-wave chassis selects the tuning ranges of 15-25, 25-50, and 50-100 meters; the long-wave chassis tunes from 190 to 550 meters. The power pack is designed for the use of a line-voltage regulator tube. Including the rectifier, there are eleven tubes, viz.: six '24s (screen-grid tubes) two 27s, two '45s, one '80. There is included in the design a dynamic reproducer; and there are tip-jacks for a phonograph pick-up connection.

Here is the explanation of the manner in which the short- and long-wave units function together. The incoming short-wave signal is amplified and detected at its own frequency; the detector's output modulates an oscillator of the "dynatron" type, working continuously at a fixed wavelength of about 195 meters. The modulated output of the dynatron oscillator is fed to the broadcast-wave tuner—now adjusted to the fixed wavelength of the oscillator, or about 195 meters; and then amplified, etc., in the same manner as signals between 200 and 550 meters. This reception system, therefore, does *not* utilize the superheterodyne principle.

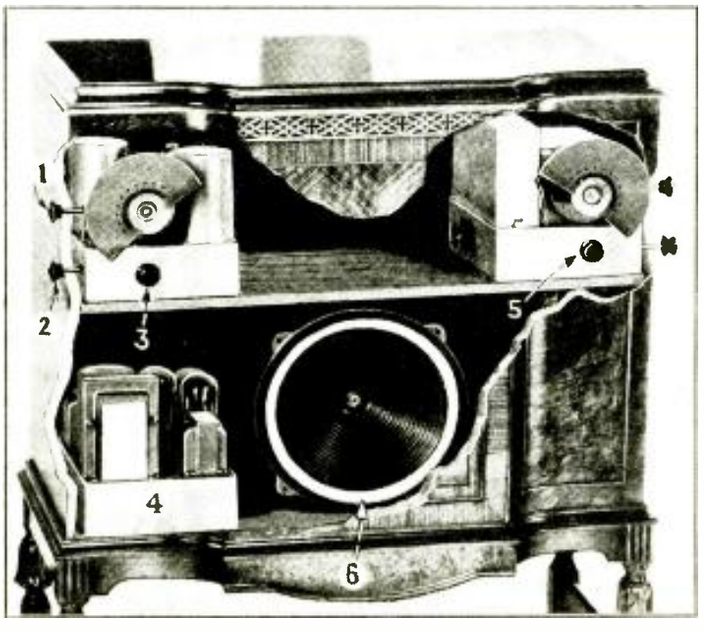


Fig. B

A cut-away view of the short and long wave set: 1, short-wave tuning knob 2, waveband selector; 3, regeneration - volume; 4, power pack; 5, long-wave tuner; 6, reproducer. The circuit is Data Sheet 36, on page 463 of this issue.

IMPROVED DIRECT-COUPLED AUDIO AMPLIFIER

CONTINUED laboratory investigation of the Loftin-White direct-coupled audio amplifier has unearthed numerous technical improvements of construction details. These have been incorporated in the new power amplifier pictured in Fig. A. It is manufactured in three models: the "201M" is designed especially for public address work, and contains, in addition to the power amplifier, a microphone transformer and a microphone current supply; the Model "201D" has a screen-grid detector and *two* stages of audio amplification, and will work well in conjunction with practically any radio-frequency tuner; the third instrument, which is pictured in Fig. A, has the standard tube arrangement—a type '24 screen-grid tube feeding into a type '45 power output tube. This is the most popular model, because of its utility. The manufacturers are quoted as follows, "This unit has a gain of about 450, with practically a flat amplification characteristic from 40 to 10,000 cycles." The instrument is a product of Sound Systems, Inc.

Fig. A

One of the models of the popular Loftin-White direct coupled amplifier.

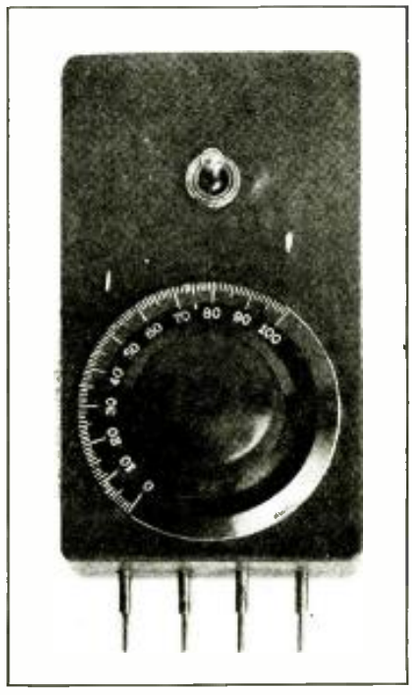


Fig. C

A special accessory for the kit of the Service Men, who is called upon to balance superheterodyne intermediate amplifiers

"SUPREME" I.F. OSCILLATOR COIL

TO increase, in accordance with the demands of modern superheterodyne receiver service, the adaptability of the well-known "Diagnometer" (set analyzer), the Supreme Instruments Corp., of Greenwood, Miss., has designed the oscillator coil shown in Fig. C, for use at the frequencies most needed in making adjustments. The intermediate-frequency calibrations are as follows: 130, 172½, 175, 177½, and 180 kilocycles; with provisions for varying these frequencies by means of a variable condenser—thus meeting the requirements for "flat-topping" intermediates which have been prescribed by some set manufacturers. The new coil, although interchangeable with the component which is standard in the "Diagnometer," must be calibrated to the individual instrument.

The inductance is contained in a hardwood case 6x3½x2½ in. thick, and is provided with connection prongs. (The method of "flat-topping" the resonant characteristic of the intermediate amplifier has been described in Data Sheet No. 29 [for the Radiola "80"] in the November, 1930, issue of RADIO-CRAFT.)

WESTON "MODEL 564" VOLT-OHMMETER

SERVICE MEN long have wanted more than merely an "ohmmeter" when purchasing an instrument to indicate accurately resistance values and continuity; some device providing a convenient means of disconnecting that internal battery and connecting just the meter into circuit. The "Model 564" Volt-Ohmmeter, made by the Weston Elec-

(*Continued on page* 502)

Practical Hints to Radio Manufacturers

By Radio Users and Service Men

BETTER DISTANCE TUNING

IN the receivers which have trimming condensers, adjusted from the panel to sharpen tuning for distance, more accurate logging would be permitted by the use of backstops for these "verniers." This would enable them to be returned to a certain point, from which their setting could be determined.

CHAS. H. REGNIER,
RFD 2, Saint Anne, Illinois.

COLORED SCALES FOR TUNING DIALS

MY suggestion to some radio manufacturer is to make replacement drum-dial scales in different colors, such as green, orange, blue, pink, etc., or of several colors blended together.

Often, in A.C. models, the pilot light is very bright and hard on the eyes, because of the whiteness of the white scale. So, if some manufacturer would make these different-colored scales, I think a good many set owners would appreciate this. The set owner could put this in himself without any trouble, and it would add to the appearance of the set.

EINAR NELSON,
Box 467, Burlington, Wash.

(It would seem that the same result might be obtained more conveniently and inexpensively by substituting a colored pilot-light bulb.—*Editor.*)

SCREEN BEHIND THE CONSOLE

LET the radio manufacturers revive the custom of putting *backs* on console cabinets. This may be done very inexpensively, and without causing "barrel-tone," by using a cloth-covered frame. It will not only keep prying and dusting hands out of places where they often do harm; but it will also satisfy the sense of fitness of a great many customers.

I have lost several sales because women—in particular—fancy that a cabinet without a back looks cheap.

MYRL ED. DE BEAUCHAMP,
415 North 11th Street, Muskogee, Okla.

HINTS TO RADIO MANUFACTURERS

Until further notice, each "What the Public Wants" suggestion published here will be paid for at the rate of $1.00; and their practical value, rather than their ingenuity or curiosity, will determine the selection, since this feature is intended to be of educational value to the radio industry. This means that we ask ideas from our readers, not for new inventions, but for simple details, often very small ones, which make all the difference between convenience and inconvenience, satisfaction and dissatisfaction, on the part of the radio set owner and the radio Service Man.

USE TWO RECTIFIERS IN LARGE SETS

SINCE the multi-tube superheterodyne is here, and the rectifier tube is being taxed more and more in modern sets, why not provide a suitable margin of safety by incorporating *two* '80-type tubes in parallel, in place of the single tube whose margin of output is being taxed more and more? This would be an excellent measure for manufacturers of the larger sets, and prolong the lives of the tubes with more satisfactory performance.

FRANK DE MARCO,
63 Oak Street, Yonkers, N. Y.

PROVISION FOR LONGER RECORDS

MANY users of radio feel that the present home-recording systems are inadequate: to the extent, at least, that the playing time of the small records is exceedingly short. If these records were 12 inches in diameter, the playing time would still be only six minutes. Every one knows the dissatisfaction now caused by the need of changing records in the middle of an aria or a symphony.

I would suggest that the solution is to record at 33 1/3 revolutions per minute (*standard speed for the discs used with talking pictures*), instead of 78 r.p.m. as at present. This would entail the use of motors geared to this speed; but, under present conditions, it would be desirable to have

(*Continued on page* 504)

Values of Filament-Ballast Resistors

THE question, "What resistance is needed, in series with a tube's filament, to reduce to the proper operating value the voltage supplied by a battery or transformer?" is very frequently asked; notwithstanding that every radio worker is supposed to know Ohm's Law in the form

$$R = E/I$$

—that is, the resistance in ohms equals the voltage divided by the current in amperes. That question is now being asked in connection with the problem of using the new two-volt tubes in an ordinary receiver.

The table given below may make it a bit easier to visualize the needs of the different tubes: the voltage drop required need be multiplied only by the figure in the last column, for any given type of tube.

For instance, if a '30-type, 2-volt tube is to be operated from a 6-volt battery, four volts must be dropped in the resistor. Since 4x16.67 is 66.68, the answer is 66 2/3 ohms; and this may be checked by the fact that this figure is just twice the resistance of the tube's filament, in which 2 volts are dropped.

In connection with this, it may be said that the makers of the new tubes recommend that the operating voltage be held as closely as possible to the exact rating of 2 volts; preferably by the use of a meter. It will be remembered that the voltage of a battery varies with the condition of charge; and therefore a fixed ballast resistor is not desirable in the filament circuit, except in series with a hand- or automatically-adjusted (Amperite) rheostat. The maximum value of the resistance thus available should be slightly above the theoretical figure worked out from the table; that of the Amperite, which varies with the current, should be taken at the normal rating for tube current and voltage drop.

Filament Characteristics

Type of Tube	Volts	Amps.	Ohms	Ohms per Volt
'80	5.0	2.000	2.50	0.50
'27, '21	2.5	1.750	1.43	0.57
'15	2.5	1.500	1.67	0.67
'10, '50, '81	7.5	1.250	6.00	0.80
'26	1.5	1.050	1.43	0.95
D'11, X'12	1.1	0.250	4.40	4.00
'01A, '71A, '12A, '00A, '40*	5.0	0.250	20.00	4.00
'22, '20	3.3	0.132	25.00	7.58
'31	2.0	0.130	15.38	7.69
'99	3.3	0.063	52.38	15.87
'30, '32	2.0	0.060	33.33	16.67

*The obsolete '01s, '12s, '71s, etc. (without the A) drew 0.500-ampere, and had half the resistance.

(It is possible also that, in a set which has been carefully balanced for the old dry-cell tubes, the different characteristics of the 2-volt tubes may cause instability; and there may be trouble when a regenerative unit is of the fixed type. In such case, an expedient might be the use of a good variable high resistor [0-10,000, or even 50,000 ohms] in series with the detector "B—" post and the detector tap on the battery, and by-passed by a suitable condenser, of, say, 1-mf. value.)

In the use of the table, it will be remembered that any number of similar tubes in *series* draw no more *current* than a single tube; but tubes in *parallel* draw current in proportion to their numbers. Consequently, it is necessary, in the latter case, to divide the resistance by the same figure with which we multiply the current, in order to get the same voltage drop. So one '01A, in series with a 6-volt source, requires 4 ohms to drop the current from 6 to 5 volts; but two '01As, in parallel, require only a 2-ohm resistor; four '01As, 1 ohm, and so forth.

Similarly, when grid bias is to be obtained by tapping a filament circuit, the value of the resistor required is easily determined. A screen-grid ('22-type) tube operated from a 6-volt battery with 1.5-volt grid bias requires 11.37 ohms between the grid return

(*Continued on page* 504)

Tone Controls in Commercial Radio Sets

And methods, old and new, of applying this convenience to other models (Part II)

By R. D. WASHBURNE

IN the January issue of RADIO-CRAFT, the subject of tone control, as it is applied in manufactured receivers, was discussed with some illustrations.

Before continuing the description of other representative methods of tone control (and, therefore, disproportionate volume control), it is well to glance at the methods used by manufacturers to alter in more or less permanent manner, a standard audio amplifier for the purpose of obtaining more pleasing reproduction.

A particularly interesting example for our discussion is found in the Stromberg-Carlson "Model 654" receiver. Here (Fig. 11) we find two filter networks, A and B; and, for the purpose of illustrating our point, we have shown the connections when a certain make of filtered magnetic reproducer is connected to the output of the amplifier for some special reason. The filter built into this reproducer is shown at C. It should be obvious that increasing the values of any of the by-pass condensers in the filters A, B or C will modify the audio output quality; and this change may be made gradual by inserting a variable resistance in one lead of the condenser.

In some makes of sets, the tube elements are shunted by capacities. An instance of this is the A.C. Dayton "Model XL-30" receiver, a portion of the audio circuit of which is shown in Fig. 12. By putting an off-on switch at X, control may be obtained.

In certain other receivers, the audio transformers are by-passed at the high-potential ends, as shown at C in Fig. 13.

A standard R.F. filter circuit, which has some affect on audio reproduction, is shown in Fig. 14, which illustrates part of the Atwater Kent "55." In some Amrad sets, the R.F. choke is replaced by a 1,000-ohm resistor, as shown dotted.

In Fig. 14, rather large values of by-pass capacity are used for C1 and C2; thus exercising considerable control over the higher audio frequencies, in addition to by-passing the R.F. currents. In Fig. 15, which shows the detector plate circuit of the Majestic "Model 130-A," a "super-screen-grid" receiver, these capacities have been greatly reduced in value; and the audio control has been centralized in an audio filter circuit composed of R and C3. Making R adjustable, and C3 a little larger in value, would result in adjustable tone control.

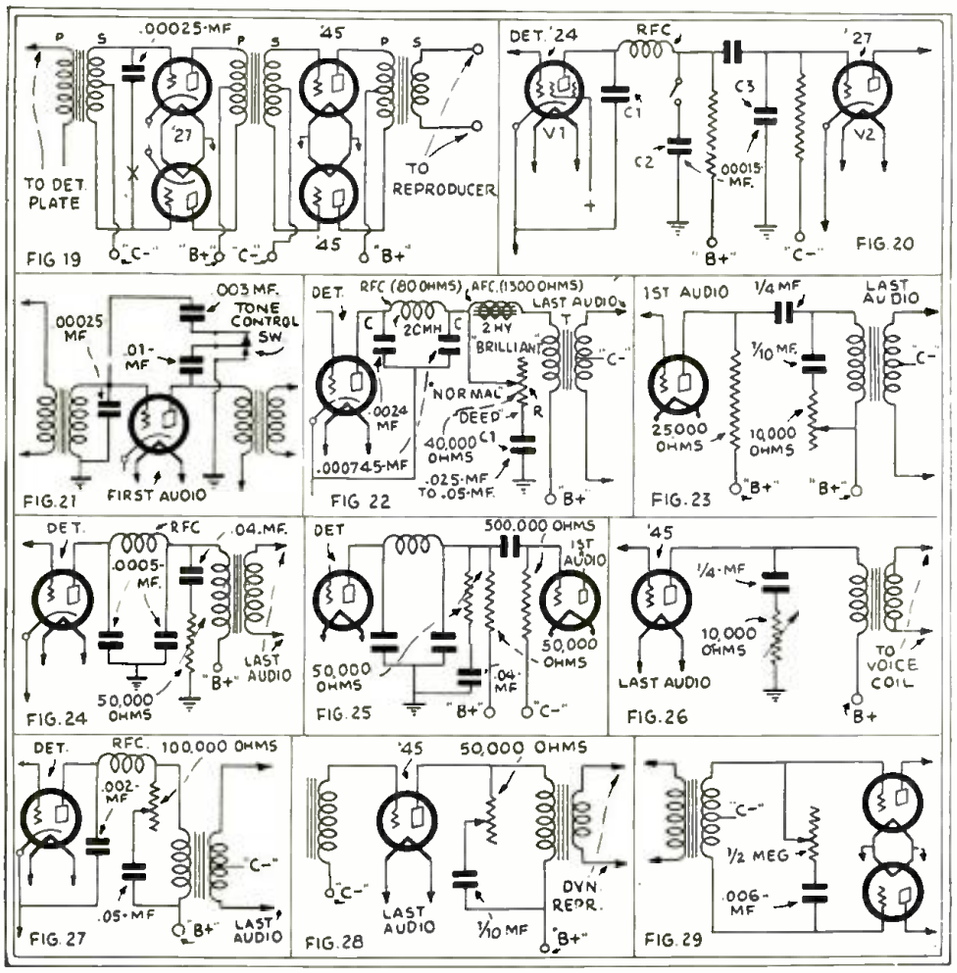
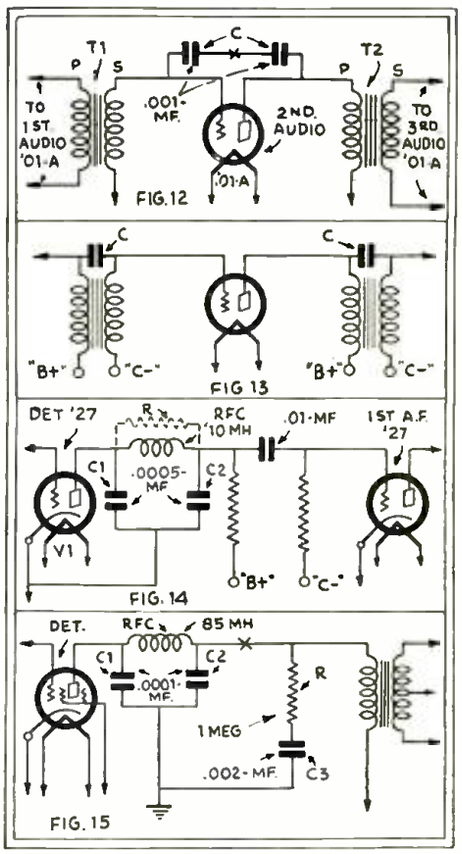


Fig. 19, All-American Mohawk "No. 90"; Fig. 20, Silver-Marshall "Model 720"; Fig. 21, Bremer-Tully "7-70" and "7-71"; Fig. 22, new RCA superheterodynes; Fig. 23, Silver-Marshall "34-A" and "35-A"; Fig. 24, Kennedy "Model 26"; Fig. 25, a representative commercial circuit; Fig. 26, "Jackson-Bell" midget sets; Fig. 27, Grebe "Super-Synchrophase Type AII-1"; Fig. 28, Remler "Midget receiver"; Fig. 29, Bosch "Models 58" and "59" radio sets. Note particularly the RCA circuit, Fig. 22, which is perhaps the best yet developed. In Fig. 23, a tapered variable resistor for tone control is utilized.



These diagrams show fixed tone-modifying devices, used in commercial sets as listed in the text. External methods of manual tone-control might be added.

Switch-Operated Tone Controls

The "Story & Clark" and the "Clarion, Jr." midget sets have a capacity in shunt with the grids of the output tubes, as shown in Fig. 16. A switch puts the condenser in circuit, when desired.

Another switch-operated tone control is shown in Fig. 17, illustrating the connections in the All-American Mohawk "Lyric, Model D." Condenser C is the R.F. by-pass unit; and condenser C1 is the audio by-pass, or tone-control condenser.

Two condensers in series, shunted across the output transformer primary, will change the timbre of the reproduction. In the "Model II" Mohawk receiver, illustrated in Fig. 18, this idea is incorporated, a control switch being used. (In the No. 90 chassis, shown in part in Fig. 19, the condenser was connected in the grid circuit; a switch at X would control this unit. Condensers in this position are sometimes used to prevent push-pull circuit oscillation.)

Silver-Marshall, in their "720-A.C." receiver, connected a switch in series with the by-pass condenser across the detector's plate coupling resistor, as shown in Fig. 20.

In the Bremer-Tully "7-70, and 7-71," a novel tone switch circuit was incorporated in the manner shown in Fig. 21.

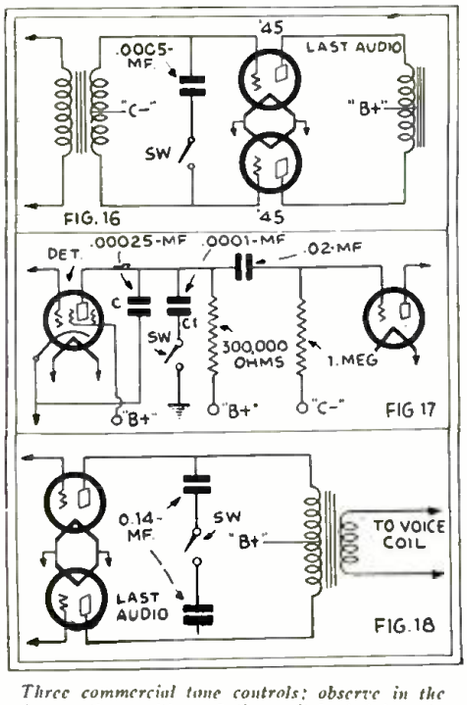
Smoothly-Variable Tone Controls

Perhaps the most satisfactory tone-control, so far incorporated in commercial receivers, is that used in the new Radiola, Westinghouse, Graybar, and General Electric superheterodynes. This unit, which is illustrated in Fig. 22, comprises components L, R and C1. The advantage of the circuit is that *either* the lows or the highs may be made predominant.

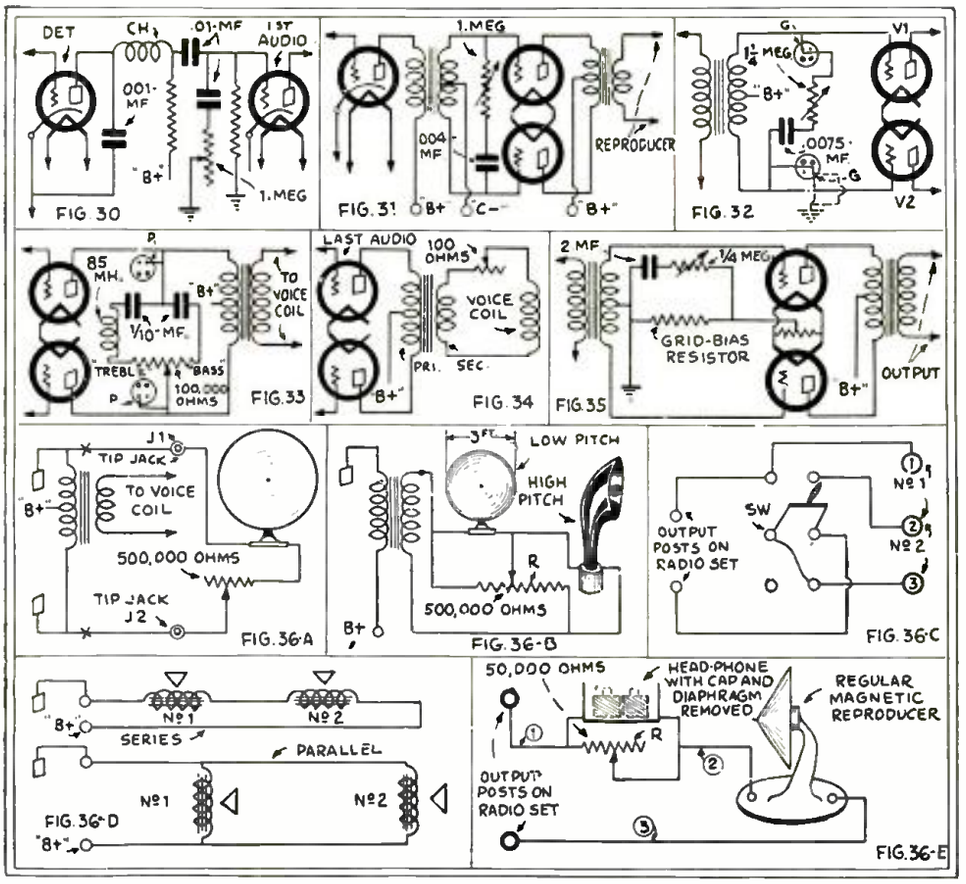
A fixed condenser and a variable resistor are the most widely used form of tone control. Much can be said in favor of other systems, but it is interesting to observe the choice of the majority of engineers.

In Fig. 23 are shown the connections of a tapered variable resistor and a fixed condenser, as used in the Silver-Marshall "Models 34-A and 35-A" receivers. The Kennedy "Model 26" illustrated in Fig. 24 has a detector-plate circuit connection in the transformer-coupled job, while Fig. 25 shows the constants recommended by manufacture for use in a resistance-capacity coupled circuit. The Jackson-Bell "Midget 62," and the "63 and 64" sets use the values indicated in Fig. 26 in the power-tube plate circuit.

For the Grebe "Super Synchrophase Type AH-1" the values and detector plate circuit connections are given in Fig. 27; and the power tube's plate-circuit arrangement in the Remler "Model 14" (midget) is Fig. 28. The power-tube grid circuit connections in the Bosch "Model 58 and 59" receivers are shown in Fig. 29. In the Fada "40" the values are quite different (Fig. 30); while Fig. 31 is a detail of the General Motors "Model A" chassis.



Three commercial tone controls: observe in the lowest the position of the switch, halving the plate voltage on each condenser, as well as the effective capacity of the pair.



Top, two chassis connections; right, "Gen-Win" adapter, connecting in grid circuit of power tubes; second row (33) Insuline "Variotone," used in plate circuit; (34 and 35) applicable methods to receivers. Fig. 36: (A) addition of an external reproducer to supplement built-in unit; (B) means of balancing reproducers of complementary characteristics; (C) switching system giving connections as at (D); (E) method of obtaining tone variation thereby.

Tone-Control Adapters

It is interesting to note that the "Gen-Win" tone-control adapter, recently put on the market, uses the fixed-condenser and variable resistor idea; its circuit is Fig. 32. Two 4-hole discs are provided for connecting the unit (which is placed at any convenient point outside the set) to the *grid* prongs of the power tubes; other connections may be tried, however. Where the output requires only one tube, V1, the remaining lead may be grounded as shown in dotted lines.

The connections for the "Variotone," another output stage tone-control adapter, intended for *plate-circuit* use, are diagrammed in Fig. 33.

The new Clarostat adapter, designed to connect to the grids of the power tubes, is of the type comprising a fixed condenser and a series variable resistor. The resistor is of the tapered type. Although this unit was first produced in table type, it is now available also in compact form for mounting behind a panel, on which its control knob appears. The fixed condenser is a .006-mf. unit, and the resistor has a value from zero to 1 megohm.

Several years ago, Mr. Clyde J. Fitch suggested to the writer the method of connection shown in Fig. 34. While primarily intended as a volume control, it acts also as a tone control; since the low notes are retained at low volumes, and the high notes are reduced without the use of a by-pass condenser. It is observed that one or two manufacturers have adopted this idea.

Another interesting manner of modifying audio quality is to vary the reactance bypassing a power tube's grid-bias resistor. A convenient way of doing this is by means of a variable resistor in series with the bypass condenser, as shown in Fig. 35.

Use of Two Reproducers

In Fig. 36, at A, a magnetic reproducer is connected to the primary of the output transformer coupling into a dynamic reproducer. An improvement in quality may be obtained by connecting fixed condensers, about 2- to 4-mf., at points X. The resistor R may be panel-mounted, or located elsewhere.

If set manufacturers only would install tip-jacks (such as J1 and J2) in their chasses, how much more convenient it would be to connect an external reproducer! The

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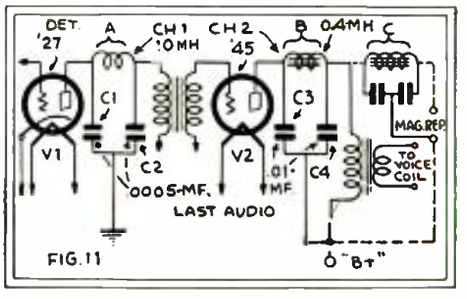


The fixed tone filter of the Stromberg-Carlson "654;" the quality may be varied by the use of a resistor control.

Modernizing the "Sargent-Rayment 710"

A method of converting one of the best types of battery sets to full electric operation

By F. L. SPRAYBERRY*

OF many battery-operated screen-grid receivers, brought out in 1928 and 1929, the Sargent-Rayment (Silver-Marshall) was one of the most popular receivers ever released in kit form. Many long-distance records were established with this receiver, which has only one disadvantage—it is battery operated. It is true that the "B" current, in most cases, is furnished by a power unit; but there is a storage battery to bother with, which is undesirable, to say the least.

The purpose of this article is to describe how this model (the "No. 710") may be changed to full A.C. operation, and its already good qualities improved without a large investment for additional parts. The owner may think the original receiver is still good; but he has an agreeable surprise coming, if the circuit is changed as indicated. A station can be received at almost every point on the dial, at low and high frequencies, and stations at the low-frequency end of the band will come in much better than before. Selectivity is much improved at the high-frequency end; a result due in large measure to the band-pass stage and the additional tube.

Triple-Unit Construction

As remodeled, the cabinet houses only the tuner proper; the power supply and amplifier are separate units. Five '24 screen-grid tubes are used, one more than in the original model; and an additional tuning condenser is employed, making a total of six operated from one control. Each tuning condenser has connected across it a midget variable condenser for fine tuning. The new power supply is double; one unit for the R.F. and detector stages, while the "S.M. 675" has been rearranged to include a power amplifier circuit. With less current drain in the new arrangement, a higher plate voltage is available for the operation of the type '50 power tube. The plate potential for this tube is slightly under 425 volts, in the original it was about 350 volts.

The band-selector stage prevents the cross-modulation that is present in so many screen-grid receivers. Inductive coupling was first tried in this stage; but the capacitive method was chosen after considerable experimenting.

A list of the parts that are utilized in the construction of the receiver, power supply and amplifier will be found at the end of this article. The additional parts which must be obtained are marked by asterisks.

Assuming that we are ready to begin construction, the first operation is to tear down the old set, by removing all wiring, R.F. coils, sockets, volume control, audio parts, and by-pass condensers.

Rearrangement of the Parts

An "S.M. 3201" variable condenser (C5) is then mounted in the seventh compartment (Fig. 1, reading from left to right) and an "S.M. 340" midget condenser (C11) is mounted under this, as in the other compartments. A Hammarlund flexible coupler is used to couple the sixth condenser shaft to the fifth.

A new 10,000-ohm potentiometer is used as a volume control; this is mounted at the left end of the cabinet, near enough to the rear to clear the first tuning condenser. *It should be thoroughly insulated from the aluminum cabinet.*

The old tuning coils are discarded and replaced by new S.M. coils, which match the plate impedance of the '24's. All coils are mounted with the openings toward the

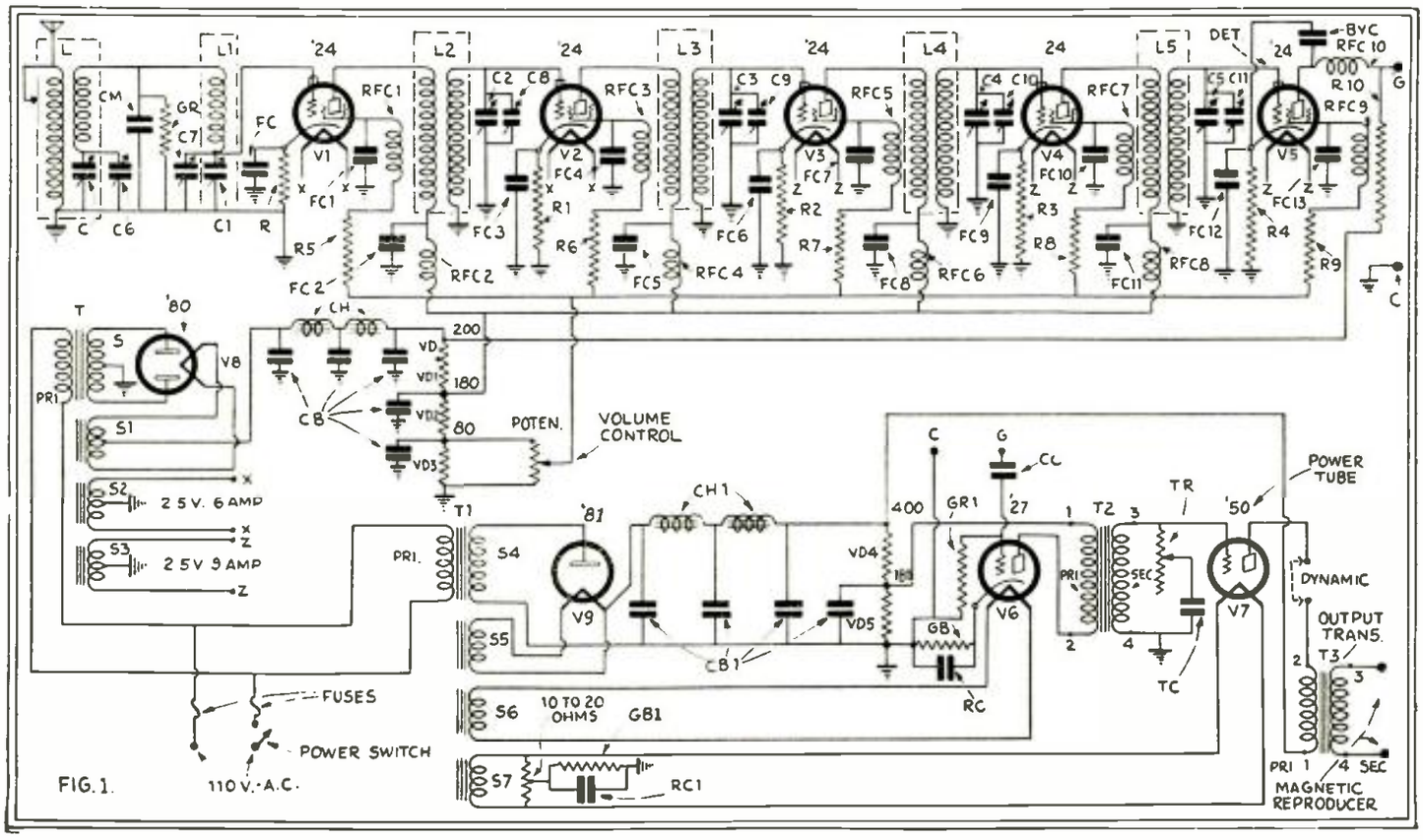
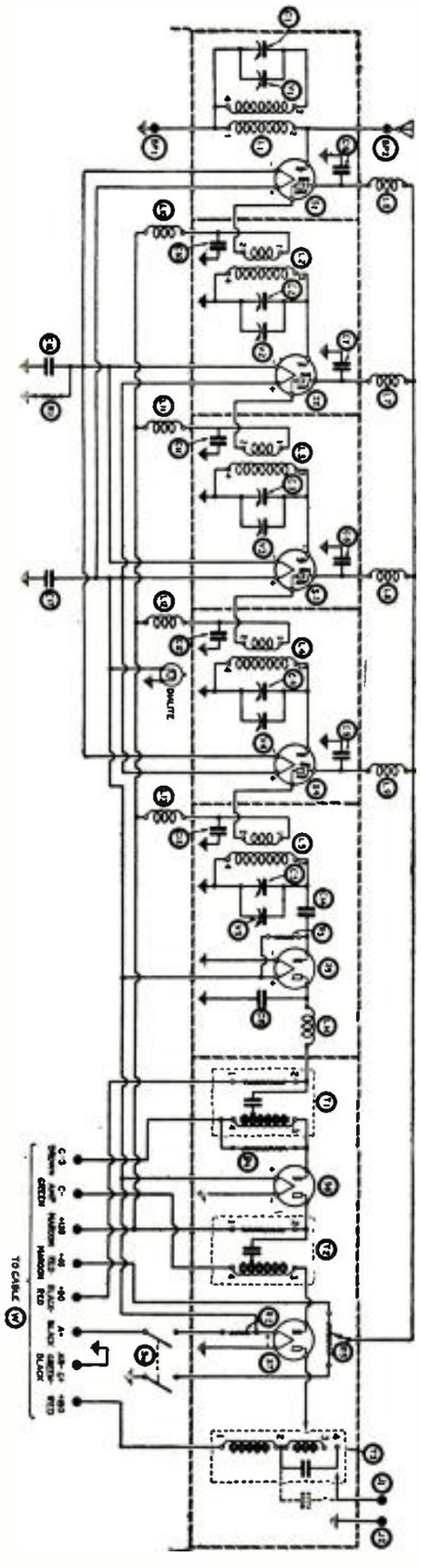


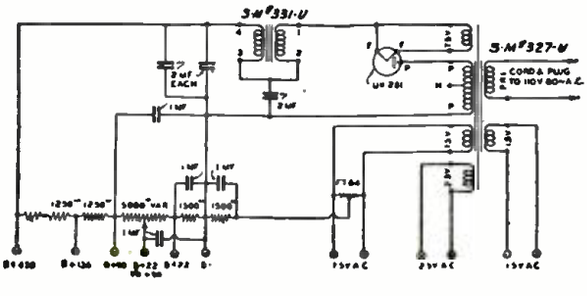
FIG. 1.

Fig. 1

Schematic circuit of the Silver-Marshall "Sargent-Rayment Model 710" receiver, and the Silver-Marshall "Model S.M. 675" power amplifier, after being revamped in accordance with the latest principles of set design. A type '50 power amplifier has been incorporated in the layout, the '22s (battery-type screen-grid tubes) have been replaced by the A.C.'24s; and a screen-grid detector is now part of the circuit. These improvements make the set "all-electric"; and the consequent increase of "pep" necessitates the use of a good band-selector (L, L1, C, and C1 in the diagram) ahead of the first R.F. tube.

* *Radio Service Consultant, National Radio Institute.*





tube sockets, and should be located halfway between the tuning condensers and tube sockets. You will find lugs at the ends of the coils; bend these down until they touch the chassis, then secure them by means of screws and nuts. An "S.M. 124" coil is used in the first compartment, an "S.M. 122" in the second and "S.M. 121's" in the third, fifth, sixth and seventh compartments. Five-prong tube sockets are mounted in the second, third, fifth, sixth and seventh compartments.

When wiring the grid returns of the R.F. and detector stages, do not allow the chassis to form a part of the high-frequency current path. Instead, connect a wire from the F2 terminal of each coil to the rotor terminals of its main tuning condenser and its midget condenser; continue this connection to the point where the cathode of the tube is grounded. Then ground F2 of the coil and make *another* ground connection from the rotor terminals of the tuning and midget condensers. The writer did not use the old 0.25-mf. by-pass condensers as they tested "leaky"; instead of these, 0.1-mf. condensers were installed. The R.F. choke coils may be mounted beneath the chassis as before; it is not necessary that they be placed in any particular position, as their magnetic fields do not interfere.

The two phone tip-jacks are left in the assembly; point G is connected to one of these while the other is grounded. An ordinary phone cord connects G and C of the receiver to G and C of the amplifier.

Power Supply and Amplifier

Transformer T is an "S.M. 336U" power transformer; the 2.5-volt secondaries are used to feed the filaments of all tubes in the tuner except the '80, which is fed from the 5-volt secondary. The other secondaries are left unconnected. A low- and a high-amperage secondary are provided on the transformer. Connect the filaments of the first two tubes to the low-amperage secondary S2; connect the other three tubes and the dial light to the high-amperage secondary S3.

Inasmuch as the power unit is separate from the receiver, it will be absolutely necessary to use very heavy wire (No. 14 or larger) for the connection between the receiver and power unit. If small wire is used, the applied filament voltage will be very low at the tube sockets, because of the resistance of the wire.

Choke Ch. is a standard R.C.A. choke unit, of the type used in Radiolas "17," "18," "33" and "51." CB is a Dubilier 11-mf. condenser block; the first capacity is 2-mf.; the second 2, and the third 6. The two condensers across the voltage divider are 0.5-mf. each.

The audio power unit utilizes most of the original equipment found in the "S.M. 675" power unit; practically the only change that has been made is in the voltage divider. The actual placement of the parts must of course be rearranged as suggested schematically. In addition to the regular equipment of the "675," two sockets and two audio transformers T2, T3, are mounted on a baseboard and connected as shown.

Notice the "tone control" across the grid of the '50; it works very well and gives emphasis to high or low tones, depending on the adjustment of the variable resistor, TR. The circuit has been arranged to use either a dynamic or magnetic speaker; both may be used at the same time if desired. If it is desired to use only a magnetic, connect a jumper (dotted lead) across the two posts marked "Dynamic."

Adjusting Operating Voltages

It is important to use adjustable resistors (VD, VD1, VD2, VD3, VD4, VD5) in the voltage divider of both power packs; because the exact resistance values cannot be purchased as standard equipment. The writer used "Electrad" resistors which have sliders, making it possible to obtain the correct voltage by adjustment in conjunction with the use of a voltmeter.

The R.F. tubes should have a plate potential of 180 to 190 volts; the screen-grids, about 80 to 90 volts. With the volume control turned all the way off, the screen-grid voltage will drop to zero and the plate voltage will rise to about 220; so be sure to use filter condensers that will withstand this voltage.

The plate voltage on the detector V5, as measured with a set analyzer, will be somewhere between 68 and 74; while the screen-grid voltage will be about 60. The plate voltage of the A.F. amplifier V6 will be 185, and a set analyzer will indicate a bias of only one volt, negative.

When buying the screen-grid tubes get them matched as near as possible and try each of them in the detector socket to see which is the best detector.

New Coil Data

Silver-Marshall coils "121," "122" and "124" are wound on forms having a diameter of 1.25 inches. Coil "121" is the antenna coupling coil, and is wound with 124 turns of No. 30 enameled wire for the secondary, and 45 turns of No. 36 double-silk-covered wire which is wound directly over the lower end of the secondary and separated from the secondary by a thin strip of celluloid.

The primary winding for this coil is tapped at the 25th turn for a long-antenna connection. The 45 turns are used for a short-antenna connection.

Coil "122" is wound on the same size form and is a secondary winding, having only 124 turns of No. 30 enameled wire.

Coil "124" is wound on the same size form and has 120 turns of No. 30 enameled wire for the secondary, and 13 turns of No. 36 double-silk-covered wire for the primary.

The primaries are wound on the lower ends of the secondary forms, and small pieces of celluloid separate the windings.

After the coils have been wound they are placed in shielded cans with a 1-inch space between coil form and shield; there is ¼-inch space between the top of the coil form

(*Continued on page* 501)

Fig. 2

The "before changing" circuit of the old "Sargent-Raymont 710" receiver (above) and the Model "S.M.675" power amplifier (left) often used with it. Since the "710" chassis was designed for battery service, many of them will be found still operating with "B" batteries instead of a "B" eliminator as the plate supply; and with the usual storage-battery "A" supply.

A Short-Wave Push-Pull Receiver

A novel circuit which will give short-wave craftsmen the opportunity to exercise their ingenuity in construction

By JAMES S. CEBIK

WHILE no end of short-wave receivers have been described in various magazines, the great majority are simply regenerative detectors, with or without a stage or two of screen-grid amplification ahead of them. The writer tackled the proposition from a new angle and, after very good results with push-pull transmitting circuits, he obtained very good results from a similar idea in the receiver.

Let us consider the differences between the straight single-tube circuit and the push-pull circuit and see what are the advantages of the latter.

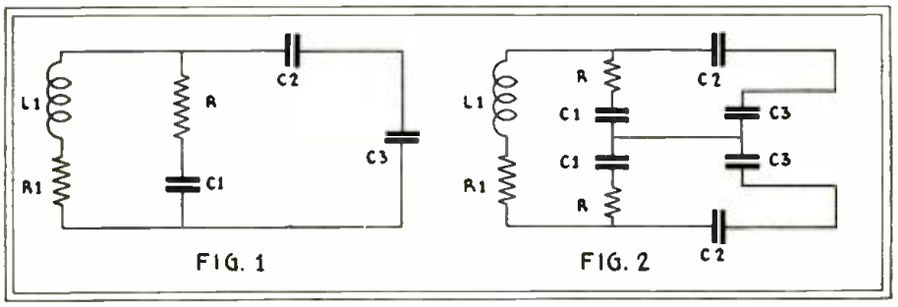
In Fig. 1, the various interelement capacities of a single-tube circuit are indicated; we have a relatively high grid-filament capacity, lowering the input impedance. This is of importance in determining the input energy and the signal voltage impressed on the tube's element. We may represent the tube's input impedance by a capacity in series with a high resistance, which causes the absorption of signal energy in the tube.

Benefits of Push-Pull

In Fig. 2, we have the two push-pull tubes represented in circuit; their grid-filament capacities are now in series, thereby reducing the capacity present in the circuit to half that in a single-tube circuit. Also, since the grid-filament resistances are in series, the resistance of the circuit is doubled, thus reducing the absorption from grid to filaments.

This gives us a greater internal input impedance, allows us to use more inductance at a given frequency, and to maintain a much higher signal voltage across the terminals of the tuning condenser.

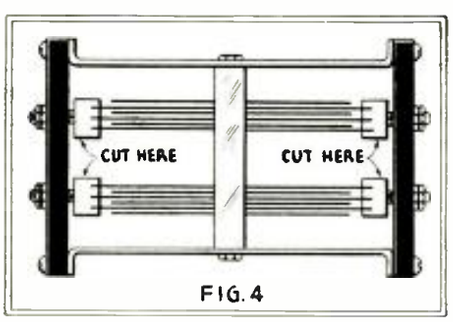
Also, we have in the push-pull circuits increased inductance with which to couple the tickler, thus obtaining more stable oscillation over the frequency range. In the single-tube circuit, the capacity is so large that, at frequencies above 16,000 kilocycles (below about 19 meters) we cannot use enough inductance to give proper coupling between the grid and plate circuits for uniform oscillation. The push-pull circuit overcomes this disadvantage.



At the left, the virtual circuit of the ordinary tube at high frequencies, the grid-filament resistance and capacity cause losses. At the right, a similar representation of the push-pull circuit of Fig. 3; the series capacities C1 are lowered in value.

Construction of the Receiver

As the diagram (Fig. 3) indicates, a special tuning condenser (C2) is required; this was made by cutting apart the stator section of a commercial instrument, to obtain



A split-stator condenser is obtained thus.

two stators with a common rotor. It must be borne in mind that these two capacities, thus formed, are in series; thereby reducing the effective capacity of the whole condenser to one quarter of the value with the remaining stator plates in parallel. For instance, say a six-plate condenser covered a certain range with the single-tube circuit; with a similar coil the double-stator condenser must have 12 plates in each section or 24 in all.

A condenser of low capacity was used to broaden the tuning, with a .0001-mf. midget (C1) in parallel across the coils to extend the range and decrease the number of coils required. Because of their economy and compactness, UY tube bases were used as coil forms; they were wound according to the following table:

Wave Band Meters	Grid Turns L2	Plate Turns L1	Range Mega-cycles
20	5	10	11-14
40	8*	20*	6-7.4
80	19	30*	3.2-4.5

The wire used was No. 22 D. C. C., except for the 40-meter L2, which was No. 22 enamelled; and the two larger L1 windings, which were No. 32 enameled. All windings are in the same direction; the connections to the prongs are shown in Fig. 5. The tickler windings L1 must be adjusted to maintain oscillation uniformly over the whole range of the coil; if the receiver does not oscillate properly, turns must be added or removed until it does (and, sometimes, the connections of the grid winding must be reversed.)

The antenna coupling coil L3 may be almost anything; the writer employed a four-turn coil which was adjustable to give the proper coupling for each of the different frequency-bands. The antenna condenser Ca is the usual capacity.

The remainder of the construction may be grasped quickly from Figs. 6 and 7, showing the plan and rear view of the panel. A small sub-panel is mounted, with the aid of a pair of brass angles, on top of the tuning condenser C2. This arrangement makes the control-grid leads very short, and the coils very easily accessible.

Regeneration is controlled by the plate resistor method, the 10,000-100,000-ohm resistor R2 being variable; a 1-mf. condenser

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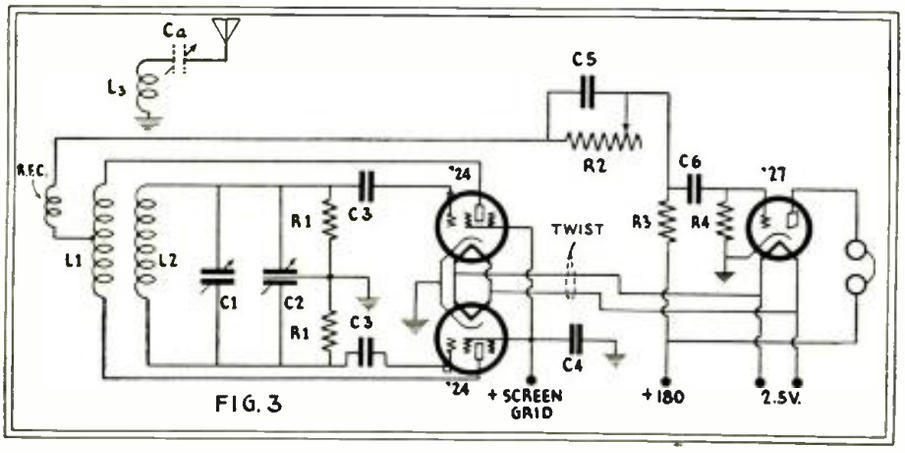

Mr. Cebik's circuit was suggested by short-wave transmitting work. It is very simple, as will be seen. Additional amplification may be added, if desired. Note the position of R2, the regeneration control. A high resistance at R4 tends to cause self-bias on the '27.

New Operating Ideas for Television

Inventive and experimental suggestions for improving the quality, scope and utility of the art

CRYSTAL DETECTOR IMPROVES TELEVISION IMAGE

RADIO experimenters, including the large family of "Interflex" and "Peridyne" fans, who retain their fondness for the crystal rectifier, will be interested in the notes of an English television experimenter, Mr. William J. Richardson, who has communicated his finding to *Television* (London).

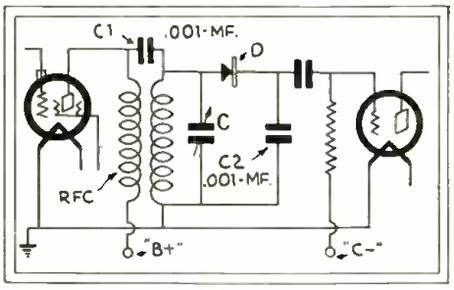

Fig. 1

Fidelity is everything in television work, for the eye is more critical than the ear. The quality of the crystal is demonstrable.

In view of the general belief that the tone quality obtained from the crystal is purer than with any other type of detector, after experimenting with the "diode" (two-element detector—usually obtained by coupling the grid and plate of an ordinary tube) Mr. Richardson decided to modify his circuit to the arrangement shown in the diagram (Fig. 1). The value of C2 is merely tentative, and should be varied until the optimum adjustment is reached. (British television is on the broadcast waves). The crystal D is placed at the point of highest R.F. voltage in the tuned circuit; to interchange it with C2 would give very inferior results.

As all experimenters know, television is the severest test of any reproduction's fidelity, since it makes any distortion plainly apparent, however indistinguishable by the ear. The results were found to be more satisfactory than with any tube detector; the field of the image was clearer and the details very much sharper.

It may be remarked that, since the detection in the crystal depends on its one-way conductivity, its polarity is important. If it is turned end for end in the circuit, the television image will be converted from a positive into a negative, or vice versa; according to which half of the wave is rectified.

X-RAY TELEVISION

By Dr. Eugen Nesper

IN spite of the great progress which X-ray technique has made in the last ten years, there are still deficiencies which physicists and medical men are working to remove. One of these is found in the shadow image, on the fluorescent screen, for the clear production of which a strong exposure is required; and this may not be desirable either for the patient or the operating personnel. In addition to this fault, it is possible to view the shadow from only a limited angle.

An ingenious application of the principle of television to X-ray work has been devised by A. Dauvillier, and is illustrated in the accompanying diagram. In the X-ray tube, it is well known, the stream of electrons emitted at high velocities from the cathode strikes the target, or anticathode; from which a cone of X-rays is emitted. In the arrangement shown (Fig. 2) these rays are intercepted by a Nipkow scanning disc; so that only a very narrow pencil of X-rays at one time is allowed to pass through the object (a hand, for instance) which is exposed to them. The ray, more or less absorbed by the material through which it passes, falls into a photoelectric cell, which is connected in the normal way to an amplifier. In the output of the amplifier is a large glow-lamp, which is placed behind a much larger scanning disc mounted on the same shaft as the first. The result is that a magnified image, in perfect synchronism with the X-ray scanning, is produced in the viewing frame of the larger disc. This method lends itself to the detailed production of an image with 3,600 elemental points. However, it is difficult to see why Dauvillier should cling to the scanning-disc, when the mirror-wheel, as used in the Karolus system, permits much finer detail and much larger reproduction of the image. This idea, however, promises to be of much value in medical and physical research work.—*Abstract from* FUNK, *Berlin.*

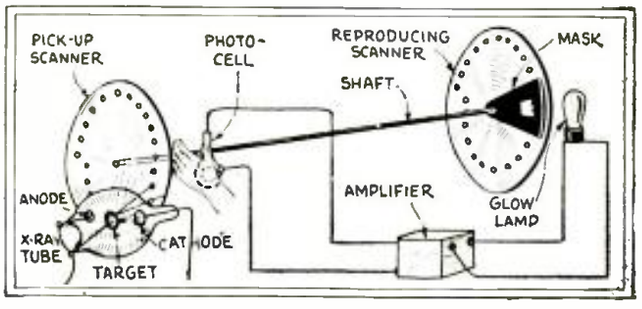

Fig. 2

Continued observation of a patient by X-rays is undesirable, for both the subject of the study and his physician. A European research worker proposes to overcome this difficulty ingeniously by using the television set-up at the left. The pick-up, covered say with lead, is opaque to X-rays except at the scanning hole. Injurious exposure, therefore, is avoided.

(One of the troubles in X-ray work is that, while these rays are of the same nature as visible light, their wavelengths are so short that a molecule of matter interposed in their path does not affect them as it does visible light. While this gives X-rays their power of passing almost unweakened through opaque substances, it makes it difficult to reflect them accurately, and practically impossible to refract them.

While X-rays are invisible, and cannot be felt, continued exposure to them destroys the cells of the body; it is therefore undesirable to apply them to a patient longer than is necessary for the specific purpose. The metallic scanning disc in the illustration keeps all but a slight pencil of the rays from the part of the body being scanned, and therein serves the same purpose as when televised subjects are scanned by a pencil of intense light; instead of being flooded with it, as in the earliest television setups. The holes of the X-ray scanning disc are covered with black paper, which is transparent to the X-rays, but not to the visible light thrown off at the same time by the cathode-ray tube; and therefore eliminates the effect of the latter on the photocell. The visibility of X-rays on a screen coated with barium-platinum cyanide is due to the fact that the latter substance *fluoresces* (that is, throws out visible light) when it is exposed to X-rays; the latter never become visible. The photoelectric cell, exposed to X-rays, throws out electrons, just as when it is exposed to visible light; hence the practicability of using it in this manner.—*Editor.*)

BYPASSING A.F. IN TELEVISION

By Paul L. Clark

THE width of the band, required for sending a 48-line television image, varies from 70 to 100 kilocycles, depending upon the scanning speed. If this speed is such that the change from a light to a dark elementary area of the scanned subject is made (causing a signal-impulse) in 1/50,000-

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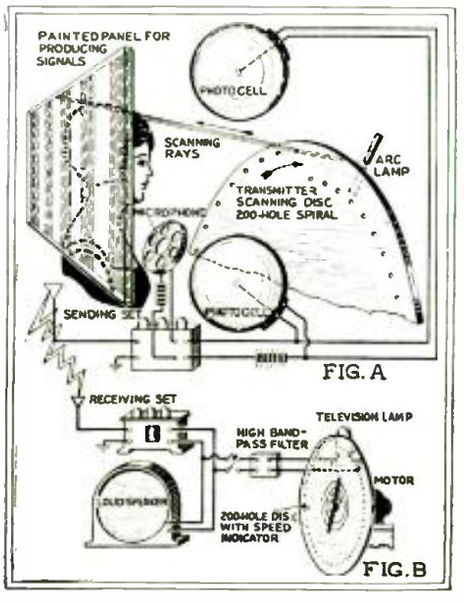


By breaking up the background, as shown above, low sustained frequencies in television are prevented; and audio frequencies, therefore, can be imposed on the same carrier without interference.

The "Day-Lite-R" Receiver

A unit designed for the custom trade, to meet the eternal demand for "DX" reception with quality

By PETER WINTHROP

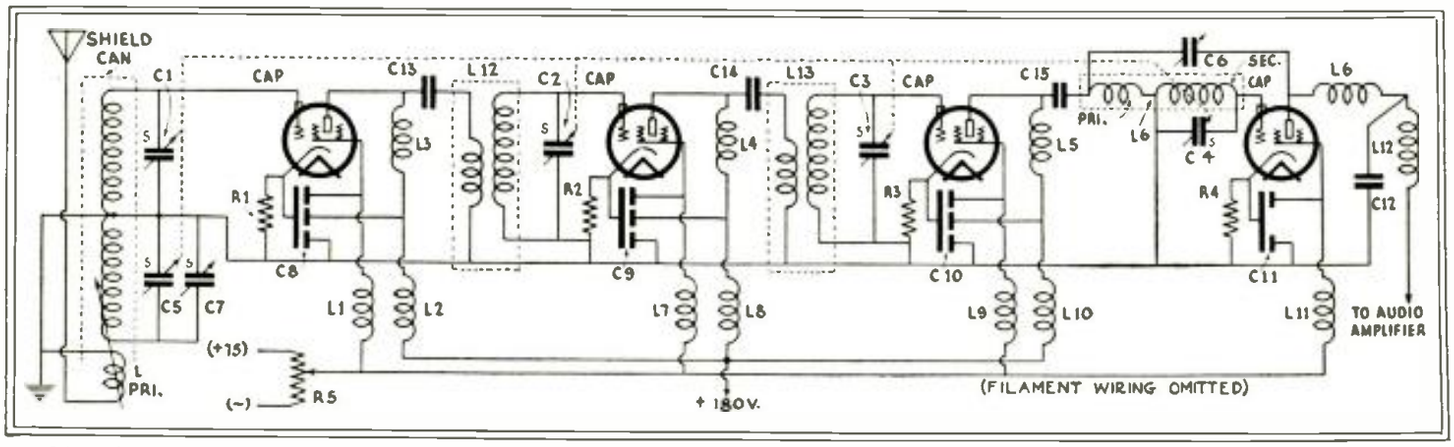
EVERY custom builder has at one time or another encountered a hypercritical customer who, no matter how expensive or elaborate the set, has never been satisfied with any receiver; invariably complaining of its lack of ability to penetrate through powerful locals in early evening or daylight for outside signals; and very frequently comparing the results from this standpoint with the "three-tuber" he built for himself for twenty-five bucks some years ago.

Now, however, it is entirely possible for the hard-pressed set builder to earn a handsome profit, and make the irate and disgruntled customer into a lifelong friend and booster, by the simple expedient of constructing and selling him a chassis designed for exactly those results he so much desires. The "Da-Lite-R" tuner chassis was designed for this specific purpose.

The antenna primary is adjustable by a knob on the panel, varying its inductive relation to a circuit which is tuned by the first section of a five-gang condenser; varying from zero to approximately 7.5% in coefficient of coupling. This tuned circuit is, in turn, loosely coupled to another tuned circuit which supplies signal energy to the control-grid of the first screen-grid amplifier; the two tuned circuits composing a "band selector."

Shielding is more than ordinarily complete; and by-pass condensers correctly isolate the circuits.

Stabilization of oscillatory effects, due to the inter-element capacity in the tubes (which is appreciable, even with screen-grid tubes), is accomplished by the use of the "Chromophase" system in each output circuit. In this circuit, by combining a high shunt impedance with the proper values of resistance and coupling capacity, a slight phase displacement between input and output circuit is established; thus avoiding feed-back without affecting the amplification obtained.



Schematic circuit of the tuner chassis of the custom-built "Da-Lite-R" receiver. For most stable performance it should be used with a power amplifier in which the voltage divider has a very low resistance (in the neighborhood of 8,000 to 12,000 ohms, total, and well bypassed) and a power transformer with particularly good regulation. Type '27 tubes are used throughout and, for clarity, the filament circuit is not shown. One 2.5-volt secondary will light all the filaments, and may be either grounded to the chassis or connected to a plus potential of 10 to 50 volts, in the usual manner.

Regenerative Detector

A particularly unique feature of this A.C. tuner, and one to which much of its astounding amplification is attributable, is the use of a regenerative power detection circuit employing a screen-grid tube. The input circuit of the detector is arranged to form a modified Hartley oscillator circuit, with the plate coupling capacity controlled by a

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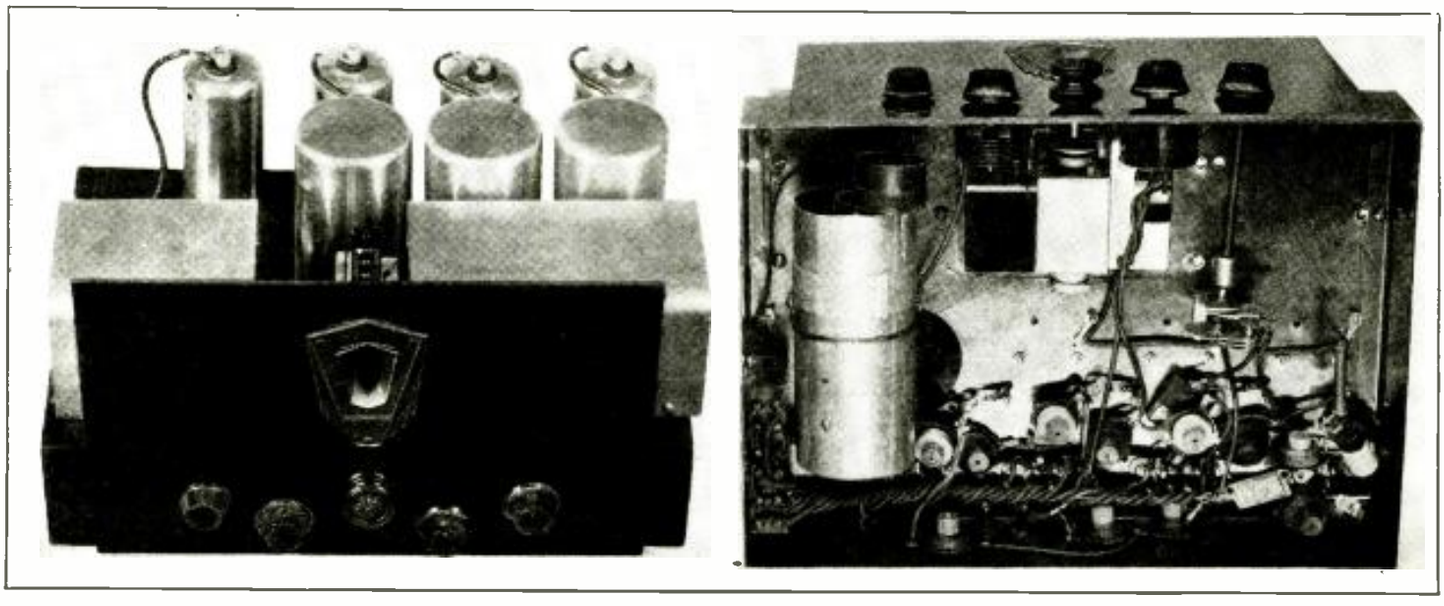


Left, front; and right, the base of the chassis of the supersensitive "Da-Lite-R" tuner chassis. This receiver, while giving audio signal output of excellent quality was designed with the primary purpose of tuning in distant-station programs. The knob at the extreme left controls the primary winding of the antenna coupler; this coil being arranged to slide past one end of the doubly-tuned secondary.

The D.C.-A.C. Convertible Radio Receiver

A veteran set builder describes the way in which he met the problem of different house current supply conditions some years ago. (The set is still working!)

By SAMUEL WHISK

"I AM going to move into a '110-volt D.C.' district, where the lighting current is direct and not alternating. However, there is talk of a change-over, at an early date, to 110 volts A.C. Can you design for me a radio set that will work equally well on D.C. or A.C.; so that in the event of a change in the current supply it will not be necessary to exchange the receiver?"

Perhaps six years ago the writer was nearly floored by this request. Technical data on the design and performance of light-line operated electric receivers were difficult to find. The true "A.C." tube as we know it today (either the heavy-filament, or the cathode-and-heater filament type) was not then available. Then again, the "authorities" on the subject, to whom reference was made at the time, stated that "it couldn't be done."

In fact, it was the positive nature of the statements to the writer, by numerous technicians on Radio Row (*Cortlandt St., New York City*), when recently he inquired for a commercial radio set adaptable either to A.C. or D.C., that a receiver of this type was quite inconceivable; which really egged him on to tell how he did it—six years ago!

Incidentally, the necessities of the times resulted in the production of a receiver simple and inexpensive to build; and with a low current demand (about 40 watts) not equalled by a comparative, modern radio set using the present type of "A.C." tubes.

The receiver, whose circuit is shown above, is still in use substantially as first designed. By removing one of the line fuses from its position at F1, to the clips marked F2, the "D.C." electric set becomes an "A.C." receiver!

Because of the low plate voltage available on the D.C. circuit (about 100 volts), every artifice was used to obtain maximum gain through each stage. The antenna circuit is independently tuned; the remaining three condensers being ganged together and operated by a second tuning dial. The sensitivity of a crystal detector, preceded by three stages of R.F. amplification, was found to be adequate and served to eliminate hum. Three stages of A.F. amplification delivered sufficient output to drive two type '01A tubes connected in push-pull (thus obtaining better than 2.5 times the undistorted power output obtainable from a single tube of this type; yet retaining the high amplification of this tube). A magnetic reproducer (not too sensitive to low frequencies) completed the receiver chassis.

The problem of power pack design was finally solved in the following manner. It was decided to heat the filaments by connecting them, in series, directly across the light line; with a power choke Ch1 and filter condensers C6, C7 to smooth the supply, whether A.C. or D.C., and lamps V9, V10 (15 watts rating at 110 volts, each) to limit the amount of current passed to the filaments of tubes V1 to V7. A gaseous rectifier, V8, eliminated the need for rectifier filament supply.

Take special notice of the fact that the receiver is completely fused.

Resistor R4 adjusts the current through the pilot lights to the desired amount; if one pilot light burns out, the receiver still will function. This design was necessitated by the case with which the average pilot light, of questionable manufacture, would pass out of the picture at inopportune moments. Since both lamps were in series with the remaining filaments, without the service of R4 the set would stop working if the filament of either V11 or V12 opened.

The milliammeter MA is required for adjusting the output of the power unit to the correct amount when the receiver is operated on A.C. Without this instrument it would be difficult to determine the correct setting of the "B" output-control resistor R9 used on A.C. lines to adjust the "B" current supply to the same value as when used on a D.C. line. To obtain maximum voltage from the D.C. line for "B" potential, a separate "C" battery was used to furnish the required grid bias potentials.

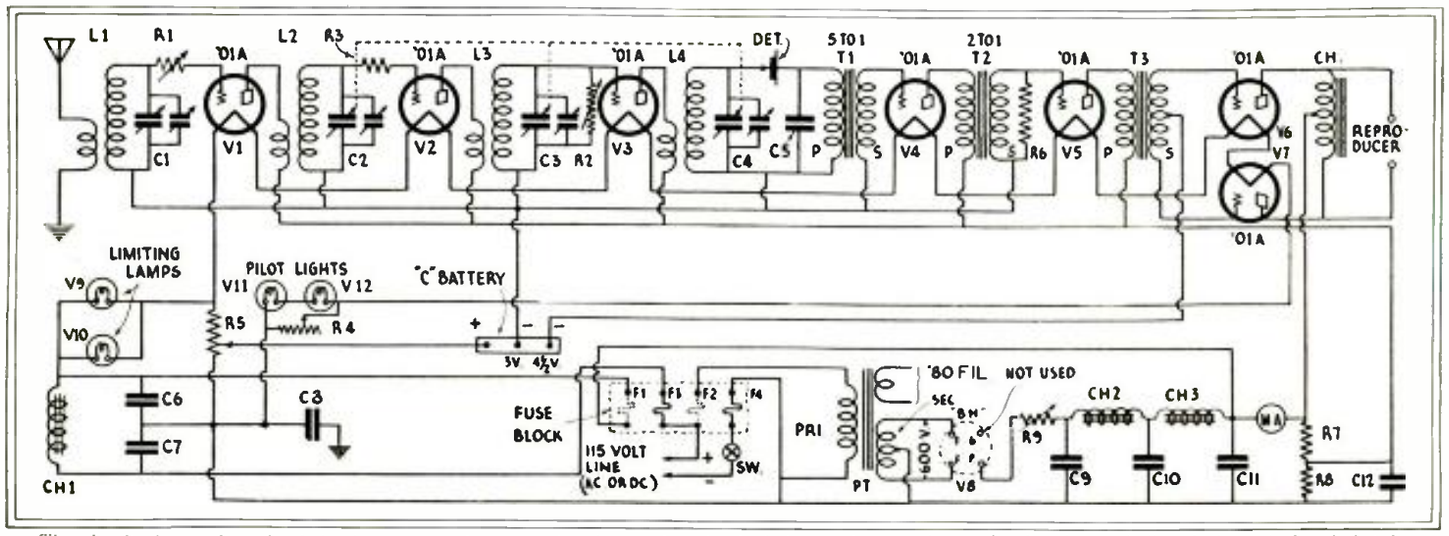
Note that T1 has a high ratio; this is important and necessary.

Provision has been made to use higher power output tubes of 5-volt type, if desired. The only changes required will be to use a "C" battery of sufficient voltage, replace the '01A's in sockets V6 and V7, and adjust R9 to the required plate potential; or, perhaps, (when operating on 110 volts A.C.), replacing the "BH" with a type '80 rectifier (the filament winding for which is indicated in the diagram above, and further details being shown, in the October, 1930, issue of RADIO-CRAFT, in the article "Choice of Rectifiers," by Edward J. Arnold, page 220). The latter modification is recommended only to the experienced constructor or Service Man prepared to cope with circuit oscillation in the R.F. stages, and distortion due to incorrect "C" bias.

Resistor R1 is one of the two small units mounted on the instrument panel, and used as a sensitivity control; the other, at the right, is the volume-control resistor, R2. Resistor R6, with the original audio transformers, eliminated a slight whistle.

While, doubtless, a constructor will use his own discretion in the choice of apparatus.

(*Continued on page* 502)



The circuit shown above is obviously not a modern one; but it was far ahead of the regular practice at the time it was built. It is so designed that its owner can operate it from either an A.C. or a D.C. socket (you see, in New York people move with a good deal of regularity) and for several years it has given him very satisfactory reproduction in his successive apartments. At present, it is housed in a modern commercial console.

A Unique Superheterodyne Receiver

A screen-grid set, battery-operated, and designed for high signal amplification, with constructional data for all inductances required

By R. WILLIAM TANNER, W8AD

THE following is a description of a superheterodyne receiver giving a considerably higher gain, for the same type and number of tubes, than any yet constructed by the writer. The complete schematic diagram is shown in Fig. 1.

It will be seen that only six tubes are employed, namely: a '40 high-mu first detector, an '01A oscillator, two '22 screen-grid intermediate-frequency stages, a '12A second detector and a '12A audio amplifier. The original model had two '01A I.F. stages and an '01A second detector; but the circuit has been modified to conform with the modern practice of using screen-grid tubes in the I.F. amplifier.

Both the first detector and oscillator are somewhat different from those generally employed in a super. The second detector is of the grid-bias or plate-rectification type, resulting in practically no distortion even on loud signals.

Regeneration, provided in the second detector, is useful in increasing the audibility of far-distant stations to a point where they may be brought in on a loud speaker. Only one audio-frequency stage is shown in the diagram. This gives sufficient volume on local and nearby stations. If desired, the output may be fed to a second stage using either one or two 71As, '45s, '10s or '50s.

The oscillator, first detector and the two I.F. stages are individually shielded; the second detector and audio unit are mounted directly on the baseboard, and the entire assembly is placed in a pressed steel cabinet.

The antenna tuner, oscillator coupler, I.F. transformers, etc., are all wound on midget coil forms, with five-prong (UY) sockets as mounting bases.

A Novel Input Circuit

The first detector is a product of the research of Stuart Ballantine. He states that the detector action is increased from 4% (with the grid leak-condenser combination) to over 50% with this method. It is believed that the tube also amplifies at the intermediate frequency; although not to any great extent, for the grid bias is incorrect for amplification).

Referring to Fig. 1, it will be seen that the grid circuit contains an inductance L2 tuned to the incoming signal by means of an .00035-mf. condenser C. Another inductance L3 (termed a grid impedance), tuned to the *intermediate frequency* by the .0005-mf. condenser C1, is placed in the circuit where the condenser and leak would ordinarily be. Its condenser C1 acts also as a bypass for the signal-frequency currents.

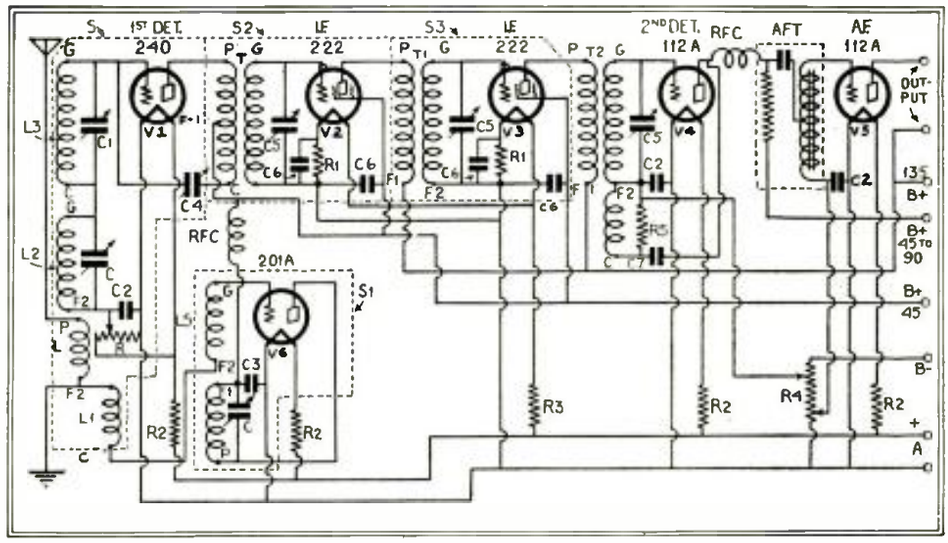


Fig. 1

The schematic circuit of this receiver, to which a power stage of any desired characteristics may be added. The first-detector and oscillator circuits are of an unusual type; a high-mu tube is used for the former, and it is neutralized. A short aerial should be used.

Now, with L3-C1 tuned to the intermediate frequency, the tube would, in all probability, oscillate because of the large inductance in the primary of the first I.F. transformer. Therefore, means are provided to neutralize these oscillations by doubling the primary turns, taking off a tap at the center, and connecting a small variable condenser C4 between the grid and one end of the primary.

A 200-ohm potentiometer R is shunted across the "A" supply to provide a variable bias of from approximately 1 volt negative to 5 volts positive. (The approximate value for best detector operation is between 0.2 and .05 volts positive). This resistor acts also as a very efficient volume control. The R.F. currents are by-passed around it by the 1-mf. condenser C2.

The grid impedance L3 is wound with 138 turns of No. 30 enameled wire; the two leads being soldered to the "G" and "C" contact pins on the coil form.

Three windings are needed for the antenna coupler: a primary L, a secondary L2, and an oscillator coupling coil L1. The primary and coupling coil are wound in the slot and are, in reality, one winding of 30 turns of No. 28 enameled with a tap taken off at the 15th turn for connection to the shield and ground. The start goes to the "P" prong, the finish to "C" and the center tap to "F2." The secondary consists of 98

(*Continued on page* 507)

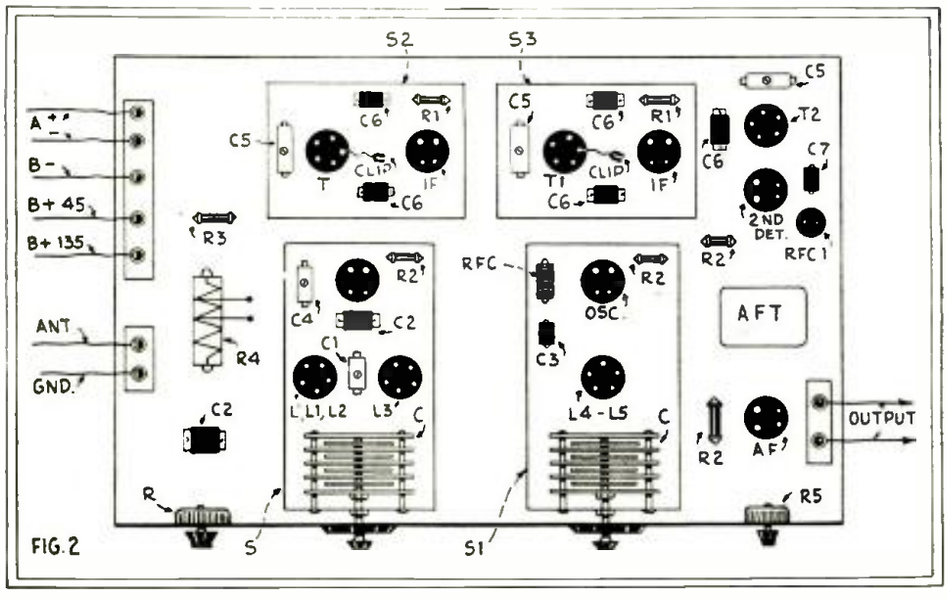


Fig. 2

The arrangement of parts used by Mr. Tanner is indicated above, although the components are not drawn to scale. It will be observed that complete shielding is needed up to the second detector. The constructor has latitude in the selection of components to be used.

RADIO CRAFT KINKS

A CONVENIENT TERMINAL

By Russell L. Woolley

MORE and more, pressed eyelets are being used in the manufacturing of radio parts. Radio-frequency transformers, R.F. choke coils, connector strips, and the ends of the wires of a cable are all parts of a radio receiver where eyelets may be used to advantage. Perhaps the most notable example of the use of punched eyelets is the A. K. terminal strip.

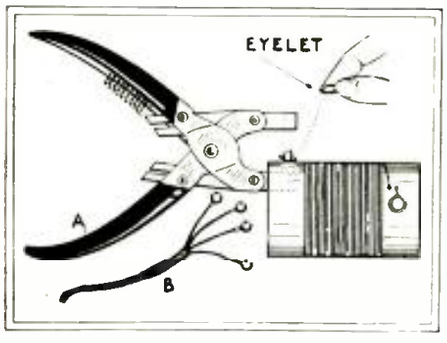


Fig. 1

At A, a simple eyelet punch used to form terminals on a coil; B, a cable with neat eyeletted terminals.

Now then, the point is that the set builder may also use this comparatively simple manufacturing process, with practically no expense; and at the same time, make a really neat job of his experimental home-made apparatus.

The use of the punch and eyelet kit is illustrated in the accompanying drawing. Here the punch pliers is shown, inserted into a hole drilled in the solenoid coil form. To use, without removing punch from hole, put on the eyelet over the punch—small end down—and close tool.

A second illustration, suggesting the use of punched eyelets, shows a dynamic speaker's four-wire cable with eyelet terminals. It is apparent that, when these terminals are put on a 6/32 or 8/32 machine-screw binding post, they cannot come loose.

RULING PEN HANDY TOOL

By Arthur Bernd

IN putting nuts on bolts in tight corners and down deep in the set, I use a draughtsman's steel ruling pen, which (as you know) is shaped like a pair of tweezers, with a stud running through to tighten it.

By placing the nut in the ends of the pen and screwing down on the stud, it is very easy to set the nut on the bolt; after a few turns the pen is withdrawn and the job finished with a "spin-tite" or other wrench. This little trick saves a lot of time and patience; and is far better than breaking off the point of a lead pencil or using some adhesive paper on the end of an instrument or piece of wood.

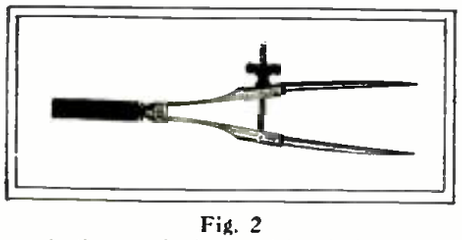


Fig. 2

Another proof of the might of the pen.

CONVENIENT WORKBENCH LIGHT

By Boris S. Naimark

THIS handy extension light for the workbench takes the place of several lamps permanently installed; it is available at any point of the workbench and can be shifted from point to point with ease; and it requires nothing, that can not be found in the junkbox, for its installation.

Stretch a length of steel or "stovepipe" wire from one end of the bench to the other, preferably over the center of the bench and approximately three feet above it. Slip over it a piece of insulating tubing which may be between three and five inches long. Secure the electric-light socket, as shown in the accompanying drawing, at the height considered most convenient.

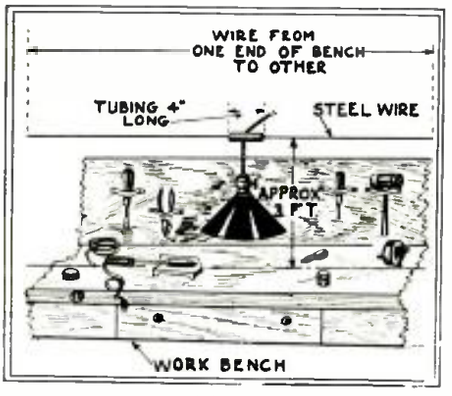


Fig. 3

The method of suspending a lamp above a work bench is safe and convenient to a high degree.

The lamp can now be moved the entire length of the bench, and thus makes light instantly available wherever it is needed most.

A SHORT-WAVE CABINET

By M. D. Rubin

THE average short-wave set has no cabinet; because the constructor generally either does not wish to spend the necessary sum on such a set, or cannot make a good cabinet himself. Thus the set is open to dust, etc., and people handle the parts indiscriminately, with the result that the set depreciates rapidly. A suitable cabinet should not cost much, should allow space for an uncrowded, reasonably-sized receiver, have a place for the coils and, if possible, for the earphones. If it could also hold several small batteries, wire for the antenna, have a handle and yet not be too big, it could be used as a case for a portable. One of this sort would be the *ne plus ultra* in shortwave set cabinets.

Such a cabinet can be improvised very easily, by utilizing an old 100-ampere-hour battery case. When the set is made, cut the panel to two-thirds the size of the opening in the battery case, then put in a partition, leaving a third of the case for other things, (coils, batteries, etc.) Mount the parts on a baseboard and then put the set in the case; do not try to mount the parts on the inside of the case, as it will be very difficult. Use the extra third of the panel as a cover for the extra division. Keep this closed with several hinges and a catch.

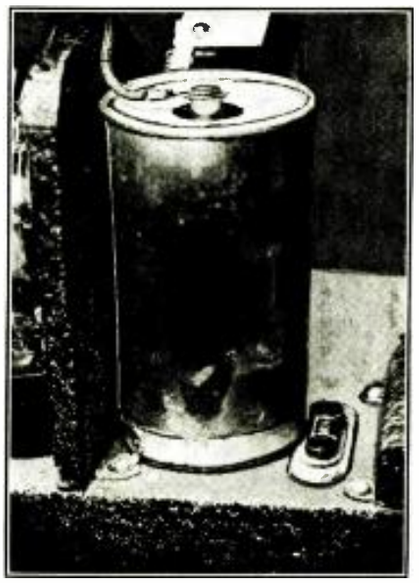
Of course, such a cabinet can be used for any small set, especially a portable one. With such an arrangement, a short-wave set should make an excellent portable; especially since a short-wave set uses such a small antenna, and will work such long distances with so little power.

A GOOD SCREEN-GRID SHIELD

By John J. Nothelfer

AN efficient and attractive screen-grid tube shield can be made from an ordinary baking powder can; the latter is turned upside down and a round one-inch hole is cut for the cap of the screen grid connector, as illustrated. Two soldering lugs are soldered to the cover of the can and bent;

(*Continued on page* 501)



Almost every kind of improvised coil and tube-shields has been used. Mr. Nothelfer finds a tin one, however, which would seem sufficiently inexpensive.

A Home Made Slide-Wire Bridge

Apparatus which will add to the experimenter's Laboratory the means of making many desired measurements

By A. W. BONSER

ONE phase of radio electrical measurements, which is too little discussed, is the measurement of resistances. Of course, "ohmmeters" are a familiar radio service tool in many kit bags—but not everyone can afford this complete resistance-indicator; nor even the milliammeter used in its construction. And besides, seldom are they sufficiently flexible to accurately cover such extremes of resistance as may be found between the partially-shorted voice-coil of a dynamic reproducer, and a grid leak of wrong value.

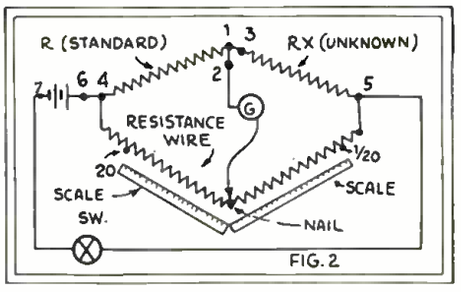
From past experience, I know that there are times when rheostats, grid leaks, and resistors generally, get mixed; the tags that are pasted on, or the painted markings, come off and the only way of determining their value is by guesswork. For these reasons, an article showing the construction of a measuring device should be of interest to every experimenter; particularly, if it may be constructed at little cost, and yet have a practical degree of accuracy.

The parts required are as follows:

Nine binding posts;
One brass strip, 3 x ½ x 1/16-in.;
One paper strip 36 x 1 in. (B);
One length of No. 22 resistance wire, 4 ft. long (C);
One S.P.S.T. switch, (D);
One baseboard 4 x 26 in., (E);
One small compass, (F);
One compass block 3½ x 2¼ in., (G);

To hold the compass (F) a hole is bored in the block (G) in the middle of the narrow width and as near the end as practical; leaving about ¼-in. from the edge of the hole to the edge of the block. The hole should be bored just deep enough to leave the face of the compass flush with the surface of the block. Drill two holes on the opposite end for the binding posts, (8, 9). Place the compass in the hole and wrap about ten turns of No. 22 D.C.C. wire directly over the center of the compass, in the manner shown in Fig. 1. Bring the two ends to the binding posts. Apply a coat of shellac to the wire to hold it in place. The result is a "galvanometer."

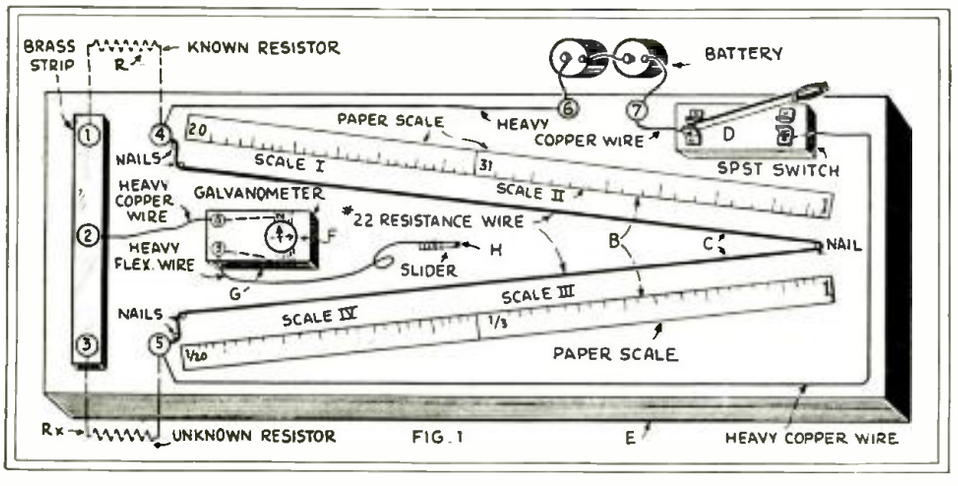
The next step is the assembling of the "Wheatstone bridge" proper. Drill three holes in the brass strip; one ⅜-in. from each end, and another directly in the center. The size of each hole is 3/32-in.; or large enough to pass a bolt for the binding posts (1, 2, 3). Then, drill holes in the baseboard for binding posts 4, 5, 6, 7. Mount the brass strip, ½-in. from the end of the base. Measure off 40 inches of No. 22 resistance wire, 4 inches longer than the paper scale; two inches at each end are allowed for connections. Fasten the two ends under the binding posts, as illustrated, with a small wire nail and draw the wire tight, without stretching, to form a long "V", then, drive the nail into the baseboard in the approximate center. Cut the paper in half, or at



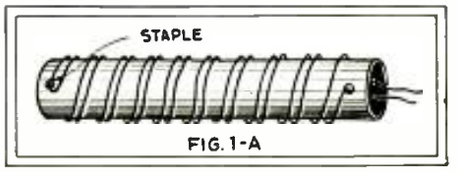
The familiar Wheatstone bridge circuit, showing schematically (not in structural arrangement) the principle of the device described here.

1-1; and paste it beside the resistance wire; the scale provided in Fig. 3 may be copied on it, and will serve to eliminate most of the figuring required with a 0-100 scale, more commonly used.

When measuring small resistances, a low value of known resistance is used, and the same relation applies to a large resistance



The lay-out of the slide-wire bridge; it will be seen that practically no expense is incurred in its construction with the home-made meter used. Fine copper wire might be used for C, except for its mechanical weakness; but it is desirable to have a standard resistance value at R to start from.



In order to make a non-inductive resistor, the value of which can be closely determined, use fine wire in a double winding

by using a high, known resistance. Low resistances may be made; but high resistance units should be of the manufactured type; and guaranteed accuracy.

When making a resistor, care should be used to construct a *non-inductive* unit. For example, a 100-ohm non-inductive resistor would be made by winding 72½ in. of No. 34 resistance wire on a tube about ½-in. in diameter and 6 in. long. The wire is first doubled into half its full length, the loop caught over a pin, and the two strands wound as one, as shown in Fig. 1A. About ½-in. is allowed on each end for connections. The resistance of No. 34 wire is 16.6 ohms per foot. Attention is called to the fact that this resistance wire seldom is insulated; and care must be taken to keep the turns from each shorting.

For measuring small resistances (of about 10 ohms) cut a piece of No. 34 resistance wire about 7¾ in. long and connect it to the proper binding posts; letting it hang in place, as this length of the wire is sufficiently stiff to be self-supporting.

All connections should be kept as tight as possible; so that the least possible amount of resistance will be added at these points. "A straight line is the path of least resistance."

To make the slider H cut a piece of No. 14 copper wire, preferably stranded, just long enough to reach the length of the mounting board. Get a small piece of No. 10 or No. 12 wire, about 2 in. long, and solder it solidly to the stranded wire. Wrap the connection with friction tape. When soldering, use only resin as a flux to prevent the slight corrosion that would occur if other flux was used. Use a hot iron, (not red hot) and clean the joint with alcohol.

Before measuring a resistance, arrange the galvanometer so that the coil, as wound over the compass, points in the same direction that the needle normally would—that is, toward the earth's magnetic poles. (As in Fig. 1). Then, when the current is sent through the coil, the magnetic field established will deflect the needle and the needle will try to arrange itself at right angles to the coil, as indicated by the dotted needle. Connect the known resistance between 20 and the brass strip (posts 1 and 4), and the unknown resistance between 1/20 and the brass strip (posts 3 and 5).

After the galvanometer has been properly arranged, close the S.P.S.T. switch D

and touch the slider to the No. 22 resistance wire, note which way the compass needle is deflected; then, on the opposite side of the scale, touch the wire again and, if the needle is deflected in the opposite direction, the point of balance lies between the two points touched. For example, first touch the slider to 5, and note the direction the needle is deflected. Then touch the slider at 0.5; and note the direction in which the needle is deflected. If in the opposite direction, the point of balance lies between 5 and 0.5; if in the same direction, the point of balance will be found either between 20 and 5, or between 0.5 and 1/20.

When the slider strikes a balance on the scale lower than 1, the unknown resistance will be less than the known resistance; and when the point of balance is above 1, the unknown resistance will be higher than the known resistance. The known resistance, in either case, is multiplied by the reading on the scale.

As the slide-wire used for two of the legs of the bridge is very small, it is necessary to be careful and avoid excessive wear. For this reason the slider should be *touched* to the wire at various points, to obtain readings—not slid along its length.

Practically every electrical handbook discusses the slide-wire bridge. Therefore, the constructor will find numerous examples which may be studied, after he has built his bridge for experimental verification of his figures.

After you become familiar with the workings of the bridge, it can be operated in a very short space of time.

One advantage in the use of a carefully-made bridge is the convenient determination of such elusive radio receiver faults as leakage and shorted turns, sometimes found in R.F. coils. In particular, it is sometimes difficult to determine whether a voice-coil having a normal resistance of only 15 ohms has a short across only three or four turns; unless some such arrangement as the bridge is available for checking against a voice-coil of similar type which is known to be good. In this test, the resistance of the good coil is the "known" value to be checked against the "unknown" of the other voice coil.

To Save Figuring

The scale given in Fig. 3 has been carefully computed, to save the user of the slide-wire bridge a great deal of the figuring which would be necessary with the conventional 0-100 scale. If it is used with a known resistance R of a value of 1, 10, 100, 1000, etc., ohms; the values may be read directly from it. Its accuracy is greater than that which is likely to be obtained in the set-up of the apparatus.

It is 36 inches long, and intended for use with a 40-inch length of resistance wire, which is doubled back at its electrical center—the point 1 on both sides of the scale. The two sections I and II are continuous, and represent, as in Fig. 1, the upper side of the scale, where the value of the unknown resistance Rx is higher than that of the standard resistor R. The value of the latter is therefore multiplied by the number on the scale at which a balance is obtained on the slider.

The sections III and IV are also continuous, but reading back from right to left (if the constructor wishes to use a continuous length of resistance wire, he can mark off these divisions in reverse on a straight 36-inch scale). Here the known resistance is also multiplied by the scale reading, but it is in this case a fraction less than one, as the unknown resistance is the smaller. From 99 to 10, the scale readings are in percentages; below 1/10 they are common fractions.

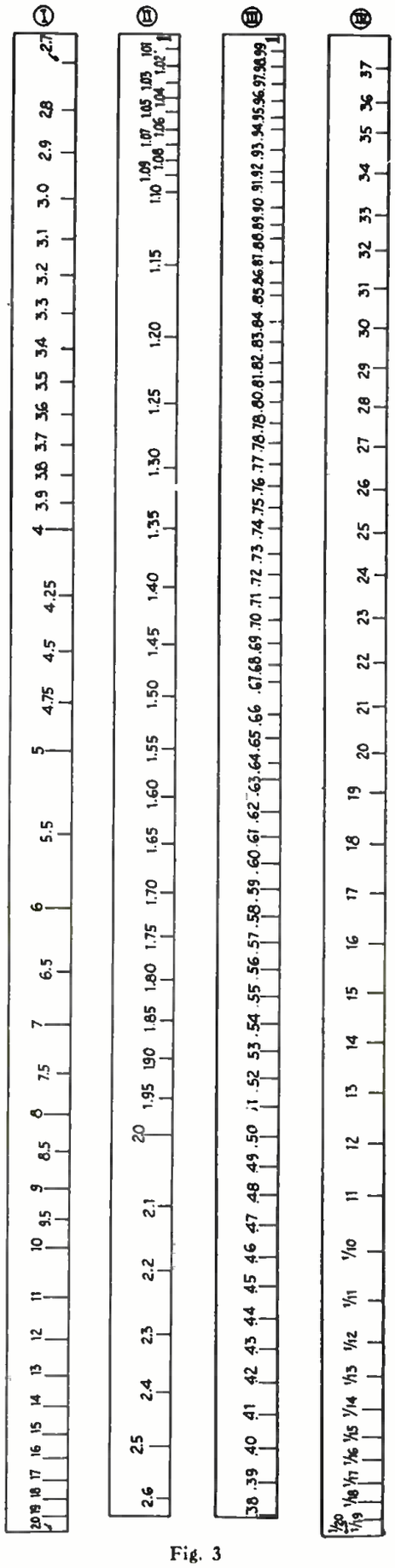


Fig. 3

The calibrations on this scale indicate directly the ratios between the two sections of a 40-inch resistance wire, when the two figure 1s are at its center; reading up on I and II, and down on III and IV. The markings may be transferred to the experimenter's own chart.

While the scale divisions might have been carried further, there is hardly practical value in doing so with apparatus as simply designed as the above. The sensitivity of the circuit will depend upon that of the galvanometer used; and the accuracy of the reading on the lowest attainable figure of the resistance in the connections and leads of the bridge.

Before the scale is permanently attached; it will be well to test the balance of the bridge with a number of resistors, not necessarily of known value. By placing one at R and another of considerably higher or lower value at Rx, one reading is attained. They are then interchanged, and a second reading is taken. If the two readings, multiplied together, equal 1, the bridge is well-balanced; otherwise, some correction or compensation will be needed.

From one resistor of accurately-known value, it will be possible to calibrate a set for ordinary purposes of the experimenter's shop. The attempt should not be made, with this bridge, to measure ratios too high; for reasons pertaining to the external circuit, particularly with low resistances. While the scale will measure a resistance 20 times, or 1/20th, that of the standard, inaccuracies creep in more regularly when working at either end.

Commercial resistors within 5% of their rating are not expensive; those accurate to a greater degree are expensive in proportion to their degree of precision. However, measurements cannot be more accurate than the meter.

Incidentally, the experimenter might find a suggestion in using a standard vacuum tube in a socket whose filament prongs are connected across R. A '26 tube, for instance, has a filament resistance of 1.43 ohms; an '01A, of 20 and a '99 of 52.4, nominally. A variation is allowed in manufacture; but a number of tubes might be tried, and the one nearest the average used as a test resistor, for low values.

Below are some figures which may be of use to the experimenter as an indication of the resistance of certain standard wires:

TABLE I

Resistance in Ohms of 40 Inches of Wire

Gauge	Nichrome	Con.	Iron	Copper
11	0.48	0.24	.06	.008
16	0.77	0.37	.09	.013
18	1.25	0.60	0.15	.020
20	1.95	0.97	0.22	.032
22	3.12	1.53	0.37	.051
24	4.95	2.44	0.60	.081
26	7.91	3.86	0.94	.130

(Con. stands for constantin; the resistance of pure iron is about the same as that of nickel. These resistances, of course, may be slightly different in a short stretch; and current enough to change its temperature should not be applied to a resistance-wire standard.)

The Radio Craftsman's Own Page

What our experimental readers have found out for themselves

ADDING AN AMPLIFIER

Editor, RADIO-CRAFT:

Your readers may be interested in the diagram of my short-wave receiver which I am using for the present; although I intend to build a set of more advanced design—more sensitive, selective, and powerful—at a later date.

Desiring to avoid the objectionable squeaks and howls incident to tuning in various stations for the edification of the rest of the household, this system was evolved.

Stations are logged so that they may be approximately tuned in, by setting the tuning dials at the indicated numbers. Then, the change-over switch SW1 is set in the position for headphone reception and the battery receiver (a modified "Wasp") turned on. A little more juggling of the controls, and the station, if on the air, comes in clearly on the headphones; which are in the plate circuit of the '01A, working at 90 volts, connected as the second A.F.

It was found that this combination—an '01A detector, '01A first A.F., and '01A second A.F.—resulted in a signal level at the headphones, from weak input signals, of a value about right to operate two '71A tubes in push-pull for reproducer operation, when the input to these two tubes is taken from the output circuit of the first A.F.

Therefore, the next step was to wire up a single stage of '71A push-pull amplification as a complete unit; which is switched into use by closing the light-line switch in the primary of its power supply transformer and moving switch SW1 to its second position.

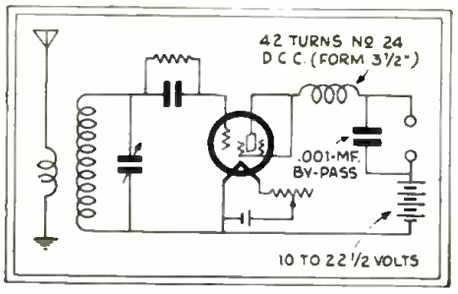
This idea for conveniently monitoring a radio set may be applied to any type of set, whether short-wave, broadcast, or television.

C. MAGGIO, JR.,
6403 14*th Avenue, Brooklyn, N. Y.*

A SCREEN-GRID TRIODE

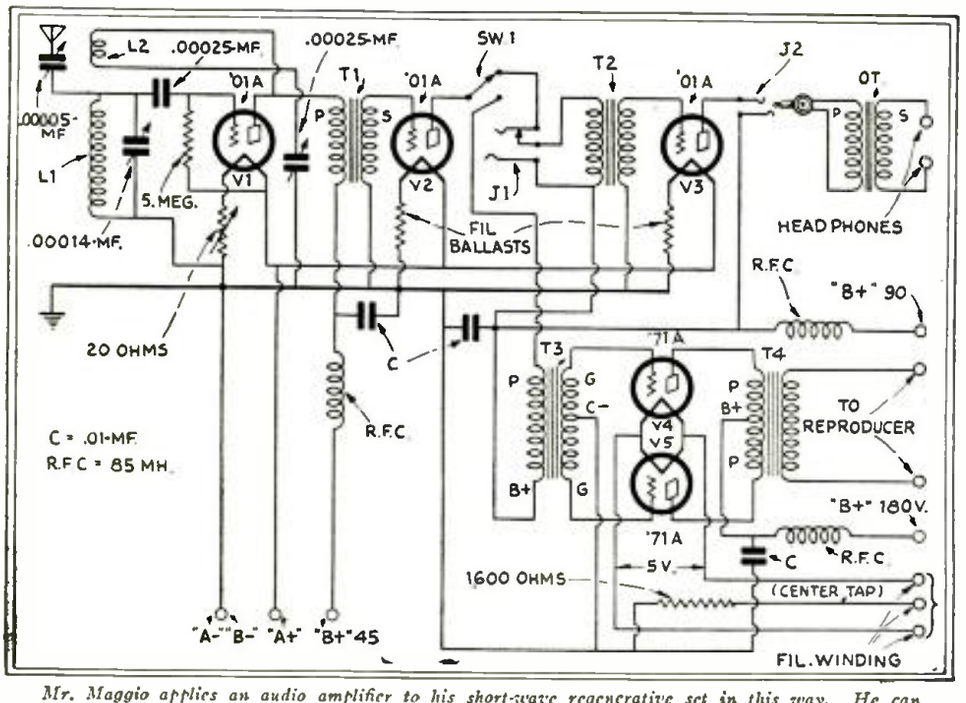
Editor, RADIO-CRAFT:

Here is a circuit which is apparently a combination of the Solodyne and the regenerative principles. It is not what I was searching for; but it may interest other readers. It is obvious that the screen-grid tube is well suited for use in a circuit of this nature, because of the large surface of the anode when screen-grid and plate are connected as shown; this reduces the space charge and increases the plate current. I used an oscillator for preliminary tests; and, for final tests, used a broadcast station thirty miles away. I found that signals were audible without a "B" battery, and with 3 volts from a flashlight battery on the plate they had fair volume. With 22½ volts on the plate, the volume was very good; and a higher voltage, instead of raising the signal level, seemed to reduce it, probably because the tube was choked by the heavy plate current.

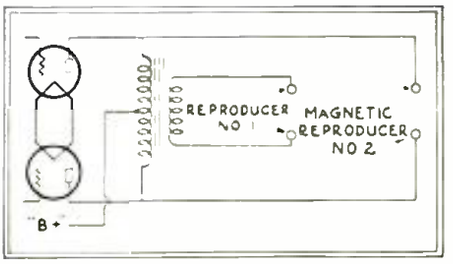


Mr. Shanahan's low-voltage regenerator.

In this circuit, the regeneration is effected by feeding back energy, not by an inductive secondary winding, but direct to the screen-grid. Of course, it is well known that, when the tube circuits are in resonance, feedback will take place through the inter-electrode capacity of the tube.



Mr. Maggio applies an audio amplifier to his short-wave regenerative set in this way. He can thus conveniently tune in stations and put them on the loud speaker.



Mr. Tinker's set is monitored at No. 2; but this connection should be taken out only through high-voltage condensers.

I made the experiment of disconnecting the screen-grid again from the plate, and applying the same positive potential to the former from a separate "B" battery. The signal level was then considerably less, and proved that the increased sensitivity was not due merely to the increased plate current.

The only advantage of this circuit is that one can get regenerative results with but a few volts on the plate.

JOHN SHANAHAN,
96 *Edson Avenue,*
Waterbury, Conn.

(The screen-grid is really a second plate, when hooked up in this manner, and draws what is truly a "plate" current. It is possible to apply interesting circuits to the multi-electrode tubes, and experimenters will find a good deal of pleasure in the possible combination.—*Editor.*)

WIRING THE HOUSE

Editor, RADIO-CRAFT:

Wanting for some time to have extension loud speakers in the other rooms, I finally solved the problem when the women were out—as they object strenuously to the extension of wires "all over the place." My set, it will be observed, has a push-pull output; I can use two speakers in the manner shown.

I attached two wires to the secondary of the transformer, running one of them to the hot-water radiator. The other, a very fine wire (about No. 28 cotton covered) I concealed along the picture moulding and door trims, extending it to every room in the house.

I then had only to fix a small jack, or pair of tip jacks, in whatever room I might want a speaker; connecting one side to the radiator, and the other to the fine wire. By proper location, I could practically avoid any visible wiring. The connection to each radiator was made by loosening the screw of the valve handle, and tightening it on the connection.

With a magnetic speaker, the music comes through with excellent volume, not being affected when the radiator is used as a ground; but the "choke" connection to the primary can be used in this way only if some method of isolating the speaker from the D.C. plate potential is used. I use No. 2 to monitor my tuning, and then disconnect it, when only the extension speakers are used.

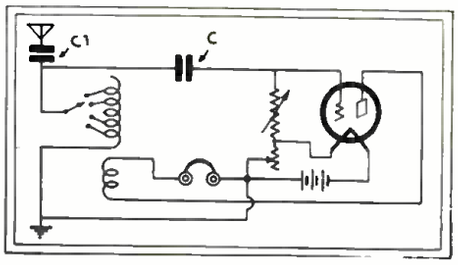
A. M. TINKER,
856 *No. Lockwood Avenue,*
Chicago, Ill.

ANOTHER ONE-TUBE SET

Editor, RADIO-CRAFT:

I found Mr. Hall's circuit, in the October issue, very interesting; because I have had some experience with one of a similar type. With an '01A or a '99 tube, and an ordinary aerial and ground, I have received WGY regularly and WJZ frequently, as well as WHP, a 500-watt station at Harrisburg, Pa., 35 miles away.

Standard parts are used, with a variable 1-5-megohm grid leak. The aerial condenser is .0005-mf., and the grid condenser the usual .00025. The circuit is shown in the accompanying sketch, which will, I trust, be interesting to other readers of RADIO-CRAFT.



Another circuit without a "B" battery.

CHARLES S. LUPP,
Aspers, Pennsylvania.

(As previously explained, while none too efficient, these circuits do operate to a certain extent on strong signals; because the plate is positive as regards the negative end

(*Continued on page* 499)

Dual Rectification With Crystals

By R. J. ROBBINS

IN these days of multi-tube sets involving several stages of radio-frequency amplification, tube-detectors and audio amplifiers of terrific powers one is prone to disregard the older and less complex crystal circuits which were their forerunners.

For the serious-minded experimenter, however, much remains in the opinion of the writer, to be discovered and written of the lowly crystal. The object of the present article is to present an interesting phenomenon pertaining to the crystal—that of dual-rectification.

Most ideas on this subject involve the use of split headbands. In the present experiments, the output of two crystals is very satisfactorily handled by a single headset.

Two circuit-arrangements are here offered, but the basic principle in each will be seen to be the same. The only difference is in the tuning arrangements. In Fig. 1, the R.F. currents from the antenna pass through a variometer which is placed in simultaneous inductive relation with two exactly matched secondary tuning circuits. These coils may be tuned individually to resonance with the antenna-circuit by means of the two .00035-mf. condensers shown.

The tuning-arrangement of Fig. 2 is an alternative method for the benefit of the experimenter who has no variometer at hand. It may consist of two secondaries, as previously outlined, and a simple aperiodic primary L of from six to ten turns (all three coils being wound on the same tube) or, better still, the primary may be tuned. In such case the coil may have approximately half as many turns as the secondaries; it may be tuned through a considerable range by means of a .001-mf. condenser used in conjunction with a series-shunt switch. This affords three possible variations of connection; condenser in series with coil; in parallel; or out of circuit, as desired.

The actual functioning of the circuit as a whole, being somewhat complex, will be described as follows: (1) the incoming signal wave induces currents in primary-coil, X.

(2) Similar R.F. currents are induced in the two exactly matched secondary inductances, Y and Z, which are tuned in unison.

(3) By means of the switch D, either or both of the coils Y and Z may be put into operation. Assuming that a signal has been tuned in and that the switch D is in the position shown in Fig. 2, the coil Z is temporarily disconnected from the circuit allowing independent tuning of coil, Y.

(4) The wave passes through the switch-arm which makes contact at points 5 and 7, to the center-tap on the special output auto-transformer A-B-C; it then is rectified by the crystal E, and impresses audio currents upon the winding, A-B. Owing to the fact that there are twice as many turns in the total winding A-C, as there are in the section A-B, the voltage existing across A-B will be doubled at the terminals where it is impressed upon the phones. It is understood that this process has thus far utilized but one half of the wave; the other half being lost in rectification.

(5) The coil Z, meanwhile, has been disconnected from the circuit. Let us now assume the switch-arm to be in the opposite position, with contact arms resting on the points 1 and 3. Coil Y is now dead and coil Z is permitted to function. The wave now passes, as before, through the switch to the center-tap of auto-transformer, A-B-C, passes through the winding B-C, and back to coil, Z, via the crystal F where rectification takes place. This crystal, however, is reversed, allowing the opposite side of the wave to pass, this being the half of the cycle previously lost.

(6) The wave in passing through the rectification circuit produces audio currents in the winding B-C of the audio choke, which now functions as a primary while the total winding A-C acts as a secondary. Again the voltage doubles; but this time in a cycle opposing the current flowing in the other leg of the circuit. From the terminals of the choke the resultant current is fed into the phones.

(7) It being understood that current can flow in either leg of the circuit *in but one direction only*, we must conclude that each side of the circuit is temporarily dead during one-half of each alternation. During that period the opposite leg functions, delivering exactly the same volume of audio (providing both R.F. circuits are in resonance and are tuned to the same wave) to the mixing-circuit, A-B-C.

(8) The coil, Z, thus being allowed to function and both R.F. circuits tuned to the same exact wave, we now set the "V"-shaped switch-arm to the points 3 and 5. Both tuning circuits will now deliver rectified R.F. to the mixing-circuit, A-B-C. If all adjustments have been carefully made, a noticeable increase in volume should immediately become apparent.

(9) The primary inductance is next adjusted to a value calculated to allow the greatest voltage transfer to the two secondaries, Y and Z.

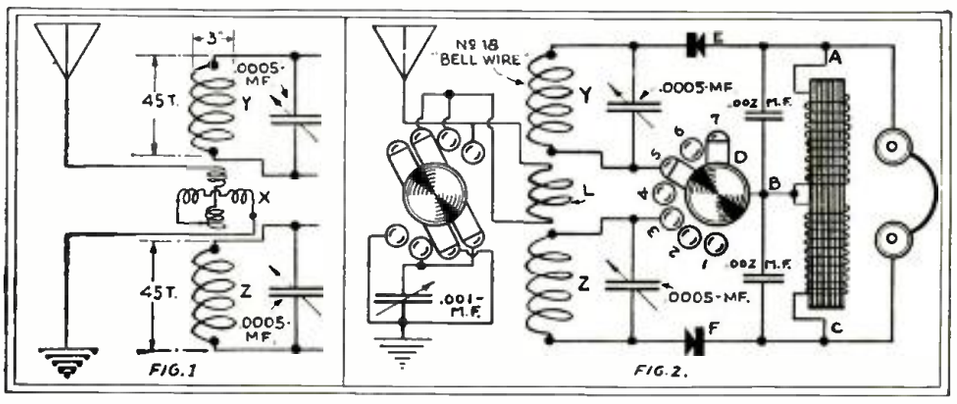
(10) It is obvious, from the nature of the circuit, that the tuning-condensers are electrically independent of each other. Condensers of the tandem type with common rotor will not do.

The writer does not wish to convey the impression that the "Duo-rectifier" is necessarily a distance-getter. The actual result obtainable with this fascinating circuit is the production of louder, clearer musical and voice reproduction than is possible with the crude, conventional crystal receiver.

Several interesting experimental possibilities will doubtless present themselves to the research worker as he progresses in his study of the circuit. For instance, it will be entirely possible to tune two stations into the "mixing circuit" by making slightly different adjustments of the two secondary condensers. The "mixing" should be rather complete in such case. This experiment is more interesting than useful.

Needless to state, this circuit or any other

(*Continued on page* 507)



At the left, the dual-crystal tuner with a variometer: it is connected to crystals as in Fig. 2. Right, the switching arrangement used by Mr. Robbins in his experiments.

The Screen-Grid Frequency Changer

Some ingenious experimental suggestions for the use of multi-grid tubes to obtain superheterodyne circuit action

By R. TABARD (Paris)

IT is well known that the great merit of the superheterodyne lies in its sensitivity, the counterpart of which is a lack of musical fidelity. However, we must avoid the conclusion that it is undesirable to seek for extreme sensitivity; for in a highly-sensitive receiver we may introduce "flat-top" tuning which gives us better reproduction. This, however, implies a loss of sensitivity which would be serious in apparatus of lesser amplification; but it may be ventured upon with well-constructed apparatus.

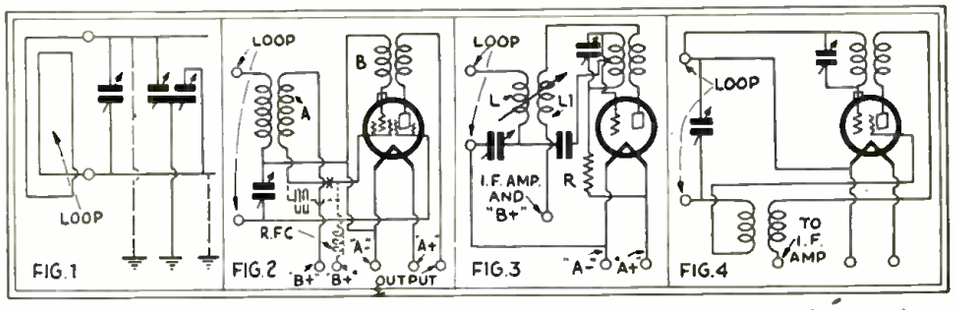
The ideal method of reception is to employ a very symmetrical, well-balanced loop, which may be accomplished by the use of the Mesny compensator, a double condenser, which serves to equalize the capacities to ground of the two circuits on either side of the loop (Fig. 1). In case of battery operation, care should be taken to reduce the capacity of the leads to ground, by supporting them with insulators.

Another method of increasing sensitivity is to introduce regeneration into the loop, which tends to balance its positive resistance by a virtual "Negative" resistance. For this purpose we may use a three-grid tube as shown in Fig. 2. The two coupled circuits, A and B, are heterodyning A.C. generators; the first of which uses the middle grid as a plate, the other the usual control-grid and plate. The rule is that in A we must keep below the point of oscillation which is reached in B. It is possible to utilize a choke coil and condenser for coupling into the circuit A, as shown in the dotted lines.

This regenerative effect is more satisfactory as the intermediate frequency is higher. The Tropadyne circuit is especially well fitted for this purpose. Fig. 3 shows a standard arrangement, in which the winding L is in series with the collector loop, and is coupled to another winding L1 in series with the plate circuit.

We prefer, however, to return to the use of a double-grid tube as a frequency-changer, and to apply regeneration as shown in Fig. 4. A thousand and one arrangements of this idea may be employed. The experimenter may see what is to be done with these first circuits as a starting point.

The loop, we have seen, should be carefully balanced; wound with wire of sufficient size, carefully insulated, and designed for low losses; the latter requirement is necessary in all coils employed.



Left, a loop-balancing method with a double-stator condenser; next, a regenerative pentode circuit; center right, a form of the Tropadyne hook-up; and lastly, a double-grid combination. Figs. 2 and 4 use tubes of distinctly European type.

When we consider the oscillator, it is evident that it must live up to its name. The formula says that oscillation is approached as the positive resistance in the grid circuit is overcome by the "negative resistance" caused by the coupling between plate and grid. When they are equal, oscillation begins.

It is easy to see that oscillation commences more easily when the tube's amplification factor is very high, and in the same order as its capacity. This, in particular, produces feedback when the tube's plate circuit is blocked by its own resonance. We must not lose sight of the fact that the internal resistance of the tube is not a uniform one—thereby causing detection—and that, consequently, the quality of detection depends on the over-all characteristics of the tube.

In the double-grid tube, which is the most interesting type, we may avail ourselves of the low inter-element capacity and the high amplification factor, both of which increase the over-all sensitivity of the receiver. At the same time, it is necessary to use high plate voltages because of the high internal resistance of the tube.

Without going too deeply into the case, we find the characteristics of the ideal tube in the new and already large family of screen-grid types. The same remarks apply to them as to the old double-grid tubes in which, for the greatest efficiency, we must provide proper neutralization between grid and plate. Take Fig. 5 for an example; the circuit is standard, except for the compensating circuit L-C. Again, a very simple procedure is to take a regenerative circuit, such as we have shown already, and reverse the connections.

We have now come in a circle, from the application of regeneration to that of counter-regeneration; it is easy to turn from one to the other. In the latter case, desiring to use the tube with the highest amplification and the least internal capacity, we come again to the screen-grid tube as our best frequency-changer.

Local oscillations may be coupled to this tube in many ways, conductively, inductively or capacitively. For best results, the impedance of the I.F. amplifier input must be in the order of that of the tube itself, which is not attained without difficulty.

A skillful technician, Mr. Blondel, states that he has found results most satisfactory when the primary of the I.F. transformer resonates at twice the intermediate frequency. If we use the Tropadyne circuit previously mentioned, the I.F. input coil may be inserted in either the plate or the screen-grid circuit, which gives us a choice of two new circuits. (See Fig. 6.) This coil may be connected across either A or B; a jumper being used in the other position. For correct operation, the values of the circuit must be so chosen that, in the normal condition of the circuit, no plate current flows.

An improvement due to Mr. Blondel is found in the reduction of the damping impedance by utilizing only half the inductance of L. If we consider the R.F. signal as applied between the control grid and the filament (Fig. 6), half the coil L is on the grid side; since the signal is applied at the center tap. This reactance is sufficient.

We encounter difficulty when a capacity is substituted, as in Fig. 7; but, since we cannot leave one end of the coil in the air.

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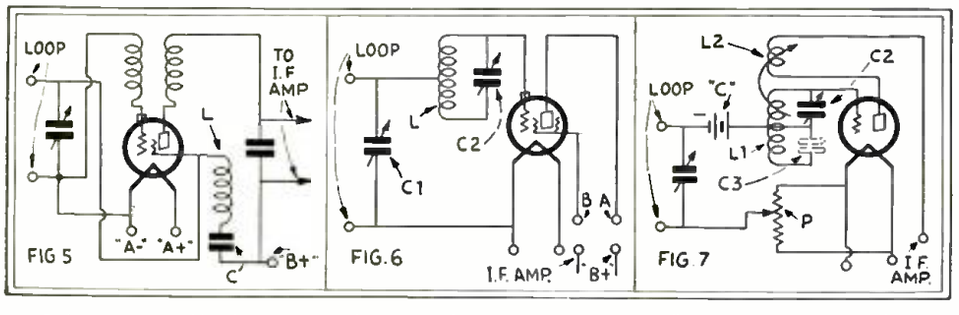


Left, a screen-grid tube used as a frequency-changer; center, another Tropadyne adaptation; right, an improvement of the preceding. These circuits are given only for their theoretical value; since the tube constants are not available (*Adapted from* L'Antenne.)

SPECIAL NOTICE TO CORRESPONDENTS: ***Ask as many questions as you like, but please observe these rules:***

Furnish sufficient information, and draw a careful diagram when needed, to explain your meaning; use only one side of the paper. *List each question.*

Those questions which are found to represent the greatest general interest will be published here, to the extent that space permits. At least five weeks must elapse between the receipt of a question and the appearance of its answer here.

Replies, magazines, etc., cannot be sent C. O. D.

Inquiries can be answered by mail only when accompanied by 25 cents (stamps) for each separate question.

Other inquiries should be marked "For Publication," to avoid misunderstanding.

"CLARION, JR., MODEL 60" MIDGET SET

(105) Mr. A. B. Carrig, Muskegon, Mich.:

(Q.) The schematic circuit of the Transformer Corporation of America's "Clarion, Jr." midget was shown on page 408 of the January, 1931, issue of RADIO-CRAFT, but without constants. Are the values available? Please print them in RADIO-CRAFT, if the answer is in the affirmative.

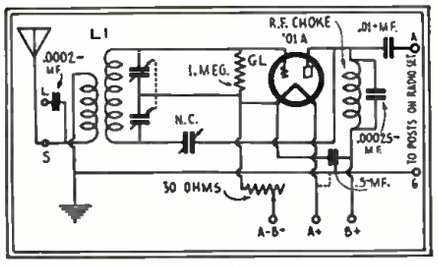


Fig. Q.107A

Original circuit of the Walbert "Penetrola" a shielded signal booster for connection to the "Ant." and "Gnd." posts of any standard receiver. The condenser N.C. must be properly balanced for neutralization of this R.F. amplifier.

(A.) Following are the values of components shown in the circuit of the "Clarion, Jr." radio receiver. The following reference letters appear in the diagram mentioned above, and previously printed: Tuning condensers C1, 420 mmf.; C2, C12, 0.1-mf.; C3, C15, 0.24-mf.; C4, C9, 0.5-mf.; C5 (tone control), .0005-mf.; C6, C10, 1.0 mf.; C7, C9, 1.5 mf.; C11, 0.4-mf.; C13, C14, 12 mmf. The resistors have the following values: R1 (volume control), 25,000 ohms; R2-1, 167; R2-2, 13,400; R2-3, 8,200; R2-4, 4,600; R3, 40,000.

KNIGHT "8/9 A.C." RECEIVER

(106) Mr. George Haag, Martins Ferry, Ohio:

(Q.) Please show in an early issue of RADIO-CRAFT the schematic circuit, with constants and color code, of the Knight "8/9 A.C." set. The receiver uses five '26s, a '27, and push-pull '71-A's; also, there is provision for connecting the line side of an A.C. dynamic reproducer to the light-line connections within the set. The Knight "8/9" is being offered by several different companies.

(A.) The schematic circuit of the Knight "8/9," with all data, is shown in Fig. Q.106. It is manufactured by a Chicago company; but is being handled under the "Knight" trademark, and several private brands, mostly by mail-order houses.

SCREEN-GRID "PENETROLA"

(107) Mr. J. A. Frederick, Portland, Ore.:

(Q.) Is it possible to modify an old battery type "Penetrola," using a type '01A tube, by replacing this with a screen-grid tube? Please show the simplest way of making this change, if practical.

(A.) By modifying the wiring of the original "Penetrola," or external R.F. amplifier (booster stage), shown in Fig. Q. 107-A, to conform with the screen-grid circuit shown in Fig. Q.107B, little difficulty should be encountered in obtaining the desired result.

It will be noted that the screen-grid tube will require a plate potential of 135 volts, for best results. Also, there has been added a binding post for the 45-volt tap, required for the screen-grid. The control-grid (cap lead) connects to wires formerly on the "G" post of the socket. As the dotted lines indicate, the neutralizing condenser N.C. is to be removed. Also, the return lead of the grid leak is to be moved from the filament side of the rheostat to the battery side; and another resistor, R, is added to the circuit to sufficiently reduce the "A" voltage (which should be checked by an accurate meter); the old rheostat, acting as combined filament control and "C" bias regulator, is to be

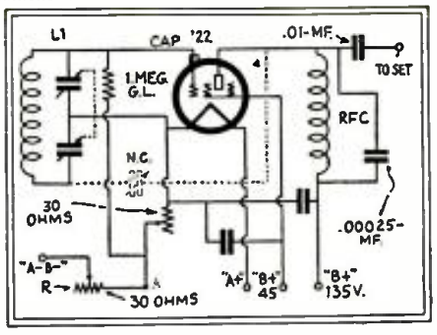


Fig. Q.107B

The "Penetrola" rearranged to use a '22 instead of an '01-A; the same antenna coil is employed, but the extra rheostat R is needed to reduce filament voltage and give proper bias. N.C. is eliminated; the two new bypass condensers should be 0.5-mf. or larger.

left in the position of best sensitivity. The bypass condensers may be of about 0.5-mf. capacity.

Whether the ground connects to "A+" or "A—" depends upon the "A" connections found in the particular receiver with which the unit is to be used.

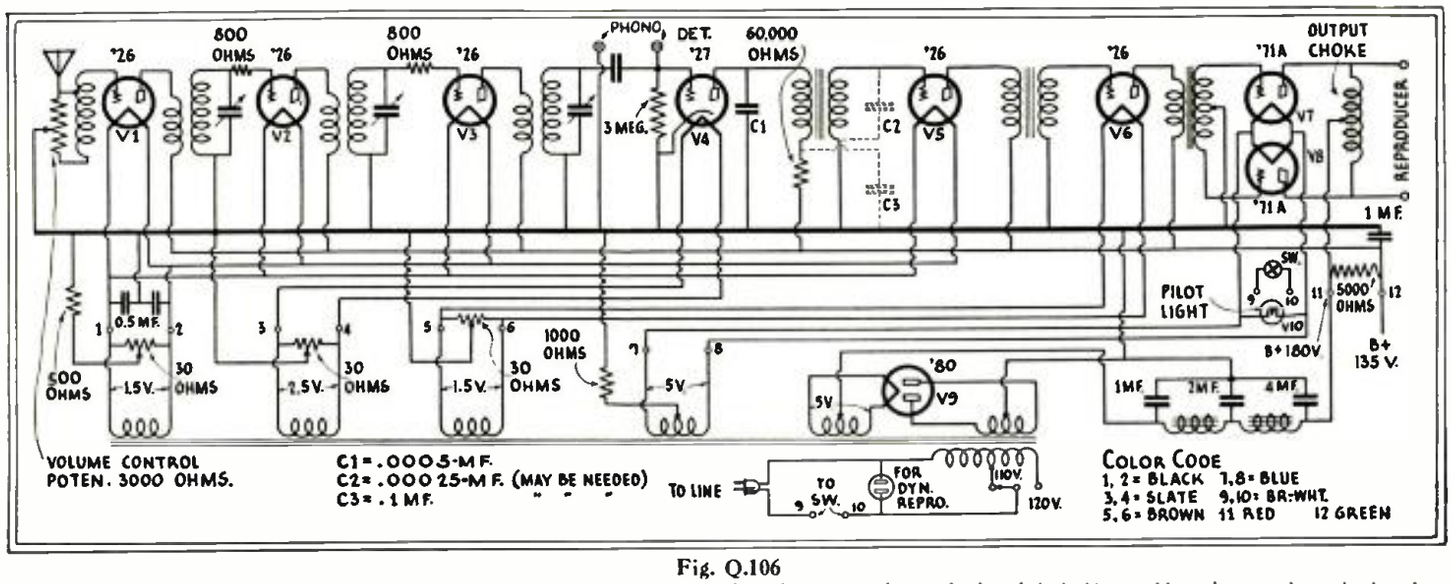


Fig. Q.106

A schematic circuit of a popular receiver, sold as the "Knight 8/9," and under other names; it may be found desirable to add condensers shown in dotted lines. C2, to check audio oscillation, will cure a high-pitched whistle in some cases; C3 may be required in some instances to improve tone quality. An open in its 60,000-ohm resistor will be indicated by lack of voltage on the detector; an open in the 5000-ohm resistor, between posts 11 and 12, by lack of voltage on all but the power tubes.

Earliest Radio-Recording

(*Continued from page* 469)

In March, 1913, this system of high-speed recording, and slow-speed reproducing, by means of the telegraphone and audion amplifier, was installed for commercial work by the Federal Telegraph Company between their San Francisco and Los Angeles stations.

Speeds up to 90 words per minute were thus handled.

In the fall of 1912, Logwood and C. F. Elwell, chief engineer of the Federal Telegraph Company, installed for the U. S. Navy at the Arlington station a complete three-stage audion amplifier-telegraphone recording outfit, which was purchased by the U. S. Navy.

In the spring and summer of 1913, the writer spent several months in recording voice and music on the telegraphone, using of course the audion amplifier both in recording and reproducing; having in mind to use this method for synchronized talking-pictures.

All of this work was so long ago, prior to any attempt to electrically record radio or voice on phonograph cylinders, that until I read Mr. Washburne's interesting article I had almost forgotten these historic incidents of 1912-13 in California and Washington. Very sincerely,

We are very glad to publish this interesting bit of historical material from Dr. de Forest. However, the story, "Home Recording of Radio Programs and Speech," in the December, 1930, issue of RADIO-CRAFT, was written only along the lines of amateur experimentation and did not take into consideration work which might have been done at a prior date in development laboratories.

In this connection Mr. Charles E. Apgar remarks: "The letter from Dr. de Forest, containing his kind comment on the work I did in 1913 on recording high-speed telegraphy and reproducing it at a slower speed, thus rendering it intelligible, came as somewhat of a surprise; for I was not aware that elsewhere high-gain amplifiers had been put to the same use, and as far back as 1912, at the Palo Alto laboratory of the Federal Telegraph Company.

"However, this work was undertaken by a well-equipped laboratory, with a commercial motive, whereas I was attacking the problem, at a later date, (in my home) from an amateur standpoint, and with no expectation of financial gain. Of course, for some time now, we have had laboratory recordings of radio programs; but only within the last few months has it become convenient for the amateur to record these programs.

"Again, it is interesting to observe that, while Dr. de Forest used a high-gain amplifier for his experiments, the recordings were made magnetically on the steel wire of a telegraphone; and not, as I did it, and as it is done today in home-recording, on a phonograph record sensitive to the vibrations of a recording stylus."

Operating Notes for Service Men

(*Continued from page* 459)

reducing the effective resistance to 200 ohms. It will often be necessary to experiment with this value; an Electrad resistor of the adjustable-end type, with a maximum of 500 ohms, may be used conveniently. Adjustment of the R.F. compensator and, sometimes, the oscillator trimmer at the extreme right, will be needed.

In these models and the "64," an open oscillator grid leak will sometimes cause unstable operation, and oscillation. The value is not critical; usually, about 40,000 or 50,000 ohms.

No. 1 on the audio filter unit, and tape it well. The black wire which runs to terminal 7 on the condenser block should then be unsoldered from this and connected to the red wire, which is removed from terminal No. 3 on the audio filter. Then a wire, soldered to the relocated tip jack, should be run to the plate of the audio tube. Often the slate-colored wire, soldered to the plate prong, has been disconnected and taped. These instructions, thus detailed, are given to obviate disturbing the cabled wiring of the receiver.

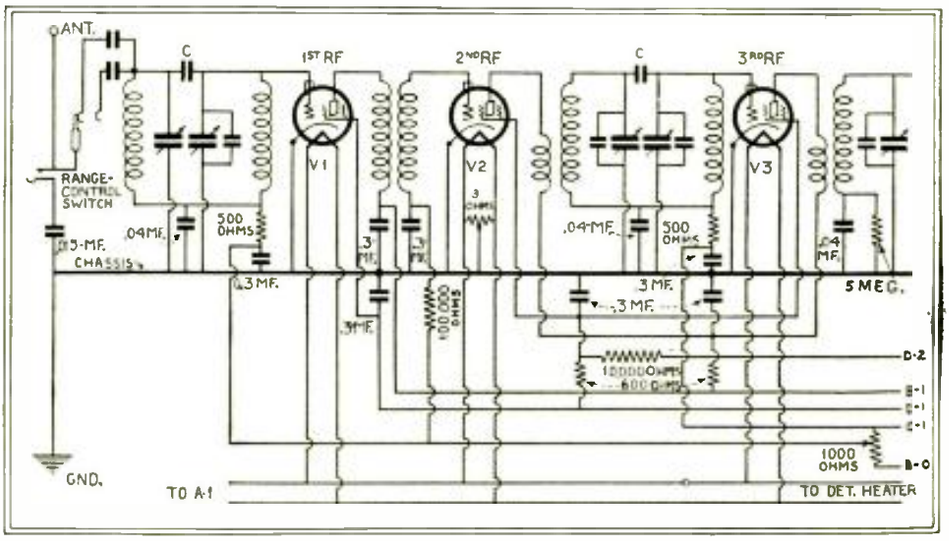


Fig. 2

The critical tuning capacities (C) of the "Bi-Resonators" or band-pass filters of the new Stromberg-Carlson models "10" and "11" regulate the amount of signal coupling. If these short to the shields, signals disappear.

Stromberg-Carlson

With the Stromberg-Carlson "635 A.C.," the use of a dynamic speaker which is not of the best is apt to result in distortion and lack of volume. Usually, the A.C. dynamic reproducer incorporates an "output transformer" which matches the impedance of the voice coil. The receiver named, however, has a choke-and-condenser output device, of a familiar type. The combination, therefore, of the unit with the transformer built into the speaker caused a drop in volume which could be remedied only by rewiring the chassis of the receiver to place the primary of the speaker transformer directly in series with the plate of the power tube (Fig. 1).

At the rear of the chassis, two tip jacks are provided, for connection to a speaker; one is grounded to the chassis, from which the other is insulated. To rewire the output, it is necessary to insulate this last tip jack; unsolder, and tape well, the wire which leads to it. Then remove the jack; it cannot be used in the same hole, because there is not room for insulating washers, but between or near the two hum-balancers, there will be found a small, unused hole. Fasten the jack into this, properly insulated.

The next step is to remove the red wire from the "B+" terminal of the output choke, and the black wire from the "P" terminal of the same unit. Couple and solder these two leads, and tape the joint well. Unsolder the black wire from terminal

The Stromberg-Carlson "612 A.C." has an output transformer, built into the chassis, with terminals at the rear; one side of this unit is at ground potential. This chassis is often used in a console belonging to the customer, and with a dynamic speaker of another make. Since these speakers often have one side of the voice coil grounded to the frame, care must be taken that the speaker frame is not grounded to the chassis; or it may happen that the grounded side of the voice coil will be connected to the wrong side of the output transformer—thus shorting the coil.

In the "846" Stromberg-Carlson, trouble may be encountered with the visual tuning meter. If the indicator does not swing over far enough for accurate tuning, a check of the second and third screen-grid R.F. tubes will usually disclose the defect. At other times, the indicator will swing over to the left, without giving a reading; checking the cathode by-pass will show the trouble. The meter will seldom fail to read if the set is operating efficiently; but if the 390-ohm biasing resistor is open, the meter will not register.

In the new models ("10" and "11"), the same manufacturer employs a novel band-pass coupling arrangement, called the "Bi-Resonator." There are two of these; the aerial is coupled to the first '24 R.F. tube by one; the second R.F. tube to the third by another. Each coupler is tuned by two variable condensers. The diagram shows a

condenser of small capacity coupling each pair of tuned circuits (Fig. 2). Lack of signals has been traced to these small condensers (which are nothing more than screws through the shields) shorting to the chassis. It is necessary to remove the shield from the condenser gang to determine this.

Other Makes

A short time ago, a Sparton "301 A.C." receiver gave much trouble, and many service calls were made to eliminate the distortion and rattle in the dynamic speaker. This unit was taken back to the shop, to replace the cone; and the Service Man who returned it could not complete his task satisfactorily. After the speaker was connected to the set, analysis of the latter showed low plate voltages on the '50 push-pull amplifiers. New '50s and '81s were rushed to the spot and inserted; but to no avail. Finally, it was found that the field coil of the dynamic was wrongly connected to the set chassis. In this model, the output transformer is located in the reproducer unit; while the field coil is used as a choke in the power supply filter, and connected, through the other, to the center tap of the high-voltage secondary winding on the power transformer. If this coil is reversed, then the power stage tubes will receive only about 110 volts; and this mistake may be made if the paint on the terminals is scratched so that the colors are not discernable. (Fig. 3.)

In a Majestic "90 A.C.," fading puzzled a number of Service Men until, after changing tubes and making all possible tests, they examined the nuts fastening the receiver's cable plug to the power-pack terminals. Vibration caused the plug to shift, and caused the fading. In this and similar models, it is wise to tighten every nut in the pack, to avoid future calls and dissatisfaction to the owner.

In the Brunswick "31," trouble may be experienced with the combination 25,000-ohm volume control and switch, which cleaning and treating with Nujol will not remedy. It is best to replace this part with the newer type of volume control obtainable from the manufacturer.

In the Kolster "K20" models, thrown on the market in great numbers, difficulty is most frequently encountered with the "starting howl," which occurs when the line switch is turned on and the '27 detector starts to heat; this is due to the unequal rate of heating between the '27 detector and the '26 first audio. Inserting a quick-heating '27 shortens the duration of this annoyance, but does not eliminate it.

A remedy is to connect a small 100,000-ohm carbon resistor across the secondary of the first audio transformer; this will not materially reduce the volume of the set; but it will remove the starting howl, and, incidentally, lower the hum level considerably.

WRITE—DON'T WAVE

THE problem of eliminating noise in broadcast studios has been solved, as regards inter-staff communication during programs, by the installation of telautographs in several N. B. C. studios. It was necessary to develop for the purpose a new type of instrument which is silent both mechanically and electrically.

Television and Service

(*Continued from page* 458)

new development and new life for the radio industry, television cannot be kept from the public—no matter how elementary the form of transmission and how far from perfect the image may appear.

Now is the time for all Service Men to become interested in television; to carry on all sorts of experiments; to determine the operating characteristics of various forms of amplifiers, recommended as suitable for television reception; to improvise various methods of maintaining constant motor-speed when synchronous motors are not available; to study the operation of gas-filled lamps, the operation and troubles in short-wave receivers; to experiment with tuned-radio-frequency short-wave systems. Time lost will be money lost.

RADIO RETAILERS' EXAMINATION

SERVICE MEN, in this country, have declared that radio manufacturers should test dealers for their technical, as well as financial, qualifications. In England, however, where the competitive conditions force very active trade cooperation, radio retailers themselves are demanding it.

The Birmingham branch of the Wireless Retailers' Association has prepared "a reasonably simple set of questions on battery charging, Ohm's Law, fault finding (*i.e., trouble-shooting*) on straight sets, knowledge of correct values for associated components, effects of varying plate resistance on performance of tubes, etc., etc.; and then added certain "honors" sections (*optional questions*) on advanced theory, dealing with multistage R.F. work, electric sets, power amplification and the like." Then, says its chairman in a letter to *Wireless World*, "a dealer will be able to pass the examination if he is capable of running a service depot at all." This association, at least, is working to ensure that "the man in the street shall have evidence, before entering a shop, that the owner has sufficient knowledge to give him assistance or technical advice he needs."

It may be observed that the British retailers are actively endeavoring to eliminate the spare-time set builder or servicer, whom they describe in all their literature as "the dabbler;" and to prevent his purchase of supplies from the manufacturer. But, on the other hand, they recognize their own duty to give efficient technical service on all products sold by them.

SEVENTY MILLION TUBES

TUBE sales in 1929, estimates *Good News*, house organ of the RCA Radiotron Co., amounted to 31,500,000 accompanying new sets, and 37,500,000 as replacements sold by Service Men and dealers. In the years 1924, 1925, and 1927, commercial sets were produced in such numbers that sales of tubes with sets many times exceeded separate sales; but in 1926, as in 1928 and 1929, the replacements were much greater in number. The percentage of these compared to complete-with-set sales increased from 109 in 1928 to 119 in 1929. "Approximately 50 per cent of the tube renewal sales are today made by the Service Man," says *Good News*, commenting on these figures.

Leaves from Service Men's Notebooks

(*Continued from page* 461)

Using a potentiometer of this type, connected in this manner, will control the volume effectively, even when the location is close to a powerful station, and still maintain the full sensitivity, of the set for distant reception; for, as the arm is turned toward the grounded side, the resistance between the antenna and grid is increased, while the antenna-to-ground resistance is decreased and, of course, vice versa.

CORDLESS SOLDERING IRON

By H. R. Wallin

WHEN one is using an electric soldering iron, especially in wiring radio sets, the cord of the iron is usually in the way; yet at times it is not long enough.

To prevent this annoyance, the connection shown in the sketch was used; it is very

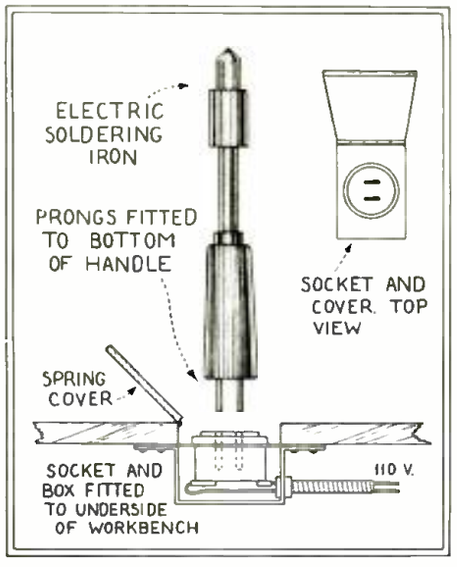


Fig. 3

By inserting the soldering iron into a fixed socket to keep it hot, it may be used without a cord.

simple to rig up. A standard 110-volt socket is set into the top of the bench, by cutting a hole to fit. A flat metal-plate cover is set over this hole, to prevent dirt from falling in; a spring should be used on this cover, so that it will close automatically.

Into the handle of the soldering iron, two prongs are fitted and connected to the terminals of the wires.

For heating, the soldering iron is set upright into the socket; and when needed for use, it is pulled out and brought to the work. Where continuous work is necessary two irons may be used. The heat will be retained in the iron for some time.

NEW VICTOR MODELS

By J. G. Sperling

IN the new Victor models, the "35" and others shown in last month's Radio Service Data Sheet (No. 33), there is no variable hum adjuster. If there is abnormal hum, inspect the '45 center-tap resistor (R15) which is immediately underneath the '45 sockets. The '24 center-tap (R11) is underneath the terminal connection board; each has a resistance of 55 ohms. Bad detector and A.F. tubes, and open connection to ground will cause hum. Watch the 0.1-mf. condensers in the chassis.

If there are no voltages in the set, inspect the fuse. It is located in a small box on the left of the amplifier, looking from the back, and is of the 1½-ampere auto type.

The adjusting screws for the tuning condensers are found underneath the small circular plate, which is screwed to the cast-iron plate on the chassis. There are five sets of five screws, one set for each condenser, and one adjusting screw for each frequency.

The long narrow rectangular cover on the right side of the amplifier contains the terminal strip, the connections of which are shown in the Data Sheet. A cable leads into this box. All screw-terminal connections should be tight, or trouble will occur.

In the phonograph models, there is occasionally a case where the motor refuses to start. In nine times out of ten, it is because the switch beside the motor is not making contact. This switch has a long thin arm, and one end rests upon a stud or finger near the front of the set. This statement also applies to last year's models.

This writer has lately completed the designing of a new, complete set analyzer. It embodies the new copper-oxide-rectifier meter; has six voltage and six milliammeter and ammeter ranges, controlled by a single switch. There is an ohmmeter of three ranges, an A.C.-operated tube tester with an oscillation-testing feature, and a modern R.F. oscillator. This oscillator will work at five frequencies in the broadcast band, and at the low frequencies for use with the modern superheterodynes.

AND NOW, WOMAN-MADE STATIC!

By Russell L. Woolley

PARADOXICAL as it may seem, the increasingly colder weather reminds me of an unusual, yet comparatively simple, problem that my service partner encountered one cold, dry day last winter. The lady who telephoned the call to the shop said that she had received a shock every time she turned her radio set on. When the Service Man arrived at her home, he too, received a shock; and he removed the escutcheon plate expecting to find the "hot" side of the A. C. wiring to the snap-switch touching the metal. But it was not.

He received the shock, however, the first time *only* that he touched the metal front plate; and *none* afterward, as he handled the escutcheon, while removing it! He thought this to be curious, but nevertheless called the lady of the house and told her everything was O. K., that she would receive no more shocks. She came out of the kitchen, walked across the thick Persian rug which covered the floor, and let out a big whoop as she touched the escutcheon.

However, in spite of the difficulties involved in explaining a phenomenal happening to a woman of foreign birth (or any woman, for that matter) he finally convinced her that her shuffling across the thick rug on a cold, dry day, had caused to collect a charge of static which discharged from her body to the metal escutcheon plate.

Testing Equipment for Service Men

(*Continued from page* 465)

either is turned off the other operates independently. For testing heater-type tubes, the original rheostat is turned completely off and the new rheostat used. For other tubes, the new rheostat is turned completely to the left and it is in effect out of the circuit, leaving the other rheostat to operate as before the change. With the new rheostat in circuit, tests are made in the usual way and the two readings are secured as with other tubes.

Now came the problem of testing screen-grid tubes. I took a piece of wire and attached a clip to each end. Then, with the tube in the adapter (See Fig. 4) I connected the grid terminal of the socket to the grid cap at the top of the tube. This had the effect of tying the screen-grid and control-grid together and the meter gave readings in the usual way. Then I found that, by shifting the clip over to the plate terminal of the socket, and connecting that with the control-grid cap, I could by pressing the two buttons get a third reading which would be higher than the other two. The effect of connecting the plate of the socket to the grid cap of the tube and pressing No. 1 button was to give the plate-current reading with grid and plate tied together, while the screen-grid acted as a regular grid. Then, when No. 2 button was pressed, the two grids and plate were tied together, and the total space current could be read. The three readings will indicate any abnormality in the screen-grid.

Utilizing a Low-Priced Analyzer

A Beede set analyzer which I have, though listing at only $25, is a very practical instrument, giving all the ordinary socket and tube tests through the use of one A.C. and one D.C. meter with a rotary switch which cuts in various resistances for the different scales. There are no provisions in this instrument, however, for continuity testing and making separate voltage tests.

This deficiency, I found was very easy to supply; and the usefulness of the device has been very much enhanced by a simple plan, as follows.

First, prepare a short wire about 4 inches long with one tip to be plugged into the filament connection of the 4-hole adapter. The filament prong of an old tube, soldered to the end of the wire, served very well for this. Attach the other end of the wire to one side of the 4½-volt battery which is part of the analyzer. This can remain permanently attached. Next, prepare a long wire with a similar prong, and plug it in to the other filament hole of the adapter. A third wire (a clip on either end is handy for this one) is now attached to the other side of the battery; the rotary switch knob is turned to "A-10;" and you have the 4½-volt battery in series with the 10-volt scale of the meter and the two test leads. This arrangement (See Fig. 5A) can now be used for ordinary continuity testing. The resistance of the meter is 100 ohms, and external resistances can thereby be roughly estimated.

Now, to one of the long wires, solder one of the thin legs of the old tube and plug it into the plate hole of the adapter. Plug the other long wire into the filament hole at the right (facing front of tester). Turn the knob to "B-500" and your meter will give voltage tests on the 500-volt scale (Fig. 5B).

Now, by shifting the wire from the plate to the grid hole while leaving the other in the filament connection, and turning the knob to "C-50," you can make voltage tests on the 50-volt scale; while, with the same connections, by shifting the knob to "C-100" you can make voltage tests on the 100-volt scale (Fig. 5C).

By means of these connections you can also check up the percentage of accuracy of the meter. Test a known voltage, such as a block of 135 volts of "B" battery, and note the reading. The percentage of inaccuracy will be fairly constant, and allowance can therefore be made for the error to get true readings. I found mine to read about a third low on the high-voltage readings—that is, 135 volts reads about 90 and 90 reads about 60.

Eliminating Warming-Up Wait

In a distributor's service shop, where testing is being continuously done with heater tubes, a useful method is employed to keep the tubes constantly heated and ready, without any waiting after the tubes are placed in the set.

A line of several sockets is mounted against the wall beside the bench, and 2½-volt filament current is supplied to them from a power transformer. As the tubes are removed from the set under test, they are placed in this rack of sockets, where they remain lighted and ready to operate instantly when inserted in the next set.

It can be seen that, in the course of a day's work, this idea saves a great amount of time.

RENEWING THE SOLDERING IRON

By Frank N. Bemis

AS they grow older, many electric soldering "coppers" grow weak. Often this is due to oxidization of the surfaces where the point joins the boss which protects the heating element; for heat is much like electricity in preferring clean contacts. The remedy is, of course, to remove the point and brighten the surfaces. Some solder run into the screw joint will help the transfer of heat to the point. Also, if the metal parts of the tool, except the point, be covered with wrappings of asbestos paper, much more of the heat generated will be driven to the point of the tool, instead of being radiated by the air, and hotter solder, with stronger and more quickly-made joints, will result. Some windings of fine copper wire around the asbestos paper will hold it snugly in place.

KILLING MOTOR-MADE "STATIC"

Wireless beam stations, receiving wavelengths in the neighborhood of 10 meters, are subject to considerable interference from passing motor-cars, which radiate short-wave oscillations from the ignition systems. In order to avoid this type of disturbance, a screen of short conductors is sometimes hung across the road forming a kind of archway. The conductors are grounded at one end and act as reflectors to absorb the disturbing radiation away from the beam aerial.

—*Amateur Wireless*, (London.)

The Service Man's Open Forum

(*Continued from page* 461)

Man had made a hasty decision; whether it was willful or not will never be known.

It might be in order to call the reader's attention at this point to the advisability of being honest; you might not get the job of repairing the set in question and another man might be called who would unconsciously prove your dishonesty. Such an experience leaves the customer under the impression either that you do not know your stuff or that you are a gyp artist; and it mars the confidence in all Service Men in general.

It is a known fact that, in every large city, there are a few hammer-and-tongs artists who think they know how to service radios; but this need not interfere with any one who has a good working knowledge of radio, so long as he does not make snap judgments.

F. G. Poli,
1905 *Spruce, Detroit, Mich.*

GOOD SERVICE IS APPRECIATED

Editor, Radio-Craft:

I think Mr. Graham's article in the November issue was splendid, and he hits the nail on the head when he insists on good service and good pay for doing it. No store can keep all the customers that it comes in contact with, and our experience is that customers are not lost so often by the amount of the bill as by the character of the service work done and the man doing it. I am for more articles by Mr. Graham and Mr. Freed—surely a man of much experience.

R. Murray, *Service Mgr.,*
Martin's Radio Service,
1520 *Howard St., Chicago, Ill.*

SERVICING RATES

Editor, Radio-Craft:

I have just finished reading the letter, in the November issue of Radio-Craft, written by Louis Minatel.

I have noticed the trend of complaints to come from young Service Men, who have taken up servicing through one of the correspondence schools.

I do not think they are justified in laying the blame of servicing difficulties on the older men who have been in the game since the one-tube days; because these men have had years of practical experience in radio and have had the necessary experimenting and actual experience that makes a good background for a radio Service Man.

There are a lot of older Service Men who have not kept up to the minute by reading magazines; but I think you will find that the majority have kept abreast of the times in everything.

I think the trouble lies in the idea many men get; that, by completing a good correspondence course in radio, they can go out and immediately get all the service work they can do at, say, $2.00 per call and make $200 a week or more.

Such ideas are all wrong. Radio service is a good steady profession; but, like doctoring, mechanics, or being a good lawyer, it requires time to build up a good radio following.

If the man who makes calls at 50 cents is a quack or a magazine-reading ham, and not up to the minute, he will not last very long in radio servicing; because the public want what they pay for and if they pay $2.00 for a call they want $2.00 worth of service—which they should have.

If they get their money's worth and the radio talks, they are on your list; but if your job is not *entirely* satisfactory you lose their work. Likewise, that of their relatives, friends and neighbors; because bad news travels much faster than good.

Every job should be done to the best of your ability. Honesty is the best policy in all cases and, if you are the right kind, of Service Man and know your stuff, you won't have to worry about your business because you will get your share.

Charge what you are worth and no more.

Roy Douglass,
Hastings, Michigan.

ACROSS THE WATER

THE following editorial expression by one of the staff of *Wireless World* (London) appears under a page headed "Unbiased," and the appropriate pen name of the writer is "Free Grid." It deals with a condition which is rapidly passing in this country, where much larger and more complex receivers are generally distributed among the urban population, at least. But the implication in the last line remains cryptic.

"Pity the Poor Service Man

"Much acid has flowed over our carpets since the birth of broadcasting gave us all something fresh to grouse (*Amer., "grouch"*) about; and although commercial receiver design has made steady progress since that date, with one or two notable exceptions, no reliable service system has been organized by the big manufacturers. Furthermore, they have done little to make trouble tracing as straightforward as possible for the radio doctor by the obvious method of supplying with the instrument a diagram of the circuit employed. Nobody who has not tried it can fully appreciate the length of time taken up in working out the diagram of, say, an electric set by the painful process of tracking each individual wire to its lair. A straightforward theory diagram, minus all switching and other frills, and also a detailed diagram would be all that would be needed, and these could well be mounted in some easily accessible position, such as inside the lid of the cabinet.

"The old argument that the circuit employed is secret and 'unique' will no longer hold water today. No good manufacturer has anything to lose by disclosing the circuit he uses. This old cry of 'unique circuit' was originally raised by certain manufacturers of the baser sort in order to conceal the poverty of the land in the matter of sound design. The home constructor who makes a foolproof set for the benefit of his maiden aunt, and then very wisely departs into a far country, might also take heed and have pity on the unfortunate man who sooner or later will be called upon to effect

(*Continued on page* 496)

(*Continued from page* 495)

some repair to the horror he has perpetrated. Fortunately, really knowledgeable radio Service Men are becoming less scarce, at any rate in the larger centers of civilization; although in small county towns the set owner still finds himself between Scylla and Charybdis, or, in other words, between the local plumber and a member of some foreign radio-engineering institute."

It is worthy of note that the immediate response to this invitation, on behalf of the British radio trade, was a letter from a set manufacturer (J. G. Graves, Ltd.) saying that the company acknowledged it has missed a bet, and is now printing circuit-diagram cards, one of which will be attached to every new receiver. And yet there exists in the United States a popular superstition that the English are conservative and slow to take a hint.

Circuit Diagrams and Service

"*Editor, Wireless World*:

"Sir,—Whilst reading the November 5th issue of your valuable Journal the writer was particularly struck by the contents of your Editorial. Certainly there is no reason why Circuit Diagrams should not be attached to the lids, or the backs of receivers. This omission in the past, cannot, as you remark, be easily explained. There is nothing to hide, and much to gain, and the manufacturer ought to have used this method of service assistance.

"As you are aware, we manufacture yearly many thousands of receivers, and do all our servicing by correspondence, sending circuit diagrams when requested, but your remarks have awakened us to the fact that many a customer could get valuable assistance from a technical, or semi-technical, friend, if a circuit diagram were immediately available. Many people would no doubt value a diagram if they had it, but would not trouble to send for it, preferring to return the receiver.

"Thanks to your bringing this matter to our notice, again we must mark against ourselves the fact that these diagrams should never have been omitted. We are now printing suitable diagram cards, which, when ready, will be attached to all new receivers.

For J. G. Graves, Ltd.,
Wireless Manufacturing Dept.,
G. Bagshaw,
Sheffield. *Engineer and Manager.*"

RECORDS WERE GOOD

BY a test recently conducted by the Stuttgart (Germany) broadcast station, an effort was made to determine whether there is sufficient departure from natural reproduction in modern broadcast records so that a keen ear can distinguish them from the actual artists in the studio of the station. A program interspersed with records was broadcast, in a contest to determine how many listeners could be certain whether they heard original voices and music, or its mechanical reproduction. Of 16,274 replies received, just fifty-two distinguished correctly in all cases. Of course, we may imagine that many of these listeners are equipped with receivers and reproducers which are obsolete according to our most modern standards of fidelity; but the percentage of accuracy in mere guesses would seem to be nearly as high as the above ratio, on the law of probabilities.

Radio Generates "Health Fever"

(*Continued from page 466*)

is therefore increased. It is not even necessary that the introduced dielectric shall make contact with the plates; the phenomenon of body capacity is familiar to all radio workers.

Now, if a substance even slightly conductive, like a human body, is introduced into the field of such a condenser as we have described, the capacity of that condenser is again altered; and, obviously, there must be some electrical reaction on the body in its field. This body—in the case we are illustrating, the patient—is not in the path of the currents from the oscillating circuit, except as electricity flows into the dielectric, first from one side of the condenser and then from the other, while they alternately are negatively charged. But the leakage of the condenser must be very slight; and therefore the currents in the patient's body are supplied from its own potentials. They suffice, however, to raise the temperature of the blood, which is a salty solution and therefore somewhat conductive. The heat, as will be seen, is applied to the body from the inside, and not from the outside.

The temperature thus created is limited, in practice, only by the power of the apparatus, and the ability of the patient to bear it safely. It is hoped to cure germ infections, when the invading parasite is less heat-resistant than the host, by this process; without the unpleasant alternative of introducing a new disease, like malaria. The applications, also, are deemed to be of special value in deep-seated affections, as in the bony joints.

It will be observed that the wavelength used is longer than that which was found, in the earliest laboratory experiments, to give maximum results—about 6 meters. At the shorter figure, the entire body, of average size, serves as a receiving antenna, being approximately resonant to transmitted energy. The longer wave probably permits of more gradual application of a gentle warmth. Physicians have issued a warning that, since the physiological effects of the waves below, say, five meters, are not yet fully appreciated, experimenters should be careful in the use of high power.

In the use of the apparatus illustrated in the first part of this article, it is customary to suspend the patient on a webbing of tapes stretched across a long frame; so that the body is surrounded by air to the greatest possible extent. This air is confined by a box of composition boards; and two small "hair-dryers" warm, while circulating it; so that the body shall lose the least amount of its generated internal heat by convection or radiation. When a suitable temperature is reached, the plates are separated more widely (the normal distance is about 30 inches) or the voltage is reduced or shut off entirely.

Airplane Radiophone Installation

(*Continued from page 467*)

plug together. The nut is run up a little over one-half inch, forming a tubular sleeve with a groove at its base. The cap which fits over the plug is made of nickel steel; and the prongs, fitting down over the plug sleeve and clamping into the groove at the base, are tempered to hold the spring action imparted to them during manufacture.

This installation effectively shields the radiation of electrical energy and is sufficiently durable.

Shielding of the leads from the magnetos to the plugs was accomplished by combining woven copper braid with flexible carburetor hose, the braid being placed inside the hose. The braid in itself proved to be a very good electrical shield; but, after a few hours of service, oil would soak into the braid and insulate each strand from its neighbor, so that the effectiveness of the shielding was impaired. The flexible carburetor hose protects the braid from oil; so that the combination, as developed by the Boeing engineers, is effective.

The shielding of the magnetos is relatively simple and consists of two aluminum sheets, bolted to the magneto, and a band of spring bronze covering the gap between the plates. In front of the shield is a removable block with the outlet tube.

These three types of shields compose a complete covering of metal for the ignition system, suppressing the interference so that it is not audible in the receivers, with their enormous gain. On this shielding the effectiveness of radio-telephone aircraft operation depends.

Another great source of interference with the reception of voice signals was the emission of static electricity from the different parts of the airplane; every place where one piece of metal could rub against another proved to be a source of interference. Consequently, all joints had to be bypassed with a pigtail of copper braid, which was soldered to both of the moving parts. The standard turnbuckle was varied with the replacement of the usual brass safety wire by a strip of bronze, wired and soldered to the eye of the turnbuckle.

All wires in the plane are either shielded with the copper braid or else carried in conduit. The latter method is preferable, since it permits the replacement of wires with a minimum of labor and expense.

When the ship is equipped with a high-frequency transmitter, it is imperative that all the wires be completely covered with a grounded shield; as otherwise they will pick up the energy, and either burn out or absorb enough of the energy, already too small, which is radiated from the antenna system.

With the effective bonding and shielding of the airplane itself, the greatest difficulty encountered in the installation of the radio-telephone equipment was overcome.

The choice of an antenna system presented a considerable problem: the trailing-wire type is undesirable, since it offers considerable head resistance and, over the San Francisco-Chicago and San Diego-Seattle airways of the Boeing System, it is necessary at times to fly at altitudes so low that they preclude the possibility of a trailing-wire antenna.

Therefore a mast-type antenna was devel-

oped, consisting of a dural (light-metal alloy) stream-line shaft, projecting six feet into the air behind the pilot's cockpit.

Every traffic station along the two airways of Boeing System is equipped with the Teletype, or telegraph printer, which is a source of radio interference. Boeing System engineers found that they would have to develop some means of checking this interference to permit satisfactory operation of the radio-phone equipment.

They decided to equip the Teletype machines with a rotating squirrel-cage type of induction motor. This removed the cause of the radio interference, because the usual type of motor has five sparking contacts. The reliability of the printer was not impaired by this installation.

With the elimination of interference from the various forces detailed in this article, Boeing System engineers were able to insure effective transmission and reception of the voice signals exchanged between the twenty-two ground stations along its airways and the pilots of its fifty mail and passenger ships.

It is the belief of the Boeing communication engineers that the long-standing debate over the relative merits of voice versus code aircraft radio has been answered in favor of the voice radiophone by reason of interference elimination.

S.-G. Frequency-Changers

(Continued from page 486)

it is necessary to use a second capacity C3. In practice, the two capacities are obtained by using a double condenser, of twice the value used normally to tune the grid circuit.

In Fig. 7, it will be noticed, plate detection is employed, a "C" battery being connected in the grid lead, and the best operating point is found by adjusting the arm of the potentiometer. We may also use a grid condenser and leak, which must return to "A+."

With the screen-grid tube, the windings are on concentric tubes. The grid coil is 55 turns of silk-covered No. 30 wire, covering ⅞-inch on a 2-inch tube. The plate coil is 60 turns of the same wire, an inch long, on a 1⅝-inch tube placed inside the other.

SOME RADIO LAWS

IN Australia (which country, by the way, has prohibited the importation of foreign radio receivers, in order to protect home industry) every electric set must have a "Danger!" notice on the inside of the cabinet lid, with a warning that the power should be shut off before any adjustments or alterations are made.

In Jugoslavia, it is punishable by a year's imprisonment or 10,000 dinars fine to "willfully or negligently interfere with the working of a radiophone, or intercept the current necessary to the working of such apparatus." A British columnist inquires whether this legislation was prompted by someone's stealing the prime minister's storage battery.

In Ilford, England, there is an ordinance prohibiting anyone from taking a storage battery aboard one of the municipal street cars. Probably the council thinks that there is no use crying over spilt acid.

The Radio Craftsmen

(*Continued from page* 485)

of the filament. A '12A tube would be much better than either of those named, being more sensitive.—*Editor.*)

SHORT-WAVE CONVERTERS

Editor, RADIO-CRAFT:

I am much interested in the frequency converter described by Watson Brown, in the September issue of RADIO-CRAFT; but am much perplexed over my failure to secure results from a variation of the circuit to operate on D.C. Apparently, the circuit is identical with an ordinary single-tube short-wave set but without a grid-leak and condenser and with a radio-frequency coil in the output. Assuming it to be such I wound coils on tube-bases suitable for the tuning condenser I happened to have; made up the spiderweb coil, used an '01-A tube, but couldn't get even a whistle. I then put in a grid-leak and condenser and tried the outfit as an adapter connected to the audio end of my regular receiver; and it seemed to work about the same as the usual run of adapters perform.

Observing that Mr. Moss (in your December issue) failed to get results with a regular set of short-wave coils, I am wondering what there is about the circuit that makes it work, anyway. Personally, I don't understand how the circuit could work, unless the coils used serve as an oscillator instead of functioning only as tuning coils. If the set will work with an A.C. tube, it should work with a D.C. tube. I connected the primary of the spiderweb coil to the aerial and ground posts on my regular set, supplying the plate current through the secondary to the tube. I should be much pleased to see something further in an early issue about the probable reasons for the lack of results mentioned in this letter and in the case of Mr. Moss who, I presume, used the A.C. circuit with the Dresner coils.

R. A. BONHAM,
Springfield, Missouri.

(This converter differs from the ordinary short-wave adapter; the latter has an *audio-frequency* output. For that reason, a circuit wired as an ordinary short-wave set or adapter has an output which the radio-frequency stages of a broadcast receiver are not fitted to handle. When the normal short-wave detector circuit was used, the output became audio frequency, and the audio amplifier of Mr. Bonham's set would pass and amplify it. The purpose of the converter is to oscillate at a frequency, distinct and separate from that of the input signal, creating a second signal the frequency of which is in the ordinary broadcast band.

The set should work with a D.C. tube, if the proper voltage is applied and there is the proper coupling to cause oscillation through its grid and plate circuits at the desired frequency. Some tubes are not as good oscillators as others; the internal capacity of the '27 is lower than that of the '01A, while its mutual conductance is higher. Mr. Bonham's letter indicates that the spiderweb coil was reversed; but we may suppose that this is a clerical error. He does not state what the input circuit of his receiver is like.—Editor.)

Tone Controls

(*Continued from page* 473)

reproducer may be doctored up to reproduce any note, or series of notes, above the level of all the others; or to overcome any particular acoustic condition; and its output may be brought to just the right volume level for best results by adjusting R.

In the same figure, at B, a high-pitched horn is used in conjunction with a cone reproducer; and, again, R may be panel-mounted. This circuit arrangement is now in use in a number of private radio installations, and the tone control is very satisfactory.

Simple Tone-Control Methods

For the owners of radio sets in which the reproducer's binding posts are conveniently accessible, Mr. Hugo Gernsback offers three very novel extra-receiver suggestions; which he has found in practice to be extremely effective.

The first is illustrated in Fig. 36 at C, in which it will be noted that switch Sw is wired as a series-parallel circuit changer. Although a standard D.P.D.T. switch is shown, one of the new panel mounted D.P.D.T. switches makes a more commercial-appearing installation. The resulting electrical circuit when two magnetic reproducers are used, is shown in diagram form at D.

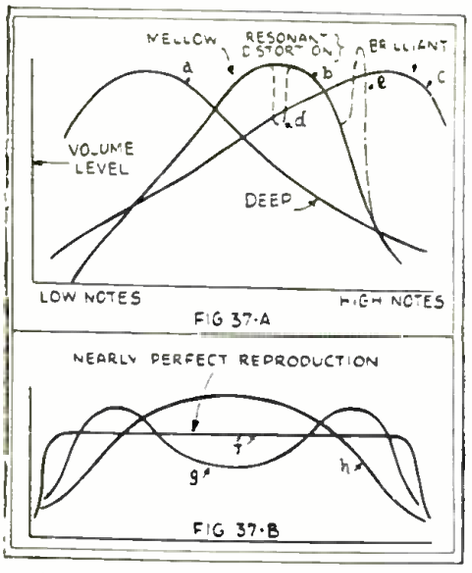
This method of tone control takes advantage of the audio effect which results when the load impedance, "looking into" (connected to) a signal output source, is changed in value; as by changing two load impedances from series to shunt or parallel connection. This circuit does not necessitate the use of matched reproducers.

The second proposal of Mr. Gernsback may be conveniently applied to almost every radio set, in which a magnetic reproducer is used, and is certainly an ingenious connection. As illustrated in Fig. 36 at E, an impedance (for which an old, ordinary, single headphone will serve) is connected in series with the magnetic reproducer. The needed variation in the total load impedance may be obtained by adjusting R, thus cutting the headphone more or less into circuit. Both the headphone and R may be mounted inside the radio cabinet; the latter component being controlled by a knob on the panel.

His third proposal is to combine these ideas: the series-shunt switch will then connect to the loud-speaker posts on the receiver; and leads 1, 2 and 3 of the output load (the magnetic reproducer, the headphone, and the resistor R) to the posts similarly numbered on the switch.

A graphic representation of the various forms of audio reproduction is given in Fig. 37. An ordinary by-pass condenser arrangement may result in a "falling characteristic"—the type of reproduction shown at *a*. An old-style radio set, with large by-pass condenser values in use, may be represented by the curve *b*. The form of reproduction control, obtained in the manner shown in Fig. 34, gives a "rising characteristic"—represented as *c*.

The dotted line *d* indicates that there is great loss of volume at one frequency (as when the paper in a magnetic cone becomes



Above, "curves of response," indicating the characteristics of actual reproduction, as modified by tone control, in comparison with practical perfection (f).

worn at the apex). The effect of exceptional amplification at one frequency is indicated at *e;* this condition might be due to resonance in the room.

An acoustically ideal line is shown below at *f;* while the effect that may be obtained with two reproducers, or a tone control that introduces bass and treble accentuation, is shown at *g*. The curve *h* is similar to *b*, but better in shape.

Those who wish to go more deeply into the study of audio band selection, the control of a limited number of audio frequencies in order to correct resonant distortion, and kindred subjects, will do well to read "The Effective Use of By-pass Condensers and Resistors," by P. H. Greeley, in the August, 1930, issue of RADIO-CRAFT, and "The Ultimate in Audio Selectivity," by C. Sterling Gleason, in the September, 1930, issue. The mathematically-inclined technician will find also useful material within the tables in the articles: "Simple Radio Mathematics for the Service Man," in the September and October, 1930, issues.

The Sargent-Rayment 710

(*Continued from page* 475)

and the top of the shield can. Their construction, however, is not recommended for the set builder.

A list of parts for the construction of this receiver is given below; most of them are included in the original equipment. Their places in the circuit may be easily identified by referring to the diagram.

List of Parts

*L—Silver-Marshall shielded coil "No. 124";
*L1—S.M. shielded coil "No. 122";
*L2, L3, L4, L5—S.M. shielded coil "No. 121";
*C, C1, C2, C3, C4, C5—S.M. variable condensers "No. 320R" (one only);
*C6, C7, C8, C9, C10, C11—S.M. midget condensers "No. 340" (one only);
*FC to FC13 inclusive—Polymet 0.1-mf. fixed condensers;
VC—Electrad Tonatrol 10,000-ohm potentiometer;
*R, R1, R2, R3—1,000 ohms;
*R4—70,000 ohms;
*R5, R6, R7, R8—5,000 ohms;
*R9—150,000 ohms;
*R10—250,000 ohms;
RFC1 to RFC10 inclusive—S.M. radio-frequency chokes "No. 275" (*one only);
*CM—.025-mf. (fixed);
*GR, GR1—2 megohms;
*BYC—.00015-mf.;
*T—S.M. "336U" power transformer;
T1—S.M. "327U" power transformer;
T2—S.M. "220" audio transformer;
*T3—SM., "221" output transformer;
*Ch—R.C.A. double 30-henry choke;
Ch1—S.M. "331U" choke;
*CB—Dubilier 11-mf. condenser block;
CB1—S.M. "673" condenser block;
*VD—Electrad 500-ohm resistor;
*VD1—Electrad 500-ohm resistor;
*VD2—Electrad 3,500-ohm resistor;
*VD3—Electrad 4,500-ohm resistor;
*VD4, VD5—Electrad 15,000-ohm resistor;
*GB—2,000-ohm resistor;
*GB1—1,500-ohm resistor;
*RC—1-mf.
*RC1—2-mf.
*TR—500,000-ohm variable resistor;
*TC—.005-mf.

** Indicates new part required.*

Radio-Craft Kinks

(*Continued from page* 481)

these are to be fastened to the chassis with screws. The socket may be mounted on top of the upturned cover.

If the socket is of the subpanel or sunken type, the cover of the can should be cut out so that it fits over the socket. A 1¾-inch round hole will accommodate the largest socket. The shield can easily be removed or replaced, by slipping it in or out of the fastened cover.

A SHORT-WAVE COIL FORM

By Herbert L. DeWolf

HAVING built a number of short-wave coils and given them a thorough test, the writer is of the opinion that coils made in accordance with the arrangement shown in Fig. 4 work better than any others.

The idea is to hack-saw supporting strips from an old coil; and fasten them with machine-screws to a tube-base, and to the R.F. coil by means of top clamps.

The wire for the tuned coil should be about No. 16 enameled, spaced 1/16-in.; on the regular celluloid-acetone form. The tickler may be wound at the bottom end of the tuned coil; outside of the straps; or formed first and cemented inside the coil.

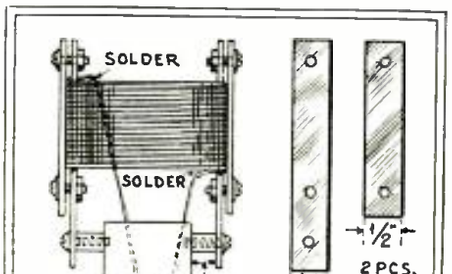


Fig. 4

Another version of the home-made plug-in coil, with basless construction.

On Page 452 you will find an interesting announcement of the Supplements to the OFFICIAL RADIO SERVICE MANUAL. It takes but a few minutes to read of the full particulars about this announcement.

New Radio Devices

(*Continued from page* 470)

trical Instrument Co., of Newark, N. J., is just this instrument combination.

By means of toggle switches and binding posts, there are made available the ranges of 0-3-30-300-600 volts, and 0-10,000-100,000 ohms. As a voltmeter, the scales are 1000-ohms-per-volt. Each instrument is provided with a pair of 30-inch cables terminating in long test prods. There is a meter zero-scale adjuster; also, a zero-ohm battery adjuster. A toggle switch selects either the 0-1- or 0-10-Ma. scale for testing the continuity of high- or low-resistance circuits.

Dimensions, 5½x3⅝x2⅛ inches deep; weight, including self-contained battery, 2.3 lbs.

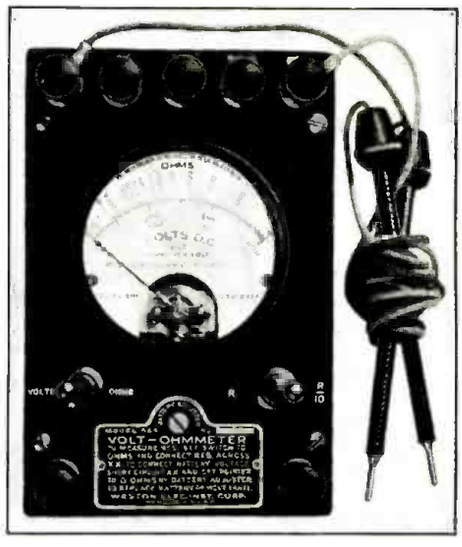


Fig. D
A combined voltmeter-ohmmeter of high quality, intended especially for radio service work.

D.C.-A.C. Convertible

(*Continued from page* 479)

there are appended some general data on the instruments used by the writer; and this should serve as a guide:

Tuning condensers C1, C2, C3, C4 are .00035-mf. U.S.L. units; the R.F. coils, Gen-Win. Filament choke Ch1 is a special 10-henry inductance capable of passing 350 to 500 mils. A Formica choke was used in the set; but an equivalent unit may be made by winding 850 turns of No. 26 enameled S.C.C. wire on a nearly closed iron core with a cross-section of about one square inch and a winding length of three inches. The requirements for PT are obvious.

Resistor R1 is a 1,000-ohm Clarostat component. A 50,000-ohm resistor is used for R2. Resistor R3 is 500 ohms; R4, 30 to 60 ohms; R5, 5,000-ohm potentiometer; R6, 0.5-meg.; R7, 10,000 ohms; R8, 20,000 ohms; R9, 20-watt 10,000-ohm Clarostat variable power resistor.

The condensers have the following capacities: C5, .001-mf.; C6, C7, C9, C10, C12, 2 mf.; C8, .25-mf.; C11, 4 mf.

The pilot lights, V11, V12, are the 5-volt type. The fuses, F1, F2, F3, F4, are of 2-amp. rating. The crystal detector ("Det.") was a Carborundum fixed unit.

New Ideas in Television

(*Continued from page 477*)

second, and the broadcast carrier is modulated on both sides, as customary, the band will extend the full 100 kc. The sharpness of television images is determined by the number of picture areas or lines; and, at the fixed sending rate of 15 pictures per second, it is evident that the scanning speed per unit elementary area increases in proportion to the fineness of grain of the picture.

Much has been written in regard to the feasibility of simultaneously receiving both music and television on a single set; and the television technician is confronted by the problem, why may not the bars be let down a trifle to enable the vast family of radio fans, whose principal equipment consists of an audio receiver and a loud speaker, to hook up a neon television lamp and a scanning disc, plug the tube into the speaker jack, and tune in their television along with the audio broadcast?

Sight and Sound Reception

Several schemes for satisfactorily accomplishing this function have been devised; but additional development is essential to perfect these two-purpose sets before submitting them to the crucial test of practicability. The most promising method is that of plurally modulating the wave at the sending station with the simultaneous sound and television signals (that is, bands corresponding to the music and the televised subject, in the studio); and, at the receiving set, demodulating the double-wave transmission and diverting each component into its respective apparatus (the sound signals going to the speaker and the television signals to the neon lamp).

Separating these signals, to avoid mutual interference, is accomplished by using one or more band-pass filters to keep the lower frequency sound-wave energy from the neon-tube circuit, and applying it after suitable amplification to actuate only the speaker (as shown diagrammatically in Fig. B). In order to assure successful operation, the television signals must lie in a frequency-band somewhat higher than that of the sound waves. For, if we consider the fact that the high-pass filter passes all frequencies above, say 5 kc., it is seen that we will have glow-lamp flashes occurring quite often in response to sound waves (of the higher musical frequencies which embrace a 10-kc. band); so that music will streak the picture—and, conversely, television signals will energize the speaker element.

The fact that the broadcast band may reach or even exceed 100 kc., does not mean that every successive television signal is sent in the uniform interval of 1-50,000th second; for the subject being televised is made up of all kinds of areas varying in size, shade and color, and not in predetermined mathematical order or sequence. A relatively sizeable area will give rise to a correspondingly long signal (persisting, say, 1/2000-second); a signal of such duration, being well within the audio range, causes a click in the speaker and mars audio program reception. It is reasonable to assume that the shortest signals—those caused by passing abruptly from a white to a black portion of the scanned subject—are less than one-fifth as numerous as signals of greater duration; so that many of the image signals necessarily fall within the range of audio reproduction. The problem resolves itself into excluding the longer television signals from the speaker.

Shortening the Image Signals

The writer's idea, which may be better understood by referring to Fig. A, is to speed up the scanning rate, and also to break up the field swept by the scanning beam; this producing a large number of artificial changes and contrasts in the shaded areas. Each such contrast creates a fresh signal; and a rapid succession of contrasts tends, because of its high frequency, to create a series of impulses alternately positive and negative whose algebraic value, in 1/10,000-second, is insufficient to produce a response in the speaker.

Forty-eight-line pictures, unless scanned at a rate in excess of 100 pictures per second, are not suited for teamwork with audio. Pictures of 200 lines (40,000 picture areas) posses greater detail and are well suited to dual transmission; for the reason that the scanning rate varies as the *square* of the number of lines scanned, correspondingly accelerating the frequency.

The rays from the lamp (Fig. A) pass through the 200-hole spiral and, as the disc is rotated 15 times per second, the field of view is scanned in successive lines at the rate of 3,000 lines per second. Consequently, to attain our assumed television *minimum* frequency of 10 kc., each line must have breaks not farther apart than one-third the width from side to side of the scanned area. To insure this condition, the panel behind the person being televised is divided into a series of alternate dark and light bands; so that, as the scanning beam rapidly travels across the field of view, signals of a minimum frequency (determined by the spacing of the bands) are generated in the photocells at a rate higher than would be derived were the background of a uniform shade.

Sharp silhouettes, or pictures showing the head and shoulders of a single person, are obtainable on a 48-line disc. A 200-line disc will transmit a group of sixteen persons who, if dressed in different-colored or striped clothing, will (on account of the more or less checker-board effect of the ensemble) produce twenty to thirty breaks in continuity as each transverse line is scanned; and this, without providing the auxiliary striped panel. So that the minimum—three breaks—(assumed above) is at least quadrupled; giving a good assurance that the longest television signal will be too short to affect the speaker, by a margin of safety which appears sufficient. That is to say, although a minimum television frequency of 10 kc. is all we theoretically need, a minimum frequency far in excess of that needed is assured by breaking up the field into a series of segments.

This article has dealt only with a consideration of the shortest practical television signals which will not produce irrelevant sounds in the audio reproducer. The

failure of the higher frequencies to affect the speaker is due to the sluggishness of the relatively heavy parts of the speaker, as well as to the impedance of the speaker circuit; so that a filter need not be placed in the latter. It is also known that the ordinary person's auditory nerves are incapable of responding to any sounds produced at a frequency in excess of 10,000 cycles.

Hints to Manufacturers

(*Continued from page* 471)

the option of both speeds, so that, by turning a switch, the set owner could play either present-day standard commercial discs or his own recordings.

I believe that the standard phonograph records of the near future will be the 16-inch discs; such as are now distributed by the phonograph companies to radio stations and theatres. It is surprising that these have not been made available to the musical public.

MILTON BERNSTEIN,
130 *Scheerer Ave., Newark, N. J.*

AUTOMATIC VOLUME—MANUAL TONE CONTROL

WITH the advent of individual tone control for general use, what reason is there for not adding other refinements to the unit sales of radio dealers and Service Men?

Automatic volume control in a universal unit would be very popular with the radio set owners, and increase the sales of sets not incorporating such a unit originally. Perhaps a unit combination of personal tone control and automatic volume control in a single housing could be produced.

STANLEY I. HOUGH,
Route 7, Spokane, Washington.

Filament Resistors

(*Continued from page* 471)

and "F—"; the remainder of the 20.47 ohms required for filament ballast may be distributed anywhere in the circuit.

The actual resistance value needed, of course, deviate permissibly from the exact figures given here. For instance, in many standard circuits, the '22 tube was ballasted by a 15-ohm resistor in the negative lead tapped at 10 ohms; with a further rheostat to equalize the 5-volt tubes as well to a battery supply.

RADIO'S ROUGH ON ROBBERS

THE police stations, which short-wave listeners hear from time to time, are not merely sources of entertainment. A few mornings ago a burglar in Buffalo, N. Y., while busy before a safe, found himself confronted by a flying squad of police, whose car had been directed to the spot by the radio at headquarters. Similarly, a report of a robbery and murder in Michigan was relayed by the state police corps through their transmitter at East Lansing; and at once eleven radio-equipped cars were converged on the route of the fugitives. Within another two hours, they were captured.

A Push-Pull Short-Wave Set

(*Continued from page 476*)

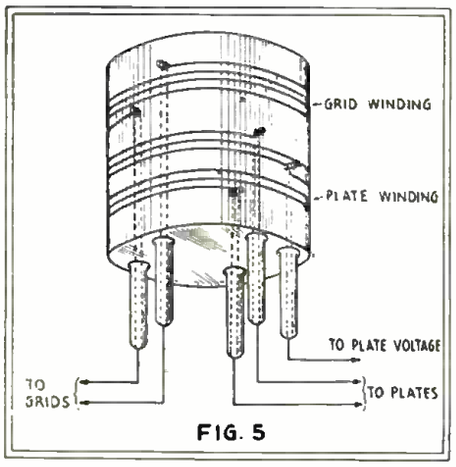


FIG. 5

Connections of the plug-in coil, as wound by Mr. Cebik on a UY tube base.

is connected across this instrument, to prevent noise during its adjustment. This method does not affect the tuning.

Resistance coupling, it will be seen, is employed in the single audio stage; as usual with detector tubes of high impedance. A second stage of audio may be added for loud-speaker reproduction. This receiver was designed, primarily, for code reception, but it works better than any other which the writer has tried on these short waves. The signals from locals—and, at times, from distant stations—are too loud to hear on the phones after the first audio stage.

It will be found that the screen-grid voltage is very critical, and that the receiver will not oscillate until the proper adjustment has been made. Once this has been done, the setting should be left alone; as it will remain at the proper value, regardless of the frequency of the signal.

The parts required are; besides to those previously mentioned: C3—.00007-mf. fixed (mica) condensers; C4—0.5-mf.; C5—1 mf.; C6—.006-mf.; R1, R4—1 megohm; R3—0.25-meg.; RFC.—S.-M. choke, No. 227.

In addition, a filament transformer with a 2½-volt secondary is required, and a suitable "B" unit for electric operation from the 110-volt lines.

The front panel is of aluminum, and the whole receiver fits into an aluminum cabinet; from which C1, and R2 as well, must necessarily be well insulated.

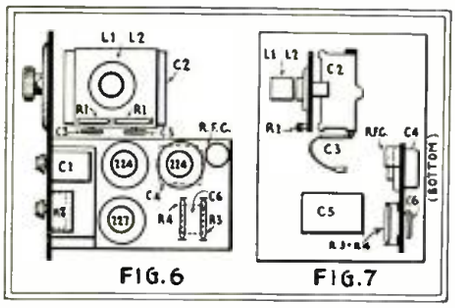


FIG. 6 FIG. 7

Left, a plan view of the set; right, a panel view of the arrangement. The heavy lines indicate two small sub-panels.

LIVE AND LEARN

ACCORDING to a statement issued by the American Federal Radio Commission, 78.8 per cent. of that country's listening public use portable wireless sets while on holiday.

—*Wireless Weekly* (Sydney, Australia).

This may be true some day, when the use of automotive radio becomes general; but the "portable" set has never been as popular in this country as in Great Britain and on the continent of Europe.

The "Da-Lite-R" Receiver

(*Continued from page 478*)

knob on the panel which permits the introduction of a very small amount of adjustable feedback at this point. The R.F. transformers are so designed that this feedback (which is effective in this circuit only) is evenly distributed over the entire broadcast band, and need be readjusted only for the weakest signals. The screen-grid of the detector tube is at the same potential as those of the R.F. amplifier tubes and, like them, connected to the arm of a potentiometer. The latter thus gives exact regulation of the amplification and regeneration simultaneously and serves as a volume control, operating the set.

The output of this receiver can be fed into any audio amplifier which has an input impedance in excess of 100,000 ohms, and will supply 750 microamperes plate current to the detector tube at the potential of 125 to 150 volts *at the plate of the tube.*

It is particularly recommended that a special low-gain impedance-matching stage of audio amplification be used in connection with the tuner. The output of this audio amplifier may be of any type desired; such as push-pull '45's or, as the writer has arranged it, push-pull '50's.

Design Data

The R.F. inductances are wound on forms 1¼ inches in diameter; the primaries being alongside the secondaries, but spaced therefrom 1⅜ inch. The primary or antenna winding of L consists of 30 turns of wire, which may be of any convenient size; for instance, No. 24 D.C.C.

The two secondary windings of L consist of 120 turns; as do the secondaries of L12, L13, and L14. The primary windings of L12, L13 and L14 consist each of 40 turns of wire. The shield cans have a diameter of 2½ inches. Note that the can shielding the antenna coil is open at the end where the antenna coupling coil is placed.

Parts Required

Instead of following the usual program of scheduling an ironclad "list of parts," the writer is going to supply in a different manner data on the instruments that comprise the standard kit of parts for the "Da-Lite-

R" receiver. Since the constants of the units are given the constructor who does not wish to obtain the regular kit may use any make of apparatus for which he has a preference.

Condensers C8, C9, C10, C11 are banks of 0.1-mf. capacities. The tuning condensers C1, C2, C3, C4, C5, used were "USL" .00042-mf. units. Condenser C6 has a capacity of .000025-mf.; C7, .000015; C12, C13, C14, .002-mf.; C15, .00025-mf. Polymet condensers were used.

The radio-frequency chokes L1, L2, L7, L8, L9, L10, L11 are the standard 85-mh., chokes which usually are scramble-wound with about 750 turns of wire on a small core. Chokes L3, L4, L5, L6 are specially designed, with 1,000 turns of small-sized wire (about No. 36 D.C.C.), and are rated at 150 mh.

Resistors R1, R2, R3 are 400 ohms; R4, 7,500 to 25,000 ohms; R5, 50,000-ohm Centralab potentiometer. Except for the last unit, Aerovox resistors were used.

RESISTOR MARKINGS

THE resistors used in all recent Crosley and Amrad receivers are marked with a color code which indicates their resistance value. An explanation of this code may help Service Men to trace circuits and order replacements.

Each resistor ha. a certain body color, a colored end, and a colored dot on the body. The body color stands for the first digit of the rated resistor value, the end color stands for the second digit, and the dot color represents the number of ciphers following these two digits, all as given in the following table:

Black	0	Green	5
Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Gray	8
Yellow	4	White	9

For example, a resistor with orange body color, green end color, and a red dot has a resistance of 3500 ohms.

A GOLDEN RECTIFIER

Professor Pelabon, the French investigator of metallic contact detection and similar phenomena, has also communicated to the French Academy of Sciences observations on the one-way conductivity of cupric oxide, as utilized in dry electrolytic rectifiers. The necessary system involves "a conductor, a semi-conductor, and an insulator." To obtain the second, cupric oxide (CuO) was obtained in a chemically pure form, and compressed into discs; which were given a heat treatment, at a certain temperature, for a certain time; then cooled. This resulted in increasing greatly the conductivity of the oxide. Over these discs, a little finely-divided gold, suspended in collodion or shellac, was brushed to form a film of very thin semi-insulating material.

With these discs compressed between metal sheets, a unit was formed which might be regarded either as a polarized condenser, or as a rectifier. Its one-way conductivity is very efficient; as shown by measurements of the current passed in either direction. The pressure and the temperature applied to the cupric oxide, and the time of heating appear to be quite important in obtaining the best results as well as the percentage of gold in the applied solution—although another metal might be substituted, presumably, if it resisted oxidization as well.

Dual Crystal Set

(*Continued from page* 485)

in which crystal rectification is used without R.F. amplification requires a good sized antenna to provide ample pickup.

Low-loss principles are of vital importance in constructing a really good crystal circuit and cannot be stressed too highly. In his experimental work the writer used grounded-rotor condensers, large wire in the coils and good tubing. Experiments in the future, however, will probably be centered around the shorter waves; in which case bare enamelled wire low-loss coils will be used.

In the original experiments, an old "Freshman" crystal detector was used and gave very good results with small need for adjustment. Any good make of crystal will do though, of course, the "Carborundum" cartridges with battery and potentiometer provide the greatest stability. The cartridges alone are very satisfactory on account of their permanence of adjustment, and will require but little space. For DX work, where the utmost in sensitivity is desired the stabilizer had better be used.

The circuit employs two phone condensers of equal size. They may be of .001- to .002-mf. capacity; and are placed, not across the phone terminals, but across each of the two crystal output circuits.

The audio-choke originally used was home-made and consisted of a wooden bobbin containing a wire core 3/8-inch in diameter. The bobbin was made in two sections, each of which was wound full of No. 28 D.C.C. wire in even layers, each section being one inch long and 1¼-inch diameter. A tap was taken between sections or the connection to the switch-arm; while the terminals were intentionally left long enough for connection to the two crystal detectors and the phone terminals.

Unique Superhet

(*Continued from page* 480)

turns of No. 28 enamelled, with the lower lead, near the slot, soldered to the "F1" prong and the upper lead to "G." The windings should all be in the same direction. When connecting the socket into circuit, the "P" terminal goes to the antenna; "F2" to the shield and ground; "C" to the oscillator grid coil; "F1" to the potentiometer slider; and "C" to the grid.

High Intermediate Frequency

The oscillator employs a tuned-plate circuit instead of the usual tuned-grid. The grid coil L5 is untuned, and connected in series with the coupling coil L1 which feeds the energy to the first detector.

L5 is wound in the slot with 35 turns of No. 28 enamelled; the start going to the "G" prong and the finish to "F2." The plate coil L4 consists of 76 turns of the same wire; the lower lead being soldered to "F1" and the upper lead to "P."

With such a high intermediate frequency (approximately 300 kilocycles) the overall selectivity of the super would suffer greatly if the usual form of tuned impedence were used to couple the different stages; therefore comparatively low-ratio

transformers were decided upon. The secondaries have the same number of turns and size of wire as the grid impedance 1.3 in the first detector circuit.

The first transformer has a slot-wound primary of 180 turns of No. 36 enamelled wire, tapped in the exact center. The start is soldered to the "C" prong, the center tap to "F1" and the finish to "P." The coil socket is connected into circuit with "G" to the grid; "F2" to the negative side of the filament; "C" to the side of the neutralizing condenser, "F1" to the B positive and "P" to the plate.

The primary of the second transformer has 90 turns of No. 36 enamelled; the start of the winding going to the "F1" prong and the finish to the "P" prong. The socket is connected in the same manner as the first except that the "C" terminal is left open.

The last or output transformer is exactly like the second, except that an additional winding is employed as a tickler. This consists of 30 turns of No. 30 enamelled, wound on a 1¼-inch cardboard tube ½-inch long, and placed inside the form near the bottom. The lower lead goes to the "C" contact pin and the other to "F2." The "C" terminal on the socket is connected to the detector plate through an .001-mf. fixed condenser C7, and "F2" to the biasing resistor in the "B—" lead.

Condenser Mountings

As the rotors of the .00035-mf. tuning condensers (C) are not at ground potential, they cannot be mounted directly on the shield. They should first be fastened to ⅛-inch bakelite or hard-rubber strips, 2 inches square. The strips may then be attached, about ½-inch from the shield, by means of four machine screws. The condenser shafts will not be long enough; so flexible couplings and 1½-inch lengths of ¼-inch round bakelite rod are needed to extend them beyond the front panel. Half-inch holes are drilled in the shield and metal panel where the shafts pass through.

The radio-frequency choke in the oscillator "B+" lead should have an inductance of 60 to 85 millihenries. It may be purchased, or constructed by the builder. A very efficient choke can be made by winding 280 turns of No. 36 enamelled wire in 8 slots (35 turns per slot) cut in a 2-inch length of wooden dowel ¾-inch in diameter. The slots may be readily cut with a hacksaw. This choke will be effective throughout the entire broadcast band.

The second detector R.F. choke may well consist of 800 turns of No. 36 enamelled, scramble-wound on a ¾-inch core. (A common thread spool will do very nicely.) Its use keeps the R.F. currents out of the audio amplifier, thereby preventing howling. Many set-builders, and manufacturers as well, overlook this important little piece of apparatus.

Bypass condensers having a capacity of 0.5-mf. each, together with R.F. chokes, similar to the one in the second detector, may be placed in the screen-grid circuits if desired. The chokes are not absolutely essential but, theoretically, their use tends to reduce feed-backs and result in greater efficiency. However, it was found that they could be dispensed with without impairing reception in the least.

The bypass condensers are necessary, unless the 45-volt tap on the "B" eliminator is shunted by at least one microfared. No condenser is shown in the diagram across the 135-volt tap; as this bypass is usually provided in the eliminator. If the eliminator is not an integral part of the receiver, or is placed over a foot or two from the receiver, all of the "B+" leads should be bypassed by 1-mf. condensers.

Voltages Required

A voltage of 45 is sufficient for the plates of the two detectors and the oscillator. If more than this is applied to the latter, a "C" bias will be needed; resulting in tuning troubles, due to the presence of harmonics in the output.

The I.F. and A.F. tubes are supplied with a plate voltage of 135. The grid bias for the A.F. tube and the second detector is obtained from a 1500-ohm resistor R4, of 7.5 watts rating, in the "B—" lead; this is provided with two sliders; the one nearest the "B—" being connected, usually, to the grid return of the second detector.

The audio amplifier is of the conventional type. Any good brand of transformer may be employed; but one of the new parallel plate-feed units is to be recommended. If greater volume is desired, the output may be fed to an additional stage.

The filaments of the tubes are controlled by means of fixed resistors, connected in the positive leads. This was done so that the negative side could be grounded to the shield.

Complete details in regard to the construction will not be given; for the builder generally has lying around idle parts which may or may not be of the same type employed in this super. For this reason, only the values of the various units have been designated. It is well, however, to use parts which are both mechanically and electrically perfect.

A layout of parts is depicted in Fig. 2. The foundation is a ⅜-inch wooden baseboard, 18 inches long by 12 wide. This size allows sufficient space for the parts without crowding, and fits into a standard 13x19-inch metal cabinet. All of the wiring is done with No. 16 flexible hookup wire. Where the leads pass through the aluminum shielding, holes are drilled and fitted with ⅛-inch hard rubber electric socket bushings.

A 50,000-ohm regeneration control (R5) and a 200-ohm potentiometer R were chosen because their shafts are insulated from the sliders; permitting direct mounting on the metal panel.

Operation

When the mounting and wiring is completed, the tubes may be inserted and the external connections made (it is assumed that the wiring is correct). The filaments may now be lighted and the I.F. tuning condensers (C5) set at very nearly maximum capacity, with the regeneration control adjusted to minimum resistance. Connect a low-range milliammeter in the plate circuit of the A.F. tube and adjust the bias until the meter shows 7 milliamps. Now tune in a fairly strong signal and vary the first-detector potentiometer (R) for greatest volume.

The I.F. stages may then be lined up. The second detector's tuning condenser (C5) is left near maximum, and that in the second I.F. stage increased slightly. That in

the first I.F. stage is then set somewhat lower than either of the others. This method of "staggering" the stages results in a band-pass effect; having a tendency to increase the selectivity without cutting off the sidebands or decreasing the sensitivity to any great extent. Although not exactly in accordance with theory, it has proven very effective, not only in this receiver but in others as well.

After the I.F. amplifier has been adjusted, the plate-grid capacity of the first detector tube should be neutralized by varying the condenser C4. To determine if oscillations are present, touch the grid terminal on the socket with the finger. If a distinct thump is heard the tube is oscillating, and a different setting of C4 is necessary. No thump will be heard if the value of C4 is correct.

The negative bias required on the grid of the second detector cannot be stated with any degree of certainty. Anything between zero and about 12 volts will work. A voltage of 2 to 4 will give the greatest sensitivity; but, at this value, loud signals tend to overload the tube, resulting in distortion. From 6 to 10 volts is usually sufficient, and it will only be necessary for the operator to vary the slider until the quality is at its best.

When a weak station is being received, regeneration in the second detector may be increased by varying the resistor R5. Too much regeneration causes distortion; so it is well not to go too far with this.

A short antenna, not over 50 feet long, should be used with this super. More than this will increase the noise-signal ratio, making reception uncomfortable, to say the least. Only eight or ten feet will bring in many stations on the loud speaker with a minimum of static and other extraneous noises.

List of Parts

Two .00035-mf. variable condensers, C;
One .0005-mf. semi-variable condensers, C1;
Three 1-mf. by-pass condensers, C2;
One .005-mf. fixed condenser, C3;
One 25-mmf. neutralizing condenser, C4;
Three .0005-mf. semi-variable condensers, C5;
Four 0.1-mf. by-pass condensers, C6;
One .001-mf. by-pass condenser, C7;
One 200-ohm potentiometer, R;
Two 10-ohm filament ballasts, R1;
Four 4-ohm filament ballasts, R2;
One 5-ohm filament ballast, R3;
One 1500-ohm Carter resistor, with two sliders, R4;
One 50,000-ohm "Radiohm" variable resistor, R5;
Six Silver-Marshall type "130-P" plain coil forms, and six UY sockets, for inductances;
Six tubes, two 222 type, two 112A, one 201A, one 240, and six UX sockets;
One S.M. "225" or "255" audio transformer, AFT;
Two aluminum stage shields, 7x6x6 inches, S-S1;
Two S-M small copper shields for I.F. stages, S2-S3;
Two R.F. chokes, home-made;
Three terminal strips (see Fig. 2) with binding posts;
Two National "Type B" dials;
One standard metal cabinet, 19x13x9 inches, and one baseboard, 18x12;
Wire for inductances and hook-up, etc.

Radio Principles in New Applications

(*Continued from page* 469)

The signals, from which the talented gentleman from East Pittsburgh takes his cues, are given by means of light. The operator who directs his motions is armed with a control tube containing a neon lamp, which is modulated at audio frequency. Throwing the light from this on the proper photo-cell operates the desired relay in the robot.

Within its figure is a miniature talking-movie equipment; that is to say, a 16-mm. projector, containing film with appropriate speeches in sequence on the sound track. This is operated at the proper time, and gives 'Rastus a very copious vocabulary in a rich, baritone voice. A green light operates this sound apparatus, and a red light the motor equipment. This talented performer made his debut before the A. I. E. E., under the chaperonage of L. W. Chubb, research director of the Westinghouse laboratories.

Lightning to Order

Under the same auspices, artificial lightning was produced for the electrical experts. An impartial commentator—much more one who crawls under a feather bed when a crash of thunder is heard—might inquire why lightning is so desirable that engineers should add to the quantity which is already more than filling its quota of static.

The answer is that artificial lightning is desirable to test protective devices which are to be exposed to the real stuff; and to determine how to safeguard telephone, telegraph and power lines, etc.

In the illustration reproduced on page 468, we have a portable lightning generator—the ladder-like device on the truck—sending a million-volt flash through a wire which glows dazzlingly with the discharge. (The wire, it is said, is of little use thereafter for practical purposes.) Corona discharges, line surges, etc., and other phenomena of wire lines under high voltage, and natural atmospheric peaks are reproduced in this manner. Nowadays, too, oscillographs can be used to record all the vacillations of a flash of lightning, showing its path during a ten-millionth of a second. This is done by the cathode-ray tube; for no mechanism can move so fast.

A few years ago, electrical engineers went into the mountains and spent a summer trying to snare lightning. As with other fishermen, the biggest prizes undoubtedly got away. Now we have the artificial apparatus, which produces thunderbolts "just as good," if more expensive than the real article. And the improved lightning arresters are now more efficient to prevent the tie-ups of public utilities, which were once not infrequent. The new "porous-dise" type is termed an "autovalve."

THIS month we are offering a great variety of battery sets at such ridiculously low prices that they cannot fail to astonish you.

These sets are so-called store demonstration models and are not sold as brand new. However, all sets have been carefully tested and put into good shape and we guarantee them to be in good working order.

All other merchandise listed on this page is brand new and is shipped in original factory sealed cartons and carries the same guarantee of absolute satisfaction.

Act immediately as the supply is limited and we reserve the right to return remittances as soon as items are sold out.

In many instances, our sale prices are lower than the actual manufacturer's cost. For terms, see bottom boxes.

Radiola 25 Superheterodyne

The "25" is a loop-operated set requiring 6 "X-199" tubes. No outside aerial is needed. The receiver has "10-kc selectivity. Tuning of this receiver is accomplished through large "thumb-operated" tuning drums, so designed that stations may be "logged" directly on the drums. The small center knob controls a multiple-contact switch which changes the circuit to include one or two stages of A.F. A two-tone mahogany veneer cabinet of original pattern houses the chassis and batteries. Its overall dimensions are 28x19x12 inches high. Shipping weight, 55 lbs.

List Price $265.00.
YOUR SPECIAL PRICE $10.95

Stromberg-Carlson 523

This fine set uses 4 201A and 1 200A tubes. The cabinet is one of the finest ever made for radio sets. A slanting, beautifully grained wooden panel carries the tuning escutcheons. The panel controls include a "Long-Short Antenna" switch; 3-ohm and 20-ohm rheostats; "On-Off" snap switch; audio output jack; and a Weston 0-7 voltmeter. The jack on the panel is for phonograph pickup. A neutrodyne circuit is used. 26 long x 11 deep x 13 inches high. Shipping weight 75 lbs.

List Price $160.00.
YOUR SPECIAL PRICE $24.95

Utah Dynamic A.C. Power Speaker—Model 33A

110-volt, 60-cycle A.C. light socket supply for field excitation with Westinghouse dry rectifier, 9 in. high, 9½ in. wide, 7½ in. deep. Speaker comes packed in wooden crate. Weight 19 lbs. It is one of the most powerful as well as best reproducers in the market. 9-inch cone.

List Price $50.00.
YOUR SPECIAL PRICE..... $7.50

A.C. Phonograph Motor

SYNCHRONOUS—revolves EXACTLY 80 turns per minute despite any voltage variations. Most compact made—only 1¾ in. thick—mounts in any limited space. For 110 volt, 60 cycle, A.C. Complete with turntable. Shipping wgt. 10 lbs. **List Price $15.00.**

YOUR SPECIAL PRICE..... $4.25

245 A.C. Power Transformer

For five 224 (or five 227), two 245, one 280 A.C. tubes, OR ANY COMBINATIONS OF 2½-VOLT TUBES. All secondary windings CENTER TAPPED. 600-VOLT HIGH VOLTAGE SECONDARY. 75 WATT CAPACITY. Size 5¼x11¼x3¾ inches. For 110 volt, 60 cycle, A.C. Shipping weight 12 lbs.

List Price $15.00
YOUR SPECIAL PRICE..... $3.40

2½ Volt A.C. Fil. Transformer

Two windings, both center tapped. One "lights" six 227 or six 224 2½-volt tubes, and the other lights two 245 tubes. Total: 11 amps. For 110 volt, 60 cycle, A.C. Size 4¼x2⅝x3¼ inches. Shipping weight 6 lbs.

List Price $10.00.
YOUR SPECIAL PRICE..... $2.75

Radiola 28 Superheterodyne

is a "Second Harmonic" superheterodyne. However, the circuit of the "28" includes 7 type X199 tubes and 1 type X120 tube. The Radiola 28 includes 3 S.L.F. condensers, 2 1-mf. safety-lamb by-pass condensers; center-tapped loop (necessitated by the stage of neutralized R.F.); 1 off-on switch; 2 filament rheostats; 1 4-coil R.F. inductance; 2 jacks; and the special 8-socket "catacomb" containing the I.F., R.F. and A.F. transformers. Coast to coast reception is a rather usual accomplishment! Uses 2 drum dials—space for station logging thereon. Many easy ways of electrifying this receiver. Revolving loop—greatly assists tuning. Access to battery compartment obtained by raising receiver on hinge. The mahogany cabinet imitates a secretary.

List Price $295.00.
YOUR SPECIAL PRICE $24.98

600 Volt Condenser Sections

Impregnated in pitch. Flexible lead terminals.

.5 mfd.....25c	2. mfd.....40c
1. mfd.....30c	4. mfd.....60c

FREE

We have just issued our new "RADIO SERVICE TREATISE." It's red hot all the way through. 52 new hookups and circuit diagrams. 110 illustrations.

Partial contents: Modernizing old radio sets. How to convert battery to power sets. Selection of tubes. The detector tube. The power tube. Changes in grid or "C" bias circuits. Push pull amplifiers. Replacing audio transformers. Phono. attachments. How to choose power transformers. Voltage dividers. Wattage of power transformers. Selecting and installing replacement parts in radio sets. Filter condensers. Repairing "B" eliminators. ALL BRAND NEW DOPE—NOT A REPRINT. Chuck full of REAL radio information all the way through. Even the catalog section has dozens of hookups—never found anywhere before.

WRITE TODAY. A postal card brings it by return mail.

Ware Type T. Neutrodyne

This is the most economical in operation of all radio sets. The circuit is that of a REFLEXED NEUTRODYNE incorporating 3 UV-199 tubes. The mahogany cabinet is 11 in. long and 13 in. deep. This design provides room for the "A" supply of 3 dry cells, 2 "B" and 1 "C" battery. There are 2 15-plate variable condensers, 2 neutrodyne-type R.F. transformers, 2 A.F. transformers, rheostat, 2 jacks, R.F. choke, 2 tuning dials, shock-absorbing mounting for the 3 tubes. Shipping weight 16 lbs.

List Price $65.00.
YOUR SPECIAL PRICE $5.95

R.C.A. Double Filter Chokes

(No. 8336)

This heavy-duty, extremely strong, double filter choke can be used for all types of filter circuits, experimental work, power amplifiers, receivers, eliminators, power packs, converted sets, etc. Known as R.C.A. replacement part for all Radiola models, particularly Nos. 33, 17 and 18. Each choke D.C. resistance, 500 ohms. Connected in parallel, these double filter chokes have a rating of 15 Henries at 160 Mills; connected in series, 60 Henries at 80 Mills. Fully shielded in heavy metal case with special insulating compound. Size 5¼ x 3¾ x 2⅞. Shipping weight 6 lbs.

List Price $10.05.
YOUR SPECIAL PRICE..... 95c

Radiola Superhet. AR-812

One of the most famous radio sets in America. This set placed on a table, the battery switch turned to "on," and music will be heard,—without an outdoor antenna: It works with a loop aerial built inside the cabinet. The set is super-sensitive and, in certain localities, it is possible, on the east coast, to hear west coast stations. The cabinet holds all the batteries for the six "dry-cell" tubes required. Some experimenters tune in short wave stations and use the AR-812 as the INTERMEDIATE FREQUENCY AMPLIFIER. In that way the tremendous amplification obtainable from this receiver is used to the fullest extent. A push-pull switch (center) turns the set on and off; another, (lower left) cuts in either one or two stages of A.F. amplification. Although the cabinet is 35 inches long, 11½ deep and 11½ high, the panel of the receiver is only 19 inches long and 9 inches high. The difference lies in the two end compartments for "A" and "B" batteries. Six type UV199 tubes are required for this receiver. Dry-cell power tubes, the type '20, may be used in this set if a Naald or similar adapter is used. Shipping weight 45 lbs.

List Price is $220.00.
YOUR SPECIAL PRICE $10.95

Atwater Kent Model 35

One of the most compact receivers ever offered to the public. 3 stages R.F, 3 variable condensers are used. Overall dimensions are: 17½x8x8½ inches. The chassis is housed in a brown crackle-finish pressed metal cabinet. This is a "one-dial control" receiver. Incorporated in this set is a 6-wire cable, each wire of which is rubber insulated and "color coded." This shielded receiver has very high "gain" and may be used with antennas of any length, without in the least affecting the tuning. The variable condensers are of the "single bearing rotor" type. This set takes the following tubes: 5 type-201A and one type-112A or 171A tubes. Shipping weight 16 lbs. **List Price $65.00.**

YOUR SPECIAL PRICE $14.95

Earl Power Transformer

Make money revamping the old battery set. This power transformer used in Earl Model 22 receiver supplies "A," "B" and "C" potentials for: two '27's (for screen - grid '24's), three '26's, two '71A's and one '80 rectifier; total current output of high-voltage winding at maximum output (about 200 volts) is 80 ma. High voltage secondary, filament winding for '27's, and for '71A's are center-tapped. May be used in any number of combinations. Suitable resistors, a couple of 4-mf. filter condensers, two 30-henry chokes and by-pass condensers complete fine power pack. Size 3⅝ x 3 x 2⅝ inches. 16 long leads and full wiring directions. Shipping weight 5 lbs. **List Price $7.50.**

YOUR SPECIAL PRICE..... $1.75

The Radiola 20

Two stages of tuned frequency amplification, a regenerative detector, and two stages of A.F. amplification, using 4 type X-199 tubes and a X-120 for the last audio stage, is the arrangement of this receiver. The A.F. transformers used in this set are perfectly designed for the required performance. Heavy, soft iron encases the windings, and the frequency characteristic is exceptionally good. Cabinet is mahogany. Overall dimensions are: 19x16x11 inches high. Shipping weight 35 lbs. **List Price $102.50.**

YOUR SPECIAL PRICE $12.50

Atwater Kent 20 Compact

Five 201A tubes are used in this very sensitive and selective tuned radio frequency set. Dimensions: 20x6½x6½ inches high. A six-wire cable, "color coded," 6 ft. long, is included. Cabinet is finished in walnut. The panel is metal, finished in flat brown. Variable condensers having 16 plates are used. The variable condensers are independent of the receiver chassis. 3 brown molded "full vision" dials are used. A 3-point switch on the panel selects taps on the first R.F. coil, for "local" or "distance" reception. Non-oscillating. Easily re-wired for A.C. operation. Shipping weight 20 lbs. **List Price $60.00.**

YOUR SPECIAL PRICE $10.95

Freshman "Masterpiece" A

It is of the tuned Radio Frequency type. Requires 4 201A, 1 171A tube. Has 2 A.F. transformers, and 3 variable condensers. Overall dimensions are: 20½ x 12 x 9¼ inches; mahogany bakelite panel. The cabinet is finished in mahogany. 3 19-plate variable condensers used. The dial settings are read through recessed windows. 2 jacks mounted on panel. Shipping weight 25 lbs. **List Price $80.00.**

YOUR SPECIAL PRICE $7.00

Allen Hough ROTROLA

This remarkable new instrument enables you to play phonograph records through your radio loud speaker. Plugs into any radio set, whether same uses batteries or A.C. Connected to your radio in a jiffy. Equipped with fine electric motor operating only on A.C., 60 cycles, 110 volts. New Webster pick-up; volume control; special constant speed electric motor. Beautiful portable cabinet. Full bronze trimmings. In factory sealed case. Shipping weight 18 lbs. **List Price $45.00.**

YOUR SPECIAL PRICE..... $13.50

Replacement Power-Pack Condenser Blocks

Exact duplicate, physical size, placement of connection terminals, and electrical specifications of original blocks.

For Majestic 171 type receivers ..	$5.00
For Majestic 250 type receivers.....	$5.00
For Majestic 245 type receivers.....	5.00
For Atwater Kent 37.....	4.95
For Freshman M-12	5.00
For Majestic "B" Eliminator.....	2.90
For Majestic Master "B" Eliminator.	2.90
For Majestic Special Master "B" Eliminator	3.00
For Majestic "A" Eliminator.....	3.25

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If C. O. D. shipment is desired, please remit 20% remittance, which must accompany all orders; balance on delivery.

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Order from this page; you will find special offers from time to time in this magazine. Get our big FREE catalog for the greatest Radio Bargains in the U. S.

BARGAINS

At the tremendously low prices at which the merchandise below is offered, every radio dealer, service man or mechanic should equip himself with stock for future use. It is probable that such low prices will not prevail for long.

KOLSTER 245 POWER AMPLIFIER WITH MATCHED DYNAMIC SPEAKER

an outfit of
Proven Superiority

LIST, $98.00
Less Tubes

Our Price $24.50
Less Tubes

For radio, phonograph or public address systems. Reproduces speech and music with marvelous fidelity of tone. The amplifier has 2 stages, using a 227 in the first and two 245 tubes in the push-pull stage with a 280 rectifier. For 115-volt, 60-cycle alternating current.
The Kolster Dynamic speaker chassis supplied with and included in the price of this outfit, is ACCURATELY MATCHED.

RADIART POWER TRANSFORMER

All Secondaries are Center-tapped

SUPPLIES VOLTAGES AS FOLLOWS:

Primary—110 volt, 50 to 60 cycles A.C.
Secondary—2.5 volt, supplies filament for five or more Screen-Grid or 227 type tubes.
Secondary—2.5 volt, supplies filament for two 245 Power tubes.
Secondary—5 volt, supplies filament for one 280 Rectifier.
Secondary—High Voltage, 375 volts each side of tap, supplies sufficient plate current for two 245 Power tubes.

Our Net Price $3.75

245 POWER TRANSFORMER

For use with a 280 rectifier tube, to deliver 300 volts D.C. at 100 milliamperes, slightly higher voltage at lower drain, from 105 - 125 - volt A.C. line (marked 110 v.), 50 - 60 cycles. The primary is tapped at 82½ volts in case a voltage regulator is used. The black primary lead is common. If no voltage regulator is used the other primary lead is the green one. If regulator is used, the red and black form the circuit. The secondary voltages are all center-tapped: 672 volts A.C. for 280 plates, 2½ v. 3 amps. for 245 output, single or push-pull; 5 v. 2 amps. for 280 filament; 2½ volts 16 amps. for up to eight 224 or 227 tubes. Center taps are red and all leads are identified on name plate. Laminations are hidden except at bottom. Eight-inch leads emerge from the sides, but if preferred may be taken off through the bottom of the transformer by pushing them through the rubber grommets. Shipping weight, 12 lbs. Overall size: 5" extreme width x 4½" high.

Our Net Price $7.35

No. 250 POWER TRANSFORMER
Same as above
Our Net Price.....$8.50

No. 171 POWER TRANSFORMER
Same as above
Our Net Price.....$5.50

245 B SUPPLY CHOKE

100 m. choke coil for B filtration in 245 circuits; 200 ohms D.C. resistance. Inductance 30 henrys. A continuous winding tapped in two places, giving three sections and four outleads, and permitting a "choke input" to filter. This method lengthens rectifier tube life and filter condenser life, yet filtration is splendid. The black lead goes to the rectifier filament center, the red, green and yellow leads are next in order. Capacities suggested: black, none; red 1 mfd.; green, 8 mfd.; yellow, 8 mfd. In shielded polished aluminum case. Shipping weight, 4 lbs.

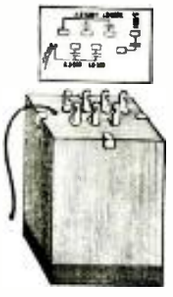
Our Net Price $3.65

SPECIAL FILAMENT TRANSFORMER

105-120 v., 50-60 cycles, with two secondaries, one of 2½ v., 3 amps. for 245s, single or push-pull, other 2½ v., 12 amps. for up to six 224, 227, etc., both secondaries center-tapped. Shielded case, polished aluminum, 6 ft. A.C. cable, with plug. Shipping weight, 4 lbs.

Our Net Price $3.95

ACME 8.7 Mfd. REPLACEMENT BLOCK CONDENSER



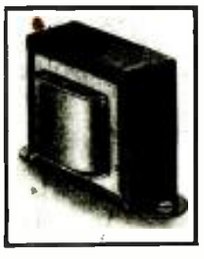
Tapped at 2.3 600 Volts
1.8 600 "
2.3 300 "
1.8 300 "
.5 300 "

5" High, 4" Wide, 2½" Deep. Ideal for replacements in "B" Eliminators — Power Packs — or the average Electric set.

Our Net Price

$1.75

G. T. C. PUSH-PULL TRANSFORMERS



1st Stage — 3 to 1 ratio.
2nd Stage — Input push-pull, 2 or 3 to 1 ratio.

Our Price

$2.75

Per Pair

THORDARSON

Input and Interstage Transformers

A Transformer possessing a ratio of 2 to 1. Built primarily for use with 210, 250 and 245 types of power tubes in push-pull stage.

Size 3½x3¾x3¾ inches
Weight 3½ lbs.

LIST, $12.00

Our Net Price
$3.95

T-2030-A Filter Chokes

A single open frame choke, 30 Henry, 150 M.A., D.C. Resistance 290 ohms. 3,000 volt insulation. Size: 3x3¾x3¾ inches. Weight 3 lbs.

LIST, $7.50

Our Net Price
$2.75

CROSLEY DYNACONE SPEAKER-CHASSIS

A speaker chassis so well known for its satisfactory performance, that manufacturers of Automobile, Midget, and other sets, will soon exhaust our available supply.

Don't mind its recent price.

Our Net Price
$2.75

ROLA DYNAMIC SPEAKER-CHASSIS

With output Transformer of 1,000, 2,000 or 2,500 ohm field.

Our Net Price
$8.75

BARGAINS IN TUBES!

Regular SILVER SHIELD Vacuum Tubes — 100 per cent. replacement within three months provided they still light.

NO LESS THAN SIX TUBES SOLD AT ONE TIME

X201A	$0.35	X281	$1.05
X226	.40	X250	1.25
Y227	.50	X210	1.25
Y224	.75	UX199	.60
X245	.50	UV199	.65
X280	.75	UX120	.65
X171A	.50	WD11	.75
X112A	.50	WD12	.75

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All types listed below furnish all plate and filament voltages for any A. C. set.

MODEL 171 PUSH-PULL
For 4-226. 1 or 2-227. 1 or 2-171A. 1-280. **$2.55**

MODEL 245 PUSH-PULL
For 3 or 4-227 or 245. 2-227. 2-245. 1-280 **$3.25**

MODEL 250 PUSH-PULL
For 5 or 6-227 or 224. 2-250. 2-281 **$5.55**

2½ Volt Fil. Transf.

Two windings, both center tapped.
Total Cap. 16 Amperes **$3.75**

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For Radiolas 44. 46. for 3-224. 1 (or 2)-245. 1-280 (and 2-227) **$4.65**
For Radiolas 60. 62. For 6 or 7-227 (or 224). 1 or 2-171A. 1-280 **$5.80**
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For A-K 36, 37, 38, 40, 42, 43, 44, 52. For 4-226. 1 or 2-227. 2-171A. 1-280 **$4.25**
For A-K 55-55 C. For 2-224. 2-227. 2-245. 1-280 **$4.95**
For Kolster K-24. For 4 or 5-226. 1-227. 1 (or 2)-210 (or 250). 2-281 **$9.40**

Hundreds of other models for ANY STANDARD SET are listed in our catalog.

Convert Any Battery Set for A.C. Operation, Using Super-Powerful 245 or 250 Push-Pull Amplifier.

Simply connect detector plate lead of any battery set to input terminal. Keep using present 1 or 6 volt tubes in present tuner. No rewiring of battery set—no changing of sockets or coils. Whole change over takes a few minutes. Battery set audio amplifier stages, or tubes, not used. Use any 2500 ohm, 110 volt D.C. dynamic, such as the PEERLESS, listed on this page. Can also be used with any magnetic or A.C. dynamic speaker.

As illustrated, less tubes **$27.85**
Same, but uses 2-250. 2-281. 2-227 **$45.50**

UNITS AVAILABLE SEPARATELY

The RADAX power amplifier can be used with any tuner, phonograph pick up, or in any public address system.

*245 Amp. Unit, and A.C. "ABC" Power Supply **18.75**
*250 Amp. Unit, and A.C. "ABC" Power Supply **$35.75**
4-6 Volt "A" Unit (2½ amps.) Bone-Dry. **11.95**

*Choice of AC fil. supply for tuner—either 12 amps. 2½ volts, or A.C. Filament current for 4-226. 2-227.

Kolster K-6 Speaker

So realistic in reproduction it almost rivals a good dynamic, even though it is actually a magnetic speaker! Will operate PERFECTLY with any receiver, using 171-245 or even 250 tubes. Never blasts—nor distorts! 12½ inches high. Very attractive cabinet.
Reg. $35.00 **$4.90**

Condenser-Choke Block for A-K 37-38 etc.

Contains three chokes and four filter condensers. Original color leads **$4.95**

A-K 40, 41, 42, 44 A.C. POWER SUPPLY
Contains above block, plus A.C. power and fil. transf., housed in metal box. Ideal for any A.C. set using 4-226, 2-227, 2-171A, 1-280 **$11.50**

Dubilier-Majestic Cond. Blocks

For "Super" and "Master B" eliminators **$2.75**
For "Special Master B" eliminators **$3.85**
For MAJESTIC 171 Sets **$5.45**
For MAJESTIC 245 Sets **$5.45**
For MAJESTIC 250 Sets **$7.45**
For ANY eliminator or power pack.

Surge-Proof "Hang-Up" Filter Condenser Units

Dipped in black pitch, with long flexible leads protruding.

450 VOLT
.5 mfd. **23¢**
1 mfd. **26¢**
2 mfd. **38¢**
4 mfd. **55¢**

600 VOLT
1 mfd. **30¢**
2 mfd. **40¢**
4 mfd. **60¢**

800 VOLT
1 mfd. **45¢**
2 mfd. **75¢**
4 mfd. **$1.10**

1000 VOLT
1 mfd. **75¢**
2 mfd. **$1.10**
4 mfd. **$1.60**

Dry Electrolytic Condensers

No. Anodes	Total Cap.	Price
1	1 mfd.	$ .38
1	2 mfd.	.65
1	4 mfd.	.85
1	8 mfd.	1.25
3 (2-4-8)	14 mfd	2.85
2	16 mfd.	2.13
3	24 mfd	2.75
4	32 mfd.	3.38

Loftin-White Direct Coupled Amplifiers

Afford more than sufficient volume, sufficient for most dance halls, schools, small auditoriums, etc. The very finest of parts only are used—made of finest parts.

Also furnishes all ABC voltages to any 2½ volt A.C. tuner. Easily connected by any novice. **$13.90**

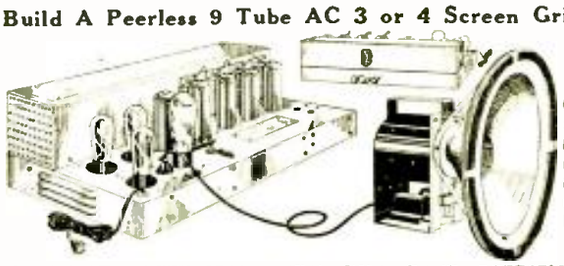
250 MODEL
Requires 1-250. 1-281. 1-224 **$24.50**

103 RCA Speaker Chassis

Has built-in transformer—will stand big volume without any distortion, rattling or blasting. 9 in. outside diameter. 4½ in. deep. Can be mounted in any radio console, or against any baffle arrangement **$3.25**

For 100A Speakers **$4.95**

Build A Peerless 9 Tube AC 3 or 4 Screen Grid Receiver



Complete parts, including nickel finished, punched metal chassis. **Assembled by any novice in three hours!**

Uses THREE SCREEN GRID TUBES! LINEAL POWER DETECTION! PUSH PULL 245 AMPLIFIER! PHONOGRAPH ATTACHMENT! RECEPTACLE FOR SHORT-WAVE SUPERHETERODYNE ATTACHMENTS! TUBE VOLTAGE REGULATOR! TOTALLY SHIELDED! IMMENSE POWER PACK! TONE CONTROL! Requires 3-224. 2-227. 2-245. 1-280 and AMPERITE VOLTAGE REGULATOR. Operates with a 15 foot aerial—even picks up 2,000 miles on same.

Designed for any 110 volt D. C. dynamic speaker, 2500 ohms resistance—Use any MATCHED Peerless speaker listed below. For 25 or 60 cycles. 21" x 9½" x 12" deep. **FULLY GUARANTEED.** **$22.50**

less speaker
Amperite Voltage Regulator **$1.75**
Set of 8 A. C. Tubes **$7.50**

(Note: We can furnish this chassis assembled for $29.50)

Peerless 16 inch Dynamic Speakers

110 v. D.C. MODEL
2500 ohms resist.
Produces super auditorium volume, with uncanny perfection of realism of reproduction. Contains push-pull output transformer. Can be used with any set. **15.95**

110 v. A.C. MODEL—16" Diam. Model
Uses a 280 Rectifier tube—more superior than metallic disc rectification. No finer speaker made! **$19.75**

12" 110 V. A.C. **$14.50**
12" 110 V. D.C. **$10.50**
9" 110 V. A.C. **$10.95**
9" 110 V. D.C. **$10.00**
UTAH 110 VOLT A.C. DYNAMIC
Special **$7.50**

Radax General Replacement A.C. Power Packs

Can be connected in 30 minutes. Detailed instructions and diagrams included.

171-A "B" ELIMINATOR. 200 volt output, and 45, 67, 90, and 135 volt terminals. Requires 280 Rectifier. **$6.75**

Same as above, but also furnishes A.C. filament current for 5-226. 2-227, 2-171A. 1-280 tubes **$8.25**

245 "B" ELIMINATOR. Output 250 volts, and 45, 67, 90, 135 and 180 output terminals. Also furnishes 3 amps., 2½ volts A.C., for lighting TWD 245 tubes. Proper "C" bias for these tubes also provided. Requires 1-281 rectifier tube **$10.45**

Same as above, but also furnishes A.C. filament current for 6-224 or 227 tubes, 2-245 tubes, 1-280 tube. MAKES AN IDEAL ENTIRE A.C. POWER PACK REPLACEMENT UNIT **$12.45**

NOTE

All of the above models contains two filter chokes—for $2.00 additional ANY MODEL will be made to furnish 110 volts D.C. for D.C. dynamic field coils.

Build a Radax "Round the World" Short Wave Set

Most compact 3 tube set made! Noted for extreme long distance reception. Tunes 10 to 200 meters. Can be assembled in one hour! Requires 2-201A. 1-112A or 1-171A. Our big leader! **$12.50**

Build a Three Stage, Double Push-Pull Auditorium Super-Amplifier and ABC Power Pack

Here is the very last word in power amplifiers. Use with any Radio Tuner, as a PHONOGRAPH AMPLIFIER of exceptional efficiency, or as a PUBLIC ADDRESS AMPLIFIER. Input feeds into a 227 1st A.F. stage, followed by a PUSH-PULL 2nd A.F. stage using two 227's followed by a 3rd A.F. PUSH-PULL STAGE, using TWO 250 super-power tubes. Amplification produced ample for huge auditoriums or outdoor gatherings. AMPLIFIES WITHOUT DISTORTION. Requires 2-281. 2-250. 3-227 tubes. Furnishes 45, 67, 90, 135, 180 volts "B" for tuner, as well as choice of 2½ volt or 1½ volt and 2½ volt A.C. filament current for any tuner. Also furnishes 110 volt field current for any 2500 ohm D.C. dynamic—for exceptional results, use the 16" 110 volt D.C. PEERLESS DYNAMIC! Can be assembled by any novice—detailed diagram included. For 110 volt, 60 cycle A.C. 21½" x 8" x 7" high. **$39.75**

Wired, ready for use **$47.50**

245 MODEL
Requires 3-227. 2-245. 1-280 tubes **$28.25**
Wired, ready for use **$33.75**

Build a Peerless 3-4 Screen Grid A.C. Tuner

Can be used with any amplifier. Requires external A.C. filament and plate supply. Shielded r.f. coils. Tube shields. Uses either a 227 LINEAL POWER DETECTOR, or a 224 SCREEN GRID DETECTOR. Modernize any old battery or A.C. receiver with this marvellously efficient tuner. Requires 4-224, or 3-224 and 1-227. Most unusual value! **$14.95**

Elkon M-16 Rectifier

Ideal for ANY "A" ELIMINATOR or MOST ANY A.C. DYNAMIC SPEAKER. Furnished as illustrated, or with new base, with 5 heavy brass strip lugs **$2.95**

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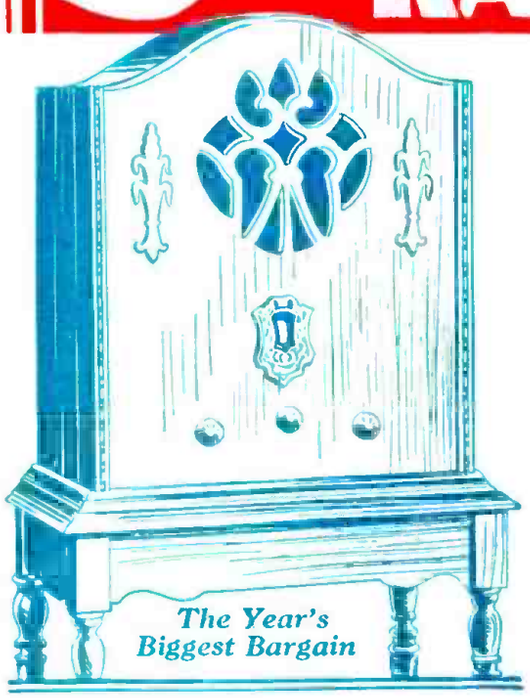

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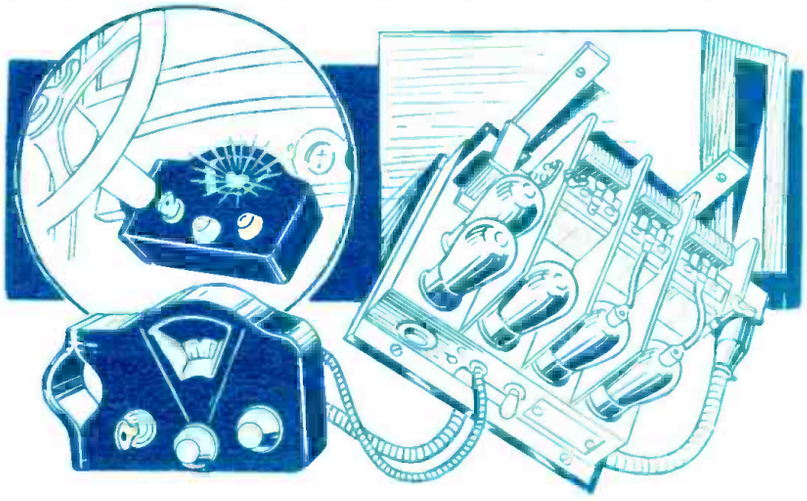

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Provides oscillation test of tubes under radio frequency dynamic operation conditions.

Tests all types of tubes, including screen-grid, overhead heater types and the new 2-volt tubes. Tests both plates of 80 type full-wave rectifier tubes.

All tubes tested independent of radio.

Oscillator furnishes modulated signal for testing, synchronizing, neutralizing, etc.

Provides means for aligning of condensers by thermo-coupler meter.

Neutralizing of tubes actually used in set—only accurate method.

Tests gain of audio amplifiers.

Locates unbalanced power transformer secondaries.

Reads either positive or negative cathode bias.

Provides D.C. continuity tests without batteries.

Indicates resistances without use of batteries in four ranges, .1 to 25, ohms; 10 to 200 ohms, 150 to 30,000 ohms (calibration curve furnished) 5,000 ohms to 5 megohms.

High resistance continuity for checking voltage dividers, insulation leakages, bypass and filter condenser leakages, bias resistors, grid leaks, etc.

Low resistance continuity for checking resin joints, shorted variable condensers (without disconnecting R.F. Coil), Center tapped filament resistors, etc.

External connections to all apparatus.

Screen-grid and pentode socket analysis.

Measures capacity of condensers from .1 mfd. to 9. mfd.

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