

RADIO'S LIVEST MAGAZINE



June
25 Cents

Radio-Craft

FOR THE
SERVICE MAN - DEALER - RADIOTRICIAN

1931

HUGO GERNSBACK Editor

Radio
Prospecting

See page 728



How to Record on Discs
Service Testing Methods

How to Measure Inductances and Capacities
Hotel Radio

Short-Wave Converter

Announcement!

OFFICIAL RADIO SERVICE MEN'S ASSOCIATION

EVER since the appearance of the commercial radio broadcast receiver as a household necessity, the Radio Service Man has been an essential factor in the radio trade; and, as the complexity of electrical and mechanical design in receivers increases, an ever-higher standard of qualifications in the Service Man becomes necessary.

The necessity, also, of a strong association of the technically-qualified radio Service Men of the country is forcing itself upon all who are familiar with radio trade problems; and their repeated urgings that such an association must be formed has led us to undertake the work of its organization.

This is the fundamental purpose of the OFFICIAL RADIO SERVICE MEN'S ASSOCIATION, which is not a money-making institution, or organized for private profit; to unite, as a group with strong common interests, all well-qualified Radio Service Men; to make it readily possible for them to obtain the technical information required by them in keeping up with the demands of their profession; and, above all, to give them a recognized standing in that profession, and acknowledged as such by radio manufacturers, distributors and dealers.

To give Service Men such a standing, it is obviously necessary that they must prove themselves entitled to it; any Service Man who can pass the examination necessary to demonstrate his qualifications will be elected as a member and a card will be issued to him under the seal of this Association, which will attest his ability and prove his identity.

The terms of the examination have been drawn up in co-operation with a group of the best-known radio manufacturers, as well as the foremost radio educational institutions.

The following firms are co-operating with us:

GRIGSBY-GRUNOW CO (Majestic), CHICAGO
STROMBERG-CARLSON TELEPHONE MFG. CO., ROCHESTER, N. Y.
CROSLY RADIO CORP., CINCINNATI, OHIO
COLIN B. KENNEDY CORP., SOUTH BEND, IND.

The schools who have consented to act as an examination board are:

International Correspondence Schools, Scranton, Penna.; Mr. D. E. Carpenter, Dean.
RCA Institutes, Inc., New York, N. Y.; Mr. R. L. Duncan, President.
East Bay Radio Institute, Oakland, Calif.: Mr. T. T. Tonnehilt, Director.
Radio Training Association of America, Chicago, Ill.; Mr. A. G. Mohaupt, President.
School of Engineering of Milwaukee, Milwaukee, Wisc.; Mr. W. Werwath, President.
Rider-Goll Radio School, New York, N. Y.; Mr. John F. Rider, Director.
Radio College of Canada, Toronto, Canada; Mr. J. C. Wilson, President.
Radio Division, Coyne Electrical School, Chicago, Ill.; Mr. H. C. Lewis, President

We shall not attempt to grade the members into different classes. A candidate will be adjudged as either passing or not passing. If the school examining the papers passes the prospective member as satisfactory, we shall issue to him an identification card with his photograph.

If the candidate does not pass this examination the first time, he may apply for another examination three or six months later.

There is absolutely no cost attached to any service rendered by the Association to its members, no dues, no contributions.

If you wish to become a member, just fill out the coupon below and mail it to us. We will send you all the papers necessary to become a member.

O. R. S. M. A.,
c o RADIO CRAFT,
98 Park Place,
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I wish to become a member of your Association. Please mail me the examination papers and application blanks.

Name

Address

Town..... State.....



Train *with* R.T.A. *for* Radio Service Work

Important and far-reaching developments in Radio create sudden demand for specially equipped and specially trained Radio Service Men.



With this
Radio Set Analyzer
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You Can Earn
\$3⁰⁰ an hour

THOUSANDS of skilled Radio Service Men are needed now to service all-electric sets. By becoming a certified R. T. A. Service Man, you can earn \$3.00 an hour full time or spare time, and fit yourself for the big-pay opportunities that Radio offers.

We will quickly give you the training you need to qualify as a Radio Service Man . . . certify you . . . furnish you with a marvelous Radio Set Analyzer. This wonder instrument will then put you on a par with experts who have been in the radio business for years. With its help you can quickly diagnose any ailing Radio set. The training we give you will enable you to make necessary analysis and repairs.

Serving as a "radio doctor" with this Radio Set Analyzer is but one of the many easy ways by which we help you make money out of Radio. Wiring rooms for Radio, installing and servicing sets for dealers, building and installing automobile Radio sets, constructing and installing short wave receivers . . . those are a few of the other ways in which our members are cashing in on Radio.

As a member of the Radio Training Association, you receive personal instruction from skilled Radio Engineers. Upon completion of the training, they will advise you personally on any problems which arise in your work. The Association will help you make money in your spare time, increase your pay, or start you in business. The easiest, quickest, best-paying way for you to get into Radio is by joining the Radio Training Association.

This amazing Radio Set Analyzer plus the instructions given you by the Association will transform you into an expert quickly. With it, you can locate troubles in all types of sets, test circuits, measure resistance and condenser capacities, detect defective tubes. Knowing how to make repairs is easy; knowing what the trouble is requires expert knowledge and a Radio Set Analyzer. With this Radio Set Analyzer, you will be able to give expert service and earn \$3.00 an hour. Possessing this set analyzer and knowing how to use it will be but one of the benefits that will be yours as a member of the R. T. A.

Special No-Cost Memberships Now Open

To all ambitious men. No-Cost Memberships that may not—need not—cost you a cent are available. The training and the valuable Radio Set Analyzer can be yours! Now is the time to prepare to be a Radio Service Man! By the time you're ready, demand will exceed supply. Bigger salaries, rapid promotion, bigger opportunities! For the sake of extra money made in your spare time, bigger pay, a business of your own, a position with a future, get in touch with the Radio Training Association at once. Send for No-Cost Membership Plan, and FREE Radio Handbook that will open your eyes as to what Radio has in store for the ambitious. Don't wait! Don't delay! Get started now!

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VOLUME II
 NUMBER 12

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In Forthcoming Issues

HOW TO MAKE A RADIO ROBOT, by H. G. Cisin. The remarkable doings of robots now command a great deal of interest, as every visitor to late radio shows can testify. In this article Mr. Cisin will describe the construction of a robot of considerable versatility, by means within the reach of resourceful radio experimenters.

THE DESIGN OF POWER TRANSFORMERS AND CHOKES. Many constructors have very clear ideas about the R.F. components of a receiver, but they would like to know more about its heavy end. While you may not wish to build your own pack components, this article will give you the necessary information, which will be otherwise useful.

HOW TO FIGURE R.F. COILS, by Clifford Denton. No question has been asked so often of radio editors as "How many turns of wire on the coil?" We would not say that all editors are tired of answering it; but the reader who is interested in "rolling his own" should keep this article always within reach, and save postage stamps.

THE MODERNIZATION OF THE SUPERHETERODYNE, By C. H. W. Nason. An explanation of the sudden revival of the superheterodyne, with many new features added to the fundamental merit of its principle of operation; and some hints for the constructor. Incidentally—there is not a formula in the article.

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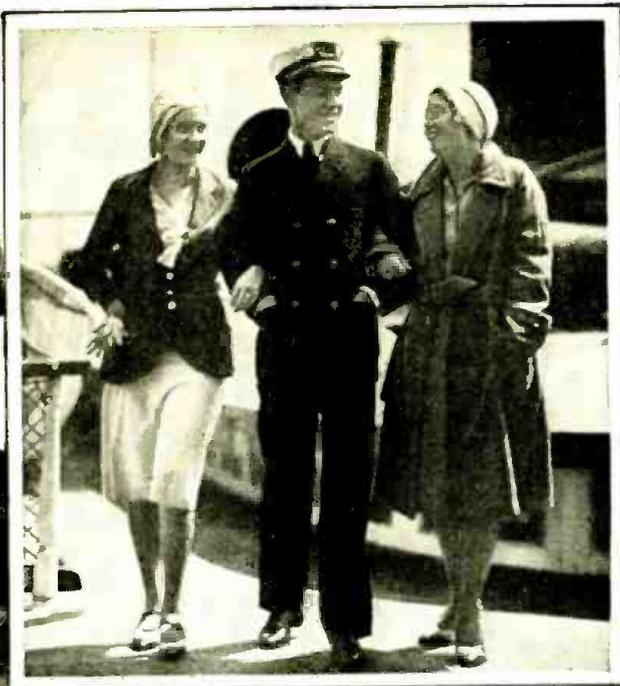
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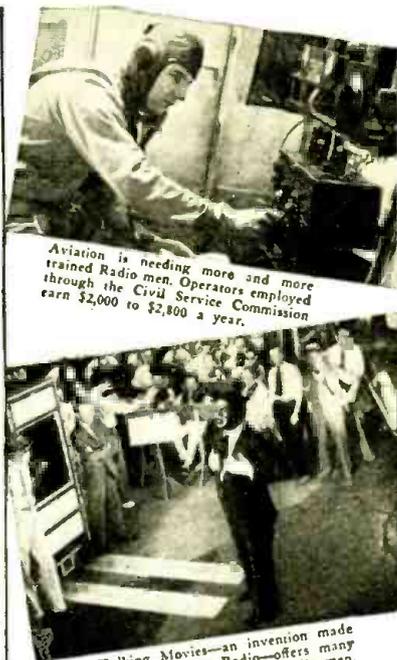
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Aviation is needing more and more trained Radio men. Operators employed through the Civil Service Commission earn \$2,000 to \$2,800 a year.



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for men with Radio training in Television and Talking Movies. My free book tells all about these and many other branches of Radio that bring you in contact with interesting people, pay big money and make life pleasant for you. Without doubt, Radio training is the key that opens the way to success. And my training, in particular, is the only training that makes you a "Certified RADIO-TRICIAN"—the magic words that mean valuable recognition for you in whatever type of Radio work you take up after graduation. You'll see why, when you receive my interesting book.

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here that a Radio business of your own is one of the money-making opportunities my training prepares you for in case you wish to settle down at home.

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Send the coupon below for my 64-page book of opportunities in Radio and information on my home-study training. It has put hundreds of fellows on the road to bigger pay and success. It will tell you exactly what Radio offers you, and how my Employment Department helps you get into Radio after you graduate. I back my training with a signed agreement to refund every penny of your money if, after completion, you are not satisfied with the Lesson and Instruction Service I give you. Fill in and mail the coupon NOW!

J. E. SMITH, Pres., Dept. 1FX
National Radio Institute,
Washington, D. C.

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

Travelled 75,000 Miles

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\$400 a Month

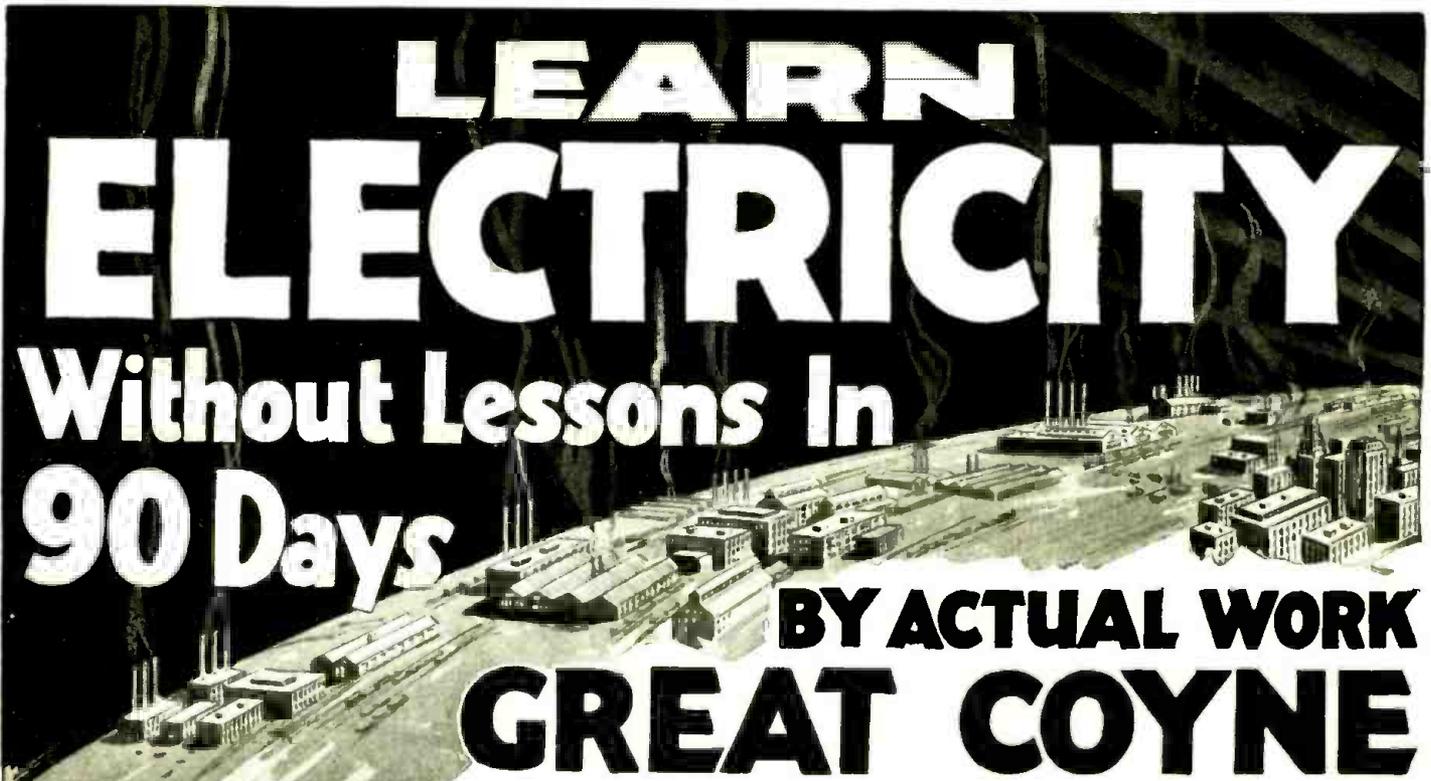
"The Radio field is getting bigger and better every year. I have made more than \$400 each month and it really was your course that brought me to this." J. G. Dahlstead, 1484 So. 15th St., Salt Lake City, Utah.

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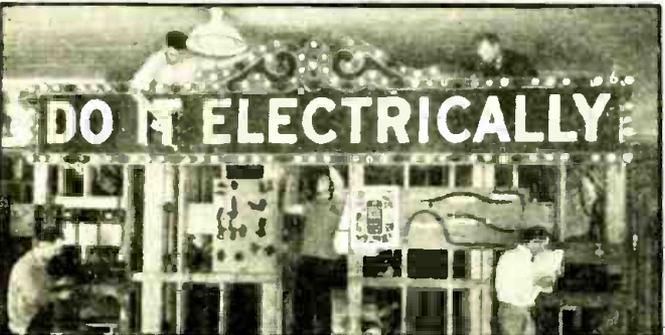
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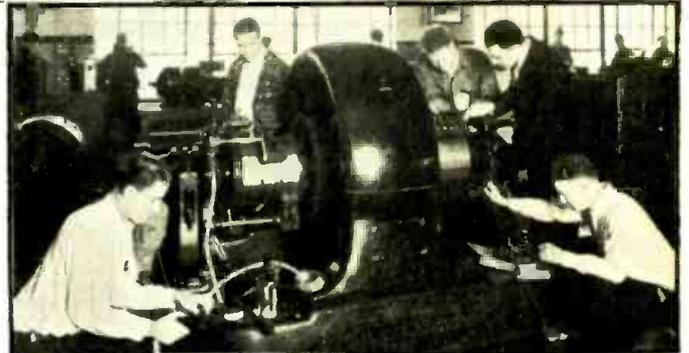
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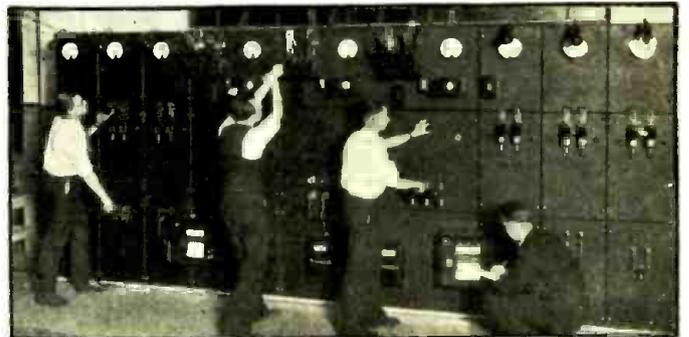
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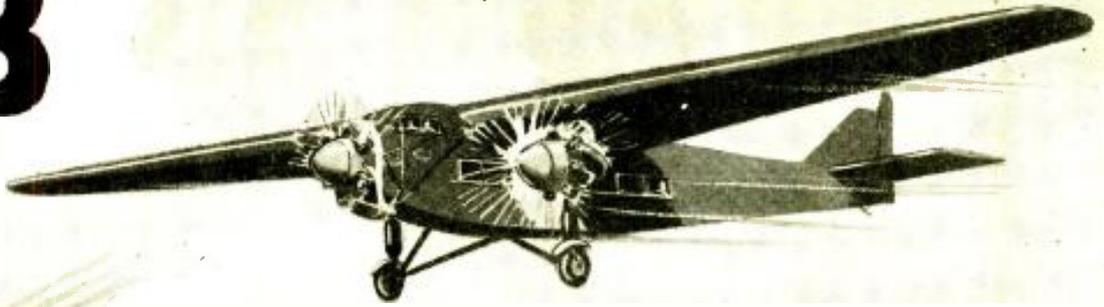


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Electrical School

Dept. A1-8H Chicago, Illinois



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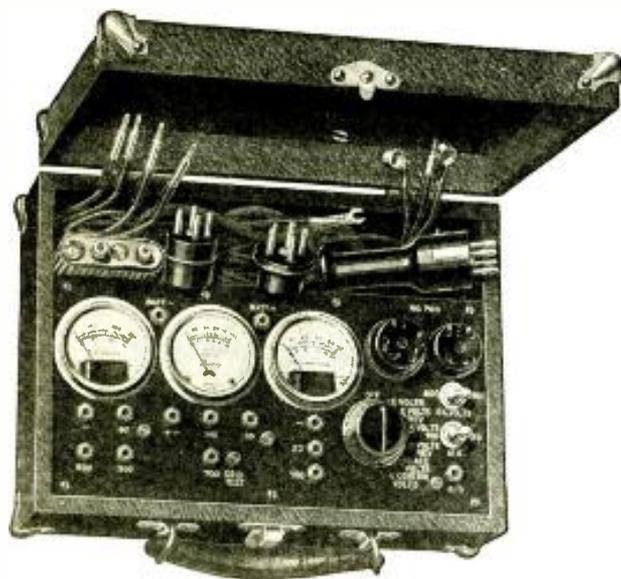
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This model is housed in a strong case with leatherette covering; it is attractive and compact, as well as complete. Cover is removable. It fills every need for the expert servicemen or the beginner for radio set analyzing. Size $10\frac{1}{2} \times 3\frac{1}{2} \times 8$ inches.

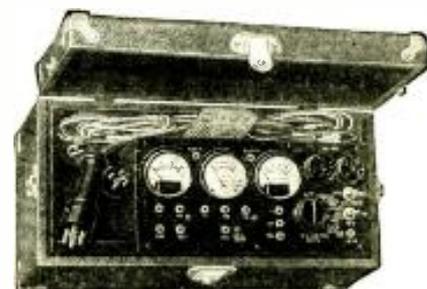
No. 700 List Price \$25.00

THE MODEL 600 contains exactly the same testing equipment as No. 700 but the carrying case is much larger and is equipped with a lock. Room is provided for carrying tubes, tools and supplies. The test equipment and panel is in a removable tray in the top of the case. The tray may be used separately as a complete test panel for shop purposes. Size $14\frac{1}{2} \times 7 \times 7\frac{1}{2}$ inches.

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Future Radio Developments

By HUGO GERNSBACK

I AM in receipt of the following letter, which is typical of dozens of others that reach me weekly. I am, therefore, publishing it in its entirety:

"Steubenville, Ohio,
April 4th, 1931

Mr. Hugo Gernsback,
New York City, N. Y.
Dear Sir:

I am seeking information along the following lines, i. e., Radio, Television and Sound Pictures. I have a son who is interested in these lines, and I myself am also. I would like to have your opinion as to the future of the Television development, and its bearing upon Radio and the Talking Picture Industry.

As I view the proposition, Radio, Television and Talking Pictures are all in the same classification, belonging together, and will be developed and operated practically as one unit of industry.

Your advice and opinion relative to the Radio, Television and Talking Pictures will be greatly appreciated by both of us, and any data which you may be in position to lend us (or advise where we can get same) will also be appreciated; as we are desirous of obtaining all the information possible relative to all three mentioned.

Thanking you in advance, I am,

Yours very truly,

O. M. RICE

1535 Euclid Ave., Steubenville, Ohio"

The answers desired by Mr. Rice, as well as many other radio *interestants* who ask the same questions, cannot be given without contemplating the entire radio picture.

It has been found in the past that similar arts usually develop along roughly parallel lines. When galvanic electricity first became known in the latter part of the eighteenth century, not even the wildest dreamer could foresee the developments which we have with us now. Yet, wonderful as electricity is, it may be confidently stated here that the marvelous rise of the electrical art which we have witnessed during the last 150 years is nothing at all compared to what is yet to come. After galvanic electricity was first practically demonstrated, nearly a hundred years elapsed before the advent of the telegraph, telephone, X-Rays and radio (which latter is only an off-branch of electricity itself).

What electricity will be able to do in a hundred years from now, not even the most imaginative science fiction writer can predict. The future actuality will no doubt make his predictions look absurd in their tameness.

It is so with radio and all of its side branches, be they television or allied developments, such as sound pictures, and many others.

Without fear of contradiction, I may state that the entire art of radio, as well as its branches, is in its merest infancy as yet, and that extraordinary advances remain to be made. All of our radio instrumentalities are still extremely crude, if we compare them with what is to come twenty-five and fifty years hence.

There is not a single type of apparatus in radio that is not enormously improved every two or three years; the old ones becoming obsolete regularly.

Therefore, if I am asked about the future development of radio as a whole, it is easy to see that volumes would be needed to give an adequate answer. In the first place, we must dis-

tinguish between the commercial future and the technical future. The progress of an art may be great so far as the technique alone is concerned; but the commercialization of that art presents an entirely different aspect, because so many important considerations come into the problem that it is impossible to give a comprehensive answer to it.

Of all these considerations, perhaps the greatest factor in the equation is the human element. There are, today, hundreds of excellent radio engineers and technicians who have grown up in radio since its infancy, but may not be able to capitalize their radio education from a financial standpoint; not because they do not have the necessary knowledge, *but because they do not know how to apply the knowledge itself.* The technical side of any art is one thing, whereas the commercial side is an entirely different one.

Therefore, I answer those who have asked for advice, that the only way to tackle the problem is to work on it from the most practical side. That means, in other words, **SPECIALIZATION**; do one thing, and do it thoroughly. Of course, in order to do so, you must also know everything possible about the entire art. If, for instance, you choose to be a radio vacuum-tube expert, it is not sufficient to know all about vacuum tubes themselves, but you must know all the applications of radio wherein the tubes can be used. This is, of course, a large order; but you will find, in the end, that this knowledge is essential, and that without it, failure will be experienced.

In order to succeed then, you must, first of all, have the right mental equipment, with the right technical background. No man, in my opinion, can amount to much in radio, if he has not a thorough electrical training behind him. In addition to this, a good business education will go hand in hand with the development.

Then, of course, it is necessary to have access to all of the important radio literature comprised in text books on the subject, of which there are many, and to read all the current radio publications in the different branches of the art. All new publications should be perused religiously every month to keep up to date.

With this background, it becomes then, of course, a necessity to have a thorough *practical* knowledge of your particular subject. This practical knowledge today can be readily secured in the best, and perhaps cheapest manner by taking a course in one of the manual training schools where these subjects are taught. There are in this country a number of excellent schools of this kind, where practical knowledge of the radio field can readily be secured. I consider this practical training of paramount importance. If possible, the practical training should be preceded by a radio correspondence course, of which there are several most excellent ones. These two courses complement each other, and will give a real background to the man who wishes to specialize in radio, and to amount to something in this field.

Once this experience, and all that goes with it, has been secured, the rest should be comparatively easy. It is then a question only of keeping up to date in the particular branch of the art, and following it from month to month.

It makes no difference whether the man who has secured such a training takes a position with a radio company, or whether he goes into business for himself. Then, as the art keeps on developing, it will be possible for him to keep abreast with it at all times, and to make the best of his opportunities as they come along.

But again I say, specialize in one particular field, and stick to it. In the end you will have no cause for regret.

How to Run a Service Business At a Profit

An article full of business shrewdness and experience, for every Service Man to read

By CHARLES G. MARTINDALE

OFTEN, Service Men come into my shop, look at my test equipment and ask me if it is not foolish to spend so much for equipment that is not absolutely necessary, when I could get along with one-fourth of it and still have more than ninety percent of the radio repairmen? My answer is, absolutely, "No!" The impression it gives to the customer, and the advertising it gives me as an expert who takes pride in his service work, is worth the price of the equipment if I never used it.

My test bench is just inside the door; so that, the instant a customer enters, it is the first thing that catches his eye. As I happen to be located in a district where there are a great number of factory workers, they tell each other about my equipment; and consequently it gives me advertising that I cannot get from newspapers or hand bills.

The real Service Man who is capable of giving his customers a real job, and can

hold on through the business crisis we are going through, will be able to make money in the next few years and from then on.

Overproduction has caused the dumping of sets at low prices which have induced people to buy sets, that they would otherwise have done without for the next couple of years, on account of the price. So, instead of moaning and cussing the "gyp," we should thank him; for it is going to mean millions of dollars to the Service Man in the next few years.

Another thing we should be thankful for is the return of the superheterodyne. The "hammer and cold chisel" men, and the fellow that once built a radio and now does repairing on the side in the evening, will be put out of business; because they haven't the equipment, don't know supers, and the peaking and balancing of this circuit is going to be "gray" for the old-timers who used to think the old Best, Victrola, Ultradyne and Lincoln were the "berries".

The radio Service Man is the worst-paid craftsman today; for the stores and retail radio shops look on the Service Man as a necessary evil and it is not "How good a man can I get?" but "How cheap can I get him?"

The wages paid in this town and a great number of other towns are from twenty to thirty dollars a week, and the man must furnish his own car and test equipment. That is why there is so much dishonesty with these men; for they have to steal to make both ends meet.

The Service Man's Pay

My men are paid a dollar for each call and are guaranteed six calls per day; then the remainder are divided among them equally, and the next ten pay them seventy cents apiece and, from then on, fifty cents each. They furnish their own cars; but I furnish their test equipment, tools and oscillators and output meters.

My service charges are \$1.50 for the call and fifteen minutes' labor; and from then on it is \$1.50 per hour, of which the Service Man gets 50c per hour. All Service Men are instructed not to make any major repairs on the job—unless the customer will not let the set leave the house—and never to replace a part with another that does not look exactly like the one that was defective; as the customer cannot understand why, if there was a green resistor in the set, you did not put in another of the same kind. He does not believe that the black one that you have in your kit is of exactly the same resistance, (if it is, why is it of a different color?) and, the first bad tube or bad night, the black resistor is blamed.

Any calls back within ten days the Service Man must make on his own time and at no charge to either customer or shop; these average about 2 per cent, or less.

Every man working for me must be married and over 25 years of age, have over three years' experience, dress neatly and have a good personality; and more than three complaints in regard to careless or unduly rough handling, impertinence or not keeping a promise, writes his discharge ticket.

When we get a service call we get all information possible and place this on the service ticket, together with the shop diagnosis, which is correct about 80 percent of the time. Each ticket has the customer's name and telephone number; and he is phoned, five days after the call was made, to see if he is satisfied and to verify the price he paid.

An inflexible rule is cash to all, regardless of whether the customer is the president of our largest factory or a street cleaner;

DIRECT-MAIL ADVERTISING FOR A RADIO SERVICE SHOP

EVERY month, Mr. Martindale sends a MARTIGRAM to each customer and prospect on his mailing list. For this purpose, the photograph which forms the illustration at the head of this article has been reduced to post-card size. The "copy" for the cards is changed regularly: some are specially written for professional men, some for business men, and some for the general run of customers. A few of these advertising bullets are quoted below:

FOR PROFESSIONAL MEN:

MARTIGRAM

From one professional man to another. You have studied to make yourself competent and efficient and take pride in your work. So you can appreciate what 11 years of repairing, with the same ideals, have done for us.

MARTIGRAM

You give immediate service to your patients. Our customers get the same prompt, courteous treatment.

MARTIGRAM

It is not ethical for you to advertise as I do; and your business is advertised from the satisfied patients. Eighty per cent of our business comes the same way.

MARTIGRAM

Tubitis is marring your radio pleasure, just as a cylinder missing in your auto would spoil your driving pleasure. Have them renewed. I handle all standard tubes; let us call and renew your tubes.

MARTIGRAM

Last month we tested one hundred and forty-seven sets of tubes. Eighty-one had one or more weak or bad tubes, and were improved with new tubes. **HOW ARE YOUR TUBES?**

FOR "LAY" SET OWNERS:

MARTIGRAM

We will wager that, some time or other, you have listened to one of the hundreds of sets we built when radio was young. We have serviced the sets of many of your friends. **GIVE US A CALL.**

MARTIGRAM

You get the most pleasure out of your set in the evening. That is why we will gladly give you night service at the same price.

MARTIGRAM

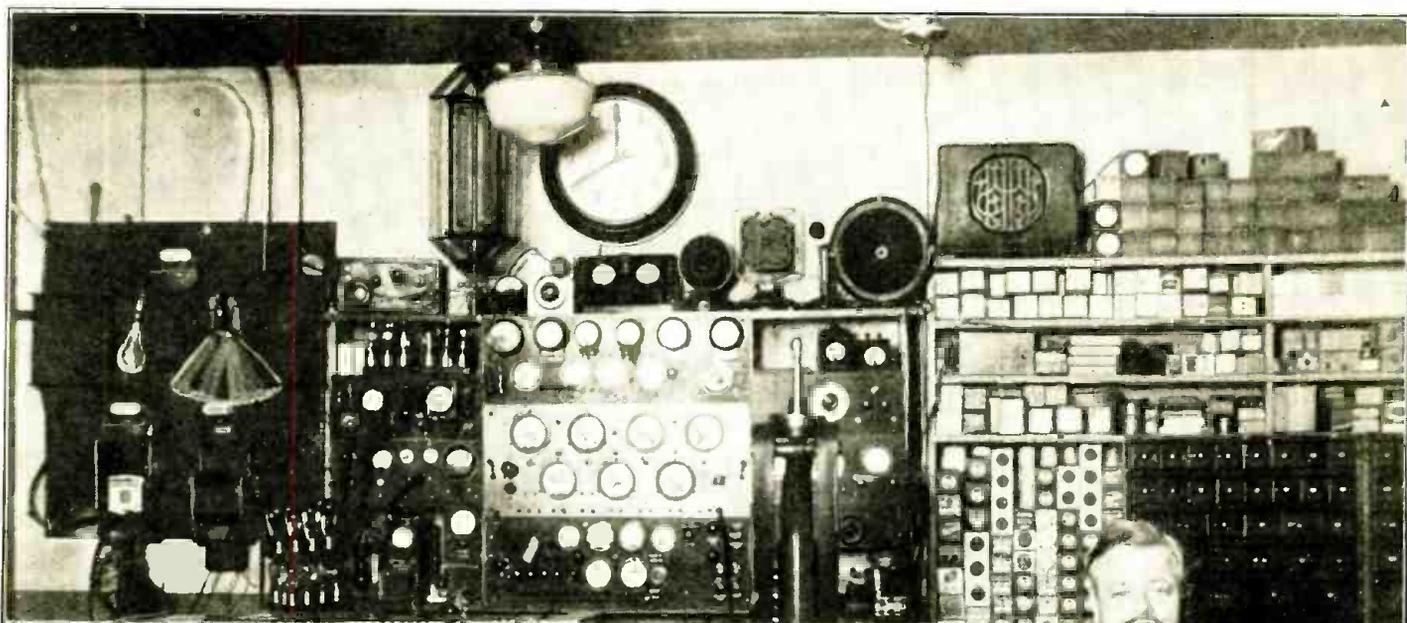
Is your set working as good as it used to? If it isn't, don't you think that it would be a good idea to call us and have it put into new condition?

MARTIGRAM

We believe it is not how much your service bill is in dollars and cents that counts. But it is how much you get for the money that counts.

MARTIGRAM

You have to depend on the Service Man's word that a certain tube or part is bad in your set. Don't you think that you will get a more honest deal if you are paying for service, than you would if you got free service and what the Service Man gets would be what he sold you?



Not only does an elaborate testing board like this make work easier and surer, but it impresses customers. The Service Man needs "showmanship" to sell his services to better profit.

for one man's dollar will buy just as much as another's.

When a Service Man is asked for credit, he is told to explain that he must turn in

MARTINDALE RADIO SHOP	
10 YEARS OF SERVICE THAT SATISFIES DAYTON'S OLDEST AND BEST EQUIPPED SHOP	
MR. _____	
ADDRESS _____	
PHONE _____ DATE _____ 193__	
MAKE _____ MODEL _____	
TYPE _____ PROMISED _____	
INFORMATION _____	
TUBES _____	
PARTS _____	
LABOR _____ HRS. _____ PER HR. _____	
SERVICE _____	
TERMS CASH _____ TOTAL _____	
SERVICED BY _____	
CUSTOMER O. K. _____	
FOR YOUR PROTECTION SIGN AFTER TOTAL AND SLIP IS COMPLETELY FILLED IN	

This blank in triplicate shows the customer what he is getting and gives an office file and mailing list for "Martigrams," etc.

the money out of his own pocket if they do not pay him. Of course, he does not; but it is surprising how many who ask for credit pay cash, and the small percentage of losses due to their believing that the man doing the work will take the loss. And when one who has had credit comes in and pays, I always say before the customer: "Credit this to Service Man number so-and-so," thus leaving the impression that this had been charged to the repairmen.

I run catchy advertisements of three or four lines in all the newspapers (by the year); such as "Service That Satisfies;"

"Service by Men Who Know How;" "Dayton's Oldest and Best-Equipped Shop;" "We probably built your father's set;" "Sooner or later you will call us;" "After the rest have tried, we'll fix it;" "You don't get your hair cut at a blacksmith shop, why take a chance with your Radio?" etc. We find these pay if they are run continuously.

I often have customers who do not want to get a set fixed until they know what it is going to cost. Since the Service Man has no authority to make a price on a major repair, he tells the customer that he will take the set into the shop where it can be properly tested and will call back telling the exact price; and if that is not satisfactory he will return the set and the charges will be one dollar.

Less than half of one percent. have to be returned without making the repair.

I have on my call book the names of twelve Service Men, located in different parts of town, whom I can get in touch with and so give ten-minute emergency service. Often times, late at night when there is no Service Man on duty, and on holidays, I have made arrangements with a leading taxicab company, to deliver a tube and collect for it and refund to me. In sending two tubes we pay the taxi bill and this often leads to the sale of an extra tube.

I have a large gold-leaf sign on the window—"TUBES TESTED FREE"; this brings in a number of tubes. In one month we tested 506 tubes of which 124 were defective or weak; and we replaced 101, or about twenty percent., at a profit of \$100.50.

Each service man has a copy of the Official Radio Service Manual in his tool box; and practically all radio books and magazines are on file and subject to easy access by the men. Any of my Service Men can have use of the reference library and can call in and get a resistance or condenser value while on the job.

It does not pay to replace a single condenser section and, whenever possible we replace the entire block.



Mr. Charles G. Martindale, the author of this article, has built up a large business under severe handicaps. Here, he tells other Service Men how.

Equipment for the Job

Below I am giving a list of what every Service Man carries in his car:

1 Jewell 4-Meter test kit; 1 Jewell oscillator and output meter; 1 Hickok ohm- and capacity meter; neutralizing adaptors; 3 screw drivers L.M.S.; 3 spintites; small drill press; 10 drills; rosin core solder and "Solderall"; 1 roll push-back wire; 1 roll tape; 1 clutch nut holder; 1 screw starter; 10 assorted resistors; 1 dentist's mirror; 1 bottle denatured alcohol; 1 neon "testalite"; 6 volume controls; 1 pair headphones; 1 knife; 3 different kinds of pliers; 2 neutralizing wrenches; 2 neutralizing screw drivers; 25 tubes; 1 box assorted screws and nuts; 1 No. 6/32 tap, 1 No. 8/32 tap, and wrench for above; 1 soldering iron; 1 extension cord; 1 flash light; 1 bottle furniture polish; 10 assorted condensers, .00025- to 2 mf.; 1 magnifying glass; insulators and ground clamp; batteries, "B" and "C"; 10 ft. belt cable.

For the above a Service Man must give \$300.00 bond, and he must pay for the repair of any equipment broken or burnt-out.

My service men average better than \$50.00 a week and I can show a profit in

(Continued on page 750)

Operating Notes for Service Men

By BERTRAM M. FREED

Experiences of a veteran Service Man with the peculiarities of many sets, which may be time-savers for others

USUALLY, it is possible to find the cause of the trouble in a receiver by considering the effects; for instance, choky reproduction is caused by a lack of proper "C" bias. However, it often happens that, even after the cause has been determined, we are at a loss to find the position of the defect.

Recently, a complaint of very low volume and incoherent reproduction in a Brunswick "Model 22 AC" caused that very difficulty. After a thorough test of both receiver and tubes, it was found that the parallel '45 output tubes received only about 100 volts on the plate; while all other set voltages were correspondingly lower. Unless the Service Man is familiar with this set, it is exceedingly difficult to trace the leads from the power transformer and condenser block without the aid of a code color chart, or a pictorial diagram showing the colors of the leads. Leads emerge from both these units without the semblance of a color scheme. Since a partially-shortened or leaky condenser was suspected, some time was spent in disconnecting leads from the condenser block and a "short" reading was found between the two green leads. With these leads disconnected, proper voltages on all tubes were obtained, but no reception.

The obvious indication being that these leads were connected to a single coupling condenser, a 2-mf. component, with a working-voltage rating of 400, was connected into their place and soldered; and the set was again in operating condition. After the green leads had been taped and placed out of harm's way, the job was done. At the first opportunity, the schematic circuit of this model was examined; and it was

seen that the capacity in question was the 1-mf. output condenser between the plates of the power tubes and one side of the output transformer's primary (Fig. 1). Perhaps ten sets since then have been repaired in like manner.

An annoying, and yet interesting, job of servicing was encountered with a Fada "46 AC" receiver. The complaint was hum of a kind usually caused by a poor heater in one of the '27 audio amplifiers; this set has three such, and unless they are perfect,

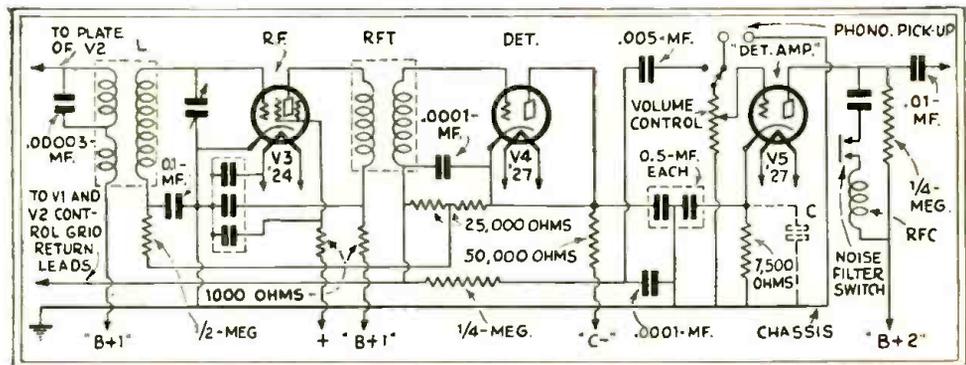


Fig. 2
The two-element detector and automatic volume control of the Fada "46 A.C." The detector-amplifier is a sensitive first-audio stage. Adding condenser C overcame a tendency to hum.

with good insulation between filaments and cathodes, a loud hum will be encountered. However, no matter how good the tubes in a circuit, one may develop a defect in a short time and cause a similar complaint—and another service call.

With this fact in mind, it was sought to devise some method of reducing the hum level and preventing its increase by a

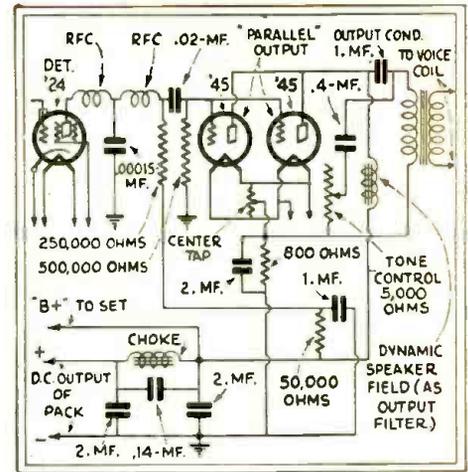


Fig. 1

Parallel power stage of the Brunswick "22," and filter connections. The 1-mf. coupling condenser carries the output to the speaker.

weakening '27. Condensers of high capacity were added to the filter circuit, and resistors were bypassed with little effect.

Finally, a 2-mf. non-inductive condenser, with a working rating of 300 volts, was connected from cathode of the second '27 ("detector amplifier") to ground on the chassis (Fig. 2). This procedure has turned the trick in every case where it has been tried and cuts down to practically nil any hum in this series of receivers (Models "41, 42, 44, 46, 47").

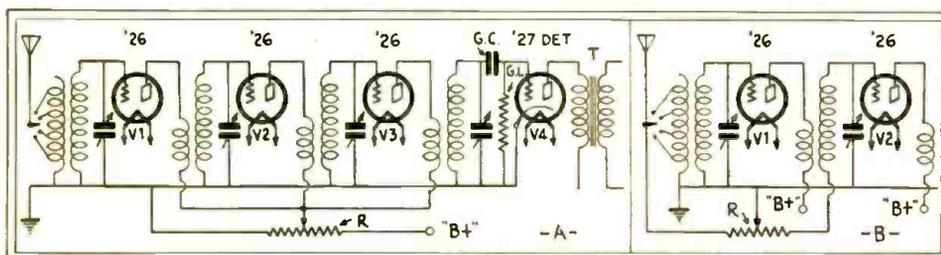


Fig. 3

The Zenith "11E," an early A.C. set, used a rheostat in the 1.5-volt. It may be modernized, as at A, with a potentiometer controlling plate voltage; or as at B, by controlling grid bias, as well as shunting the antenna coupler.

In cities where large hotels and apartment houses are common, difficulties arise frequently because provision of some external antenna has been neglected or even forbidden. An inside antenna is of little value, because of the shielding effect of the steel framework. Such a problem was recently encountered in one of Brooklyn's large hotels during the installation of a Philco D.C. "Baby Grand." In this locality, the noise pickup is great, and especially in a hotel with its countless elevators and motors. Without the use of some external wire, the noise-signal ratio makes for poor reception with a set of this type. Aerials of different types were tried: the metal framework of the windows, for instance, which worked to a certain degree of satisfaction on two stations. The light-line was then tried, with a socket-type condenser; but the line noise, added to the interference picked up within the building, was impossibly high. Use of the ground as an aerial gave the least amount of noise, but

also insufficient signal. With nothing else left to do, and with little hope of success, a wire was run from the antenna post to the bell-box of the house telephone. Signal pickup was increased three or four times, without proportionate increase in noise. However, in the past, when this had been done in other buildings, the noise was found very disconcerting.

How many service calls have been made because of a shorted aerial, or even several aerials, lying across your customer's? To eliminate countless unnecessary calls, the manager of one of the largest service departments in the country has adopted the policy of supplying 150-foot rolls of rubber-insulated No. 16 wire; the bare No. 14 being omitted entirely from the installation kit. The aerial is thus erected in a single piece which serves also as lead-in and runs to

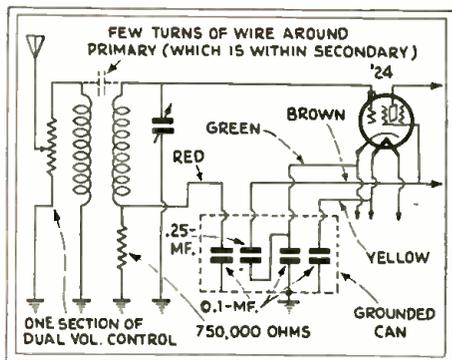


Fig. 4

The input of the Colonial "32 A.C." in which opening the first bypass condenser increases the R.F. resistance and causes fading.

the post on the set. No lead-in strip is employed, thus eliminating the possibility of corroded clips and high-resistance contacts. Slots are made in the window frames and sills, to introduce the wire and prevent the possibility of its being cut by closing the window down upon it. This method has been advocated for a long time by the writer, and mentioned by him in previous articles in RADIO-CRAFT. Its adoption will be worthwhile by those dealers and Service Men who wish to obviate at least two service calls on the average (as records show) during the period of free service.

A complaint of intermittent reception readily suggests a loose wire, a corroded or improperly soldered joint, or a break in some winding which is subject to vibration. However, after several complaints of intermittent reception of a Zenith "11E-AC" set, which had been thoroughly checked without finding such a condition, it was rigged up on one corner of the work bench for a "life" test; so that, whenever it stopped, an examination could be made to determine the location. But, as soon as the set was turned over or even touched, it started in to operate again as smoothly as could be desired. During a period of several days, it stopped perhaps a dozen times; during the period of examination, two more sets of the same model were brought in for service with the same complaint.

Visual inspection failed to show any defects; neither electrical nor mechanical tests helped to clear up the trouble. Finally, after the audio side had been pronounced perfect, an analyzer (with plate and grid
(Continued on page 749)

Leaves from Service Men's Notebooks

Problems of a more or less unusual nature, and solutions which RADIO-CRAFT's readers have worked out

MENDING A TUNING SCALE

By John Bruskin

IN default of a new scale to replace a broken one, I removed the drum dial from a model "S-21" Brunswick set and took it to the shop. Procuring some acetone from a drug store, and a piece of old photographic negative, I placed the latter on the broken scale and wet it with the acetone. The film started to dissolve over the celluloid of the dial scale, and made an effective patch after it had dried. I then replaced the dial in the set, and I do not think anyone could notice the presence of the patch.

TRANSFORMER REPAIR

By B. T. Stubbs

THE other day I had another Crosley "Showbox" with the primary of the push-pull input transformer burned out. The first audio transformer and the input transformer are sealed into the same can and, to replace one, you must replace the entire assembly, at about double the cost.

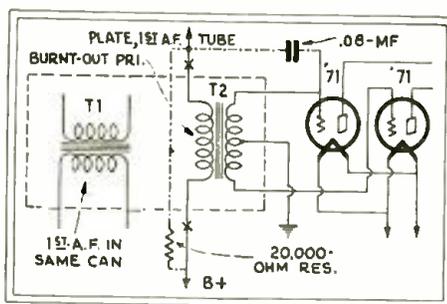


Fig. 1

Mr. Stubbs makes an external repair which saves replacing two transformers at once.

I happened to recall Mr. Cook's diagrams of the Kylectron "K-70" (on page 588 of the April issue) and just reversed his repair. I cut out the broken primary and hooked the plate of the first audio to one of the push-pull grids through an .08-mf. condenser, placing a 20,000-ohm resistor between the plate and the "B+" lead. There was no noticeable loss of volume, and the quality was better than ever. Victor uses this same method in their latest machines. Thanks, Mr. Cook.

I have repaired quite a few power transformer jobs, and wonder how many Service Men do their own work. No doubt many do not care to take the trouble, but the

independent Service Man may wish to save every bit possible. Recently I had a Victor "RE-15" in which the high-voltage winding had shorted, completely ruining the transformer. The Victor distributors only wanted \$15.00 for a replacement so I decided to rewind it.

First I made up a winding jig (as shown in Fig. 2) out of scrap pieces, and used the register out of a water meter for a counter. I then took the old transformer to pieces, and unwound the coil. Having carefully counted the low-voltage secondary turns, and knowing it was used on 115-120 volt A. C., I soon figured out how many turns should be used on the primary, and also on the high-voltage secondary.

For instance, there were 16 turns for the 5-volt rectifier winding. Then by simple proportion $120 V : X = 5 V : 16 T$. (Here 120 V is the primary voltage; X is the number of needed primary turns to be found; 5 V is the voltage of one of the low-voltage secondaries; and 16 T the number of turns on that winding.) Solving, $X = 384$ turns. The high-voltage winding is calculated in the same way.

The old transformer had been wound with enamelled wires. I used silk-covered wire of the same size, there being very little difference in the outside diameter. Between layers I used the paper dielectric of an old high-voltage condenser.

The high-voltage winding is the only one that will give any trouble. If you use the wire guide as shown in the sketch you will be able to wind layer after layer evenly after you get used to it.

The transformer will be better, electrically, than the old one because of the better-insulated wire.

(Continued on page 718)

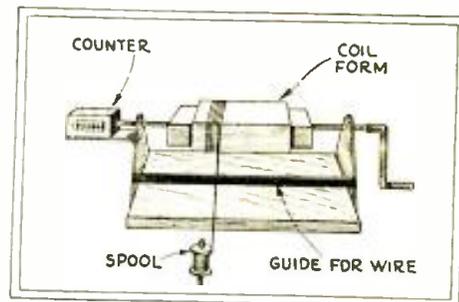


Fig. 2

Replacement transformers can be bought far below list price nowadays; but there are remote places where the idea shown will come in handy.

Leaves from Service Men's Note Books

(Continued from page 717)

REJUVENATING ELECTROLYTIC CONDENSERS

By William E. Cairnes

REPLACEMENT of condensers in "A" battery eliminators costs a great deal of money. The method of repair described saves the customer a few dollars and still allows the Service Man a large margin of profit: I have used it satisfactorily many times, and my original cost was only 32 cents, for a pound of chemical.

If hum, noise, and distortion make it impossible to use the set, the condensers are at fault. Procure a pound of ammonium phosphate, and dissolve it in a gallon of water; let the solution stand a day or so. Remove the condensers from the unit, and take off the cover. (The insides of the condenser are delicate, and should be handled with care.) Place the condensers in the solution, which has been shaken or stirred before using, and let them remain there for seven or eight hours. Remove them and let them drain for an hour, then replace them in the eliminator.

I have tried this on several types, including Knapp and Majestic, using the same solution over and over again. A few cautions: in the Majestic, all the condensers are in one can; remove the fiber top, but do not remove the electrodes, as they might be damaged. In Knapp eliminators with the individual Elkon condensers, these units may be removed from the can. They are wrapped in a heavy paper, which is sealed; cut an opening in the top of this paper, so that the solution may freely enter.

PHONO PICKUP ATTACHMENT

By Edward J. Brockway

THE method shown in the accompanying diagram is suitable for the attachment of a pickup to the Victor "R35." The links must be opened, or taken off altogether. No volume control is shown in the sketch; since this may be incorporated in the pickup, or separately arranged, as preferred.

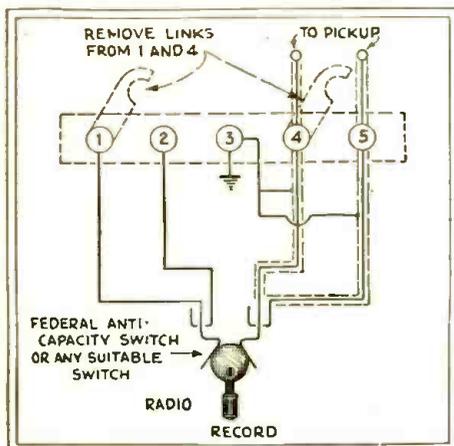


Fig. 3

A simple method of connecting a magnetic pickup to the well-known "R-35" Victor.

Shielding was found essential in eliminating hum in the grid circuit of the first audio tube, a '27. Any similar switch or jack may be used, in accordance with the preferences of the individual operator.

I would, personally, like to know how many other service men have come across a complete mouse nest inside a chassis. I found one, with a dead mouse. Unfortunately, it had built across the center tap and one plate of the '80 rectifier at the condenser terminal—thus blowing the condenser and giving me a new customer. The set was an Apex, with four nice corner entrances to the chassis. Unfortunately, I haven't a photo to submit; but this isn't the first time a mouse was found in a radio here.

P.S.—I believe in the ability of the Flying Service Man; give him credit.

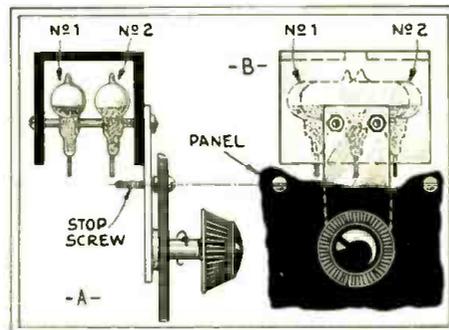


Fig. 4

The mercury-contact switches shown here are noiseless, and well fitted for phono-radio work when arranged as above.

NOISELESS CHANGE-OVER SWITCH

By Dana S. Greenlaw

THE change-over switch from radio to phonograph is a source of trouble on many radio-phonograph combinations. The contacts of the switch corrode and thereby cause a noise not unlike static. The switch described here will never develop bad contacts. It will work successfully on most combinations and it can be constructed and connected by anyone with a fair knowledge of radio.

The working parts of the switch are two General Electric Kon-nee-tors, which can be purchased for a small sum from dealers handling this class of equipment. The Kon-nee-tor consists of a glass tube containing a pool of mercury and having two leads (see Fig. 5). When the tube is tilted one way, the mercury connects the two leads; when it is tilted the other way, the mercury separates and breaks the contact. Thus the contact is always a positive one.

The two Kon-nee-tors are mounted in a small frame (shown at B) of thin, hard wood. The two Kon-nee-tors rest on the two machine screws, and the top of the frame prevents them from tipping out of position. As the tubes are of glass, care must be taken in mounting them. It is best to pack them into the frame with

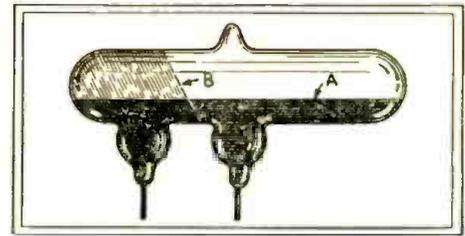


Fig. 5

The "Kon-nee-tor" makes and breaks contact by a liquid conductor A, which occupies position B when the tube is tilted.

cotton batting or some other such material. They are mounted in opposite directions so that one makes contact when the frame is tilted in one direction; when it is tilted in the other direction, the other Kon-nee-tor makes contact. The frame is fastened to the shaft by means of the brass strip shown at A (Fig. 4).

This switch is mounted on the front panel of the radio, and is operated by the knob. Two stop screws are fastened behind the panel to limit the swing of the switch. The frame is mounted above the shaft so that the weight will allow the switch to rest in the two positions against the screws.

The leads from one Kon-nee-tor go to the two leads formerly connected to one side of the old switch; the leads from the other side of the old switch are taken to the other Kon-nee-tor. Care must be taken to make tight joints; in soldering use a small iron—a flame or torch might break the glass of the Kon-nee-tors.

IMPROVING A.K. "35"

By F. S. Oberman

THE volume of an Atwater Kent "Model 35" can be increased over two hundred percent by installing an antenna coupling transformer of the type used in the "Model 42" or "44." Remove the antenna choke and the antenna binding post; then cut off part of the spring contact to the grid prong of the first R. F. socket so that, when the antenna post is replaced, there will be no connection between it and the grid of the first R. F. tube. The antenna coupling transformer is connected between the grid of this tube and the ground, with the center tap going to the antenna post. The transformer can be mounted under the first variable condenser by drilling a hole through the metal subpanel and bringing the two leads through the holes left by the choke coil.

With this arrangement this set will work very well as an automobile set, if the plates of the R. F. stages are changed over to the "B+" lead of the last audio and given 135 volts. This increased voltage is necessary to compensate for the small antenna used.

If there is any complaint of this set being broad on the low frequencies, be sure that the variable plates of the condensers are meshing properly.

CANADIAN SERVICE NOTES

By J. E. Kitchen

WHEN it is necessary to "pull" a DeForest Crosley "Serenata" model (two-volt) chassis, it looks as if many wires have to be unsoldered. Not so. Unsnap the filament switch and rheostat at the lower right of the cabinet and also the "local-distance" switch at the rear. Disconnect

the filament voltmeter at the bottom of the cabinet and pull the wires through the speaker supports. Disconnect the speaker by removing the screws through the lugs on the wires; and all the loose wiring can now be pulled through the hole under the chassis in the cabinet shelf. The hole is just big enough to pass the rheostat and switches. While it may look quicker to unsolder the wires it should be remembered that, if the chassis is being taken to the shop, it is still necessary to remove the rheostat and switches and that they will have to be soldered up again at the test bench.

As not much information is available on the Mercury "Super-Ten" Superheterodynes the following may be useful.

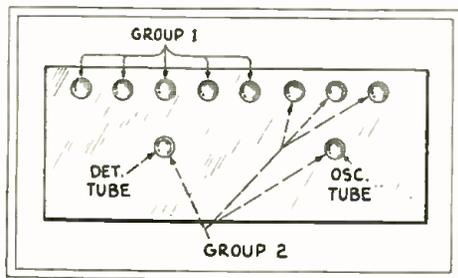


Fig. 6
The Mercury "Super-Ten" has two series circuits of 1.1-volt "N" tubes, working from a 6-volt battery.

These models employ ten "N" tubes in series-parallel to operate from a six-volt filament battery; the two groups are shown in Fig. 6. Total filament current is 0.5-amp. Complaints of intermittent reception from owners of these receivers have been found due to the loosening of the bolts holding the fixed condensers in the intermediate amplifier unit, no lock washers having been used here by the manufacturer. This slackening up allows the gear to short on the copper case. No trouble will be experienced when re-assembling this unit; as all the coils and condensers comprising the five stages are of fixed value. There is nothing to adjust.

SONORA "44"

By Trafton C. Smith

MR. FREED'S article in the March issue of RADIO-CRAFT deals with the volume control used in the converted Sonora "Model 44." (The diagram appears on page 554, and text on the opposite page.) As a radio man long connected with Sonora, first in the production and engineering departments, and later in charge of service with a distributor, I offer a diagram (Fig. 7) of the proper way of obtaining cathode bias and controlling volume in the converted models.

Fig. 4A, in Mr. Freed's article, is correct, but Fig. 4B is very misleading and the average Service Man, inexperienced with these sets, would be at a loss what to do. I also wish to dispute Mr. Freed's assertion that this variable resistor does not give gradual control; I have converted dozens of these sets, belonging to residents of Detroit, and have yet to find one that does not give gradual and positive control, on both local and distant transmitters. In fact, it is my belief that it operates much more satisfactorily than the average set using '27-type R.F. amplifiers. The only objection

(Continued on page 752)

The Service Man's Open Forum

A COUNCIL OF PERFECTION

Editor, RADIO-CRAFT:

The Service Man seems to be rapidly developing a reputation for incompetent, unfair, unbusinesslike dealing; he is not entirely to blame, however, for the industry as a whole seems to be very sick. We find many unfair practices the rule, rather than the exception: unloading of sets; unfair discounts; incompetent servicing; dishonest ads; cheap (?) service; low down payments; and so on without end.

Our nearest neighbor, the electrical contractor, runs a legitimate business, employs only trained men and is, himself, versed in business methods. His men receive a fair return for their work, are thoroughly-trained, competent mechanics, and the contractor would not consider employing incompetent, half-trained men. His billings are based on an average of about 20% and 10% over net on stock and labor.

It is time that the radio men woke up. Theirs is the right to a decent income, but they must work for it. The unfit, unfair and unbusinesslike must be eliminated. A national organization, backed by the right men, built around the right trade paper, with local chapters in each city, to organize the men, build up ideals of competency, fairness and a professional attitude—isn't this what we need?

Let us picture such a local chapter: composed of trained and experienced men, bonded together by an understanding of fair dealing, competency and fair prices; advertising periodically in the local newspapers to educate the public and keep their ideals before the public; refusing to keep in membership anyone guilty of unfair practices; carrying identifying cards in their windows and on their cars. With such an organization, it would be possible to say eventually: good-bye to unfair practices and incompetents; hello to clean business with a fair return on your investment. The jobbers would have to recognize their power and cut down (as I know they are only too willing to do) to unfair discounts and unloading.

J. A. LYNN,
992 Main Street,
Wareham, Massachusetts.

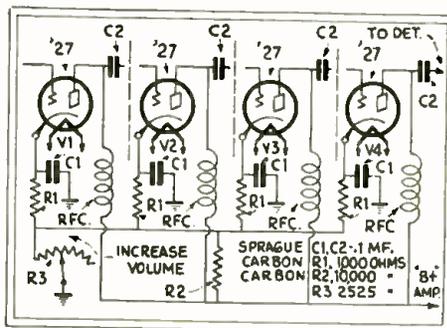


Fig. 7

The biasing arrangement used in the Sonora "44" receiver with 2.5-volt tubes. All R.F. cathodes return through R3.

AN INDEPENDENT SERVICE MAN'S POSITION

Editor, RADIO-CRAFT:

I have been a constant reader of RADIO-CRAFT, and still have the first copy you published in my file. I know that RADIO-CRAFT is the best magazine a Service Man can read, and I am very much interested in the Service Men's Open Forum.

In the February issue I read the copy of a letter sent to RADIO-CRAFT by the General Motors Corporation of Dayton, Ohio, in which they refuse to supply RADIO-CRAFT with confidential data, as the G. M. call it, which makes me laugh. No doubt their confidential data is as big a joke as their radio is; and I would not be a bit surprised to see them put a back cover on their radios with a combination lock on it—only their high-powered dealers knowing the combination. Well, I don't blame them any. If I ever made as big a mistake as they have, I would want to keep it confidential too.

I think it is about time that all independent Service Men should get together and discourage the sale of such confidential radios as the G. M. I have been servicing radios since they have been on the market, and to make a long story short, I for one don't need any of the so-called G.M. "confidential" data to service their radio, but hereafter will refuse to service a G. M. and will let the sad owner know that it is a confidential radio and can only be serviced behind locked doors.

Now I think it is about time some of these manufacturers wake up to the fact that their radios are no better than the service they can give on them. In my opinion they should cooperate with any qualified Service Man to help him give the best service he possibly can, and I would like to hear from other Service Men in regard to confidential data.

D. C. KARR.

2827 Frederick St., Shreveport, La.

FREE SERVICE CALLS

Editor, RADIO-CRAFT:

I read my RADIO-CRAFT from cover to cover, and back again, gleaning much valuable help from it. In the Open Forum, I have read the items pertaining to service charges that appear so often. Now in my town, many people are somewhat mistrustful of the radio service trade in general, and I fear, with some cause. Too many "Service Men" throw off the disguise and become salesmen if they find a new tube won't do the job. Also, the streets are daily infested with ambitious individuals, armed with a bag of tubes and a tube tester, who go from house to house offering to test tubes free. Most of these men could not use a set analyzer if they had one along.

So I have found that the best way to obtain work is to advertise that I "test" radios free, and to let the public know

(Continued on page 751)

CROSLEY MODEL 120 SENIOR SUPERHETERODYNE
(PLIODYNATRON) CHASSIS

"Super-Sondo," "Super-Rondeau," and "Super-Administrator"
Receivers

In the diagram below is shown the foundation chassis incorporated in a number of super-heterodyne receivers manufactured by the Crosley Radio Corp., Cincinnati, Ohio. Standard consoles are the models Super-Administrator and Super-Rondeau; while the Super-Sondo console is a radio and phonograph combination. Available constants for the components will be the first consideration.

Condensers C6, C13, C14, 0.5-mf.; C7, C8, C9, C10, 0.1-mf.; C11, .001-mf.; C12, C15, .02-mf.; C16, C20, C21 (optional), .00025-mf.; C17, C19 (electrolytic), 9 mf.; C18 (electrolytic), 18 mf.; C3B, .001-mf. (fixed); C3C, 50 to 300 mmf. (variable).

Resistor R1 (volume-control potentiometer, ganged to power switch Sw), 10,000 ohms; R2, R4 (flexible), 375 ohms; R3 (flexible), 165 ohms; R5 (red, black, orange dot), 20,000 ohms; R6, 6,500 ohms; R7 (tone-control potentiometer), R8, 1750 ohms; R9, 2,000 ohms; R10, 545 ohms; R11, R13, 10 ohms (each half); R12, 850 ohms.

Normal operating readings (as measured with speaker connected, volume control on full, and line potential of 117 volts with fuse in "high" position; or 107 volts with fuse in "low" position), are as follows:

Plate potentials, V1, V4, 160 volts; V2, 155 volts; V3, 20 volts; V5, 145 volts; V6, V7, 260 volts; V8 (each plate), 275 volts. Filament potentials, V1, V2, V3, V4, V5, V9, 2.5 volts; V6, V7, 2.4 volts; V8, 4.9 volts. Screen-grid potentials, V1, V2, V3, V4, 90 volts. Control-grid potentials, V1, V4, 3 volts; V2, 7 volts; V3, 1.0 volts; V5, 15 volts; V6, V7, 54 volts.

A long antenna on this receiver is a detriment to good reception.

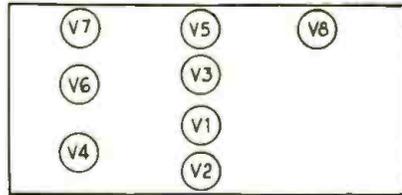
Phonograph pick-up connections P, C, S, will be noted in the grid-return circuit of the second detector, V5. The pick-up must be connected to the detector circuit through an audio coupling transformer, and a volume control must be provided; since the volume control on the receiver operates in the R.F. portion of the circuit. Phonograph motorboards are supplied with Crosley phonograph combinations. It is merely necessary to connect the marked leads from the pick-up switch to the terminals P, C and S on the chassis, and to break the wire between terminals P and C. If the pick-up is later disconnected, a wire must be connected between terminals P and C for radio reception.

The "fixed tune" I.F. stages (including variable condensers C4A-C4C, and C5A-C5B) are tuned to the intermediate frequency of 175 kc. Since care is taken at the factory to properly align these circuits, no attempt should be made by the experienced Service Man to re-align them, unless tests indicate positively that they are in need of readjustment. In that case, the following procedure will apply:

Remove oscillator tube V3 from the chassis, and remove the clip wire from the control-grid

of I.F. amplifier tube V4. Connect the output leads of an accurate 175-ke. oscillator to the control-grid of V4 and the chassis. Adjust the two screws (C5A-C5B) on either side of the rear I.F. coil L5 (between the socket of V4 and the power tubes), until the test-oscillator signal gives the largest reading on an output meter connected to the audio output circuit of the receiver.

Next, replace tube V3, connecting screen-grid clip to the top of the tube. Remove the first detector tube V2, and connect the oscillator output from the control-grid of V2 to the chassis; then adjust the two screws C4A-C4C on either side of the front I.F. coil, L4, for maximum output meter reading. Slight readjustment of the screws beside the rear coil may improve the output somewhat.



Tube layout, Crosley Model 120.

Oscillator V3 is a screen-grid tube connected as an oscillator of the dynatron type (more correctly, a "pliodynatron"; the generic term applied by Dr. Hull to a 4-element or screen-grid oscillator as differentiated from the dynatron or 3-element oscillator). Its plate potential is lower (20 volts) than its screen-grid; which is at a positive potential of 90 volts. It may be necessary to try two or three tubes in this position to obtain a satisfactory one.

The volume-control resistor R1 performs the dual functions of increasing the control-grid bias of amplifiers V1 and V4, and grounding the antenna—that is, when reducing volume—and vice versa. The tone-control circuit is ingenious and should be carefully noted as to electrical values and arrangement.

If, when receiving some signals, the volume control is turned up so far that the first detector is overloaded, a whistling note will be heard. This is a perfectly normal characteristic of superheterodynes, and does not mean that anything is wrong with the receiver; when the volume is adjusted for normal reception, the whistle does not occur.

If it becomes necessary to re-align the main tuning-condenser gang, the procedure is as follows: leave the shield cover in place, and tune in a station or modulated-oscillator signal near 1,400 kc. Turn the volume control on fully. If all signals within the required range are too

loud, connect a fixed condenser C21 to the posts marked "A" and "G," and loosely couple the antenna to the leads of the local-distance switch.

If, when the receiver is carefully turned to the middle of the band, the dial reading does not correspond to the frequency of the signal, but is not more than two channels off, set the dial at the correct frequency, and adjust the trimming condenser C3A (the control farthest toward the rear of the chassis) until the signal is loudest. Check the tuning by readjusting the station selector. It may be impossible to regulate the oscillator trimming condenser C3A so that the oscillator condenser is properly aligned with the exact dial setting; in which case align the trimming condenser with a dial setting as close to the actual frequency as practicable.

After aligning the oscillator circuit by adjustment of C3A, adjust the trimmers C1A and C2A for greatest volume. This completes the adjustments for best reception at the low wavelengths. Now proceed as described below, for test and possible re-adjustment at high wavelengths.

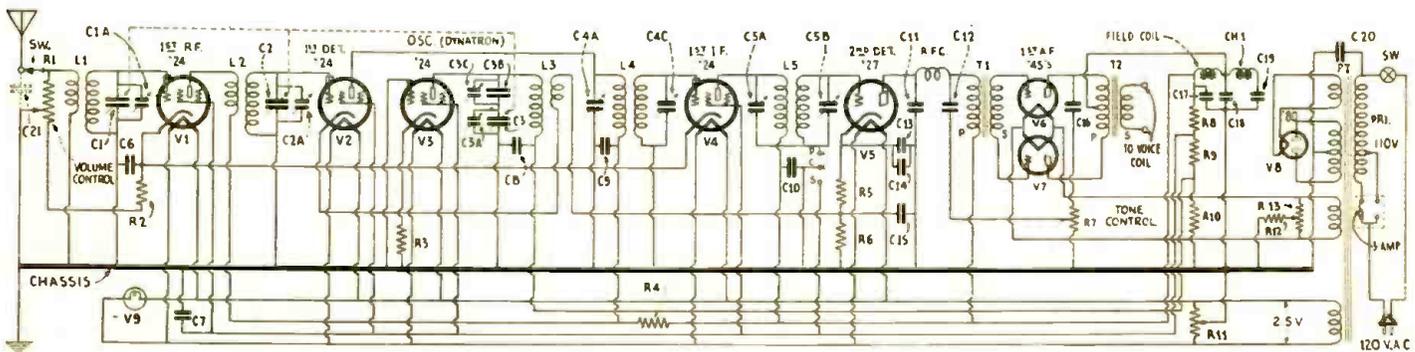
Tune to a signal near 600 kc. If the dial setting, when carefully adjusted, is not more than a single channel (10 kc.) away from the actual frequency of the signal, it is possible to align the low-frequency tracking. DO NOT MAKE THIS ADJUSTMENT UNLESS ABSOLUTELY NECESSARY.

For this purpose, a bakelite screwdriver will be required. The low-frequency adjustment (condenser C3C) is at the rear of the chassis, behind the shield, and is sealed at the factory. It is necessary to break this seal before the screwdriver can be inserted and turned. Turn the tuning control until the actual frequency of the signal is indicated by the dial reading, and adjust for best volume. If it is not possible to align the condenser with the dial set at the exact signal frequency, set the dial as close as practicable to the exact frequency.

If signals are not heard after trying a new tube, the circuits may be checked as follows: remove the top of the condenser shield and, having removed the antenna, touch n to C2A. Tune to a strong signal; if not received, the oscillator may not be functioning, or remainder of set requires checking. Touch antenna to C1A; if signal is not increased, check the circuits of V1. Of course, lack of signal only at the antenna post indicates a defect in the antenna circuit. In lieu of a powerful broadcast station, an A.F.-modulated R.F. oscillator, operating in the broadcast range, may be used.

Switch Sw1 is the "local-distance" adjustment. The manufacturers refer to the tone control as the "static and tone control."

The Model 120 receiver may be considered non-radiating; since V3 and its circuits are shielded, and preceded by circuits sharply tuned off the oscillator frequency.



Schematic circuit of the Crosley Model 120 series "Senior Superheterodyne" (Pliodynatron) chassis.

WESTINGHOUSE "COLUMNAIRE" MODELS WR-8 AND WR-8-R (REMOTE CONTROL)

Also WR-5 (RCA Victor 80, G.E. H-31, Graybar 700); WR-6 (RCA Vic. 82, G.E. H-51, Graybar 770); WR-7 (RCA Vic. 86, G.E. H-71, Graybar 900); WR-6-R, and WR-7-R remote-control models

The fundamental circuit of these receivers is the WR-5 receiver chassis and power pack shown in Data Sheet No. 29. The model WR-6 is a highboy; its circuit is the same as used in the WR-5, except as modified for tone control. The Model WR-7 is similar to the Model WR-6, except as modified for an electric phonograph. Models WR-6-R and WR-7-R are the same as the respective WR-6 and WR-7 chassis, except as modified for remote control. The Model WR-8 uses the same chassis and power pack as the Model WR-6, only an electric clock and the cabinet distinguishing it as the "Columnaire;" the remote-control model being coded as the Model WR-8-R.

The resistance of each individual unit appears in Data Sheet No. 29. The values of only the resistors, capacities, and chokes follow:

Resistors R1, 4,000 ohms (potentiometer); R2, 170 ohms; R3, R6, 6,000 ohms; R4, 18,000 ohms; R5, R10, 2,000 ohms; R7, R8, 40,000 ohms; R9, 500 ohms; R11, 14,300 ohms; R12, 10,000 ohms; R13, 110,000 ohms; R14, 60,000 ohms; R15, 715 ohms; R16, 55 ohms.

Condensers C1, C2, C3, C4, 18 to 330 mmf.; C5, C7, C24, 0.1-mf.; C6, 0.5-mf.; C8, 4.5 mmf.; C9, C18, 745 mmf.; C10, C11, C12, C13, C14, C15 120 to 220 mmf.; C16, C23, 1.0 mf.; C17, .0024-mf.; C19, C21, 3 mf.; C20, 2 mf.; C22, .05-mf.

The tone-control units have the following values: C, .025-mf.; R, 40,000 ohms (potentiometer); Ch, 2 henries.

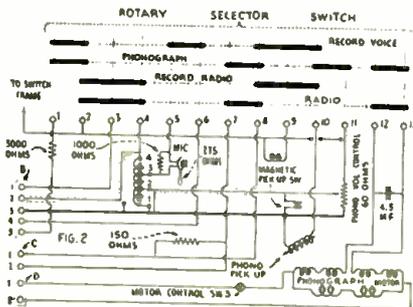
The phonograph attachment is shown in Fig. 2. The remote-control attachment is shown in Fig. 3. Variations in Fig. 1 are dotted.

The normal operating voltages of all these receivers, with volume control R1 at maximum and switch Sw1 at "distant," are given below:

Plate voltages, V1, V4, V5, 240; V2, 70; V3, 235; V6, 210; V7, V8, 200. Plate currents: V1, 4 ma.; V2, 6 ma.; V3, 0.25-ma.; V4, 5.5 ma.; V5, 2 ma.; V6, 0.5-ma.; V7, V8, 30 ma. Control-grid voltages: V1, V4, 2.2; V3, 8; V5, 5; V6, 23; V7, V8, 20. Screen-grid voltages: V1, 90; V3, 80; V4, V5, 85;

Filament voltage (between 2 and 3 on the terminal strip A), 2.5. Power-pack output voltage (between 4 and 5 on the same strip), 250.

The color code of the push-pull A.F. transformer is as follows: T1 input, red and yellow; red with yellow tracer. Output, yellow (center-tap); and green. Transformer T2 input, red (center-tap); and blue; output, black. Power transformer PT, primary, black-with-red-tracer; black-and-red (110 volts); black (120 volts). Secondary, 2.5 volts, brown; 5 volts, black-with-green tracer; high voltage, yellow-with-red-tracer (center-tap), and black-with-blue-tracer.



The combination model (the Model WR-7) has substantially the same receiver and power pack chassis as the Model WR-6, except as modified for the special rotary switch which makes the necessary circuit changes for the following operations: personal home recordings; radio home recordings; radio reception; phonograph operation; (see Fig. 2). See page 521, March, 1931 issue of RADIO-CRAFT for details of phonograph automatic switch. The turntable's speed is 78 r.p.m. In normal operation the motor develops considerable heat.

In the microphone-coupling auto-transformer (Fig. 2) read 3.2 ohms from 1 to 2; 2 to 3, 150 ohms; 3 to 4, 4,300 ohms.

In the remote-control receivers Models

WR-6-R and WR-7-R, the control motor is part of the receiver chassis. Operation of the tone control or local-distant switch must be done at the receiver; but tuning and volume control may be effected at a distance of not more than 75 feet. The details of this external equipment are shown in Fig. 3. The 60-ohm resistors reduce the potential to 23 volts for station selection, and 18 volts for volume control, (special); the end thrust of the motor at the different speeds causing the proper gears to engage. The tapped phase-changing impedance and capacity change the phase-angle of the applied current, so that operation of the motor in either direction is obtained. The "on-off" operation of the set is relay-controlled; a series of drums and contactors start the motor in the right direction for station selection. In normal operation the pilot light dims, until a station has been tuned in (when the volume control is to be operated to suit). If trouble develops in the drum assembly, the entire unit must be replaced.

The "Columnaire" Model WR-8 is, except for the cabinet, the same as the Model WR-6; while the Model WR-8-R receiver chassis and power pack are almost identical with the Model WR-6-R. Leads for the synchronous electric clock are shown and, (in dots) the leads for the remote control attachment. The primary of T3 connects to the 110 V. line; the secondary output is 23 V.

Do not use the manual station selector with the chassis removed from the cabinet, unless the chassis is in a vertical position; otherwise, damage will result. Push either the "+" or the "-" button; the armature should not rise and engage the station-selector gear. Now push a station-selector button; if the armature does not rise and engage the station-selector gear, increase the tension of the spring. Next, increase the spring's tension until the armature just rises when a volume-control button is pressed; then decrease the tension until the armature just fails to rise when one of these buttons is pressed.

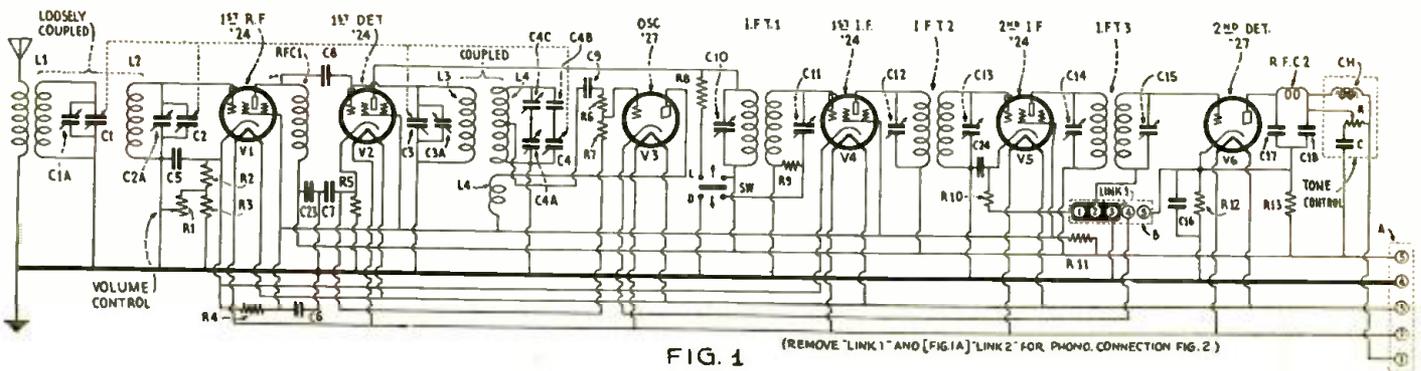
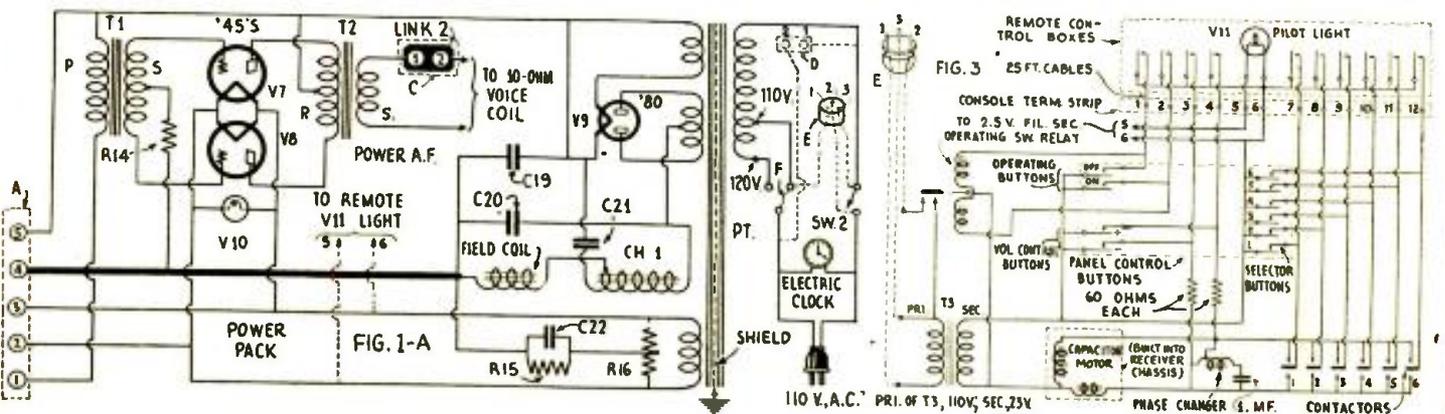


FIG. 1 (REMOVE LINK 1 AND [FIG. 1A] LINK 2 FOR PHONO CONNECTION FIG. 2)



Methods

Service Men

For Shop Bench and Kit

off, as a dummy. By making a pair of neutralizing adapters, one a five prong-to-five prong, and the other a four prong-to-four prong, and omitting one of the filament or heater wires in each case, the necessity of a dummy tube is obviated. Furthermore, with these adapters, the set can be balanced with its own tubes; which is, after all, the only true method.

AN AUDIO OSCILLATOR

By Frederick E. Ward

THE kink on page 416 of the January issue, "The Howler as a Service Oscillator," is very good as far as it goes, but the device shown will go it one or two better. It has many advantages, and covers more than one field. I have been using one for some time.

The essential parts comprise merely an 01A tube and socket, mounted with an A.F. transformer on a block of wood, with the connections shown; a switch in the "A" lead would be an added convenience. Three dry cells are sufficient for most purposes; the filament does not require much heating, so two cells are sufficient for this purpose. For the "B" voltage, a single flashlight cell will give a good signal through phones; though it usually requires 4½ volts to operate a loud speaker.

Such an oscillator gives a loud, pure note in the output circuit; its pitch depends on the transformer used. If desired, this pitch may be lowered by adding a small condenser across the terminals of the primary.

Small, cheap transformers give high-pitched, musical tones; while the more modern transformers of better quality give very low tones. A Samsom "Symphonic" transformer, for instance, has a frequency so low that it sounds like a riveting hammer. By substitution of transformers, there-

fore, we may use the apparatus itself as a means of comparison; the transformer giving the lower note is probably the better for use in an amplifier.

The key has several useful purposes; it may be used to adapt the oscillator for telegraph signalling, over quite long lines, for phones. It may be adjusted to give a 500-cycle note, and used with a loud speaker to instruct a class; for teaching the telegraph code, it has no equal. The writer has found a demand for headphone sets for use by Boy Scouts in their code practice, and it is probable that many such sets can be made up and sold at a profit.

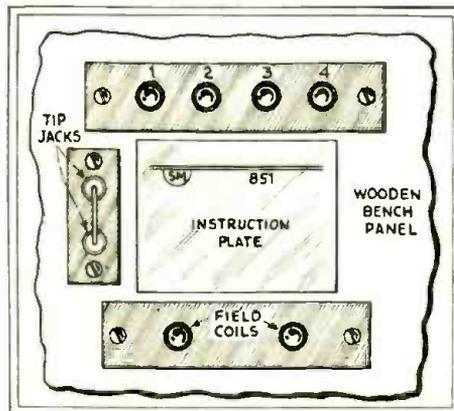


Fig. 5

The connections shown provide a dynamic speaker for bench tests of various chassis types.

A REPRODUCER FOR THE SHOP

By Norman W. Smith

A DYNAMIC speaker, that can be used on practically all makes of radio receivers, is of great help in a repair shop. The Silver-Marshall "Model 851" unit makes it unnecessary to bring the set's speaker into the shop; for it will operate on almost every kind of radio.

The speaker unit is mounted on a baffle board and suspended under the bench by springs which prevent vibration of the bench. The instruction plate is removed from the transformer and placed on the bench panel, with the speaker connections as shown in the drawing. The binding posts are mounted on bakelite strips and placed near the middle of the bench panel.

The four posts above the plate may be used to connect any radio set: a single-tube output is connected to 1 and 3; a push-pull output to 1 and 4. If the push-pull amplifier has no output transformer or choke, No. 2 also is connected, to the highest "B+" voltage. The speaker had no direct connection to the voice coil; so the two tip-

jacks at the left of the plate were put in series with the voice coil and the transformer secondary. These are shorted when not used for direct connection. The lower two posts connect to the field coil; which has a resistance of about 2000 ohms and is designed for use with 90 to 120 volts direct current. When sets designed for a speaker with less resistance or with higher voltage are tested, a resistance is placed across the field posts to adapt it to the required current. Current for the field is supplied by the shop power pack when it is desired to use the speaker on sets designed for only a magnetic speaker.

We have used this speaker in our service work for about one year and have found it very good.

TESTING AUDIO TRANSFORMERS

By Charles Felstead

IF CHEAP audio-frequency transformers are used in a receiving set, there is always a possibility of their burning out, that is, in fact, most often the trouble with receiving sets that suddenly go dead. The first thing to be done to a set that will not work is to test the audio transformers; if one of them is burnt out, it must be replaced. It is always best to use as a substitute a transformer with about the same ratio as the one that had to be replaced. Transformers generally "go out" when the receiving set is turned off, because of a voltage surge; and so, when the set is again turned on, there is no sound in the reproducer.

The simplest and quickest way to test the audio transformers is by the aid of a high-reading voltmeter, with a scale covering the highest "B" battery or plate voltage, used in the set. The voltmeter should be equipped with two long, flexible leads ending in test terminals, which can be made by soldering six-inch lengths of bus-bar to the free ends of the leads. Pieces of spaghetti tubing can be slipped over the wires for protection, leaving only the ends bare.

To test the transformers, the receiving set is turned on and all of the tubes in the set are removed; although the batteries are left connected. Now, the primary of the first audio transformer can be tested by touching the test terminals of the voltmeter to the plate and one of the filament prongs in the detector socket. This connects the voltmeter and the detector plate voltage in series with the transformer primary. If the winding is not burnt out, the

(Continued on page 718)

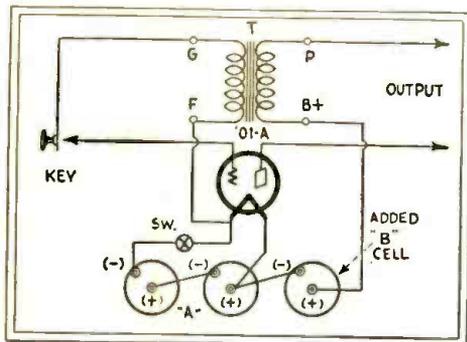


Fig. 4

A very simple oscillator which will serve many purposes; well fitted for code practice.

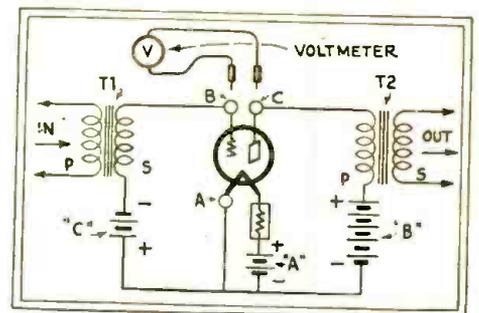


Fig. 6

A quick and easy method of testing the windings of audio transformers in a battery set.

"Instantaneous" Recording of Sound on Discs

A New Activity for the Radio Technician and Experimenter,

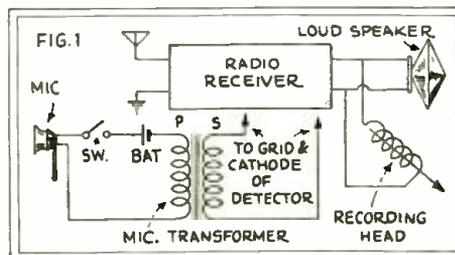
By GEORGE J. SALIBA

INSTANTANEOUS" recording, or home recording as it is more popularly called, is a new art as compared with the method of making commercial records. In commercial recording, it is necessary to go through several operations before the finished record is obtained. Where only one record is desired, instantaneous recording offers the advantage of making this record in one operation. (See "Home Recording of Radio Programs and Speech," in the December, 1930, issue of *RADIO-CRAFT*.)

The midget radio set saved radio in 1930, and now this new art seems destined to surpass even the midget in tiding radio over the rough spots; at the same time it opens up a very lucrative field to the alert Service Man and radio dealer. Wherever there is an audio amplifier available, a recording system is waiting to be exploited.

The uses to which this instantaneous recording can be put are varied and many; and the profits to be realized therefrom

will be proportional to the foresight and ability of the Service Man or salesman who puts across the idea and makes the installation. Every home that has a radio receiver, every music school, music store, amusement park, department store, club, and broadcast station is a good live prospect. In short, the field of application for this novel method of making records is unlimited; and it remains only for the energetic salesman or wide-awake Service Man to familiarize himself with the technique of obtaining good results, then go out and demonstrate. The idea sells itself.



The general arrangement of the standard voice and radio recording-reproducing equipment.

Valuable Uses of Records

The uses to which instantaneous recording can be put are unlimited. Orchestras and bands are now being recorded, so that their technique may be studied carefully and improved upon. Singers, instrumental artists and music students everywhere are making this recording a regular part of their course; since they can thus watch their progress and note their improvement. Students of elocution record their talks and study their delivery. Records of broadcasts can be made, and, if necessary, encore programs can then be broadcast. Likewise, anyone who broadcasts can have his selections recorded for his personal file.

Vaudeville singers or musical acts will find this new art very much to their advantage; for they can use these records for advertising purposes and auditions at distant points. Another novel application of this instantaneous recording is in the making of "sound effects" for amateur theatricals. The ambitious producer can, after patient experimenting with the recording of different sounds, electrically reproduce them whenever desired; thus giving his presentation the realism of the professional theatre.

Still another idea and one which is presented to those owning home-movie outfits, is that the "domestic" photographer can make records to match the action of the pictures; thus producing a "talkie." A more advanced form of this idea is that two turntables be used, and a "continuous"



Fig. D

A home-recording model made by the Callophone Co.: left, two-button "mike"; right, special cutting head, for blank records. The reproducing pickup is behind the disc in the center; microphone panel above speaker in console.

show be arranged after properly "dubbing" the records (patching the sound together), by fading one record into another as each length of film (to which has been cemented the next length) is run through the projector.

Although the previously-mentioned issue of *RADIO-CRAFT* contained a description of the procedure of instantaneous recording (page 340, December, 1930), the writer asks the indulgence of the readers of this magazine while, as a matter of completeness, and prior to making an extensive study of this subject, we gloss over outstanding facts.

Recording Systems

Whether the recording equipment is utilized in commercial enterprises or for home use, the apparatus in either case is substantially the same. For home use the audio amplifier of the radio receiver, used in conjunction with an ordinary magnetic phonograph pickup and a microphone makes a simple but efficient and practical recording system. (See Fig. 1).

This system makes use of *pregrooved* records, which are now available at all music and radio stores. The *pregrooved* record, which is made up on either a metal or a celluloid disc, has a blank groove already cut into the surface; and this groove serves the same purpose as the feed screw used in recording on blank uncut discs; namely, to guide the recording head across the face of the record. The microphone transformer, being of the step-up type, amplifies the audio-frequency voltages; and this gain, combined with the *mu* or amplification factor of the detector tube, really adds a transformer-coupled stage to the audio amplifier.

A weight (about 10 oz.) should be attached to the recording head to prevent the needle from jumping the groove, as it tends to do when modulated. The weight also serves the purpose of pushing the needle

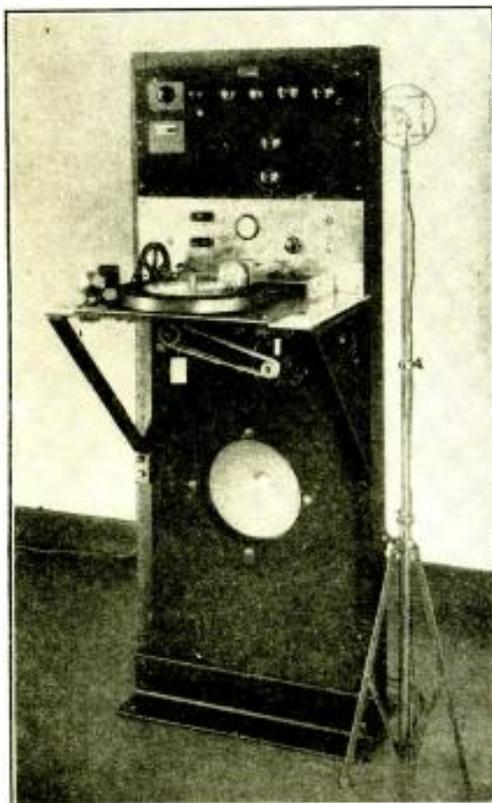


Fig. E

The Callophone studio equipment: top panel, three-stage amplifier and pack; then, microphone panel; shelf with turntable, feed-screw, cutter and pickup; driving motor; and, lowermost, reproducer. Blank, ungrooved discs are used. Right, two-button microphone and stand.

deep into the groove, thus making available more mass to work against; with the subsequent result of more volume in the reproduced record.

Only home-recording needles should be used for recording and playback. These needles, which have a relatively dull point, with a red shank to differentiate them from regular phonograph needles, can be obtained at all radio and music stores.

In recording from the microphone, the switch Sw. is closed, and the volume control of the radio set is turned way down; and *vice versa* when records are to be made from the air. With a little patience and experimenting the home recorder can achieve results that will be almost on a par with commercially-pressed records.

These pre-grooved records at present are obtainable only in the six-inch size and have



Fig. C
The Presto portable recording kit, with case closed for carrying. Below, it is shown open.

a playing time of one minute and ten seconds. The home recorder who wishes to make larger records, must resort to blank ungrooved discs, which necessitate the use of a feed-screw to guide the cutting head across the face of the disc. Figs. A, B, and C show different views of a recording kit, for cutting blank discs, which is intended for homes where a motor-driven turntable is not available. A microphone, microphone amplifier, selector switch, volume control, feed screw, recording head and pick up, electric motor, and turntable, are all neatly mounted in this very convenient portable case.

hearing, is a notoriously poor judge of level from day to day. The small outlay of money necessary for a volume indicator is more than offset by the insurance of good records at all times.

For radio recording, a good radio receiver and a double turntable, equipped with a "fader" so that continuous recordings can be made, are absolutely necessary. If facilities are to be provided for bands and orchestras, a "mixing panel" should be built. This panel should be able to accommodate at least three microphones.

In addition to this special equipment, it is necessary that the blank records con-

High-Quality Recording

Commercial instantaneous recording naturally requires a more elaborate set-up. The prime requisite is a good audio amplifier, which should be of the three-stage transformer-coupled type, and have a fairly flat characteristic from about 30 cycles to 9000 cycles. The turntable should be thoroughly "filtered;" so that any mechanical flutter in the motor or any back lash in the gears will not be transmitted to it.

A high-quality double-button carbon microphone is absolutely essential and, to insure its efficient operation, a D.C. 0-50 milliammeter should be provided, so that the current in each button may be read.

A good loud speaker, preferably of the dynamic type, should be used for monitoring purposes, and, lastly, a "volume-indicator panel" is necessary in order that all the records shall be made at the same level, thus insuring a positively good result. Some will argue that a volume-indicator panel can be dispensed with and the loud speaker used for level indication; but the recorder will find that the average human ear, no matter how acute the sense of

tribute their bit to the engineering necessary for good sound. Their composition, the manner in which they are cut, the type of cutting tool used, and the *modus operandi* of the playback, while they have been discussed in the December, 1930, issue of *RADIO-CRAFT*, will be viewed in the light of later developments.

Materials for Recording

At the present time there are several materials available for instantaneous recording: namely, gelatin, aluminum, celluloid, and zinc. Gelatin records are of the blank type requiring a feed-screw for cutting. A special cutting stylus is used and, before recording, the surface is treated with a lubricant, such as vaseline, in order to preserve the keenness of the needle. After the record is made it is again treated with this grease in order to attain reproduction without extraneous noises. Playback is effected by means of a steel needle whose point has been ground smooth and round. An excellent record can be made with this substance; but it possesses the disadvantage of being brittle. Great care must be exercised in putting the record on the turntable and removing it; otherwise the record will crack. Water must be kept away from this record, because gelatin dissolves in water.

Aluminum, like gelatin, also requires a feed-screw for recording. A diamond needle or a special steel needle is required for recording, and a fibre or a thorn needle is used for playback. The aluminum record possesses the advantage of being unbreakable and can be preserved indefinitely. The recording is excellent, the low frequencies and the high recording equally well. If sufficient weight is not used on the recording head, the groove will be shallow and, consequently, difficulty will be experienced in making the playback needle track. This needle must be very sharp, otherwise poor reproduction results.

Celluloid for recording is obtainable in either blank or pre-grooved discs. When the blank is used, a sharp diamond needle is necessary to cut the grooves, and a thorn or fibre needle is used for playback. The pre-grooved disc requires a special home-recording needle for both recording and playback. With the latter type record, it has been found that the high frequency notes are missing after the first or second playing; this is due to the fact that celluloid is resilient and tends to come back to its original shape. The volume is a trifle lower

(Continued on page 751)



Fig. A (above)

The portable kit arranged for recording; the pickup arm is resting in off position, and the cutting head and feed screw are in operation. Microphone at the left, 27 microphone amplifier tube at upper left. At the right, in Fig. B, the cutting head is seen put away in its recess, and the pickup in its operating position. The disc at the lower left is the switching mechanism.

Fig. B (below)
Kit arranged for playback.



Installing Radio in a Big Hotel

The elaborate controls, receivers, amplifiers and distributors required to feed 2,500 reproducers.

By ELI M. LURIE, B.E.E.

"HOTEL" radio, as an added attraction for guests, has made most elaborate advances over the simple installations of a few years ago. One of the first, to the writer's knowledge, was located in the Boulevard Hotel, in Winthrop, Mass. The receiver was a home-made affair using the familiar regenerative circuit, and consisting of three tubes. The only stations that could be received, at that time, were WGI (Medford Hillside, Mass.) and, occasionally, KDKA in Pittsburg. Always, through the background of WGI, could be heard the old spark notes of local "hams" with their rotary gaps.

Nevertheless these pioneers—both the "hams" and the owners of hotels who were kind enough to give radio in its crude form a trial—prepared the way and paved it well for our present-day systems.

Today there is virtually an unlimited amount of good music and entertainment to be received and, though years ago there were only one or two broadcast stations, today the major problem is to find room for

more. To climax this, short waves have led to international reception; so that foreign broadcasts are no longer a novelty.

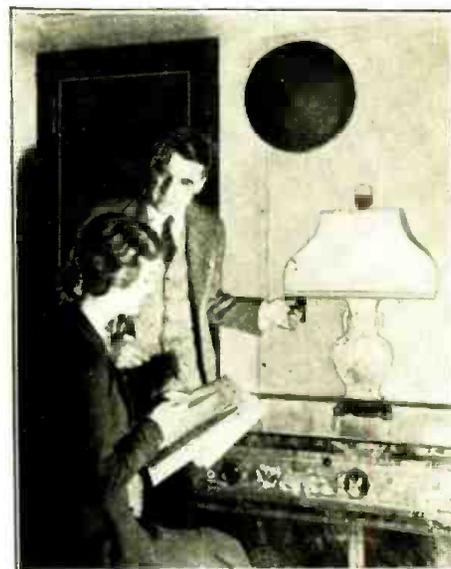
A Complete Hotel System

Naturally, with all this excellent entertainment available, hotels were not long in actually planning installations on an extravagant scale. The result was that electrical and radio engineers had to solve some very difficult and complexing problems.

And so we come to the largest and most difficult of all installations, that in the recently-opened New Yorker Hotel, at Eighth Avenue and Thirty-fourth Street, New York City, which will be described here.

The radio contract for this work was given to the Stromberg-Carlson Tel. Mfg. Co., while the public-address apparatus, an auxiliary system, was installed through a subsidiary of that concern, the Bludworth-Davis Co.

The New Yorker has approximately 2500 rooms, each of which has the option of radio reception through four channels; that is, the guest may listen to one of four pre-selected



A typical room installation in the New Yorker Hotel. The wall plate under the man's hand contains the four-station selector switch and volume control; the reproducer cone is above it.

stations, by merely twisting the dial of a four-way selector switch in his room. In addition to this, provision is provided for international reception on short waves. Also, phonograph records can be played and public announcements made on each or all channels and, if desired, either voice or music can be made predominant through an arrangement of faders and mixers. The radio system power panel, on the 41st floor, is shown in Fig. C.

The public-address apparatus used to supply the public rooms (viz: restaurants, ball-rooms, etc.) with music or speech, is com-

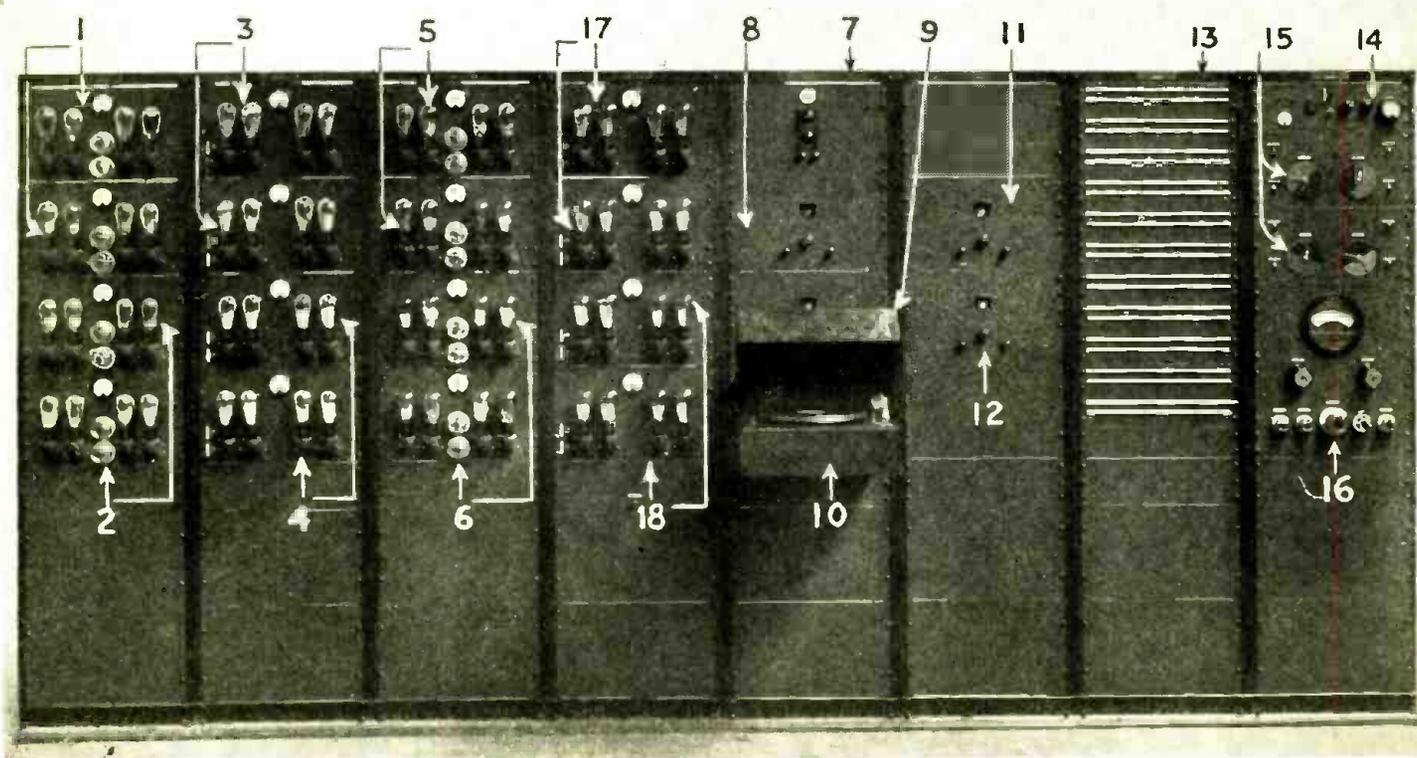


Fig. C

Power panel of the hotel's radio and address system. Of channels 1, 2, 3 and 4, the radio receivers are 11, 12, 8, 9; power amplifiers, 17, 18, 3 and 4; and rectifiers 5, 6, 1 and 2, in respective orders. The speech-amplifier panel is 7; phonograph turntable 10; test board 13; volume-level indicator 14; electric clocks (switching programs on or off at predetermined hours) 15, and switch panel 16.

pletely remote-controlled and can be operated from any of the public rooms, as well as from the main radio room on the 41st floor of the hotel.

Master Remote-Control Box

Here, without doubt, is one of the wonders of the age. Imagine being able by remote control to connect in one section of the hotel a microphone which, we may assume, will be used for speech pickup; transfer this speech to a remote location, as well as reinforce the speaker's voice in the room itself. Then, on the completion of the speech, the microphone is faded out and the radio system is brought into the circuit; and the control will then tune completely (and by this I mean being able to "sweep the dial" from 200 meters to 550 meters) the associated radio receiver (Fig. B) which is located on the top of the hotel, 41 stories up! Dynamic speakers are put into operation, in any part of the hotel, by merely pushing buttons and, of course, there are many other

tricks which are all performed with a little oblong box 6" wide, 10" long and 3" thick.

The marvel or it all is that no hand has to touch a switch anywhere except on this little box, which is shown in Fig. A. This not only controls the entire system but, upon opening, starts up a 2-kw motor generator set, automatically, to supply alternating current for the equipment. Both remote-controlled and guest-room apparatus can be interconnected; so that programs originating on one can be transferred to the other. Thus music or speech can be picked up from any of the public rooms and sent through the entire hotel and also (over leased wires) to points outside the hotel. Programs originating outside can be tied into the hotel system by these same leased wires.

Man-Made Static

Now let us suppose that you are given the job of designing a similar system. The first thing to do is to realize just what will be your greatest problems. Without a doubt

one of the greatest will be the elimination of "man-made static."

Usually a large hotel is located in a thriving section where any number of electrical devices are apt to be in use; a great many operating 24 hours a day. To make matters still worse, many large cities use direct current in the city proper. Naturally, the greatest amount of this type of interference is caused by D.C. machinery where arcing takes place between brushes, circuit-breakers, relays and elevator apparatus. The importance of such problems is easily understood; they have been of the greatest difficulty, not only for the radio dealer, Service Man and layman, but also to a great many well-versed radio engineers.

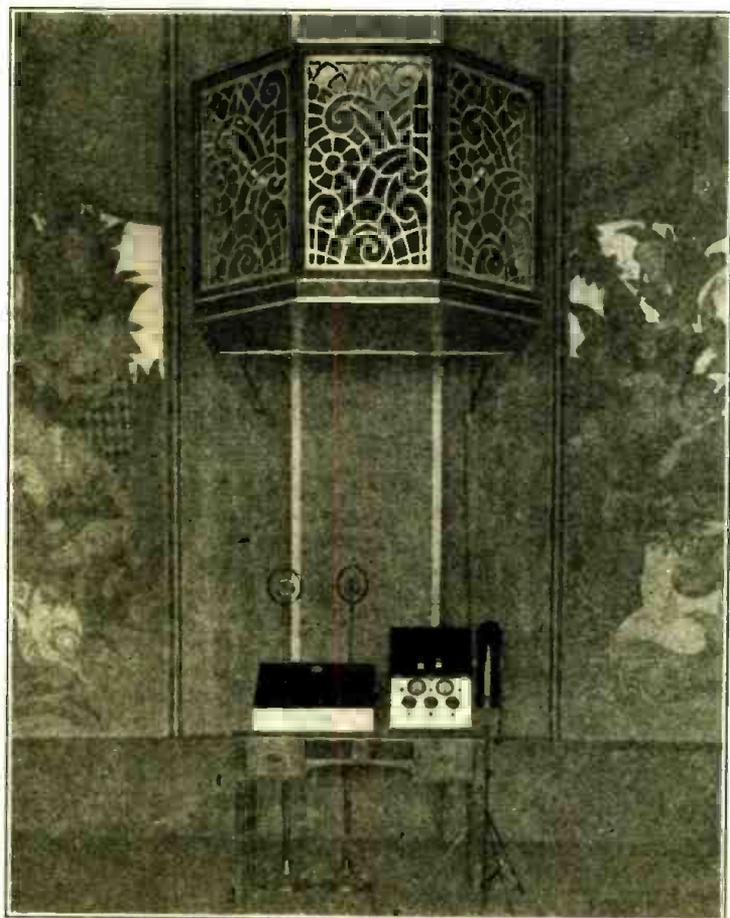
Before screening and shielding were used, individual filters were the vogue. Picture chasing around and tying a filter on the tail of each motor, circuit breaker, bell and "rock-crusher" in any city block, or especially in a hotel of forty stories! Most of the elevator equipment here is situated in rooms adjacent to the radio room; in fact the six antennas of the radio receivers go through the elevator section and run in close proximity to the elevator motors. Yet, when the gain on any of the receivers is advanced to maximum position, there is hardly any noticeable background noise.

Individual filters for each offending piece of apparatus would be not only very expensive but quite impractical. The solution of this great problem was accomplished very effectually and economically by completely shielding the entire radio room with heavy copper mesh and running the antenna lead-in wires down in lead sheath enclosed in 3/4-inch conduit; the whole assembly was grounded. The antennas were raised ten feet above the structure to insure negligible pickup from any apparatus in the building.

Matching Reproducer Impedances

Of course in an installation of this type, correct impedance matching is vitally necessary to obtain good reproduction.

(Continued on page 758)



The grille is a sound projector, movable about the ballroom, as needed. Two other projectors are built into this room, and may be put in operation from the remote-control box. At the right of the table is a condenser mike (which incorporates a built-in stage of audio) and beside it a mixer capable of blending the output of three such. Left, a mixer for three carbon mikes of the usual type, two of which are standing behind it. Below, right, the remarkable remote-control box, which operates from any of twenty outlets in the hotel.

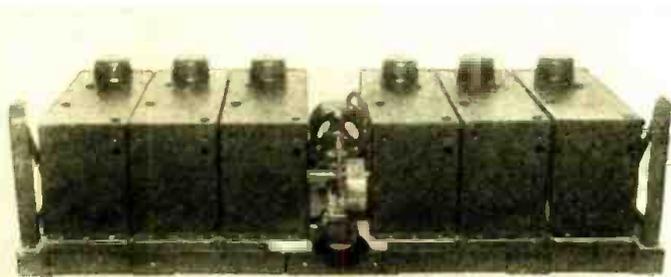


Fig. B

This special remote-control tuner (observe motor in center) with four R.F. stages and automatic volume control, is on the 41st floor and feeds into the amplifier on the 4th.



Fig. A

Opening this box releases the button at lower left, and starts the public-address system. The buttons at the right control five sound projectors—one button being used for resetting.

FROM time to time radio has been put to such extremely odd uses that it has become almost impossible to forecast what the next application will be. An organization, of which the writer is a member, has afforded a very fine vantage point from which to view a great many of the channels that radio experimentation is following. One of the most novel uses, by far, to which ultra-high-frequency oscillation and radiation has been put, is that of electrical prospecting. Although this art is not by any means new, and has been known and used for a great many years, the use of these extremely high frequencies is novel.

Ideas Not Unique

It is true that a great number of men are working on this problem independently; and it is rather odd, from our standpoint, to receive visits from engineers unacquainted with each other who outline to us practically the same procedure and ask for the same apparatus. A curious part of it all is that most of them ask us to keep their ideas secret; not realizing that perhaps a dozen others have given us the same ideas and ask for the same secrecy. We fail to see how engineers in their position can afford to fail to keep in touch with current developments, as they appear in magazines such as this one.

The prospecting instrument to be described was built by us for test work and experiments in Alaska. It seems that a company wished to determine the exact shore line of a river but were unable to do so because of the thick ice and snow crust which covered both river and banks. Sinking shafts proved too expensive, and so were several tapping measurements which were tried. One of the engineers of this company then consulted us about an electrical method of locating the earth line.

Prospecting At 1.6

Sharply reflective characteristic to discover

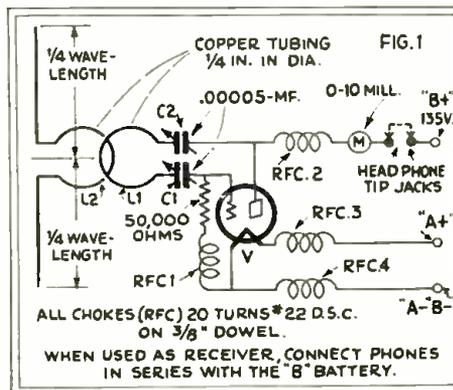
By JOSEPH I.

Because the instrument had to be extremely portable and efficient, and no more than two men could be assigned to a single survey, we determined to use extremely high frequencies; since they entail a minimum of

at one point picked up the wave reflected from the shore line and, at another point, picked up a much stronger signal which evidently came from a point 50 or 80 feet from the river. They did nothing about this, however, until it was found that one of these strong reflection points coincided with an abandoned gold mine. Extending the shaft of the gold mine some ten yards farther than the last point worked, laid open a sizable body of high-percentage ore. The engineers then went back to several of the "off"-points previously noted, and in each of the points were able to find a trace of metal-bearing ore.

Of course, a great many false readings were obtained, and it will require a great deal of experimenting to evolve a finished apparatus. However, there are at least five groups of experimenters working on this idea, that we know of; and we are herewith publishing such constructional hints as we have in hand in order to enable anyone who desires to build similar apparatus and to make experiments of his own.

The receiver and transmitter are built in exactly the same manner as the circuit shown in Fig. 1; except that the transmitter may use a higher-powered tube. We have found that the '99, '30, and '12A types of tubes work equally well; although all tubes of the same type do not necessarily operate. Different tubes should be tried until several are found that oscillate well. The controls for the variable condensers C1 and C2 should be brought as far as possible from the condensers, in order to minimize hand-capacity effects.



Circuit of the simple set illustrated in Figs. 1 and 2. The R.F. chokes need little inductance and must have very low capacity.

apparatus. It has been shown by several investigators that the attenuation of radio-frequency currents rises with frequency and, therefore, it was to be expected that using an extremely high frequency would get us nowhere. However, when using a "beam" transmitter together with a "beam" receiver, each working at very high efficiency, we believed the work possible; and so it proved. The procedure was as follows:

Discovery of Gold Ore

A transmitter generating a signal of 1.6 meters was used to direct a beam into the ice. A receiver, set to the same frequency as the transmitter, was carried around by another operator and tried in different locations until the reflected beam was picked up. Simple measurements of the distance between the transmitter and receiver, together with the angles they made with the horizontal and vertical planes, enabled the operators to get a rather good idea of the position of the reflecting surface which, in this case, was the earth.

If their experiments had stopped there, this article would probably never have been written. However, in their testing they found several inconsistencies which set them wondering as to what the cause might be. They found, for instance, that the receiver

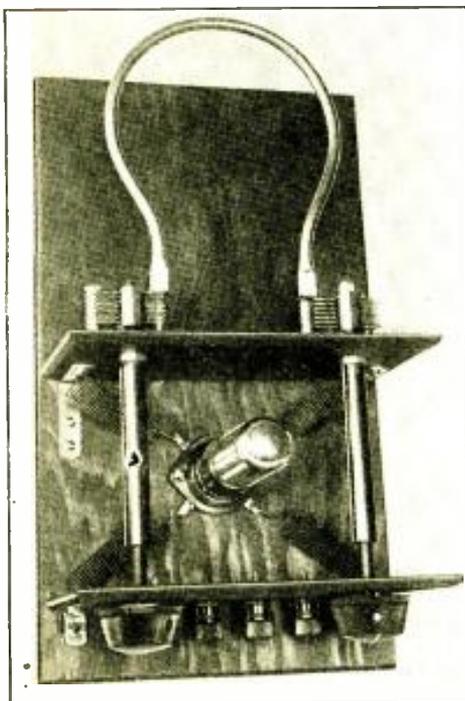
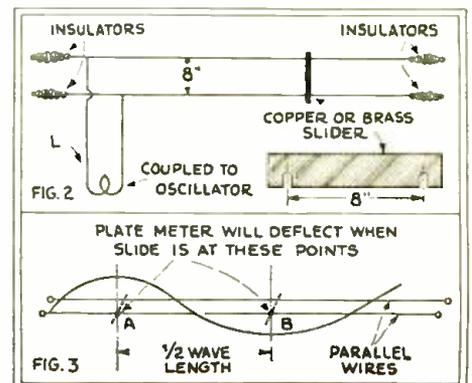


Fig. A

The dual-purpose ultra-short-wave set used as transmitter or receiver. Note its simplicity and balance, and the long condenser shafts.



Above, the Lecher wires used to determine wavelength; below, the "standing wave" set utilized in this manner.

By Radio Meters

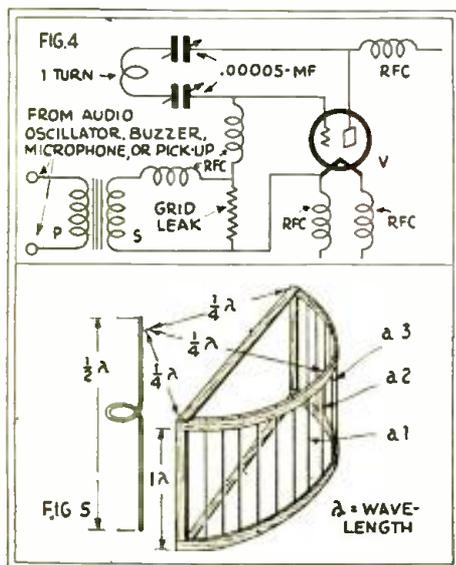
of ultra-short waves utilized mineral bodies

HELLER, E. E.*

Using the Lecher Wires

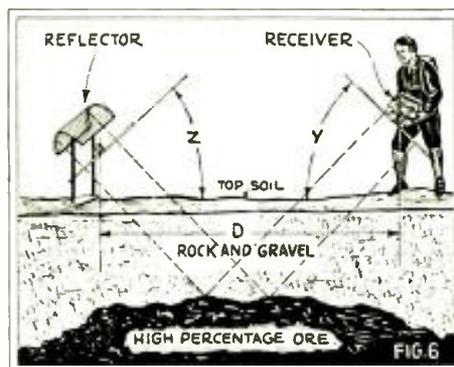
In order to determine the wavelength of the oscillator, the following procedure should be used: two parallel wires, about eight inches apart and about sixty feet long, are strung up, and a metal slider arranged as in Fig. 2. One end of this antenna system is brought to a three-turn coupling coil L. (No. 18 D.C.C. wire on a 5-inch tube, spaced 1/4-inch.) which is coupled rather closely to the oscillator. A milliammeter M is placed in the plate circuit of the tube, V. When the tube circuit is oscillating, moving the metal slider along the wires will result in sharp upward movements of the milliammeter needle at certain positions of the slider. The point at which the greatest deflection takes place represents a "loop" in the standing wave on the wires; if you could see the waves, their magnitude would be represented very much as shown in Fig. 3. Moving the slider to points A and B will result in sharp upward movements of the milliammeter; the distance between A and B will represent one-half the wavelength in the actual test. Several of these points should be found and the distances between points averaged and multiplied by two; this will give you the exact wavelength of the oscillator.

In actual use, it is highly desirable to modulate the transmitter in some way.



Above, a method of modulating the transmitter to make the signal more distinct. Below, a simple reflector to give the beam more concentration; a half-wavelength antenna.

While it would be possible to pick up and heterodyne a C. W. signal emanating from the transmitter, the tuning for this point is so highly critical at this frequency that some form of modulation is almost a



The method of working with ultra-short-waves to detect sub-surface conditions. A practical knowledge of geology is, of course, needed to interpret the readings obtained in any locality.

necessity. One of the easiest, and yet one of the best methods of doing this is indicated in Fig. 4. In this case an audio current from an A.C. source (which may be either a buzzer, an audio oscillator, a microphone or a phonograph pick-up) is sent through a transformer and into the grid circuit of the oscillator. The secondary of the transformer should have as high an impedance as possible; a choke similar to the others should also be placed in the secondary lead, as shown.

As to the dimensions of the transmitting and the receiving coils, both should be made of loops of 1/4-inch copper rod, 3 1/2 inches in diameter. The antenna should be half the wavelength, from top to bottom; if the transmitter frequency is 1.6 meters (as in the equipment above) the overall length should be 0.8-meter or 31.5 inches.

While this system is suitable only for low values of modulation, it is simple and has proven itself entirely practicable.

A further refinement which should be added to the transmitter is a reflecting and focusing attachment. If the transmitter is used as shown on the front cover of this magazine, a rather broad wave will result, and angular readings will be rather rough approximations. Fig. 5 gives the specifications of a reflector which will cause the emitted signals to be exceedingly sharp, and receivable through only two or three degrees

of arc. The length of the individual wires a_1 , a_2 , a_3 , etc., should be a little greater than that of the entire antenna system.

Operation in the Field

In use the reflector and antenna should not have their relative positions changed but both should be moved as a unit. It will be found that, with a set up as indicated in Fig. 5, the wave emitted is exceedingly narrow and can be picked up only when the receiver is exactly in line with the transmitted wave.

Reference to Fig. 6 will indicate how the angles can be measured. We will assume that it is wished to determine the depth of a body of high-grade ore below ground level; and that, after several tests, it is found that the receiver will pick up a signal from the transmitter when they are in the relative positions shown. The angle Z which the transmitting antenna makes with the horizontal, the angle Y which the receiving antenna makes with the horizontal, and the distance D should be measured. From Fig. 6, it can be clearly seen that we have as a result a triangle of which we know two angles and the included side; from this information we can compute the depth by trigonometry.

Another way of determining the depth is to measure the angles and distance as above, and lay the whole thing out to scale on a large sheet of paper. The depth can then be measured.

* Chief Engineer, Wireless Egert Engineering, New York City.



Fig. 8

The set of Fig. 4 coupled to its antenna rod—in a laboratory set up for testing.

New Radio Devices for Shop and Home

*Of interest to technicians, Service Men and all
radio workers*

THE LATEST IN VARIABLE HIGH RESISTORS

By H. G. Cisin

FOR years technicians have been trying to produce a satisfactory variable resistor which, in high-resistance ranges (such as 0—500,000 ohms, or 0-2 megohms) would meet the following exacting conditions: (a) constancy of minimum and maximum values; (b) smooth-feeling control; (c) constancy in value at all points within its working range throughout its service life. Of these three conditions, the most difficult to meet has been the last.

A little consideration of this problem will show that the conductive film of a potentiometer or a two-connection resistor must be extremely thin, where the maximum resistance value, to be encompassed within a rotational length of about 2½ inches (a diameter of about ¾-inch), may be perhaps 1 megohm.

Consequently, if an arm making electrical contact to this film is permitted to rub its surface in the slightest degree, there is abrasion of the resistance material to just that extent, resulting in either an open circuit or an increase of the resistance.

How to prevent the rub is—if we may be permitted a pun—the rub. The new graphite-element volume-control Clarostat (obtainable with any characteristic, for a replacement in every radio set on the market) solves this problem in the manner illustrated in Fig. A.

A metal roller makes contact with the resistance element. However, a plain roller, like an automobile tire on the road, always

slips just a trifle, because the traction is not 100% efficient; which means wear of the resistance strip. The answer to this problem was to mold a toothed rack, TR, and to put a toothed idling pinion P, on the end of the roller R—which results in perfect operation.

The clearance between the rack and pinion is such that the spring pressure of the arm always maintains a good contact pressure between the roller and the resistance element. The shaft is of standard diameter, ¼-in., and is 1½-in. long. The overall size of the instrument is 2 x 2 in. in diameter.

CONDENSER REPLACEMENT KIT

THE Polymet Mfg. Corp. has just introduced a kit of 25 fixed condensers



Fig. B
This kit of filter and A.F. bypass replacement condensers meets any need of the Service Man; the units are in standard sizes and capacities.

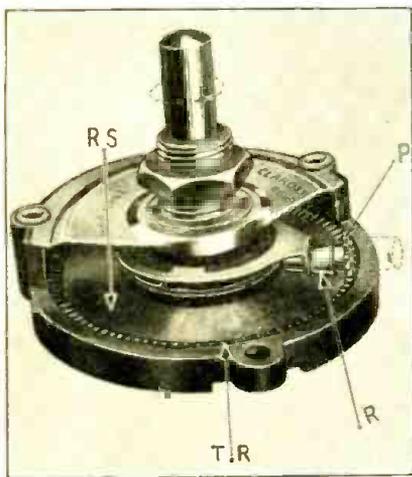


Fig. A

This new volume control eliminates the previous effect of wear on the resistance element, by the pinion P, which prevents slipping of the contact R. The graphite element RS is of standard type.

for radio repair work; these units, which are unsealed, being intended for use in servicing filter blocks, are illustrated in Fig. B.

Each condenser is plainly marked to indicate its capacity and voltage rating; and is equipped with 6-inch rubber-covered leads. As protection against moisture, each unit is vacuum-impregnated, and sealed with black wax. Ratings are in accordance with R.M.A. standards.

The condensers contained in this valuable kit are of various dimensions to fit standard power-pack condenser blocks. For the information of the Service Man, the following concerning these units are given: (working voltages are indicated; while the number of sections furnished are shown in parentheses): 200 volts, 0.5-mf. (2); 1.0-mf. (1); 300 volts, 0.5-mf. (1); 1.0-mf. (2); 400 volts, 0.5-mf. (1); 1.0-mf. (1); 600 volts, 0.5-mf. (1); 1.0-mf. (4); 2-mf. (1).

A complete set of replacement condensers such as these enables the Service Man to increase his profits, by making power pack repairs more convenient, speedy, economical and permanent.



Fig. C

The luminous globe of the "Royale" tone control shows its tone-frequency adjustment.

"ROYALE" LUMINOUS TONE CONTROL

GLORIFICATION of the tone control has been achieved in the unit pictured in Fig. C, a product of the Lee DeForest Mfg. Co., which combines art and science in a pleasing ensemble.

A small, tubular 3.2-volt flashlight bulb, carrying, lengthwise, transparent stripes of blue, red and green, is screwed into a socket at the end of a brass support which is fastened to the moving arm of a variable resistor; the lamp therefore turns as the resistor's

control knob is rotated. This knob, varying the resistance, also cuts a fixed condenser into circuit, and thus changes the tone quality of the reproduction. (Fig. 1.)

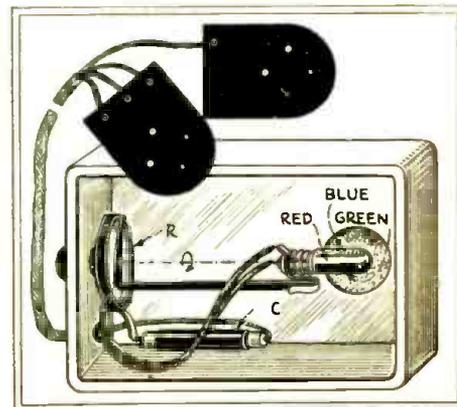


Fig. 1

Interior view of the "Royale" tone control; the pilot lamp is directly under the translucent glass sphere.

A four-wire cable is connected to the mechanism, which is housed in an art-bronze casting having as its motif a crystal-gazing maiden. The cable terminates in two fiber connection plates, which are provided with phosphor-bronze springs to grip the prongs of the power tubes. Two of these springs connect to the grids and two remaining spring connections, on one of the plates, give access to the filament terminals of one of the tubes. The first two leads shunt the resistance-capacity tone control across the input circuit of the power stage; while the last two conduct the current to light the moving lamp within the decorative unit.

The "Royale" measures $3\frac{1}{4} \times 5\frac{3}{4}$ inches high. It is available equipped with a bulb to suit the filament voltage of whatever power tube is used; the lamps being rated at 3.2, 6.0 and 7.5 volts.

NEW RCA AND CUNNINGHAM TUBES

THE Service Man who has toiled to memorize the table of vacuum-tube characteristics now must "bone" to add the figures of five new tubes; unless he is satisfied to paste up the values in his Handy-book.

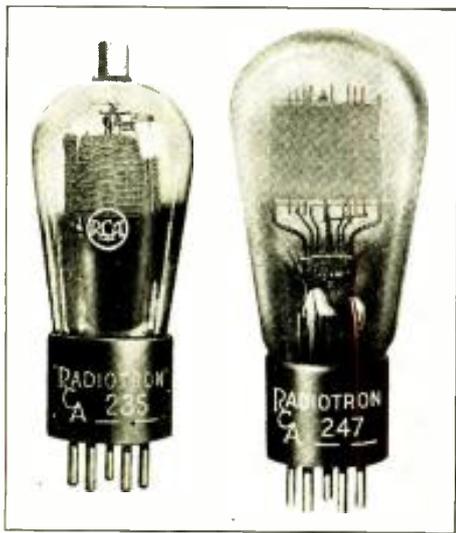


Fig. D

Left, variable mu tube, for R.F. amplification; right, a $2\frac{1}{2}$ -volt high-amplification pentode power tube.

The new RCA "Radiotrons" bear the following numbers: UY-235; UY-236; UY-237; UY-238; UY-247. They are classified as follows: '35, variable-mu (or "super-control") heater-type screen-grid tube, with 2.5-volt filament; '36, heater-type screen-grid tube, with 6.3-volt filament; '37, heater-type general-purpose tube, with 6.3-volt filament; '38, heater-type pentode power tube, with 6.3-volt filament; '47, pentode power tube, with 2.5-volt filament. The '35 and '47 are designated particularly for use in 110-volt A.C. receivers; the remaining three tubes, the '36, '37 and '38, may be classed as battery tubes for automotive use, although they may be used also in 110-volt D.C. receivers to advantage.

The theory of the variable-mu tube was discussed in the April, 1931, issue of RADIO-CRAFT; the advantages, in automotive radio set design of a heater type tube with a

(Continued on page 758)

The Latest Model Superheterodynes

The latest developments in high-power, selective receivers of this popular type

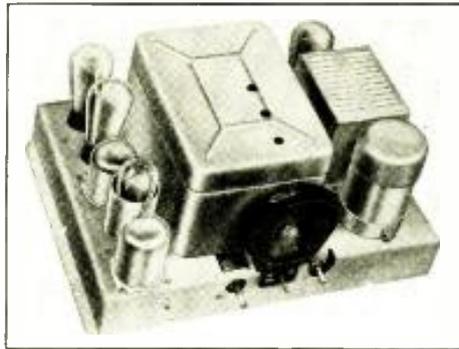


Fig. E

Chassis of the Crosley "Model 120" which is the heart of several console models. Its circuit appears on page 720.

CROSLY SUPERHETERODYNE

THE advent of the Crosley Radio Corp. into the field of superheterodyne receivers is marked by the introduction of a number of models incorporating the "Model 120" chassis; or, as it is tagged in more grandiose style "Senior Superheterodyne "Pliodynatron."

The three new receivers bear the names "Super-Administrator," "Super-Rondeau," and "Super-Sondo" (combination), and are described below. Their chassis, the Model 120, is shown in Fig. E. In addition to the rectifier, there are seven tubes; a type '24 screen-grid R.F. amplifier for the signal frequency; a type '24 first detector; a type '24 I.F. amplifier; a type '24 oscillator, operating on the dynatron principle described in past issues of RADIO-CRAFT; a type '27 second detector; and push-pull '45's, feeding a dynamic reproducer.

Having observed the salutary effects of a tone control unit during periods of strong static, the Crosley company calls attention to the combined "static and tone control" device. Selectivity better than 10-ke. separation is obtained in the design of the "Model 120." The dial is graduated from 55 to 150 (adding a cipher indicates the resonant frequency at that setting.) The power switch is incorporated in the volume control. Variations in design are described below.

"Super-Administrator:" A veneer and solid mahogany cabinet model with "Repwood B" front panel. Provided with terminals for phonograph pickup. Dimensions, $36\frac{3}{4}$ in. high, $23\frac{1}{2}$ in. wide, $13\frac{3}{4}$ in. deep.

"Super-Rondeau:" An all-veneer cabinet model equipped with phonograph connections. Dimensions, $37\frac{3}{4}$ in. high, $25\frac{1}{4}$ in. wide; $15\frac{1}{2}$ in. deep.

"Super-Sondo:" Combination radio and electric phonograph. The cabinet is of particularly pleasing design; in its construction is used a new material known as "Carve-

Art." Dimensions, $42\frac{5}{8}$ in. high, $29\frac{1}{4}$ in. wide, $16\frac{3}{4}$ in. deep.

Service Men should have little difficulty with this very efficient but extremely simple receiver; the circuit of which appears in Data Sheet No. 43, in this issue.

SILVER-MARSHALL MIDGET SUPERS

THE latest product of Silver-Marshall, Inc., is a midget superheterodyne in "Compact" and "Cadet" Models "37," "38," and "39." The foundation chassis is pictured in Fig. F and shown in diagrammatic form in Fig. 2; note the convenience with which this receiver may be serviced.

To obtain the requisite selectivity, the input circuit includes a band-selector arrangement—a "siamese" circuit incorporating two tuned circuits inductively coupled. The output of this selector circuit feeds directly into the grid circuit of the first detector, V1. This type '24 screen-grid tube is followed by two more, the intermediate-frequency stages. The second detector V5 is a '27, outputting to push-pull '45's. A type '27 tube is used for the oscillator; while the rectifier is the usual '80.

It is interesting to observe some of the technical details of the circuit design. Although the intermediate-frequency IFT1 is tuned in both its primary and secondary circuits, it is made broadly resonant by reason of an "R.F. iron" core. The two remaining I.F. transformers IFT2 and IFT3 are shielded air-core units, having tuned secondaries. The peak of the I.F. amplifier is at 175 kc.

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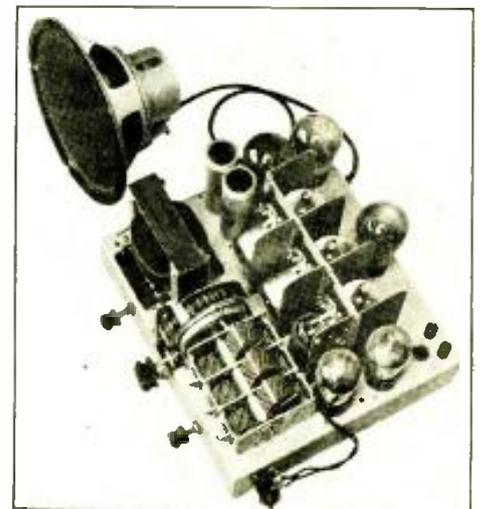


Fig. F

The midget super chassis and dynamic reproducer of the latest Silver-Marshall models.

How Movie Film Switches "Sound" Discs

Automatic Switch of New Double Turntable Effects Continuous Operation with a Single Projector

By A. WYETH*

ONE of the primary rules of good showmanship decrees that the show shall proceed continuously and without avoidable interruptions. In order to meet the above requirements to the letter, in the case of a regular theatre's sound-picture performance, two projectors are necessary; while one projector is in operation the other projector is being threaded with the successive reel of film to be shown. At a predetermined time (indicated either on the film or by means of a cue sheet accompanying the film) the operator starts the second projector and, when the machine is up to full speed, a shutter is dropped in its line of projection and a like shutter is removed from the line of projection of the incoming machine. The shutter operation takes place instantaneously; with the result that it is practically impossible to detect the changeover from one machine to the other. Since there is no recorded sound corresponding to the extreme beginning and end of each reel of film, there will be no break in the reproduction when switching the amplifier to the incoming projector. (See the articles on modern sound projection, in the Feb. to June, 1930, issues of RADIO-CRAFT.)

Notwithstanding the advantages of a double-projector installation, there are thousands of single-projector installations scattered throughout the world. These small installations are generally in clubs and private homes in this country, but abroad there are many small theatres having but one projector. If the customary type of sound-on-disc reproduction attachment is installed on a single-projector installation, it becomes necessary to re-thread the projector and change records at the end of each 1,000-foot length of film. Now, since the quantity of sound which may be recorded on a 16-inch record corresponds in running time to approximately this length of film, it is obvious that, for a feature picture consisting of about 10,000 feet of film, the showing would be interrupted ten times merely for the purpose of changing records and reels.

These frequent interruptions could be avoided if some method could be devised for automatically changing from one to another synchronous turntable at the end of each 1,000-foot reel of film. (The showing of the picture could then be carried on continuously as long as film remained in the upper projector magazine).

The double turntable automatic change-

over described here and pictured in Fig. A automatically accomplishes the changeover from disc to disc; and the length of one uninterrupted showing therefore depends on

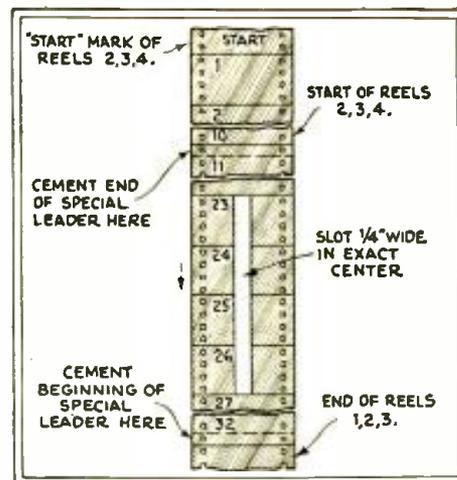


Fig. 1

Successive reels of film are patched with a "leader," the slot in which permits an electrical contact to be closed through a relay.



Fig. A

The double turntable carrying incoming and outgoing sound discs; the change is made automatically as a reel of film goes off, by the mechanism between the turntables, shown in detail on the opposite page.

how many 1,000-foot lengths of film, cemented together to make one large reel, can be accommodated in the projector film magazine.

Large standard magazines are of such size as to accommodate 4,000 feet of film, which length takes slightly over forty minutes to run through the projector at the prescribed speed of ninety feet per minute. On this basis then, only two interruptions are necessary in the showing of a ten- or twelve-reel feature picture, compared with as many interruptions as there are records when the ordinary single synchronous turntable is used.

For the sake of clarity, it may be well to outline briefly at this point the operation of the double turntable. Short strips of slotted "leader" (length of blank film) are cemented between the four 1000-foot lengths of film (See Fig. 1) and, as these slotted portions pass over a specially constructed roller in the projector, (diagrammed in Fig. 2) an electric circuit is closed through a magnetic-clutch mechanism (Shown at 1, Fig. B.). The actuation of the clutch immediately causes the incoming turntable to start up in exact synchronism with each succeeding 1,000-foot length of film. The electrical circuit by which this is accomplished is shown in Fig. 3. As soon as the changeover has been completed, the outgoing turntable is then manually disengaged from its driving source and allowed to stop in order to change the record and place the pickup needle at the "starting point" in readiness for the next changeover.

* Engineering Department, Patent Electric Co.

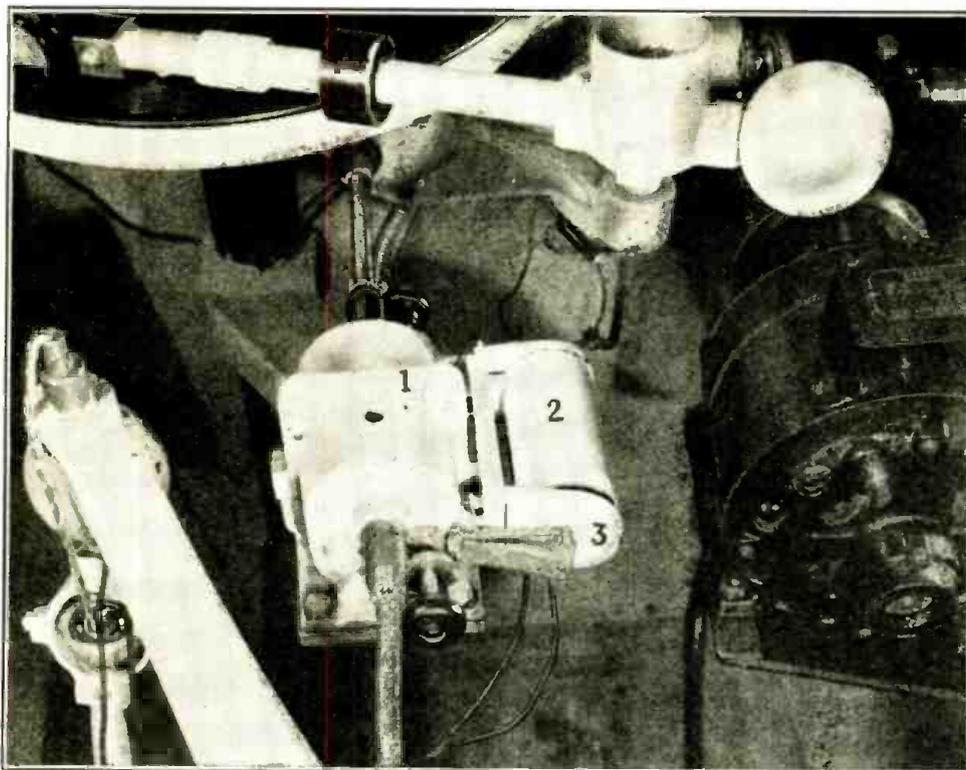


Fig. B (above)

A close-up of the clutch-release mechanism which starts the "incoming" turntable.

Right, the manner in which the slotted film is used as a switch.

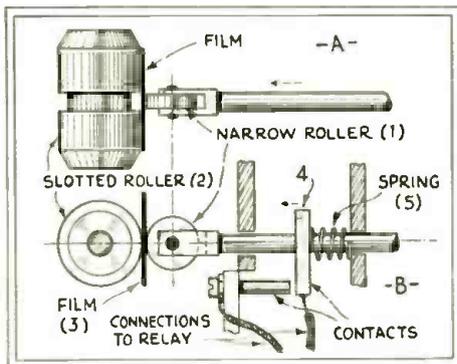


Fig. 2

disengaged from the continuously revolving gear system within the housing. The plunger is held in the disengaged position by the grab hook and may be released when the armature is drawn toward the magnet.

Operation by Slotted Film

Assume that the projector has been threaded in the usual manner, and the pick-up on the turntable to be used first has been placed at the starting point of the record. The turntable drive shaft is next engaged with the flexible drive shaft from the projector gearbox, by manually pulling out the knob which, in this position, engages the clutch mechanism. Before the projector motor is started, the second turntable is disengaged from the driving source by pushing its clutch knob all the way in and allowing the grab hook to catch the edge of the plunger collar. While the projector is in operation, the succeeding record to be played is placed on the second turntable and the pickup properly located.

When the end of the first 1,000-foot length of film has been reached, the slotted leader passes between the rollers shown in detail in Fig. 2. The narrow roller (1) projects through the slotted portion of the film (3) during its passage, thus bringing together the two contacts shown in the picture and closing a primary circuit through a relay. The operation of the relay causes the clutch magnet to be momentarily energized which trips the armature; thus allowing the clutch shaft to spring back and cause the incoming turntable to start. Since the slotted strips of film are cemented in a given relation to the "start frames," the incoming turntable will commence revolving at the same instant that this frame is passing through the picture gate. Accurate synchronization between the disc and film is thus assured.

Fig. C is a closeup view of the special film rollers and film switch assembly, which

(Continued on page 755)

The process of changing from one disc to another, as outlined, is continued until the four 1,000-foot strips of film, which were previously cemented together with the three slotted-strip sections, have been run through the projector. It is then necessary, of course, to stop the projector, remove the reel of film which has been shown and re-thread the machine with the succeeding 4,000-foot composite reel. Next, the following record to be played is placed on one of the turntables and the pickup properly located before restarting the projector.

Fig. A is a view of the double automatic synchronous turntable and driving mechanism. The two turntable discs are alternately driven by means of a flexible-shaft drive extending to the projector gearbox, which may be seen directly behind the counter-balance weight, of the farther pickup arm. The shaft extending from the right of the gearbox drives the projector, and the shaft projecting from its left side drives the turntables through a specially designed clutch mechanism; a closeup view of which is shown in Fig. B. To the right of the picture may be seen the projector driving motor. From the opposite ends of the clutch housing extend spiral-wound turntable driving shafts which terminate at the turntable gearboxes. Mounted on the right side of the housing is the clutch release magnet 2 which is energized at the instant of change-over. At each end of the electromagnet is a hinged armature provided with a grab hook (See Fig. 3). Normally a spring holds the armature away from the magnet in the position shown at 3, Fig. B. When the knob and the plunger are in the position illustrated, the nearer turntable is mechanically

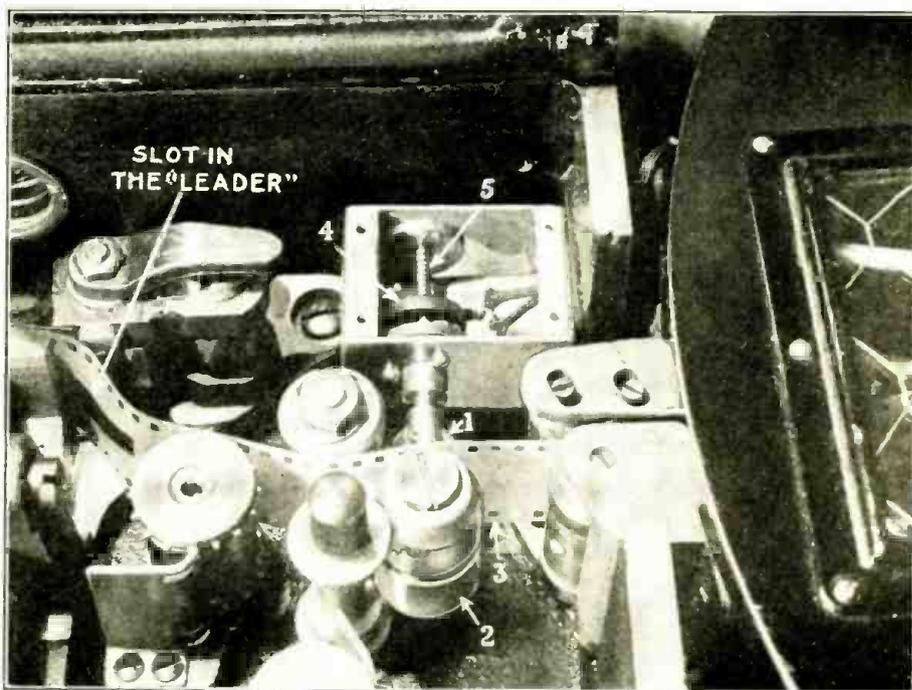


Fig. C

A view of the film-rollers between which contact is effected, as shown in diagram form above in Fig. 2 (The figures in the two diagrams correspond). At the left will be seen the central slot, in the vertical film, by which the mechanism shown in Figs. B and 3 is started.

A NEW SUPER CONVERTER

A pre-tuning unit with which any broadcast receiver becomes a single-control short-wave super, covering the important S.W. broadcast ranges without change of coils

By L. M. BILLIG

THE ease with which the modern broadcast set may be adapted for relatively consistent short-wave reception, through the use of a single-control, compact unit, such as the "Air King" Super Converter illustrated in Fig. A, is particularly striking.

It is well-known that the superheterodyne system of reception affords high efficiency, and it is becoming equally well known that this efficiency is comparatively higher at the short wavelengths. Accordingly, this method of signal reception was adopted for the Super Converter described below. The front view of this instrument is Fig. A; and Fig. B, the interior.)

Before discussing the mechanical construction details of this unit, let us examine the schematic circuits (Figs. 1 and 2, respectively) of battery and electric models of commercial "Air King" adapters or converters. It is assumed that the antenna has been removed from the broadcast set and connected to the input of the adapter; the adapter's output is in turn wired to the input of the broadcast receiver; and the entire system is in operation.

Circuit of the Converter

Tube V1 is an R.F. amplifier; V2 is the first detector or "modulator"; and V3 is the oscillator. The input circuit of V1 is broadly resonant (in the sense, however, that signals below 100 meters [about] will be favored); this action is obtained by the use of an R.F. choke, L1, of very small dimensions, with an inductance of only 1/4-millihenry. Except in isolated instances,

a value so low is not utilized in receivers designed for operation at the broadcast wavelengths of 200 to 550 meters; in this position, an R.F. choke of more "normal"

reception on short wavelengths of music, talks, singing, code, beacon signals, etc., is to tune the single variable condenser, C1, by means of the variable-ratio vernier dial.

Analyzing the schematic circuits in somewhat greater detail, it may be remarked that, for A.C. operation, the type '27 tubes are operated as in Fig. 2, with filaments in parallel, and wired to a filament transformer, T; while the battery hookup shows them in series, the "A" potential then being obtained by direct connection to a 6-volt current source.

In Fig. 2, a single resistor R1 of 150 to 300 ohms, by-passed, supplies "C" potential for V1 and V3; the range being due to variation in available plate and screen-grid potentials. The output radio frequency choke L5 should be shielded, for best results. The tuning inductance L2 is in three sections: the largest coil is shunted by the tuning condenser, C1; a small plate inductance, or "tickler" coil, is sufficient to obtain circuit oscillation; the second little coil is the "pick-up" inductance, and couples the oscillator's output into the grid-return circuit of the detector V2.

No Plugging In Required

Only this one coil is used in the converter, and it is put in place permanently. Instead of plugging in two coils to fully cover the tuning band, a switching arrangement is used. When the switch is pushed in, the switch circuit is open, and the tuned secondary consists of eight turns. When the switch is pulled out, the switch circuit is closed and two of the eight turns are shorted out, leaving effective six; which permits tuning down to about 20 meters.

A tuning condenser C1 of .00035-mf. capacity is used to obtain tuning from around 20 meters to 110 meters. This range, much larger than might be expected, is due to the high intermediate frequency recommended. This will be around 1500 to 1600 kc. (depending of course, on the highest frequency to which your broadcast set will tune).

As stated before, the input inductance L1 should be very small. The same rule applies to the plate inductance L3 and the V2 grid inductance L4. If a larger coil is used here (say one having a value of 10 millihenries) the natural wavelength would be in excess of 400 meters. Of course that is a frequency in which we are not at all interested. Also, the converter would be deprived of initial sensitivity by the introduction of distributed capacity high enough to act as a shunt to ground for the very frequencies wanted. The quarter-millihenry value proved to be the best.

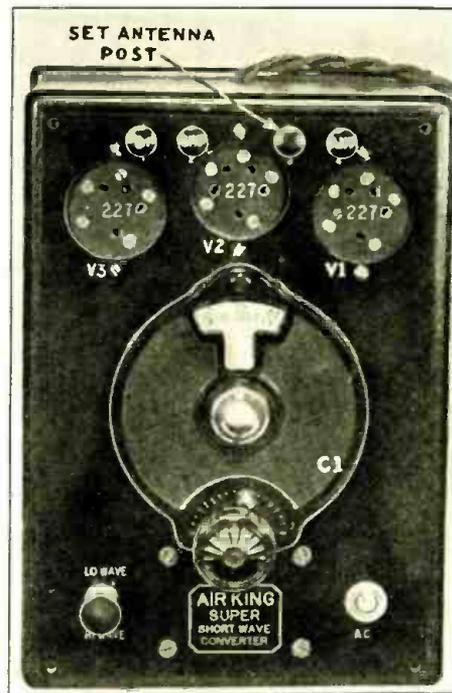


Fig. A

Front view of the "Air King" converter, tuned by the single vernier dial of C1. Volume is controlled at the receiver with which it is used.

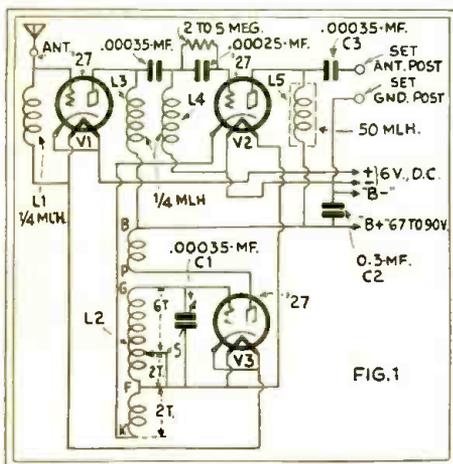


Fig. 1

For battery use, the efficient '27 type tubes are used, as in the A.C. model, but with filaments in series, giving proper bias. Note the wave-changing "Hi-Lo" switch S, across two turns of L2.

value (say, 85 mh.) though broadly resonant and particularly efficient at longer wavelengths (in which we have no interest) would have such a large self-capacity as to be literally shorted out of circuit at the shorter ones—below 110 meters.

Signals within the (approximate) range from 20 to 110 meters are amplified *en masse* by V1. The output of this tube is impedance-capacity coupled to the modulator, second-detector, or mixing tube, V2; in the grid circuit of V2 the output of oscillator V3 (to which it is inductively coupled) heterodynes with the incoming signals, thus producing beats. If one of these beat frequencies is in exact resonance with the sharply tuned circuits of the broadcast receiver to which it is impedance-capacity coupled by L5-C3, only this program will be further amplified by the broadcast set; the R.F. amplifier stages of which now constitute an "intermediate frequency" amplifier, and its detector, the "second" detector.

The only operation necessary for the re-

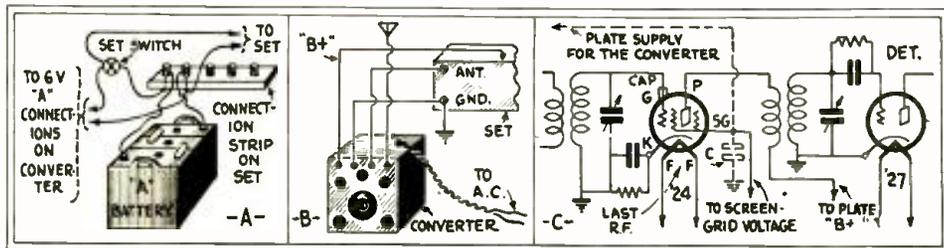


Fig. 4

Connections of the converter (Fig. 1) to a 6-volt battery set are shown at A. The A.C. converter is shown at B, though either type uses similar antenna and ground connections. One method of obtaining "B" voltage from the set is shown at C; though a separate battery is often more satisfactory.

Such a choke may be referred to as of the "pencil" type, the form having the shape of a short pencil. As to its construction, a form of bakelite tubing $\frac{3}{8}$ -inch in diameter may be used, and wire wound on it to a length of 1 in. The wire may be as fine as No. 40. The inductance depends upon the number of turns of wire; so, if larger wire is used, for the same winding space, the inductance will be less than if smaller wire is used. If you have No. 38, 36, 34, 32 or 30 wire, you may use that. No. 40 enamelled wire winds 278 turns to the inch, giving an inductance of 234 microhenries for a $\frac{3}{8}$ -inch diameter.

are wound. A tap is made, and two more turns are wound. Tap again, and the final six turns are made. (If you haven't No. 25 single-silk-covered wire, you can use No. 24 single-silk- or single-cotton covered.)

Viewing the coil from top to bottom, as at A, the connections, B, are: first, to plate of the oscillator; next to "B plus;" next (Fig. 2) to the cathode of the modulator; next to the ground and one side of the switch; next to the switch tap and the other side of the switch; last to oscillator grid.

Installation of the Converter

After the set is constructed, the following details should be read carefully. They regard the installation and operation of the unit, and are extremely important.

Four connections are made to the converter, as shown in Fig. 4B. First, the antenna is removed from the antenna post of the receiver, and connected instead to the antenna lead of the converter, as explained above. Then the ground lead of the converter is connected by a wire to the ground post of the receiver, which is left connected also to the ground. The output of the modulator, (marked "Set Ant. Post" on the diagram) is then connected by a wire to the vacated antenna post of the receiver. The required positive "B" voltage is connected to the "B plus" of the converter; this need be only high enough to insure oscillation, say from 67 to 90 volts.

If the antenna is left connected to the antenna post of the receiver, and the lead from the converter marked "Set Ant. Post" is connected also to the receiver's antenna post, signals will be heard; but usually not as loud as if the connection were split up as recommended above. The segregation of the connections (whereby the antenna alone goes to the converter, and the converter's output alone goes to the antenna post) uses the untuned stage of short-wave radio frequency amplification in the converter, which the other method of connection cuts out of the circuit. Unlike the split connection in the antenna circuit, the ground connection is undivided. The ground lead is left at the ground post of the receiver, and in addition the ground lead of the converter, which is marked "Set Gnd. Post," is joined to the set ground post.

Tapping for Plate Voltage

Regarding the "B" voltage for the converter, see Fig. 4C. If the receiver you have is of the screen-grid type, the voltage is nearly always obtainable properly from the screen-grid itself. If a standard connec-

tor plate is not available, the looped end of the insulated converter lead intended for this purpose, may be bared; so that the loop fits snugly over the screen-prong of a tube removed from a radio-frequency socket in the receiver. The tube should be replaced in the same socket, pressing it firmly in place, when the contact of the looped end of the wire with the screen prong of the tube will introduce the screen-grid voltage into the converter. If you have a standard lug, you may fit this, instead of the looped wire, over the screen prong, and solder the converter wire to the free end. Usually the last R.F. screen grid tube will afford a constant "B" voltage from the screen, independent of a series resistor.

In the battery-operated sets, using type '22 tubes, this potential will be around 15 volts; while in A.C. sets, using type '24 tubes, it will be from 50 to 75 volts. In most instances the voltage is controllable; since the volume control is a potentiometer that permits variation of the screen voltage. If so, put the volume control at or near the maximum volume position, to operate the converter.

In a receiver which provides its screens with voltage dropped through a series resistor, since the converter draws about 10 milliamperes plate current, this current will flow through the series resistor, lowering the effective voltage. The voltage, however, will scarcely be lower than 40. The oscillator will function, as well as the detector and R.F. tubes of the converter, on 40 volts. At these low voltages, an extra 1-mf. condenser (C, in Fig. 4C) should be connected between the "B+" lead of the converter and the ground, to afford better oscillation.

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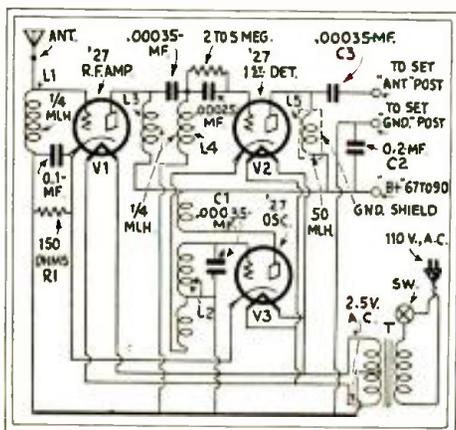


Fig. 2

Schematic circuit of the "Air King" for A.C. operation, incorporating a 2.5-volt filament transformer.

In the output circuit, a regular broadcast radio-frequency choke coil L.5 is used, say from 50 to 75 millihenries. This type can be used here; since the frequency to be transferred corresponds to the lowest broadcast wavelength, and not the enormously higher frequencies of short waves.

Construction of the Coupler

The coupling of the modulator and the oscillator is effectuated by means of a two-turn winding. Thus when the oscillator coil is wound, it will comprise a tickler that provides oscillation, a tuned secondary with a tap for the switch, and a pickup winding which is a continuation of the winding that constituted the tuned secondary. (This is shown in detail in Fig. 3; all turns are made in the same direction.) Assuming the use of bakelite tube, $1\frac{1}{4}$ inches in diameter and $1\frac{3}{8}$ inches high, eight turns of No. 25 single-silk-covered wire are wound for the tickler. Space of $\frac{1}{4}$ -inch is left and, in the same direction, two more turns of the same wire

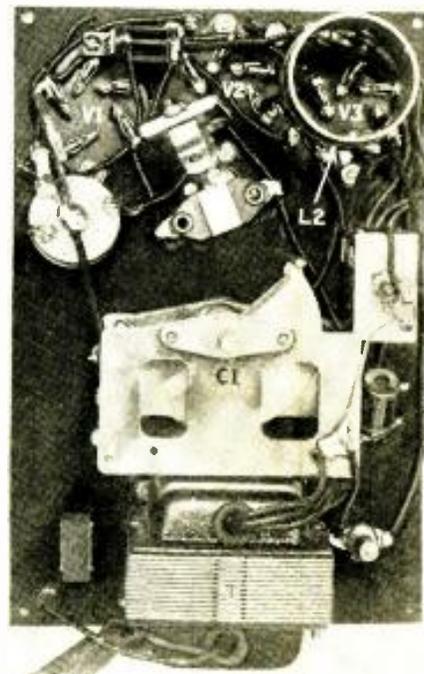
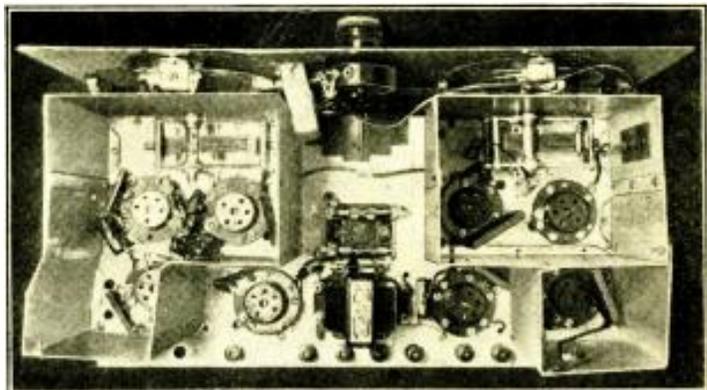


Fig. B

Under side of the panel of the A.C. model "Air King," showing the double-ranae coil L.2, comprising feedback, pickup and oscillator tuning inductances, and other parts which may be identified from Fig. 2. A "pencil" type R.F. choke is at the upper left.



Mr. Ulrich's remodeled "Super-Wasp," with tubes, coils and rear shields removed to show the placing of parts. The R.F. stages are seen at the right; detector and oscillator left; audio between.



This vertical view of the receiver may be compared with Fig. 2, below. The panel volume control supersedes the original midget antenna condenser. beside it is the 1-mf. condenser C7, which bypasses the regeneration-control potentiometer R10. C4 is .001-mf.

A Novelty in Short-Wave Receivers

Employing a separate tube for smoother oscillation control

By VINTON K. ULRICH

EXPERIMENTERS may find increased facility of short-wave reception in the circuit illustrated here, and obtain results which will repay the additional time and material required for its construction.

The short-wave set I am using is rebuilt from a "Super-Wasp," to which I have added an untuned R.F. stage, as well as a separate tube to provide oscillation. This seems to work much better than the autodyne-type detector, though it is necessary to cut down on the R.F. coil to have it match the detector tuning coil. The coils are hooked up as before, none of the connections being reversed.

The resistors R3 and R4 are wire-wound, and act as R.F. chokes; R10 must be of the most noiseless type, if quiet regeneration is wanted. The volume control may be mounted in the panel hole intended for a rheostat, if a D.C. model set is used.

For greatest volume, a low voltage is desirable on the screen-grids of the R.F. tubes. The volume control R12 is adjusted for greatest volume; the resistor R13, in series with the oscillator plate, is adjusted until R10 gives perfect control of regeneration with all coils.

The filter used for the "B" supply has but one choke, in contrast with most designs; yet it filters out all hum, so that phones can be used. The hum level is so low that one must listen attentively to hear it.

The values used in this circuit are as follows:

Resistors: R1, 100,000 ohms; R2, 450; R3, 900; R4, 650; R5, 9 megohms; R6, 1 meg-ohm; R7, 500,000 ohms; R8, 2000 ohms; R9, 20 ohms, center-tapped; R10, 0-200,000 ohms; R11, total, 25,000 ohms; R12, 0-5,000,000 ohms; R13, 0-5,000,000 ohms.

Condensers: C1, .01-mf.; C2, 0.2-mf.; C3, .0001-mf.; C5, .0005-mf.; C6, .006-mf. C7,

1.0 mf.; C8, .00016-mf. The 1-mf. condensers of the filter are 180-volt rating; the 2-mf. condensers, 400-volt rating. The choke Ch is of 30-henry type.

The variable antenna resistor R, which serves as a volume control, is of 50,000 ohms maximum; it may be placed in shunt, as shown, across the fixed resistor or replace the latter entirely. I mounted it above the center of the panel, over the oscillator control. It should not be turned down (as I

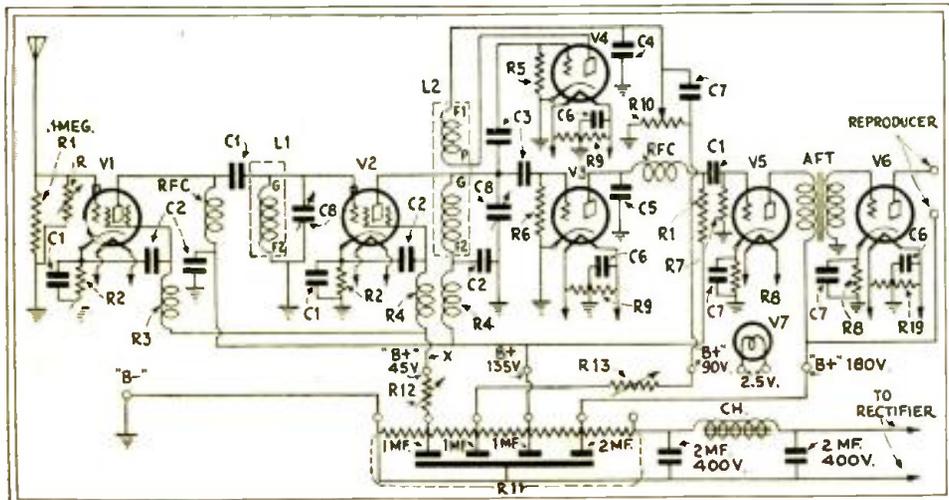


Fig. 1

The oscillator V4, which beats with the R.F. input of the detector V3, produces thereby an audio-frequency, instead of I.F., output. This method gives better control of the operation of the set. The power unit (lower right) uses a portion of the voltage divider instead of a second filter choke.

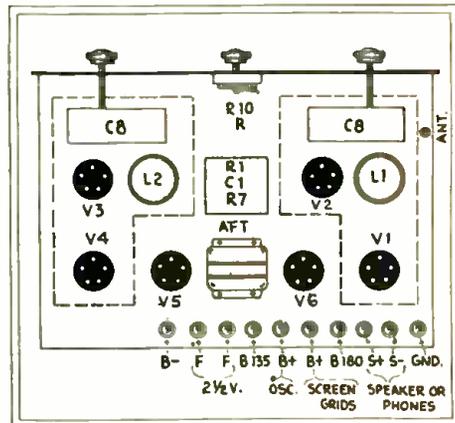


Fig. 2

The new layout, necessitated by the addition of V4 and V3 to the original four-tube receiver. R is above R10.

once did) when searching for distant stations; but will be appreciated when copying code of the high-power transmitters.

The values of the wire-wound resistors R3 and R4, shown as chokes, may be altered; they are used for their inductance value.

In altering the standard coils, such as were used in the "Super-Wasp," only one turn should be removed at a time; testing each pair of coils to see that the dials of the R.F. and detector tuning condensers track. When they do, the coils are matched.

The advantages of the separate oscillator

are many, first, it is possible to operate each tube with the voltage best suited to its particular duty. Then, too, the best value for the grid leak can be chosen.

The audio circuit is practically that used in the "Super-Wasp," although the arrangement of parts is different, as shown.

The power unit used here is a hybrid with parts of different origin, a standard Pilot pack would probably supply the proper voltages. Mine is of the conventional type with an '80 rectifier. The variable resistors R12 and R13 correct the voltages obtained from the taps on the voltage divider; though they are here of 5-meg. maximum rating, any component of sufficient rating will do.

A separate filament transformer of 11-amp. rating was used, because that in the pack was not of sufficient capacity. With

some tubes, a center-tap resistor across the filament of the oscillator is needed, as shown, to prevent hum. The other resistors, and the by-pass condensers, are in accordance with "Super-Wasp" practice.

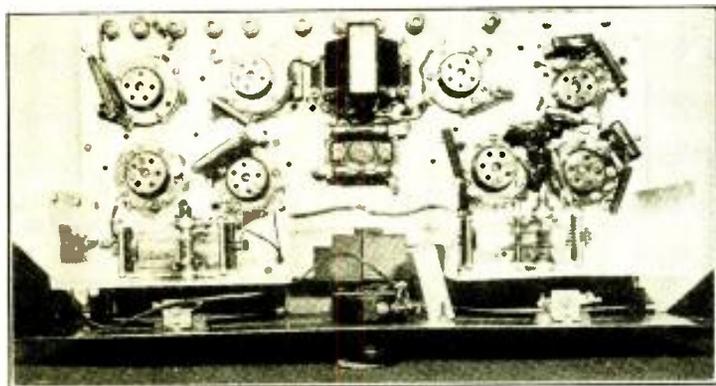
It was necessary to add extra sections to the original shields, as indicated; and of course, to do considerable drilling in the sub-panel to mount the additional parts. The new holes should be made amply large, to pass the filament leads without danger of cutting into the insulation.

The photographs reproduced here show all the parts used, in the remodeled receiver; and the layout of Fig. 2 is a key to the arrangement. The two grid condensers C3 are connected to the coil socket by means of metal strips, of the type supplied with the Super-Wasp kit. The condensers across

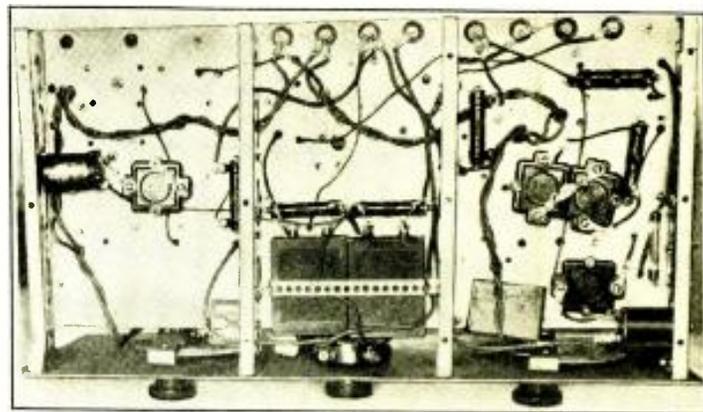
the filament resistors are bolted on one side to the sub-panel, to obtain an electrical connection; and connected on the other by a flexible lead to the filament circuit.

The 1-mf. bypass across the regeneration control is mounted rather slantingly to the panel. This was done, with some disregard of appearances, to utilize an existing hole.

(We have here a heterodyne without the super; in other words, without the super-audible intermediate frequency which gives the hook-up its name. Instead, there is a "zero beat," which reproduces the audio frequencies at their original values, but must be very carefully and exactly controlled to give quality. It will be observed that the upper portion of the voltage divider here serves to give additional filtration of the plate voltage.—Editor.)



Another view of the layout of the Ulrich six-tube S.W. set. The condensers are mounted, wherever possible, to the sockets; to shorten leads and make for greater compactness.



Under view of the chassis; a special bracket holds the bypass condensers across the audio biasing resistances—one center-tapped 900-ohm unit. Upper right, wire-wound resistor chokes.

More Notes on the "Model L-32" Ultradyne

By H. J. COX

SOME interesting information has been obtained on the experiences of constructors of the new "Model L-32" Ultradyne superheterodyne, described in the May, 1931, issue of RADIO-CRAFT, and these findings are here passed along for their practical value.

Perhaps the first question asked by the layman, when introduced to an A.C. set, is, "Will it hum?" As stated in the previous article, the hum level of the "Model L-32" is extremely low; a particular instance where hum may be noticed is, nevertheless, of special interest.

The second-detector V5 has a grid-biasing resistor R12 of 15,000 ohms, by-passed by a fixed condenser C8 of 1.0 mf. Increasing this capacity to 4 mf. has served to eliminate a small amount of hum, otherwise present in some models that have been brought to the attention of the laboratory.

Circuit Oscillation

The gain in the "Model L-32" is so high that circuit oscillation may result; it must be pointed out that this is not the fault of the receiver design, and its correction rests almost solely with the set constructor. For instance, every precaution must be taken to see that the shielding fits tightly; a loose shield being practically certain to permit enough energy to stray to undesired points of feed-back coupling. Another point

to be watched is the use of fixed condensers having the necessary qualities of rated capacity and normal dielectric efficiency. Even though the specially tested condensers in the receiver kit are used, it is a wise plan to test each one, to make sure that there has been no change in them due to shipment or subsequent handling.

If the circuit oscillation can be isolated to the intermediate-frequency stages, a remedy may be effected by changing the position of the power transformer's tap switch. (Incidentally, this power transformer has an electro-static shield to prevent a "light-line antenna" effect, which does not show in the diagram. Its main advantage, as stated in past issues of RADIO-CRAFT, is to prevent local station signals "riding in" via the light-line coupling through the power transformer.)

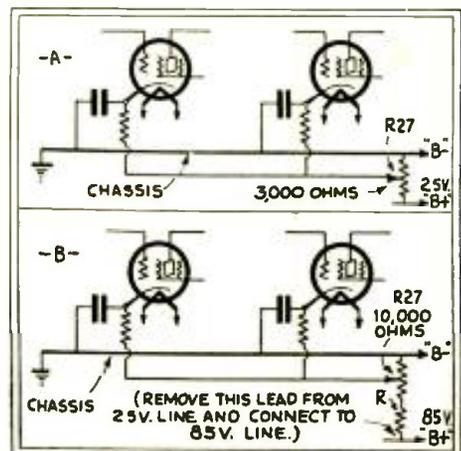
Hissing Sounds

Experimenters who have worked on some of the very early superheterodynes will recall the very strong "hiss" that was evident at times; particularly, after tuning in a distant station signal. This undesirable sound is, in most cases, a stranger to the "Model L-32," though occasionally it may be heard. If the tubes have been absolved from all blame for the action, the next step is to check up the antenna installation. An

aerial which is too short will necessitate pushing up the amplification to a point where normal electronic action within the tubes becomes itself audible; an action referred to as the "shot effect." Lengthening the aerial will correct this condition.

A convenient test to determine whether the set is operating down to the point where the "shot effect" comes into play, is to

(Continued on page 761)



Above, the original layout of the "L-32," for volume control with '24 tubes. Below, change for '35 or '51 variable mu tubes.

FOR many months the advent of the pentode tube has been heralded by the radio press, but with no commercial realization of its advent. Even before the power pentode could appear upon the market, another tube, with remarkable characteristics for use in R. F. circuits, made its bow and was snapped up as a gift of the gods by the manufacturing brotherhood. Within a week of this writing, however, one of the most conservative of the manufacturers has placed on the market a small receiver of the superheterodyne type employing a power pentode in the output stage; and, by the time this reaches your hands, others will undoubtedly have followed suit.

Aware of the importance of these new tube types, the writer has designed a receiver circuit embodying them both, which should make an ideal job for the custom set builder's fall trade.

Our receiver will employ three of the new *variable mu* tubes as R. F. amplifiers, and a '27 power-grid detector, followed by a pentode output tube, transformer coupled to the detector. In order to limit the plate current of the detector tube during inoperative periods, the by-passed resistance system described by the writer in the May issue of *RADIO-CRAFT* will be employed. Because of the unique characteristics of the *variable mu* tube, no band-selector systems will be required; the tuning being accomplished by means of four tuned circuits of normal arrangement.

The "tone-control" in the plate circuit of the output tube may be used as such if desired. Its real purpose is the limitation of the voltage across the output of the Pentode during high frequency passages.

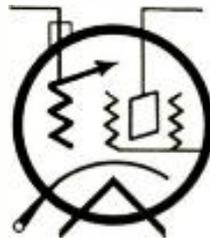
The Variable Mu Tube

A full realization of the wonders accomplished in the development of the 551 tube is difficult without experience of its actual operation. Here is a tube which presents one portion of its characteristic curve to a signal of high strength while, at the same time, accepting a weaker signal on a portion of its curve favorable to amplification; a tube in which the irremediable "electron noise" is so low as to permit the production of receivers of at least twice the sensitivity heretofore deemed the maximum; a tube which does not suffer from "modulation hum" due to indifferent filtration of the R. F. supply voltages.

Receiver for the

The sensation of this season is the development true volume control without distortion, and of specifications of a

By C. H. W.



This symbol for the variable-mu tube, the amplification factor of which is varied enormously by its grid, is offered by RADIO-CRAFT to the radio profession, to fill a need which is now apparent.

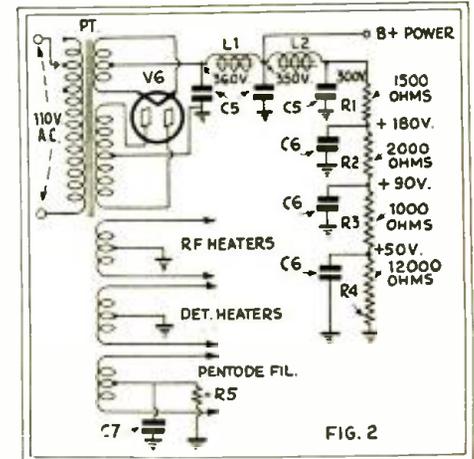
Volume control is obtained by variation of the biasing potential over a range of from three to fifty volts. This has always been the ideal method of regulating the volume; but, at high bias levels, the '27 and '24 were operated on unfavorable portions of their characteristic curves, and rectification resulting in "cross-talk" was experienced.

The ability of this tube to accept high signal levels without distortion makes the complex, double volume-control a thing of the past and renders the use of band-selectors in tuned R. F. circuits unnecessary. In superheterodyne receivers we are not interested alone in the "numerical" selectivity of a receiver (as determined from the number of tuned circuits and their figures of merit) but must take into consideration the "image-frequency" selectivity as apparent prior to the first detector tube. This might require the use of coupled circuit systems, even with the advantages of the new tube.

The Pentode Output Tube

The advantages of the pentode tube over the three-electrode tube are also manifold. In the beginning, the pentode was condemned not because of its lack of promise but because, while second-harmonic distortion had been brought down to the level required, the distortion due to odd harmonics in the output was above that considered allowable in broadcast reception. The characteristics of the pentode are not even remotely similar to those of the triode, and it has taken some months of research to fit the tube for popular consumption.

The main advantage of the pentode is in its high power sensitivity; that is to say, the grid voltage necessary for maximum undistorted output is much lower than that for the triode having similar characteristics, and with equal power consumption. A comparison of the Arcturus "PZ" pentode with

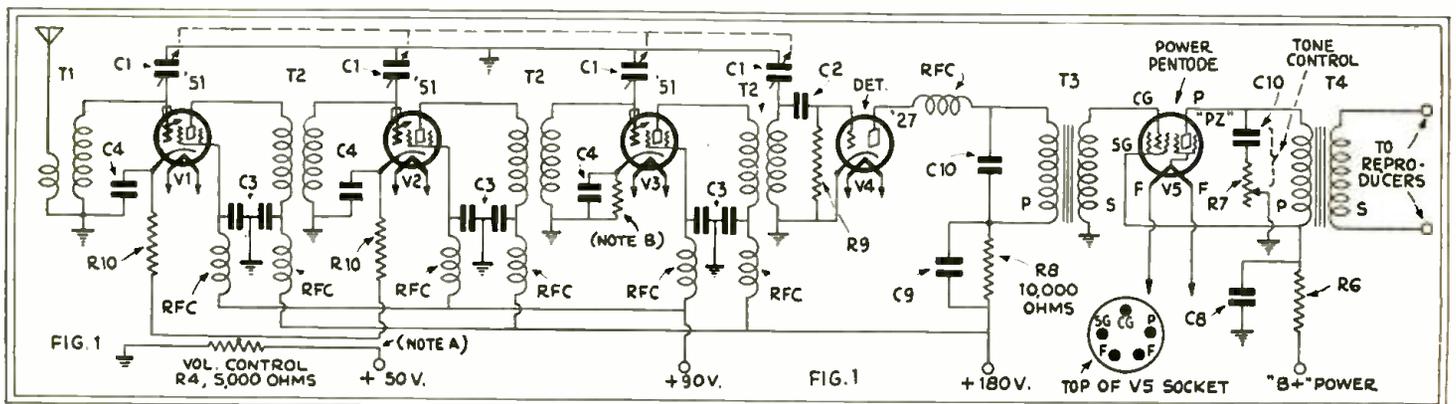


The power unit of the receiver shown below. R4-C6 are shunted across the volume control.

the '45 tube gives some idea of the advantages:

	Power Pentode	'45 Triode
Plate Consumption	10 watts	8.5 watts
Plate Voltage	250	250
Grid Bias	16.5 volts	50 volts
Maximum Undistorted Power Output	2500 milliwatts	1600 milliwatts
Power Sensitivity	.3	.8

The factor of power sensitivity is taken,



With four tuned circuits, this receiver gives selectivity; while the three variable-mu tubes, controlled by R4, may be operated below the cross-talk level in the face of strong interference. The arrangement of the pentode socket is shown in the small detail at the right.

Two New Tubes

of a "Variable-Mu" R.F. Amplifier which gives the Pentode high-output tube. Here are the set built around both

NASON

as recommended by Ballantine and Cobb, as equal to the square root of the maximum undistorted power output divided by the R. M. S. grid swing required. The pentode is shown as better than the triode by a factor of 3.75; which is to say that the pentode is equivalent to a triode having the same characteristics as the '45, preceded by a stage of undistorted amplification having a gain of 3.75.)

The pentode effects certain simplifications in design, which will be apparent from a study of the schematic circuit. Its optimum load is between seven and eight thousand ohms.

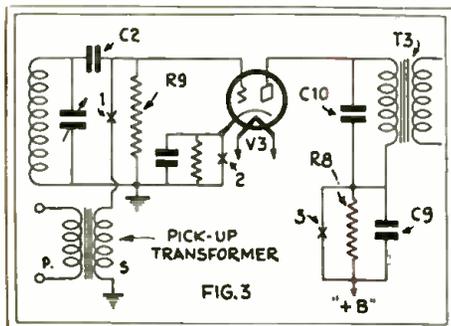
The receiver circuit is so simple as to make detailed description unnecessary. Volume control for the receiver is taken by varying the cathode potential of the two R. F. stages across a 3,500-ohm resistor in the bleeder circuit. The shielding necessary for the variable-mu tubes is the same as in the usual screen-grid receiver.

Phonograph Combination

If a phonograph pick-up is desired, it may be connected in by means of a multiple-switch, which must perform the following tasks in changing over:

- (a) Short out the current-limiting resistance in the plate circuit of the detector tube;
- (b) Switch a suitably-bypassed 2,700-ohm resistor into series with the cathode, for biasing the grid;
- (c) Connect the phonograph pickup, or its transformer secondary, between grid and ground of the detector's input circuit.

Referring to Fig. 3, which shows the phono-radio changeover arrangement, it should be noted that in the "phono" position



When a phonograph pickup is thus connected to the input of V3, the equivalent of three full stage of audio amplification is obtained.

The Pentode tube, with an interior connection putting its third or "Cathode" grid at cathode potential, gives enormously greater output from the same signal than other tubes and saves a stage.



contacts 1 and 3 should close, and 2 should be open. In the radio position 1 and 3 should be open, and 2 should close to short out the biasing resistor R8 and condenser C9.

List of Parts Used

All parts used in the writer's receiver were as specified in the following list:

- T1—Hammarlund "AC17" antenna coil;
- T2—Hammarlund "SGT 17" R. F. coil;
- T3—Amertran "DeLuxe" second-stage transformer;
- T4—Amertran "115" output transformer, to match dynamic voice coil;
- C1—Hammarlund "MQS" four-gang condenser, with "SDW 1" dial;
- C2—Aerovox .0001-mfd. mica condenser;
- C3—Aerovox 0.1 mf. double unit "No. 461-21";
- C4—Aerovox 0.1 mf. single unit, "No. 260";
- C5—Aerovox "B-400" block, 2—4—4 mfd.;
- C6—Aerovox "B-2" block, three 1-mf. units;
- C7—Aerovox "No. 202," 2-mfd.;

- C8—Aerovox "No. 302," 2-mf.;
- C9—Aerovox "No. 202" 2-mfd.;
- C10—Aerovox .001-mfd. mica condenser;
- RFC—Hammarlund "RFC 85" choke;
- R1, R2, R3—Electrad "Truvolt D45," tapped to give 1500, 2000 and 1000 ohms;
- R4—Electrad 5000-ohm "Royalty" potentiometer, shunted by a 12,000-ohm Electrad "Type B120" resistor;
- R5—Electrad "Type B7.5" resistor, adjusted to 540 ohms;
- R6—Electrad "Type D22.5" resistor;
- R7—Electrad "Royalty Type D" 5000-ohm potentiometer;
- R8—Electrad "Type B10" resistor;
- R9—Electrad 0.25 megohm leak;
- R10—Electrad "2G350" flexible Resistor;
- V6—Arcturus "Type 180" rectifier;
- V1, V2, V3—Arcturus "Type 551" variable-mu tubes;
- V4—Arcturus "Type 127" quick-heater detector tube;
- V5—Arcturus "Type PZ" power output pentode.

The operating characteristics of the two new types of tubes utilized in this receiver are given by the manufacturer as follows:

	Power Pentode (Arcturus "PZ")	Variable Mu Tube (Arcturus "551")
Heater Voltage	2.5	2.5
Heater Current, amps.	1.5	1.75
Plate volts	250	180
Screen volts	250	90
Plate current, ma.	32.5	5.5
Screen current, ma.	7.0	less than 2.0
Plate Impedance, ohms	38,000	300,000
Mutual Conductance		
mmhos.	2500	1000
Grid Bias, volts	16.5	3
Grid-plate Capacity		
mmfd.	—	.006
Optimum Load, ohms	7-8,000	

The tubes of other manufacturers, so far brought to the writer's attention, will not vary so far in their characteristics from those listed above as to prevent their efficient operation in the same circuits.

Letters from Radio Craftsmen

FIVE-PRONG UX BASES

Editor, RADIO-CRAFT:

Having tried the "Unique" superhet method of mixing, described on page 480 of the February issue, I find that it gives a stronger output than any I had previously tried. However, it seems that my best results were obtained with the first detector's grid about 0.75-volt negative; whereas Mr. Tanner said between 0.2- and 0.5-volt positive. How come? (The article specified a bias variable from 1 volt negative to 5 volts positive, to allow for variations in tubes, etc.)

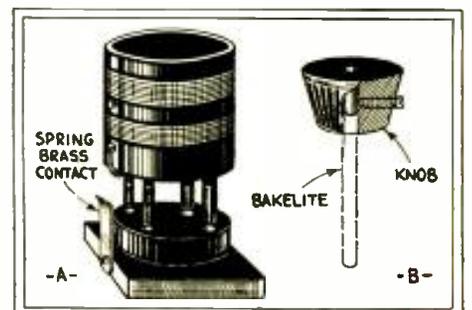
For this, or any other place where five-prong coils are required, UX tube bases may be used; sometimes 5-prong tubes are at a premium. Make the fifth connection to the bayonet pin, and fix a narrow piece of spring brass to the socket, under the hole holding the latter in place; so that this spring makes contact with the pin when the base is seated in its socket. This brass strip, of course, should be the ground connection.

An even better method is to drill a 1/16-inch hole near the bottom of the tube base, diagonally under the pin (between "G" and

"P") so that it will pass through both side and bottom. Pass a couple of turns of bare hook-up wire through this hole (at as A), cut close, and solder the ground terminals to this wire. The spring from the socket now need be only about half an inch long.

An insulated extension for a tuning condenser which is located in a plate circuit, a la Hartley, may be easily made by extending the 1/4-inch hole in a rheostat knob

(Continued on page 757)



Mr. Jackson finds the ideas illustrated here useful in his experimental construction work.

The Whole Ohm Family —R, X and Z

A Simple Explanation of Reactance and Impedance

By HAL WYMAN

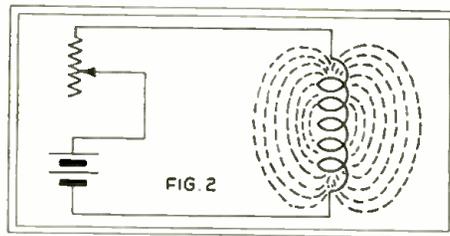
THERE are several different kinds of ohms—as many readers already know, and others have suspected from some of the theoretical formulas which they have encountered in their studies as Service Men, set builders and experimenters. That is to say, the ohm is not merely the unit of resistance (R), which, under a constant potential of one volt, allows one ampere to flow; but it is also the unit of reactance (X) and of impedance (Z). In order to explain the latter terms, let us first consider the fundamental nature of an alternating current; and, in connection with the latter, the common expression, a "sine-wave."

The Sine Wave

The *sine* is the distance between two sides of an angle; measured in terms of the length of one side, on a perpendicular dropped to the other side. See Fig. 1A, in which the line OA is the radius of a circle. Its length is r; the length of the line AB dropped from A perpendicularly on OB is y, then the *sine* of the angle between OA and OB is y/r. It is customary, in calculations, to take the length of the radius OA as 1; in which case, the sine will always be represented by a fraction the greatest possible value of which is 1.00.

For every possible angle, there is therefore a corresponding *ratio* called its "sine." The angle may be carried beyond 90°, around to 360°, and it may be increased still further as the radius continues to revolve around 0; but the numerical values of the sine will repeat at every quarter turn though alternately positive and negative. Similarly, in radio graphs, where alternating voltage and current are represented by curves, different polarities of voltage and directions of current flow are indicated by the spaces above and below a zero line drawn horizontally through the figure.

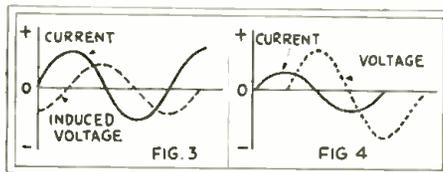
In Fig. 1B, we have a circle in which a radius is revolving around the center O, like the hour hand of a clock but in the opposite direction here; the height y of its end A above the zero line X-X, indicates the value of an alternating current. If the



Every conductor (even a straight wire) carrying an electric current creates a magnetic field, as indicated at the right.

maximum value of that current is taken as 1, when the radius is pointing straight up, its value at any other moment will be indicated by the *sine of the angle* through which the radius has moved.

But, in drawing a graph like this, we make it difficult to measure the movement of



Inductance makes current "lag" behind voltage as at the left; capacity makes current lead the voltage, as at the right.

OA after it has completed the first revolution; and so, to represent an alternating current, it is customary to suppose that the center of our circle is moving steadily along the line X-X (as in Fig. 1C). Then we can determine the time during which

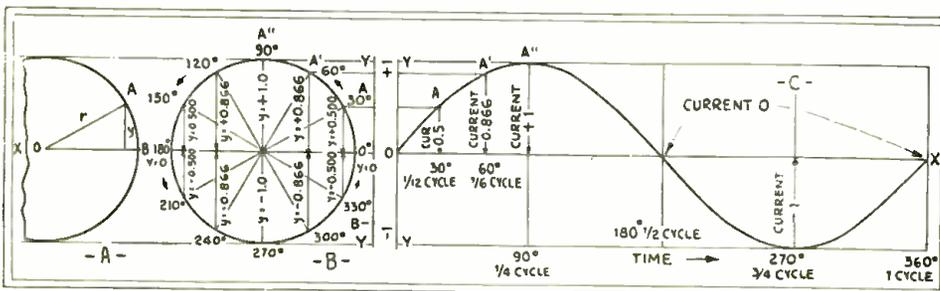
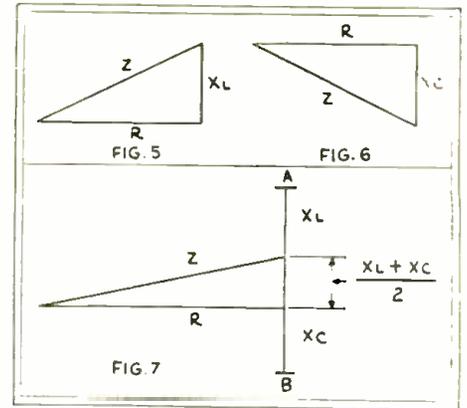


Fig. 1

Left, a single "sine." Middle, a flock of sines, each corresponding to its respective angle. Right, the conventional "sine wave" showing how it corresponds to the circle, and how the current (or voltage) fluctuates during the different portions of an A.C. cycle.



Graphic methods of computing impedance; left upper, from resistance and inductance; right upper, resistance and capacity. Below, the resultant of all three factors.

the alternations have been taking place, by measuring straight along X-X, which represents time. At the same time, measuring parallel to the line Y-Y, we determine current values which, in a true sine-wave, will be in exact proportion to the *sine* of the time-angle, or clock-hand, of Fig. 1B. This is called "plotting amplitude against time."

When the clock hand of Fig. 1B passes 90° (which represents the first quarter of an alternating-current wave) it begins to come closer to the line X-X; and when it is right on the line again, zero current is represented. As the moving hand gets farther from this line, the current again increases; but it is reversed, as compared with its former polarity. When it gets to 270°, the current is at its negative maximum; and when it is again 0°, having completed 360° of turn, current is again zero, and the first cycle is over.

The same conditions are represented, but by a line which is pulled out into a "sine wave," instead of by a circle, in Fig. 1C. If we are speaking of 60-cycle current, the time represented by this curve is 1/60 of a second; if we are speaking of 600-kilo-cycle current, the time represented is 1/600,000 of a second. But, in either case, if we are dealing with pure sine-wave A.C. voltage, the curve will be of the same shape.

The Effect of Inductance

For the moment we will leave our pretty pictures and attempt an explanation of the term *inductive reactance*—pausing, of course, for a brief definition of the word *inductance*. Suppose that we have constructed a coil of wire wound around either an air core or on a pile of iron laminations, and connected as in Fig. 2. Magnetic lines of force are set up—our coil has become an electro-magnet. Now this inductive action will not be purely external, but there will be also interaction between the turns of wire within the coil itself. The strength of the magnetic field is proportional to the number of turns and to the current flowing. If the current is varied, the strength of the magnetic field will also vary in direct proportion.

It is only when the current is changing that this secondary effect, due to the common linkage of the turns, takes place. While the current is changing, *Lenz's law* informs

(Continued on page 760)

Measuring Inductance and Capacity

How the Experimenter May Utilize a Reactance Bridge

By JAMES A. DOWIE*

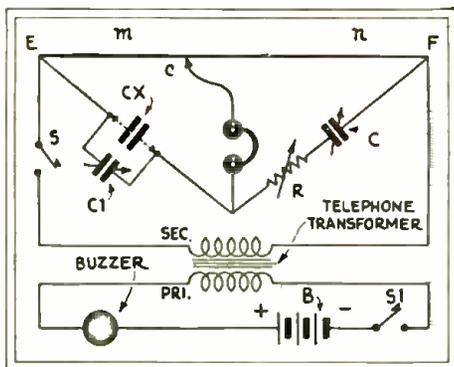


Fig. 4

The circuit connections of a Wheatstone bridge using a high-frequency buzzer, for accurate measurements of capacity.

IN the February issue of RADIO-CRAFT appeared a description of the construction of a Wheatstone bridge which could be used to measure unknown resistances, such as are used in radio work. ("A Home-Made Slide-Wire Bridge," by A. W. Bonser, page 482). The object of this article is to show how the Wheatstone bridge may be used also to good advantage by radio-tricians and Service Men for making various measurements of inductance and capacity—two important factors necessary for satisfactory reception of radio signals. Inductances, as used in radio work, function under alternating current; therefore, measurements should be carried out with alternating current.

Fig. 1 shows the circuit arrangement used in this bridge. In series with the battery "B," a buzzer is placed; and the combination is utilized to give an alternating current through the various arms of the bridge. (A high-frequency buzzer or a vacuum-tube A.F. oscillator, such as have been described in RADIO-CRAFT, may also be used for this purpose.) With this arrangement a pair of phones serves as the indicating device; they are connected as shown in the diagram. If audio-frequency current flows through the phones, a sound will be heard; while, if no alternating current flows, no sound is heard. The Wheatstone bridge is then balanced by sliding the contact *c* over the arms *m*, *n* of the bridge until a minimum of sound is heard; this is the condition of balance.

(Note: "Minimum" sound is specified; because it may be impossible to obtain a zero sound-balance with this apparatus, on account of induction and stray capacity effects. Knowing this, we will now consider the case of measuring the inductance of a coil by means of such an arrangement.)

Measurement of Inductance

In the circuit arrangement of this bridge used for inductance measurements, *m* and *n* are the slide-arms of the bridge; *c* is the sliding contact; *L* the known inductance, and *X* is an unknown coil whose inductance is to be measured.

This circuit is in theory the same as that used in the resistance measurement, described in the preceding article; when the slider *c* is moved along *m* and *n* until a balance is obtained, a minimum sound will be heard in the telephones. Then the following relation is true:

$$\frac{X}{L} = \frac{m}{n}, \text{ therefore } X = L \times \frac{m}{n}$$

Thus, if a single standard inductance *L*, and a slide-wire bridge with phones, battery and buzzer are available, the values of unknown inductances may be easily measured.

This relationship is only true in practice

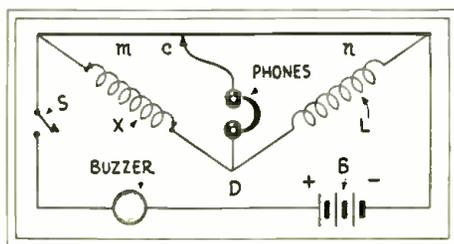


Fig. 1

The simple bridge, with buzzer and phones, for measurement of inductance.

when the unknown inductance *X* is of the same order of magnitude as the standard inductance *L*. By this it is meant that inaccuracies will arise in these measurements if the standard inductance is about 0.1 millihenry, for instance, while the unknown

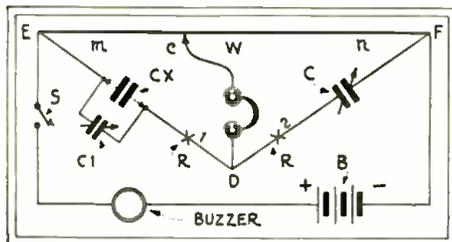


Fig. 3

Use of the bridge for capacity measurements, with the necessary compensation for zero setting.

inductance is 10 millihenries; because the ratio of *m* to *n* would then be too great to obtain an accurate balance. If the ratio of *m* and *n* is about 1 or 2, then a sharp balance will be had.

The following notes should be of interest to radio-tricians interested in accurate measurements with a bridge:

The formula given above for inductance is sufficiently accurate for all practical purposes; however, it does not take into consideration the resistance of the inductance coils. If there is a great discrepancy between the resistances of the two coils *L* and *X*, it is quite possible that a sharp balance will not be obtained. Balancing a Wheatstone bridge circuit is something like tuning a resonant radio circuit; since resistance in a resonant radio circuit makes for extremely broad tuning.

Balancing a Wheatstone bridge is equiva-

lent to reducing the resistance, and thus enables sharp balance or tuning. If the resistances of the coils are not balanced, a sharp balance will not be secured and, therefore, the accuracy of the measurement will be destroyed; since the accuracy of the measurement in a Wheatstone bridge depends upon the sharpness of the balance.

Correction for Resistance

Since all inductance coils have some resistance, a better arrangement of the bridge is shown in Fig. 2, where each coil has its compensating resistance (*R3*, *R4*) in series.

For precision measurements, it is necessary to strike a balance for both the inductances and the resistances of the coils. The inductance balance is secured by means of the buzzer and headphones; while the resistance balance is secured by a voltmeter and the battery *B2* for the source of supply. In this bridge, Fig. 2, we use two double-pole double-throw switches (*S1* and *S2*); one is used for switching on either the voltmeter *V* or the phones *PH* for the balance indicator. (The potentials of *B1* and *B2* must be found by experiment).

The buzzer and phones are used for the A. C. inductance balance, with switches *S1*, *S2* thrown left; the battery and voltmeter, for securing a D.C. resistance balance, the switches thrown right. The variable resistors, *R3*, *R4*, placed in series with each of the inductances enable us to balance the inductance arms for resistance.

The following gives the method used for operating this type of bridge circuit. First, a balance is obtained for the A.C. signal; the double-pole, double-throw switches are both thrown to the left, to use the buzzer and phones. The sliding contact *c* on the wire *m-n* is varied until a balance is obtained. The switches are then thrown to the right to place the battery and voltmeter in the circuit. With the sliding contact *c* fixed at the position previously obtained,

(Continued on page 762)

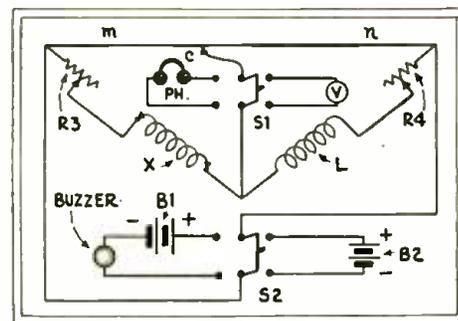


Fig. 2

The bridge arrangement for balancing inductance and resistance to obtain a true reading of the former.

* Chief Instructor, National Radio Institute.

Radio-Craft's Information Bureau

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.

PHONOGRAPH MOTOR HUM

(119) Mr. M. H. Whitten, Knoxville, Tenn.
(Q.) I replaced the spring motor in my phonograph with a 110-volt A.C. synchronous electric motor. It was my intention to operate this motor and an electric phonograph pick-up in conjunction with my radio set, which is provided with connections for a pickup. However, the motor causes a loud hum in the reproducer when the motor is put into operation; although there is no interference when the motor is not turning.

If the pick-up head is moved about six inches from the motor, the hum stops; it can also be stopped by turning the pick-up to an odd angle. The leads from the pick-up are not inductively coupled to the motor, since shielding them does not reduce the hum. How can this trouble be remedied?

(A.) If grounding the frame of the motor does not eliminate the interference which is experienced from the phonograph motor, it will be necessary to shield the entire motor in the manner shown in Fig. Q119. The shield is to be made from soft iron sheeting, of any convenient thickness.

Before making this shield, it may be advisable to try grounding the frame of the phonograph pick-up, and shielding the A.C. leads to the motor and to the switch controlling the motor.

MODEL 9 READRITE TEST KIT

(120) Mr. Manual Smith, Bennington, Okla.
(Q.) Please show in a forthcoming issue of RADIO-CRAFT the circuit arrangement of the Readrite "Model 9" test kit. This is a portable test set in which four out of nine meters may be plugged into sockets, to give instantaneous reading in four different parts of a tube circuit; with a fifth receptacle, connected to test prods or probes, for making external tests. I am having difficulty replacing one of the wires.

(A.) The circuit of this tester appears in Fig. Q120. For reference, the ranges of the nine meters are given in the table in the upper left corner of the illustration; the meter receptacles are shown in dotted outlines. The two sockets (in solid outline) are for the various 4- and 5-prong tubes which may come under suspicion; their elements are connected into the receiver circuit by means of a 5-wire cable having a 5-prong plug and a 4-prong adapter.

A screen-grid tube under test must have its cap connected to something, of course; and the "something," when using the "Model 9" tester is the cap connection in the radio receiver. A long

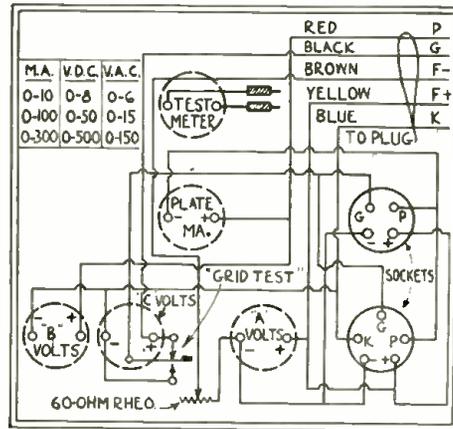


Fig. Q.120

Circuit of the Readrite "Model 9" analyzer; nine meters are used in the four sockets, as required for the particular test.

lead for this purpose is provided. One end of it has a cap which fits the control-grid connection on the top of the screen-grid tube, and the other end has a plug over which fits the control-grid cap in the radio set.

MAYOLIAN MODELS 609, 611, 612, 614 AND 615 "B" ELIMINATORS

(121) Mr. Carl T. Knowlton, West Springfield, Mass.

(Q.) I have a Mayolian "B" eliminator, "Model 612." As one of the resistors in the system has burned out, I am asking for a diagram showing the values in this unit in order that I may properly service the eliminator.

(A.) A diagram of the connections of this model of the Mayolian "B" eliminator are shown at A in Fig. Q121. As a matter of reference, the circuits of other standard Mayolian models are shown in the same figure, as follows: (A), "Models 609, 611, 612;" (B), "Model 614;" (C) "Model 615." The Clarostat resistors R have a range from about zero to one megohm.

DEFECTIVE AUDIO TRANSFORMER

(122) Mr. C. J. Hanrahan, Mechanicsville, N. Y.

(Q.) What would cause the audio-frequency transformer in the second stage of a standard two-stage amplifier to burn out when new "B" batteries were connected to the set?

I have had this happen twice; and, each time it happened, the transformer in the second stage was the one to burn out; while the one in the first stage remained "good." I am using UX-199 tubes with 45 volts on the detector and 90 volts on the amplifiers, and a 4 1/2-volt "C" battery.

(A.) It is regretted that Mr. Hanrahan has failed to observe the stipulations in "Special Notice to Correspondents" which leads this department.

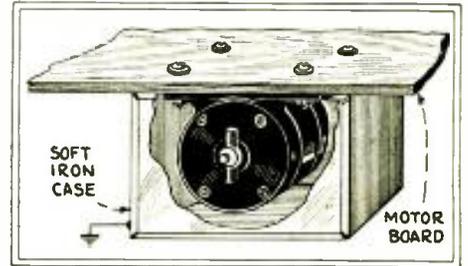


Fig. Q.119

Shielding a phonograph motor to prevent hum.

How did the transformer test after the "accident"? Did the primary or the secondary open-circuit? Did the set "play" at all, before the mishap?

If the secondary of the second A.F. transformer burned out, it is probable that the grid and plate of the power tube were shorted together; thus connecting the "B" battery (with the reproducer in series) across the secondary winding. Most A.F. transformers will stand this abuse, although in some instances the overload proves too great. A short between secondary and primary may cause the same effect—an open secondary. This short may be internal, or it may be at the binding posts. It is seldom that the socket wiring is mixed up enough to cause a winding to "blow."

If the primary burned out, it might be attributed to a short inside the first A.F. tube; or a short between primary and secondary windings, as explained above.

Transformers, if soldered with a corrosive flux, may test perfect as to continuity, and yet open up under even the small plate current of a tube operating normally.

This brings to mind also that a reversed "C" battery may cause a weakened winding to open circuit, because of the excessive current which will flow in the plate circuit of a tube when its grid bias has a positive polarity.

THE RCA '35 VARIABLE-MU TUBE

(123) Mr. Charles E. Pomeroy, Croton-on-the-Hudson, N. Y.

(Q.) In what manner does the construction of (Continued on page 765)

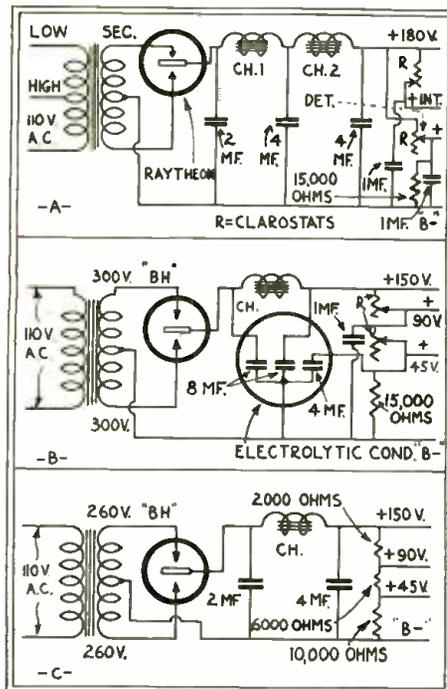


Fig. Q.121

Superseded circuits of Mayolian "B" eliminators; A and B apply high potentials before the set tubes draw current.

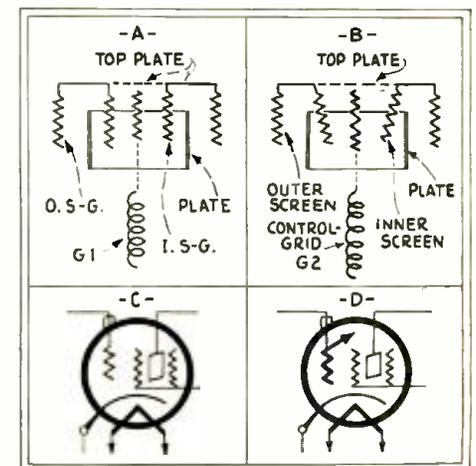
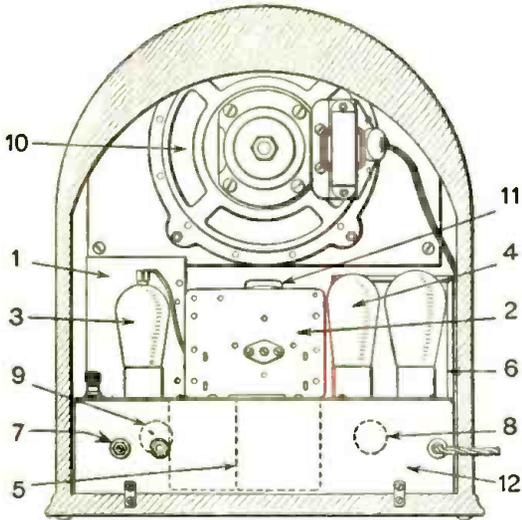


Fig. Q.123

Arrangement, and symbol, of the '35 screen-grid tube at A and C; of the '35 variable-mu, at B and D.

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- 11 A positive drive, easy visioned dial with pilot light detachable.
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- 13 Complete aerial equipment included.
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RADIO-CRAFT KINKS

Discovered by our ingenious readers

A PHONOGRAPH-CASE OSCILLATOR

By R. Douglas Clerk

SINCE my article, "The Flying Service Man" aroused such comment, perhaps the constructional details of one of my earlier test sets will be of some interest to the readers of RADIO-CRAFT. It is shown by diagram in Fig. 1.

Totally shielded, and fitting into a portable phonograph case, is an audio-modulated R.F. oscillator covering the broadcast band. The R.F. coil used in this job was taken from an Atwater Kent "Model 35" receiver; coupled to this coil L1 is a 10-turn winding L2 in variable inductive relation. This pick-up coil is connected to the antenna and ground binding posts of the receiver under test.

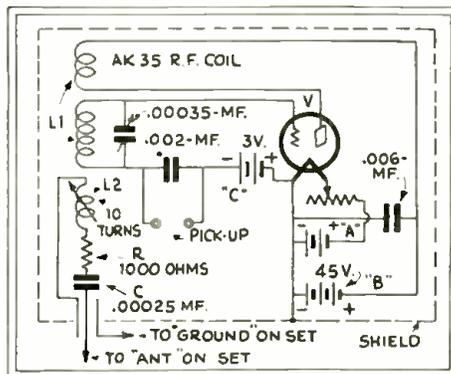


Fig. 1

Mr. Clerk's "portable broadcaster" is a very compact oscillator, built into a portable phonograph, which gives modulation.

The electrical characteristics of an average antenna are simulated in the electrical values of a "dummy antenna" arrangement of the complete input connections to the radio set being tested; its components being L2, R, and C.

The entire set-up is shielded, as indicated in the diagram, and the phonograph turntable motor and the phonograph pick-up are grounded to this shield. In this particular unit, tube V was a Northern Electric "peanut" tube (which has a 1.1-volt filament), and the pick-up was a Canadian Marconi unit of the high-impedance type; although, of course, any make of apparatus having equivalent characteristics may be used without the least bit of trouble.

The writer referred to a similar unit, in his story in the November, 1930, issue of RADIO-CRAFT; and described its use in his letter on page 523 of the March, 1931 issue.

A SIMPLE WAVETRAP

By C. H. W. Nason

SERVICE Men at times face the necessity of providing a wavetrap of simple but effective characteristics. Although in years past many such devices were on the market, they have now ceased to be a standard commodity; and the radio fan or the Service

Man must shift for himself in the construction of a suitable circuit arrangement.

"Just anything" will not serve this purpose. It is often desirable to eliminate the signal from a station which is but a few kilocycles removed from a desired carrier. If this is to be done it is essential that the losses in the wavetrap be small, so that a sharp effect may be obtained. Figure 2 shows the schematic circuit of a simple wavetrap employing a Hammarlund "MC-M" Midget condenser in conjunction with a "Type HQC-29" antenna coupling coil. The degree of effectiveness of the device is determined by the tapped connection to which the antenna is connected; it is necessary to find the best arrangement in each case.

If the entire winding is connected in the circuit, the maximum effect is obtained; but with the possibility of removing the desired signal also, if the interference is from a station on an adjacent channel. With the antenna connected so that but a small portion of the wavetrap winding is in series with the antenna lead, the sharpness of the effect is greatly increased; although its magnitude is somewhat reduced. This will allow us to separate stations having dial readings quite close together.

In some localities it may be desirable (to prevent picking up the signals of powerful locals) to shield this wavetrap; and perhaps ground the shield, as indicated in dotted lines.

When the selector switch is set on tap 1, the wavetrap is entirely out of the circuit—except for a slight "dead-end" effect (which cannot be detected unless the wavetrap is in close inductive relation to unshielded coils in the radio set). When the switch is on tap 2, only one turn is in use and the wavetrap action is very slight; a good condition when trying for "distance," with just a little cross-talk observable between two weak, distant stations.

The maximum effect in the use of the wavetrap is observed when the switch is placed on tap 6; in which position primary L1 is not in use and has a practically negligible action on the circuit.

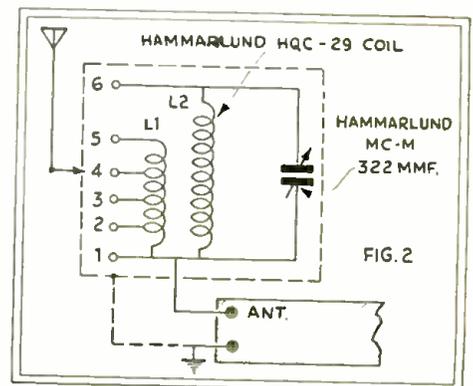


Fig. 2

The combination of low-loss tapped inductance and variable condenser makes this wavetrap adjustable for varying conditions.

Although the coil in Fig. 2 may be used with the old 350-mmf. Hammarlund variable condenser, it may be used to even greater advantage with the more efficient "Type MC-M" 322-mmf. unit recommended. This tuning capacity slants a coil 1.2 having 60 turns of No. 22 D.C.C. wire, spaced 36 turns to the inch, on a form 3 in. in diameter; while in inductive relation to it (inside and at the filament end) is the primary winding I.J., consisting of 15 turns of No. 24 D.C.C. wire, spaced 39 turns to the inch, on a form 2 1/4 inches in diameter. The leads are brought from the 1st, 4th, 8th, and 15th turns. (Of course, these coil and condenser proportions may be varied to suit individual preference as to parts or connections).

MAKING AUTOMATIC RELAYS
By A. J. Anderson

ONE of the inconveniences that arise, when a battery radio is electrified by

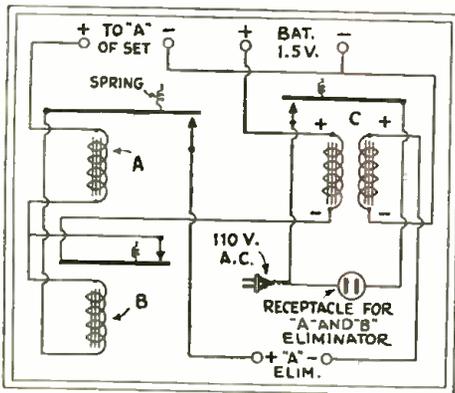


Fig. 3

Mr. Anderson's home-made relays are made from old automobile parts. The power required is taken from one dry cell.

the use of "A" and "B" eliminators, is found in the numerous switches that have to be manipulated whenever the set is turned on or off. As a result, the eliminators must be placed near at hand, which means that, usually, they are in the way.

If the radio receiver switch itself controlled the whole combination, the entertainment value of the radio would be greatly increased. This can be done with little trouble by a simple system of "relays" and a dry cell. Three relays are needed (A, B, C, Fig. 3), one (the latter) with a double winding. If none are on hand, a visit to the battery service stations will usually net a sufficient number of burned out "automobile cut-outs." If these are used, four are needed; since there is not enough room for two windings on the one core. The armatures and contact points of the two are then connected in parallel.

The cores must be removed for unwinding and rewinding, though sometimes they are riveted on. Care must be taken when removing them so that they can easily be soldered on again.

The cores are wound with about No. 20 gauge copper wire and as many turns as possible. As the resistance is comparatively high, it will be necessary to move the variable voltage control on the "A" eliminator, if there is one, to a higher point.

Contact points should be thoroughly cleaned of oil and carbon. The contact point

for relay "B" will have to be devised, by some means or other, and so arranged so that the armature touches it when at rest. Sometimes the strip which limits the upward path of the armature can be used for this purpose.

The tension of the spring on the armature of an automobile relay is quite high. It must be reduced to where it is just strong enough to hold the armature above the contact point (except, of course, on relay "B"). As the contact point is above the armature, the spring tension should be a little stronger so that the points make good contact even when subjected to vibration.

In some types of relays, the tension is difficult to adjust; one in particular gave a little trouble. The spring strip used as the hinge was fastened on with two rivets on each side; the lower contact point prevented bending it. An attempt was made to partly cut the strip, but it accidentally split around one of the rivets on the base part. By pivoting the armature around perpendicularly on the one remaining rivet, it could be bent to the proper position.

If one relay is doubly wound, the current must flow in the same direction in the two coils. A small compass will show the polarity of the core when the coils are connected separately to a battery. In this way, the positive lead to each coil can be marked when the polarity is the same.

Besides the relays, six binding posts and a baseboard receptacle (for the "A" and "B" eliminator plugs) are required.

Although a battery is necessary to operate this device, the current flows for a very small fraction of a second and only when the set is turned on. A No. 6 dry cell will therefore last a long time. The resistance of the tubes when cold is much less than normal and it is because of this that only one and a half volts is needed.

MAKING TEST PRODS

By Clarence W. Trost

THE following description of how I made neat and efficient test prods may be of interest to fellow Service Men.

I purchased two screwdrivers, each having an overall length of 3 1/2 inches. Next, I removed the blades from the handles and, using a drill smaller than the tang of the screwdriver, continued the hole through to the top of the handle.

The next step was to thread one end of a flexible test-lead wire through each of the handles, and bend these ends over the opposite end of the wooden handle. The rod portions of the screwdrivers then were forced back into the handles; the rods pinned in position; and the metal ferrules

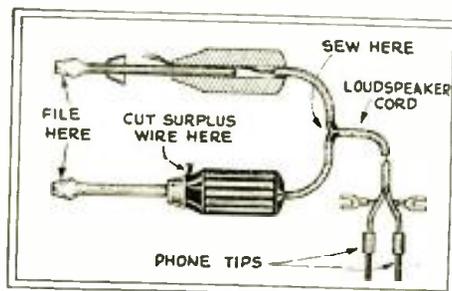


Fig. 4

Another form of test prod for use in service and experimental work.

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BE sure to read the message on page 754 of this issue. It is an important announcement and tells all about the Supplements to the OFFICIAL RADIO SERVICE MANUAL.

forced onto the handles and over the flared end of the flexible lead.

The opposite ends of the leads may terminate in phone tips, lugs, or both; the latter combination, a particularly convenient one, being illustrated in Fig. 4.

The blade ends of the screwdriver rods may be filed to a point, as shown.

INEXPENSIVE "B" ELIMINATOR

By G. Scott Morris

PERHAPS the readers of RADIO-CRAFT will be interested in a simple and inexpensive "B" eliminator, designed to deliver somewhat under 90 volts when connected to a regular 110-volt A.C. lighting circuit; *without using a power transformer.* The drawback of a unit of this type is that the design, as shown in Fig. 5A, is not capable of supplying a very great amount of current; and the voltage output is not sufficient to operate power tubes at their rated plate potentials. However, as a handy current-supply instrument for general testing, and to furnish plate current for about two or three tubes, it will serve very well.

Instead of resistors R2 and R3, regular filter chokes may be used. The detector's plate-supply resistor R1 may be of any standard make with a range up to about 100,000 ohms, or even higher. Try reversing the connections to the secondary of the toy transformer; as this may reduce any residual hum. Also, try reversing the position of the plug in the light-line outlet. The filter capacities may be of lower values, if choke coils are used in place of R2, R3. The rectifier V is an ordinary type '27 A.C. tube, with grid and plate connected together.

(This circuit arrangement may also be used in conjunction with a regular rectifier tube, such as the half-wave '81 or the full-wave '80. If the latter tube is available, it is necessary to tie the two plates together with a jumper to obtain the effect of half-wave rectification; and make the "B+" amplifier connection to the filament instead of the cathode.

Also, it is necessary to make certain the transformer delivers the proper filament voltage and current to light the particular tube used. For instance, if the type '27 tube is used, it will be necessary for the

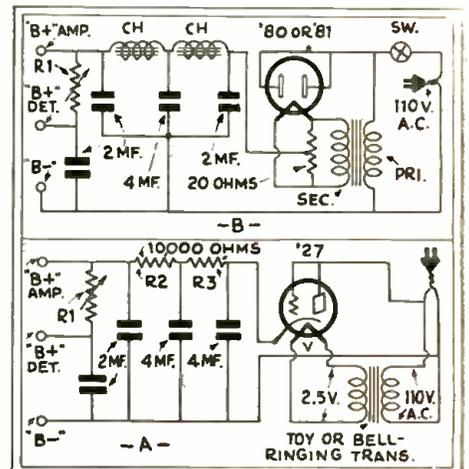


Fig. 5

Below, Mr. Morris' eliminator, using a '27 rectifier. Above, a suggested arrangement of higher power and efficiency.

filament winding to deliver 2 amperes at 5 volts.

The advantage of using either of these tubes, in preference to the '27, is the increased life of the rectifier tube when the eliminator is connected to a 2- or 3-tube receiver; and also, the available plate voltage increases somewhat. — *Technical Editor*.

MEASURING PLATE RESISTORS

By J. E. Kitchen

WITH the increased use of resistors in plate circuits, it may be sometimes desirable to determine their value without pulling the chassis and using an ohmmeter.

Plug a set tester into the receiver in the usual manner and place the tube in operation in the tester. Note the plate voltage reading, say 130 volts, and the plate current reading, say 0.2 ma. Now take a lead from the "B" tap concerned and plug it into the unused socket of the analyzer (which is connected in parallel with the socket being used). Note the new plate voltage reading, say 180 volts. The voltage drop across resistor is seen to be 50 volts. As a current of .0002-ampere is flowing, the resistance will therefore be $50 / .0002$, or 250,000 ohms.

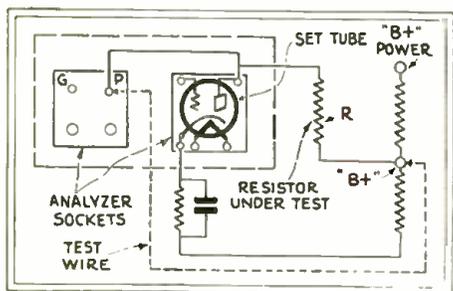


Fig. 6

This simple method of measuring voltage on both sides of a resistor, when the current is known, quickly gives its value. (A high-resistance meter is needed).

This method shows up high-resistance joints in the plate circuit and is quicker, and slightly more accurate, than going over the set with an ohmmeter. It also affords an easy way to try new values of resistors.

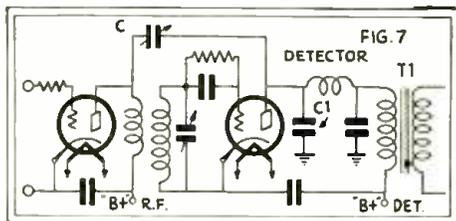
IMPROVING SENSITIVITY

By C. H. W. Nason

SOME of you may have noticed that, in the old Freshman "Q" sets, the antenna was connected to the detector circuit through a small variable condenser. In this receiver a '22 tube was used as an R.F. amplifier with raw A.C. on the filament. In order to reduce the modulation hum, the tube was given a relatively high grid bias which, in turn, reduced the sensitivity of the receiver. In order to regain this lost sensitivity many tricks were attempted; but none was so successful as this means of obtaining regeneration.

Radio receivers bordering on the antique may be given a boost toward longevity by the use of a similar system, as shown in Fig. 7. Connect a Hammarlund "MC-S" 100-mmf. midget condenser between the plate of the detector tube and the plate circuit of the last R.F. stage. In order that this system may be effective, it is essential that the signal voltages in the two plate circuits be *in phase*; if this is not

the case a loss rather than a gain in sensitivity will result. If the two voltages are out of phase, the feed-back voltage will neutralize the signal rather than increase it. All this is readily discovered by trial; and failure of the system to regenerate at the high-frequency end of the tuning range may be remedied by reversing the connections to the primary of the R.F. transformers, thus changing the phase relations.



This condenser is used, not to neutralize, but to give a bit of regeneration.

The new Hammarlund midget condensers are fitted with a set-screw for locking the adjustment. If an additional control is not desired, the condenser may be adjusted so that the receiver just breaks into oscillation at the high-frequency end of its range. The condenser setting may be locked in this position by means of the set-screw, and will hold its adjustment indefinitely.

Should no case against the additional control be established the condenser may be brought out to the front of the panel and used to increase the sensitivity and selectivity of the receiver over its entire range.

TOO GOOD A CONNECTION

PROPOS of an article on another page, in which Mr. Freed preaches a sermon on his favorite text, of a one-piece aerial and lead in, we have noted in an English radio magazine the sad story of a radio fan who had followed this idea. The continuous antenna wire was led into the house in the usual manner and attached firmly to the proper post of the receiver.

A few days ago a violent spring gale swept over the tight little isle, leaving behind it trees and chimneys in debris and, among other aerial masts, that of the installation just described. Its owner was startled to find his receiver missing from its accustomed spot; and tracing it, he found that the broken mast had dragged after it, not only aerial and lead-in, but the set as well, in its fall.

Moral: Nail the set to the floor, or at least weight it.

RADIO TREATMENT SUCCESSFUL

RADIO FEVER, the production of which was described in the February issue of RADIO-CRAFT, is proving quite successful in the treatment of paresis, according to reports to the American Medical Association. Dr. Clarence A. Neymann, of Northwestern University, in the *Journal* of that association, states that, out of twenty-five cases of this usually incurable disease treated in the manner described, sixteen were enabled to leave the hospital in a condition to care for themselves; and two others showed marked improvement. Treatments were given bi-weekly over an average period of three months; in some cases, the patient's temperature was raised to 106 degrees and maintained for hours at that figure.

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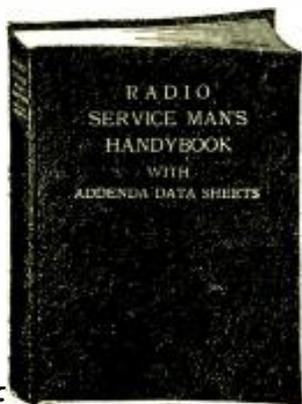
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Testing Methods

(Continued from page 723)

voltmeter will show a reading; although, because of the resistance of the winding, it will be somewhat less than the actual detector plate voltage.

Similarly, the secondary of this first transformer and the primary of the second transformer can be tested simultaneously by placing the test terminals on the grid and plate prongs of the socket of the first audio amplifier tube. This connects these two transformer windings, the voltmeter, the amplifier plate supply, and the "C" voltage in series. If either winding is burnt out, there will be no reading of the voltmeter. However, since the two windings are in the circuit, the voltage drop through them will be considerable and the meter reading will be low.

The speaker, or the primary of the output transformer, and the secondary of the second transformer can be tested by touching the voltmeter terminals to the grid and plate prongs of the second audio socket.

In all cases, the positive terminal of the voltmeter must be connected to the plate prongs of the sockets.

PENTODE TESTING EQUIPMENT

By Floyd Faussett

MANY radiomen who have investments in radio testing equipment are interested in the adaptability of this equipment for the new test requirements imposed by the new power pentode tubes. The new variable mu tubes will not apparently introduce any problems by way of design limitations in present testing devices.

In general appearance, the new power pentode tube is similar to the type '45, there being no top or side terminals. The base prongs or terminals correspond to the terminal arrangement of the type '27, except that the "space charge grid" of the new tube utilizes the terminal which corresponds to the cathode prong of the type '27. The space charge or pentode potential may be ascertained with present analyzers or testers in the manner prescribed for measuring cathode potentials, provided the meter range connected to the cathode switch contacts is adequate for accommodating the higher space charge potentials. These potentials will probably be about 250 volts.

The Supreme Instruments Corporation has announced to the service trade that the Supreme Set Analyzer is adaptable without modification for measurements of all potentials involved in the new power pentode tubes. This adaptability is automatically provided by the switching arrangement which permits the optional connection of any range of the meter across any tube circuit; so that cathode or power pentode potentials may be read on meter ranges of 3, 9, 30, 90, 300 and 900 volts. The power pentode tests will best be accommodated on the 300-range.

Adapters are being furnished for all Supreme tube testing devices, so that these may be immediately adaptable for the new power pentode tests. The average tube test readings of the new tubes will be published by the Supreme Instruments Corporation as soon as available for the information and guidance of all concerned.

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Operating Methods for Service Men

(Continued from page 717)

buttons pressed) was plugged into the first R. F. socket. When the set next stopped, both readings were perfect. The second R. F. stage was then tested in the same manner and, when the set became inoperative, no reading was shown on the grid voltmeter. A similar test showed the third R. F. stage O. K. In this manner, the defect was finally traced to the second R. F. grid circuit and found in a shorting compensating condenser. Similar trouble was found on the other two sets; but in the *third* R. F. compensator in one of them.

These compensating condensers are two-plate units, located in front of each variable condenser (except the first) and adjusted with a set-screw which moves the front plate closer to or away from the other. No mica or insulating material is used, to prevent the possibility of a short. However, to prevent the occurrence of any such trouble in future, small squares of gummed paper, a little larger than the rear plate, were pasted over it.

This receiver model uses a rheostat, in series with the filaments of the '26-type amplifiers, as a volume control; and it is no simple task to adjust this to the desired volume and control oscillation at the same time, because of the "thermal inertia" of the '26-type filaments. The "HIF" is an oscillating set and lack of this tendency is a sure sign of some defect or needed adjustment.

There are several means of overcoming this difficulty. The first (Fig. 3A) is to use R. F. plate voltage control. Remove the rheostat (solder together and tape well the two wires which connected it into the filament circuit) and replace it on the panel by a 50,000-ohm potentiometer, the shaft of which is carefully insulated from the chassis with washers. The "B₊" plate lead, running to the R. F. by-pass condenser from the R. F. transformer primaries, is then cut and connected to the arm of the potentiometer; one side of the latter is then connected to the lead from the condenser, and the other to ground. (The choice of sides will depend on the direction in which it is desired that the control should operate). This system gives good control over oscillation and reduces volume; but there is a slight tendency toward mushiness at low-volume adjustments.

To overcome this latter condition, yet another hookup was tried (Fig. 3B); here the shaft of the resistor need not be insulated from the chassis. The grid return from the second R. F. tube is disconnected from the chassis, and connected to the other side of the potentiometer, the other side of which goes to the antenna post. Though the result may be a slight loss in selectivity, the even control of volume and of oscillation will more than repay the trouble of making the change. For the plate-voltage control, a good wire-wound resistor is used to best advantage; for the antenna-grid system, the writer used a Centralab carbon-type component.

Low, mushy reception was finally traced to a partially shorted 0.1-mf. condenser in the

resistance-capacity coupled stage of a Philco "77"; in this set, reception will be obtained even with this condenser open, though not very strongly.

It is best to use some form of indicating output meter to line up a Philco "96" receiver, because of the automatic volume control. With most receivers, when aligning the condensers by ear, it is common practice to turn down the volume control; but in this series, the volume control should be turned all the way up. If an output milliammeter is used, the voice coil may be disconnected with some trouble; but, if an A. C. voltmeter of low range (0-3-scale will do nicely) is used, this will not be necessary.

Recently the writer received a complaint of indistinct reproduction on low volume, though good quality on loud signals, in a Philco "76." The volume control was suspected at once, from previous experience, but worked and tested O.K.; so did the tubes. The chassis was replaced in the console, with the speaker outside. On applying the antenna wire to the control-grid cap of the third R. F. screen-grid tube (to produce a hum) it was found that the voice coil was slightly off center. The dynamic used in this set cannot be adjusted visually, or by inserting small strips between voice coil and pole piece. The center adjusting screw should be loosened, and the voice coil shifted into its proper position.

In the Colonial "32 AC," a cause of fading may be found in the small four-unit condenser block in the first R. F. stage (Fig. 4); this is part No. 1728. There are three such blocks in this model, each located at the left of its R. F. stage, with leads at the base connecting inside the chassis. Their colors, as shown in the diagram, are red, yellow, green and brown; it is the capacity to which the red lead is connected which opened and caused the fading. This condenser is between chassis and the transformer's secondary; across a 750,000-ohm red resistor. The remedy is replacement with the proper capacity, 0.1-mf.

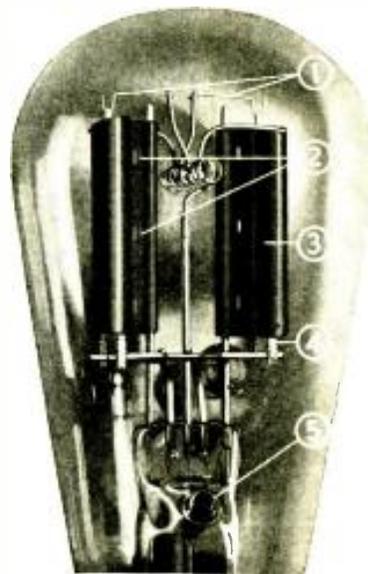
THE RADIO BLACKSMITH

HARDENING steel surfaces by nitro-genous compounds has been known since a very early date; but the use of nitrogen directly is comparatively recent. It has lately been discovered in a Paris laboratory, says *Amateur Wireless*, that the penetration of the nitrogen, and consequent surface hardening, is increased thirty-five times in depth by treating the steel in a field of radio-frequency oscillations. The case-hardened layer is then about a third of a millimeter, or 1/72 of an inch, thick.

ANOTHER WORD FOR IT

"TELESCRIPTION" is the word suggested by *La Radio-Industrie*, of Brussels, for the radio transmissions of photographs, facsimile images, etc., which the public are apt to confuse with television when odd sounds of a mechanical nature are heard in the loud speaker. Transmissions of this kind, as well as true television, are still given on the broadcast band in Europe.

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CITY..... STATE.....

Profitable Service Business

(Continued from page 715)

spite of business conditions; simply because I use service as a business and not as a necessary evil and have tried to build for the future.

I find that a majority of men would rather have their service at night; so the service day starts at four o'clock and runs until eleven, except for the aerial crew.

Meeting Cheap Competition

The average production radio, after it has been used 60 days, can be improved 20 to 100 percent, by three hours' labor of a good Service Man with the proper equipment. This is what I have to sell and my Service Men are trained to sell it. A man listening to a set operate, and knowing the receiving conditions in that locality, can just about tell how much benefit that kind of adjustment will give; and has a good chance of a five- or six-dollar job for which the set owner is glad to pay and will tell his friends about.

We have the 50c and \$1.00 Service Men in this town also; but I cannot see why they should worry any good service organization. Of course, they will get some business, but it is a class of service that a high grade shop does not want.

When a man complains about the \$1.50 service call I ask him whether he thinks that the man can get to his house and repair his set in less than an hour; whether he thinks a first-class mechanic will work for 50 cents; whether he thinks such a man will give him an honest test of his tubes; and whether he honestly thinks that the job is not worth more?

My men never replace a tube unless it is defective or down ten percent. Every tube tested is marked and labelled with its condition, with the advice written on as to the date when they should purchase an entire new set.

I handle no cheap tubes. Nothing but standard brands and highly advertised and made by companies whose adjustment policy is fair.

I have seen over a hundred radio service shops come and go in this city and have tried to analyze the cause of their failures; in most cases, it was incompetence mixed with the idea that you can gyp the set owner and he will never find it out. Another class start with the idea of getting all they can in the biggest chunks that they can get it in. Also, there are shops that fail to watch their collections; this alone has put more good high-class repairmen out of business than anything else.

Psychology in Servicing

There are two kinds of service: one for the man, who likes to see the Service Man tighten up the inside of a set and check everything for tightness; and the other is for the woman who delights in a Service Man who, when he is through, takes a rag and some furniture polish and wipes off the fingermarks and a few scratches, (whether they are imaginary or real).

And, above all things, if the Service Man must make dirt, he must clean it up; and he must listen interestedly while the cus-

tomers tells him how he got California at seven o'clock without an aerial and what a wonderful set his old three-tube blooper was.

I find that the customer is better satisfied with a man of some age even if he doesn't know as much as a younger man might, for the majority of sixteen- or eighteen-year-olds are too cocky and have no sense of responsibility.

There are two things in the service business that are absolutely necessary for the successful service shop. The first is the arrangement you have for taking care of your telephone calls; the person who answers your telephone must know radios, must have a pleasing and sympathetic voice and be able to give information in a way that the customer can understand. Then, too, you must be careful never to send the same Service Man again on a job where the customer wasn't thoroughly satisfied.

The second is the appearance of the shop. Keep it painted and use colors that harmonize. Keep the junk hid away, and have one rack in plain view for sets and chassis brought in for repairs, and another for those that are done and ready for the owner's call, or to be delivered. Have these tagged (with the charges plainly written on the front of the tag and what was done to the set, and the parts used, on the back) and let the customer keep this tag.

All telephone orders are taken in triplicate; one copy is kept in the office, so that the Service Man may be reached by telephone if I have another call in the same locality; and the other two are given to the Service Man who is to make the call. The duplicate is given to the customer; and the original is signed by the customer after the full charges have been filled in and what was done to the set put on the back. This signed copy is filed at the shop (in alphabetical order) and the file is used for reference and as a mailing list.

Get the highest-priced gold-leaf signs on your windows; for they are an index to the kind of business going on inside. They are your bid for the prospective business going by your place and are your highest-class salesmen, whose service costs you nothing.

Building Up a Clientele

I have a number of calls every week from prospective set buyers who ask me which set is the best, or which set they should purchase. I name over three or four of the best sets and try to explain the difference between them and let the customer decide for themselves. By helping them decide, you are the first one they think of when they need service.

Give information freely and courteously and, at the same time, sell yourself and your service. It may be a year before you get any results, but it will pay dividends. And do not make your store a "hangout" for a bunch of "radio nuts" and "radio liars."

When you sell a short-wave or television kit, tell the customer just what he can expect. Then, if it works better than you told him, he thinks he is smarter than you

are; and he tells his friends to get a kit and he will help them build it. This means business for you and that is what you want.

A stock of used and new parts is not "to be sneezed at"; and that will be better as short waves and television become more popular.

The best way to get yourself a real live mailing list is to get a bunch of station logs with your name and business on them. Get a high-class log that every set owner will like; then, when a customer comes into the store, give him one and ask him to write the names of a number of his friends on the pad, as you want to mail one to each of them. Also, have the Service Men work the same idea. A list of this kind has very little deadwood in it, and you do not have a lot of losses from sending advertisements to people who have no radios.

Radio service used to be referred to as a "game"; but that day is past and, fellows, if we want to survive we have to dig and specialize in our line. Forget competition and make ourselves stand out above the others in the same line. It takes time, but it can be done; and don't be discouraged. Good times are coming.

Now, I am not advertising RADIO-CRAFT or the Gernsback Publications—but they have done more for the radio Service Man than all other books and magazines published (and I take them all) and the serious perusal

of them will do more to keep you up to date than any other one thing.

From the illustration heading this article, you will see that I am an invalid and that my means of transportation is a wheel chair in my place of business. For the outside I have a special-built automobile which I have driven 90,000 miles in six years; so you see that I get some pleasure out of life also. I absolutely do not trade on my physical condition and my first job, on meeting a strange customer, is to make him forget my condition and do business on a straight business basis, and to let him know that I want no favors or edge on my competitors.

I went broke in the auto service business eleven years ago and started in the radio business by building crystal sets. I have followed the business right on, having constructed 667 custom-built sets and serviced over 9,000 sets in that length of time. I am married and have made some money by using my head and one arm; so, fellows, you can make it if you try hard and use the old bean as well as both arms and legs. I do not want you to think me egotistical, but I am telling you what you can do if you concentrate and try hard.

I may later write some articles on service kinks and the methods I have found for quick servicing of different sets. I am no "flying service man"—and I have not been able to find one.

"Instantaneous" Recording

(Continued from page 725)

after a few playings, an effect also due to the resiliency. These records can be played back about fifty times.

The *nitrate* celluloid (pre-grooved) which is the kind used generally for recording, is highly inflammable and great care should be exercised in keeping it away from any flame. It should be stored in fire-proof containers. The *acetate* celluloid, which is non-inflammable, also makes fairly good records; but, at present, it is obtainable only in blank discs.

The pre-grooved zinc composition record is the oldest instantaneous record and was originally used for home recording by means of the sound box in the acoustic phonograph. Recording was then accomplished by placing the disc on the turntable and singing or talking in a loud voice into the horn. At best the reproduction was faint. These records can now be used for electrical recording with fairly good results. An ordinary phonograph steel needle is used for both recording and reproducing.

This about completes a preliminary discussion of the absorbing subject of instantaneous (home) recording; it is planned that subsequent articles will bring to light many interesting and valuable bits of information. Meanwhile, every owner of a home-movie camera, phonograph, radio set, or home-recording outfit (in fact anyone with practical interest in this subject), is invited to correspond with the writer on ways and means of getting the best effect in sound. For instance, you may want to know where to obtain certain sizes or types of records, pick-ups, motors, etc., or how to accomplish a certain result; and all this

information you may obtain by addressing your inquiry to the Sound Recording Department of RADIO-CRAFT. We are particularly interested in receiving suggestions, and discussing plans by which sound recording may be profitably and interestingly applied.

Service Man's Open Forum

(Continued from page 719)

that I do not sell radios. The free test offer brings many calls that I otherwise would miss because of the fear of a stiff service call charge. Where the trouble is simple and is fixed in the customer's home, a minimum charge of one dollar plus materials is made. If the set must be taken to the shop, I make a careful check of it, and then quote a price for the job. In a few cases the prospect decides not to have the work done, in which case the free test call is a loss to me. However, this seldom occurs.

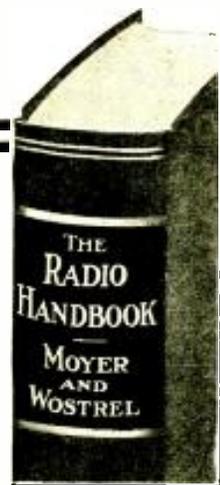
The worst part of it is on the calls where a new tube does the job. In order to hold my trade against the tube-tester toters, I charge only for the tube. However, my records show that the bulk of calls are due not to tubes, as some advertisers wish us to think, but to shorted condensers and open resistors. Many keep an extra tube or two on hand and when the set quits try changing tubes—this self-service cuts out a lot of tube replacement calls.

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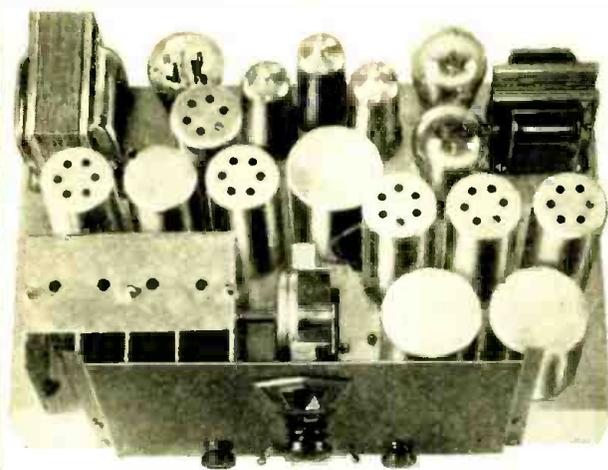
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SERVICE MEN — DEALERS

A few minutes of your time NOW, spent in reading the interesting announcement of the OFFICIAL RADIO SERVICE MANUAL which appears on page 748 of this issue, might save you hours of time in servicing in the future. Every dealer, Service Man and custom set builder should have a copy at his disposal.

I will fix the set, I make it a fair one; but enough to pay the proper profit on good materials for whatever replacements are needed, plus a proper recompense for the work involved. The fact that the customer knows the price of the job before the set goes to the shop inspires confidence, and helps a lot. With a good analyzer and careful checking, it is possible to do this. And, in the few cases where I cannot be sure of the total expense till the set is in the shop, I tell the prospect this; naming the probable total cost and stating that I will verify this estimate by phone as soon as I get the set to the shop. Once the set was at the shop, I never have lost the job yet.

R. B. LAWTON,
9 Chester St., Glens Falls, N. Y.

Service Men's Notebooks (Continued from page 719)

to the factory conversion is that the control must be turned counter-clockwise to increase volume. I have solved this by reversing the shaft and mounting on the outside of the tuner; or a right-hand 2000-ohm rheostat can be used, instead of the left-hand component used in the factory job.

Another fault of the converted job is the fact that the connecting cables have too high a resistance for the heavy current consumed by five or six '27 tubes and (in the Models "A-32," "A-40") two '45 output tubes. In many cases, the heaters in the R.F. tubes are not at voltages sufficiently high to give proper operation, and this causes insensitivity; although '27s of some makes are less affected by this condition. A supplementary pair of No. 14 leads, between power pack and amplifier, will help a lot in this case.

RADIOLA CATACOMBS By George F. McCann, Jr.

RADIOLA catacombs are sealed, and their construction seems to be a mystery to many Service Men. This attitude is hardly justified, however. All parts are fastened directly to the socket assembly, resulting in a very compact job. When heated (see page 670, May RADIO-CRAFT) this assembly will come out of the can completely, though care to avoid breaking the small wires must be exercised. The wax may be melted from it, the last traces being removed by passing it back and forth over a gas flame.

If an audio transformer is open, it may be removed by taking out two screws holding it to the frame; mark the colors of the four leads before unsoldering them. If necessary, a transformer from the "RCA 20" may be used, after removing the cover; the color code is exactly the same.

If an audio by-pass condenser is open, it may be unsoldered and removed; there will be a slight change in tone, but this will hardly be noticed on most speakers. An open intermediate will cause some trouble; but these are well separated and may be removed by unscrewing the core. Be certain to note the spacing; for this is important to give maximum results and avoid a whistle.

It is a pleasure to work on these sets, and there is no reason why they should be avoided as at present.

Hotel Installation

(Continued from page 727)

There are about 2500 rooms, each of which has a four-way selector switch and speaker. During the day and evening, loud speakers will be thrown on and off the system. However, if we keep data of the actual speakers in use, we would find that they approximate an average number for any particular period. Thus an *average* impedance must be decided upon as the actual "working" value. One of the major requirements is that the addition or subtraction of a large group of speakers on the system shall not greatly affect the response-characteristic of the other speakers. (One of the greatest faults of trade practice is that different manufacturers rate the impedance values for transformers, speakers, etc., at different frequencies; one uses 1000 cycles, another 500 cycles, and so it goes. Personally, I believe that 1000 cycles is an excellent frequency for impedance matching.)

There are about 90 reproducers on each floor, as shown in Fig. 1; and the manner in which each floor is tied in is illustrated in Fig. 2, which shows the connections to the "riser" on the South side of the building, these leads being duplicated in a North-side riser.

If all our speakers are of the same make and contain similar values of resistance, inductance and impedance, then for all practical purposes we can solve our matching problems using the given manufacturer's impedance value as a matching standard.

Also, since a great many speakers must be connected in parallel, it is important to know what method of computation to use in order to find a final or total value of the combined impedances. Naturally to solve such a problem in "complex," or by alternating-current analysis, would result in mathematics entirely useless to the majority of the readers. For all practical purposes, however, it is possible to design an excellent system using the given impedance value as a matching standard and using the law of parallel resistors where speakers are connected in parallel.

With this factor in mind we can solve for the following problems: (1) The impedance of an average group of speakers which the system will actually use on each channel. (2) The power in watts required to supply this average group of speakers. (3) The design of an amplifier to supply the required power.

The use of dynamic speakers in such a large installation would be poor policy, both for reason of cost and necessary field supply; therefore, magnetic speakers should be used.

Their impedance should be of such value as to have little, if any effect on the average impedance of the entire line when thrown on or off the line.

Since there are four channels in the system and approximately 2,500 rooms, we can assume that the four channels are to be evenly distributed at any one time. Then there will be $2500 \div 4$ or 625 listeners per channel; we can take this figure as our average minimum. However, there will be periods when an important event will be broadcast; since there are usually at least



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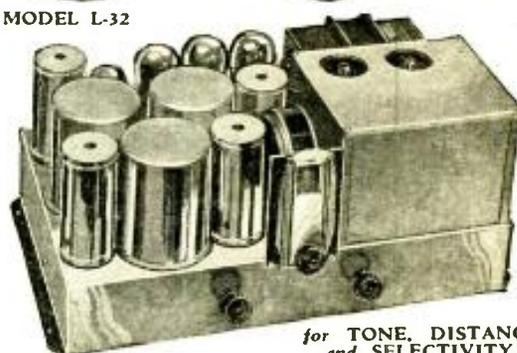
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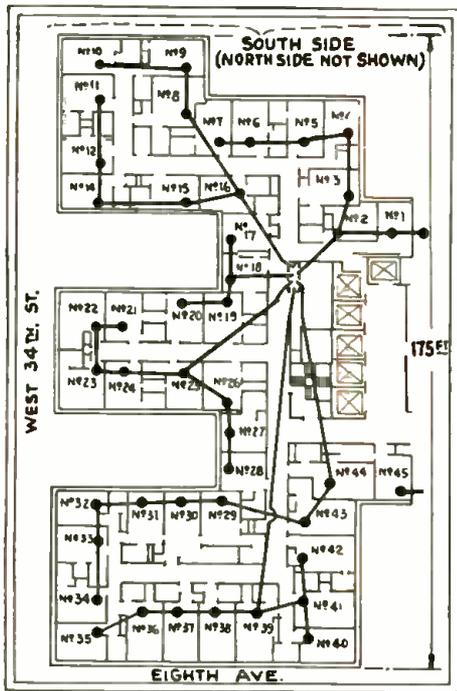


Fig. 1

The south half of a typical floor of the Hotel New Yorker, showing radio distributing system.

two stations broadcasting such events, if we assume that the entire house will listen on either of these two channels, our average maximum should be 1250 listeners on each channel.

Now, if provision is made for additional power output for such occasions, it should be possible to reduce the size of the regular amplifier. Therefore let us take as an average working value a number somewhere between our assumed minimum and maximum values; 800 is an excellent figure which should fit the final solution. Having decided on 800 as our average number of speakers, we must next realize that our speaker impedance must be fairly high in order to have negligible effect when a group is thrown on or off the line. The actual design of such a loud speaker is beyond the scope of this article; but an impedance of 1000 ohms is satisfactory.

Distributing the Load

Now if we put 800 speakers all in parallel, and each speaker's impedance is 1000 ohms, then our total impedance is 1.25 ohms (1000 divided by 800).

An output transformer with a secondary of 1.25 ohms would have to be built with a fairly heavy wire. If, however, we could double the total output impedance not only could we decrease the size of the wire but the impedance value itself would be much easier to match in the transformer.

To double the output impedance we must either cut our total average number of speakers down to 400 or increase the individual speaker's impedance from 1000 ohms to 2000 ohms. Either way will accomplish our purpose, but the most logical and best method however would be the former. That is, we build two amplifiers, each of which would supply 400 speakers; then, by connecting the inputs together, it is possible to supply the load with the same input. This is the method used here.

Our total output impedance should now

be that of 400 speakers in parallel, or 2.5 ohms; which is just twice the value with 800 speakers. So that we have broken our output into two equal branches, each having an impedance of 2.5 ohms. Let us now suppose that our line is fully loaded, or that 400 speakers are in use; and that, suddenly, 100 speakers are thrown off the line, leaving the remaining 300 still connected. Our impedance variation will be from 2.5 to 3.33 ohms, which is negligible in effect. The loud-speaker load in the hotel can be compared to that of an ordinary electric lighting system, where the actual load is fairly constant except during peak hours. This is due to the fact that, as one load speaker is thrown on another is thrown off.

The frequency response of the installation is excellent; the most important reason for this is that with line impedance of such a low value, the impedance variation with frequency change is very low. This results in a uniform distribution with surprisingly good reception. Also the fact, that almost the entire load may be thrown on or off the line with little if any effect on the reception, helps the response-characteristic to "keep its figure".

Tests made on the type of loud speaker used here indicate that 50 milliwatts is ample power for the average hotel room. Therefore, since our unit amplifier must

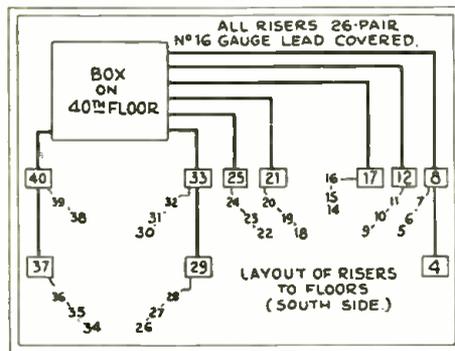


Fig. 2

The risers to different floors branch off from the shaft as shown.

supply 400 speakers, each must have a power of twenty watts. Since there are four channels, and as each channel requires two 20-watt amplifiers, a total of eight are used to supply the entire load.

(To be continued)

Double Turntable

(Continued from page 733)

are shown diagrammatically in Fig. 2. The narrow roller (1) which rides over the surface of the film (3) is partly visible behind the large slotted roller, (2). The former roller is held in contact with the film by means of the spiral spring (5) visible in the film switch assembly. This spring pushes the narrow roller into the slotted leader, thus allowing the contacts of the film switch to come together.

Fig. 3 shows the electrical connections of the film switch, relay, and clutch magnet. Since the current necessary for the operation of the magnet is too great to be handled by the delicate contacts in the film switch,

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ON Page 754 you will find an interesting announcement on the Supplements to OFFICIAL RADIO SERVICE MANUAL. It takes but a few minutes to read full particulars about this message.

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a relay is provided and connected as shown in the diagram.

Fig. 1 shows the slotted leader. The slot is a quarter of an inch wide and extends along the center of the film for a distance equal to four picture frames. The total length of the leader is equivalent to twenty-two picture frames, or a little over sixteen inches. One end of the leader is cemented to the end of the first 1,000-foot length of film, and the opposite end is cemented to the beginning of the second reel—exactly ten picture frames ahead of the "start frame." Successive leaders are cemented between reels in the same manner as described above.

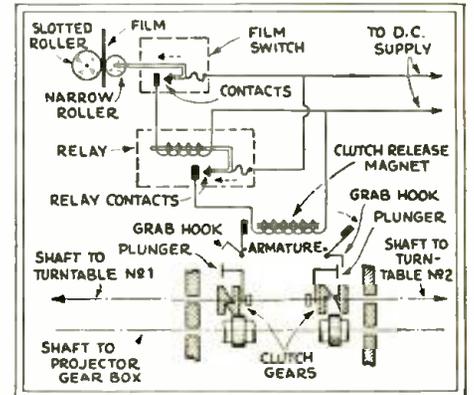


Fig. 3

The slot in the film serves as a switch to operate the relays shown, which change over discs.

The double turntable is economical in first cost and is readily attachable to any standard-make projector (using any size of film from 16 to 32 mm.). By its use, the purchasing of an additional projector and associated sound reproduction attachments are rendered unnecessary, since the results obtained will be more than satisfactory for all small installations. The double unit may be used in connection with a sound-on-film attachment, if this added feature is desired.

SEVEN-METER TELEPHONY

THE radio-telephone apparatus to be used in the new ultra-short-wave system, linking the Hawaiian Islands, represents the highest-frequency equipment yet utilized outside of the laboratory; and special construction is necessitated by tropical climates. Eight stations, on the island of Oahu (the "central"), Hawaii, Maui and Kanai, serve as links in the wire system of Hawaii, which also has a radiophone connection to the Bell System lines on the continent. They will operate between 7 and 8 meters (13 to 37.5 million cycles) and, because of the peculiar phenomena of extremely short waves which travel only in a horizontal plane, it will be necessary to erect the apparatus on the summits of extinct volcanoes in order to secure sufficient elevation to overcome the earth's curvature.

The transmitting and receiving apparatus are enclosed in specially-insulated cases to protect the mechanism from tropical insects, moisture and volcanic gases. Most of the metal parts are of brass to prevent rusting, and the condensers are made of a special alloy with a zero temperature-coefficient, so that varying temperatures will not affect the delicate tuning adjustments.

Craftsmen's Letters

(Continued from page 739)

completely through it, and cementing a 1/4-inch bakelite or hard-rubber rod of the desired length half-way through the knob (as at B.) The condensers, of course, are mounted to suit the experimenter.

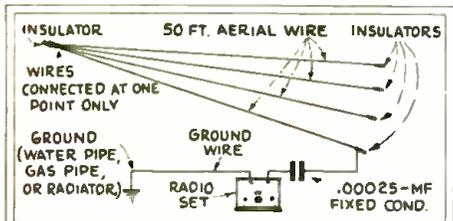
RALPH C. JACKSON,
71 Alba Street, Portland, Me.

COPPER-PLATED GROUNDS

Editor, RADIO-CRAFT:

I have not seen the use of proper aeri-als emphasized sufficiently; in the mad scramble of companies outdoing each other in high-powered sets with more tubes and more expensive cabinets, the essential value of aeri-als and grounds seems to be overlooked. (We are under the impression that in the pages of RADIO-CRAFT, at least, a good deal of space has been given regularly to this subject—Editor.)

Each set requires its own particular aerial. R.C.A. superheterodynes and others of that type take a 50-foot lead-covered aerial, with the lead covering grounded two or three times on separate grounds. Also a copper-and-vitriol ground is essential. (Two pounds of junk copper buried three feet in the ground, with half a pound of blue vitriol [copper sulphate] on them, and wet every two or three days) to obtain distance and remove static.



Mr. Bickford's fan aerial affords a good deal of pickup, as may be seen. In some locations, perhaps too much.

A 12-inch cylinder of 22 gauge copper answers for a Majestic, removing static 100% in connection with a copper-and-vitriol ground. Also, a seven foot by eight inch copper screen answers for a Grebe and others of that type.

For midget sets, a fan aerial with water pipe ground makes perfect reception. Spread out a number of aerial wires from five to ten feet, and slope them downward. They should be pointed toward the principal stations, for local reception. We got Cincinnati on a Jackson-Bell here with this hookup, with volume and tone to equal a Victor, or any other high-powered set.

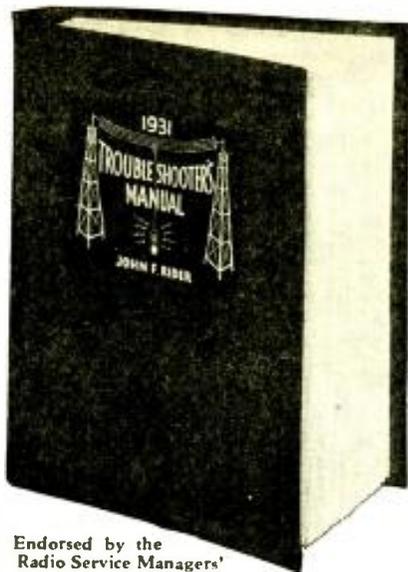
Philcos act better with a 100-foot straight aerial, grounded on a water pipe at the far end.

These hookups eliminate static, power line and transformer interference 100%.

FRED L. BICKFORD,

109 North Hope St., Los Angeles, Calif.

(While we cannot guarantee that Mr. Bickford's prescription will cure all static troubles, or bring in distance for other readers, we reprint his interesting experiences. While every set of one model is as near like another as the manufacturer can make it, no two locations in the United States are exactly alike for reception; and



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- Section 5.—Wiring diagrams of public address and power amplifiers, inclusive of the most famous manufacturers.
- Section 6.—Wiring diagrams of ALL popular eliminators and power packs.
- Section 7.—Wiring diagrams of ALL popular short wave receivers and adaptors.
- Section 8.—Wiring diagrams of ALL popular kit receivers, old and new.
- Section 9.—Wiring diagrams of the popular Set Analyzers, old and new.
- Section 10.—Wiring diagrams of midget receivers.
- Section 11.—Peculiarities in radio receivers, a section which you can remove from the book, bind separately and carry with you. This section is a distinct innovation in radio service literature. It will tell you of any special features which you must know of when testing the receiver. Every commercial receiver in the 1931 Trouble Shooter's Manual by Rider is mentioned in this section.

No matter what other books you may have, YOU NEED THE 1931 TROUBLE SHOOTER'S MANUAL because it includes many diagrams and details which have NEVER BEFORE appeared elsewhere. . . . This book contains many diagrams which are not available from any other source. . . . Remember that one diagram with color code may save you enough time and enable you to complete a successful repair in such fashion that it will repay you for the entire cost of this book. . . . Hot off the press!

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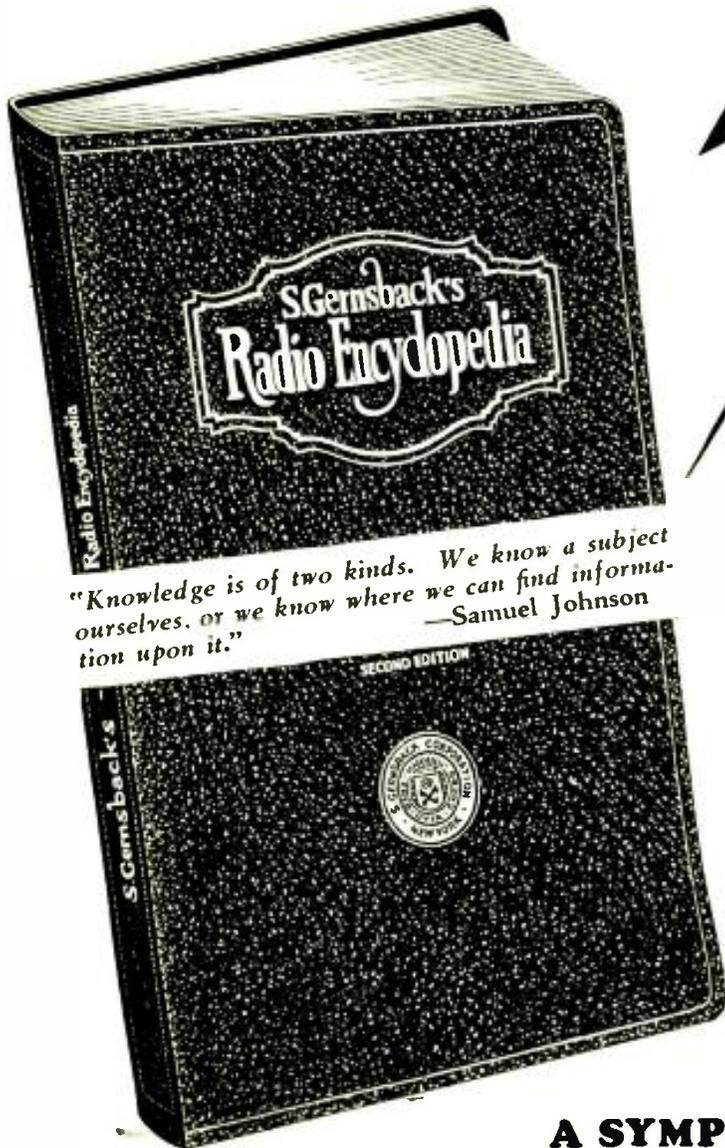
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one man's perfect aerial is another's total failure. The idea of the Idue vitriol, etc., is to impregnate a naturally dry and non-conducting ground. As a matter of fact, probably the only true "ground" is the Pacific ocean; and most "grounds" are really only counterpoises. A soluble substance, like copper sulphate, will remain in the neighborhood of the "ground" only when there is "hard pan" under it; and it is probable that driving a standard ground pipe through this would produce a like effect.—Editor.)

New Radio Devices

(Continued from page 731)

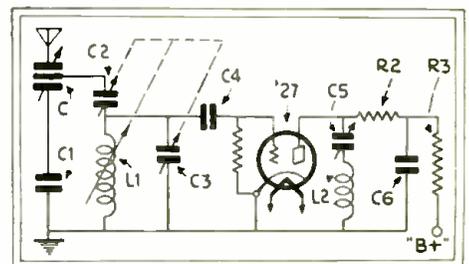
6.3-volt filament were discussed last month; while the power-pentode (as distinguished from the "R.F. pentode"—see the April, 1930, issue) was considered in an article which appeared in the May, 1930, issue.

Tubes of similar characteristics are available in the Cunningham line, and bear the following numbers, which are equivalent to the above RCA types having similar numerals for the last two digits: C-335; C-336; C-337, C-338; C-347.

For convenience in referring to the available characteristics of these new tubes, the tabulation appearing on page 759 has been prepared.

A GERMAN RECEIVING CIRCUIT

EUROPEAN sets for the popular trade have never been designed with the emphasis upon selectivity which has been predominant in American set manufacture. It is interesting, therefore, to note the emphasis laid upon the selectivity of a new German electric receiver, the input circuit of which is shown here. The variable inductance L1 is a flat-coil variometer, coupled mechanically between the shafts of the two tuning condensers C2 and C3; the aerial is connected to ground (through C1) and to the grid circuit by the differential condenser C, which has two stators in the same plane, and a rotor. Regeneration is controlled through C5. The tuning system is so designed that inductance and capacity increase together, giving constant impedance, whatever the frequency, from 200 to 2000 meters (the European broadcast range—covered on one large semi-circular scale). The differential condenser not only adapts the tuning circuit to the characteristics of the aerial, but serves to some extent as a volume control. The A.F. stages are standard. The D.C. model of this set, it is stated, has the voltage divider outside the metal cabinet, at the rear!



The complicated input circuit shown serves to tune the aerial for sensitivity, and keep impedance constant between 150 and 1500 kilocycles.

Type of Tube	Filament Potens. Volts	Filament Curr. Amps.	Plate Potens. Volts	Plate Curr. Mill.	Screen-Grid Potens. Volts	Screen-Grid Curr. Mill.	C.-G. Bias Volts	Plate Resist. Ohms	Mutual Conduct. Mhos.	Power Output W watts	Ampl. Factor "Mu"	Load Resist. Ohms
'35	2.5	1.75	180	9.0	75	3.0	1.5	200,000	1,100		300	
36	6.3	0.30	135	3.5	75	1.2	1.5	250,000	1,100		275	
'37	6.3	0.30	135	4.5			9.0	10,000	900	75	9	12,500
'38	6.3	0.30	135	8.0	135	2.5	13.5	110,000	900	375	100	15,000
'47	2.5	1.50	250	32.0	250	7.5	16.5	38,000	2,500	2,500	100	7,000
'30	2.0	0.06	90	1.8			4.5	15,000	700	16	95	15,000
'31	2.0	0.13	135	6.8			22.5	4,950	760	150	38	9,000
'32	2.0	0.06	135	1.4	67.5	0.5	3.0	1,150,000	505		580	

*Maximum value. Screen-Grid current should not exceed one-third plate current †Approximate.

Announced average characteristics of new tubes, together with revised figures for the two-volt types. The '35, it is learned at the last minute, may be used more effectively with 3, 90 and 250 volts on the control-grid, screen and plate respectively. A new 2-volt battery pentode, to be known as the 233, will draw 0.26-amp. with a plate current of 14 ma. and screen current of 3 ma., at 135 volts on each and -13.5 on the grid. The output is rated at 650 milliwatts.

New Midget Superhets

(Continued from page 731)

The two band-selector condensers C1 and C2 are nearest the tuning dial.

The output of the oscillator V2 is inductively coupled to L2 in the band-selector. Note that the variable volume-control resistor R13 (10,000 ohms) is connected between two resistors, R3 and R4; it varies the negative bias on the control-grid of the 2nd I.F. tube, V3. The resistor R3 between R13 and the chassis has a value of 200 ohms; and R4, between R13 and the "B+" 68-volt connection, is of 25,000 ohms. A variable resistor R14 and condenser C10 constitute a variable tone control in the detector plate circuit. Electrolytic condensers of 8-mf. furnish exceptionally good filter action in the power pack.

In addition to the special circuit-balancing condensers C3A, C4, C5 (the theory and use of which have been described in connection with superheterodyne receivers of other makes mentioned in past issues of RADIO-CRAFT), there is a particularly noteworthy arrangement of the entire tuned circuit of the oscillator, V2. It will be noted that the tuned inductance S11-S1 is grounded at one

end and "floats" at the other. This arrangement secures a permanency in the frequency of the oscillator output which was not obtainable in earlier forms of oscillator design; since the resonant circuit is now independent of variations in the constants of the vacuum tube and its associated current supply.

The following S.M. units are used in the Models, "37," "38," and "39;" L1, "Type 161" R.F. coil; L2, "Type 160" R.F. coil; L3, "Type 163" oscillator coil; T1, "Type A-270" A.F. transformer; PT, "Type 360" power transformer.

The operating voltages are as follows: filament potentials, V1 to V5, 2.2 volts; V6, V7, 2.25 volts; V8, 5.1 volts; plate potentials, V1, V3, V4, V5, 200 volts; V2, 68 volts; V6, V7, 245 volts; V8 (filament to ground), 400 volts; screen-grid potentials, V1, V3, V4, 68 volts; control-grid potentials, V6, V7, 46 volts; cathode potentials, V1, 6 volts; V2, 5 volts; V3, 1.6 volts; V4, 2.3 volts; V5, 20 volts; normal plate currents, V1, 3.2 ma.; V2, 5 ma. V3, 5.7 ma.; V4, 5.6 ma.; V5, 0.8 ma.; V6, V7, 28 ma.

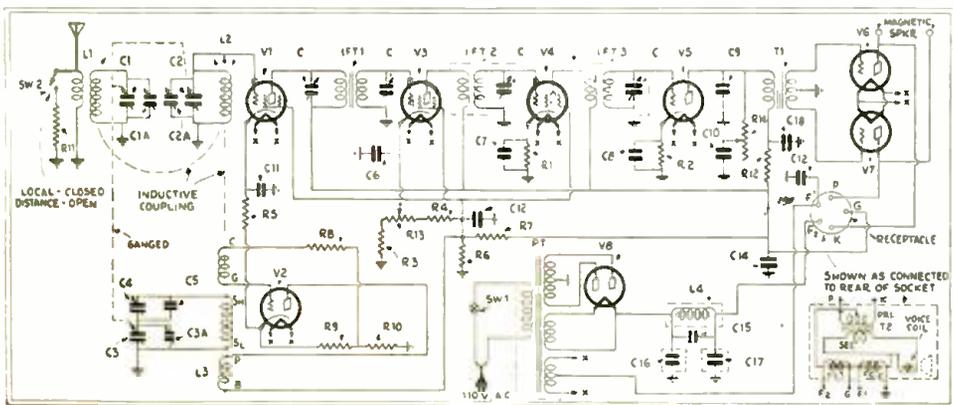


Fig. 2

The new "37, 38 and 39" Silver-Marshall super circuit, for midget chassis. Resistances (ohms): R1, 750; R3, 200; R5, R6, R7, 10,000; R8, 400; R9, R11, 100; R10, 1,000; R12, 4,000; R13, 10,000; R14, 500,000. Capacities (mmf.): C1, C2, C3, 425 max.; C4, 250-600; C5, 750; (mf.) C6, C7, C11, C13, 0.1; C8, C12, C14, 1.0; C9, .001; C10, C15, 0.25; C16, C17, 8 (electrolytic). R2 and R4 are 25,000-ohm resistors of one-watt rating.

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RCA VICTOR MIDGET SUPER

WITH the "Superette" model midget superheterodyne receiver, the RCA Victor Company makes its advent into the field of small radio sets. This compact instrument, shown in Fig. G, uses eight tubes, including two of the new "variable mu" type.

As stated in the April, 1931, issue of RADIO-CRAFT, the variable-mu tube reduces "cross-talk," that species of interference which results when a powerful broadcast station is in operation in the vicinity of a radio set tuned to another station.

Tone control, push-pull type '45 power tubes, an 8-inch dynamic reproducer, and a particularly efficient form of volume control are found in this receiver; this control is so designed that it obviates the need for the "local-distance" switch required on sets of earlier design.

Selectivity and sensitivity are exceptionally good; being due, in part, to the use of the superheterodyne circuit. Particular attention has been given to the cabinet's design, in order to obtain good audio reproduction.

The tubes line up as follows: first detector, type '24; oscillator, type '27; intermediate-frequency amplifier (two of the new

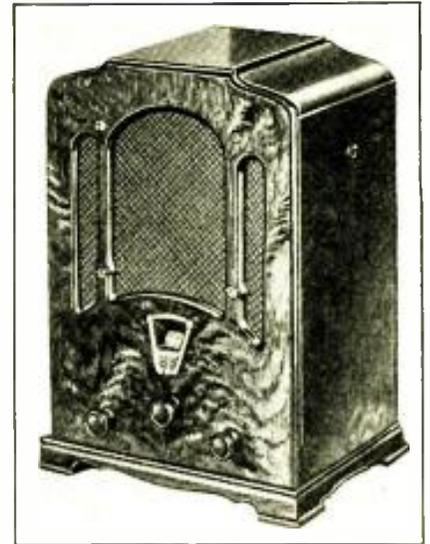


Fig. G

The new RCA Victor midget super employs variable mu I.F. amplifiers, obviating the need of "local-distance" switching.

variable-mu tubes), type '35; second detector, type '27; two push-pull power amplifier tubes, type '45. A type '80 rectifier is used.

The Ohm Family, R, X and Z

(Continued from page 740)

us, the induced E.M.F. or voltage acts in such a way as to oppose the change which is taking place. Mark the fact that the direction of the current's flow (whether positive or negative) or its magnitude have nothing whatever to do with this—it is the rate of change in which we are interested.

Look again at the curve in Fig. 1C, and you will see that the current's magnitude is continuously changing, except at the instant in each half-cycle when the maximum positive or negative value is reached.

Since the inductive effect is at maximum when the "rate of change" is greatest, we may assume that the opposing E.M.F., due to the inductance of the circuit, is at its peak when the current wave is passing through its zero value; and we can plot a curve to this effect as in Fig. 3. The "peak" value of the current is as shown by the curve, while the R.M.S. (root-mean-square) or effective value is but .707 of the maximum (ordinary A.C. meters read R.M.S. values.)

At any instant the slope of the current curve gives the rate at which the current is changing; and it can be seen that the slope is steepest at the points where the current crosses the zero line. We may plot the dotted "sinusoidal" line shown in the Fig. 3 as representing an arbitrary relation between the current and the "back" or "counter" E.M.F. in an inductance coil of *L henries*.

Since the back E.M.F. is defined as being exerted in a direction opposing the current change, we also have shown the back E.M.F. as negative in value while the growth of current is in the positive direction. The curve of this induced voltage (the back E.M.F.) is seen from the figure to be just

one quarter-cycle out of step with the current; and we say that it is out of phase by 90 degrees, and that the current "lags the voltage" or that the voltage "leads" by 90 degrees. This brings us up to the problem of phase difference from which we will beat a hasty retreat for the moment.

If the frequency in cycles is taken as *f*, the voltage induced by the changing current is equal to 6.2832 times *f* times the inductance in henries times the current in amperes:

$$E = 2 \pi \times f \times L \times I$$

This leads us back to Ohm's Law for direct current; and we will find that, with the frequency set at a single value, the equations are parallel to those of Ohm's law but with *X_L* (the inductive reactance—6.28 *f L*.) taking the place of *R*; so that just as simply in the case of direct-current calculations:

$$E = I \times X_L; I = E / X_L; X_L = E / I$$

(To be continued in July RADIO-CRAFT)

FIFTEEN MILLION SETS

THE total number of receivers in use in American homes on the first of this year is estimated at fifteen million, on the basis of a survey made by *Radio Retailing*. Of this number, nearly four million were sold during 1930; about 14% less than in 1929, although the average selling price of each set was \$87 last year, as against \$133 in 1929.

At this rate, there are still over ten million families to be supplied with radio, in addition to the market for extra sets in individual homes, offices, etc.

"L-32" Ultradyne

(Continued from page 737)

short the antenna to the chassis; when the hiss still will be heard. Then by-pass to the chassis, with a 1.0 mf. fixed condenser, the plate of V1, when the hiss will stop.

On the other hand, an antenna which is too long necessitates turning the volume control adjustment to a "retarded" setting which yet will not stop a certain amount of cross-talk and tone distortion. One solution of this problem is to use a "variable-mu" tube.

Using the Variable-Mu Tube

Although it was stated in the preceding article that variable-mu tubes may be used in this receiver without making any circuit changes, a modification of the circuit which will result in somewhat better control of these tubes, is recommended by the writer. In Fig. 1, at A, is shown the volume-control potentiometer R27 and its position in the original circuit diagram (Fig. 1, page 667); and at B the rearrangement of the circuit for best operation of variable-mu tubes (Majestic '31's, RCA-Radiotron '35's, etc.) in place of regular screen-grid (type '24) tubes.

For operation of the variable-mu's, the 3,000-ohm volume-control potentiometer R27 is to be replaced with a 10,000-ohm potentiometer. In addition, a fixed 3000-ohm resistor R is to be placed between the "high" side of this potentiometer and the positive potential lead. Note that the cathode's variable positive bias (which is really the control-grid negative bias of the two I.F. amplifier tubes V3, V4) will have a higher maximum value, due to the fact that instead of their connecting to a 25-volt potential source, as at A, the 85-volt line is tapped, as at B.

Condenser Backlash

Some constructors have reported difficulty in tuning to shortwave stations; and, in still fewer instances, to long-wave broadcast stations. They find that it is necessary to wiggle the tuning knob right and left several times before stations can be heard at maximum volume. This is due to a certain amount of "backlash" in the main condenser shaft, and may be prevented by taking greater care in setting up the variable condensers.

After running the 1/4-in. steel rod (which is 10 in. long) through the tuning condensers, the condensers should be moved around until the rod slips easily through the shaft holes; and then the condenser mounting screws are tightened. Next, the condenser rotors should be adjusted at their bearings until they swing freely on the steel rod; not until then should the rotors be tightened to the steel shaft.

The procedure then is to mount the condensers so that the rod slides freely through condensers and tuning dial; tighten condensers, then dial and, lastly, the rotors.

Any further questions concerning the new "Model L-32" Ultradyne may be addressed to the attention of the writer (in care of Radio-Craft), who will be glad to give them his personal consideration.

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Wheatstone Bridge

(Continued from page 741)

vary the resistance of R3 and R4 until the voltmeter *v* indicates a balance, by zero deflection. Now switch over again to the buzzer and phones, and vary the position of the sliding contact until a balance is obtained, as indicated by a minimum sound in the phones. Again switch back to battery and voltmeter, keeping the sliding contact *c* fixed in the new position previously found; and vary the resistors R3 and R4 until a balance is obtained. Alternate this way until a very sharp balance is obtained on both D.C. and A.C.—then note the values of *m* and *n* and apply the formula previously given.

$$X = L \times \frac{m}{n}$$

It will be noted that the important adjustment of the sliding contact *c* was not changed in balancing the resistances of R3 and R4; since the important adjustment of the slider determines the inductance measurement. The above formula is absolutely correct and is based upon both types of balance thus obtained.

Measurement of Capacity

The Wheatstone slide-wire bridge may be used also to measure unknown capacities, there being required in this circuit but one known capacity. Fig. 3 illustrates the connections for this bridge; in which C is the known capacity and CX the unknown capacity, while *m* and *n* are the lengths of the two arms of the slide-wire, which are adjusted for a balance by a minimum sound in the phones.

It is evident that, with this arrangement, the resistance in one arm of the bridge is balanced against the impedance of the condenser in the adjacent arm. (The impedance of a condenser is the resultant of resistance and reactance but, as the resistance is so very low, compared to the reactance, it can be disregarded and the entire impedance considered as reactance.)

The reactance of a condenser varies *inversely* as its capacity; while the reactance of an inductance varies directly, and therefore the preceding formula must be rewritten and used in the following form:

$$CX = C \times \frac{n}{m}$$

For example, the scale has 100 divisions and the sound is minimum in the phones at a point on the wire 25 divisions from E (Fig. 6); leaving 75 divisions for *n*, between F and *c*. Assuming that we use a standard capacity value of .002-mf. for C, we may substitute these values, giving

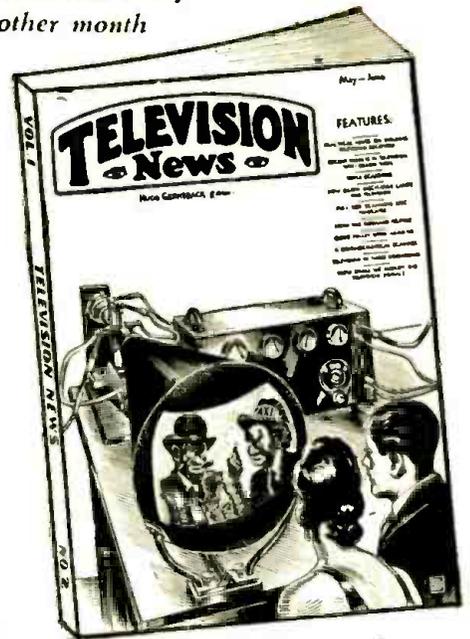
$$CX = .002 \times 75 = .006\text{-mf.}$$

25

In all these measurements using a buzzer to supply the alternating current to the bridge, it is advisable to set the buzzer at some distance from the bridge, or muffle it in some way; for otherwise it will be difficult to determine whether the sound is coming from the phones and due to the current passing through them, or whether it is direct noise from the buzzer. (A "high-frequency" buzzer is more quiet. See Fig. 4.)

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CITY AND STATE

An excellent source of A.C. voltage for measuring inductance and capacity is a vacuum-tube audio-frequency oscillator, which does not have the above-mentioned fault of buzzers. The terminals of the oscillator are connected to the points E and F of the bridge. (See Fig. 5) Resistor R1 controls the amount of A.C. fed to the bridge.

In these measurements, a calibrated variable (air dielectric) condenser may be used as the standard C; with this, a very large range of unknown capacities may be very simply measured.

First, the slider is set at the mid-point of the length of resistance wire, thus making m equal to n . The variable condenser C is then adjusted until a balance is obtained. Then, the dial reading of the standard condenser C will indicate the capacity of the unknown condenser CX; since m and n are equal.

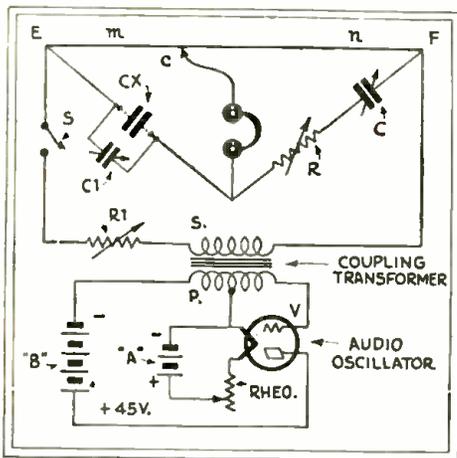


Fig. 5

The most satisfactory operation of the bridge is obtained with an A.C. oscillator giving a good note.

A midget condenser, C1, is necessary in this measurement so that a balance (at the minimum capacity of C) may be had, and the zero reading of C taken without the unknown condenser CX in the circuit. It is required also to bring the balance point further up the scale on C when measuring small values of CX.

The effective resistance of the condensers enters into the measurement of capacities exactly as in the measurement of inductances; but, in the case of condensers using air as the dielectric, this is not very important because the resistance of such condensers is almost zero. However, where condensers have different dielectrics, (for instance, air, and "mud" compositions), there will be a considerable difference in

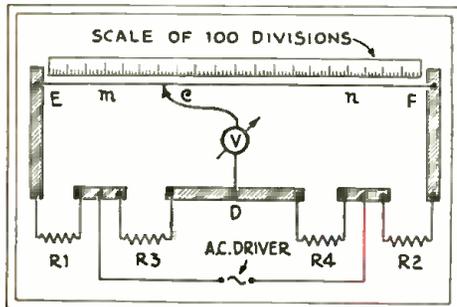


Fig. 6

A wooden base, 8 x 45 inches, will mount a one-meter rule as shown; or the "reciprocal" scale of the February article may be used.

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their resistances; which means that it will be impossible to get a silent point in the telephones. However, a fair balance point can usually be secured.

Because of the insulating properties of condensers, the circuit will be open; therefore, it is impossible to balance this bridge with direct current. However, a good balance, with fair accuracy, is generally found when using the fundamental circuit shown in Fig. 3.

In order to secure a more accurate balance with this bridge, it is necessary to connect a variable resistor R in one or the other of the condenser arms, (X1 or X2, Fig. 3.); the proper place is found by trial. This will compensate for any resistance effect introduced by the condenser in the other condenser arm. The readings of this resistance, with and without the condenser CX, are indicative of the losses in the condenser under test. This is a check-up of "leaky" condensers.

Construction of a Slide-Wire Bridge

The connections between the components of the bridge are made on the top of the wooden base by means of brass straps 1½ inches wide and ¼-inch thick (Shown in Fig. 6.). The holes for the terminals are tapped the correct size.

The wire used for m and n may be of any standard make of resistance wire (such as nichrome, German silver, constantin, etc.) and its gauge from No. 24 to No. 28 B & S.; as these are the most convenient sizes with which to work. (Note: Be careful to secure uniform wire, for the resistances of the two arms of the bridge m and n are proportional to their lengths only if their cross sections are equal.)

The resistance wire is stretched taut almost flat on the board, and securely fastened at E and F to the brass strap at each end of the bridge. The meter-scale is mounted directly beneath the resistance wire, thus positioning the slide-wire about ¼-in. above the meter-scale. The contact slider c may be one of the sharp edges of a ¼-in. brass rod; the opposite edge being soldered to a length of rubber-covered lamp cord. Compare Fig. 6 with Fig. 2.

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The "Air King"

(Continued from page 735)

If you cannot pick up adequate "B" voltage from your receiver under any circumstances—and this is a very rare condition—then you may introduce a 45-volt "B" battery, connecting the negative terminal to the ground and highest positive to the "B+" lead of the converter.

Operation a Simple Task

And now for tuning in. Turn on the switch of the receiver, and see that the tubes in the converter are lighted. Press in the coil switch at the rear of the converter. Then, after waiting for the tubes to heat up (which should not take more than one minute even with slow-heating tubes) listen carefully to your broadcast receiver, for the familiar rushing sound in the loud speaker. If this sound is not present, turn up on the volume control of your receiver. If this still does not cause the sound to appear, then turn the volume control in the opposite direction; for if the broadcast receiver oscillates at the high frequency to which it is tuned, only a quiet hiss will be audible, and you may not be able to tune in a short-wave signal. Be sure that the receiver is not oscillating; if possible operate it just under the point of oscillation, or (if it is a stabilized receiver) at or near the maximum volume position of the volume control.

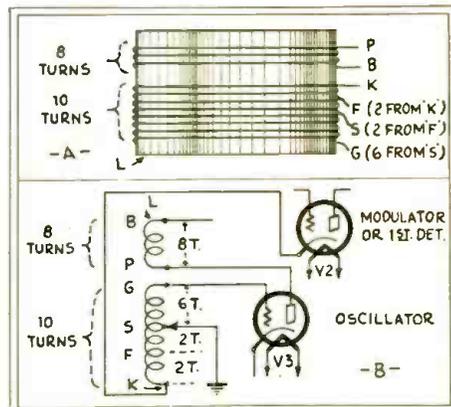


Fig. 3

Oscillator coil form at A; schematic at B. The "Hi-Lo" switch, shorting F to S, lowers the minimum wavelength of tuning.

Now, very slowly, rotate the tuning dial of the converter. If you have had no previous experience with short-wave reception, recognize now the well-established fact that it is easier to pass over the short-wave signals within the sensitivity range of your receiving system, than to tune them in. The loudest short-wave station receivable will come in strong at a given position of the converter's dial, yet, possibly, be tuned out completely by a movement of that dial equal to only one eighth of a division.

After having tuned in a strong signal at one position of the converter dial, try to tune it in at another position of the same dial. About one third of the number of strong stations you will be able to receive will come in at two settings of the oscillator dial. If interference is suffered, try the alternative setting, whereupon this interference may disappear. If it does not, another

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remedy is to change the setting of the receiver dial ever so slightly; thus barely altering the intermediate frequency, and retune the converter.

With the switch out and the full eight turns used on the tuned secondary, the greatest number of stations will be received; as most people will listen at night, when wavelengths from 35 to 120 meters come in strong. Below 35 meters, there is little to be heard at night, and around 20 meters, next to nothing, because of the peculiar behavior of short waves at night. During the daylight, however, stations on the lower wavelengths should be received.

Information Bureau

(Continued from page 742)

the RCA-Radiotron type of UY-235 "super-control" tube differ from the regular '24 screen-grid tube which it replaces, in circuits designed for its use?

(A.) As stated in the article, "Recent Advances in Radio Tube Design," in the April, 1931, issue of RADIO-CRAFT (page 599), the variable-mu tube may take any of a great number of different forms, in the design of the elements, to obtain the "automatic variation of the mutual conductance" of the tube which prevents "cross-talk," due to the proximity of a powerful local station.

The construction of the regular type '24 screen-grid tube is shown at A in Fig. Q123. The control-grid G1 is wound symmetrically, and the screen-grid has two cylindrical meshes: an outer screen-grid O. S.-G., and an inner screen-grid I. S.-G.

The design of the elements of the new variable-mu screen-grid, particularly the RCA-Radiotron type '35 "super-control" tube, is shown at B. The control-grid G2 is wound with uneven spacing, and the inner screen-grid I. S.-G. is made conical, one end coming closer to the control-grid, and the other to the plate.

The symbol of a type '24 tube is shown at C; and a proposed symbol for the '35, at D.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Radio-Craft, published monthly at Mt. Morris, Ill., for April 1, 1931.
State of New York
County of New York

ss. Before me, a Notary Public in and for the State and county aforesaid, personally appeared Irving S. Manheimer, who, having been duly sworn according to law, depose and says that he is the business manager of Radio-Craft and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Techni-Craft Publishing Corp., 404 North Wesley Ave., Mt. Morris, Ill.; Editor, Hugo Gernsback, 98 Park Place, New York City; Managing Editor, R. D. Washburne, 98 Park Place, New York City; Business Manager, Irving S. Manheimer, 98 Park Place, New York City.

2. That the owners are: Techni-Craft Publishing Corp., 404 No. Wesley Avenue, Mt. Morris, Ill.; Hugo Gernsback, 98 Park Place, New York City; Sidney Gernsback, 98 Park Place, New York City; D. Manheimer, 98 Park Place, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, bond stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

IRVING S. MANHEIMER

Sworn to and subscribed before me this 1st day of April, 1931.

MAURICE COYNE, Notary Public.
(SEAL)

(My commission expires March 30, 1932.)

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CUT DOWN USELESS SERVICE CALLS: You will find this article to be a money-saver, as well as a money-maker, for you. The majority of your service-calls are due to line-noises. How much time and material has been wasted by your Service-Department making special apparatus to cut down line-noises? Now a simple installation of the "MAXIM FILTERAD" and your troubles are over. Works on all currents—Automatic—Requires no adjustments—Take advantage of this offer now!

Heavy Duty Model

OUR PRICE **2.65** Net

ELKON 5,000 HOUR DRY "B" RECTIFIER

Type EB11. For "B" eliminators using Raytheon BH tube.



Replaces rectifier tubes in "B" eliminator. Dry, solid, rugged. Not affected by accidental overloads or line surges. Fully self-healing. Power is much smoother, and quieter.

List Price \$6.00
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GENERAL ELECTRIC HIGH VOLTAGE FILTER CONDENSER

3 MFD. — 800 VOLTS

Size: 5x2 3/4 x1 Inch.



Encased in a sturdy metal container with 8 inch flexible insulated wire leads. Equipped with handy mounting brackets.

OUR PRICE **95c** Net
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MAXIM "Silent" Power Supplies Reduced



DRY "B" POWER

Contains no liquids. A distinct radio bargain that will be of interest to the experienced radio buyer. (Complete with tube.) For A.C. Current.

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DRY "A" POWER

Regardless of price no finer "A" Power Eliminator can be procured. No need of bothering with expensive "A" batteries. Complete—for A.C. current.

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DRY "A-B" POWER

Ultra modern design. Compact. Simple to install. Only one switch. Comes complete with a 280 tube ready to operate.

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A C M E HANG-UP REPLACEMENT CONDENSER SECTIONS



FOR GENERAL REPAIR AND POWER-PACK WORK

Every Service Man should always have on hand several units of each capacity and voltage to meet every emergency!

Working Capacity	Voltage D. C.	Our Price
1/2 Mfd.	500 V.	\$0.35
1 Mfd.	450 V.	.45
1 Mfd.	600 V.	.60
1 Mfd.	800 V.	.80
1 Mfd.	1000 V.	.90
2 Mfd.	400 V.	.70
2 Mfd.	600 V.	.90
2 Mfd.	800 V.	1.10
2 Mfd.	1000 V.	1.25
3 Mfd.	400 V.	.95
3 Mfd.	600 V.	1.15

MAXIM DRY High Voltage ELECTROLYTIC CONDENSERS



For use in modern filter circuits. Dealers and Service Men may use these units of standard size for general replacement and repair work. They have 400 V. working voltage—500 V. peak voltage.

8 MFD.
 Easy to Mount
 OUR PRICE **\$1.25** Net
 List Price \$2.75

List \$5.00 NATHANIEL BALDWIN RIVAL UNIT



This Nathaniel Baldwin unit is one of the finest made by that company. Can be used for Phonograph, Automobile and Portable Radio Outfits. Order your supply today before it is too late.

OUR PRICE **65c** Net

WESTINGHOUSE CARBON PIG-TAIL RESISTORS



Fine for AC sets and Power Amplifiers.

ohms	Price
100	1,200
150	1,500
200	2,000
300	2,500
400	3,000
500	3,500
700	4,000
750	4,400
875	5,000
1,000	10,000
1,125	15,000
2 Meg.	
3 Meg.	

OUR PRICE **1.00** Per dozen

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STAR MIDGET

A record-breaking seller

6 TUBE—SCREEN GRID RADIO

A wonderful little radio. Looks beautiful and sounds better. Sells an unusually big percentage of customers. Designed and engineered with every modern improvement in radio circuit engineering.

Has an attractive walnut finished cabinet, beautifully built chassis using 3-224's; 2-245's; 1-280. Employs power detector and push pull amplification; has automatic local distance switch; tone control; phonograph jack; full shielding; electrolytic self-healing condensers; and matched Dynamic Speaker of outstanding power and tone qualities. Licensed under RCA patents.

An outstanding value! A fast seller! Play it up big for summer homes.

List \$65.00

To You . . . \$29.50

Set of Triad Tubes \$1.75
RCA or Cunningham Tubes \$7.00

A few striking values from our big Catalog

Dependable values. The kind that make friends for you as well as for us. Merchandise you do not have to be afraid of. That's what you can depend upon getting from Radio Circular. That's why Radio Circular does a business running into the millions every year. And that's why it will pay you to get acquainted with the real bargains, the sound values and the big profits Radio Circular can offer you.

FOR INSTANCE:

Bright Star Focusing Flashlight, No. 716—A large two cell focusing Flashlight. Solid Brass corrugated case with Nickel-plated Head and Bottom Cap. Pool-proof switch that locks on and off and also flashes for signaling. The octagon Head prevents rolling and ring on bottom facilitates hanging. Can be used as a Candle-Light. Equipped with a Genuine Mazda Bulb and a Bright Star Battery. Complete with 2 No. 10 cells. An exceptional value. Usual price \$1.00, **To YOU 75c**

Standard Hi-Voltage Unused Surge-Proof Condensers. For general repair and power pack work. Small and compact, impregnated in pitch with long flexible leads of push-back wire to facilitate quick connections. Can be placed outside of pack. Guaranteed for 100% free replacement.
1 mfd.—600 Working Volts, each 30c
2 mfd.—600 Working Volts, each 40c
4 mfd.—600 Working Volts, each 60c
1/2 mfd.—300 Working Volts, each 25c
1 mfd.—800 Working Volts, each 50c

Condenser Block for Majestic "B" Eliminator. Majestic Super B; Majestic Master B; Majestic Special Master B. **To YOU \$2.65**

Naald Bakelite Sockets—for sub panel mounting. Phosphor Bronze Contact Springs. For 226—227—224—280—245 Tubes. **To YOU, each 6c**

I.C.A. Test Leads—a convenience to the set owner and a necessity for the radio service man or dealer. Unsurpassed for testing sets and tracing trouble in sets where shorts, opens and other defects common to radio sets are encountered. Easily attached to any meter for testing batteries or any electrical apparatus. **To YOU, per pair 45c**

Sprague Electrolytic Condenser. High capacity in compact space. Absolutely puncture proof, self healing. Screw socket facilitates installation in every type of set. Rated 8 mfd. at 430 volts D. C. List \$2.50. **To YOU only 95c**

Gordon Arnie 4 Pick Up with volume control. The arm is made of genuine Bakelite with a beautiful natural wood finish. Is good looking and will not show wear as will plated metal parts. Faithfully reproduces the entire musical range. **To YOU \$4.50**

New Bosch Speaker. The newest model—beautiful design and superlative accuracy. Built to withstand the vibrations of deep tones and to reproduce every shading with surprising smoothness and volume. For all types of receivers without adjustment of the speaker or attention to the correct polarity of the cords. Sells readily at \$25.00. **To YOU \$3.50**

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These are only a few samples of the values to be found in our catalog. It is full of items on which you can make from 50% to 300% profit. And the best of them is, they are sound, well known, trademarked articles you can depend upon.

Send 20% with the order and articles will be shipped C.O.D. Order any of the above articles direct from this page. And be sure to ask for the catalog. It means money to you!

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225 Varick St. New York City

Midget Radio Table



Artistic design, sturdy, well constructed and beautifully finished in walnut. Size of top 11x17 in. Height 28 in. Weight 10 lbs.

List \$9.75

To YOU . . . \$2.50

Kolster Speaker

Here's the year's best buy. The name alone, sells it. Kolster magnetic type cone loud-speaker. Dimensions: Height 11 inches, width 11 inches, depth 6 1/2 inches.



List \$35.00

To YOU . . . \$3.95

Famous Model "G" Gordon Phono-Motor and Turntable

First time at this price. Ruggedly constructed throughout. Spanish felt gears assure silence. Equipped with automatic stop control. Induction type, no brushes. Easy to install—exceptionally quick starting torque. For 110 volt 60 cycle alternating current. Proven dependability has made this New Gordon Electric Phonograph Motor and Turntable the accepted standard of excellence for the industry.

First time at this price. Make a nice profit and build good will with everyone.



List \$30.00

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Farrand Dynamic Chassis

Height
9 in.
Width
8 1/4 in.



Depth
7 in.
For A. C.
Current

Famed for its simplicity and reliability. Easily installed in all types of radio or phonograph consoles. Tonal range and fidelity superior to any other reproducing unit in general use.

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Please send me your catalog of radio bargains I can make a profit on.

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you the latest and lowest prices up to the time this ad is printed. We watch our competitors and do not allow anyone to undersell us. We meet ANY price on NEW merchandise. Order direct from this page and save money. 100% satisfaction on every transaction.

Dry Electrolytic Condensers

Mount in any position! Guaranteed never to blow out! Remarkably compact and very inexpensive, permitting generous use of filtering systems. The greater the mfd. capacity employed, the less A.C. hum remains. 500 volt peak rating. Ideal for all 171A - 245 power packs—use two of each capacity desired for 250 power packs (1,000 volt peak thereby assured).



YOUR PRICE

No.	Mfd.	Diameter	Length	PRICE
1804	1	3/4 in.	2 1/2 in.	\$0.27
1802	2	1 in.	2 1/2 in.	.44
1804	4	1 1/2 in.	2 1/2 in.	.83
1808	8	1 3/4 in.	3 1/2 in.	1.20
1816	16	3 in.	4 1/2 in.	2.10
1824	24	3 in.	4 1/2 in.	2.70
1832	32	3 in.	4 1/2 in.	3.30
1854	54	3 in.	4 1/2 in.	4.73

Adjustable Voltage Divider



Designed for extra heavy duty. It can be used in any radio power operated set. "B" eliminators, power packs, amplifiers, etc. Especially useful in all radio set reconverting battery sets into power sets. The correct voltage is obtained by loosening screws of sliders and by moving the latter into the correct position. Voltage cannot vary due to the peculiar construction of the resistor and contact sliders. Shipping weight 3/8 lb. List \$1.50. No. 2275—Divider, 10,000 Ohms. 75c

3 sliders..... 75c
No. 2276—Divider, 25,000 Ohms. 75c
4 sliders..... 75c

Peerless ABC Power Transformer—80 Watts

As used in "Courier Model 65" chassis. Plate, control-grid, screen grid. Filament voltages for three '24's, two '27's, two '45's, and '80 rectifier (electrostatic reproducible blurring potential rectifier). Has approximately the following output ratings: 2.5 V., 10 A.; 700 V., center-tapped, 350 V., and 120 Ma. on each side; 3 V., 2 A.; 3 V., 60 Ma. Primary tapped for low or high line voltage. The correct replacement for big sets. For 110-120 volts, 50 or 60 cycles. Dimensions 4x4x3 1/2 in. Weight 6 lbs. List \$12.00. \$2.65
No. 1403—YOUR PRICE



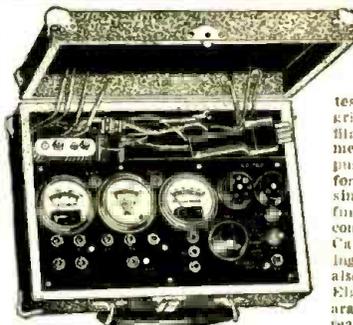
Kolster Speaker Chassis

May be connected directly in the plate circuit of type '12A' tubes; or to higher-power tubes through an output device. In push-pull circuits, speaker may be connected from plate to plate. "9 inch cone" type. Paper-ratio is prevented by a flannel damper; bass notes are well reproduced due to the "free-edge" effect. Its small dimensions make it eligible for use in home-constructed mid range sets.

Comes with 6 ft. cord. Dimensions: 10 x 8 1/2 x 9 1/2 inches. Shipping weight 6 1/2 lbs. List Price, \$18.00. \$2.80
No. 1500—YOUR PRICE

A.C. Short Wave Converter

The thrill of tuning in short waves is yours, because you can connect this short-wave converter to your broadcast receiver, no matter what type receiver you have. Tunes from 10 to 200 meters, using only two plug-in coils. Coils, already wound, are supplied with outfit. Converter has built-in filament transformer to heat three 227's. All you need obtain from your receiver is a positive "B" voltage, anything from 45 to 180 volts. Voltage not critical. No modulation of the receiver. No tricky regeneration control, only a single, smooth-operating dial to manipulate. No squeals, no grinding, no body capacity. All parts for 3-tube short-wave converter, including cabinet, with filament transformer, complete instructions and pictorial diagram. Shipping weight 8 lbs. List Price \$20.00. \$9.45
No. 1617—YOUR PRICE, less tubes



NEW READRITE Analyzer

This three-meter analyzer has selector switch for checking all parts of tube circuits by connecting to the set sockets. Selection for testing voltages of plate, grid, cathode and screen-grid done quickly and accurately. Plate current, filament volts, line and power supply volts are measured. Grid swing test for tubes used. Just push one button for screen-grid and other button for other tubes. Makes testing of all type tubes simple and thorough. 4 1/2-volt grid battery is furnished. Battery is used for grid test and continuity testing of transformers, chokes, etc. Capacity and resistance charts furnished showing use of instruments for testing condensers, also measuring resistances up to 100,000 ohms. Eight scale readings of meters may be used separately with the jack terminals provided. Scale readings are 0-60, 300-600 D.C. volts, 0-10-140. 700 A.C. volts and 0-20-120 milliamperes. A.C. and D.C. filament voltages are accurately measured on the one meter. Strong case with leatherette covering. Attractive. Compact. Complete. Fills every need for the expert serviceman or the beginner for radio set analyzing. Size 10 1/2 x 3 1/2 x 8 inches. Shipping weight 15 lbs. List Price \$25.00. \$14.70
No. 700—READRITE ANALYZER. YOUR PRICE

R.C.A. Double Filter Chokes

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 180 Mils; connected in series, 60 Henries at 80 Mils. Fully shielded in heavy metal case with special insulating compound. Size 5 1/2 x 3 3/4 x 2 1/2. Shipping weight 6 lbs. List Price, \$10.05. 90c
No. 8336—YOUR SPECIAL PRICE



Earl Power Transformer 70 WATTS

Make money re-wiring 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, 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 1-mf. filter condensers, two 30-henry chokes and by-pass condensers complete fine power pack. Size 3 1/2 x 3 x 2 1/2 inches. 16 long leads and full wiring directions. Shipping weight 5 lbs. List Price \$7.50. \$1.73
No. 1410—YOUR SPECIAL PRICE



"250" A.C. Power Transformer

This power transformer supplies currents for five 15-volt Aroturus tubes drawing 5 Ma. and 3/4 amp. on filaments; one 2.5 V. tube; two '50's, two '81's. Two 227 or 223 (if suitable resistance is used) and 750 volts. Full wave "B" and "C". Entirely shielded in metal. 4 1/2 x 1 1/2 x 6 1/2 inches high. Weight 15 lbs. For 110-120 volts, 50-60 cycles. List \$20. \$3.75
No. 1412—YOUR PRICE



Professional Telegraph Key

Used for telegraphy, radio, home practice, house-to-house communication, as a keying means in test circuits, etc. Mounted on heavy micanite base 3 1/2 x 1 1/2 in. Has 2 switches to telegraph on two circuits, independently or together. A wonderful chance to get a commercial telegraph key with sturdy 1/2-in. silver contacts! Handles a lot of power. Shipping weight 2 lbs. List price \$3.50. 70c
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FREE!

NEW SUMMER EDITION



The new Summer Edition of our greatly enhanced RADIO SERVICE TREATISE has just come off the press. If you liked the Winter issue, you will like this one a hundred-fold. It contains some 75 new hook-ups, circuit diagrams; and some 350 illustrations. POSITIVELY THE GREATEST BOOK EVER PUT OUT BY ANYONE. Among the new matters listed are:

VACUUM TUBE TREATISE, with many illustrations; full page Vacuum Tube Average Characteristic Chart; How to Take Care of Your Tubes; How to Connect Phonograph Pick-ups; Improving the Tone Quality of Old Sets; Connecting Additional Loud Speakers; Other articles: Modernizing Old Radio Sets; How to Convert Battery to Power Sets; Selection of Tubes; Push-Pull Amplifiers; Replicating Audio Transformers; Phono Attachments; How to Choose Power Transformers; Voltage Dividers; Winding of Power Transformer Parts in Radio Sets; Filter Condensers; Replacing Eliminators. WRITE TODAY. Enclose 2 cents for postage. Treatise sent by return mail.

6 MONTHS GUARANTEED NEONTRON TUBES

Sold on a 6 MONTHS FREE REPLACEMENT GUARANTEE BASIS, PROVIDING TUBE LIGHTS! All tubes are carefully meter-tested before shipment, and carefully packed. Do not confuse these HIGH QUALITY tubes with any other "low priced" tubes—our low prices are possible because we do a VOLUME business!

Choice of	Choice of	Choice of	Choice of	NEW
226	112A	245	222	Choice of
227	200-A-199UX	280	210	230
171A	199UV-120	171	250	231
201A	224		281	242

63c each 69c each 79c each \$1.58 each \$1.08 each



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, 9 1/2 in. wide, 7 1/2 in. deep. Speaker cones 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. \$7.45
No. 1506—YOUR SPECIAL PRICE



Kolster Power Transformer 85 WATTS

Will supply sufficient current and voltage for push-pull '10's in conjunction with type '81 half-wave rectifiers. The 225-volt secondary output is just below the rated maximum for type '24 and '27 tubes; tubes will last much longer than when heated from a higher-voltage transformer. Four secondaries are rated as follows: Secondary S1, 7.5 V., 1.25 A.; S2, center-tapped, 7.5 V., 1.25 A.; S3, 1.5 V., 4.25 A.; S4, 2.25 V., 1.65 A.; S5, 725 V., 90 Ma. Primary is tapped for low line voltage. For 110-120 volts, 50-60 cycles. 4 1/2 x 4 1/2 x 4 1/2 inches. Shipping weight, 12 lbs. List Price, \$19.50. \$4.55
No. 4336—YOUR PRICE



NEW! NEW!! Superheterodyne S-W Converter

Positively greatest converter ever built. It brings in European stations daily, clear as a bell. At last a short-wave converter that converts any broadcast set into a superheterodyne short-wave receiver. Employ three 227 tubes and covers from 20 to 15 meters. No plug-in coils! Coil switch is used to cover all wavelengths. Single dial control, no body capacity, no squeals. This converter has built-in filament transformer to heat the three 227's. All you need to obtain from your receiver is a positive B voltage anywhere from 45 to 180 volts. Voltage is not critical; no modulation of the receiver. So simple a child can operate it. Size 7x10x5 inches. Shipping weight 8 lbs. No. 1614—Super Converter. List \$15.93 Price \$25. Your Price (less tubes) \$15.93



Genuine Magnavox Microphone

Do Your Own Home Phonograph Recording Made by the world-famous Magnavox Co. Originally made to strap on the head, it is easy to screw a handle onto one of the side brackets. The side brackets are covered with soft rubber and place the microphone at the best speaking distance from the mouth. Comes with 6 feet of cord. The biggest mike bargain in America! Complete with straps and buckle to fit around head. Brand new, in original factory packing. Shipping weight 1 lb. List Price, \$10.75. \$1.55
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High-Voltage Condenser Units

We guarantee these condensers unconditionally. They are ideal for general replacement purposes and can be installed in any new power-pack. All condensers are furnished with 8-inch lengths of tinned "push-back" wire.

600 VOLTS			800 VOLTS		
Cat. No.	Mfd. Capac.	Your Price	Cat. No.	Mfd. Capac.	Your Price
1702	1/2	\$0.25	1706	1	\$0.40
1703	1	.30	1707	2	.70
1704	2	.40	1708	4	1.05
1705	4	.60			

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The Entire World of Radio

ON A SINGLE KNOB

15 TO 650 METERS

NO COILS TO CHANGE



The New **PILOT** **UNIVERSAL SUPER WASP RECEIVER**

Pilot's wonderful wave band changing switch, incorporated in the new Universal Super-Wasp, revolutionizes the short wave art. No longer need numerous coils be changed to cover the various wave bands. No longer need dial settings change each time the same distant stations are tuned in. You can log permanently all the stations you can get throughout the world, you can tune from the short waves to the high ship waves without removing your hand from the single control knob.

Universal Features Revolutionizing the Short Wave Art

Complete coverage all wave bands from 15 to 650 meters *without coil changing*. Complete A.C. operated chassis in cabinet. (Also available in battery model) All Metal Chassis.

Highly sensitive and selective circuit. Screen Grid TRF amplifier *plus* Screen Grid Detector.

227 First Audio Stage.

Two 245's in push-pull output stage.

Stations can be logged *permanently on dial*.

Regeneration control does not alter tuning.

Provision for *Phonograph Pick-up*.

Earphone Jack on *Front Panel*.

Illuminated Dials.

Handsome Walnut Cabinet.

Most advanced construction yet used for short wave work.

In kit form for easy home assembly; no drilling or cutting, all parts fully prepared.

What You Can Get on the UNIVERSAL Super-Wasp

On the short waves are hundreds of relay broadcasting, experimental and amateur stations transmitting voice and music; actually thousands of amateur and commercial stations sending code; numerous trans-oceanic and ship-to-shore telephone stations; dozens of television transmitters; and police radiophone stations in many cities.

On the broadcast ranges, the Universal Super-Wasp covers the full maximum and minimum limits, bringing in broadcasts never heard on the average broadcast receiver.

Above broadcast ranges, the Universal brings in ship and shore stations on 600 meters.

What other receiver offers you as much radio with as little effort?

Ask your dealer for a demonstration!

NOTICE TO "HAMMS": Pilot will continue building the original Super-Wasp in kit form for licensed amateurs and others who want to spread the tuning on their pet wave bands and add their own audio features. A. C. and battery models.

Pilot Universal Super Wasp **\$79.50** A.C. Model (K-136) in Kit Form

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ANNOUNCED
IN APRIL
"RADIO"

WHEN THE PENTODES ARRIVED

SUPREME WAS WAITING FOR THEM

A GAIN Supreme engineering vision and insurance against early obsolescence writes its record in radio servicing progress. When the SUPREME SET ANALYZER (known as Model 90) was introduced, it was prepared for the advent of the new pentode sets. The only Analyzer already provided with adequate meter ranges and switching facilities for all tube tests and circuit analytical indications of the new space charge (pentode) power amplifiers. When the pentodes arrived Supreme was waiting for them.



Dealers Net Price.
F. O. B. Greenwood, Miss. **\$78⁵⁰**

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YOU can't service today's radio with yesterday's equipment. So when you buy an ANALYZER now to replace the one incapable of giving a modern complete service, profit by the experience of more fortunate radio-men and INVEST in engineering foresight and leadership—choose the SUPREME ANALYZER, the instrument with the one "wonder-meter," whose flexibility will prove astounding.



AN ADVANCED

OSCILLATOR, TOO



SETS a new standard in oscillator design. Hundreds were glad to wait for the "Supreme" Oscillator, (known as Model 70) placing orders in advance of delivery date, April 15th. The Radio World recognizes Supreme's reputation in Service Instruments "SUPREME BY COMPARISON."

Both Oscillator and Output-Ohmmeter of advanced design. Model 70 covers intermediate frequency range from 90 K. C. to 550 K. C., and broadcast range of 550 to 1500 K. C. Operates from A. C. or D. C. 110 volt line or self-contained batteries. Completely shielded—tapered output control. Output meter of rectifier type is also provided with resistance measuring range of 0 ohms to 1 megohm.

SUPREME DIAGNOMETER 400-B and SUPREME TUBE CHECKER Model 19 are also adaptable to Pentode servicing. Write for instructions.

Keep pace with radio service progress—place your order today.

Supreme Oscillator Model 70, Less Tube and Batteries. Dealers Net Price, F. O. B. Greenwood, Miss. **\$49⁷⁵**

Supreme Output-Ohmmeter. Dealers Net Price, F. O. B. Greenwood, Miss. **\$30⁰⁰**

Handsome carrying case of hardwood for combined Oscillator, Output-Ohmmeter, and Accessories. Dealers Net Price, F. O. B. Greenwood, Miss. **\$5⁰⁰**

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