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Special Beginner's Number

OVER 175 ILLUSTRATIONS

Radio-Craft

HUGO GERNSBACK EDITOR

March
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MAKING A SNOW LOUDSPEAKER

See Page 526

Making "The Beginner's 'Book-End 3'"—How to Make a "Junior" Oscilloscope
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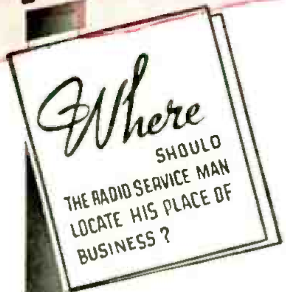

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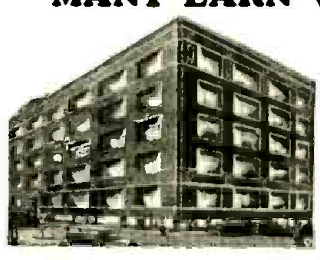

If you need part-time work to help pay living expenses while at school, tell us your problems and we may be able to help you as we have hundreds of other students. Then, after you graduate, our Free Employment Department will give you life-time employment service. Every Coyne graduate also receives a Life Scholarship, with free technical and business service and privilege of review at any time without additional tuition charge.

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Radio-Craft
For The Service Man · Dealer · Radiotrician

Special Beginner's Number

HUGO GERNSBACK, Editor-in-Chief
C. W. PALMER, Technical Editor
C. P. MASON, Associate Editor
R. D. WASHBURNE, Managing Editor

CONTENTS-MAR., 1937, ISSUE

Volume VIII Number 9

FORTHCOMING ISSUES WILL TELL YOU—

—How to make an up-to-date short-wave diathermy machine!
—How to make the RADIO-CRAFT tube checker that tests all the tubes now on the market!
—How to make a combined "color organ" and "color-tuning" adapter for any superhet. receiver!
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—How to make a beginners' radio set that entails only about one evening's work and only a small cash outlay!

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National Radio Institute

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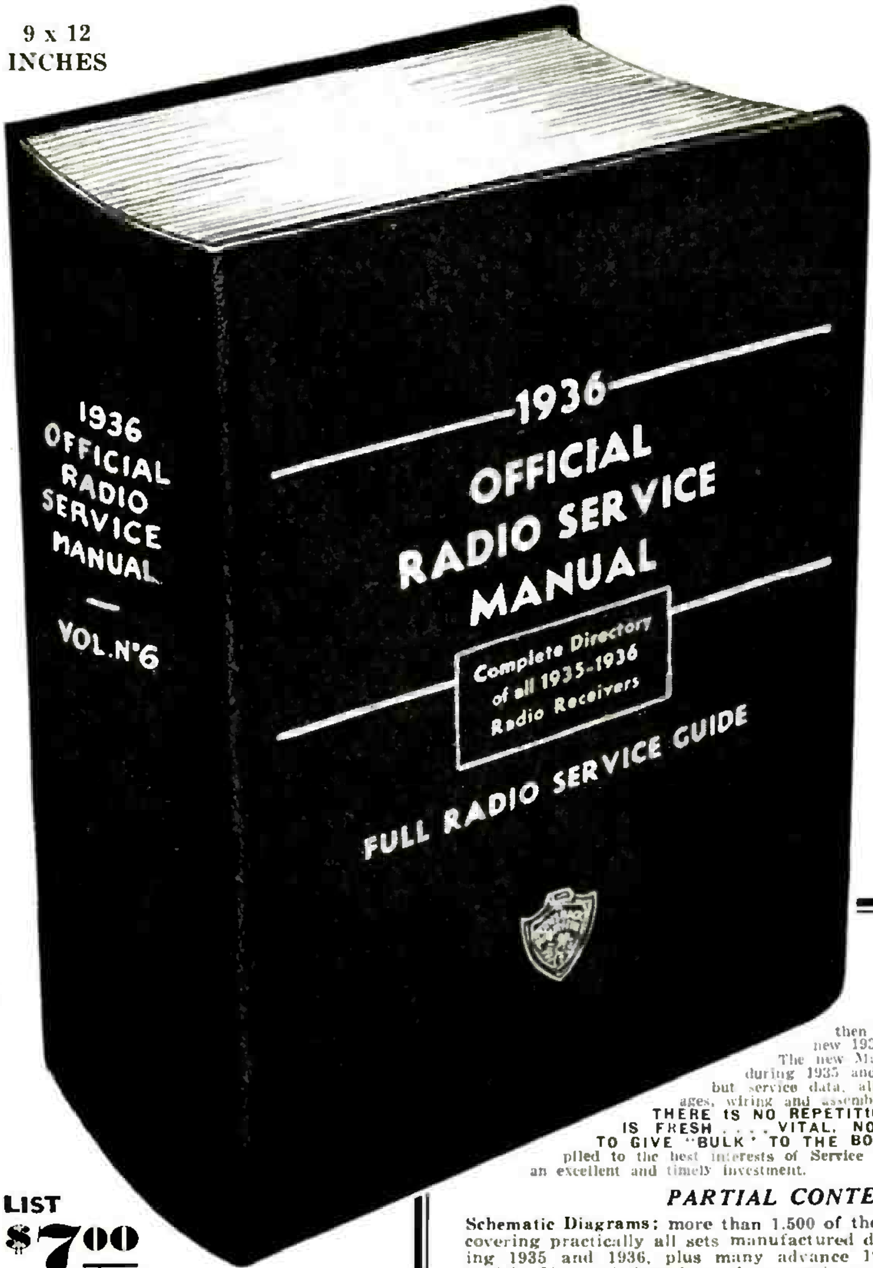

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more diagrams, more data, more pages, more essential service material and considerably greater value for your money. If the sale of previous Gernsback Manuals is any indication then many thousands more Service Men will be using this new 1936 Manual than any of the previous volumes.

The new Manual incorporates all available diagrams of sets manufactured during 1935 and 1936, plus many advance 1937 models. Not only diagrams, but service data, alignment procedure, intermediate frequency peaks, socket voltages, wiring and assembly diagrams, etc., etc., are included.

THERE IS NO REPETITION IN THIS MANUAL! EVERY BIT OF INFORMATION IS FRESH . . . . VITAL, NO REHASH . . . . AND NO USELESS MATERIAL JUST TO GIVE "BULK" TO THE BOOK. The entire contents has been carefully edited and compiled to the best interests of Service Men. The 1936 OFFICIAL RADIO SERVICE MANUAL is an excellent and timely investment.

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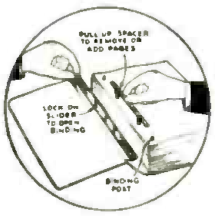

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PARTIAL CONTENTS OF 1936 MANUAL

Schematic Diagrams: more than 1,500 of them, covering practically all sets manufactured during 1935 and 1936, plus many advance 1937 models. Many of them have the operating voltages of the various tube elements printed directly on them.

Wiring Diagrams: wherever they have been obtainable, the wiring diagrams of the more complex receivers, such as the all-wave and high-fidelity sets, have been included.

Miscellaneous Diagrams: these include speaker connections, optional phonograph connections, power transformer connections, R. F. and I. F. coil connections, complete phonograph motor connections on combination receivers, etc., etc. Wherever these diagrams were available they have been included in the 1936 Manual.

Intermediate Frequency Peaks: all set models (with few exceptions) have their respective intermediate frequency peaks marked either directly on their schematic diagrams or in their notes on alignment procedure.

Alignment Procedure: even if space permitted, it would not have been advisable to print the alignment procedure on all the simpler sets for one would have been a repetition of the other. On the more complex receivers, however, the all-wave and high-fidelity sets, complete alignment procedures, step-by-step, have been included.

Service Data: wherever the information was made available to us, such data as typical faults in a given receiver, their symptoms and remedies, was included in the 1936 Manual.

Assembly Diagrams: on combination models, i. e., sets combined with phonographs (either the manual or automatic types), complete assembly diagrams are given. These diagrams show the relationship of the separate units to each other and the way they are inter-connected.

Operating Voltages: the operating voltages given in this Manual (for more than 80% of the sets listed) are the normal voltages; any deviation from these values indicates trouble in the associated circuits.

Trade Name Index: in the back of the book, is a complete index of trade names and their respective manufacturers.

Complete Tube Chart: in the back of the Manual will be found the latest, and most complete tube chart of all type tubes ever manufactured for receivers.

Large Cumulative Index: includes all sets printed in the 1931, 1932, 1933, 1934, 1935 volumes as well as the present 1936 Manual. The sets in this volume have been listed in the index in an entirely new and more convenient manner so that the busy Service Man need no longer thumb through an entire manufacturer's section in order to find some particular piece of information. He need but consult the index.

If your jobber or mail order house cannot supply you, order any of the OFFICIAL RADIO SERVICE MANUALS or the OFFICIAL RADIO SERVICE HANDBOOK from the publishers. Send your remittance in form of check or money order—or, if you send cash or unused U. S. Postage Stamps, be sure to register your letter. ALL ORDERS ARE FILLED PROMPTLY. BOOKS ARE SENT TO YOU POSTAGE PREPAID.

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FOR THE SERVICE MAN · DEALER · RADIOTRICIAN
"Takes the Resistance out of Radio"
Editorial Offices: 99 Hudson St., New York, N. Y. HUGO GERNSBACK, Editor Vol. VIII, No. 9, March 1937

THE RADIO NEWCOMER

An Editorial by HUGO GERNSBACK

EVERY YEAR radio attracts a new crop of people who sooner or later come into the fold and stay for many years.

Believe it or not, radio still holds a great lure for thousands of people who suddenly develop a burning interest in radio, which must be satisfied at all costs. *Nor are all these people youngsters or schoolboys;* frequently we see mechanics, bankers, dentists, lawyers, etc., who, intrigued by the mysteries of radio wish to know more about it, and they soon fall prey to the allurements of the art.

This process has been going on ever since radio started —when it still was called "wireless" in the early days after the turn of the century. The movement is still going on unabated, new recruits being gathered every day of the year.

And, believe it or not, there are still many of these radio beginners who start in as did their fathers with a modest crystal set. The radio crystal set still presents a tremendous attraction to tens of thousands of radio beginners. If this were not so, it would be impossible or at least difficult to purchase crystal detectors these days. They are still sold, however, in great variety—proof of the popularity of the crystal detector. And, indeed, the radio beginners are still hoping some day to find the *ideal crystal circuit* which will be both selective and sensitive. Also, if you are located within a mile or so of a powerful broadcast station, you can dispense with earphones, as a good magnetic type of loudspeaker or new-type magneto-dynamic reproducer will bring in the broadcast program from that station, not only fairly loud, but clear as well.

And, in our correspondence with hundreds of readers, we find that the single-tube radio set still holds a great deal of attraction for the beginner who wishes to explore the mysteries of radio. In this he has a vast advantage over the radio beginner of 10 years ago, because he now has at his disposal dozens of new and very efficient radio tubes—many of which do wonders, not only for long-distance ("DX") reception but for bringing in local stations with good loudspeaker volume, and all on a single tube. In addition, the present-day beginner has a tremendous library of radio information to choose from; the cost of his experiments is much less than that of his brethren of 10 years ago; practically all parts, including the tools, can be bought at much lower prices than was the case a decade ago—besides, the tubes and the parts are much better in quality than they were years ago.

The small, portable 1- or 2-tube set as well as the miniature pocket set are another item which constantly intrigues the radio beginner and keeps him occupied for weeks and months on end. In the daily correspondence that we receive is the proof of this popularity. Then, of course, these modern little sets are good for real distance work—and in short waves (something that the experimenter of 10 years ago had not dreamed-of).

Then we have radio beginners whose interest lies chiefly in audio-frequency amplification. They do not "go in" for radio sets, but they will take a standard set and begin to build amplifiers for different purposes. They will tinker with public-address systems, either for fun or for profit. Thus, we know a banker whose hobby it is to build intercommunication systems which he uses in his bank so he can talk to his different departments—all by means of small, compact outfits, which look like radio sets but nevertheless, are solely amplifiers.

Lately, there has developed a small boom among technically-minded *physicians* and *dentists* who are now beginning to test the possibilities of short-wave radio therapeutical apparatus.

Now, of course, this is nothing new. The point is that heretofore doctors and others bought their equipment complete. Such physicians, as a rule, do not know much about the intricacies of radio; whereas those physicians who are technically-inclined build their own equipment for their own, individual needs.

There are not many short-wave therapeutical sets available to dentists because ready-made machines do not suit the dentists' particular requirements. It is one thing to treat a boil or abscess on the neck by means of short waves, but quite another thing to treat an infected tooth. For this reason, a number of experimenting dentists have found it advisable to build their own machines to suit their particular purpose. Of course, this art is, as yet, new and a good deal of pioneering work remains to be done. So far, short-wave therapy has proven its worth, particularly, in the treatment of infections, especially, where we have to do with pus accumulation. The application of short waves here does wonders.

Another branch which holds a steady and increasing interest to beginners is what often is erroneously called radio "treasure" finding. By means of new and sensitive radio equipment, it is possible today to do not only real *geophysical prospecting* (oil and ore locating) but also serious work in commercial fields. Finding treasures is, to be sure, a romantic as well as a practical magnet to the beginner. The same instrumentality, however, has its utilitarian, though more prosaic, uses when it comes to locating hidden pipes, wires in walls, etc.—all of which, because of its recognized value to professional men in several fields, is becoming of increasing interest to a special class of beginners in radio.

The use of short waves for industrial purposes always attracts new people to radio. Thus many good engineers who have read an article or notice that short waves can be used for certain baking processes, for curing cheese, for killing insect pests in cigars, food, etc., frequently find it necessary to take up a study of radio in order to build certain radio devices for experimental research work.

The list could thus be drawn out almost indefinitely, because as soon as one new radio application becomes known, there are two new ones in the offing ready to be pounced upon by the radio experimental fraternity.

And this process is destined to increase in scope as the years go on!

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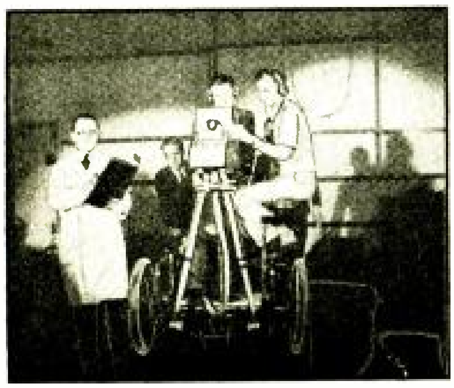
THE RADIO MONTH



An action view of the new Marconi-E.M.I. television camera.

TELEVISION NEWS SHORTS

AS usual, the past month has brought out many new facts in the erratic and somewhat haphazard movement of television toward its inevitable though somewhat obscure goal of practical scheduled transmissions.

The Crystal Palace—long known as the center of television activity in England, until the newer Alexandra Palace equipment was installed by the B.B.C.—burned to the ground, taking with it the research laboratories of Baird Television, Ltd. Fortunately, however, most of the transmission equipment of this company had been previously moved to the newer locality.

The English television transmissions which had been alternating on weekly schedules between the Marconi-E.M.I. and the Baird transmitters changed to a daily schedule, alternating daily.

At the annual convention of the Institute of Radio Engineers at Rochester, N. Y., some interesting facts were disclosed, including the news that although the present television channels are "quasi-optical" or "line-of-sight" in their characteristics, *trans-continental interference occurs* even on these *channels*! This may result in the television channels moving out of the 7-meter band into the 3-5 meter channels. And, what is more, it may be the solution to rural distribution of television service!

The Columbia Broadcasting System announced that their new "Columbia Broadcasting Center" which will be erected in New York will be designed especially for the accommodation of television broadcasting.

The *coaxial cable* between New York and Philadelphia which was completed last month by the Bell Telephone Labs. was given its first test. Dr. Frank A. Jewett, president of the Laboratories said: "This is not a television circuit as we are demonstrating it, but it is a necessary step toward television. We think we know how to use it for television, but *that is several months off*."

David Sarnoff stated, last month, that: "In the world of creative and expressive art the hardest question which television propounds is that of supplying talent. Unlike a play on the stage or a motion picture which may run for a year, the television program, once it has been shown to a national audience, is on the scrap heap. Television will call for a whole new generation of artists."

The prediction that television will be a commercial fact by 1938 was voiced by Dr. Alfred N. Goldsmith.

The British Broadcasting Company made a pretentious scale model of the route of the Coronation which will be used soon to broadcast views of the fete in London. This is one way of avoiding the pitfalls of direct outdoor pick-up!

Farnsworth Television, Inc. was granted an experimental license for their television transmitter, in Philadelphia, by the F.C.C. The new station will be known as W3XPF.

LIVING PHOTOCELLS

IN the annual report of the Carnegie Institution of Washington, some work done by Dr. Gordon Marsh at the Tortugas Laboratory of the Institution were disclosed.

These experiments concerned photocells in the form of genuine living plant cells which do, to some extent, the same work as the glass-and-wire PE. cells known to the radio profession.

These plant cells were of the species of strange sea plant—Valonia. These plants consist of a single giant cell, ranging in size from the size of a pea to that of an egg. In the experiments these plant cells had wires attached to their opposite ends. They were kept in light-tight boxes and illuminated through openings in the boxes with strong electric lamps. The cells generated weak electric currents which varied with the light intensity.

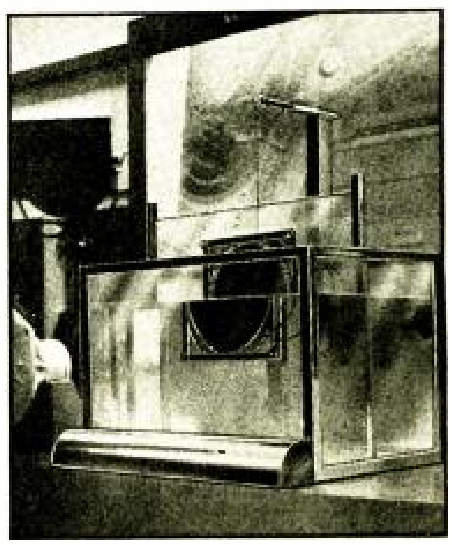
Dr. Marsh does not consider the Valonia a substitute for commercial PE. cells, but believes his experiments give a promising lead for further study.

WATERPROOF SPEAKERS

THE fragile radio loudspeaker — that device which transforms electrical impulses into sounds—has taken on new ruggedness according to information received from Germany, last month.

A new type of speaker which will actually perform when totally immersed in water and which is not injured by the immersion was demonstrated in Berlin. This type of speaker would be ideal for the "snow speaker" shown on the cover of this issue.

The Crystal Palace which burned last month. The television tower is at left.



The waterproof speaker being demonstrated.

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IN REVIEW

Radio is now such a vast and diversified art it becomes necessary to make a general survey of important monthly developments. RADIO-CRAFT analyzes these developments and presents a review of those items which interest all.

SPEAKER TALKS TO CONVENTION VIA DX 'PHONE

AT the Cleveland convention of the Institute of Radio Service Men, last month, John Rider caused a wild scramble when he failed to make an appearance at the time at which he was scheduled to speak before the gathered Service Men.

John, who had planned to reach Cleveland by plane, was grounded at Kylerstown, Pa. Hurriedly, arrangements were made for a long-distance telephone hook-up, only to find that the emergency crew of the telephone company was out on another call.

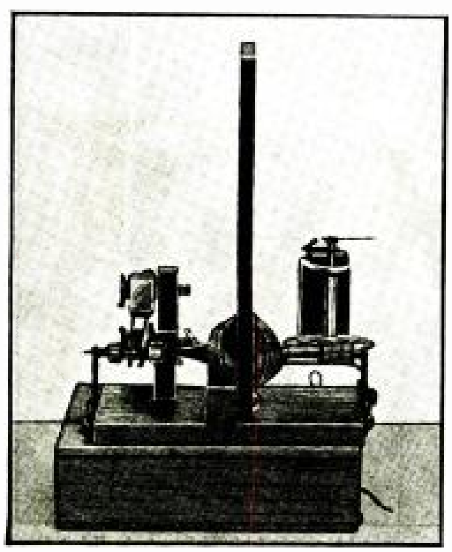
Fortunately some one at the Convention knew something about telephone circuits and an amplifier was finally rigged up to the line and the scheduled talk, sounding somewhat "tinny" but intelligible, was delivered.

We wonder if anyone thought of calling John "a grounded remote speaker" on that occasion?

MOTOR FOR RADIO METEOROGRAPHS

IN connection with its work on radio meteorographs, which are carried aloft by small balloons and are used to send out automatic radio signals giving information on weather conditions, the National Bureau of Standards disclosed, last month that they had developed a tiny electric motor which weighs less than 100 grams and operates on 8 milliamperes at 4.5 volts.

This tiny electric motor will be used to replace the spring-driven clock motors formerly used for the purpose.



One of the tiny meteorograph motors.

SOME RADIO STATISTICS

ACCORDING to the RMA report, issued last month, there are 24,269,000 families equipped with radio receivers, in the U. S. in January of this year. The year 1936 was a record one for radio set manufacturers—7,600,000 receivers being the total production which eclipsed the previous high mark of 6,300,000 set in 1935.

Over 70 per cent of the sets in use in the U. S. are obsolete—indicating good business ahead in set replacements.

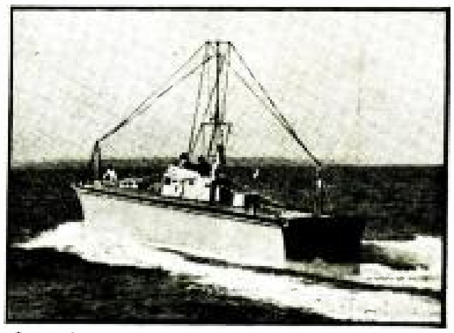
American broadcast stations made over $2,000,000 on the National Election last fall—according to final figures just made available.

The Hollywood studios of the NBC which were opened only last year—and were ballyhooed as the most elaborate and best thus made, have become too small and large extensions are planned.

The network advertising rates of the CBS have just been increased by 9 per cent which is justified according to CBS officials by the increase of 30 per cent in Columbia's audience.

The Federal government, feeling the vast interest displayed by the American people in radio, has just set up the first government studio in the new Department of Interior building in Washington. According to Secretary of the Interior Harold L. Ickes—"there is a definite place for government radio programs, just as there is a definite place for government publications.

"The government has no more desire to compete in the broadcasting industry than it has to preempt the printing business or to edit all commercial publications"—said Secretary Ickes. The Dept. of Interior controls the *National educational activities!*



One of John Bull's new motor torpedoboats.

BRITISH NAVY'S TORPEDO BOATS

THE first three of a new type of motor torpedo boat were commissioned last month by the British Admiralty.

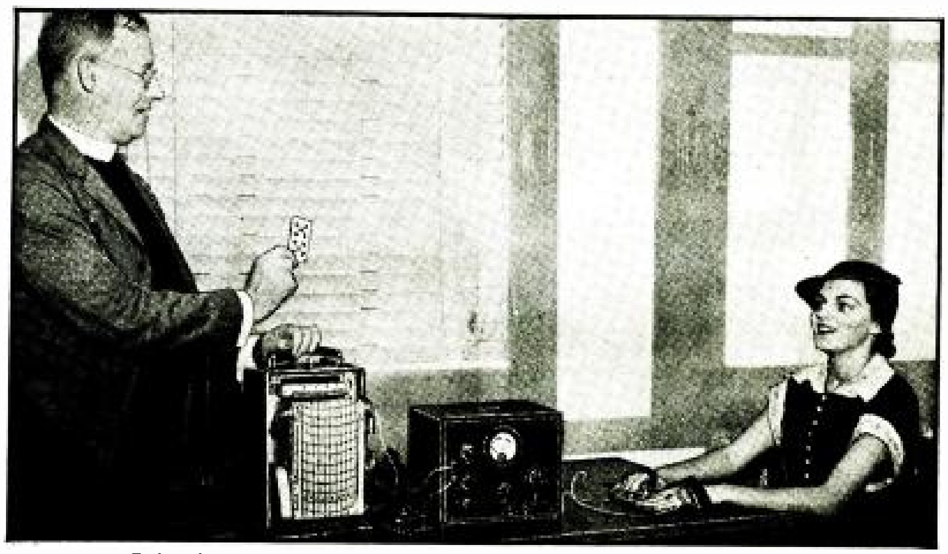
These new naval boats contain a veritable super-power radio station so that they can, at all times, keep in direct contact with the "mother ship" or supply base.

The importance of radio equipment to these comparatively small, though powerful ships can be readily understood, when it is realized that they are not self-supporting either from a fuel or food supply standpoint, over long periods of time. They must, therefore, keep in constant touch with their supply base or ship. Their effectiveness as fighting boats also depends on immediate response to instructions from the intelligence service.

A NEW PSYCHO-GALVANOMETER

A NEW type of "lie detector" depending on the minute electrical currents generated in the body under condi-

(*Continued on page* 550)



Father Summer's psychogalvanometer in operation at Fordham University.

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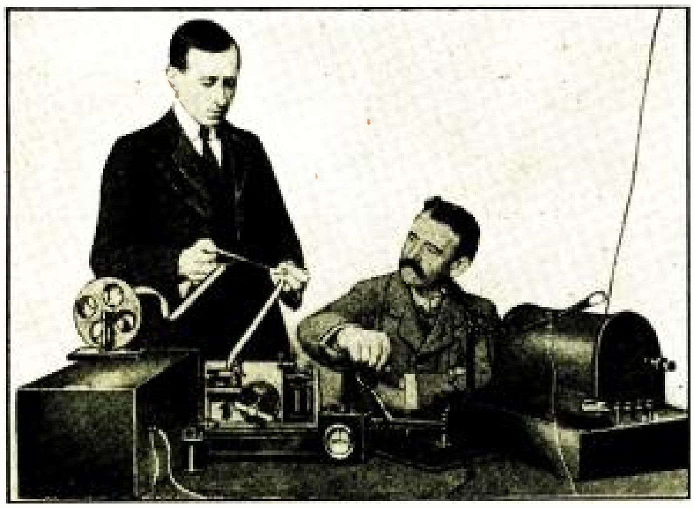

Marconi standing in front of the receiving and recording apparatus, and his assistant G. S. Kemp (seated at the massive key of the spark transmitter), at the time of his memorable reception of the letter "S" across the Atlantic from Poldhu, England to St. Johns, Newfoundland.

MY FIRST TRANSATLANTIC WIRELESS SIGNAL

December 12, 1936, was the 35th anniversary of the first transatlantic transmission of radio signals which took place in 1901.

GUGLIELMO MARCONI

A reconstruction of the kite used by Marconi in receiving the signals from England. This was an emergency aerial which replaced the large aerial blown down by a gale.

FROM THE time of my earliest experiments I had always held the belief—almost amounting to an intuition—that radio signals would some day be regularly sent across the greatest distances on earth, and I felt convinced that Transatlantic Radio Telegraphy would be feasible. Very naturally I realized that my first endeavor must be directed to prove that an electric wave could be sent right across the Atlantic and detected on the other side.

What was at that time a most powerful wireless (today, the word "radio" is ordinarily used instead of "wireless" —*Editor*) station, was built at Poldhu, in England, for this purpose, and an antenna system was constructed, supported by a ring of 20 wooden masts, each about 200 ft. high. In the design and construction of the Poldhu Station, I was assisted by Sir Ambrose Fleming, Mr. R. N. Vyvyan and Mr. W. S. Entwistle. A similar station was erected at Cape Cod, in Massachusetts, U.S.A.

By the end of August, 1901, the erection of the masts was nearly completed, when a terrific gale swept the English coasts, with the result that the masts were blown down, and the whole construction wrecked. I was naturally extremely disappointed at this unforeseen accident, and for some days had visions of my test having to be postponed for several months or longer, but eventually decided that it might be possible to make a preliminary trial with a simpler aerial attached to a stay stretched between two masts 170 ft. high and consisting of 60 almost vertical wires. By the time this aerial was erected another unfortunate accident, also caused by a gale, occurred in America, destroying the antenna system of the Cape Cod Station!

AERIAL ELEVATED BY BALLOONS AND KITES

I then decided, notwithstanding this further setback, to carry out experiments in Newfoundland, with a receiving aerial supported by a balloon or kite, as it was clearly impossible at that time of the year—owing to the wintry conditions, and the shortness of the time at our disposal—to erect high masts to support the receiving aerial.

On November 26, 1901, I sailed from Liverpool, accompanied by my two technical assistants, G. S. Kemp and P. W. Paget. We landed at St. Johns, Newfoundland, on Friday, December

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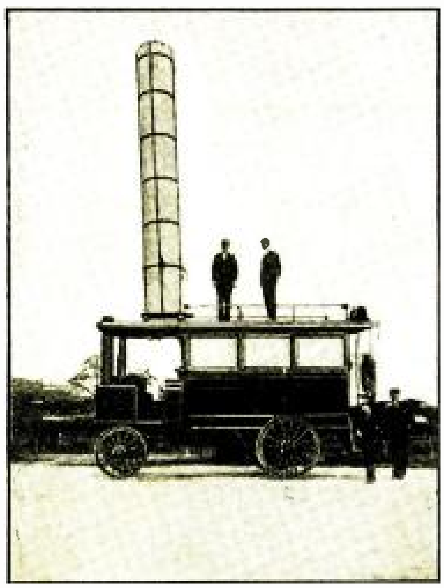

This is, perhaps, the first auto-radio installation ever made! The "Car" was equipped with both transmitting and receiving apparatus. It was used by Marconi in some of his early experiments *in the year 1901!*

Marconi is shown at the extreme left of this photo as he went to aid some of his assistants in flying the aerial kite in the teeth of a heavy gale. This kite aerial was the one used to pick up the signals from Poldhu, England, on December 12, 1901.

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NEW INFORMATION ABOUT ANTENNAS

In this semi-technical discussion the radio beginner is given a hasty insight into the commercial set-up of antennas and antenna systems of comparatively recent designs.

R. D. WASHBURNE

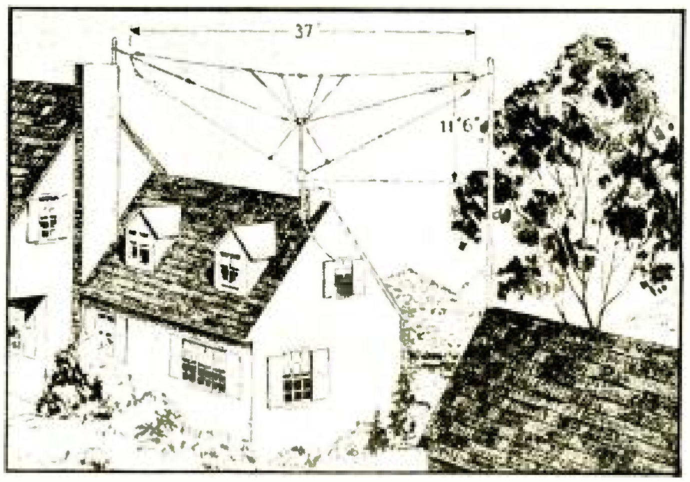

Fig. D. The RCA multiple-doublet "Spiderweb" set-up.

A SURVEY has revealed that the larger set manufacturers appear to have declared a moritorium on new antenna-system designs!

Although laboratory workers in the bigger radio companies are industriously investigating the radio antenna situation there have been few changes in the antenna-system "picture" since the writer's article in the July and August 1934 issues of *Radio-Craft;* however, such subsequent developments as have taken place will be outlined further along in this story. We refer you, meanwhile, to the following short discussion of the several new and novel *antennas*, here illustrated in Figs. A, B, and C, recently brought out by some of the smaller radio concerns for the owners of car-radio receivers and all-wave radio sets.

Note, before we proceed further, that a line of demarcation has been drawn between "antennas" and "antenna systems." The former, for the purpose of this discussion, is taken to mean a simple antenna without provision of any sort for noise reduction; the latter, is more comprehensive, and usually includes an *antenna coupler* as an essential element in completing the "system."

NEW "ANTENNAS"

The "Topper"—for Automobiles. One of the most recent additions to the field of automobile antennas, is the "Topper" illustrated in Fig. A. It mounts, as the name implies, on top of the car. (The top-type development, to overcome the shielding effect of the car-body, is an outcome of the introduction of the all-steel or "turret-top" automobile.)

It will be noted that this antenna introduces a new idea; it can be used in either a semi-vertical position *or* a nearly horizontal position. For normal pick-up in and around large cities or near broadcast stations, the antenna is deflected downward, and then locked in this position, so that it is parallel with the top of the car (to clear garage doors, etc.). Out in the country and away from broadcast stations, the antenna is permitted to ride almost vertically in order to obtain added sensitivity. The "Topper" aerial consists of the antenna proper and the shielded staff; this construction reduces tire static to a minimum. The lead-in staff is permanently attached to the car, as shown by the illustration, while the antenna proper can be removed at will since it merely "snaps" into the lead-in.

The "Streamline." Another of these top-mounting antennas for turret-top cars is illustrated in Fig. B; we have dubbed it the "Streamline." The attractive antenna fits-in with the streamline design and the styling of modern automobiles. It consists of 2 chromium-plated metal tubes, mounted one on top of the other, and attached to the car by means of special cement blocks that eliminate the need for drilling.

The "Fishpole." The automobile "fishpole" antenna, although not as new (See *Radio-Craft*, January 1937, pg. 414) as some others, should be mentioned here, since it is becoming increasingly popular. The new type by Tobe Deutschmann Corp. will be used as reference.

This antenna consists of 4 telescoping sections of steel tubing. The effective length, when extended, is 96 ins. and, when telescoped, 36 ins. The lower end is provided with a mounting clamp which fits all automobile bumpers. High-quality rubber insulation prevents

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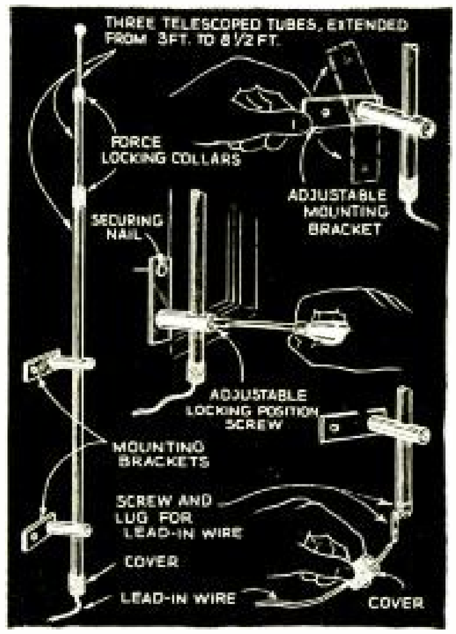

Fig. C. The A.R.H. Co's. "Window-Tenna."

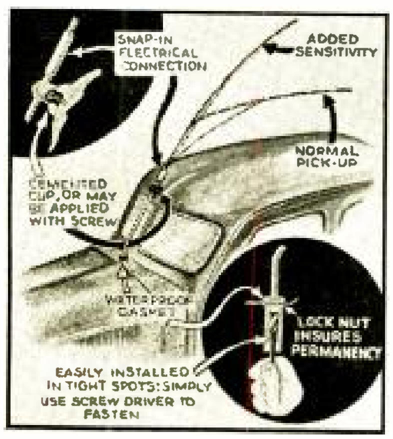

Fig. A. The Motorola "Topper."

Fig. B. A "streamline" type by Ward.

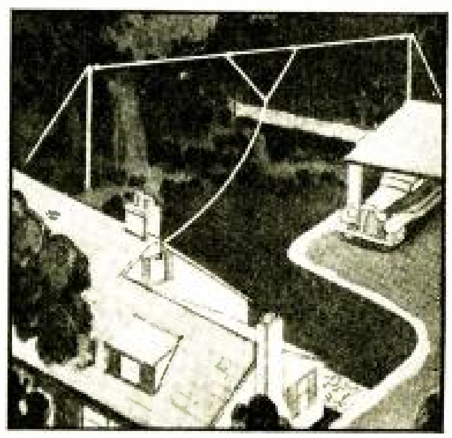

Fig. E. The "V-Doublet" of General Electric.

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Fig. 1. The beginner can understand what's in it!

RADIO DEBUNKED
FOR THE BEGINNER

Radio is not so very difficult for the beginner to understand if certain fundamentals are kept in mind. The author explains these and gives some advice on circuit reading.

WILHELM E. SHRAGE

NEWCOMERS into the realm of radio amateur activity are often quite discouraged after inspecting the inside of a modern radio receiver. The "shell" or outside appearance of present-day radio sets appears to be streamline-smooth and simple, but the "interior-decoration," if we are allowed to say so, is full of confusing elements and wires which often so frighten the radio beginner as to induce him (or *her*!) to turn disgustedly to other activities and hobbies.

The oldtime amateurs are quite shocked by this trend, because in their opinion radio has not become more complicated since its early days, but rather, more simple. They recall very well the days, 20 years ago, when not only dexterity and knowledge but also *luck* was required to squeeze from an antenna wire enough radio "juice" to produce a faint whisper in a pair of headphones.

That their point of view is correct is easy to verify by recalling how a radio receiver used to look in the old times. Simply, it was a reversed edition of our present radio receivers. That is, one saw much outside, but very little "inside story," in connection with oldtime "wireless reception devices."

Upon a panel of wall-size dimensions one saw arranged in the time-honored switchboard manner a breathtaking labyrinth of various parts and connecting "ropes," and our friends (the early birds in the realm of radio amateur activity) jumped continuously from the switchboard's left to its right in order to persuade this veritable monster to show at least *some* good will!

And what was the final result of all this effort? A few lonely Morse signals came in once in a while, in a mass demonstration of electrical interference; and a few broken sounds (representing "wireless telephony") if and when successfully picked-up, were celebrated as events which made the world shake.

LOW-LOSS AND GREENBACKS

That was all the pleasure oldtimers obtained by spending day and night hours in tickling their almost gigantic switchboards. Considering the money they had to invest in their tubes, coils and condensers, and measuring their financial and mental efforts against the results obtained, one can truly say that radio amateurs of today have no reason to kick. It sounds like a fairy tale today if we are told that in former times a single triode tube of doubtful quality was priced at figures as high as about $20.00-30.00; and a 450 mmf. tuning condenser of so-called "low-loss" quality was sold for about 12 nice greenbacks or more.

TODAY'S CIRCUITS

However, there are always some doubters left who are not convinced by the facts presented to show that radio experimenting of today is much more simple than in the old days. They will argue: "But what about the radio circuits of today?" Well, this sounds at first to be a good argument, but it only *sounds* this way. Rome was not built in a day, and it would be foolish to compare the oldtime receiver with a modern 25-tube Ultrahypo-Reflex-Highfidelity-Superheterodyne Receiver. No one will expect a beginner to start with such a complex device.

One should keep in mind that the good old 1-tube-regenerative receiver, which was, and still is, the backbone of all radio circuits regardless of what make and kind, is the very thing with which to start an expedition into the realm of radio activity.

Early radio amateurs have used it, modern short-wave amateurs are still using these simple sets which seemingly have no limitations whatsoever as far as DX reception is concerned. This good old feedback circuit makes the world shrink to the size of a ball a few feet in diameter, and one can see no reason why newcomers should not be able to assemble and operate such sets without encountering difficulties.

It is no waste of time to begin with this circuit, because the experience collected will be very useful in case the oscillator circuit of a modern superhet. does not show the required signs of co-

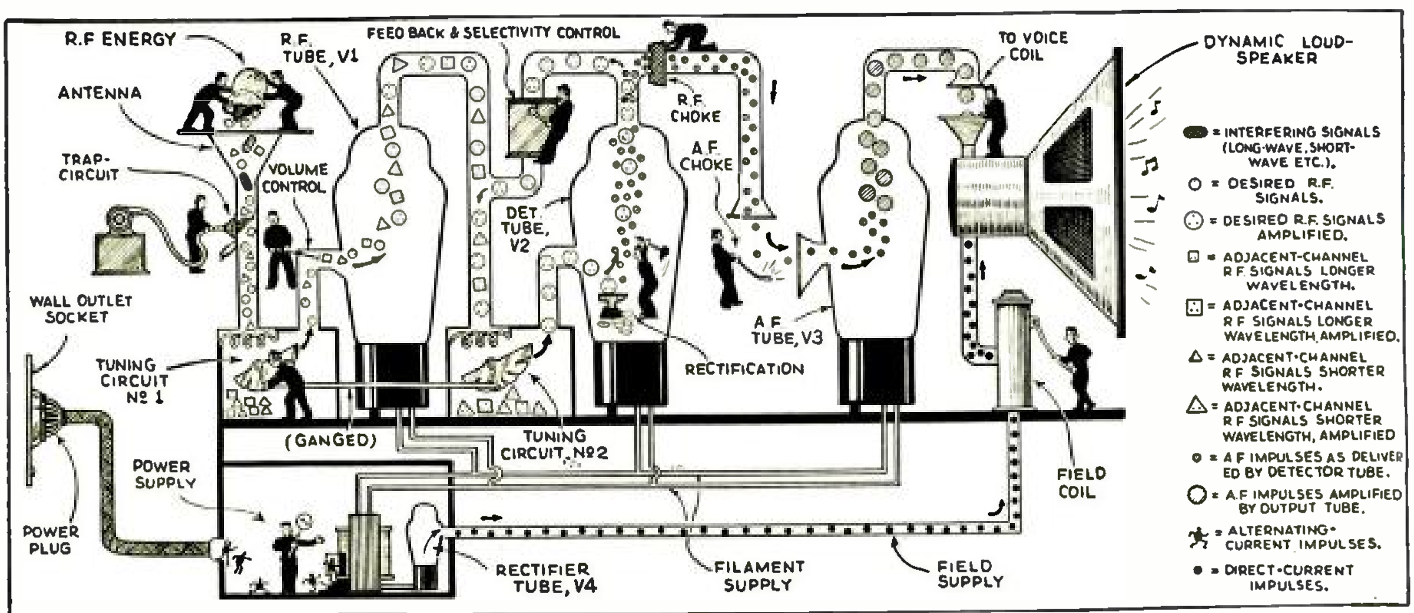

Fig. A. Another way of picturing the action in a 3-tube regenerative set—the camouflage will help the beginner to follow the action..

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operation. And furthermore it is today much simpler to make such a circuit operate than at any time before. The reason is quite obvious. Tubes are much better and of more uniform quality. The parts available are of practically foolproof design, and all this despite the fact that today parts cost as many *dimes* as in former times they cost *dollars*.

DEBUNKED RADIO CIRCUITS

However, there is one thing about radio circuits which must be explained to radio amateurs of the "greenhorn" variety:— that is the doubtful method by which some publications present so-called "brand-new-radio-circuits" to the inexperienced beginner. Rather than use many words we will refer now to a few diagrams which tell the story much more impressively.

In Fig. 3A we see our friend the 1-tube-regenerative receiver. This circuit is extremely simple and needs no explanation whatsoever. Millions of beginners have built it, and obtained with this fundamental circuit stunning results, and we hope millions more will do the same. Now, let's see what the magic of the drawing board is able to do to this simple circuit. (Note that in all these circuits it may be desirable to augment, by means of a 0.001-mf. condenser, C, in shunt to the phones, the bypass capacity afforded by the headphone cord. *Editor*)

Figure 3B shows what an *inexperienced* "circuit-magician" has done to the diagram of Fig. 3A. The circuit looks already more "substantial" and more complicated, but nevertheless, only a real greenhorn will be bluffed by this method of presentation.

However, the same circuit when redrawn by a *master* "circuit-magician," as shown in Fig. 3C, really looks like something, and in case one or two stages of an A.F. amplifier (audio-frequency amplifier) are presented in similar makeup, our familiar regenerative receiver looks like a brand new, crackerjack job of scientific research.

ANOTHER INSIDE TRICK UNVEILED

Now, let's study Fig. 3D. One must say this circuit seems to be a very brainy example of radio-circuit camouflage. This circuit could not be presented much more impressively. But what is actually new in it? Just a simple change of a single part. A change of minor importance has been effected—the grid resistor, R, is connected in a little different way, and all that we need is a fancy name for this circuit.

If the diagram nevertheless appears to be different from the circuits familiar to him, he still has a chance to try it out. Similar examples of what an ingenious hand is able to do, with a pencil and a drawing board, for a simple circuit are demonstrated in Fig. 3E to H. All the tricks applied in the example shown in Fig. 3A to Fig. 3D in camouflaging a fundamental circuit will be observed again. Only the circuit of Fig. 3H involves an actual change, namely, a variation in connecting the grid resistor into the circuit.

CAMOUFLAGE, BUT A USEFUL ONE

That camouflaging of diagrams may be of great value to explain the function of a set is demonstrated in Fig. 2 and Fig. A. In Fig. 2 we see a simplified 3-tube regenerative receiver, with an R.F. (radio-frequency) "input stage" equipped with a screen-grid tube. This stage is followed by a triode-type regenerative detector, similar in its design to the circuit shown in Fig. 3E. Finally we see the output stage which feeds the voice-coil of a dynamic speaker. That is quite simple, isn't it?

Now, let's see how the one and the same circuit looks when shown in a different make-up as it appears, pictorially, in Fig. A. This masterpiece of useful camouflage was used a few years ago by the Telefunken Co. in one of their advertisements, but is here presented with some little changes. At the very left we see the antenna which is fed by 2 gnomes that are dumping out

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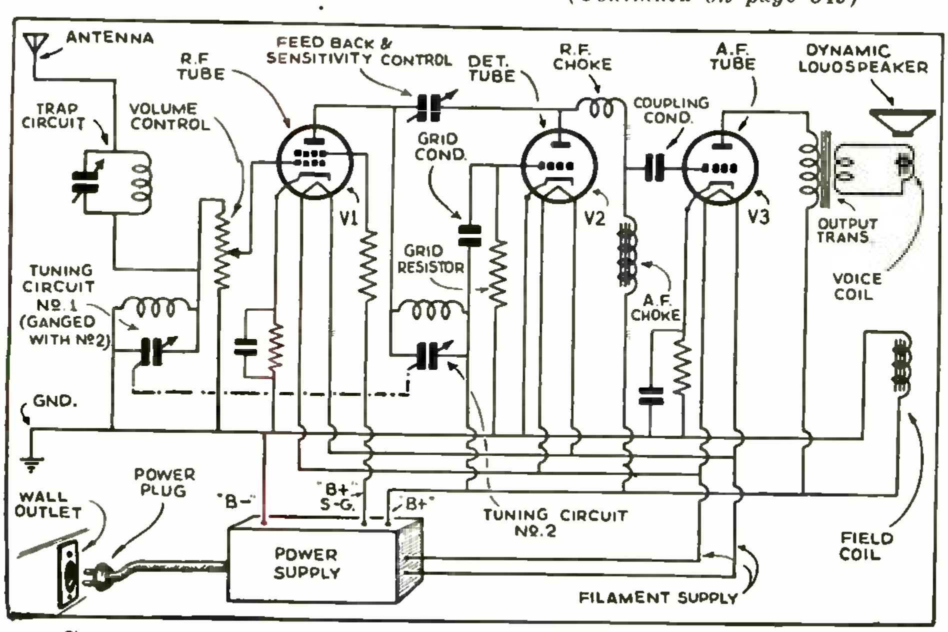

Fig. 2. This schematic is the equivalent of the pictorial circuit shown in Fig. A, at the left.

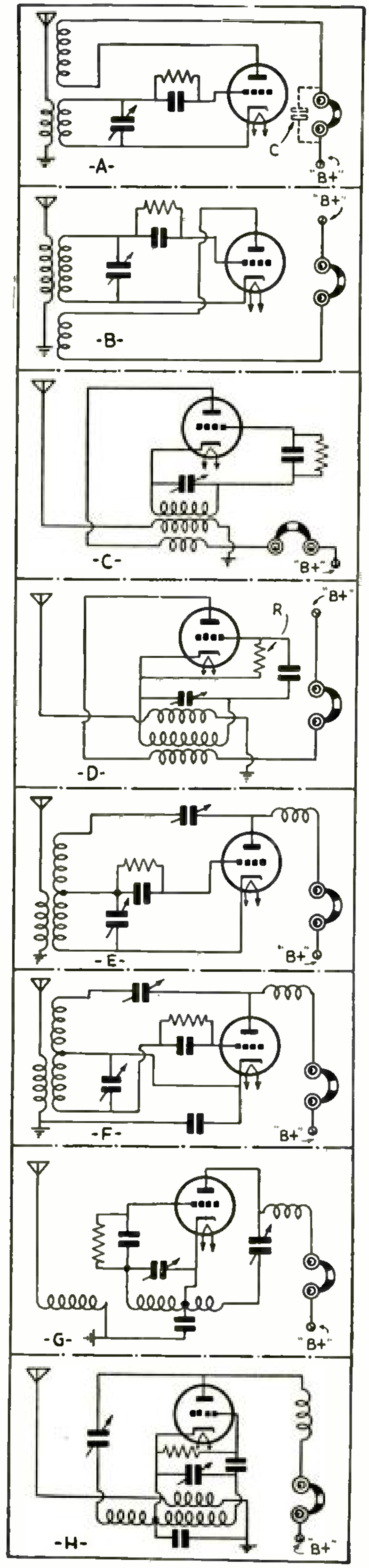

Fig. 3. Two circuits—upside down and backwards.

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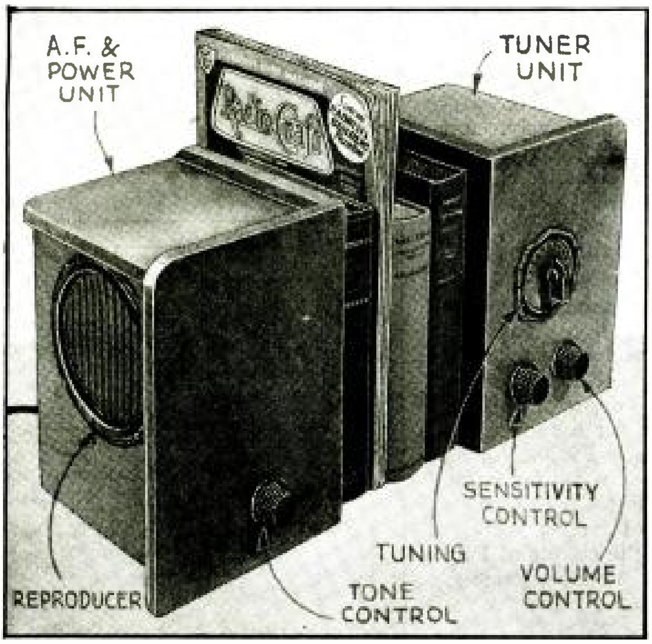

Fig. A. Here is the set doing its double duty of book-rack and radio receiver.

HOW TO MAKE THE BEGINNER'S "BOOK-END 3"

This "beginner's" set is not only unusually simple to construct, but introduces a novelty dual-cabinet design easily duplicated.

RAYMOND P. ADAMS

A CONSTRUCTION article particularly written for the *radio beginner* should describe in simple, non-technical language the business of building some novel, elemental and instructive design. One written for the *newcomer* in radio or "advanced beginner" interested in learning something about practical custom set-building should do more than this: it should present and describe, as a subject-receiver, a job which when completed will have unusual utility appeal, *and thus a definite sales value*.

It is the author's hope that the following descriptive story will meet with the approval of the serious-minded beginner aware of the present-day importance of custom activity, and that the design projected will not only serve as a "suggested circuit" receiver for more or less exact reproduction by the reader but that it will stimulate the exercise of individual initiative in directing instructive and experimental effort into practical channels.

The Book-End 3 becomes, therefore, as much an illustration of application possibilities, for the beginner, as a simplified, inexpensive, novel, educational design that may be built-up "over night."

GENERAL DESCRIPTION

As a basic, fundamental circuit, this design may be called the "least common denominator" in A.C.-D.C. jobs—and perhaps the limit in practical simplification extremes. It requires only 3 tubes, is powered directly from the line, provides full dynamic reproduction of broadcast signals, and can be made quite selective and sensitive when carefully built. Volume, of course, is limited, but will be found entirely adequate where loudspeaker reception of mainly local stations is the primary requirement.

As an instrument of "home utility" value and as an illustration of custom application, the design becomes a "book-end" or 2-piece receiver, with (a) the power supply and loudspeaker in one unit and with (b) the tuner in the other.

The cabinets shown are small, lending themselves readily to installation on one's library or bedside table, on a wall shelf, or on the arm of one's favorite easy-chair.

They have been simply, quickly built by the author—who is certainly no carpenter—primarily to suggest the general idea, and no exact constructional data will be given for them, as the individual builder will undoubtably prefer designs of his own choosing. (The cabinets illustrated have been finished, by the way, with an *antique glaze*.)

THE CIRCUIT

The circuit schematic shows 3 tubes—a 6K7 R.F. amplifier, a 25A6 power detector, and a 25Z6 rectifier—in what at first glance will appear to be a rather complex and unusual line-up but which on careful inspection will prove itself to be an extremely simplified arrangement.

Let's begin with the rectifier which is connected conventionally in an A.C.-D.C. power-supply hookup. Switch Sw.1, ganged to tone control R5, connects the A.C. or D.C. 110 V. line to the "B minus" lead. The "B minus" is NOT connected directly to chassis ground but is wired to chassis through condenser C17. The chassis, therefore, is not "hot". (It is recommended, although not specified by the author, that *both* sides of the line be fused as shown in the schematic and pictorial diagrams of the power unit. If desired a "fused plug", available from practically any electrical supply house, may be used.—*Editor*)

Resistor R6 is the 180-ohm filament dropping resistor in the 3-lead line cord and connects to the 25Z6 filament and out to one prong of the power-supply cable for connection to the tuner unit. The rectifier plates are tied together and to the 110-V. line, as shown. One output element feeds the 3,000-ohm speaker field which is filtered by parallel-connected electrolytic condenser C13, and one provides the D.C.

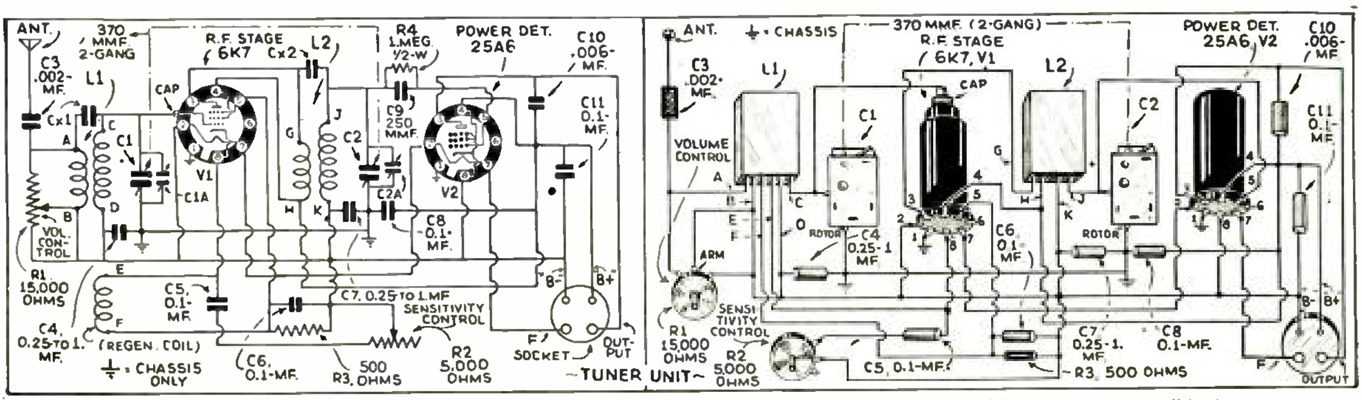

Fig. 1. The circuit of the "receiver" chassis is shown in both schematic and picture form—to make the wiring as easy as possible for everyone.

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voltage for the receiver proper. Units Ch.1, and C14-C15 are collectively the necessary filter system for smoothing out the "B" supply and permitting humless operation. By substituting either a magnetic or a permanent-magnet dynamic speaker, for the electrodynamic type specified, both the field coil and C13 may be eliminated; in the event of such substitution terminals 8 and 4 of the 26Z6 socket (the output terminals) may be tied together, with some increase in "B plus" output likely.

Connection from the power and speaker circuit to the receiver circuit is made through a 4-wire cable which plugs into a receptacle on the power-supply chassis.

Moving to the receiver unit we find the final stage to be a combination power output *and* detector set-up—very much a departure from conventional practice. And perhaps some few technical explanations may be desirable here.

THE COMBINED DETECTOR-AMPLIFIER

There are two major types of detectors—(1) grid, and (2) plate.

In the latter, the detection action takes place in the tube output or plate circuit. The cathode is properly biased for as near linear detection as possible, in the interests of distortionless reception, and the grid or input circuit acts somewhat as an R.F. amplifier.

In the former, detection takes place in the grid circuit, with the output portion of the tube performing as a separate A.F. amplifier.

The actual R.F. "gain" or amplification in a "plate" detector is not particularly great, but the actual A.F. gain in a "grid" detector may be quite appreciable; and the overall tube sensitivity of the grid detector is considered higher than the plate type as its A.F. output is at greater level for R.F. signals of equal input strength.

Now if we were to use "plate" detection with our 25A6—that is, grid-bias detection—the audio level of rectified signals would not be very great, certainly not great enough to properly actuate a loudspeaker. There would be no advantage in using a 25A6, as we would probably have to employ an additional power output stage anyway. But by using "grid" detection (in which a grid condenser and leak are utilized), we put the output circuit to work as audio amplifier, and as the pentode is a tube of high power sensitivity it provides an A.F. signal at least strong enough to afford us reproducer volume on local-station broadcasts.

The input circuit of the 25A6 is tuned to the desired signal by the C2-C7-L2 combination. Coil L2 is an ordinary shielded midget R.F. transformer, matched to the antenna transformer, L1. Capacity Cx, in L1 and L2, is built-in. Condenser C2 is one section of the 2-gang variable condenser C1-C2. Condenser C7 is required to complete the L C circuit; the secondary of L2 is brought to "B –" (which is not directly grounded to chassis), while, the variable condenser is mounted on that chassis with rotors grounded via the condenser frame. Condenser C10 is a small bypass across the output to smooth out the tone, and its use may or may not make R5, the *tone control*, an unnecessary refinement. Unit C11 bypasses "B+" to "B –", and C8 bypasses "B+" to chassis.

The power detector in this receiver is a sensitive affair.

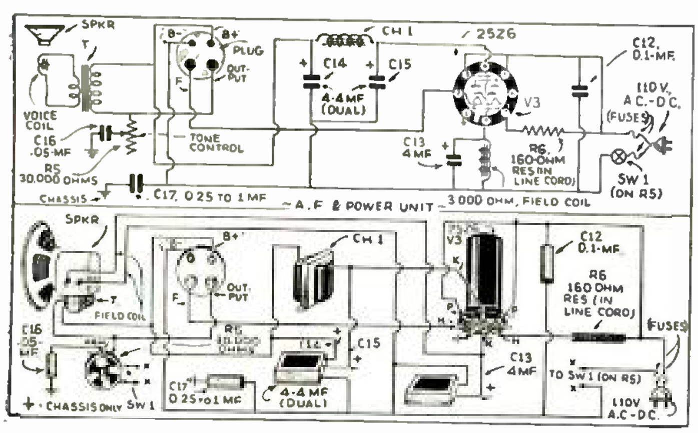

Fig. 2. The circuit of the "power" chassis—schematic and picture.

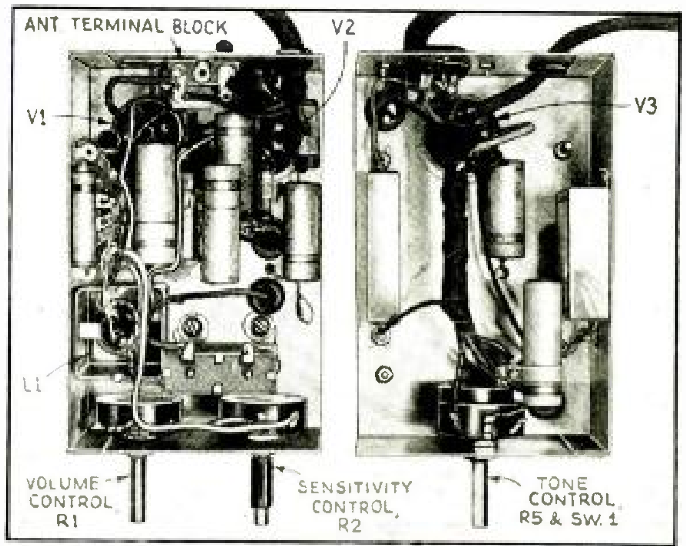

Fig. B. The 2 chassis removed from their "book-end" cases.

Nevertheless, in order to provide its control-grid with signals strong enough for speaker volume audio output, it becomes advisable to get as much R.F. amplification as possible out of our single R.F. stage. And this is achieved through the use of our old standby, *regeneration* or *feedback*.

ADVANTAGES OF REGENERATION

Feedback in the 6K7 circuit increases the strength of the amplified signal directly and effectively, as follows: *directly*, by reason of the regenerative action itself; and *effectively*, by reason of the increased selectivity which regeneration gives to an R.F. stage.

Note the connections here carefully. The suppressor-grid, ordinarily directly wired to the cathode, is tied to "B –" through the bypassed bias resistor, R3. The suppressor-grid side of R3 is then brought to cathode through a small feedback coil. This arrangement permits the proper biasing of both cathode and suppressor-grid but keeps the R.F. out of the suppressor-grid circuit.

The cathode-coil method of regeneration involves what is known as *electron coupling* and the builder should remember this admonition: NEVER TIE SUPPRESSOR-GRIDS AND CATHODES DIRECTLY TOGETHER WHEN ELECTRON COUPLING IS EMPLOYED WITH TUBES OF THE TYPES 6K7, 6D6 and 58; the suppressor-grid should be always wired as shown, connected directly to ground or "B –", or tied to the screen-grid. In "EC" (electron-coupled) circuits for regeneration, direct connection between cathode and suppressor-grid will nullify the effect of internal shielding and cause instability.

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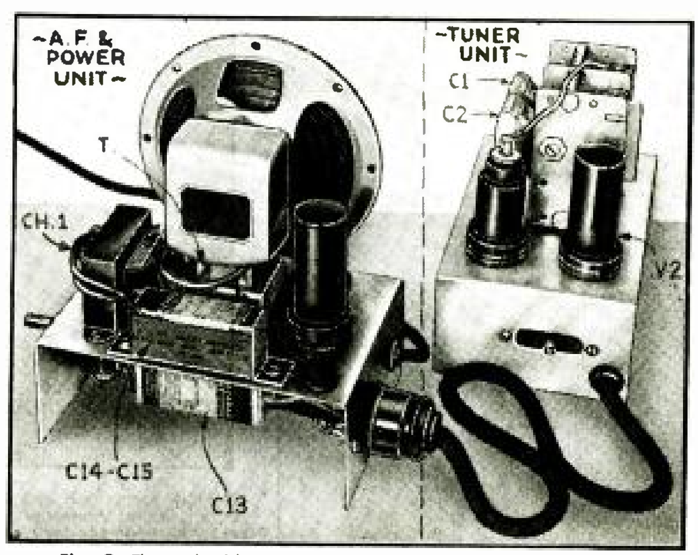

Fig. C. The underside of the 2 chassis showing parts layout.

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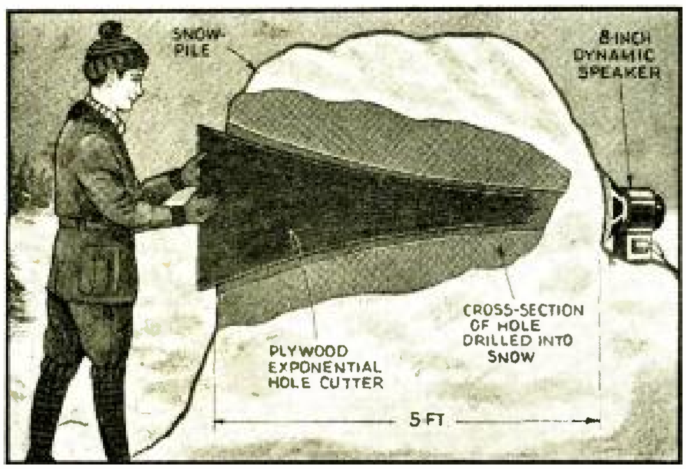

Fig. A. The board is turned like a drill through the snow.

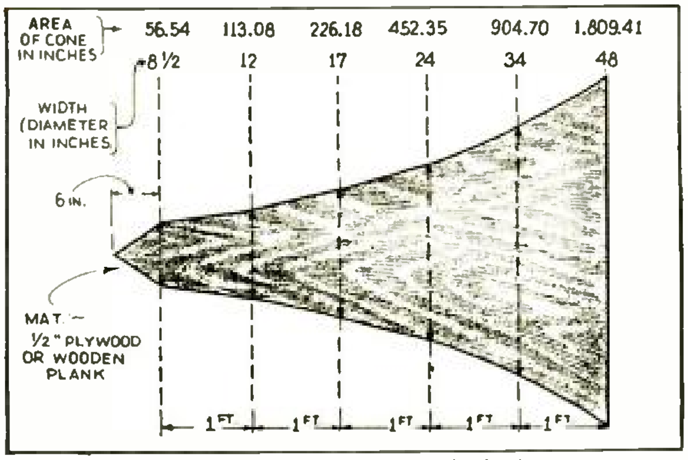

Fig. 1. The "snow drill" is exponential in shape.

HOW TO MAKE A SNOW LOUDSPEAKER

"When in Rome do as the Romans do"—is well applied in this novel speaker, for the snow months.

J. H. GREEN

THE REMARKABLY rapid development of radio communication from the early crude spark transmitters and crystal, electrolytic and coherer type receivers, to the present complex systems has been due almost entirely to the ingenuity and inventive ability of some of the men who have devoted their lives to this art, either as amateurs or professionally.

This inventive spirit has spread like a germ from one to another—old timers and raw beginners alike—and none can tell where it will pop out next.

An example of such inventiveness was observed recently when a public-address worker who, wishing to supply radio music to a certain skating rink, originated the novel idea of making a real exponential horn out of snow.

At first thought this may seem fantastic, but actually there are several technical reasons why such a reproducer should have good characteristics. In the first place, the packed snow will have no resonant frequencies so that the over-all frequency characteristic should be more uniform than speakers made from rigid materials. Second, the packed snow can be formed into any desired shape, so that a true exponential curvature rather than the usual "7 or 10 per cent" increment found in most horn type reproducers can

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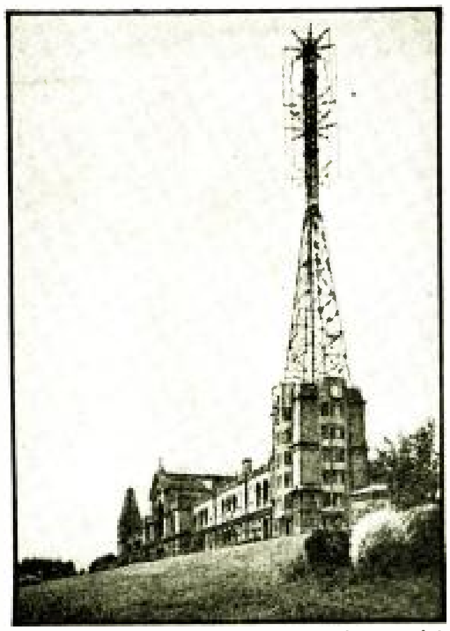
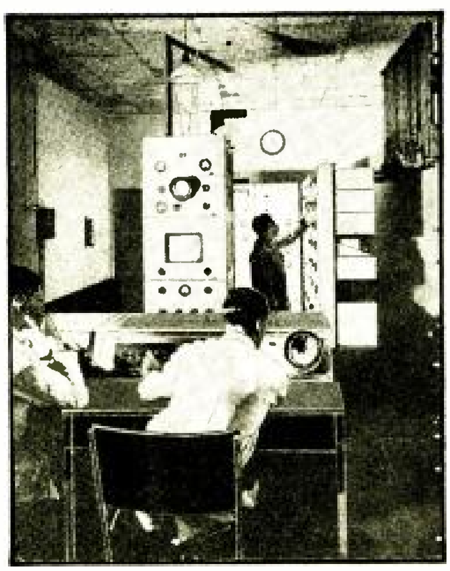
MARCONI - E. M. I. HIGH-DEFINITION TELEVISION AT ALEXANDRA PALACE


The tapering tower for the 2 transmitter aerials.


A typical English television receiver in use.


Control room and amplifier racks for the Baird installation at Alexandra Palace. Note the monitor cathode-ray image tube on the control desk (right) and the acoustically treated walls and ceiling. The Baird installation is alternated with the Marconi-E. M. I. system. Each station is usually on the air one day while the other is silent.


The Marconi-E.M.I. studio showing two Emitron television cameras in use—one ready for a "fade-in."

THE LONG-HERALDED television station at Alexandra Palace, London, began operating on an experimental basis several months ago with a twice-daily program. From a hill 306 ft. above sea level the BBC's new television station dominates London and a large portion of the suburbs. It is built into the south-eastern corner of Alexandra Palace—a north London land-

(Continued on page 562)

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HOW TO MAKE A "JUNIOR" OSCILLOSCOPE

Here is a complete metal-oscilloscope-tube cathode-ray analyzer—sweep oscillator, amplifier and power supply.

WILLIAM FILLER

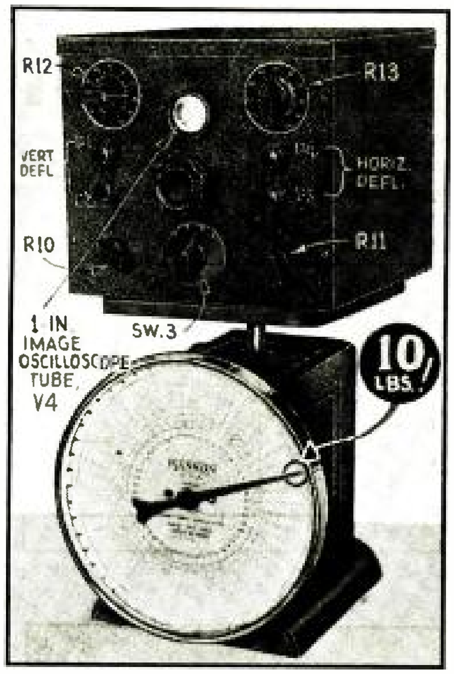

Fig. A. The complete unit weighs only 10 lbs. Cabinet dimensions—8 x 7¼ x 8¾ ins. deep.

WITH THE introduction of the new type 913 cathode-raye tube (See *Radio-Craft*, January 1937, pg. 395.—*Editor*) any number of suggestions have been made regarding the manner in which it may best be employed by the Service Man. The accompanying illustrations and (Fig. 1A) circuit diagram, covering the fundamentals of a device of this nature, will provide almost every necessary facility at the lowest cost. The 1-in. image the 913 affords is adequate for almost all servicing needs and very nicely meets the demands of a portable instrument.

Certain specific uses for a *servicing* oscilloscope, such as the alignment of the various stages in an intermediate-frequency amplifier, *can best be accomplished by the addition of a stage of amplification.* The circuit diagram for such an arrangement and the suggested changes from the fundamental circuit will be found in Fig. 1B. There is plenty of room in the cabinet for the installation of the necessary resistors and condensers for the additional amplification stage. The tube may best be located by moving the 885 back toward the power transformer and placing the 6J7 in the position now occupied by the 885. Of course, this will necessitate the cutting of another hole in the subpanel, but that is not a very serious matter since the material from which the subpanel is made is comparatively light.

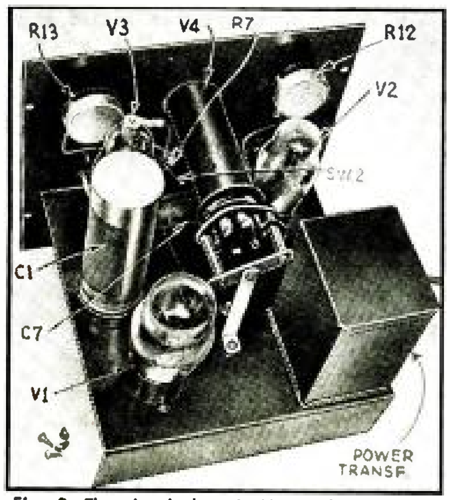

Fig. B. The chassis layout. Note tube support.

So much has been said about the design, construction and operation of various types of oscilloscopes (See "How to Make an Oscilloscope," July-Aug.-Sept.-Nov., 1936 *Radio-Craft.*) that we believe it is necessary to cover nothing more than a few suggestions concerning construction and the recommendation that for specific information regarding the most suitable manner for applying this oscilloscope that the Service Man pay particular attention to John Rider's very complete book, "The Cathode Ray Tube At Work", which covers the subject in splendid fashion. (Still another "slant" on the service angle of oscilloscopes may be obtained by reference to J. T. Bernsley's book, "Official Radio Service Handibook."—*Editor*)

CONSTRUCTION

A complete kit of parts for the "Junior" Oscilloscope, with front panel, subpanel and other portions of the cabinet punched and drilled, is available.

It is recommended that a small bakelite tube or visor be placed over the "eye" of the 913 tube where the oscilloscope is to be used in bright light. Except for this ferrule, hardware, binding posts, knobs, dials and everything else necessary for the making of this unit is included in the kit.

The first step in the assembly is to mount the sockets, potentiometers, tap switch, power transformer and filter condenser as illustrated.

It will be seen that the resistor strip, which carries resistors, R19, R1, R2, R3, and R9, and condenser C2, is mounted under the sub-base with one bracket on the bolt for the 913 tube support and the other bracket bolted through the hole approximately 2 ins. nearer the front of the panel.

The next operation is to wire the power supply, keeping in mind that *the POSITIVE side of the circuit is grounded.* This is in accordance with usual oscilloscope practice. After building the power and filament wiring proceed with

(Continued on page 551)

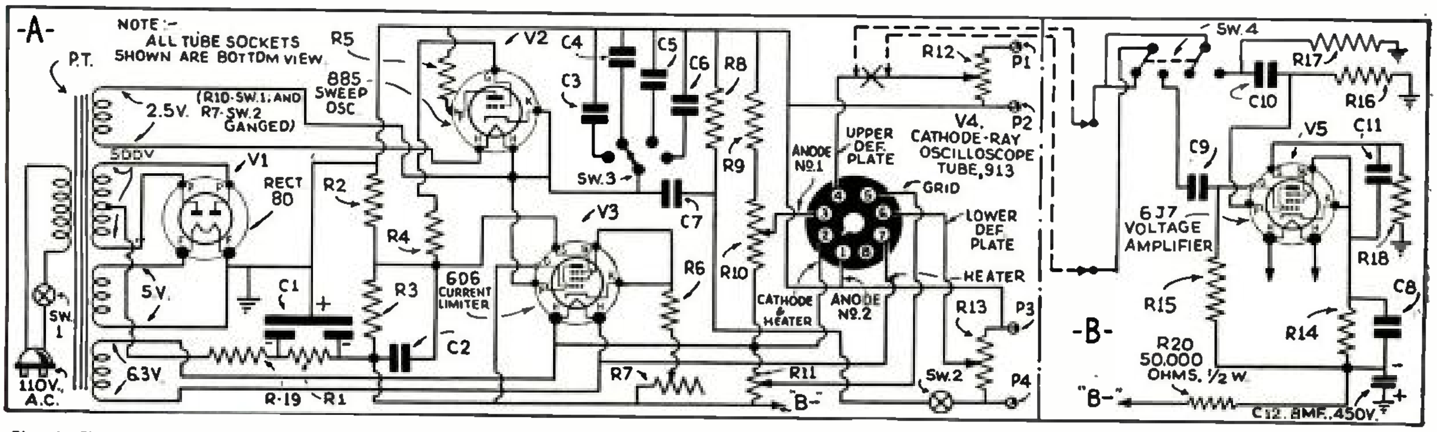

Fig. 1. The circuit of the "Junior" Oscilloscope. The unit at the right is the vertical plate amplifier which makes it a complete servicing unit. Controls: resistor R7—horizontal-sweep-frequency; R10—focus; R11—intensity; R12—vertical-sweep; R13—horizontal-sweep.

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INTERNATIONAL RADIO REVIEW

RADIO-CRAFT receives hundreds of magazines from all parts of the world. Since the cost of subscribing to each of these would be prohibitive for most radio men, we have arranged with technical translators to prepare reviews for our readers.

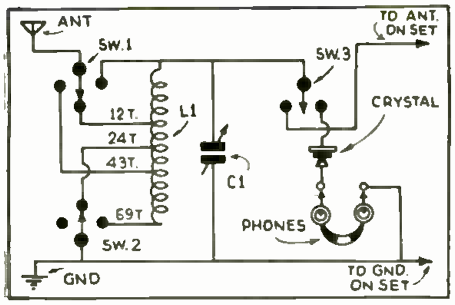

Fig. 1. The circuit of the combined crystal receiver and antenna wavetrap.

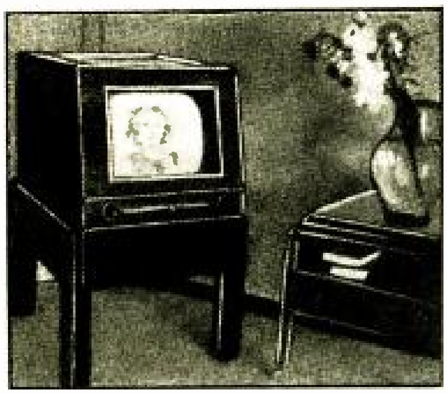

Fig. A. Notice the squat appearance of this television receiver—for seated viewers.

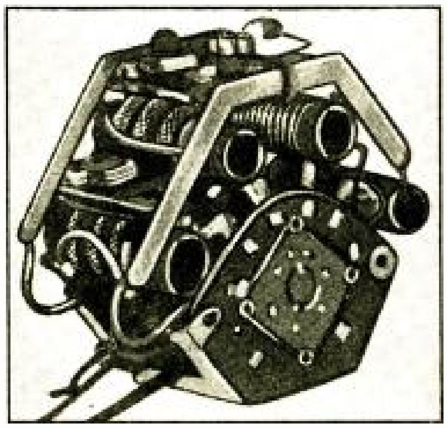

Fig. B. An Italian all-wave tuner mechanism. The unused coils are short-circuited.

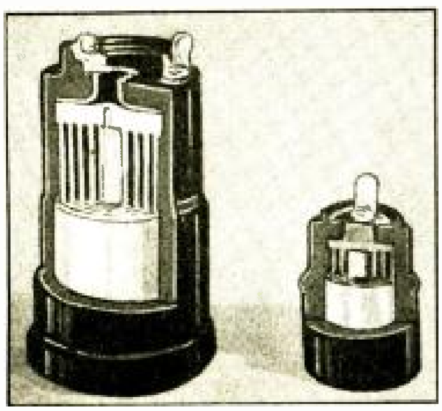

Fig. C. Air-dielectric trimming condensers are now available in Europe.

A CHINESE CRYSTAL SET

THE LATEST issue of *The China Radio* (Shanghai), a magazine published in Chinese, contained the circuit and description (if we can believe our Chinese translator—Hi!) of a handy crystal set which serves the dual purpose of stand-by radio receiver and wavetrap for removing interference on the regular vacuum-tube set.

As shown in the circuit, the unit contains a coil of 69 turns of No. 22 cotton-covered wire, on a 3-in. cardboard tube, with taps for changing the wavelengths covered; a 500-mmf. variable condenser; a crystal detector; headphones; and 3 tap switches—two for changing the wavelength (Sw.1 and Sw.2) and one for changing the unit from a crystal set to a wavetrap (Sw.3).

As a crystal radio receiver, Sw.3 is moved to the right-hand contact. The switches Sw.1 and Sw.2 are moved about and the variable condenser is adjusted until broadcast stations are picked up.

As a wavetrap, Sw.3 is turned to the left-hand contact. By adjusting the switches Sw.1 and Sw.2, the unit can be used either as a "series"- or "parallel"-type trap circuit. In other words, if Sw.1 is in the right-hand-end position and Sw.2 on the middle or right-hand contact the tuner works as a simple parallel-tuned circuit (as found in almost every radio receiver) while if Sw.2 is in the extreme left position and Sw.1 is rotated to tune to the correct band, the circuit is a "series-tuned" trap circuit.

By thus changing the circuit, the trap circuit can be used to eliminate an interfering station, or to aid in picking up one particular station (such as a weak one) by tuning the antenna circuit to resonance with the receiver.

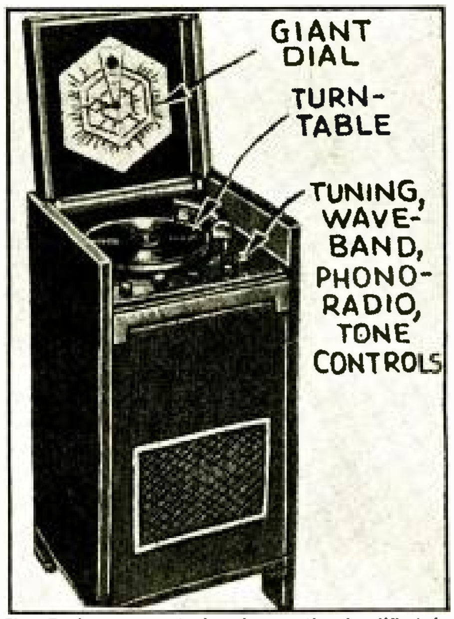

Fig. E. Short-wave tuning is greatly simplified by this giant tuning dial.

The terminals A and G connect to the aerial and ground binding posts of the receiver to which the wavetrap is to be connected. The regular aerial and ground wires are connected to the correct points on the trap, as shown in Fig. 1. (It may be desirable to connect a condenser of about .001- to .006-mf. in shunt to the headphones.)

A GERMAN TELEVISION RECEIVER

A NOVEL construction for a cathode-ray television receiver of German make was recently shown in the Austrian radio magazine *Radio Amateur* (Vienna).

The tube in this receiver, which was made by the D. S. Loewe Company of Berlin, *is mounted in an inclined*

(*Continued on page* 555)

Fig. D. With this "long arm" you can retire early and turn the radio receiver off without getting out of bed. The remote speaker is equipped with a control box for the purpose.

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ANALYSIS OF
FIDELITY CONTROLS IN THE 1937 SUPER "PRO"

The efficiency of a modern "communication type" receiver can be well appreciated by the graphs and data given here.

ELI MARTIN

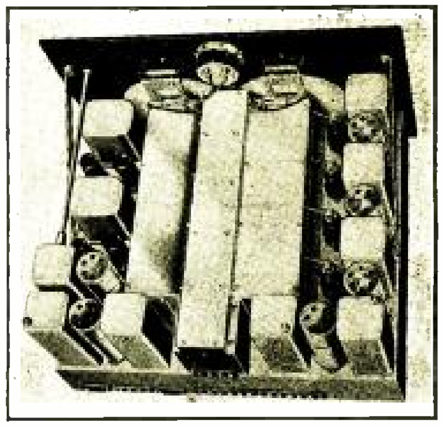

Fig. A. The rear view of the chassis described.

IN a RECEIVER with laboratory-calibrated controls, such as the new "Super Pro", extremely skillful design and construction were imperative to achieve the necessary perfect circuit and mechanical synchrony.

How many difficult problems were solved to permit the production of such a precision instrument are explained in this article.

The selectivity of the intermediate-frequency amplifier of the new "Super Pro" is continuously variable by means of a control in the front panel. This control simultaneously varies the coupling between the primaries and the secondaries of the first three I.F. transformers. Since both the primary and secondary of each transformer are tuned, this variation of coupling changes the response characteristic from a single sharp peak in the minimum coupling position to a wide double humped curve in the position of the maximum coupling. The total range of the coupling provided by this panel control is from approximately 1/3 optimum in the narrow position to about three times optimum in the wide position. The control being continuously variable, any intermediate value be-

(Continued on page 562)

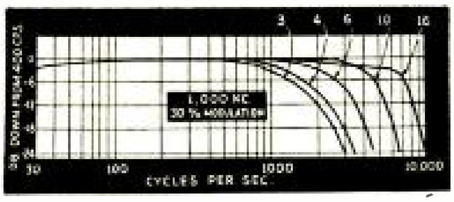

Fig. 2. Audio characteristic for 5 I.F. "band widths."

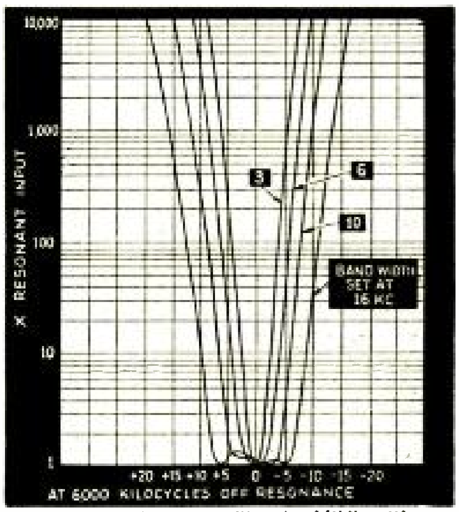

Fig. 1. Selectivity at 4 "band width" settings.

NOVEL 1-TUBE SET USES "BODY" ANTENNA

The radio beginner and experimenter will find this novel little set a fine one to tax his ingenuity and mechanical ability—try it!

COME ON all you experimenters and beginners, here's something for which you've been looking to try your hand at. This "gadget" is a radio set! It smacks of the good ol' days when radio sets assumed all sorts of grotesque shapes and sizes . . . . and, surprisingly enough, worked.

This instrument is a combined radio receiver and flashlight, the "A" batteries being common to both. The "B" batteries, consist of a series of pen-flashlight cells contained in another flashlight housing at the "head" of the instrument. Only 12 V. of "B" are used, but the greater the voltage (and, necessarily, the housing) the better and louder will be the operation. The instrument is readily portable since it requires no aerial. The hand (and consequently the entire body) which holds the set serves as an aerial. To tune the set, the lower flashlight handle has to be moved up and down, slowly, until the desired station is obtained. Regeneration is controlled by rotating the cap of the phone which is ingeniously connected to the upper flashlight housing.

The circuit of the set is the usual regenerative type. Instead of an aerial, however, a "hand-contact" coil is used. Beneath this coil are three additional pieces of thin bakelite (hard rubber or cardboard will do) tubing. The first two are lined with tinfoil, thereby serving as a condenser, the aerial condenser. The other one serves as a coil form for the primary, secondary and tickler windings which constitute the antenna coil. Beneath (inside of) this coil are two metal cans separated by some insulating material such as sheets of mica or cellophane. These cans "telescope" into each other, thereby serving as a variable tuning condenser. The type 30 tube is mounted bottom-side-up (to keep all wires as short as possible) inside the inner metal can. Since the available

(Continued on page 566)

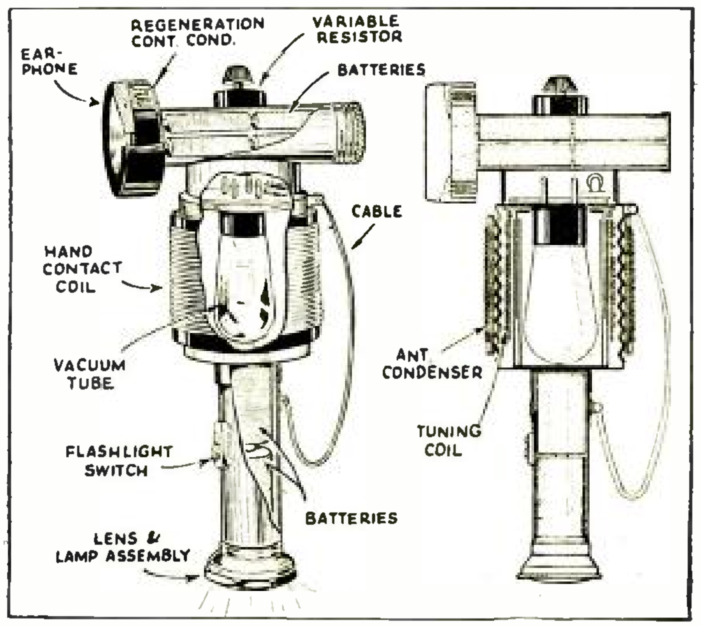

Fig. 1. The mechanical make-up of the flashlight—radio set.

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HOW TO MAKE THE TELEVISION

In this, Part III of the series of television receiver constructional articles, the cathode-ray equipment, sweep circuits and amplifier are included. This equipment will be tied up, in Part IV, with the previously described chassis.

PART III

Fig. H. The C.R. chassis is the stages of construction.

PART III of this series contains the circuit and details for making the cathode-ray equipment of the television receiver. This includes the high-voltage power supply for the C.R. tube, the voltage dividing system to apply the correct potentials to the C.R. tube, the vertical and horizontal sweep circuits which carry the cathode-ray beam back and forth and up and down across the image end of the tube (in synchronism with the scanning of the transmitter) and the wide-range A.F. amplifier which permits the rectified signals from the video channel to modulate the control-grid of the C.R. tube to cut-off.

This sounds like a big bite to make at one time—and perhaps it is the most difficult job involved in the construction of our vision receiver. However, the unit does not break down readily as all of the above functions are so closely correlated that one is not complete without the others.

Let us digress for the moment and review the construction of our set thus far. First, we made an ultra-short wave receiver of the superheterodyne type. This was used for picking up the accompanying sounds which are being sent out with the images; and signals of amateurs working on the channels adjacent to the television band. Actually, this tuner will be used as the video or image tuner and so, Part II contained details and the circuit of a second I.F. amplifier, detector and audio amplifier which couples into the output of the frequency changer of the tuner and is used for picking up the accompanying sound transmissions of the television broadcasts. By correctly tuning the two I.F. amplifiers as described in Part II, it is only necessary to tune in the weird sounds of the video transmissions on the vision channel, and the sounds which accompany the images are heard from the sound channel of the set.

The third part of the system consists of the C.R. tube and its associate equipment for scanning the image or reconstructing the visual images from the high-frequency impulses received.

In Part IV, we will tell how to make the cabinet which houses the receiver and tie-up all the individual parts of the system which, through necessity, we have left in a rather loose-ended condition.

CONSTRUCTION

The first thing to do, of course, is to obtain all the parts called for in the List of Parts at the end of this article. This includes the chassis which can be obtained already bent, or can be made by the constructor from sheet aluminum.

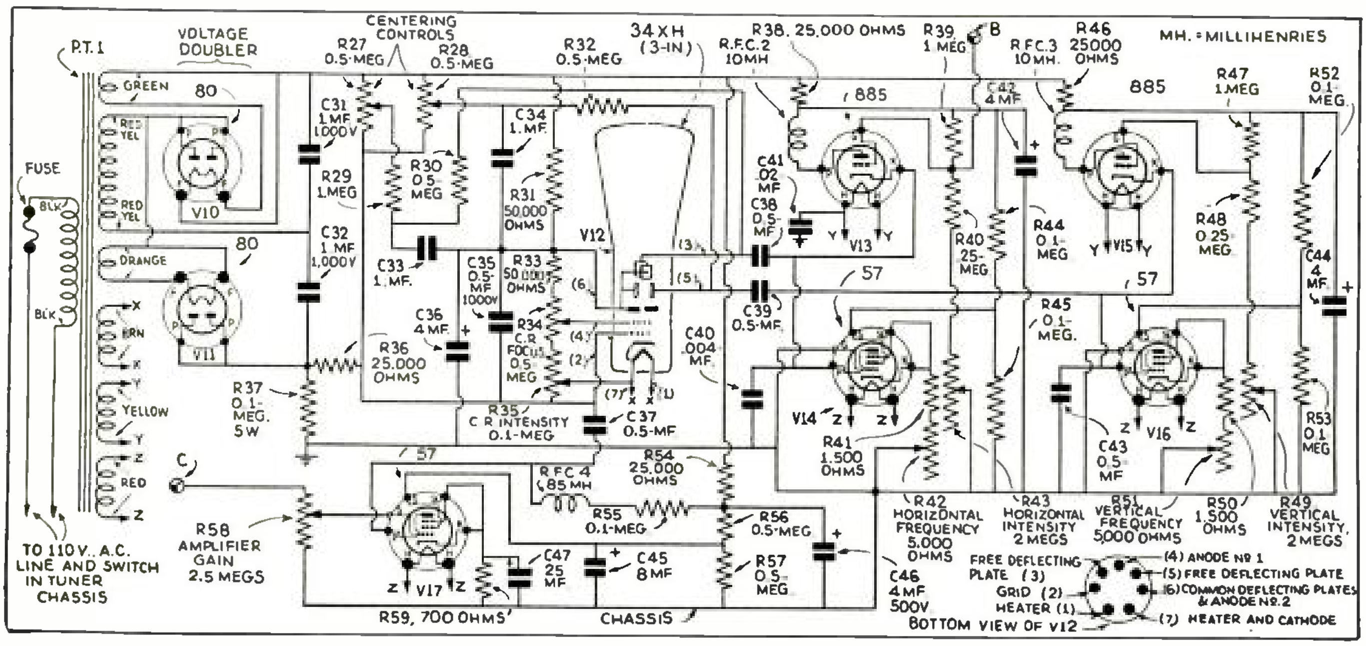

Fig. 5. The tubes services are as follows: V10, V11, power supply; V12, image tube; V13, V15, sweep oscillators; V14, V16, constant-current discharge tubes; V17, wide-range A.F. amplifier.

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RADIO-CRAFT—1937 RECEIVER

In a letter to RADIO-CRAFT, G. M. Fox of Hayes, Middlesex, England, writes: "The picture transmissions which are now a daily feature of the BBC service are being well received. Receiving equipment is being used as an attraction at some of the smart restaurants, also at the Science Museum and at Waterloo Station. As far as I can learn, there is no important difference between the Baird and E.M.I. systems and those of Farnsworth and Zworykin."

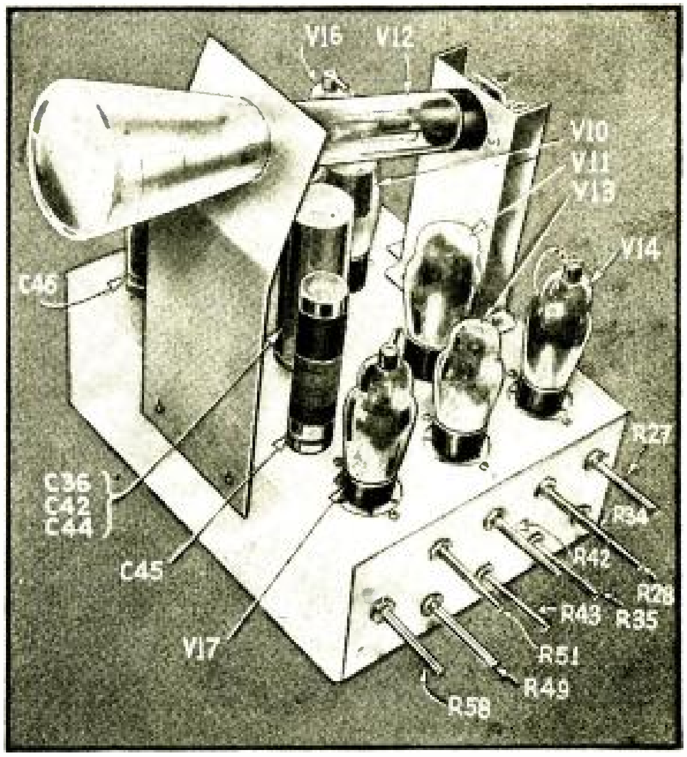

Fig. 1. The completed chassis ready to be tied to the tuner.

The dimensions for this chassis, including the positions of the large holes for tube sockets and electrolytic condensers, etc. are shown in Fig. 6. The cathode-ray tube is supported on two vertical supports, as shown in Figs. H and I which show the unit in the stages of construction and completed, respectively.

The upright brackets for the support of the cathode-ray tube are shown in Fig. 6. The back, or U-shaped upright is drilled for the socket of the cathode-ray tube which is mounted at a 10 degree angle from horizontal by cutting a triangular slice from each side of the support and bending the flat, front portion back until the sides meet. Slots are cut for the screws supporting the socket for the C.R. tube, V12. This permits rotating the tube to make the images "straight" on the front of the tube.

The flat or front support for V12 consists of a strip of aluminum with a 1⅝ in. hole at the top through which the tube passes. The two holes which secure this strip to the chassis, at the bottom are elongated so that the tube can be raised or lowered to center it in the line of the lens system. (More will be said about this lens in Part IV.)

When all the holes shown in the chassis and supports shown have been cut or drilled, the parts may be mounted. Where holes are not shown, they should be drilled to fit the parts in question. These holes have been omitted since the parts used will control the positions of these holes. The photos, Figs. H, I and J show the positions of the parts above and below the chassis.

When all the parts have been secured in place, with the exception of those which are mounted on the wiring (such as fixed resistors, small condensers, etc.) the wiring can be started.

A point of warning must be given here since ordinary precautions to insulate parts from each other and from the chassis will be entirely inadequate. The total voltage of the power supply is over 1,200 V. and special precautions must be taken to carefully insulate all parts. Use well insulated wire and rubber grommets wherever any wires project through the chassis. Otherwise, trouble, "fireworks" and breakdown of some of the parts will result, when the power is turned on.

Also, it may be well to repeat, at this time, a warning which was given in Part I—that is, do not touch the chassis or any parts or wires of this unit when the current is on. The high voltage used is DANGEROUS! Always make sure that the line plug is out of its socket before touching any metal parts of this chassis!

ANALYSIS OF THE CIRCUIT

When all the wiring is completed according to the circuit, Fig. 5, the entire wiring should be checked, wire by wire—and it would be well to have a second person check the wiring for you to be absolutely sure that everything is OK.

The unit can then be tried out and preliminary adjustments can be made to prepare it for its task in converting electrical impulses into living, moving images.

First, however, it may be advisable to do a little explaining about the circuit which we are using, so that the constructor will know something about it and thus be more able to use it correctly.

The power supply is of the type known as a voltage doubling circuit. Two type 80 tubes are used with a power transformer supplying some 600 V. on its high voltage winding. The voltage applied to the two rectifiers which are connected as half-wave tubes by shorting the plates together are fed to two series, high-voltage dykanol condensers, C31 and C32 which alternately store up the applied voltage and discharge it into the output circuit. Thus the voltage of 600 from the transformer is doubled and a voltage of some 1,200 V. is actually applied to the C.E. tube, V12.

The reason for this voltage doubling is to use an available transformer which has a very concentrated field so that the

(Continued on page 563)

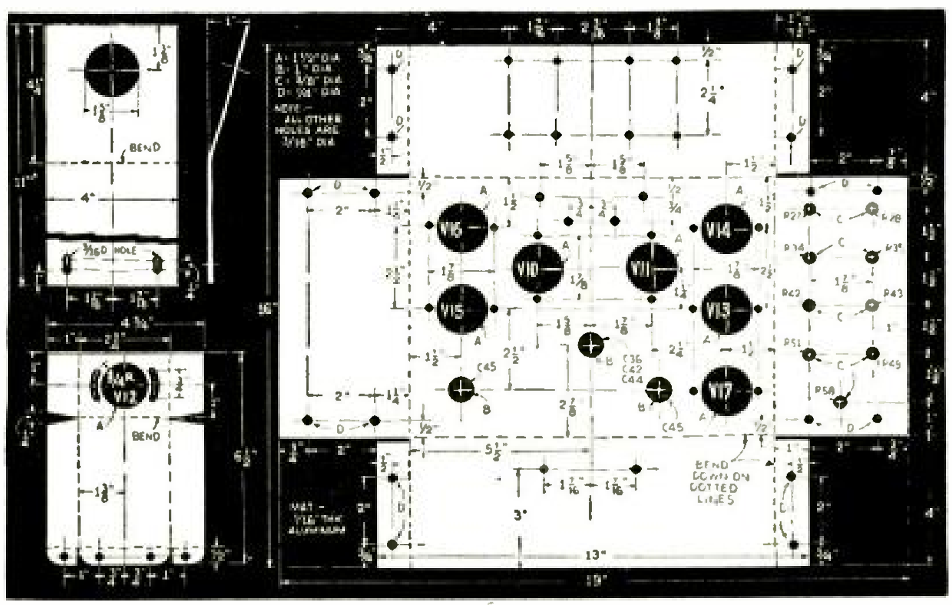

Fig. 6. The forming and drilling layout of the chassis and tube supports.

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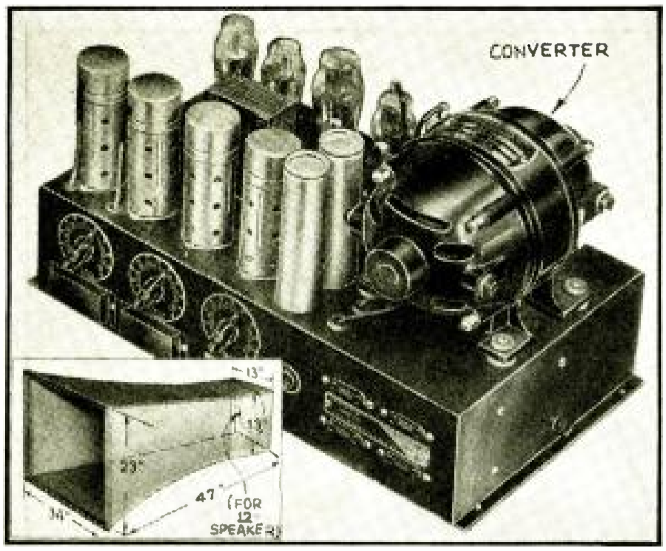

Fig. A. A 30-W. truck amplifier; and (insert), a truck trumpet.

HOW TO EQUIP A SOUND TRUCK

The beginner in Public Address work will find much instructive data in this lucid article.

H. W. PARO

THE SERVICE MAN or the beginner in Public Address who considers equipping a sound truck has first of all to determine whether the truck is to be used for general rental purposes, or whether his ultimate object will be to sell it to some user who will want it to serve a specific function. His decisions in the matter of apparatus to be installed will depend to a considerable degree upon the answer to that question, since the general-purpose rental truck will need more flexible facilities. The P.A. truck that is to be sold to meet one definite object may be limited, in equipment, to a sound system capable of serving one purpose only.

Subject to this broad division between a general-purpose rental truck and a single-function truck for re-sale, the Service Man or the P.A. beginner installing mobile equipment has 5 general factors to keep in mind when choosing his apparatus. These are: (1) The sound volume needed; (2) The amplification needed; (3) The type of sound to be reproduced; (4) The degree of high quality that will be required in the sound; and, (5) The nature of the power supply to be used.

It will be seen, by a brief inspection of these factors, that they interlock; the extent of sound volume desired will have an important bearing upon the type of power supply chosen, the nature of the sound to be amplified will in some ways govern the amount of amplification needed, and so on.

SOUND TRUCK VOLUME

In determining the amount of volume needed from any sound truck, one important point to remember is that outdoor work in general, and with exceptions as indicated below, needs more volume than indoor work serving a crowd of the same size, in an area of the same size. The reason is that sound indoors is reenforced by reflection from walls and ceilings, while in much outdoor work, particularly at fairs, athletic fields, and other open places, sound that once passes the ears of the listeners is lost; it is never reflected back to anyone who can hear it.

An important exception to this statement will be found in narrow city streets, especially streets lined with high buildings, where pavement and walls introduce a considerable degree of reflection, and provide some sound reenforcement. In such work, however, the background noise of traffic is likely to be heavy, and what has been gained by reflection

(Continued on page 565)

LOUDSPEAKER BAFFLES AND CABINET RESONANCE

The subject of loudspeaker baffles is, perhaps, one of the most mystifying to radio beginners. By considering the cone as a piston the need can be readily understood.

McMURDO SILVER

THE WRITER is so regularly and continuously surprised by daily correspondence which indicates such a lack of understanding of what a loudspeaker baffle is that he is taking occasion to dispel the many false impressions regularly met with. Even many radio Service Men do not know the "ABC" of baffles.

A dynamic cone loudspeaker functions over most of the audio range as a piston, driven by the A.F. output of any amplifier through the agency of its voice coil, which may best be considered as a "motor" driving the piston (cone). When the cone is so driven by an audio-frequency signal, it moves forward and backward, thus displacing surrounding air both in front of *as well as behind* the cone. It is this displaced air which the ear perceives as sound.

In such operation, the air pushed out in front by the cone moving forward must go somewhere, and as a partial vacuum is created at the rear of the cone as it moves forward, the displaced air in front finds it most easy to flow toward the partial vacuum at the rear, which needs new air to fill the semi-vacuum left by the forward movement of the speaker cone. The net result of this action in theory is the generation of sound waves in only the air very near the cone.

This is true for very low frequencies, but not for high frequencies. Thus in practice, an unbaffled speaker will reproduce high tones, but will lack almost entirely all low tones, due to this cancellation described above. (See Fig. 1A.)

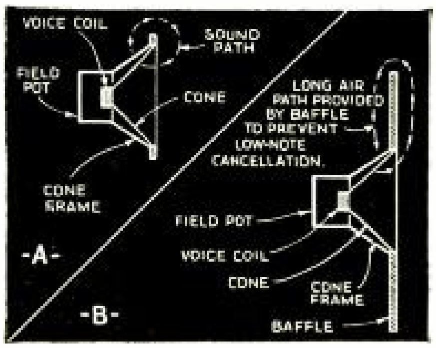

Fig. 1. The lengthening of the sound path.

DEFINING THE TERM "BAFFLE"

A baffle is *any means at all* placed between the cone front and the cone rear which lengthens the distance the air must travel from front to rear to cause cancellation of front pressure by rear vacuum, as the cone moves forward in its reproducing cycle. For high frequencies, the "baffle" provided by the size of the cone itself is sufficient to prevent cancellation. The low-tone reproduction range is dependent upon the size of the baffle, or more exactly, the length of the air path from the center of the cone in front to the center of the cone at the rear. (See Fig. 2.)

(Continued on page 558)

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THE ABC OF A.F.C.

A simple explanation of "automatic frequency control" for the beginner. This new set refinement is dissected to show the basic principles.

C. P. MASON

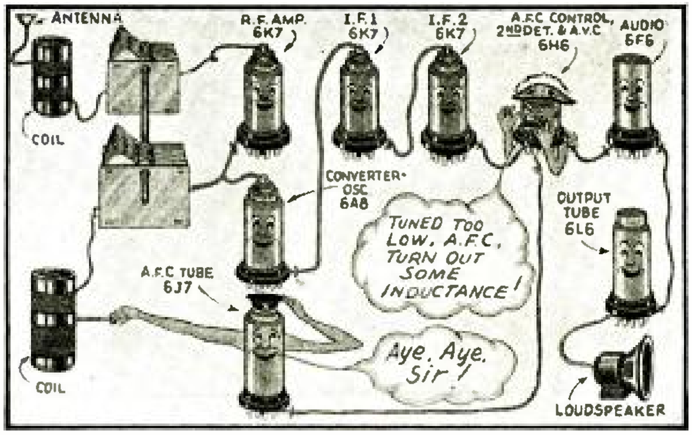


Fig. A. "Admiral" 6H6 gives orders for correcting poor tuning!

THE DEVELOPMENT of automatic frequency control (or "A.F.C." as it is called), known by several different trade names in recent receivers, is the latest of a series of refinements which have been added to radio design. Specifically, it is the addition of a tube (and associated circuits) which corrects an error in the setting of the tuning condensers, in a *superheterodyne*, by bringing the oscillator setting to a frequency such that the incoming signal will be mixed (or first-detected) to give the exact I.F. to which the set's amplifier is peaked.

The advantage is, not so much to find a station by hasty or mechanical tuning, as *to eliminate audio distortion and other undesired consequences of inaccurate frequency selection.*

If an A.F.C. set, therefore, is turned to within 7 kilocycles of a strong signal, it will adjust its oscillator's tuning until the signal is brought within 500 cycles. A weak signal can be pulled in from, say, 3 kc. (kilocycles) away; in each case, the final accuracy is increased as the receiver is more correctly tuned. So, in A.F.C. sets, tuning by hand, and then cutting-in the A.F.C. circuit with a switch, results in a correction which improves the quality. Of course, if one should set an A.F.C. receiver half-way between two strong signals, say 10 kc. apart, and turn on the A.F.C. control, the set might be puzzled to choose, like the donkey between two loads of hay; but this is not a common condition, in listening to domestic broadcasting. In some new receivers, when the tuning control is turned to "preset" stations, the A.F.C. is cut out automatically until the dial stops rotating.

EVOLUTIONARY STAGES

To explain the principle, it will be of interest to look back at the methods of set tuning which have been in use, at various times, since the manufacture of broadcast receivers began. Every circuit is tuned by the presence of a certain amount of *capacity* and *inductance* (as well as *resistance*, which can never be entirely eliminated); the higher their product, numerically, the higher the wavelength, and the lower the frequency. The combined action of the capacity, pulling electricity ahead, and the inductance, holding it back, determine the frequency which will build up the greatest voltage in the

(Continued on page 572)

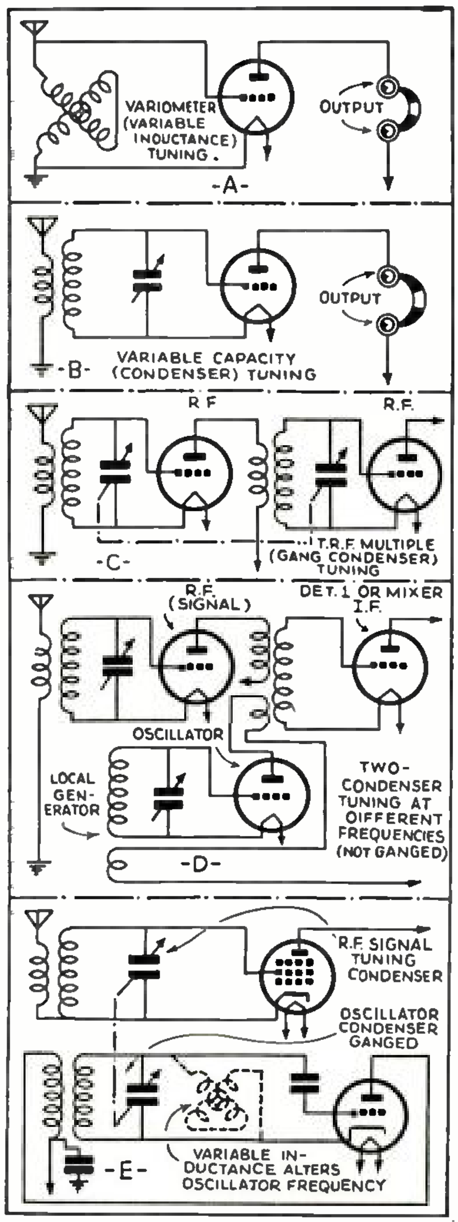
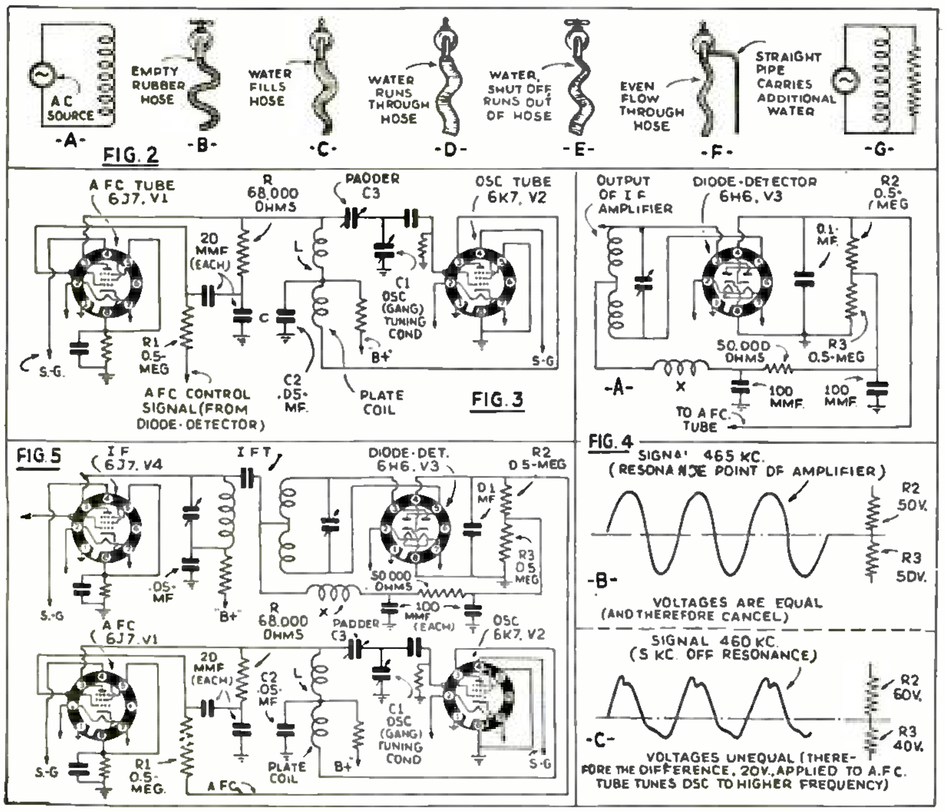


Fig. 1. Well-known principles govern A.F.C. operation.



Figs. 2, 3, 4 and 5. Analogies to show the action and the breakdown details of a typical circuit.

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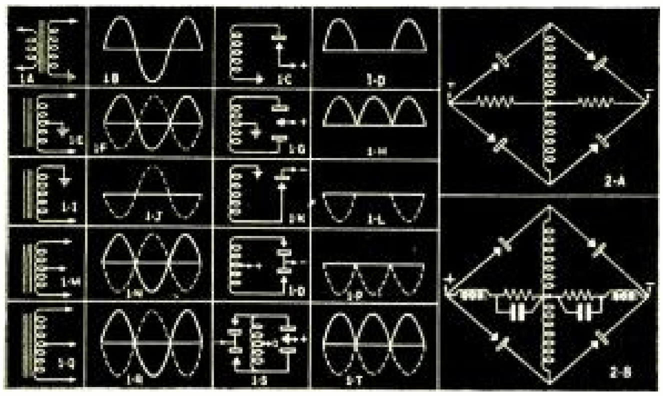


Fig. 1. A breakdown of the rectifier circuit operation.

DIRECT COUPLING IN A 30-W. BEAM-TUBE AMPLIFIER!

Direct coupling, by eliminating coupling coils and condensers, affords higher-fidelity amplification. An old idea modernized.

A. C. SHANEY PART I

IT IS quite generally agreed among sound-system engineers—particularly those who have been specializing in high-fidelity designs—that the major objections to transformer coupling (core saturation and magnetic lag) and resistance coupling (short-circuiting of weak signals and grid blocking of strong signals) *are completely avoided by utilizing* DIRECT COUPLING!

This type of circuit is actually capable of producing *equal-potential* amplification at all frequencies, within the limits set by the interelectrode capacity of the tubes, and *equal-frequency* amplification at all potentials within the audio band.

Although the idea of direct-coupled amplifiers is not new (it was first introduced by Messers Loftin and White about the time the first type 24 screen-grid tube made its appearance), it has from time to time been revived and built in great numbers only to fall by the wayside whenever the announcement of a new super-triode or pentode served to take the technician's interest away from this circuit.

DIRECT-COUPLED AMPLIFIER FAULTS

As the circuit was originally introduced (and built by the thousands) it had the following 2 major drawbacks:

(1) The circuit was subject to "trigger" action;

(2) An adequate push-pull output circuit was unavailable.

(Continued on page 556)

TABLE I

The amplifier described in this article features such modern innovations as:

(1) Non-Reactive Signal Division;
(2) Unrestricted Frequency Response;
(3) Non-Reactive Dynamic Coupling;
(4) Two-Phase Bridge Rectification;
(5) Stabilized Power Supply.

The bullet microphone employed offers the following advantages over the conventional types:

(1) May be operated up to 4,000 ft. from the amplifier without preamplifiers;
(2) High-level output (average-45 db.);
(3) Variable Polar Response Characteristics;
(4) High Sensitivity;
(5) Acaustically-compensated Dampening Chambers.

THE CAPACITY METER AS A SERVICING AID

The use of a direct-reading capacity meter covering a range of 100 mmf. to 200 mf. greatly simplifies servicing.

O. J. MORELOCK, JR.

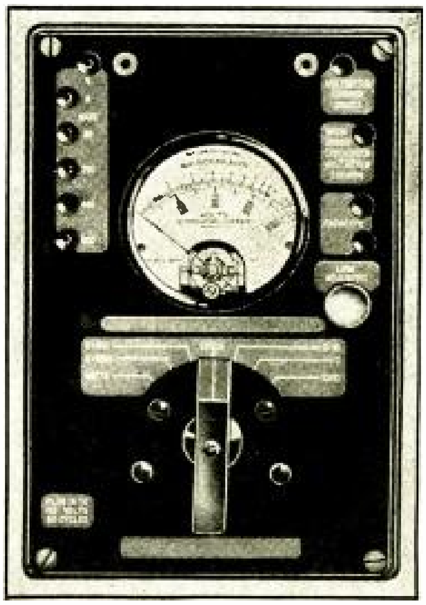
SEVENTY-FOUR condensers in a single receiver—that is what a circuit diagram reveals in a typical all-wave model that sooner or later is going to require some Service Man's attention! And a check-up would show that many others exceed this startling figure. In addition to tuning condensers, trimmers, and the like, the receiver mentioned above contains 40 fixed condensers, ranging from 100 mmf. to 18 mf. in capacity, including *paper, mica* and *electrolytic* types.

If every fixed condenser continued indefinitely to live up to its name, there is no doubt that the troubles (as well as the business, of course) of the Service Man would be considerably reduced. As it is, they constitute not only a frequent direct cause of receiver failure, but a secondary cause of lack of balance within critical circuits that hopelessly complicates effort to stabilize the receiver or make other necessary adjustments.

Like other faulty elements in a receiver circuit, a bad condenser may sometimes be located indirectly from potential, resistance or current measurements in the standard analyzing routine, such as is often the case with a complete short-circuit. Generally, however, the problem is not so simple.

ELUSIVE CONDENSER FAILURES

For instance, it is not unusual to encounter a receiver which, according to the owner, "begins to howl badly after it's been on for a while". Tube tests and resistance measurements may reveal no defects. The Service Man sooner or later arrives at the conclusion that a condenser in one of the bypassing circuits open-circuits when the receiver is hot. Then the question is: "Which one?" and a laborious substitution job is in prospect unless means are available for direct capacity readings. If the condenser opens only intermittently, due to the effect of "thermal expansion" on a weak internal connection, the job may be one of those that brings gray hairs to the heads of Service Men.



Appearance of the direct-reading capacity meter.

Often, the effects of thermal expansion or of dampness, may merely result in a change from rated capacity, seemingly slight, but sufficient to throw a critical circuit hopelessly out of balance. Too frequently, as well, the Service Man encounters a condenser block or individual condenser on which the nominal capacity rating is missing or obliterated. Whether such a condenser be good or bad, the problem is equally unsolvable

(Continued on page 557)

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RADIO-CRAFT'S INFORMATION BUREAU

SPECIAL NOTICE

Those questions which are found to represent the greatest general interest will be published here, to the extent that space permits. (At least 5 weeks must elapse between the receipt of a question and the appearance of its answer here.) Mark such inquiries, "For Publication."

Replies, magazines, etc., cannot be sent C.O.D. Back issues of *RADIO-CRAFT* prior to January, 1935, are available at 50c per copy; except the following issues: 7/'29, 1, 2, 3, 4, 6, 7, 9 and 11/'30; 5, 6, 8 and 9/'31; 6, 7, 9/'32; 7/'33; 8/'34; and 1/'35 which are out of print. Issues following January, 1935, are still available at the regular price of 25c per copy.

Inquiries to be answered by mail MUST be accompanied by 25c (stamps) for each separate question; answers are subject to subsequent publication if considered of exceptional interest.

Furnish sufficient information (in reference to magazine articles, be sure to mention issue, page, title, author and figure numbers), and draw a careful diagram (on separate paper) when needed to explain your meaning; use only one side of the paper. *List each question.* Be SURE to sign your name AND address.

Enclose only a STAMPED and self-addressed envelope for names and addresses of manufacturers; or, in connection with correspondence concerning corrections to articles, as this information is gratis.

Individual designs can be furnished at an additional service charge. The fee may be secured by addressing the inquiry to the SPECIAL SERVICE department, and furnishing COMPLETE specifications of desired information and available data.

RESISTANCE-CAPACITY ANALYZER CORRECTION

(382) William M. Reed, Baltimore, Md.

(Q.) Recently I began to assemble the "Free reference-point Resistance-Capacity Analyzer" as a companion unit for the "Set Analyzer" described in the January 1936 issue of *Radio-Craft*, but I found that at least one connection was not completed in the diagram. Will you please supply this information so that I may complete my outfit?

I thoroughly enjoy the splendid and very enlightening articles found in your magazine and every time I see useful equipment (useful to me) I begin building it or remodeling my older ones.

(A). We are reprinting here Fig. Q.382, the circuit of the test unit in question for Mr. Reed and other readers of *Radio-Craft* who have tried to build this unit. The circuit has been checked over carefully, by the author, Mr. W. C. Bellheimer, and the only error is the one found by Mr. Reed. The center upper blade of the switch Sw.4 should be connected to the positive test jack, thus completing this circuit. The added wire is shown on the circuit heavier than the other wiring which appeared in the original article.

Figure Q.382 also shows the remaining wiring of the analyzer, with the exception of the adapter units which are in the original circuit.

DIRECTION OF CURRENT?

(383) John H. Watson, Toronto, Ont. Canada

(Q.) In reading text books and magazine articles, a question has popped up which to me becomes increasingly confusing as I delve further into the subject. I refer to the subject of current flow.

In many electrical and radio texts, the assertion is made that current flows from the positive terminal of a battery to the negative terminal, through the external circuit. In books on vacuum tube action, the statements are made that the current flow is from the cathode or filament to the plate. Now since the battery current is from positive to negative how can the current possibly flow from cathode which is connected to the negative side of the "B" battery to the plate which is at the positive end of the battery?

Many conflicting statements are made in the different books and I can find no concise explanation of the apparent paradox. Undoubtedly there is a simple explanation—and I am turning to you for it. Can you help me?

(A.) Mr. Watson has run across a problem which has confused many students of electricity and radio.

To give an answer, we must turn back to the early days of radio—to the time of Maxwell and Hertz. In delving into the mysteries of the then little known subject of electricity, the early physists conducted several experiments which apparently proved to the satisfaction of everyone that the current in a battery circuit flowed from the positive terminal, out through the external circuit and back to the negative terminal.

Later, other experiments began to cast some doubt as to the veracity of the early experiments but teachers, and authors of text books stuck to the early findings since they had nothing better to offer their pupils.

In the early 1900s, when the electron theory was first evolved the question of the direction of current flow came up again—and laboratory work by such men as Thompson and Sir Oliver Lodge disclosed the fallacy of the earlier statements.

According to the electron theory—which has since been proven by innumerable experiments in research laboratories and universities to be basically correct (though the limits of experiment and research have not been reached in this work by any means)—electrical currents are the drifting or motion of electrons through a conductive circuit or medium. Thus, since it is known that the electrons are "negative" in their charge—and tend to re-unite with the positively charged nuclei of the atoms from which they were removed—it can be logically deduced that current flow (electron flow) is from the negative to the positive terminals of a potential-developing device.

The confusion which has arisen from this conflict of statements has been caused by two facts. First, teachers of electricity have found from experience that it is easier to explain that current flows from positive to negative (according to the old school) in early work with beginning students, depending on an understanding of the electron theory as the students advance in knowledge to dispel the early error in their learning. Second, human nature abhors change, and certain of the instructors and text book authors cannot bring themselves to make the break from the old to the new.

The fallacy of such a system is evident—and many modern teachers are doing everything possible to eliminate this confusion by teaching the correct method right from the beginning. This, of course, is the correct and logical procedure to follow.

We are glad that Mr. Watson brought up this problem at this time so that it could be answered in the Beginner's issue of *Radio-Craft*. Perhaps at a later date, a more detailed explanation of the various problems, together with some experiments which the student can perform himself, can be printed in *Radio-Craft*.

PORTABLE SET DIAGRAM

(384) Everett P. Jones, Norfolk, Va.

(Q.) Some time ago, I saw in a radio store in Washington, D.C. a radio receiver which was called the Sportsman. It was completely self-contained having batteries and aerial, in the small case. The set was equipped with a carrying handle which slipped over the shoulder to facilitate carrying it over some distance.

I believe the set was made by the Simplex Radio Co.

(Continued on page 566)

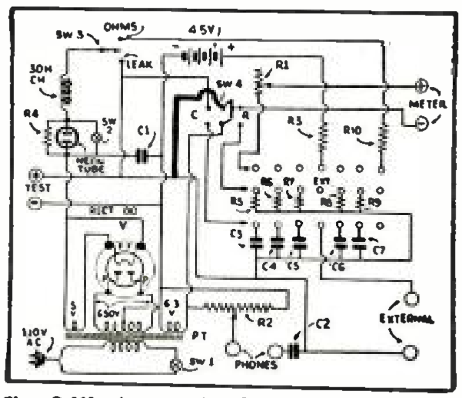


Fig. Q.382. A correction for the "Free-reference-point" Resistance-Capacity Analyzer.

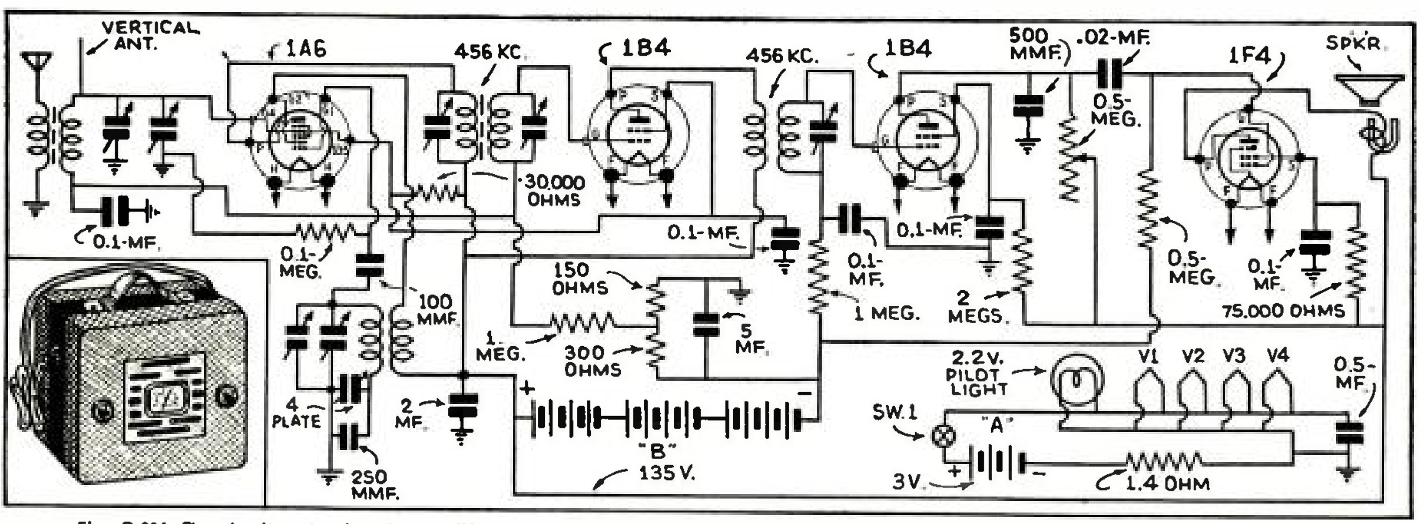
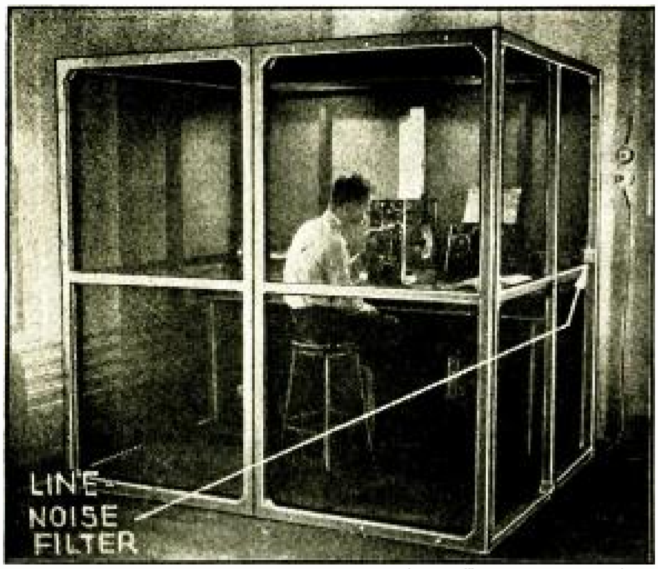


Fig. Q.384. The circuit and values for the "Sportsman" receiver. Note that either a short vertical rod aerial or an outside aerial may be used.



Photo—Tobe Deutschmann Corp.

If the Service Man wishes to have a really up-to-date service shop he must have an effective shielded test room in which he may fully utilize modern test equipment without interference from strong local fields of either man-made static or broadcast stations. Such a test room (on which specification data are available), measuring approximately 6 ft. each way, is here shown. But unless such a room includes a suitable noise filter, installed at the point at which the power supply line enters the screen, the outside interference would be carried, as "wired radio", inside the test room and its benefits would be nullified. The correct positioning of a suitable-type filter is illustrated.

RADIO'S "OLD MAN OF THE SEA"

Television and high-fidelity radio reception must mark time until Public Nuisance No. 1—man-made static—is laid by the heels. Beginners and old-timers must fight shoulder-to-shoulder in the crusade for interference-free radio reception. Present day conditions are intolerable and inexcusable.

FRANK L. CARTER

RADIO interference, which the early radio fans dismissed as "static," "strays" and "X's", is as old as radio reception. Due to the expansion of radio facilities, however, the problem, now rapidly become acute, has received national and international attention.

The older types of radio receiving sets didn't reproduce a very wide audio-frequency range and thus inherently served to eliminate a large portion of the man-made static, but as radio sets improved they began to pick up more and more disturbance. Now, in the last 2 years, all of the medium- to high-quality receiving sets manufactured incorporate not only an "extended" or widened broadcast band but also several short-wave bands in which all types of man-made interference raise havoc. It is of course possible to eliminate any of the existing types of electrical disturbance, as voluminous reports from private and commercial interests have shown, but in certain instances it may be questioned, at least for some time to come, whether the cost justifies the necessarily almost exorbitant expense incident to complete elimination of certain types of trouble when, instead, a far less expensive procedure affords an excellent palliative.

With the foregoing points in mind, *Radio-Craft* readers may be interested in the following report of conditions, typical of other thickly-populated sections of the country, that have been encountered in the area in and around New York City.

The recent, rapid, universal acceptance and adoption of police radio systems for use on patrol cars have been moving factors in bringing the problem of interference to the attention of public officials. (See the article, "WPA Police-Radio 'Noise Detectives'", in the January, 1937 issue of *Radio-Craft.—Editor*) There are many sections in the so-called Metropolitan area of New York, for example, where radio-equipped police squad cars are completely blanketed. These "radio policemen" in attempting to receive signals from headquarters are able to get nothing but "noise."

The pernicious effects of interference are reflected, in private homes, in the use of domestic receiving sets. Thus, the average family has found by experience that interference so mars reception from certain stations that only about 20 per cent or less efficiency from their sets can be realized. Radio reception in many sections of Manhattan and the Bronx, for instance, thus is confined to 2 or 3 stations instead of the 40 or 50 which, it has been shown, could be heard plainly in the absence of local electrical interference!

By way of illustration, on East 180th St., N. Y. C., there is no station that is generally received entirely above the noise level; and in the Dyckman St. section, for instance, a sub-station radiates commutator ripple and accompanying hash. Reception throughout this area is especially poor.

Numerous complaints have come from the Bay Ridge section of Brooklyn, where interference is largely traceable to trolley wires; while on the other side of Brooklyn, in the vicinity of Nostrand Avenue, the noise level at times is greater than the signal strength of any of the local broadcast stations. So far as is known nothing has been done to improve local conditions.

The outlying sections are subject to indigenous types of static. There are numerous cases of severe interference that sounds like an approaching thunder storm. This is often due to local electric light wires rubbing against the limbs of trees. Such cases will be promptly corrected by the electric company, if informed of them, because if allowed to continue the situation will cause a disruption of the service.

As an example of what may be accomplished, if local radio men and interested citizens organize for the elimina-

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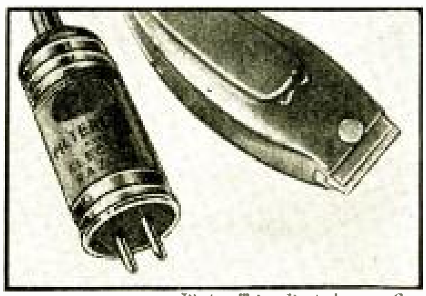

Photo—Tobe Deutschmann Corp.

Electric shaving devices and other small electrical appliances generate static that this tiny filter, which fits on the line plugs, reduces about 70 to 90 per cent.

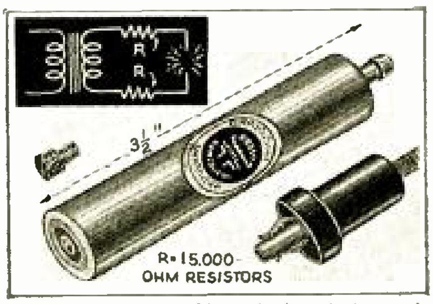

Photo Continental Carbon Co.

One each of these interference suppressors is required in each high-tension lead of an oil burner.

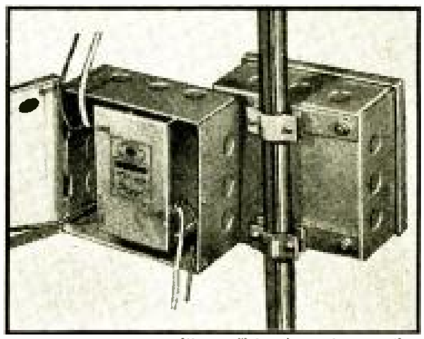

Photo Tobe Deutschmann Corp.

This heavy-duty inductance-capacity power-line filter effectively squelches oil-burner interference.

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HOW TO USE
V.-T. VOLTMETERS IN RADIO AND P.A. SERVICING

Measurement of (1) root-mean-square (effective), (2) peak, and (3) D.C. voltages by means of V.-T. voltmeters is covered in this multi-part article.

KENDALL CLOUGH PART I—R.M.S. MEASUREMENTS

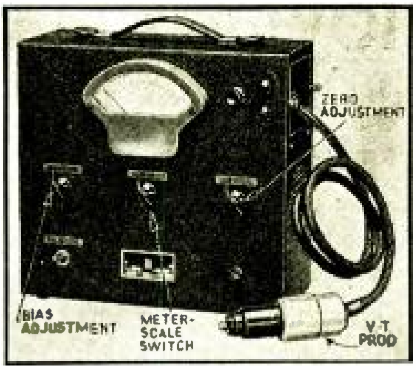

Fig. A. The appearance of the V.-T. meter discussed.

ONE OF the most useful and yet perhaps one of the least applied of service instruments is the *vacuum-tube voltmeter*. Many Service Men are either entirely without such an instrument or if they have used one, they have found it inadequate for their needs, since the early varieties of these instruments required continual recalibration and adjustment in order to be dependable.

However, recent developments in circuit design have eliminated the ills of the earlier types. It is no longer necessary to completely recalibrate such a

(*Continued on page* 568)

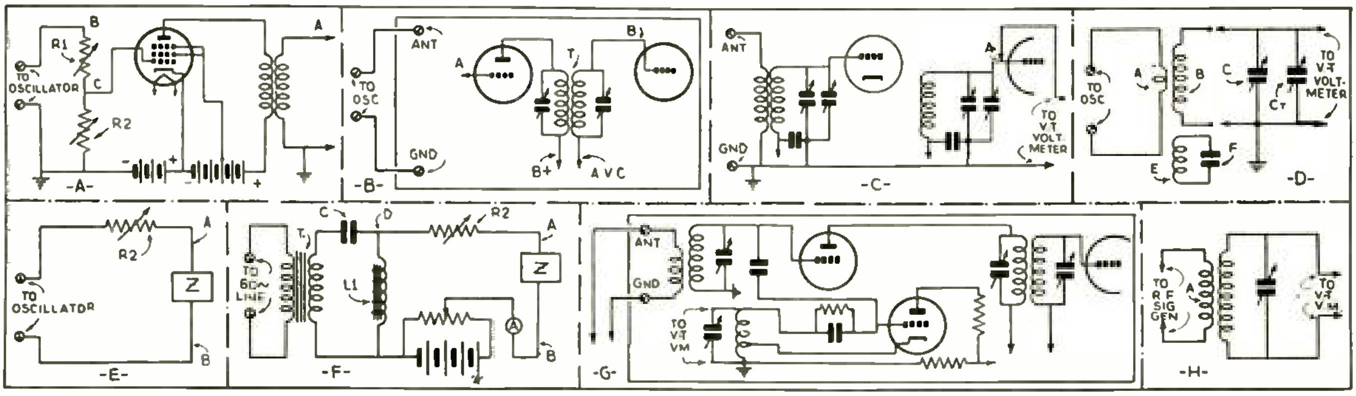

Fig. 1. Detail connections of the meter for numerous tests in radio receiver checking. Note the wide variety of "hard-to-make" tests.

A 5-BAND 11-TUBE RACK-AND-PANEL RECEIVER

The 1937 Super Skyrider receiver, described here, includes all the latest receiver advancements.

J. T. McCABE

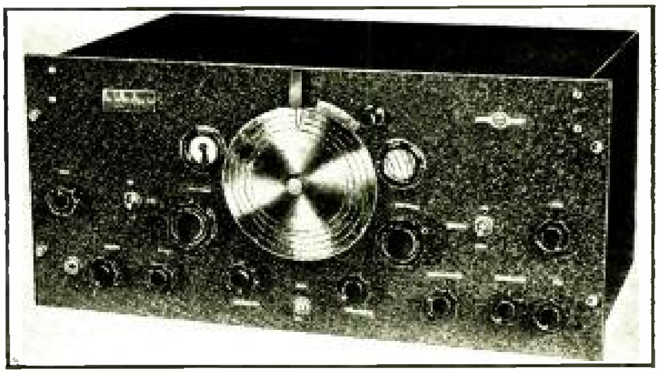
Fig. A. The set's panel showing the controls which provide flexibility.

THE NEW 1937 all-wave receiver shown in Figs. A and B is a 5-band 11-tube superheterodyne set, arranged for rack-and-panel mounting, and covering the following frequency ranges:— No. 1 band, 545 kc. to 1,230 kc. (550 to 243 m.); No. 2 band, 1.18 mc. to 2.85 mc. (254 to 105 m.); No. 3 band, 2.75 mc. to 6.82 mc. (109 to 44 m.); No. 4 band, 6.75 mc. to 16.4 mc. (45 to 18.3 m.); No. 5 band, 15.4 mc. to 38.1 mc. (19.5 to 7.85 m.).

The coil range in use is indicated by the pointer on the main dial. This pointer moves vertically when the band-change switch is moved. The calibration on this dial is in megacycles on all but Band No. 1 on which it is in kilocycles. This calibration will hold only when the "band-spread" condenser is set at 200 deg., or minimum capacity position.

The tube lineup is as follows: one 6K7—preselector, R.F. amplifier; one 6L7—1st detector—mixer; one 6C5—signal-frequency oscillator; one 6K7—1st I.F. amplifier; one 6K7—second I.F. amplifier; one 6R7—2nd-detector; A.V.C.; first audio; two 6K7—beat oscillator; one 5Z3—full-wave

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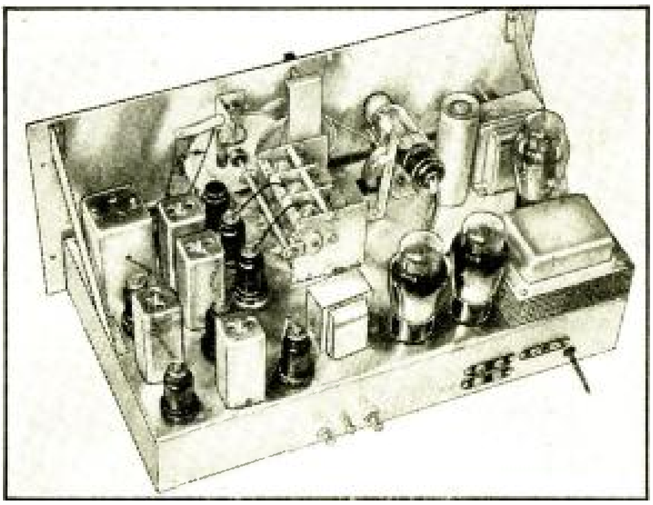
Fig. B. The rear of the chassis. Note the careful placement of parts.

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HOW TO MAKE THE RADIO-CRAFT SET ANALYZER

This article presents requisite details for concluding the construction of the RADIO-CRAFT Set Analyzer. An interesting tabulation of decibel conversions to volts and watts is given. The servicing beginner should save this article.

PART II

THE FIRST Part of this article (See *Radio-Craft*, July, 1936, pg. 18.) was devoted to the design and construction of The *Radio-Craft* Set Analyzer, and included a complete analysis of its operation in receiver circuit testing. This, Part II, is devoted to comments on the operation and construction; plus the design of a low-cost method of determining condenser capacity, a method of reading and checking the peak voltages in rectifier circuits, and a DB.—Voltage chart which increases the range of application for the sound specialist.

Some constructors did not mount the voltage multipliers properly; in other instances high-resistance connections developed due to poor soldering. Both these points should be watched very carefully. The use of separate sets of multiplier resistors for the A.C. and D.C. scales should not offer a problem; but of course in other instances where A.C. multipliers were used in the D.C. circuits the meter would not read properly.

When using the meter for external measurements be sure that the setting of Sw.2 is not the same as that of Ref. Switch No. 10. Otherwise, there will be a short across the meter; the meter will not read and it is possible to damage some external component in the circuit under test. (Particularly, if the current or voltage in the circuit under test is high.)

Be very careful in wiring. Use the best grade of insulated wire that you can buy. Try to space all wiring as much as possible. This will minimize the possibility of high-resistance leaks which cause serious meter errors when measuring high-resistance circuits.

MEASURING CAPACITY

The simplest method of capacity measurement involves the use of an A.C. voltmeter connected in series with the unknown capacity across a 110 V. A.C., 60-cycle line. Figure 2A illustrates the circuit. Here the capacity Cx can be considered as a "multiplier" of the voltmeter reading. The voltmeter, especially when it is desired to measure condensers having a capacity of 1 mf. or more, as indicated in Fig. 2A, cannot be used directly.

Figure 2B shows the final circuit used for capacity measurements. Condenser C may have a capacity of 0.5-mf. and condenser C1 a capacity of 2 mf. These condensers function as capacity shunts across the voltmeter and are superior for this purpose as their use tends to make the capacity formula more direct reading and simplifies determination of the capacity as represented by the voltmeter reading. When the switch Sw.1 is open only capacity C is shunted across the voltmeter terminals. The capacity Cx is then in series with the A.C. line and the shunt capacity C. Closing switch Sw. shunts condenser C1 across C and extends the capacity range of the meter up to 8 mf.

It is apparent from a study of Fig. 2 that *the A.C. line voltage will divide in direct proportion to the reactances of the two condensers*. It can also be stated that *the voltage divides in inverse proportion to the condenser capacities* (providing that the frequency remains constant). For example, if a 1 mf. condenser is connected in series with a 2 mf. condenser across a 100 V. line then 66 2/3 V. will appear across the 1 mf. condenser and 33 1/3 V. across the 2 mf. condenser.

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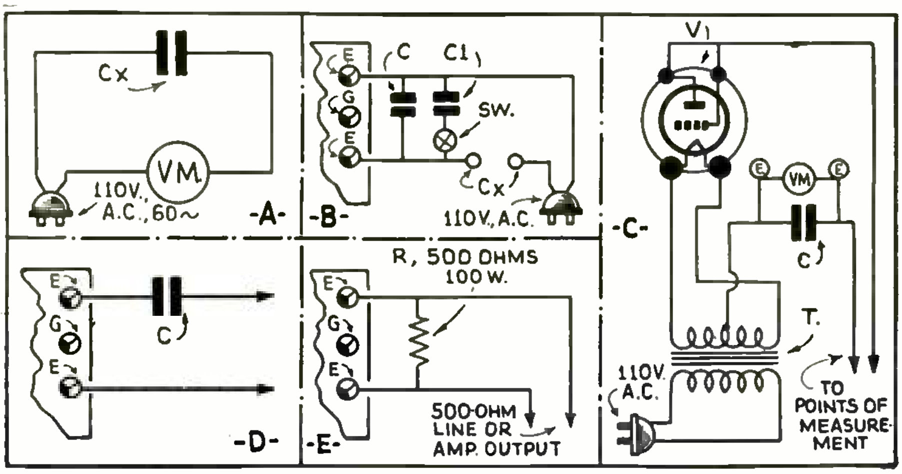

Fig. 2. Circuit details included in the description of the unit.

TABLE III—VOLTS VS. DB.

POWER LEVEL in DB.	POWER IN WATTS (0.006-W. at 0 db.)	VOLTS (at 0.006-W. across 500 ohms)
-10	0.00060	0.55
-9	0.00075	0.61
-8	0.00095	0.69
-7	0.0012	0.77
-6	0.0015	0.87
-5	0.0019	0.97
-4	0.0024	1.00
-3	0.0030	1.20
-2	0.0039	1.37
-1	0.0048	1.50
0	0.006	1.73
1	0.007	1.90
2	0.009	2.20
3	0.012	2.40
4	0.015	2.70
5	0.019	3.0
6	0.024	3.4
7	0.030	3.9
8	0.039	4.3
9	0.037	4.9
10	0.060	5.5
11	0.075	6.1
12	0.095	6.9
13	0.119	7.7
14	0.15	8.7
15	0.19	9.7
16	0.23	10.9
17	0.30	12.2
18	0.38	13.7
19	0.47	15.4
20	0.60	17.3
21	0.75	19.4
22	0.95	21.8
23	1.2	24.5
24	1.5	27.4
25	1.9	30.8
26	2.3	34.5
27	3.0	38.7
28	3.8	43.5
29	4.7	48.8
30	6.0	54.7
31	7.5	61.4
32	9.5	69.0
33	11.9	77.3
34	15.0	86.8
35	18.9	97.4
36	23.8	109.2
37	30.0	122.6
38	38.7	137.5
39	47.6	154.0
40	60.0	173.2

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MAKE THIS POCKET-SIZE MULTI-TEST UNIT

The trend toward compact, efficient testing equipment has resulted in the development of this useful pocket unit.

MILTON REINER

RECENTLY, there has been a trend to build test equipment in miniature or pocket size and this is indeed commendable because it fills a definite need in the service field. Two important advantages are convenience and economy, although if these are achieved at the expense of accuracy, limitation of ranges, sensitivity and types of measurements necessary, then of course the value of the pocket size instrument becomes doubtful.

Pocket instruments cannot by any means take the place of large, multi-purpose, multi-range testers which are necessary in every well-organized service shop. On the other hand, it might also be added at this point, there is no reasonable excuse for building test equipment in heavy, bulky units such as have appeared lately where the increased size, weight and fancy frills add absolutely nothing to the number of useful measurements that can be made; or, otherwise, does not improve the accuracy or convenience.

This pocket meter therefore has been designed to give increased sensitivity, more useful ranges and greater economy than similar meters which are available today. It may be completely assembled and wired very easily and quickly at the surprisingly low cost of about $8 to $9. Nevertheless, all voltage measurements are made *at approximately 2,000 ohms-per-volt (1,800, to be exact)*! Current measurements are available in *microamperes*, *milliamperes*, and *amperes*. These features have never before been

(Continued on page 575)

Fig. A. The size and appearance of the tiny voltmeter-ohmmeter-milliammeter-microammeter.

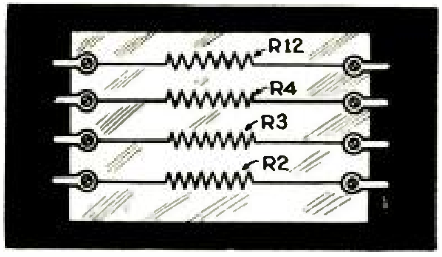

Fig. 2. The way in which the resistors are mounted.

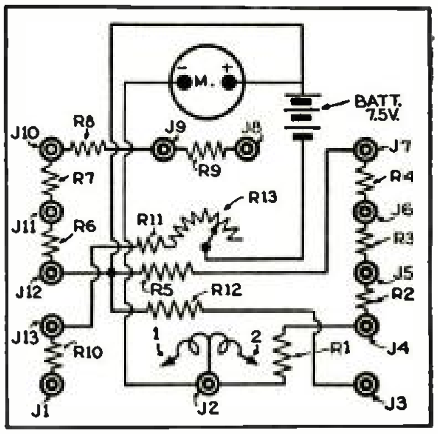

Fig. 3. The circuit of the complete meter.

A few reasons why some Service Men do not make a living are included in this colorful description.

PITFALLS OF THE RADIO SERVICE BEGINNER

R. B. LAWTON

QUICK-SERVICE JOHNNY gets a call from Mrs. Jones—"Come quick, my 'radio' smokes, and smells something awful."

"Shut it off," says Johnny, "and I'll be there at once."

He finds a bad case of power transformer fever, usually caused by malicious, cooperating, internal short-circuits, and almost invariably fatal.

"A new transformer will cost you four dollars and the labor will be three twenty-five," says Johnny, "that makes a total of seven dollars and twenty-five cents."

"Oh! that's terrible," replies the owner of the "radio," which can be smelled farther than it can be seen.

"It certainly is a very bad smell," says Johnny. This comeback knocks the wail about the price for a loop and he gets the job with the demand that the set be as good as new, no static, no fading, and have advertising elimination.

Johnny fixes the set. The transformer nets him $2.40, it costs him 2c to order it, 30c to have it delivered, and 30c to return it because it was the wrong one; 10c for a Special Delivery "mad" letter to the supply company and he had to throw in a condenser that cost 40c. On returning the set, one of the type 45 tubes loosened in the socket and went "Pow!" on the Jones' front porch. It was an old-style 45. Says, Mrs. Jones, "The news broadcaster that talks for that big radio company says my tubes must be 'matched and balanced to work right'. *I don't want different-shaped tubes.*"

So Johnny has to put in two new 45s—at the same time he curses his luck, he is thankful for the shields that hide the other "old bottles". Forty-fives are 75c each—mark up $1.50. Johnny mechanically screws in a new dial light—just another good old shop custom—chalk up another 10c.

While this is going on, the new puppy in the house takes a fibre neutralizing wrench from Johnny's tool bag and runs off with it. When found it is in very, very small pieces. "Ain't he too cute, the little dear," says the Madam.

"That cost another 60c," thinks Johnny.

"I have just $7.00 here—I'll stop in when I'm by sometime, and give you the quarter," says Mrs. Jones.

Johnny departs with the seven bucks and wisely thinks no more about the quarter.

It cost a total of 60c car expenses to

(Continued on page 558)

UNFORESEEN

—circumstances precluded publishing, in this issue of RADIO-CRAFT, certain of the items promised, on pgs. 450 and 477 of the February, 1937, issue of RADIO-CRAFT, for the March issue. Specifically, we refer to the mention, on pg. 450, of data concerning photoelectric equipment experiments and applications and the 12-tube high-fidelity receiver; and the mention, on pg. 477, of the broadcasters' mobile unit. However we plan to present this material in forthcoming issues.

Surprise! Read April RADIO-CRAFT for complete details for building an amazing adapter, that connects to any superhet. receiver, which not only changes color with variations in loudspeaker output but also changes color when tuned to station resonance!

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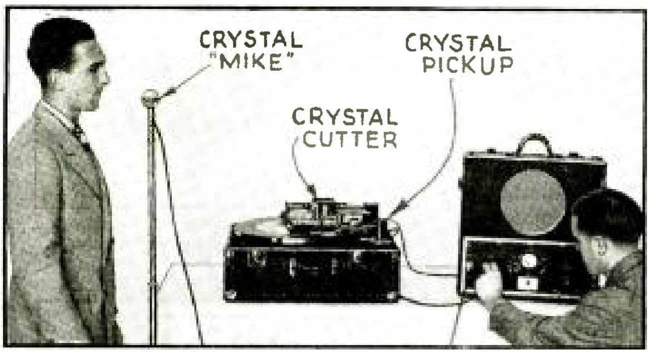
THE LATEST RADIO EQUIPMENT



High-fidelity sound recorder utilizes crystal components throughout! (1288)

A 2-CASE PORTABLE RECORDER (1288)

COINCIDENT with the acquisition by one prominent manufacturer in the sound-recording field of the manufacturing and sales rights of another company in that field, a new series of sound-recording units has just been announced. One of the first of these is the type F-26 recorder here illustrated in operation.

The crystal cutter and pickup are set to enable recording and playback over a frequency range of 40 to 8,000 cycles. This certainly is "something to write home about." The complete set-up includes a "unit 199" recorder mechanism (center), and a "unit 219" recorder amplifier (extreme right), in two separate portable trunks. The recorder mechanism incorporates a 16-in. turntable turning at optional speeds of 33 1/3 and 78 r.p.m.; the feed unit cuts 90, 110, 130 and 150 lines per inch either inside or out. A cutting head is available for embossing aluminum or cutting acetate discs. The recorder amplifier incorporates a 10-in. dynamic reproducer, output meter, control panel and 8 tubes; the gain is 115 db. and the output is 12 W.

CUTTING LUBRICANT, PRESERVATIVE AND CONDITIONER FOR SOUND RECORDING (1289)

(Universal Microphone Co.)

THREE new chemical products are recommended by a well-known sound-recording equipment manufacturer for best results in making spot recordings on aluminum. The cutting lubricant, a liquid, is applied before the cutting process; the wax preservative is applied after cutting; and, finally, the conditioner, a salt, is applied as a preservative —or, it may be used on old records as a reconditioner.

6-V. ELECTRIC PLANT (1290)

(D. W. Onan & Sons)

HERE is a compact and light-weight gasoline-driven electric plant that delivers approximately 175 W. at 6 V., D.C. This unit operates 12 to 15 hrs. on a gallon of gasoline. It is operated in conjunction with a 6-V. storage battery shunted across the line. This tiny power unit (it measures only 12 x 13 x 14 ins. high) weighs only 45 lbs.

Service Men looking for sideline items should not find it very difficult to merchandise this unit. It is recommended by the manufacturer as "ideal" for portable P.A. installations, cottages, trucks, busses, fire departments, construction work, wrecking cars, trailers, garages, roadside stands, boats, filling stations, night repair crews, etc.

RADIO SET AUTOMATIC TIMER (1291)

IN ADDITION to its immediate use to the radio man as an automatic switch for controlling the on-off operation of a radio set this switch may be handled by the Service Man as a side-line item that will be useful in connection with other electrical appliances such as sun lamps, etc. It may be set to go on and off at any predetermined periods during 12 hours. The case is of brown bakelite molded with bright chromium dial face.

PRECISION PLUG-IN RESISTORS (1292)

PRECISION resistors in handy plug-in form, and selected resistance ratings permitting of various combinations for any total resistance value, are now available. These plug-in resistors, of non-inductively-wound (bifilar) manganin wire, were originally developed for use in resistance bridges and other test equipment employed in the laboratory and plant. Housed in a standard 4-prong tube base, they are available in values of 1 to 10,000 ohms, with any accuracy up to 1/10 of 1 per cent. Due to the ingenious design, they are quite inexpensive.

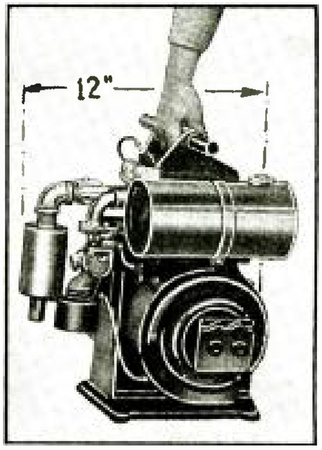
CABINET TOUCH-UP KIT (1293)

(General Electric Co.)

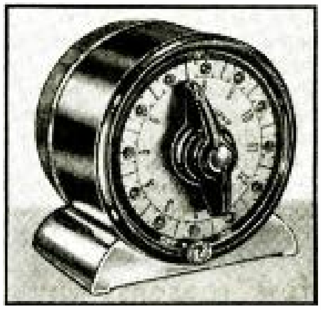
NEWEST in kits for cleaning-up the scratches, discolorations, etc., that eventually appear on even the best-kept radio cabinets, and so-on, is the modern layout illustrated (in its limp-fabricoid carrying case). It includes: walnut penetrating stain, A; camel-hair brush, B; spatula, C; stick shellac (2 colors), D; wet and dry sandpaper (may be used with oil or water), E; polishing compound, F; felt rubbing block, G; and, cleaning oil, H.

ALL-WAVE PRECISION SERVICE OSCILLATOR (1294)

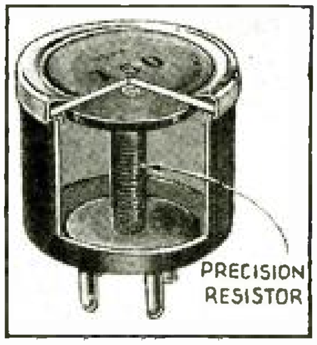
NUMEROUS features combine to make this service oscillator or signal generator a product of which the owner may be proud. The frequency range is 90 kc. to 60 megacycles. The accuracy on the I.F. and broadcast bands is said to be accurate with ½ to 1 per cent; each band is checked at 6 points against



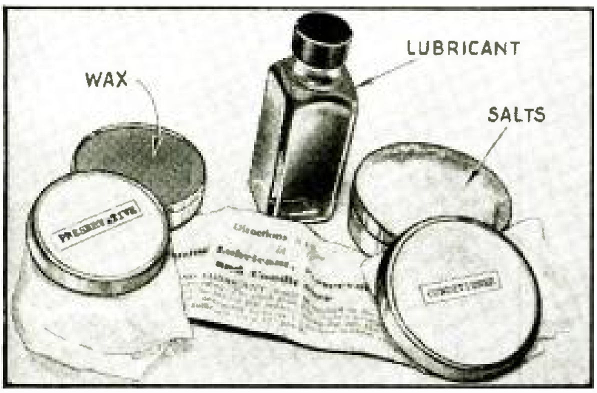
A 1-cu. ft. 6-V. unit. (1290)



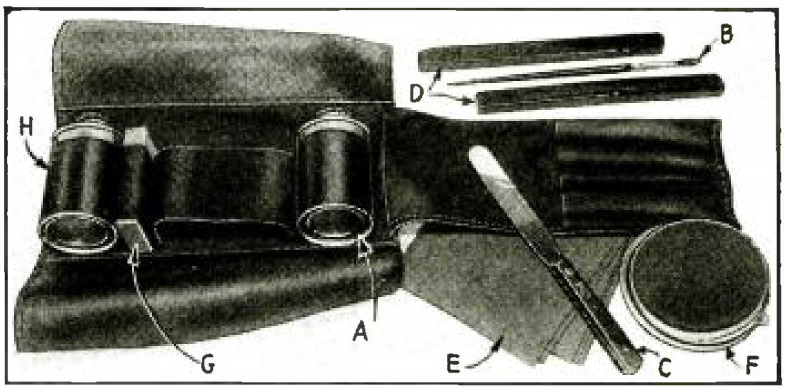
Automatic on-off switch. (1291)



Plug-in precision resistor. (1292)



Proper sound recording requires these items. (1289)



A cabinet touch-up kit for both the beginner and expert radio man. (1293)

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

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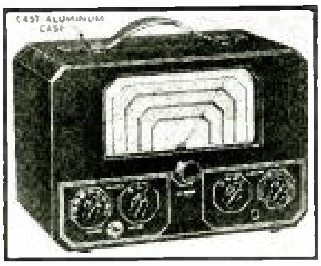
precision crystal-control frequency standards. A special color combination of black etched characters on a silver background combined with a red knife-edge pointer provides speed and accuracy in selecting frequencies. A 400-cycle A.F. signal at a modulation level of 35 per cent is provided by a separate modulator tube controlled by a demodulation switch. The A.F. modulation is available at the output lead and may be attenuated. The 1-piece cast aluminum case provides excellent shielding and reduces strays and leakage to a minimum. Signal may be reduced below the level at which the A.V.C. action starts in even the most sensitive receivers; this affords extreme accuracy of alignment. The vernier control is graduated so that receiver sensitivities may be accurately compared. Utilizes one 1½-V. "C" battery and one 22½-V. "B" battery; and two type 30 tubes.

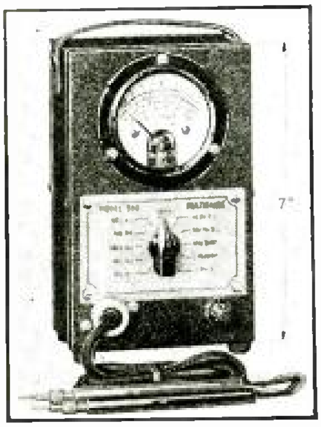


New all-wave test oscillator. (1294)

MULTI-RANGE PORTABLE METER (1295)

(Triumph Mfg. Co.)

A SELECTOR switch is used to choose any one of 11 ranges in this new A.C.-D.C., 4 lb. test instrument (which is available from the manufacturer through what is known as the "factory-direct plan") which is said to be accurate to within 2 per cent. Ranges: D.C. voltage 0-10-100-500 V. at 1,000 ohms-per-volt; A.C. voltage: 0-10-500-1,000 at 850 ohms-per-volt (approx.). D.C.: 0-50-500 ma. Resistance: 0-1,000 ohms-1-10 megs. Note that this instrument will read from ¼-ohm; a special, lance-type pointer is used.



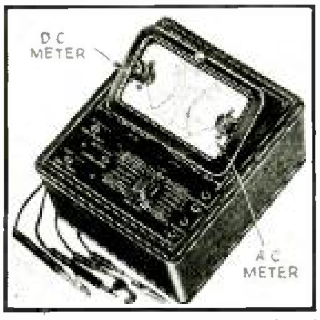
An 11-range portable meter. (1295)

DUAL-METER TEST UNIT (1296)

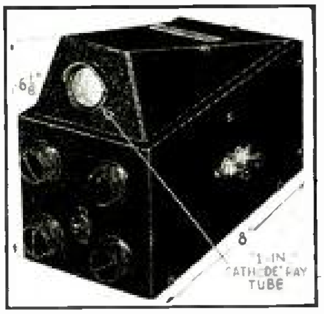
(The Triplett Electrical Instrument Co.)

HERE is a combination volt-ohmmeter that utilizes separate scales for the D.C. and A.C. movements. A copper-oxide rectifier is built into the latter. The ohmmeter section is of back-up type for checking with a minimum of contact error low values of resistance. All scale markings are in straight lines.

Scale readings: D.C. 10-50-250-500-1,000 V. at 2,000 ohms-per-volt; current: 1-10-50-250 ma.; A.C. voltage: 2-10-50-250-500-1,000 at 1,000 ohms-per-volt; low resistance: 0.5-to 500 ohms; high resistance: 1.5 and 3 megs. Note that resistance measurements have individual zero adjustments.



Separate meters for D.C., A.C. (1296)



A 1-in. image oscilloscope. (1297)

NEW OSCILLOSCOPE USES 1-IN. C.-R. TUBE (1297)

ALTHOUGH specially designed to meet the needs of the transmitting amateur this new cathode-ray tube may be utilized in any type of radio receiver service or experimental work in which trapezoidal or detector output waveform readings will suffice. Incorporates the new 1-in. cathode-ray tube illustrated and described in the January, 1937 issue of *Radio-Craft*; its general circuit arrangement and uses closely approximate those given for the midget oscilloscope described in the February, 1937 issue. Type 913 tube; 60-cycle sweep; weight, 11 lbs.

NEWEST PERMANENT-MAGNET DYNAMIC SPEAKER (1298)

(Wright-DeCoster, Inc.)

THE permanent-magnet reproducer shown as item No. 1104 in September, 1936 *Radio-Craft* has been "modernized" to include the output transformer under the housing that encloses the "nocoil" or high-coercive permanent magnet. This feature, and the "para-curve" diaphragm and air-gap dust cover are illustrated in 2 views. This 12-in. permanent-magnet dynamic reproducer is recommended not only for its wide frequency response but also as having high sensitivity.

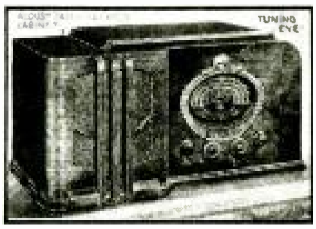
ACOUSTICALLY-TREATED CABINET HOUSES NEW SET (1299)

MANTEL radio sets may now include not only compactness and beauty but also, as incorporated in this new majestic set, greatly improved tone quality as compared to previous designs. The cabinet interior is acoustically treated and thus the undistorted power output of 8 W. is utilized to best advantage. The receiver chassis utilizes 9 tubes including a 6G5 "eye" and two type 6F6G output tubes in push-pull. Tuning range: 16-50, 50-171, and 171-550 meters. The chassis incorporates A.V.C., tone control, 16-to-1 ratio high-speed gyro tuning. Cabinet dimensions, 22⅞ x 12½ x 12⅞ ins. deep.

NEW NEGATIVE INTEGRATOR USES PHOTOCELL (1300)

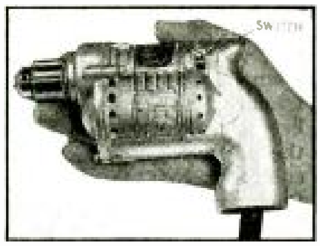
A LIGHT-SENSITIVE cell, of the oxide type which does not re-

(*Continued on page 567*)

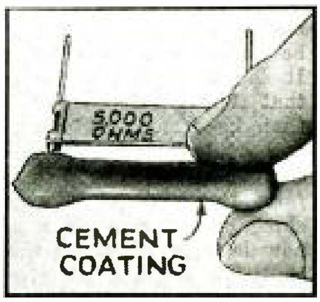


Improved-fidelity mantel set. (1299)

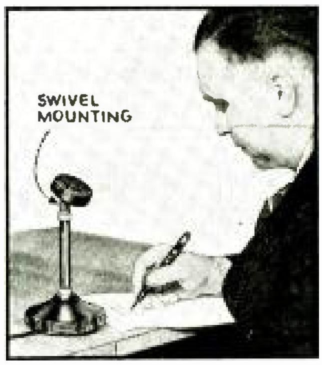
Electronics aids the photographer. (1300)



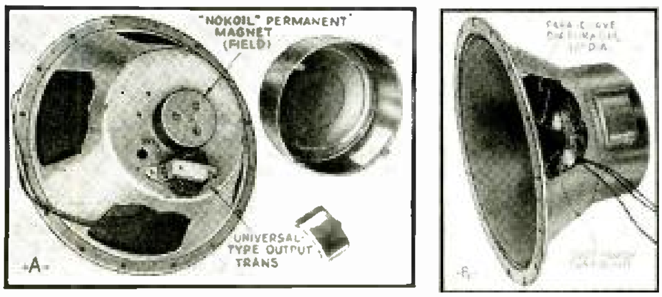
Radio man's electric drill. (1301)



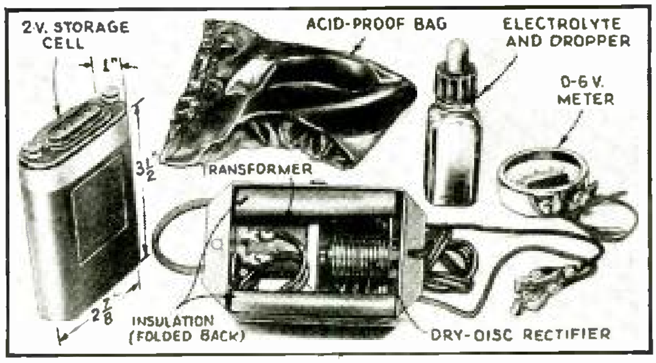
New cemented resistor. (1302)



New crystal mike for voice. (1303)



A well-known reproducer manufacturer has developed the 12-in. unit here illustrated. The frequency response graph submitted to RADIO-CRAFT indicates variations of only about 5 db. ± from 80 to 1,000 cycles, with a slight rise to 3,000 cycles, and a gradual drop to approximately 7,000 cycles and rapid drop to cut-off at about 8,500 cycles. At the low frequency end the drop is rapid from about 70 cycles to cut-off at about 50. (1298)



Storage cell for portable units. (Same-size case for 2, 4, and 6V.) Note that a rectifier is available for charging from the A.C. power line. (1304)

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The construction of the attractive desk stand which houses The Executive Set is presented in this Part. This case—with its marble finish—must be fabricated in a special way.

MAKE "THE EXECUTIVE" —A BUSINESS MAN'S A.C.-D.C. SET

N. H. LESSEM PART II

TO CONTINUE with the story, the author will now discuss the essential details pertaining to the construction of the base and cabinet of the Executive's Desk Set. (Part I, in the February issue, treated with the design, layout and wiring of the chassis.)

The material used to make the base and cabinet is one of the popular phenolic resin plastics sold under the trade name "marblette". No attempt has ever before been made (so far as the author knows) to *build* a radio cabinet out of sheets of this material. Commercially, the practice is to *mold* the complete cabinet through the medium of expensive molding forms.

Fortunately, the same tools used to machine, drill and cut hardwood, may be employed in working in *marblette.* It should be borne in mind however, that this plastic material heats faster than hardwood; therefore, the sawing and drilling operations should be executed commensurately slower. Do not *force* the material in any of the machine operations.—So much for that; now let's get down to the actual construction work.

FIRST, GET ALL MATERIALS TOGETHER

The marblette material used for the cabinet can be bought in sheet form, already cut to size, directly from the factory. Figure 4 gives you the exact dimensions of all the panels. The base piece should be 1-in. thick; all the others, ¼-in. thick.

The electric clock should be of the self-starting type, as specified in the List of Parts, to avoid the nuisance of restarting after accidental interruptions of the electric current. The hand-setting shaft should be extended sufficiently to protrude through the dust screen which forms the back of the cabinet. The method of accomplishing this is left entirely to the ingenuity of the constructor.

A pair of fountain pens and holders can be obtained from any stationery store. The holders should have ball and socket joints.

Finally, obtain a suitable desk lamp. The one used by the author has a short, gun-metal stem and a heavy base. The base was removed and the lamp, with its switch, mounted directly on the top panel of the cabinet, as illustrated in Fig. 4.

MACHINING THE PLASTIC MATERIAL

The initial step in manipulating the plastic should be to make the base. The pencil groove as shown in Fig. 4, can be cut out either by hand, using a mark-gauge and a curved chisel; or, as the author did, by machine, using an end mill bit in the chuck of a drill press. To rout-out a straight groove make sure you use a straight-edge gauge clamped to the table of the drill press. When this is done chamfer all four *top* edges to any desired angle. A ⅛-in. beveled surface at a 45° angle looks very well.

Next, on a routing machine, rout-out the large 3⅜-in. hole for the clock on the front panel. The size of this hole should be exact since the clock, as shown in Fig. 4, is held in place only by virtue of this tight fit. The two other holes on the front panel as well as those on top for mounting the lamp and those on the base for mounting the pen holders may be drilled with an ordinary metal-drilling bit and a hand-drill.

The speaker grille opening should be exactly 5 ins. square. The best method for cutting out the grille pattern is as follows: First, make a template of the design to be used. (Use thin cardboard such as Bristol drawing board). Then paste this template on the sheet of plastic material to be used as the speaker grille side. It is then a simple matter to follow the pattern of the template with the business end of a routing machine. Smooth all rough edges with a fine file.

(Continued on page 553)

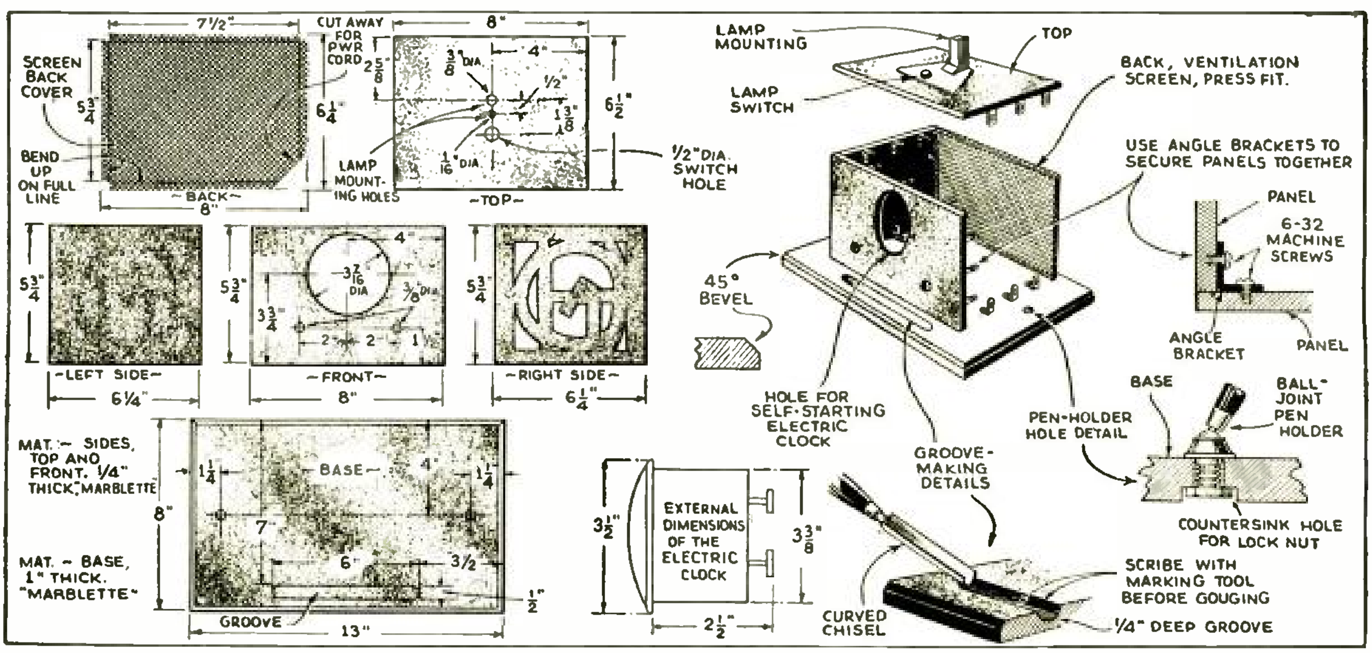

Fig. 4. Details for cutting, drilling and fabricating the cabinet. Note the use of angles for fastening the panels together.

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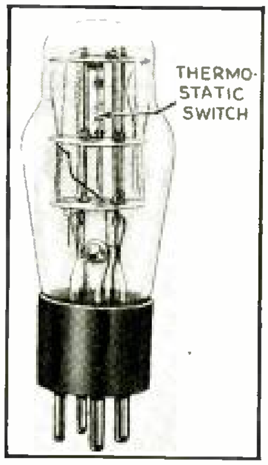
THE MUCH-ABUSED BALLASTS FOR A.C.-D.C. RADIO RECEIVERS

The author discusses the need for over 100 types; why the "tube" type is best; and introduces to Service Men a new anti-surge ballast unit.

SAMUEL RUTTENBERG



"WHY SHOULD there be over 100 types of A.C.-D.C. ballasts?" is a question many technically-inclined Service Men ask themselves.

The answer is, "there really is no good reason."

Every time a manufacturer designed a new A.C.-D.C. set the ballast supplier thought he would get all the replacement business by changing the number and specifications of the ballast so that it could not be easily replaced. As a result many ballasts of identical specifications have different numbers—or different

(Continued on page 559)

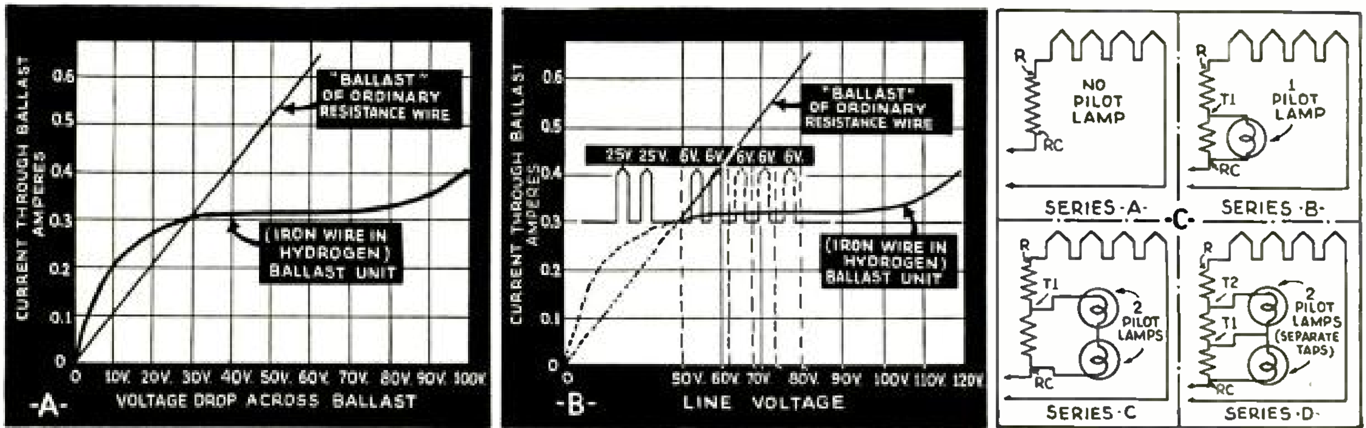


Fig. 1. Details A, B, and C, apply to the "tube type" ballasts such as the one shown in heading.

IS IT ECONOMY TO CONNECT DRYCELLS IN PARALLEL?

Schoolbooks seldom discuss an important fault, expertly analyzed by the author, of drycells connected in parallel

L. S. FOX

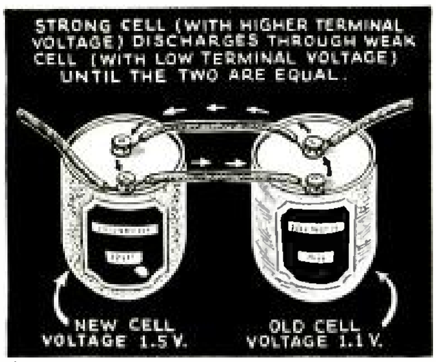


Fig. 1. Cross currents travel from one cell to the other!

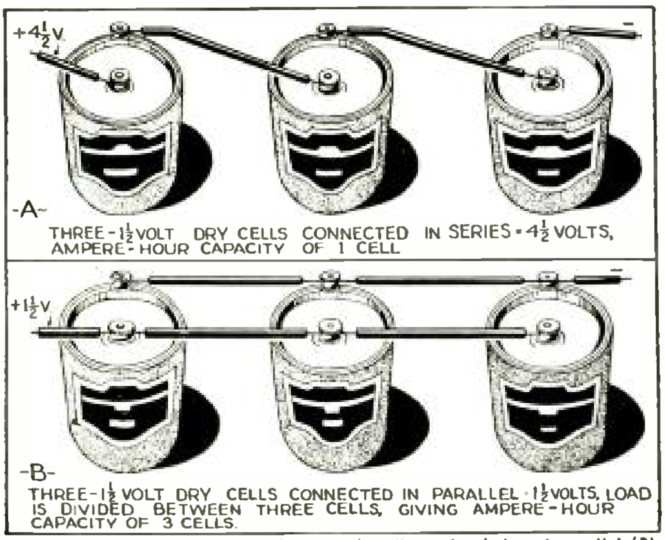


Fig. 2. The two common connections for drycells—series (A) and parallel (B).

OF THE TWO ways of connecting drycells, the most common is the *series connection*—positive to negative—which multiplies the *voltage* by the number of cells in the series (Fig. 2A.). Less used, and so less well known, is the *parallel connection*—all terminals of like polarity connected together—which multiplies the *current* by (approximately, as we shall see) the number of cells so connected. (Fig. 2B.) With parallel connection, the voltage remains that of the single cell; the result is that current drain is equally divided between each cell in the group.

In general, it is more economical to use a larger size of cell than to connect several small cells in parallel, and so cells smaller than the largest size made, the No. 6 cell (standard, "doorbell" size), are seldom found in parallel connection. Whether or not it is more economical to connect two or more cells in parallel as compared with the more frequent replacement of a single cell depends on the 3 major factors which govern all drycell service:

(1) Rate of discharge; (2) Frequency and duration of discharge; and (3) End-point voltage.

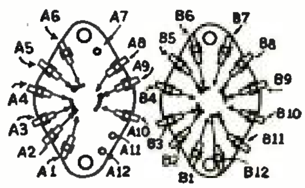
The rate of discharge is, of course, the amount of current which the battery is called upon to deliver. If the current

(Continued on page 564)

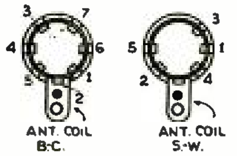
PHILCO MODEL 37-604

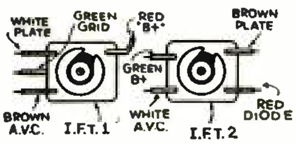
5-tube super., A.C.-D.C., glass tubes, 2 ranges (530-1,750 kc., 6-18 mc.); top-tuning table type. Output, ¾-W.

As illustrated and described in RADIO-CRAFT, Oct. 1936, pgs. 204 and 205, this set has loudspeaker grilles on 2 sides of the cabinet. Set has a "glowing beam station indicator."



SWITCHES SHOWN IN POSITION No. 1. (BROADCAST) LETTERS INDICATE POSITION OF SWITCH WAFER FROM BOTTOM OF CHASSIS





This receiver, as shown, tunes from above, condenser gang being mounted vertically, C2 beneath. The pilot lamp is attached to this. When condenser is fully meshed, glowing-beam indicator under dial must center on first index of scale.

Adjustment of I.F. circuit is made with signal generator adjusted to 470 kc., receiver at maximum B.C. setting. Condenser (0.1-mf.) connects generator to control-grid of I.F. tube, V2; and then trimmers C12 and C7 are set for max. output on output meter. Then the generator is connected to control-grid of V1, and C10 and C9 are similarly adjusted for max.

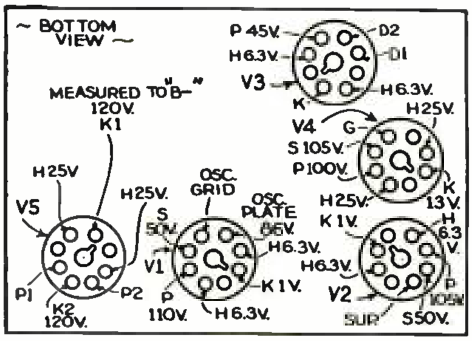
Adjustment of S.-W. R.F. circuit is made by then connecting generator to terminals 1 and 3 on input panel, and shorting 4 and 5 with link. Generator and receiver are tuned to 18 mc., and oscillator trimmer C7 adjusted for max. output.

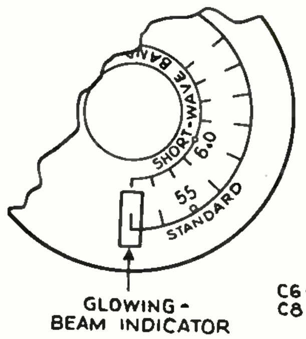
Adjustment of antenna compensator C3 detunes oscillator slightly. Overcome this by connecting a 350-mmf. condenser (vernier drive) across C2, oscillator tuning condenser. Tune this external condenser until *second-harmonic* of oscillator beats against signal generator and brings in signal; adjust C4 to max. Remove external condenser and turn C7 max. distance clockwise—then back until a *second* peak is found on output meter. (First peak is image frequency, not to be used). Adjust C7 here to max.

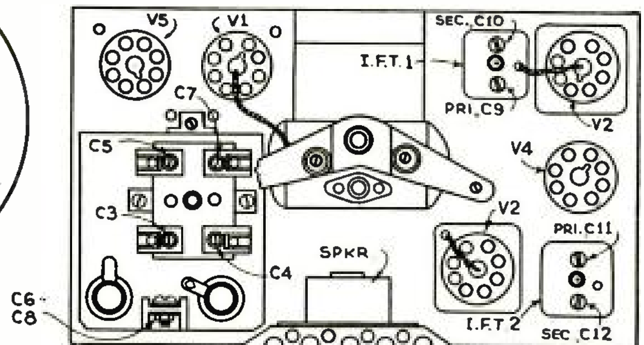
On 6 mc., C8 is adjusted for max.; then tuning condenser "rolled" back and forth for max. output; and C8 retuned, until max. falls as near as possible to 6 mc. C7 and C4 are then retuned with aid of external condenser, as in previous paragraph.

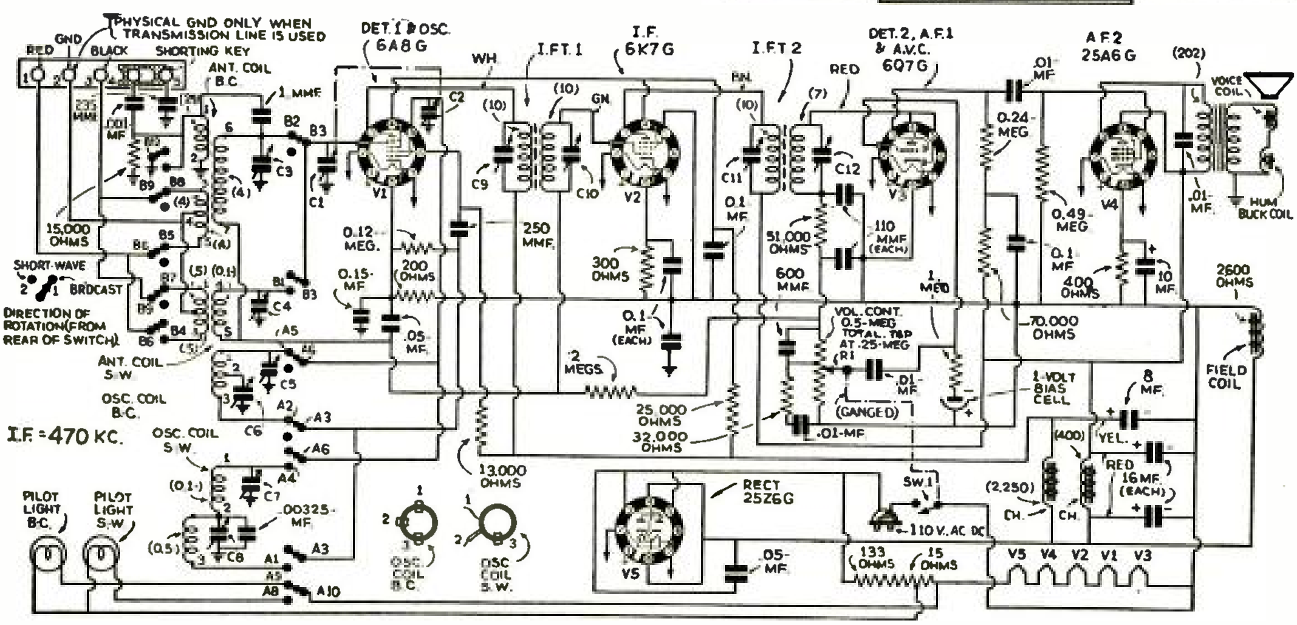
Broadcast adjustment is made with signal generator at 800 kc.; receiver at 1,600 kc., working on 2nd-harmonic. C5 and C3 are adjusted for max. Then generator and receiver are tuned to 600 kc.; and C6 is adjusted, rolling tuning condenser back and forth. Vary C6 until max. output is reached at or near 600 kc. Then 1,600 kc. readjustment is made and, finally, C3 is adjusted for max. at 1,400 kc.

Figures in parentheses on schematic, ohmic resistances. Figs. on diagrams, socket voltages (1,000 ohms/volt) Vol. at min., line voltage 115; B.C. switch setting.









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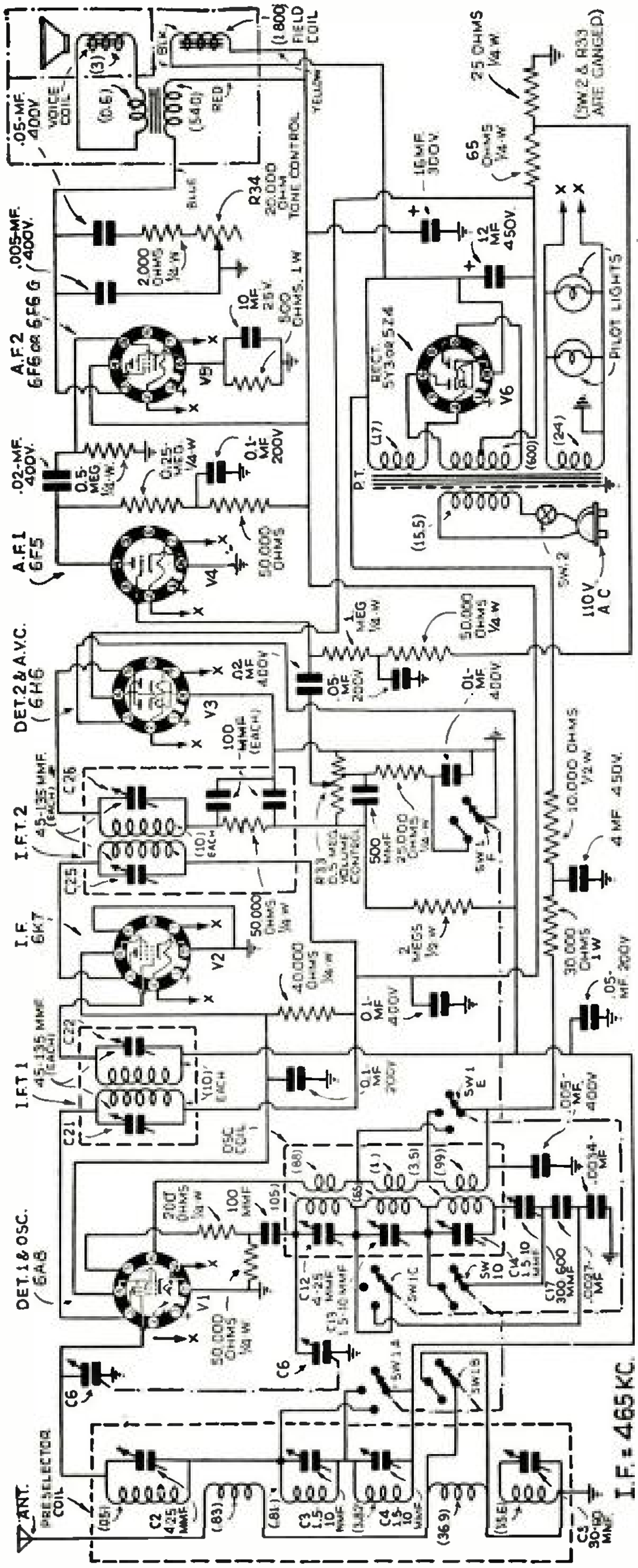
Radio Service Data Sheet

AMERICAN-BOSCH MODEL 640

6-tube super., 3-band (540-1,550 kc., 1,500-4,500 kc., 5.5-16.5 mc.), A.V.C., 3-watt output, "Semaphore Tuning," and "Automatic Maestro."



This receiver, shown at left in schematic diagram, and at the bottom of the page in chassis layouts (top and bottom) has an intermediate frequency of 465. kc. The I.F. amplifier is adjusted in the standard manner: first sending signal through control-grid of V2 through a blocking condenser (with Vol. control at maximum), and adjusting trimmers C25 and C26 to max. output. Then apply signal to V1, and similarly trim C21 and C22 for maximum. Finally, with signal applied to antenna, C5 (wavetrap trimmer) is adjusted to minimum signal, to reduce interference by code, or otherwise, to a minimum on this I.F.

Broadcast-band adjustment is made at 1,400 kc., applied through a condenser to the antenna; the oscillator trimmer C14 is adjusted for reception, and then the preselector trimmer C4 to maximum. The signal is then set to 600 kc., the variable condenser to this frequency, and C17 is adjusted for maximum sensitivity. It is then tried at a slightly lower frequency, and readjusted; and so on until highest sensitivity is found (it may be necessary to try a frequency slightly higher than 600 kc. to find this point.)

On the intermediate (green) band (Police and Amateur) start at 4,000 kc. and adjust C13 to bring in signal; then adjust preselector trimmer C3 for maximum. The sensitivity is then checked over the scale.

On the highest (red) band (Foreign) the adjustment is made at 15 mc., and trimmer C12 adjusted. If 2 points of sensitivity are found, use that with the lower capacity setting of the trimmer (screw turned farther out). Then preselector trimmer C2 (bottom) is adjusted, and the receiver checked over the band.

With a line voltage of 115 V., switch in B.C. position, and a high-resistance voltmeter, readings are (across pins stated in parentheses):

V1, plates (3-1) 238, (6-1) 130; screen-grid (4-1) 83; control-grid, reading equals 0.6 times that between pins 5-1 on V3 socket.

V2, plate (3-1) 238; screen-grid (4-1) 83; control-grid, same as V1.

V3, cathode (4-1), —3.7.

V4, plate (4-1) 100 on 600-V. scale; control-grid (cap to 8) —1.06.

V5, plate (3-1) 225; screen-grid (4-1) 238; control-grid (8-1) 15.2.

V6, plates, 310 V. The filament voltage across this tube is 5—across each of the others in the set, 6.0.

Tube Voltages

V1—plates (3-1) 238, (6-1) 130; screen-grid (4-1) 83; control-grid, reading equals 0.6 times that between pins 5-1 on V3 socket.

V2—plate (3-1) 238; screen-grid (4-1) 83; control-grid, same as V1.

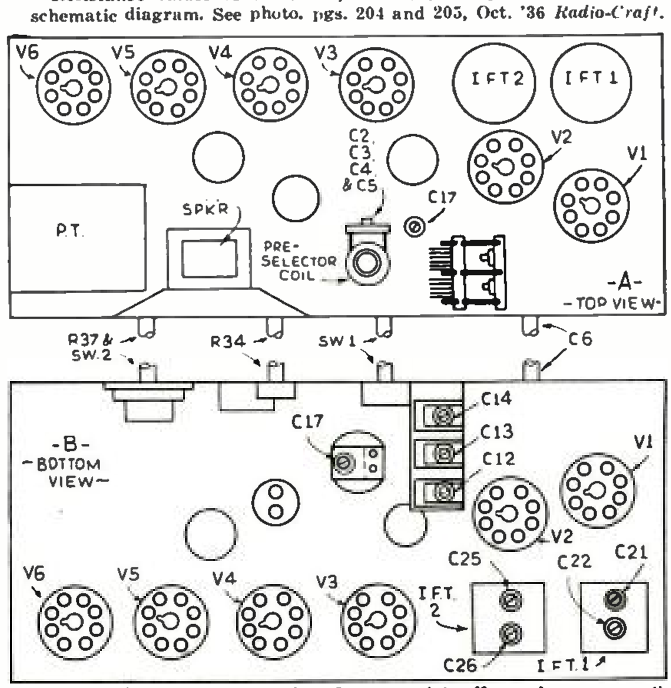
V3—cathode (4-1), —3.7.

V4—plate (4-1) 100 on 600-V. scale; control-grid (cap to 8) —1.06.

V5—plate (3-1) 225; screen-grid (4-1) 238; control-grid (81) 15.2.

V6—plates, 310 V. The filament voltage across this tube is 5—across each of the others in the set, 6.0.

Resistance values of coils, etc., are noted in parentheses on the schematic diagram. See photo. pgs. 204 and 205, Oct. '36 *Radio-Craft*.



These two views of the American-Bosch model 640 receiver carry all necessary servicing references as to locations of the various types of variable condensers.

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ANALYSES of RADIO RECEIVER SYMPTOMS
OPERATING NOTES

Intermittent Operation. One of the most difficult and often encountered troubles in radio receivers and amplifiers is really not so difficult if tackled in the proper manner, and with the equipment explained below. I am referring to the causes of intermittent reception due to high-resistance shorts in bypass and filter condensers.

Although an ohmmeter does not indicate a short of this type, it may be found by setting it on the high scale. By connecting one lead as shown in Fig. 1A and touching the other on the condenser, the meter will give a slight kick, indicating that the condenser has taken a charge. If this is again touched there should not be a second kick of the meter unless there is a high-resistance leak in the condenser. Once the condenser is charged it should not take another charge unless it has been discharged.

Still another and equally accurate, if not better method, is shown in Fig. 1B. The neon tube is connected to one side of the high-voltage supply and the other is touched to one terminal of the condenser to be tested. The other terminal of the condenser is grounded to the chassis which is the negative side of the power supply. If the condenser is good, there will be one flash of the neon bulb when the condenser charges, but if the condenser is leaky there will be intermittent flashes each time the condenser breaks down.

It is not necessary to remove the condenser to test it but just remove the leads to it.

Intermittent reception is likely to be found in a circuit such as shown in Fig. 1C where the voltage reaches the condenser through a high resistance. Due to the small current passed by the resistor the short will not burn itself out, but with surges such as snapping on a light, etc., the short clears for a short time.

Figure 1C is taken from the model 90 Lyric, where the voltage is fed to the detector through a resistance-filter circuit.

Donald G. Buck

Radiola 44, 46 and 47. A very common cause of complaint on Radiola 44, 46 and 47 receivers is weak volume and interference between stations. This points to the fact that the set is out of alignment. The experienced Service Man has learned, however, to completely check a receiver before coming too quickly to the decision that it is out of alignment. After coming to this decision when working on one of these sets you doubtless will be considerably puzzled if adjustment of the trimmer condenser does not overcome the trouble.

Due to some peculiarity in material or construction of these sets, a very great movement is often found in the tuning condensers. Usually it is let go until it is quite bad before calling in a Service Man. In fact, some of these sets have been found in which the plates touched enough to almost prevent turning the condensers, let alone the noise the owner must have put up with for a long time.

Luckily this condition may be checked quite easily by examining the tuning condensers. One of the sections of the tuning condensers is unshielded and the shields on the other 2 sections are quickly removed by simply loosening a metal bar across the top of the shields, removing it and then lifting up the shields. Turn the rotors into the stators and then with the aid of a good light, to prevent shadows, examine carefully to see if each rotor plate is midway between the stator plates on each side of it.

Due to some warping or shifting action in

(Continued on page 566)

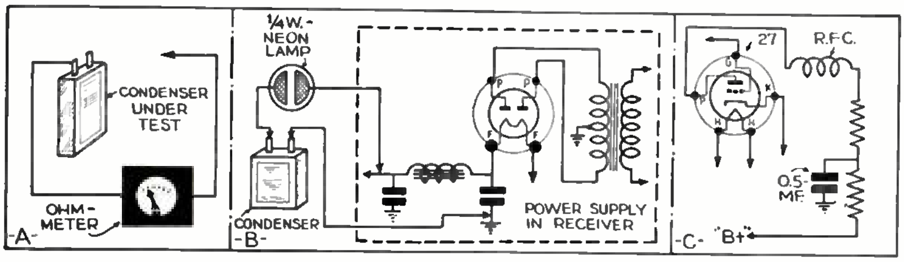

Fig. 1. Several methods for checking leaky condensers.

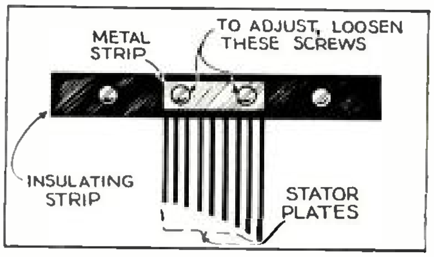

Fig. 2. Loosen the screws to adjust rotor plates.

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MEMBERS' FORUM

A department devoted to members and those interested in the Official Radio Service Men's Association. For mutual benefit, contribute *your* kinks, gossip and notes of interest to Service Men, or others interested in servicing.

Photo—Radolek Co.

Since the advent of crystal and velocity microphones, radical changes in engineering design have been necessary to compensate for the increased gain required by these mikes. The designing and testing of circuits has become more intricate than ever before. Expensive precision laboratory equipment (such as illustrated above) is required to insure fast, accurate production.

MAINE: WANTS "LIGHT ORGAN" DATA

Radio-Craft, Orsma *Dept.:*

I have tried about all the radio magazines and have always come back to *Radio-Craft*. I am an experimenter and have had fine results on all its set designs I tried.

If possible would you please print a diagram of a simple "light organ"? This should have about 5 or 6 colored lights.

Robert Harrison,
State Theatre,
Waterville, Me.

Thanks, Mr. Harrison. We're certainly glad to receive the commendation of a radio man who has "tried 'em all."

And as to the "light organ"—well, read the construction details, in April *Radio-Craft*, of a "super"-color organ!

SO. AFRICA: JOINS ORSMA

Radio-Craft, Orsma *Dept.:*

Being a regular reader of *Radio-Craft* I feel that I can write you for some information of great importance to myself.

I am employed as chief radio Service Man by a large firm of engineers in Johannesburg, South Africa. I understand that you set an examination for Service Men, and if they pass one examination you issue to them a certificate stating that they are qualified to operate as Service Men. Will you please be good enough to let me have information. I am very desirous of sitting for your examination, and feel sure that I have sufficient knowledge on the subject to pass the examination.

In the course of my duties I have the following makes of receivers for

(Continued on page 573)

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RCA ALL THE WAY

RCA Radio News

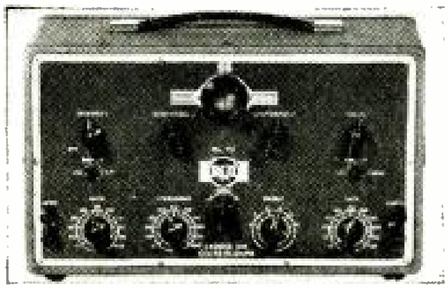
RCA Manufacturing Company, Inc. • Camden, New Jersey
A Service of the Radio Corporation of America

EVERYTHING IN RADIO—MICROPHONE TO LOUDSPEAKER

To the consumer, RCA means high quality performance at low cost . . . To the radio man, RCA means easier selling, higher profits

RCA VALUES FOR MARCH!

New RCA Test Equipment... at prices never before so low!



RCA Cathode Ray Oscillograph

Stock No. 151 **Net Price $17.50**

FEATURES

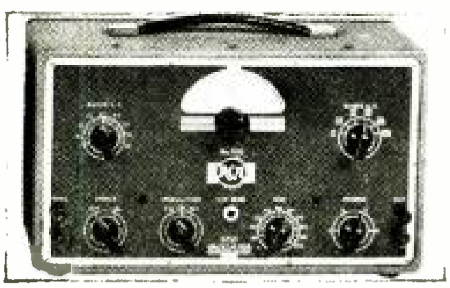
1 COMPLETE oscillograph using new RCA-913 Cathode Ray Tube.

2 High sensitivity—1.75 volts R.M.S. for full-scale deflection.

3 Both vertical and horizontal amplifiers—individual gain controls—Flat 30-10,000 cycles.

4 Linear Timing Axis—30-10,000 cycles.

5 Light shield and calibration screen.



RCA Electronic Sweep Test Oscillator

Stock No. 150 **Net price $64.50**

FEATURES

1 No moving parts. Variable electronic sweep—1 to 40 kcs.—at any r-f or i-f frequency—sweep rate, 120 times per second, eliminates screen flicker.

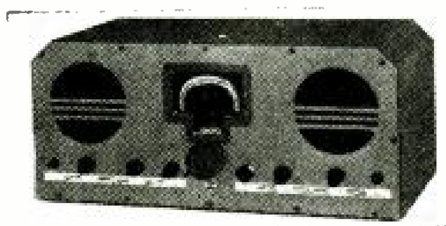
2 Wide frequency range 90 kcs. to 32,000 kcs.—fundamental frequencies—400 cycle modulation—JACK FOR EXTERNAL MODULATION.

3 Large direct-reading dial—4 inches diameter—indirect illumination—projected zero indicator lines eliminates parallax—two vernier ratios, 2:1 and 5:1.

4 AC operated—no batteries or motor.

ACR-155
A New, Moderately-Priced, General Purpose Communication Receiver

Amateur's Net $74.50 f.o.b. factory



The ACR-155 is a moderately-priced communication receiver capable of superior performance under modern operating conditions. It provides a number of features not usually found in receivers of its price class.

1 Continuous frequency coverage from 520 to 22,000 kcs.

2 Nine Metal RCA Radiotrons for improved high-frequency performance.

3 Improved, large tuning knob with crank handle for smooth, easy tuning. 100 to 1 band-spread tuning drive.

4 Improved, adjustable, air-dielectric trimming capacitors. Magnetite core i-f transformers.

5 Calibration-spread dial for accurate logging.

6 Electrically stabilized oscillators.

In addition to the performance and convenience features shown above, this receiver also provides antenna rejection filter to reduce interference . . . A.V.C. at will . . . Six-inch, dustproof electrodynamic speaker for high-quality reproduction...Preselection for better signal to noise ratio, lower image response.

Small, Low-Cost Record Player Converts Radio into Phonograph-Radio!

The smart looking RCA Victor Record Player, R-93, shown at right, is ideal for the radio owner who also desires recorded music. Attaches quickly and easily to any electrically operated radio, and converts the set into a phonograph-radio!

It's small in size, can be placed in any small space—costs less than $20—available in a walnut finish, or, at slightly higher prices, in red, black, ivory.

In the field of radio, RCA Victor offers you more for your money in 1937 than ever before! Model 9K-3, shown below, is typical of the entire new line. It's easy to look at ... easy to buy ... and a real pleasure to hear!

These radios offer you, in addition to the many great features led by Magic Voice, Magic Brain, Magic Eye and Metal Tubes—the magic of radio that's RCA ALL THE WAY. Designed by men equally familiar with broadcasting and reception (for RCA designs most of the broadcasting equipment used by radio stations), they are the finest radios you can buy. Hear them today! There's a model and a price to please you. Easy payments through C. I. T. Corp.

RCA Victor Console Model 9K-3, with Magic Voice, Magic Brain, Magic Eye and Metal Tubes. Tuning range from 530 to 22,000 kcs. Beam Power Amplification. Selector Dial. 9 tubes. Automatic Volume Control. Automatic Tone Compensation. 12 watts output. Superb Cabinet. Price $129.95 F.O.B., Camden, N.J.

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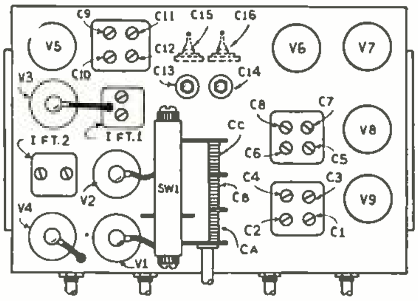
DELCO MODELS R-3208 (table) and R-3209 (console)

32 V. D.C., 9-tube, 4-band (5.9-15.3 mc., 1,590-4,500 kc., 540-1,600 kc., and 148-400 kc.)

The sensitivity control, across antenna, helps prevent overloading the R.F. amplifier, in view of low plate voltage; which also requires use of 4 power tubes in push-pull parallel. The set is to be grounded only through terminal strip connected by condenser to chassis, to avoid a short with a 32-V. system where (+) is grounded.



The I.F. stages are adjusted in the usual manner, with insulated screwdriver, and 450-kc. signal. The I.F. trimmers are not designated as Pri. and Sec. but can be determined by use of a metal screwdriver.

Blue (Long-Wave) band is adjusted at 400 and at 150 kc. If interference is strong, it can be reduced during test with added 5 to 10 mf. capacity between chassis and ground terminal.

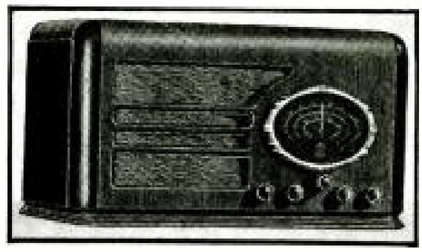
Yellow Band (Broadcast) is adjusted at 1,400 and at 600 cycles.

Green Band (Police and Amateur) is adjusted at 4,000 and at 1,700 cycles.

Red Band (Foreign S.-W.) is adjusted at 15 and at 6 megacycles.

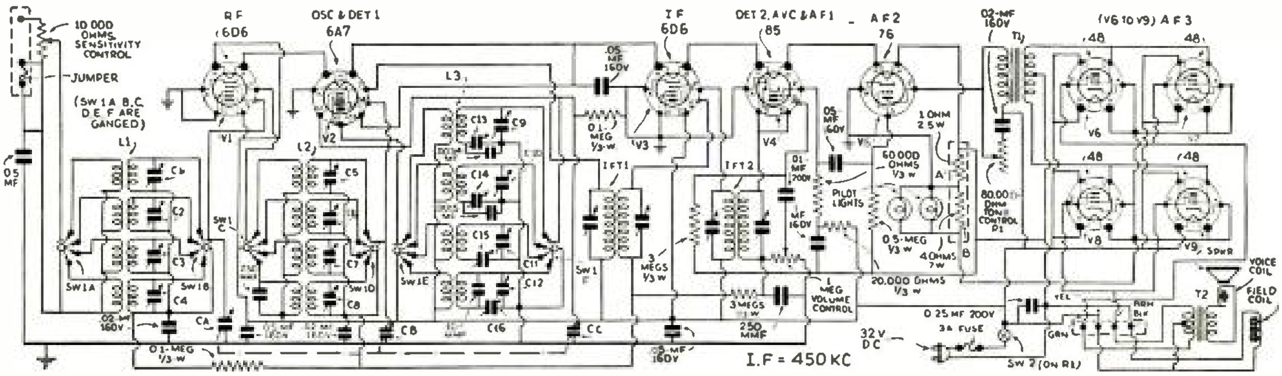
Model R-3208 has a 6 in. dynamic speaker; Model R-3209 a 10 in. speaker. Electrical output rating, 900 milliwatts. Sensitivity of receiver, 20 microvolts at 50 milliwatts.

G2 of V2 has also 30.5; the G1 terminal of V2 varies from −1 at low-frequency tuning to −3 at higher. Gs of 48s, 1.6 V.; Ks, 5.2 Fil., 6.4 V.; except 48s, 25.2; drain, 2A.



Tube voltages are as follows (supply at 32 V.):

Tube	Plate	Screen-grid
V1	30.5	30.5
V2	30.5	17.6
V3	30.5	30.5
V4	9.0	—
V5	30.0	—
V6 to V9	30.0	30.5



WILCOX-GAY MODEL A-17 (Chassis Model 3JQ6 and 3JM6)

6-tube, 3-band (540-1,500 kc., 4-1.5 mc., 5.5-15.5 mc.), A.C.-D.C. super., A.V.C.

This set operates on any commercial power supply down to 30 cycles; for voltages over 120, special ballast cord is obtained. Note: tone control not used on Model 3JM6.

Voltages are as follows: speaker field 110, "B+" 105, as read to ground:

Tube	Plates	S.-G.	K
V1	105	50	1.3
V2	105	50	2.0
V3	45	—	1.2
V4	98	105	15.0
V5	Line Drop		

A 12-in. wire attached at chassis rear should be connected to aerial, and NO GROUND should be used.

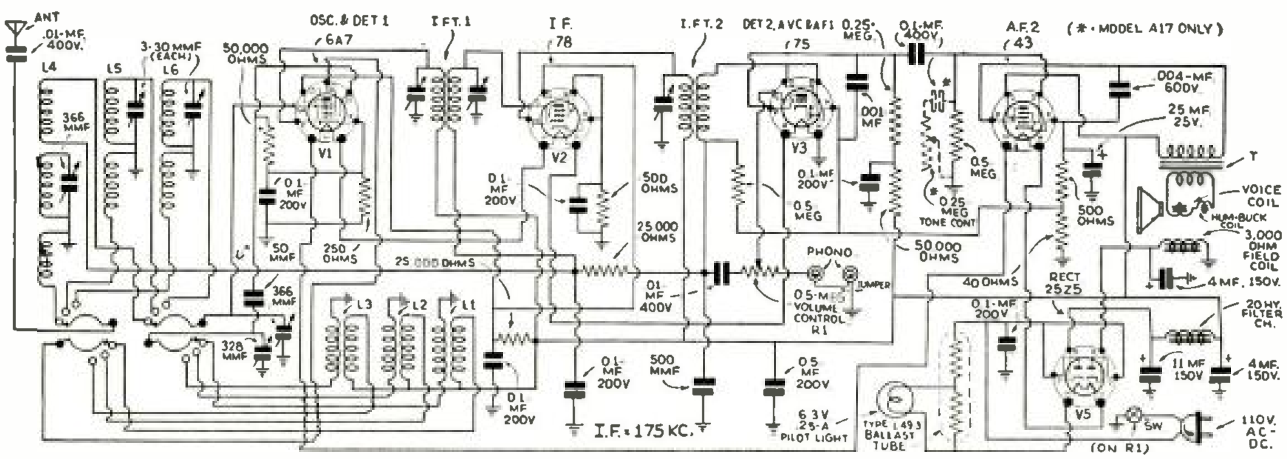
Grid of V4, 0; second grid of V1, 4.4. Drop across ballast tube (L-49-B) 49 V.

I.F. amplifier peaks at 175 kc. The 2nd I.F. transformer (right rear chassis skirt) is trimmed; then 1st I.F. transformer (right front chassis) which has secondary trimmer left and primary right, as seen from front.

The B.C. circuits are adjusted at 1,400 and 600 kc.; if necessary bending slotted plates of oscillator gang condenser to correct scale reading. The preselector circuits (center and front of gang condenser) are then trimmed to resonance.

Foreign-band circuits are adjusted at 15 mc.; there is no trimming adjustment on oscillator coil, to permit greatest extension of tuning range. Preselector trimmer on this band is at center of front chassis skirt (left side). This band should also be checked at 10 and 6 mc.

Police band is adjusted at 4 mc. The preselector trimmer is the right of two in front center chassis skirt.



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RADIO DEBUNKED FOR THE BEGINNER

(Continued from page 523)

the "radio-energy" contents of a bag. As the diagram indicates, their "atmospheric-bag" is filled with wavelengths of various "sizes," and of course contains some interfering wavelengths and also disturbing electrical impulses as well.

For the trap circuit installed into the antenna of Fig. 2 a vacuum cleaner is substituted which sucks the "coarse-pieces" into a container. This comparison is one of the best the author ever came across, since the operation of a trap circuit, to explain its function to a beginner, may be compared very well with the function of a vacuum cleaner.

After this process of "pre-cleaning" the incoming radio signal the radio energy is fed into the first tuning circuit, where a number of "blocks," representing wavelengths larger or smaller than desired, are "arrested." All the other "pieces" which pass towards the radio tube, V1, are shown larger or "amplified" after they leave the R.F. tube.

SOMETHING ABOUT FEEDBACK

The pictorial diagram explains with great simplicity how the amplified radio impulses proceed into the second tuning circuit or "detector stage", where another quantity of undesired wavelengths is filtered out, and kept away from entering the following detector tube, V2. The rectification process of the detector tube is presented in a very amusing manner. The radio-frequency component of the incoming signal is broken into pieces, and only the desired A.F. signal (audio-frequency signal) remains intact, with exception of a few "pieces of R.F. energy" which are needed for feedback purposes. The feedback condenser of Fig. 2 is presented in the form of a box with a valve or similar device. Depending upon size of the "opening" of this feedback condenser—pardon me, of the "valve" of the box—more or less feedback energy is sent back into the tuning circuit.

A frame covered with a wire mesh (presented as substitute for the R.F. choke used at this place in the diagram of Fig. 2) prevents the R.F. energy from entering the following or "output" stage. An amusing method has been chosen by Telefunken to demonstrate the function of the A.F. choke. We are probably all familiar with the fact that such an iron-filled choke bounces an A.F. signal back, but lets D.C. impulses pass with great ease. The bouncing of the A.F. impulses is left to a hockey player who executes his task with great elegance.

Now, let's accompany the A.F. impulses into the tube, V3, of the output stage. Diagram Fig. A demonstrates, by increasing the size of the tiny balls, that the incoming impulses are amplified by the tube. And we learn furthermore how the amplified impulses are directed by means of a funnel into the voice coil of the dynamic loud-speaker. The field coil of the speaker, via a good old fashioned pump, is fed with the electrical energy that makes the speaker work.

There remains only the power supply or "power stage". We see the wall outlet of the powerline and the little fellows (representing A.C. energy) entering the power transformer. A rectifier tube, V4 in Fig. A, makes them "smooth" and even, or in other words, converts the A.C. energy into D.C. energy, and our trip through the labyrinth of a modern radio receiver for powerline operation has come to an end.

This amusing trip into the secrets of radio receiver operation has shown us that there is practically nothing mysterious about the function of a radio receiver. Anyone gifted with common-sense can understand it. Everyone can, at least, *try* to build a simple receiver.

Radio beginners who want to delve a little deeper into the subject of circuit analysis in general, and the connections of 1-tube circuits in particular, should refer to the following articles in the March, 1935, issue of *Radio-Craft*: "How to Read Radio Diagrams," pg. 526 (chart of symbols appears on pg. 527); and, "Famous 1-Tube Circuits." Numerous small, simple receivers appear in *Radio-craft* from time to time which are particularly suitable for the beginner to start on. Refer particularly to "The Beginner's Book-End 3" in this issue.—*Editor.*

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TECHNICIANS' DATA SERVICE

JOSEPH CALCATERRA DIRECTOR

A special arrangement between RADIO-CRAFT magazine and the publishers of this literature, which permits bulk mailings to interested RADIO-CRAFT readers, eliminates the trouble and expense of writing to each individual organization represented in this department.

2. HAMMARLUND CATALOG. Contains complete specifications, illustrations and prices on the Hammarlund line of variable and adjustable condensers; intermediate frequency transformers, coils and coil forms; sockets; shields; chokes and miscellaneous parts for broadcast, short wave and ultra short wave reception and transmission. Also contains description and prices of the Hammarlund line of "Comet Pro" and "Super Pro" receivers.

5. ELECTRAD 1936 VOLUME CONTROL AND RESISTOR CATALOG. Contains 12 pages of data on Electrad standard and replacement volume controls. Truvolt adjustable resistors, vitreous wire-wound fixed and adjustable resistors and voltage dividers, precision wire-wound non-inductive resistors, center-tapped filament resistors, high-quality attenuators, power (50- and 150-watt) rheostats and other Electrad resistor specialties.

29. THE KEY TO SUCCESSFUL SERVICING. Four different types of combinations of courses on Radio Servicing, Public Address Work, and Television, developed by the Radio Service Institute, are described in this 24-page booklet. Complete information, including outlines of the courses and costs, is given. Two of the courses are designed for the more advanced and more ambitious Service Men who are anxious to get to the top of their profession. The other two courses are for less-experienced Service Men who want to advance more rapidly in the Radio Servicing Field. Please do not ask for this booklet unless you are interested in taking a course in these subjects.

53. POLYIRON COIL DATA SHEET 536. This folder contains complete catalog descriptions, specifications, prices, performance curves and circuits showing applications of the complete line of Polyiron radio components made by the Aladdin Radio Industries, Inc.

57. RIBBON MICROPHONES AND HOW TO USE THEM. Describes the principles and operating characteristics of the Amperite velocity microphones. Also gives a diagram of an excellent humless A.C. and battery-operated preamplifier.

65. THE 1937 LINE OF SUPREME TESTING INSTRUMENTS. This 24-page catalog gives complete information on the entire Supreme line of testing instruments, including the Model 585 Diagnometer; the Model 540 and 550 Radio Testers; the Model 500 Automatic; the Model 505 Tube Tester; the Model 555 Diagnomoscope and other Supreme oscilloscopes, tube testers, signal generators and multimeters. Complete details of the Supreme Easy Payment Plan for purchasing testing equipment on the installment plan are also given.

66. SUPREME DESIGN MANUAL "A" OF TUBE AND RADIO TESTING CIRCUITS. This interesting and useful 60-page handbook covers the fundamental principles of meters, measuring instruments and test circuits and illustrates, with detailed explanations, the basic circuits used in Supreme Testing Instruments. Every Service Man who is interested in the "why" of testing circuits should have a copy of this handbook in his kit.

73. HOW TO ELIMINATE RADIO INTERFERENCE. A handy folder which gives very complete information on how to determine and locate the sources of radio noise by means of the Sprague Interference Analyzer. A description of the analyzer and method of using it is included, together with data on how to eliminate interference of various kinds once the source is located.

74. SPRAGUE 1936 ELECTROLYTIC AND PAPER CONDENSER CATALOG. Gives specifications, with list and net prices on a complete line of wet and dry electrolytic, and paper condensers made by the Sprague Products Co. for radio Service Men, set builders, experimenters and engineers. Information on the Sprague Capacity Indicator, for making capacity tests on condensers and in servicing receivers, is included.

75. SPRAGUE TEL-U-HOW CONDENSER GUIDE. A valuable chart, compiled by the Sprague Products Co. which tells the proper types, capacity values and voltages of condensers required in the various circuits of radio receivers and amplifiers, and how to locate radio troubles due to defective condensers. Includes data on condenser calculations.

76. FACTS YOU SHOULD KNOW ABOUT CONDENSERS. A folder, prepared by the Sprague Products Co., which explains the importance of various characteristics of condensers, such as power-factor, leakage, capacity and voltage in determining the efficiency or suitability of a given condenser to provide maximum filtering and safety in operation.

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THE RADIO MONTH IN REVIEW

(Continued from page 519)

tions of emotion was demonstrated last month, for the first time, by Father Walter G. Summers, head of Fordham University's department of psychology.

In the demonstration given by Father Summers, a pack of cards was first given to the subject who picked one card out of the pack and then returned the entire pack including the card in question. The entire pack was then run through by the questioner and the subject denied that each card was the one picked out. By means of the instrument, the card formerly picked out of the pack could be determined by the "lie" marks on the recording tape.

The instrument contains vacuum tube amplifiers and a recording mechanism to amplify and record the tiny currents generated in the body by varying emotions.

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HOW TO MAKE A "JUNIOR" OSCILLOSCOPE

(Continued from page 527)

the wiring of the D.C. and sweep portions.

OPERATION

When the wiring is completed all of the controls should be in the extreme counter-clockwise position before the current is applied. The first thing to be done is to turn the current on and then focus the tube by manipulating the left-hand and the right-hand controls (at the lower portion of the unit), indicated in the illustrations as R10 and R11. Focusing is accomplished by securing a spot in the direct center of the cathode-ray tube. *Care must be taken to prevent this spot becoming too bright or the surface of the tube will become permanently damaged from burning.* This precaution may be taken by manipulating R10 and R11 in such a way that this brightness is avoided. Even though the spot may not be particularly brilliant it is a good idea not to leave the spot on for very long without any movement and plenty of movement is obtained as follows.

Once the spot has been secured, as outlined above, the sweep is thrown into play by throwing the switch Sw.2 which is attached to the center control, potentiometer R7. At the time that this adjustment is made a green light, in the form of a straight line, will appear across the cathode-ray tube. Resistor R13, which is the horizontal sweep control, is advanced to approximately the half-way position. The width of the line may be increased or reduced by changing the position of the control knob, R13.

If the line is not in a perfectly horizontal plane it may be adjusted by the simple expedient of rotating on its bracket the socket of the type 913 tube.

For 60-cycle and trapezoid sweep patterns rotate the center control R7 all the way counter-clockwise, which automatically opens switch Sw.2 and disconnects the linear sweep from the horizontal deflection plates.

When it is desired to use this oscilloscope for aligning the I.F. section of a superheterodyne receiver the additional stage of amplification to be incorporated in the oscilloscope is shown diagramatically in Fig. 1B. An A.F. modulated service oscillator will be required.

When this oscilloscope is to be used for the checking of radio transmitters—as for instance the 5-meter and other ultra-short wave units occasionally described in past issues of *Radio-Craft*—the procedure is as follows. First connect the 3-turn pick-up coil by means of a twisted-pair to the left-hand binding posts which are in turn connected to the vertical plates of the 913 tube. For observing all envelope patterns the linear sweep is used, as outlined previously. However, for trapezoidal patterns the sweep is thrown out by rotating the central knob to the extreme counter-clockwise position which automatically opens switch Sw.2. Connect the A.F. output of the transmitter—by means of the 2 binding posts at the right-hand end of the front panel—to the vertical plates.

(Continued on page 572)

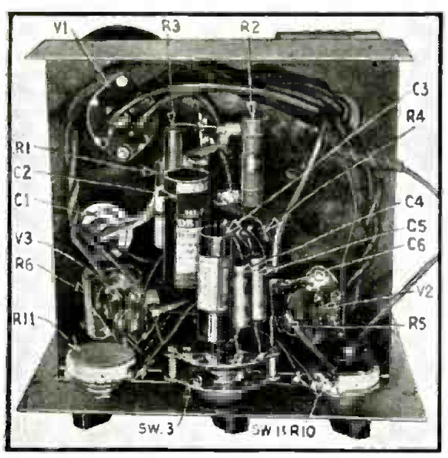

Fig. C. The under side of the chassis. The parts designations conform with the schematic circuit, Fig. 1, and the list of parts.

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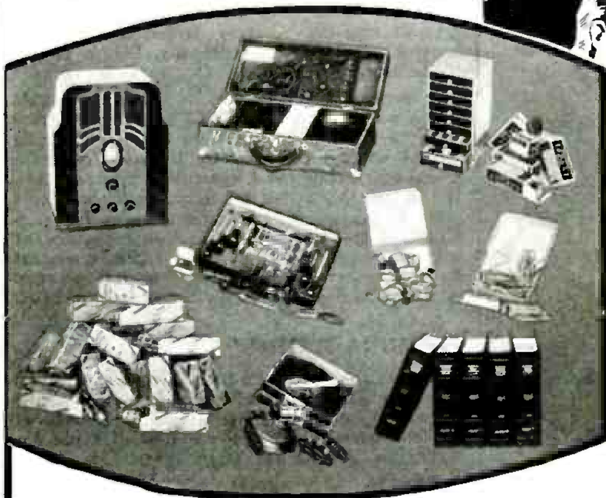

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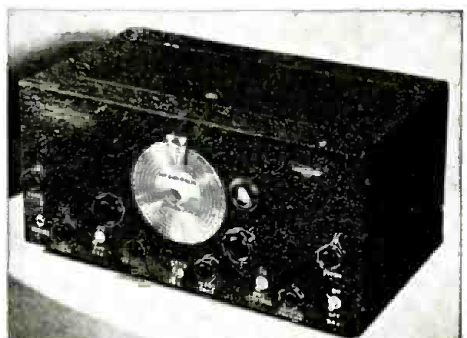

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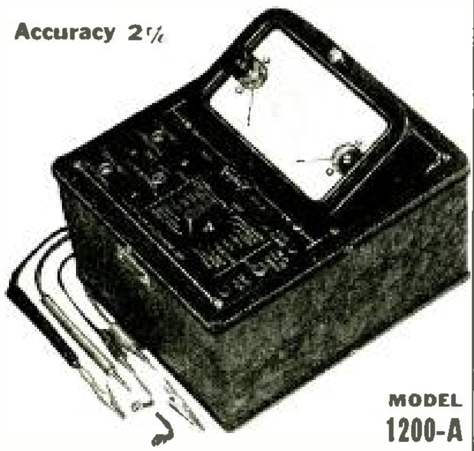

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NEW INFORMATION ABOUT ANTENNAS

(Continued from page 521)

leakage in all weather conditions. The adjustable feature of this "fishpole" antenna aids the response in certain short-wave bands.

Window-Tenna. Figure C illustrates the new type of antenna, recently developed by a well-known radio hardware company, known as the "Window-Tenna."

It consists of 3 telescoping aluminum tubes which permit the antenna to be extended from 3 ft. to 8½ ft. The antenna mounts vertically on the window casement on the outside of the window to either wood, cement or brick surface. It is admirably suited for apartment houses and other places where roof antennas are not permitted. Because of the telescoping feature of this antenna, its length can be adjusted so that its usefulness extends to the short-wave and television bands as well as the broadcast band.

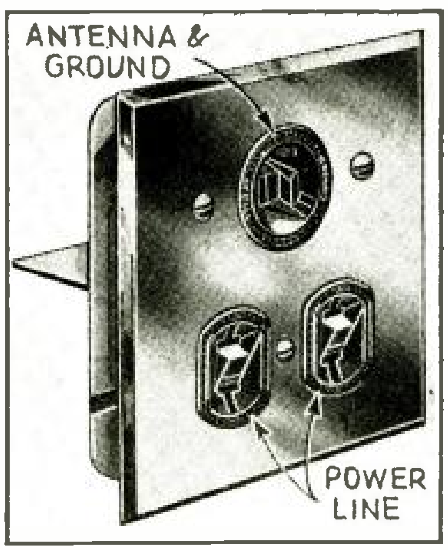
"ANTENNA SYSTEMS"

Despite the mass of advertising literature and magazine articles describing the merits of the various types of antennas (perhaps *because* of it), the question "Which aerial shall I use for best radio reception?" doggedly persists.

Recently, there appeared in a newspaper, a statement, by a well-known radio authority, condemning all types of *coupling transformers* used in connection with the various special antenna systems. "We have found," to quote one of the sentences, "that these gadgets invariably cut down the signal strength."

It is interesting to note the reactions, to this statement, of some of the radio engineers of the larger companies. One engineer writes:

(1) "The real purpose of these special antenna systems is to give an improved signal-to-noise ratio in radio reception. The engineer naturally attempts to give this improvement without a sacrifice in signal strength, but because the band is so wide—from 6 to 18 megacycles—exact matching for all frequencies is impossible and so signal reduction results. However, *the noise pick-up is usually greatly reduced*, resulting in ratios of signal-to-noise which may be as high as 100 times the original value." (Italics ours.) Here, you see, the engineer makes it quite clear that the problem is not one of, merely, DX reception, but *DX reception without noise* (static). (Or, as he phrases it, "high signal-to-noise ratio.")



This wallplate has an antenna-ground outlet (provided with an antenna coupler), and power outlets. Fine for apartments, etc. (No. 1308)

(2) Another engineer states: "Mr. X says that gadgets, such as antenna couplers, invariably cut down the signal strength. We are entirely in agreement with Mr. X in this respect because the antenna system about which he is talking is evidently not a standard engineered system such as supplied by large radio companies. *When the antenna coupler and the set transformer are properly engineered and designed the efficiency is much greater with them than without them.*" (Italics ours.) The chief engineer of this big company feels the "antenna system" should use an antenna coupler—but it *must* be of the proper type—for best results.

(3) A third engineer makes the following comment: "He is not considering the *noise reduction* feature of short-wave antenna, which feature is only possible through the use of a coupling unit. There are of course arrangements of antennas which may be advantageous on one signal frequency during a particular period without an antenna coupler. However, the coupler gives a much better efficiency over a greater range of frequencies. . . . Also, mere *listening* tests are deceptive due to the A.V.C. action of the set; and, antenna effectiveness is difficult to determine in localities where S.-W. listening conditions are ideal. The use of an antenna system is often based not only on sound mathematical analysis but the real necessity is proven by experimental observations and measurements *which eliminate the human error.*"

Let us now discuss two of the better types of *antenna systems.*

The "Spiderweb." The new RCA "Spiderweb" antenna system consists of a series of doublet antennas and an improved transmission line to the receiver, as shown in Fig. D and Fig. 1A.

This system gives excellent signal pick-up over the frequency range from 140 to 23,000 kc. and, by adding an additional doublet, sold separately as a "High-Frequency Kit", this range may be increased to 70,000 kc. with full noise reduction. This feature is especially important because of the increased frequency range of modern all-wave receivers. This "High-Frequency Kit" may be added at any time, not necessarily when the antenna is first installed. The balanced doublets, together with the transposed transmission line, eliminate all noise pick-up on the lead-in in the short-wave bands. This system is considerably easier to install than its predecessor the "double-doublet" antenna system since double supports are not required. A span of only 38 ft. and a vertical clearance of 12 ft. are the entire space requirements of the "Spider-Web" antenna system. Furthermore, the system is completely assembled and soldered at the factory and comes to you ready to be "hung."

The "V-Doublet." The General Electric "V-Doublet" antenna system incorporates a doublet, the center portion of which takes the form of a "V". See Fig. E and Fig. 1B.

It is contended that the factor responsible for the non-uniform sensitivity of a conventional single-wire or doublet antenna is the development of "standing waves" along its length, which results in points of high and low sensitivity at different frequencies. The "V-Doublet" reduces the standing waves because the center portion is tapered, making the system somewhat aperiodic (equally resonant to all frequencies). The first high-impedance point is thereby extended to such a high frequency that efficient pick-up is obtained on the antenna

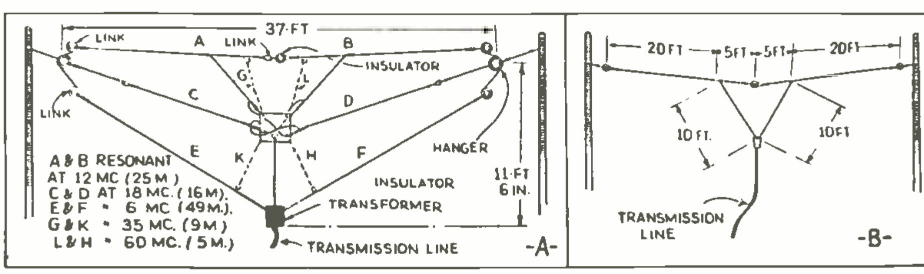


Fig. 1. Details of 2 antenna systems. At (A), RCA "Spiderweb"; (B), G.E. "V-Doublet."

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proper, and the high-impedance point does not have the usual derogation (reducing effect) of signal strength experienced with conventional doublets. The result is a doublet of better uniform sensitivity over the short-wave points.

A further function of the tapered "V" is to couple efficiently the fairly high impedance antenna to the low-impedance transmission line, in which case the taper performs the function of a transformer. The length of the transmission line and the coupling ratio of the transformer are correct to afford proper *electrical matching* for greatest energy transfer from the antenna to the receiver.

The transmission line is coupled to the receiver through a specially constructed receiver-coupling transformer. The transmission line is immune to signal pickup, either that of noise or the desired signal. Therefore, if the antenna proper is kept well out of the field of noise, the signal will be quite free from noise.

There is yet another consideration involved. With an all-wave receiver the antenna must not sacrifice performance in the standard broadcast and other low-frequency bands in order to obtain good short-wave reception. At the lower frequencies, therefore, this antenna is automatically converted, by the electrical action within the receiver-coupling transformer, from its "V-Doublet" form to one approximating the conventional "T-type", so that the transmission line acts as part of the effective antenna length.

MAKE "THE EXECUTIVE"—A BUSINESS MAN'S A.C.-D.C. SET

(Continued from page 542)

POLISHING AND ASSEMBLING

In working with plastic materials, all parts must be polished before assembly. After checking all surfaces for flatness and seeing that the edges are true and square, remove all tool marks by buffing on an 18-in. rag wheel with the aid of pumice powder (size 000) in water. Continue this operation until all traces of scratches are gone. Patience and care at this point are important to the ultimate attainment of the high lustre and rich hues possible with this material. The next operation is to apply a high polish by using a second 18-in. rag buffing wheel dressed with rouge or tripoli. This last buffing requires only a few seconds if the preliminary polishing has been properly done.

If the constructor carefully examines the detail illustration, Fig. 4, very little need really be said about the assembly operation. All parts of the cabinet are held together by means of ½-in. angle brackets and 3/16-in. machine screws. Three angle brackets are used on each side. *The holes which engage the machine screws for these brackets are drilled only 3/16-in. deep into all the panels except the thick base. There the holes are drilled ¼-in. deep and ¼-in machine screws are used.*

Assemble the front and two side panels together first; then attach the top and finally the base. Use machine screws with a 6-32 thread. If the holes for these screws are drilled just a trifle smaller than 6/32, the screws will cut their own threads in the holes as they are screwed in. No tapping of the drilled holes is necessary.

For the benefit of constructors who wish to know "where they stand," financially, before engaging in the construction of this distinctive radio set, the following supplementary listing of materials has been prepared to include approximate market prices.

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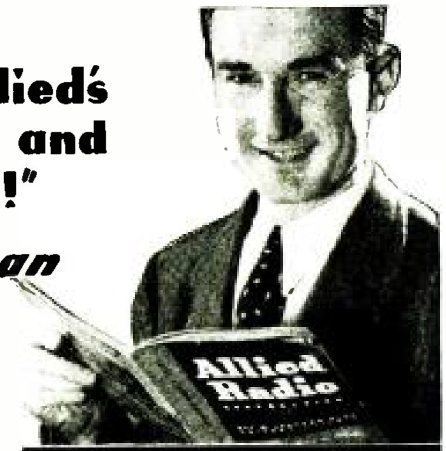

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MY FIRST TRANSATLANTIC WIRELESS SIGNAL

(Continued from page 520)

the 6th, and before beginning operations, I visited the Governor, Sir Cavendish Boyle, and the Prime Minister, Sir Robert Bond, and other members of the Newfoundland Government, who promised me their heartiest cooperation in order to facilitate my work. After taking a look 'round at the various sites, I considered that the best one was to be found on Signal Hill, a lofty eminence overlooking the Harbor. On the top of this hill was a small plateau, which I thought suitable for flying either balloons or kites. On a crag of this plateau rose the Cabot Memorial Tower, and close to it was an old Military Barracks. It was in a room of this building that I set up my receiving apparatus in preparation for the great experiment.

On Monday, December 9th, barely 3 days after my arrival, I and my assistants began work on Signal Hill. The weather was very bad and very cold. On the Tuesday we flew a kite with 600 ft. of antenna wire as a preliminary test, and on the Wednesday we had inflated one of our small balloons, which made its first ascent during the morning. Owing, however, to the strength of the wind, the balloon soon broke away and disappeared in the mist. I then concluded that perhaps kites would answer better, and decided to use them for the crucial test.

I had arranged with my assistants in Cornwall to repeat the letter "S" at a pre-arranged speed, during certain hours of the day. I chose the letter "S" (3 dots) because it was easy to transmit, and with the very primitive apparatus used at Poldhu, I was afraid that the transmission of other Morse signals, which included dashes, might perhaps cause too much strain on it and break it down. Mr. Entwistle, Mr. George and Mr. Taylor were in charge of the English Station at Poldhu during the transmission of signals to Newfoundland.

On the morning of Thursday, the 12th of December, the critical moment for which I had been working for so long, at last arrived; and in spite of the gale raging, we managed to fly a kite carrying an antenna wire some 400 ft. long. I was at last on the point of putting the correctness of my belief to the test. Up until then I had nearly always used a receiving arrangement including a coherer, which automatically recorded signals through a relay and a Morse instrument. I decided in this instance, to use also a telephone connected to a self-restoring coherer—the human ear being far more sensitive than the recorder. Suddenly, at about half past twelve, a succession of 3 faint clicks on the telephone, corresponding to the 3 dots of the letter "S" sounded several times in my ear—beyond the possibility of a doubt! I asked my assistant, Mr. Kemp, for corroboration, if he had heard anything. He had in fact heard the same signals as I had. I then knew that I had been justified in my anticipations!

The electric waves, which were being sent out into space from Poldhu had traversed the Atlantic unimpeded by the curvature of the earth—which so many considered to be a fatal obstacle—and they were now audible in my receiver in Newfoundland!

Today, wireless telephony over world-wide distances is now a reality together with transmission of photographs and already we are entering the Television Era. It may even be that the transmission of power over moderate distances may be developed in the not far distant future. I must leave to your imaginations the uses which can be made of these new powers. They will probably be as wonderful as anything of which we have experienced so far.

The Newfoundland stamp commemorating Marconi's success.

RADIO'S "OLD MAN OF THE SEA"

(Continued from page 536)

tion of interference, at the time a complaint was first lodged against the Long Island Railroad for maintaining a prolific source of radio interference, a survey was made by the Public Service Commission and the inspector found that out in the open country and at a distance of less than 7 miles from WEAF's transmitter at Bellmore, L. I., WEAF, key station of the National Broadcasting Company, was completely blanketed at a distance of 600 ft. from the railroad!

A prevalent source of local radio interference is the neon sign, particularly if it is blinking, or if the glass tubing has a heavy coat of dirt where the wires come out of the tubing. As a rule the noise emanating from these signs can be eliminated by a thorough cleaning.

Oft'times the use of special aerials, if they are properly installed, will reduce the interference. But this is just putting the cart before the horse. *The proper place to work is at the source of the interference.*

Diathermy machines, which are finding increasing use in doctors' offices and hospitals, have been heard over a distance of 7,000 miles and can completely disrupt reception in a community. There are instances in the Metropolitan area, on the other hand, where proper filtering has been so adequately accomplished that the tenants in the same apartment building were not aware when the diathermy equipment was in operation!

At present, in the Metropolitan area of New York, which is no different from populous areas in the rest of the country, there is no modern radio set that doesn't experience some avoidable interference. Owners of one-half of the better-grade sets in New York City have legitimate cause to complain of interference with reception from the 4 high-power broadcast stations in the area.

The wide-awake Service Man will do well to buy or build a portable receiving set which will enable him to track down sources of interference, and acquire as much knowledge as he can as to the many types of interference that can be eliminated at a very small cost. For ordinary requirements the writer has found that a car-radio set or a midget battery set with self-contained current supply is quite adequate, since a loop antenna is not needed for such service.

Radio men will be interested to know that the increasing hue and cry of listeners-in has resulted in the formation of a national organization that plans to do, with the strength of "union," what individual effort could not achieve in combatting "Old Man Static."

This organization, the National Association for the Prevention of Radio Interference ("NAPRI") already has received wide and enthusiastic support. Public officials, broadcast network executives, wholesale and retail organizations, Service Men, the experimental fraternity, and the entire lay public have evidenced keenest interest in the progress that has so far been made.

Radio-Craft readers who may care to have NAPRI take up the cudgel against some particularly objectionable form of man-made interference in their own locality may write to NAPRI in care of *Radio-Craft*.

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INTERNATIONAL RADIO REVIEW

(Continued from page 528)

position to face directly toward a person sitting in an easychair. The cabinet itself is low and is supported on short legs, for the same reason.

It will be noticed in Fig. A that the number of controls in this receiver have been reduced to 2, on the front panel! These are the only controls which need adjustment after the set has once been placed in operation, according to the description in *Radio Amateur*.

The cathode-ray tube in this set is approximately 12 ins. in diameter, producing images about 9 ins. square.

AN ITALIAN ALL-WAVE TUNER

EXTENDED-BAND—or as they are more frequently called, all-wave—tuners have been made in a great variety of forms. Every designer has his own ideas of how to keep the leads short and the coils free from mutual coupling or coupling to grounded metal parts which reduce their over-all efficiency.

The latest issue of *Radio Industria* (Milan) showed an example of how Italian engineers consider the job should be done. A metal frame is secured to the waveband switch and the coils for the various bands are suspended between the two ends of the frame. The long-wave coils are universal-wound while solenoids are used for the short-wave bands (See Fig. B.).

This method of mounting keeps the leads short, and since the coils not in use are short-circuited, the losses are kept at a minimum.

AIR-DIELECTRIC TRIMMER

AIR-INSULATED trimmers, similar in principle though somewhat different in mechanical structure to the American units of the same type, have made their appearance on the markets in France, according to *Toute la Radio* (Paris).

These trimmers, which come in 2 sizes (as shown in Fig. C) for trimming I.F. and R.F. circuits, are products of that Dutch organization—the Philips Lamp Company. They consist of interleaving open-ended cylinders of metal which are moved into and out of the meshed position by means of a screw. Their advantage is in reduced losses and stability of setting which prevents the "drift" often encountered in short-wave receivers of the superhet. type.

THE "LONG ARM"

A WELL-KNOWN manufacturer of radio speakers, in England, has recently placed on the market a remote-controlled speaker cabinet for use with any radio receiver. The speaker can be placed wherever desired in the house, away from the receiver itself, and the set can be turned on or off as desired. The volume at the reproducer can also be changed to suit the program and room conditions, independent of the volume of the sounds emanating from the speaker in the radio set (which may be located elsewhere).

This deluxe-type remote speaker, shown in Fig. D, was described in the latest issue of *Wireless Retailer and Broadcaster* (London).

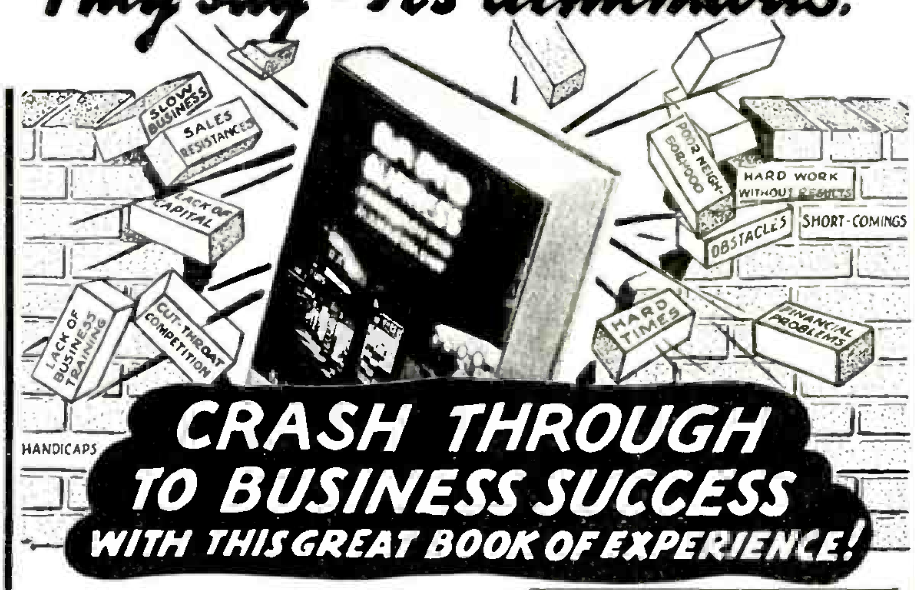
The installation of the "Long Arm" includes the speaker cabinet itself and a small control box (which evidently contains relays etc.) for turning the set on and off from the combined remote speaker switch and volume control.

SIMPLIFIED TUNING

THE DIFFICULTIES of tuning and recording short-wave stations on the ordinary radio receiver are obviated in one new English radio receiver by means of a giant dial which is mounted on the inside of the hinged lid! The set is a combined phono-radio and the turntable as well as the tuning knob, volume control and wave-band switch knob are located on a recessed horizontal panel which is exposed by raising the lid. See Fig. E.

The dial is quite large, so that the pointer position can be seen and recorded with much greater ease than with the ordinary all-wave set dial. This set was shown in a recent issue of *Practical and Amateur Wireless* (London).

They say—"It's tremendous!"



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See Page 516 for Complete Details on the 1936 Official Radio Service Manual

DIRECT COUPLING IN A 30-W. BEAM-TUBE AMPLIFIER!

(Continued from page 534)

"Trigger action" was the term then applied to the action of the amplifier which "blocked" and became inoperative when a very strong and maintained signal was fed into its input. This effect was caused by a surge in plate current which in turn affected the grid-bias voltage (lowered it) so as to throw the bias off its normal Eg-Ip curve and maintain itself in this blocked state. Naturally, the amplifier was inoperative during these periods and had to be "shut off" in order to release the trigger action. This effect is now avoided in a new amplifier (to be shown pictorially and by diagram in a forthcoming Part) utilizing a stabilized, 2-phase rectification system. (The innovations of this sound system are outlined in Table I.)

The fact that the original circuit was single-tube-ended (at a time when the advantages of push-pull were well known) proves that a suitable push-pull output circuit was not of simple design. After the circuit had gained in popularity, many attempts were made later on, with varying degrees of success, to convert the single-ended (1-output-tube) amplifier to one of the push-pull variety.

None were really perfect and few lived up to their anticipated performance. The reason for this is now evidenced in the faulty phase-inversion systems attempted. As all of these inverter systems used a coupling condenser, true inversion did not take place at all frequencies and amplitudes.

Critical adjustments were particularly annoying to the many experimenters who first attempted to build the amplifier because (1) no special attention was paid to the regulation of the power supply or (2) compensation for variations in plate current of different power-output tubes. These 2 factors contributed greatly to the unjust condemnation of this really revolutionary high-fidelity circuit.

Because of the tremendous advances made in modern amplifier engineering it becomes a relatively simple matter to design a 2-phase, stabilized, bridge-type rectifier capable of supplying a fixed voltage to a 3-stage non-reactive-coupled amplifier utilizing a non-reactive signal divider (this is not to be confused with the conventional type of phase inverter) which drives two 6L6 tubes in true push-pull fashion.

In order to simplify the discussion of this new type of circuit, each basic portion will be treated individually.

ANALYSIS OF THE RECTIFIER SYSTEM

Before explaining the action of the stabilized 2-phase rectifier system, perhaps a brief review of existing rectifying systems will clarify its operation.

If one end of a single winding is grounded (Fig. 1A) and an A.C. voltage plotted from ground as the reference point the curve shown in Fig. 1B would result. If this single-phase voltage is rectified as in Fig. 1C only half of the wave is passed through the rectifier and its plotted output approximates Fig. 1D.

If this same coil is center-tapped and grounded at this point (Fig. 1E) and voltage plotted from ground to both extremities the 2-phase voltage of Fig. 1F would result. The dotted lines are used to indicate another voltage of equal amplitude but opposite in phase (180 deg. out-of-phase). If a conventional rectifier circuit be applied as in Fig. 1G, the resultant rectified voltage would approximate the curve shown in Fig. 1H. This is known as full-wave rectification but actually is a *single-phase* full-wave rectifier for the dotted curve, which represents a voltage 180 deg. out-of-phase with the voltage being rectified, is unused. This circuit will be recognized as the conventional rectifier arrangement.

If the coil in Fig. 1A has its upper terminal grounded as in Fig. 1I and a curve plotted of its voltage, it would approximate the one illustrated in Fig. 1J. If this single-phase voltage is rectified as in Fig. 1K, the resultant rectified voltage resembles the curve plotted in Fig. 1L. Here again, if the coil is center-tapped as in Fig. 1M, the same 2 phase voltages are present (Fig. 1N) as in Fig. 1F. By utilizing the full-wave circuit of Fig. 1O, complete rectification results of only one of the phases, and a rectified voltage is produced somewhat similar to the one illustrated in Fig. 1P. This full-wave rectifier circuit may be recognized by some as the conventional bias rectifier arrangement used in fixed-biased circuits. It will be noted that here, too, only one phase is rectified (the voltage indicated by a solid line is unused).

By utilizing the same coil (Fig. 1Q) with its 2 phase voltages (1R) and combing both rectifier systems of Fig. 1G and Fig. 1O into a 2-phase rectifier Fig. 1S, the resultant rectified voltage resemble the curves of Fig. 1T. Many will recognize this circuit as the conventional bridge-type rectifier.

In Part II, this consideration of the power supply will be continued, including practical circuits of the bridge arrangement. Further discussion of the amplifier will also be presented.

This article has been prepared from data supplied by courtesy of Amplifier Company of America.

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THE CAPACITY METER AS A SERVICING AID

(Continued from page 534)

by the Service Man without means for capacity measurements. All in all, there is plenty of practical evidence that capacity measurement is no longer a secondary servicing requirement.

100 MMF. TO 200 MF.—DIRECT-READING!

The most logical answer to this growing requirement for rapid and accurate capacity determination appears to lie in the use of the direct-reading capacity meter, powered directly from a 60-cycle, 105-150 V. line, and covering a complete range of values from 0.0001-mf. (100 mmf.) to 200 mf. Among the first to recognize the need for an instrument of this type were the manufacturers of condensers themselves. Consequently, the instrument as developed was of the fundamental type, equally applicable to paper, mica, air or electrolytic condensers, with an accuracy which exceeds by several times that of the condenser ratings themselves.

The low-range setting of the instrument permits measurements from 100 mmf. to 0.02-mf., thus covering practically all of the condensers of extremely low capacity in any modern receiver. Other ranges, available at the turn of a switch, include 0.01- to 0.2-mf., 0.1- to 2 mf., 1 to 20 mf. and 10 to 200 mf.

ACCURACY OF INSTRUMENT

Service Men sometimes ask: "Can an A.C. measurement of this kind give accurate capacity measurements on electrolytic condensers designed for high-potential D.C. circuits?" The question is a reasonable one, for such condensers are known to be affected by abnormal polarization effects under certain A.C. potentials. With the capacity meter described, however, all measurements in the capacity ranges above 0.1-mf. are made at a potential of but 4 V. Tests upon which the design of the meter was based confirmed the accuracy of measurements at this low potential on all types of wet or dry electrolytic condensers.

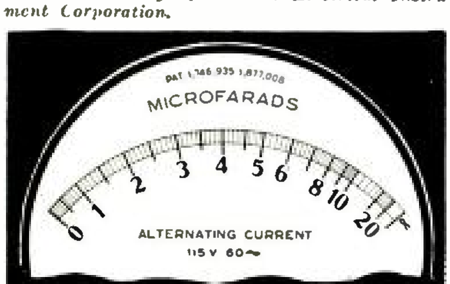
Essentially, the direct-reading capacity meter consists of a permanent-magnet movable coil type of indicating instrument, together with a copper-oxide rectifier and suitable network, adjusted for full-scale deflection at 250 microamperes.

The operation is based on the fundamental relationship between reactance at fixed frequency and the deflecting current, in a circuit of fixed resistance and potential. Reactance, in turn, depends upon capacity under fixed frequency conditions. Since the meter is powered from service lines closely regulated at 60-cycles per second for electric clock accuracy, then, the capacity of the condenser under test is the only variable causing deflection of the instrument pointer over the calibrated scale.

SECONDARY USES

Obviously, this same fundamental circuit will have equal capabilities as an A.C. voltmeter, simply by providing jacks for introducing an external potential across various fixed resistances correlated to voltage ranges on the scale. In the instrument described, ranges of 4-8-40-200-400 and 800 V. are provided, at a sensitivity of 1,000 ohms-per-volt. Thus the Service Man has at his command a double-duty instrument of wide flexibility. A self-contained condenser for blocking any D.C. component is connected through a separate pin-jack for use in output-voltage measurements when desired. In connection with the 0-4 V. range, this provides the Service Man with a spare output meter that can readily be brought into service when the shop's regular output meter is in use elsewhere.

This article has been prepared from data supplied by courtesy of Weston Electrical Instrument Corporation.



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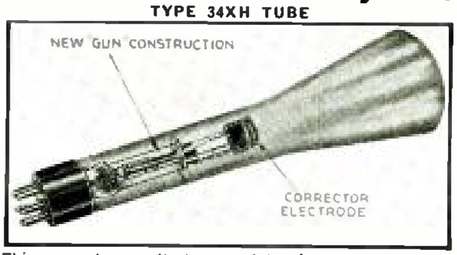

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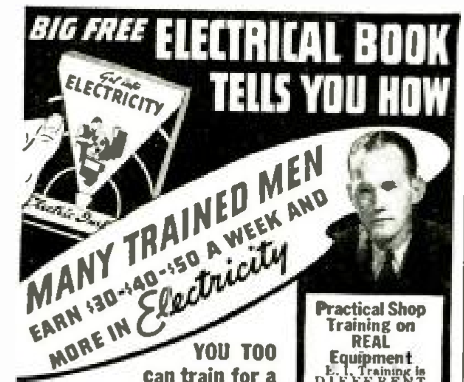

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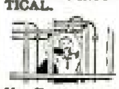

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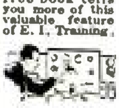

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INVESTIGATE - GET THE FACTS

LOUDSPEAKER BAFFLES AND CABINET RESONANCE

(Continued from page 532)

The purpose of the baffle is to so lengthen the front-to-back air path so that air displaced by the forward movement of the cone cannot reach the near-vacuum at the rear until the "vacuum" has ceased to exist by virtue of the cone having had time to pull backward.

The baffle can be of anything from limburger cheese to paper—anything at all that will lengthen the air path from cone-center front to cone-center rear. It should be of some acoustically "dead" (non-vibratory) material, such as softwood, celotex or the like. If it is hard and stiff (or thin) it will vibrate in itself, which it should never do, for if the baffle vibrates, it contributes tones to reproduction which were not intended to be in it, thereby causing distortion.

There is a simple rule for figuring sizes of baffles to reproduce down to any desired frequency, below which however they will cut off rapidly. It is based upon the speed of sound traveling in air (1,130 ft. per sec., approx.) and the number of oscillations (complete neutral to forward to neutral to back, to neutral again). By this same "rule of thumb," we get the path lengths, for different low-frequency cut-offs below which our speaker will not reproduce, shown in Table 1.

TABLE I

*Cut-Off Frequency (in Cycles)	**Length of Path (in Feet)
100	5.65
60	9.416
40	14.125
30	18.83
20	28.25

(*Lowest frequency to be reproduced. **Measured from front-of-cone center to rear-of-cone center.)

Remember that these are figures in feet for the *shortest* distance from the cone center at front to the cone center at rear. If our baffle is to be a flat, soft board 1 to 1½ ins. thick, we will need the air path lengths given in the Table in order to reproduce down to the frequencies given. If the baffle is a square, flat board with the reproducer at the center, then these figures are for size of the square baffle, since if the speaker is at the center, sound must travel half of each figure from front to baffle edge, and again this same distance around to the cone rear. (See Fig. 1B.)

Let us take 40 cycles as the lowest tone to be reproduced. On a 40-cycle note, the cone will move from neutral to forward, back through neutral to rear, and then to neutral again 40 times per second. It will take one-half this time, or 1/80-sec., to move from the front to the rear, so we want the baffle to delay the front sound 1/80th of a second before it is allowed to reach the rear, so that it will add to the rear sound, and not cancel it out. If we now multiply the speed of sound in air, (1,130 ft. per second) by 1/80, we will get the path length that must be interposed between the cone front and cone rear in order for our loudspeaker to reproduce all tones down to 40 cycles. Then 1,130 divided by 80 gives 14.125, which tells us that the shortest path from speaker cone front to cone rear must be 14.125 ft. long if our speaker is to reproduce down to 40 cycles.

The baffle can be a box as well as a flat board, as in a radio cabinet. Thus, some of the edges of the baffle can be bent backward to save space. In this case the baffle area will effectively be the total distance from front to back, but still measured from speaker cone center around the *shortest side* of the cabinet, and back in to the speaker cone center at the rear.

Thinking now of your own radio cabinet, and measuring it you will probably find it smaller than the size given above, and you know, it gets down to below 100 cycles, maybe even to 60, yet the figures say it *can't* do it! How then is this seeming paradox accomplished?

The answer is that it reproduces frequencies below its own cut-off largely through *cabinet resonance*, or the resonances caused by the width, height and depth of the cabinet cavity in which the speaker is installed. If these resonances are sharp, as in a thin-veneer or entirely closed-in cabinet, "boominess" results. Thus it appears that cabinet resonance is not undesirable, as is usually thought, but is very necessary to low-note reproduction; this is true, but only if it is obtained from a solid, heavy cabinet, and in carefully regulated and controlled degree.

Our Information Bureau will gladly supply manufacturers names and addresses of any items mentioned in RADIO-CRAFT. Please enclose stamped return envelope.

PITFALLS OF THE RADIO SERVICE BEGINNER

(Continued from page 539)

make 3 round trips to the customer's home —one to get the set, one to return it, and one to tell the owner that he couldn't take out the squeal caused by the nextdoor neighbor who still enjoyed (?) a 1-tube "whooper". Also he could mark up 50c shop overhead for the job.

Fine—"step up the gain" on the calculating department of the upper story and we find we have:

Total receipts	$7.00
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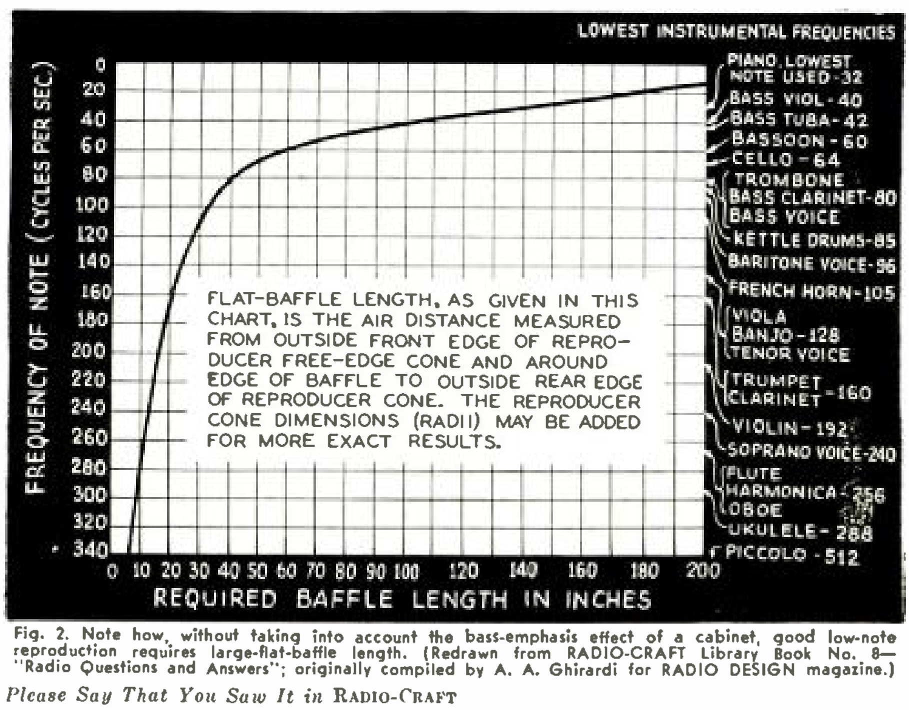

Fig. 2. Note how, without taking into account the bass-emphasis effect of a cabinet, good low-note reproduction requires large-flat-baffle length. (Redrawn from RADIO-CRAFT Library Book No. 8—"Radio Questions and Answers"; originally compiled by A. A. Ghirardi for RADIO DESIGN magazine.)

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THE MUCH-ABUSED BALLASTS FOR A.C.-D.C. RADIO

(Continued from page 543)

prong connections! Some manufacturers have gone so far as to purposely change the prong connections of the ballast so that ballasts now on the market would short across the line or short the line across the pilot light resistors, and in that way burn out some part of the ballast! This is something that Service Men will have to look out for—and the only way out is for them to be guided by a good replacement chart.

If ordinary resistance wire is used in the ballast, the amount of wire must be changed, depending upon the number of tubes in the set. This, therefore, would require approximately 10 different "ballasts" using ordinary resistance wire to take care of the variation in total tube voltages.

It is really incorrect to call units using either nichrome or ordinary resistance wire "ballasts." A real *ballast* resistance *is one whose resistance changes very rapidly with small changes in current.*

If a real ballast is used and the sets wired uniformly, the number of ballasts required for A.C.-D.C. sets could be reduced to practically one each for total filament voltages of 15 to 40 V.; 40 to 75 V.; and 75 to 105 V. The resistance of the amperite automatically varies to make up the variation in line voltages as well as the variation in the number of tubes used (Fig. 1B.). For example one such ballast can be used for any set having a total tube filament voltage of 40-75 V. This practically takes care of most A.C.-D.C. sets. As shown in Fig. 1A the voltage drop across the amperite itself varies from 30-80 V., taking care of a variation of 50 V.

Circuit details series A to D in Fig. 1 show the various arrangements in pilot light combinations used in most A.C.-D.C. sets.

By putting two pilot light resistances in the ballast, as shown in Fig. 1, series D, it could be used for either 1 or 2 pilot lights. The same ballast can of course be used without pilot lights. If not used, the small pilot light resistances will make no material difference in the circuit. The same amperite could therefore be used for (a) none, (b) 1 or (c) 2 pilot lights and for a set having a total filament voltage of 40-75 V.

A series of octal-base ballasts are numbered K42A, K42B, L45A, etc. The A, B, C, or D refers to the wiring diagram of pilot lights as shown in the series in Fig. 1. The K refers to 0.150-A. pilot light and L to 0.250-A. pilot light. Center number refers to the voltage drop across the ballast.

The amperite KL45 for example is designed as shown at D of Fig. 2 and will take care of either the A, B, C, or D arrangement, and any set with a total filament voltage drop between 40 to 75 V. It will therefore replace any octal-base ballast starting with K or L, ending with A, B, C, or D and having a center number of anything between 40 and 75.

The unusually low resistance of the 6 V. tubes causes an unusual surge when the set is first turned on. In order to eliminate this surge the amperite regulator (see photo) is equipped with a patented starting resistance which allows only approximately 70 V. on the set when it is first turned on, and is automatically shorted out when the tubes warm up. It is an ideal combination since it starts the tube at a low voltage, takes care of any voltage variation of the line from 90 to 135 V. and also takes care of variation in the number of tubes in the set.

This article has been prepared from data supplied by courtesy of Amperite Corporation.

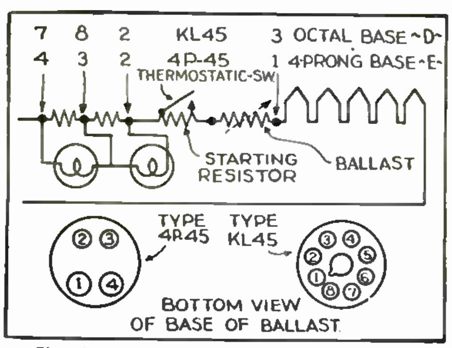

Fig. 2. Circuit details for KL45 Amperite.

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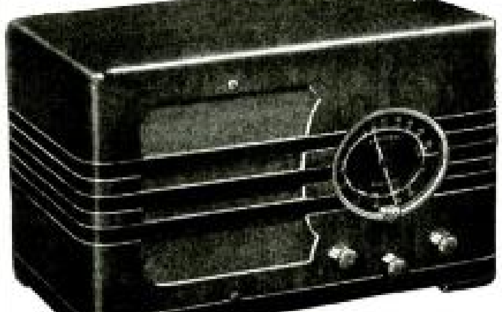

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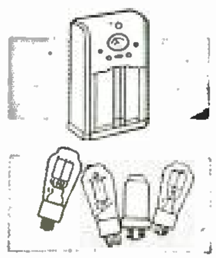

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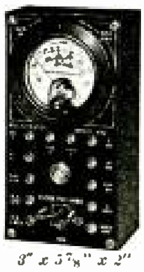

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HOW TO MAKE THE BEGINNER'S "BOOK-END 3"

(Continued from page 525)

Condenser C1 is the first section of the 2-gang variable condenser, with C4 the means of completing the circuit between condenser rotor (chassis connected via the frame) and the "B—" return for the L1 secondary. Units C5 and R2 provide means for controlling feedback and may be eliminated where a fixed adjustment for maximum regeneration and selectivity (without circuit oscillation anywhere in the tuning range) is desired and can be effectively attained. Potentiometer R2 might be simply called our *sensitivity control.*

Potentiometer R1, wired across the L1 primary, shorts the winding; and thus, by varying voltage applied to the control-grid of V1, functions as a *volume control.*

CONSTRUCTION

Two separate chassis are required, and these may be cut and formed individually from aluminum sheeting or obtained from a single, standard-size base measuring 8 x 6 x 2¼ ins. high, cut through as shown on the chassis layout diagram. If the one chassis is to be used, it may be punched and drilled before it is split in two.

All socket holes are 1 3/16 ins. in dia. For proper installation of the specified sockets they should be punched out with the special laboratory die, developed by the manufacturer of the sockets specified in the List of Parts, designed to cut a hole exactly sized for the retainer-ring-mounted sockets.

In constructing the power unit, the tone control (if required), the socket for the 25Z6, the socket for the cable plug, and the various filter components are first mounted. Condenser unit C14-C15 is placed above the chassis and C13 below; both units are fastened by one set of mounting bolts. Two small, right-angle brackets mount the loudspeaker.

Bring the 3-lead line-power cord through the hole in the back of the power unit chassis and connect the red wire to the switch, the black to the 25Z6 Nos. 3 and 5 terminals, and white (resistor lead) to the No. 7 terminal. The free switch terminal is connected to the "B –" point on the output socket and will be a convenient tie terminal for all "B –" connections (returns for C12, C13, field coil, C14 and C15) to be made in the power unit. The rectifier socket terminal No. 4 is wired to feed the field-C13 combination. The No. 8 terminal feeds the "B+" to filter choke Ch.2; the latter is wired for "B+" to the output socket. The reproducer voice coil is connected between the "B+" and the fourth terminal on the output receptacle. Place C17 wherever convenient.

In assembling the receiver unit, first mount the 2 sockets, then the volume and selectivity controls. Coil L1 is now placed under the chassis, open end upward, and bolted to the right-side wall by means of the assembly supporting the coil within its shield can. Coil L2, its open face pointed toward the 25A6 side of the chassis, is similarly mounted near the sockets. The 2-gang variable condenser is supported on the chassis, in some convenient manner, so that its shaft will align properly between the volume and selectivity controls. (The shaft will probably have to be extended.)

A 4-lead cable, its length dependent upon the desired maximum separation, will be required for the connection between the two units. One end of it is connected to a male 4-prong plug, for power supply plug-in. The receiver-end leads are then traced for proper continuity, brought through the ⅜-in. hole near the antenna terminal strip cutout and wired as follows: "B –"—to the 25A6 cathode or to a tie point; "B+"—to the screen-grid terminal of the 25A6; output—to the plate terminal of the 25A6; and, filament—to the No. 7 terminal of this same tube. Anchor the cable solidly so that it will not work the socket terminals loose.

The No. 2 terminal of the 25A6 is wired to No. 7 of the 6K7; and No. 2 of the latter tube is then tied to "B –" to complete the filament circuit. A tie point is mounted near the antenna terminal to support C3. A lead is then brought to R1 and to the primary of L1; then the returns (arm and one end of the resistance) for (a) R1, (b) both primary and secondary windings of L1, and (c) the secondary of L2 made to "B –". DO NOT GROUND "B –" TO THE CHASSIS. And as for condensers C4 and C7, connect them *right at* the return points for the R.F. transformer secondaries. *Use the two specified, even though they are electrically paralleled.*

ALIGNMENT DATA

With R1 at the maximum-right position, tune for a signal. If signals are heard, back up R1 and align C1 and C2 at both high- and low-frequency ends of the tuning range by means of the variable condenser trimmers. If signals are not intercepted, recheck the wiring, and if you have a voltmeter test for "B+" voltage at the tube plates and screen-grids. The voltage will (or should) be somewhere in the neighborhood of 100, with the screen-grid readings approximately that of the plates.

If following proper alignment the circuit breaks into oscillation or shows signs of instability, try increasing the size of R3 by 100 ohms or so. Do not make this resistor too large, however, as sensitivity will suffer—and if squeals and whistles still persist, check over C4 and C7. These two condensers have much to do with stability. Increase their size if necessary. And above all, see to it that they make good contact to chassis and that they are tied to the coils *right at the secondary-return lugs.*

If hum is in evidence, increase the capacity of C14 or C15 or both to 8 mf. If the hum can be traced to the reproducer, similarly increase the size of C13. In the laboratory model, 4-mf. units at all three points proved entirely adequate, with no hum trouble whatsoever experienced.

If the speaker hums just enough to prove that it is receiving proper excitation, or if about 100 V. can be measured across its field, and yet no "B" is measurable or the "B+" output is abnormally low, interchange the 4-to-8 terminal connections on the 25Z6. If the "B+" to the receiver jumps to normal and the field excitation disappears or drops off appreciably, the rectifier tube is faulty, one set of its output elements

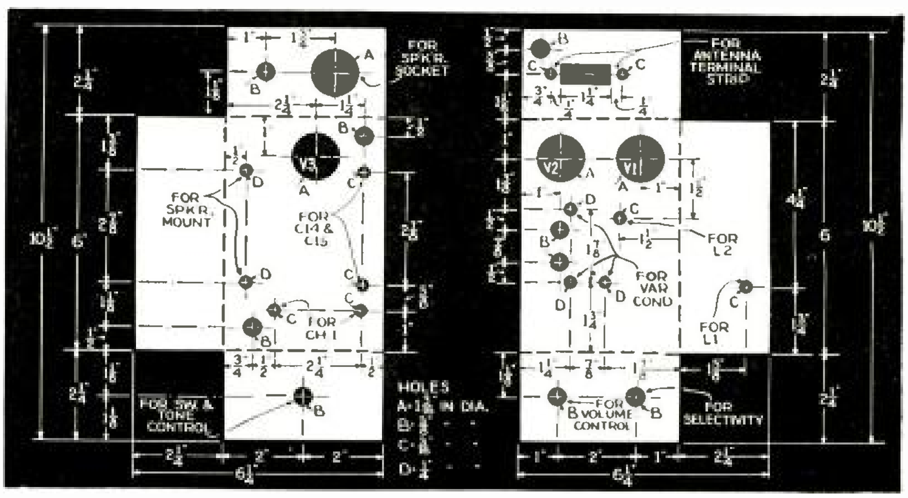

Fig. 3. Details of the two chassis needed for the "Book-End 3".

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alone giving proper service. The author has found many of the 25Z6s troublesome in this respect. (WHEN BUYING THIS OR ANY OTHER TYPE OF METAL TUBE INSIST UPON FULL AND COMPLETE TESTS.)

With the receiver properly aligned and with all voltages correct and all tubes in operation, there should be little difficulty in picking up stations all along the tuning range and reproducing them at speaker volume. The R.F. tube, however, is working under fixed conditions affording maximum possible conductance. The volume control is across the input transformer primary, with its center or variable arm connected to "B -", and changes in the position of the arm effect changes in signal input only.

They do not effect changes in the mu of the 6K7. Consequently there may be cross-talk or running together of some stations, and in spite of the additional selectivity (additional to that afforded by the R.F. stage alone) given by the detector tuned circuit. Two tuned circuits—with the R.F. stage non-variable in gain—aren't particularly good on discrimination between signals of high power and close frequency.

So the next job, not only in the interests of increased amplification and a louder audio signal but also to give us the selectivity required, is to work in the regeneration feature.

INSTALLING REGENERATION FEATURE

First, unsolder the temporary connection between the 6K7 cathode and suppressor. Bring a lead from the cathode up to one lug of a 4-point tie strip. Mount C5 conveniently near and follow C5 out to the left-hand-taper potentiometer, R2. The R2 center arm goes to "B -".

Now for some trial and error experiment.

The L1 coil core is not very large in diameter. As a matter of fact it is only about 1/2-in. across. Consequently, our feedback coil must have a smaller diameter in order to fit inside. (In the laboratory model, here illustrated, such a coil was wound on a small celluloid core not much larger across than a lead pencil.)

No hard and fast "turns" rules will, nor can, be given for the feedback coil. Begin by winding the maximum possible number of turns along the length of your "tickler" (regeneration-coil) core, dropping the wound form into L1, and bringing the leads out to 2 tie points—one connecting to cathode, one to suppressor-grid. Adjust R2 for maximum selectivity (knob turned completely to the right), and turn on line switch Sw.1. If enough turns have been wound on the feedback form, the circuit will undoubtedly oscillate—a condition which we won't exactly want but which will serve at least to show us now that regeneration is being had. If no shrill carriers on signals is obtained just increase the number of turns. Or reverse either the position of the feedback coil or the lead connections.

With oscillation obtained, back off R2 slightly. The oscillating condition should disappear; if not, remove turns from the feedback coil until the circuit will break into oscillation only when the R2 knob is at extreme right-hand position.

Tune to a signal with R2 adjusted for minimum selectivity or regeneration. Move the variable arm to the right. The signal should grow definitely stronger and sharper. With the R2 knob turned as far to the right as possible and the circuit just under the point of oscillation—as indicated by increased noise level between stations—tune across the band. Signals will come in sharply and clearly.

LIST OF PARTS

*One shielded, midget antenna coil, type 2436, L1;
*One shielded, midget R.F. coil, type 2437, L2;
One Wholesale Radio Service or Allied Radio Corp. 2-gang variable condenser, 370 mmf. (max.) per section, C1-C2;
One Aerovox condenser, type 284, 0.002-mf., C3;
Three Aerovox condensers, type 284, 0.25- to 1.-mf. (not critical), C4, C7, C17;
Four Aerovox condensers, type 284, 0.1-mf., C5, C6, C8, C11;
One Aerovox mica condenser, 250 mmf., C9;
One Aerovox condenser, type 284, 0.006-mf., C10;
One Aerovox condenser, type 484, 0.1-mf., C12;
One Aerovox single electrolytic condenser, type PBS2, 4 mf., C13;
One Aerovox dual electrolytic condenser, type PBS-2, 4-4 mf., C14, C15;
One Aerovox condenser, type 284, 0.05-mf., C16;
One Electrad potentiometer, type 201, 15,000 ohms, R1;

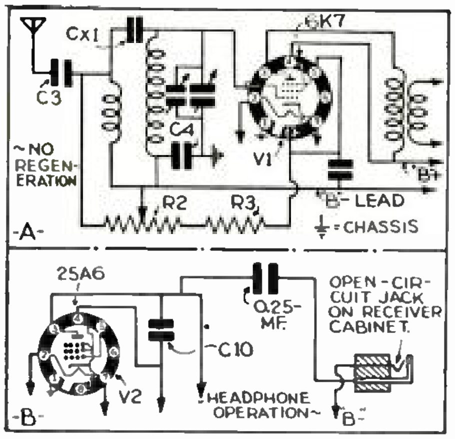

Fig. 4. The tuner without regeneration and (B) connecting a phone jack for DX.

One Electrad potentiometer, type 278, 5,000 ohms, R2;
One Continental resistor, 500 ohms, 1/2-W., R3;
One Continental resistor, 1. meg., 1/2-W., R4;
One Electrad potentiometer, type 241, 30,000 ohms, R5;
*One resistor-line cord, 160 ohms, R6;
One switch (on Electrad 241 potentiometer; or, *rotary S.P.S.T.), Sw.1;
*One length 4-wire heavy-duty shielded cable (desired size);
*One 5-in. dynamic speaker, equipped with output transformer for 25A6, 3,000-ohm field;
*One choke, type 466-420, Ch.1;
One Allied Radio Corp. aluminum chassis, size 6 x 8 x 2 1/4 ins. (or 2 pieces of aluminum sheeting; see layout data);
One National Union type 6K7 tube, V1;
One National Union type 25A6 tube, V2;
One National Union type 25Z6 tube, V3;
*Three sockets, type S8, for V1, V2 and V3;
*One socket, type S4 (used as "output" socket);
*One chassis plug, type CP4;
Miscellaneous (direct-drive dial, pointer knob, 2 round knobs, hardware, etc.).

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

HOW TO MAKE A SNOW LOUDSPEAKER

(Continued from page 526)

easily be obtained.

The method of making the horn (shown as the cover illustration of this issue) is to secure a piece of ply-wood about 1/2 or 3/4-in. thick and about 5 1/2 ft. long x 4 ft. wide. A pattern is then marked out on the board, following the dimensions given in Fig. 1. This form is then cut out of the board, using a coping saw, and making a sharp point on the narrow end as shown.

A large pile of snow is then made by rolling a ball of snow around until it "grows" to about 5 ft. in diameter.

Next, the small pointed end of the exponential-shaped board is pushed into the snowball and rotated until a cone-shaped hole is cut through the middle of the ball. Finally the inside of the "cone" is smoothed by hand and an 8 in. dynamic speaker is placed against the small opening (at the back of the snowball), using waxed paper or cloth to separate the speaker unit from the snow so that the moisture will not injure it.

In large P.A. installations—as for example at a large skating rink—a number of snow speakers can be made and connected to a radio set and P.A. amplifier of suitable size.

The latter units can be operated from storage batteries or from a 110 V. line (if one is available for lighting purposes, etc.).

The use of snow speakers at such outdoor affairs attracts a good deal of interest; produces fine quality of reproduction; and is very appropriate for such outdoor winter gatherings as ski jumps, skating rinks, hockey games, toboggan slides, winter carnivals or at any place where people gather in the open during the "snow months."

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MARCONI-E.M.I. HIGH-DEFINITION TELEVISION AT ALEXANDRA PALACE

(Continued from page 526)

mark and pleasure resort for more than 60 years—and from the large bay windows of the upper offices, below the aerial, nearly all London can be taken in at a glance.

Surmounting the reconstructed east tower, itself 80 ft. high, is the tapering lattice mast, rising to a height of 220 ft. Thus the aerial array for image transmissions, which is mounted at the summit of the mast, is more than 600 ft. above sea level. Immediately below the video aerial is the aerial for the accompanying sound transmissions.

The new station fulfills the recommendations of the Television Advisory Committee appointed to consider the development of television in Great Britain. Provision has accordingly been made for alternate experimental transmission by the systems developed by the Baird Television Co. and the Marconi-E.M.I. Television Co. respectively. Each company has provided a complete television system, including both image and sound pick-up apparatus and the television transmitter itself.

In its main essentials, therefore, the equipment comprises a television studio for each system, with an associated control room and ultra-short wave television transmitter; and, in addition an ultra-short wave sound transmitter common to both systems.

To these bare necessities, however, much has been added to provide, in the words of the Television Committee, "an extended trial of two systems, under strictly comparable conditions, by installing them side by side at a station in London where they should be used alternately—and not simultaneously—for a public service."

The entrance hall is at the base of the tower. Nearest to the entrance hall is the Marconi-E.M.I. television transmitter which, like its Baird equivalent, operates on a frequency of 45 megacycles (6.67 meters). All the apparatus at the station is finished in grey cellulose and chromium.

The Baird transmitter hall, with its control panel and array of generators and amplification stages, is at the southwest end of the corridor. Beyond this, at the southwest extremity of the Palace, is a large area, intended either for scenery construction or for televising such objects as motor cars and animals which cannot be brought into the studio or televised outside. Lorries can drive straight in. A large opening in the roof enables it to be lighted and, if necessary, televised from above. Lifting tackle can take up scenery and properties weighing a ton through a trap door in the roof of the second dock, 25 ft. above.

An interesting feature at this point is the ramp or sloping runway down which the television camera can travel to a concrete "apron", approximately 1,700 square ft., on the terrace outside, forming a platform for televising open-air performances or special experimental programs.

The two main studios, one for use with each of the television systems, are 70 x 30 x 25 ft. high. Acoustically, the studios are rather more "dead" than is general practice for sound broadcasting, since the introduction of scenery necessary for television will, in effect, control the acoustic characteristics. The walls of the studios are covered entirely, except for door and window openings, with sheets of asbestos compound which has a high degree of sound absorption. As this material has a rather rough surface, it is covered up to about 10 ft. from the floor with a protective fabric which is designed not to affect the sound absorbing properties of the compound. The ceilings of the studios are treated with building board, as commonly used in ordinary broadcasting studios. The floors are covered with black linoleum over which can be laid any type of flooring which may be required.

All the lighting in both studios is at present of the incandescent lamp type, using spot and flood lighting, on similar lines to that employed in theatres and film studios, but modifications are contemplated with developments in television technique.

ANALYSIS OF FIDELITY CONTROLS IN THE 1937 "SUPER PRO"

(Continued from page 529)

tween these two extremes is readily obtainable. Thus with the aid of a carefully engineered group of transformers and a special measuring instrument, the selectivity or band widths were both calibrated and the calibrations noted directly on the panel as 3, 4, 6, 10, 16 kc. The accuracy of this control is evident from Fig. 1. This curve was made with the input (at resonance) 1 microvolt, 30 per cent modulated at 400 c.p.s., with a 50-ohm resistor in series with each "A" post. The sensitivity was adjusted to produce a 6 milliwatt output with 1 microvolt input at resonance. The band width control was set as indicated on the curve. The signal frequency was set at 6 megacycles, the A.F. gain at 10. The band widths at two times the input or 6 db. down, are actually 2.6, 5.6, 9.9 and 15.6 kc., with settings of the band width at 3, 6, 10 and 16, respectively.

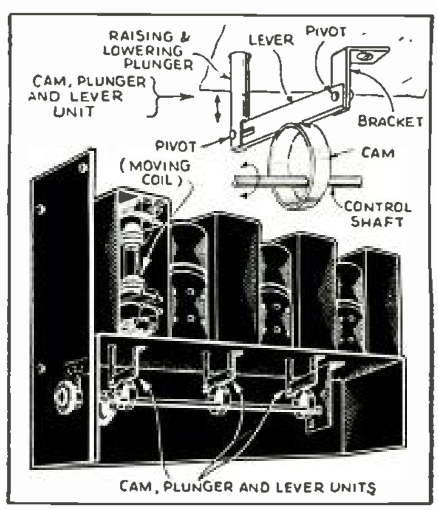
The A.V.C. system used is of the amplified and delayed type using the 6B7 as both amplifier and rectifier. A single tuned circuit link coupled to the primary circuit of the 4th I.F. transformer feeds it to the control-grid.

The audio components of the 6B7 second-detector diode circuit is capacitatively coupled to the A.F. gain control. This first A.F. stage is resistance-capacity coupled to the control-grid of the driver stage which uses a 6F6 in class "A". The output stage is a transformer coupled to the driver and consists of two 6F6s operated as triodes in class AB. A special curve was made for the fidelity of this receiver with the results shown in Fig. 2. The test was made with the input at 100 microvolts modulated 30 per cent from 30 to 10,000 c.p.s., with a 50-ohm resistor in series with each "A" post. The sensitivity was adjusted to produce 2 W. (4 V. across 8-ohm load) at a modulation frequency of 400 c.p.s. The A.F. gain was set at 10, and the signal frequency was 1,000 kc.

Taking the 6 db. loss as the cut-off point, it is seen that the fidelity follows closely the settings of the band width control with settings of 3, 4, 6, 10 and 16. The "A F" cut-off occurs at 1,400, 1,750, 2,750, 4,800 and 7,500 cycles, respectively.

The sensitivity of the receiver was found to be so great that weak-signal response was limited only by the noise pick-up of the antenna system.

This article has been prepared from data supplied by courtesy of Hammarlund Manufacturing Co.



The mechanical method of controlling band width.

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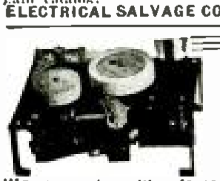

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HOW TO MAKE THE RADIO-CRAFT-1937 TELEVISION RECEIVER

(Continued from page 531)

magnetic field will not affect the very sensitive electron beam in V12. The cathode-ray tube V12 is then fed with the full 1,200 V. with the free deflecting plates connected to the positive end of the power supply through resistor networks which permit adjusting the position of the "spot" in the center of the screen before sweeping it back and forth and up and down by means of the thyratron oscillators.

Thus far, we have the equivalent circuit of a cathode-ray oscilloscope—as used in the adjustment of radio receivers, etc. The sweep circuits, however, must be unusually linear as otherwise, the images will be distorted and bent by the curvature of the sweep circuits.

The sweep system finally chosen for both vertical and horizontal deflectors is the circuit developed by Mr. Allen B. Dumont and all credit is given to Mr. Dumont for it. The condenser which develops the sweep voltage is connected in series with the thyratron tube instead of the usual way of connecting it across the thyratron. The condenser is then discharged by means of the constant-current (pentode) tube. Thus instead of the condenser being charged through the constant-current tube and discharged through the thyratron, it is charged through the thyratron and discharged linearly through the constant-current tube. This produces a much more linear sweep, the back trace is more rapid and no distortion is caused by the synchronizing impulse applied to the grid of the thyratron.

Two of these sweep circuits are used in our unit. One of these—the horizontal sweep—operates at a rate of some 10,000 cycles, depending on the scanning frequency used at the individual transmitter being received. The other operates more slowly thus carrying the spot down across the screen of the tube at a frequency of some 60 per second, also depending on the number of frames being transmitted and the type of interlacing being used, if any.

This completes the description of our unit with the exception of the amplifier which is connected to the modulation- or intensity-control grid of the C.R. tube.

This amplifier must have an extremely wide frequency range in order to allow the extremes of light and dark to be shown in the images at the fluorescent end of the C.R. tube. Unusually good bypassing is required in all circuits and all wiring must be as short and direct as possible. Also, a good R.F. choke is important in the plate isolating circuit—to prevent the high-frequency response from falling off. These requirements are answered in the circuit shown.

It will be noticed that the sweep circuits and the amplifier are not connected across the full output of the power supply, but are connected from a resistor, R37, which places the chassis of the entire unit at a potential a few hundred volts above the negative end of the power supply unit. This limits the voltage applied to these tubes which are not designed to operate at the high voltage supplied by the power supply.

ADJUSTMENT

The first adjustment to make after the unit has been completed, checked and double checked is to adjust units R34 and R35 (focus and intensity controls) to the minimum position. This is the end which is nearest to the negative side of the power supply unit. Next, open one wire from each of the sweep condensers C40 and C43. This makes the sweep circuits inoperative and the power can then be turned on. Allow a few seconds for the tube to heat up, and turn focus and intensity controls up a little at a time until a light spot appears on the screen of the tube. Then adjust this spot until it is small and clear, but do not turn up the intensity too far or the screen of the tube may be burned.

After the spot has been focused, it may be noticed that it is off center a little. The centering controls R27 and R28 can then be varied until the spot is in the very center of the fluorescent end of the tube.

The power should then be turned off and condensers C40 and C43 re-connected into the circuit. Then, when the power has been turned on, a white blur will be seen on the end of the tube instead of the spot which was noticed before. The intensity control can be turned up until the square of light is quite bright and the intensity controls of the vertical and horizontal sweeps can be varied until the white blur assumes definite straight-line borders on all sides.

The adjustments are then completed as far as we can go until the unit is connected to the tuner chassis. This will be described in the next Part.

LIST OF PARTS

One Allen B. Dumont Labs. special power transformer, P.T.1;
Two Cornell-Dubilier Dykanol A condensers, 1 mf. 1,000 V., C31, C32;
Two Aerovox paper condensers, 1 mf. 500 V., C33, C34;
One Cornell-Dubilier Dykanol A condenser, 0.5-mf. 1,000 V., C35;
One Cornell-Dubilier electrolytic condenser, 3-section, 4 mf., 500 V., C36, C42, C44;
Three Aerovox paper condensers, 0.5-mf. 500 V., C37, C38, C39;
One Aerovox mica condenser, 0.02-mf., C41;
One Aerovox electrolytic condenser, 8 mf., 150 V., C45;
One Cornell-Dubilier electrolytic condenser, 1 mf. 500 V., C46;
One Aerovox electrolytic condenser, 25 mf., 50 V., C47;
One Cornell-Dubilier paper condenser, .004-mf. (for 441-line scanning), C40;
One Cornell-Dubilier paper condenser, 0.5-mf. (for 30-frame interlaced scanning), C43;
Three Centralab potentiometers, universal taper, 0.5-meg., R27, R28, R34;
Three Continental Carbon resistors, 1 meg., 1 W., R29, R39, R47;
Four Continental Carbon resistors, 0.5-meg., 1 W., R30, R32, R56, R57;
Two Continental Carbon resistors 50,000 ohms, 1 W., R31, R33;
One Centralab potentiometer, universal taper, 0.1-meg. R35;
Four Continental Carbon resistors, 25,000 ohms, 1 W., R36, R38, R46, R54;
One Continental Carbon resistor, 0.1-meg. 5 W., R37;
Two Continental Carbon resistors, 1. meg., 1 W., R39, R47;
Two Continental Carbon resistors, 0.25-meg., 1 W., R40, R48;
Two Continental Carbon resistors, 1,500 ohms, 1 W., R41, R50;
Two Centralab potentiometers, cathode-bias taper, 5,000 ohms, R42, R51;
Two Centralab potentiometers, universal taper, 2 megs., R43, R49;
Five Continental Carbon resistors, 0.1-meg. 1 W., R44, R45, R52, R53, R55;
One Centralab potentiometer, universal taper, 2.5-megs., R58;
One Continental Carbon resistor, 700 ohms, 1 W., R59;
Two Hammarlund 4-prong isolantite sockets;
Two Hammarlund 5-prong isolantite sockets;
Three Hammarlund 6-prong isolantite sockets;
One Hammarlund 7-prong isolantite socket;
Two Hammarlund R.F. chokes, 10 mhy., type CH-10-S, R.F.C.2, R.F.C.3;
One Hammarlund R.F. choke, 85 mhy., type R.F.C.-85, R.F.C.4;
Three tube shields;
*One chassis and upright tube supports, per text;
One cartridge fuse, 2A., 110 V. type, with holder;
One Allen B. Dumont 3-in. "white and black" hard cathode-ray tube, V12;
Two Allen B. Dumont thyratron tubes, type 885, V13, V15;
Two National Union type 80 tubes, V10, V11;
Three National Union type 57 tubes, V14, V16, V17;

*As needed rubber grommets, grid clips, insulated terminals, anchors, etc.;

As needed, wire, screws, etc.

*Names and addresses of manufacturers will be sent upon receipt of a stamped, self-addressed envelope.

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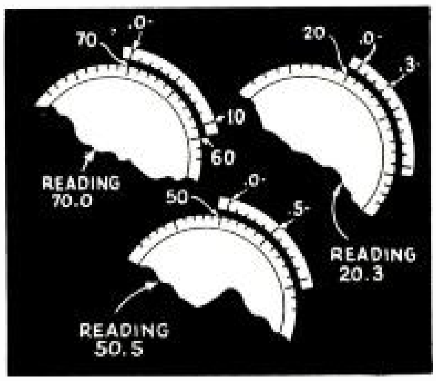
(*Continued from page 537*)

rectifier; and one 6G5—tuning indicator.

Separate coils are used to cover each band. Inductive coupling of the signal picked up by the antenna permits the maximum transfer of energy from each separate primary to the particular secondary range in the circuit. The unused coils are shorted.

The 6K7 R.F. stage gives maximum gain in relation to frequency and provides pre-selection which gives an image ratio of 80 to 1 on the highest frequency range.



The novel micrometer tuning scheme.

The first detector-mixer is a 6L7. The output from the 6C5 signal-frequency oscillator is electron coupled to the injector-grid, of the 6L7. Because no oscillator plate current flows in the 1st detector, the ratio of translation to noise is more favorable than that obtained in a composite tube, or in circuits where the cathodes of two tubes are tied together.

The 6C5 oscillator has separate coils for each band. The superior overall performance is the result of not using any harmonics of the signal-frequency oscillator throughout the tuning range of the receiver.

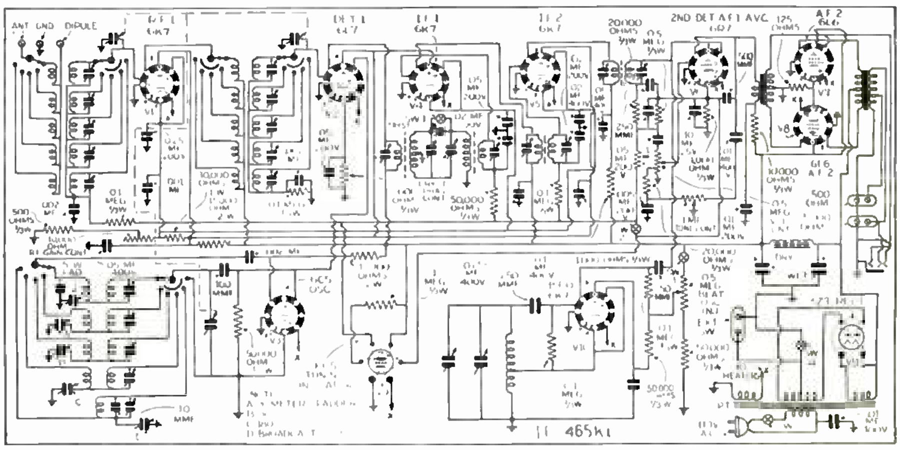
All intermediate frequency transformers are of the iron-core type and resonate at 465 kc. This type of transformer has so definitely demonstrated its superiority over the air-core type as to warrant its use. Tremendous gain, better signal-to-noise ratio, extreme selectivity are but a few of the advantages of the iron-core system.

The 6R7 2nd detector gives half-wave diode detection, A.V.C., and the triode section of this tube is used as the first stage of A.F. amplification. The plate of this section of this multi-purpose tube is transformer-coupled to the grids of the push-pull 6L7s.

The push-pull 6L7 stage running straight class A delivers 14 W. of undistorted audio power. Before actually drawing any grid current the output is in the neighborhood of 17 W.

The total consumption of power by this receiver is 127 W.

This article has been prepared from data supplied by courtesy of The Hallicrafters, Inc.



The circuit of the set with values of parts. The flexible and efficient operation can be realized from this circuit.

IS IT ECONOMY TO CONNECT DRY CELLS IN PARALLEL?

(*Continued from page 543*)

is too small in proportion to the size of the cell, the time required to discharge it will be so great that the natural depreciation which is characteristic of all drycells consumes a measurable proportion of the cell's capacity, leaving less than the full amount for useful service. On the other hand, if the current is too great for the size of the cell, then the cell will be overloaded, and this, too, reduces its capacity.

A cell which is discharged continuously will have no idle period for recuperation and so its capacity will be considerably reduced. In the opposite direction, discharge for short periods of time with long intervening idle periods will permit maximum recuperation and consequent long useful service until a point is reached where the discharge periods are so short and the idle periods so comparatively long that natural depreciation results in decreased service life.

End-point voltage is simply the lowest voltage at which the battery is still useful. A single cell, starting at 1½ V. may be discharged to as low as ¾-V. before it is completely used up. If whatever the cell is connected to becomes inoperative at 1 V. then the maximum possible capacity of the cell cannot be made useful. With the general-purpose type of No. 6 cell, the following table gives a rough approximation of various conditions, at given ampere-hour (A.H.) drains, for maximum capacity to an end point of 1. V.

Service hours per day ..	2	4	8	24
Current drain, A.	.50	.25	.20	.10
Capacity, A. H.	40	37.5	35	30

It will be seen that no economy would result from parallel connection until the current drain is at least double. For example at 4 hours per day the current drain would have to be 0.5-A. or more to make it worth while to connect 2 cells in parallel.

Note: *Only cells of the same grade, size and condition should be connected in parallel* to avoid the possibility of having one cell discharge through another. (See Fig. 1.)

When new cells of the same type are connected in parallel, they will automatically share the load and keep each other in balance throughout their service life. However if an old, partly-used dry cell is connected up with a new one, this balance cannot take place and, because of its higher voltage, *the new cell will slowly discharge itself through the old one!*

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HOW TO EQUIP A SOUND TRUCK

(Continued from page 532)

may be lost or more than lost through the presence of competing noises which the sound system must override. In general, then, the radio man consulting his experience in indoor sound work should allow a margin of at least 50 per cent for loss of power in outdoor work, and judge his volume requirements on that basis. He must bear in mind always the exact conditions under which his system must work, the extent of reflection present, the extent of background noise present, and the concentration or scattering of the crowds he wishes to reach.

In most sound trucks the problem of securing adequate volume properly placed calls for the use of *trumpet*-type loudspeakers rather than *baffle*-type reproducers. Trumpets will direct the sound over the heads of the crowd closest to the truck, giving that portion of the audience the spillage of the sound, which will be enough and more than enough; while the main beam is projected toward more distant auditors.

A method commonly used in trucks is to reduce the amplification (turn down the volume control) and speak very close to the mike. This produces the unpleasant boominess of sound so characteristic of many truck installations.

To avoid such boominess as far as possible, it is desirable to use directional or beam-type velocity microphones, set the tone control for best effect, and particularly to position and point the trumpets very carefully with reference to the orientation of the mike, taking every advantage of its directional response to reduce feedback. Further, special types of beam velocity microphones are available that have less boominess than most when used in close-talking work.

Sound trucks nearly always include phonograph equipment, and often include more than one microphone. Radio-sound is less often used in truck work.

It is always impressive to the layman to fake 2 sources of sound, using phonograph music as a background for microphone speech, and so on. The commercial advantages of simple, inexpensive mixer facilities are very great, and, other things being equal, are often the deciding factor in closing a sale or a rental contract.

There is no inherently good reason why truck sound quality should be as bad as it often is. Truck amplifiers operating from 6-V. power sources are available with characteristics of quality equal to those of any other amplifiers. Good dynamic reproducers mounted in good trumpets sound as well as any good dynamic loudspeakers anywhere. The phonograph pickup used is no different from any other phonograph pickup. The boominess that was inescapable with earlier types of microphones if feedback was to be avoided can now be largely or completely overcome by proper choice of microphones for this type of work, as indicated above.

Figure A illustrates a 30-Watt sound truck amplifier, the rotary converter being conspicuous at the right. The remainder of the amplifier follows standard lines of construction. A mixer-fader input circuit permits connection of 4 sources of sound, and simultaneous use of any two sources in any desired degrees of relative volume. Two of the input channels are of high gain—120 db. from 0.15-meg.—and two of low gain for use with phonograph equipment or, in rarer cases, with radio apparatus.

The quality of this amplifier is as high as that of any good P.A. equipment, not lowered in the least because the amplifier is designed for truck operation. Frequency range is from 50 to 10,000 cycles within 3.2 db., and harmonic content only 6 per cent at maximum output.

The Service Man finds economy in many P.A. installations by using the same system, at times, for other work, dismounting it from the truck and operating it indoors from 110 V. A.C. Truck P.A. systems can be obtained on the open market which, while primarily designed for storage battery power, are converted without difficulty to 110-V. line operation. This is true of the amplifier shown in Fig. A. Simple arrangements are incorporated for changing power sources, and the amplifier can be bought, as desired, with or without a separate power pack to drive it from a standard 50- or 60-cycle line.

This article has been prepared from data supplied by courtesy of Wholesale Radio Service Company.

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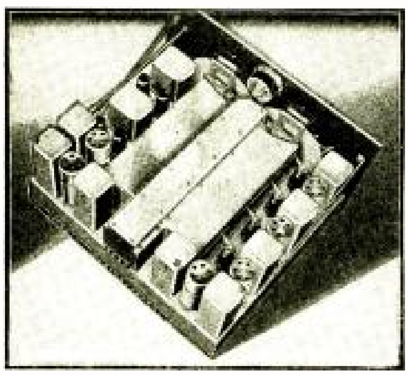

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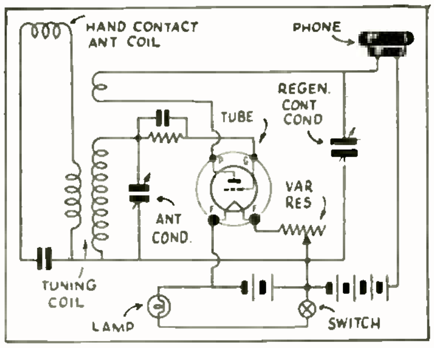
NOVEL 1-TUBE SET USES "BODY" ANTENNA

(Continued from page 529)

"A" voltage is 3 V. and that required for the filament of the tube is only 2 V., a rheostat must be used. This is attached to the upper flashlight housing. The regeneration condenser consists of 2 thin strips of tin foil; one attached (cemented) to the bakelite cap of the phone and the other to the phone frame. They are insulated from each other with a piece of mica. By turning the cap, these two strips of foil coincide with each other in varing degrees, thereby serving as a small-capacity variable condenser.

The results obtained will of course vary with the ingenuity of construction, the amount of "B" voltage used and the locality in which it is used. At any rate, you'll have lots of fun building and operating this "flashlight-radio set". (This is all the data available.)



The circuit of the novel little set.

INFORMATION BUREAU

(Continued from page 535)

I wonder if the circuit of this set is obtainable, so that a similar set—to be used in a different way than in the portable case mentioned above? I would like to try my hand at making such a set for a particular use as there is no receiver available, to my knowledge, that will be suitable for my needs.

(A.) We are printing here, Fig. Q381, the circuit of the Simplex Sportsman receiver which you requested. The values of condensers, resistors, etc., are shown on the diagram. The coil details can be worked out by experiment or you can obtain suitable coils from one of the well-known manufacturers of such devices.

OPERATING NOTES

(Continued from page 546)

these sets considerable movement of the plates will often be found. Examining the rotors, they will be found to be solidly in place, and with no adjustments provided. The stators, however, may be moved. They are suspended at each end on short insulating strips. At each end of this strip will be found screws which hold it to the metal frame. Near the middle of this strip will be found two more screws holding down a bright, short metal strip, as shown in Fig. 2. If these two screws in the middle are loosened, it will be found that the stators may be moved. Do not try to move the screws and the metal strip, which at first would appear the proper thing to do, but move the stator itself. It is advisable to loosen up only one end of the stator at a time.

The trimmer adjustments may now be made. There is a trimmer adjustment screw for each condenser section. They are located on the front of the condenser assembly. It is necessary to move the set back from the front of the cabinet or remove it altogether to get at them.

ALAN R. QUACKENBUSH

Freed-Eisemann 50. Sensitivity and selectivity of this 7-tube T.R.F. receiver may be greatly improved by making a few changes in the original arrangement of the detector input section (Fig. 1A); the modified circuit is shown in Fig. 1B. Service Men in making this change should replace the original choke, R.F.C., with one of larger size; this improves reception at the high-wave end of the dial.

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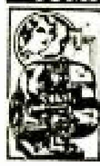

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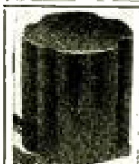

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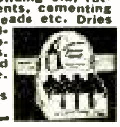

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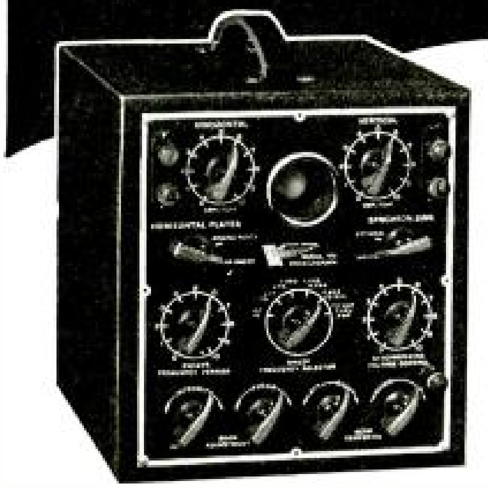

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THE LATEST RADIO EQUIPMENT

(Continued from page 541)

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SEVERAL unusual features have been emphasized by the manufacturer of this new crystal microphone. Although specially designed for voice modulation of a transmitter the head of this microphone assembly may be swiveled on the lightweight stand to meet almost any pick-up need. The aluminum case is finished in black crystalline and the stand is rubber-black and chrome. The output level is −55 db. A 6-ft. length of microphone cable is used to prevent the resonant characteristic that would be inherent in an 8-ft. cable when used in a 5-meter rig.

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TECHNICAL men will be delighted to know there is now available a 2-V. storage cell that is not only portable but which also may be conveniently recharged. The complete kit, illustrated, includes the lead-type storage cell (of miner's lamp non-spillable construction with rubber expansion chamber); oiled-silk safety bag; 110-V. A.C. to 6 V. D.C. charger with copper-oxide rectifier; bottle of electrolyte and dropper; and the battery-testing meter.

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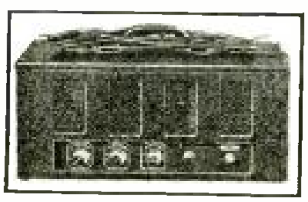
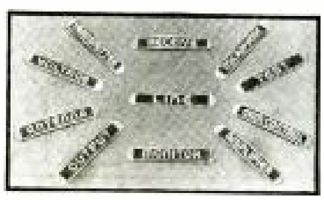
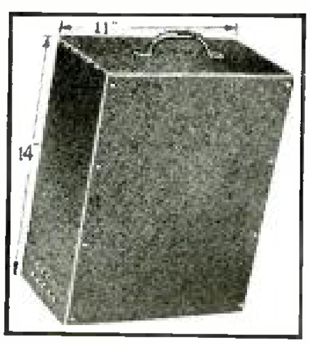


Two-stage amplifier. (1305)



Metal name tags. (1306)



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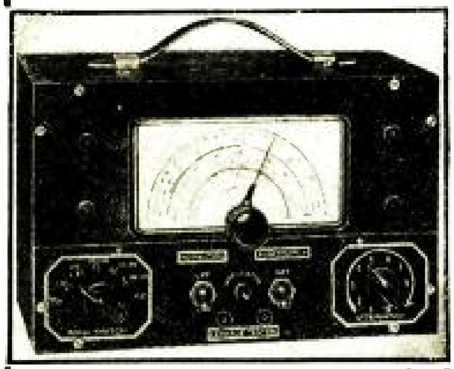

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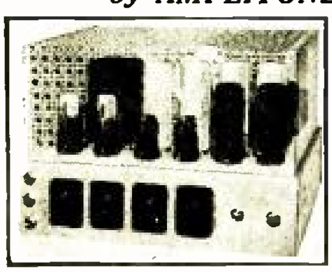

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HOW TO USE V.-T. VOLTMETERS IN RADIO AND P.A. SERVICING

(Continued from page 537)

unit when the tube in the unit is changed or when the power line voltage changes. These variations in tube characteristics and voltage are automatically compensated-for by the circuits used.

There are 3 general classifications of measurements to which a V.-T. voltmeter may be applied in the design and servicing of modern electronic circuits:—

(A) Measurement of Root Mean Square or "Effective" Voltage. This is the reading indicated by ordinary voltmeters less what error occurs in the circuit through added resistive drop due to the current drain added by the introduction of the voltmeter into the circuit being measured.

(B) Determination of the Value of Voltage Wave Peak. The so-called "slide-back" peak voltmeter has long been a favorite of leading engineers and laboratories for measurement of the peak value of voltage waves, and is now available for the first time in a commercial instrument with an internal source of buck-out potential.

(C) Measurement of Direct-Current Voltages. As in the first classification of measurements, the indications of the peak voltmeter are secured without drawing current from the circuit under measurement.

(A) MEASUREMENT OF R.M.S. VOLTAGE

General. The top scale of the instrument illustrated, is calibrated directly in r.m.s. or effective voltage, with full-scale deflection indicating 1.2 V. Potentials as low as 0.1-V. may easily be read with an instrument of this sensitivity.

The r.m.s. (root mean square) value of an alternating-current voltage wave is, by definition, exactly the same as the value of direct-current voltage which will produce an equal amount of heating in a circuit composed solely of resistance (no capacity or inductance). When considering a pure sine-wave alternating voltage, the r.m.s. value will be equivalent to 0.707 times the peak voltage value of the waveform. However, *if a wave has other than a pure sine form this relationship will not hold true.*

The r.m.s. scale of the vacuum-tube voltmeter is very valuable for many measurements of non-sinusoidal voltages, such as the checking of stage or overall gain of radio- and audio-frequency and high resistance.

It is necessary that this instrument be connected in such way that the voltmeter tube control-grid circuit is conductive to direct current, otherwise the grid may accumulate a charge which will cause an incorrect potential value to be indicated.

If it is necessary to take measurements in circuits where there will not be a D.C. path from the voltmeter control-grid to ground, a leakage path for the control-grid charge may be established either by leaving the tube prod within the instrument case (which has a built-in resistor) for low-frequency measurements or by placing a 3-meg. resistor from the voltmeter tube control-grid to ground, and capacity-coupling the voltmeter tube control-grid, to the circuit it is desired to measure, with a 0.01-mf. (mica) condenser.

With a connection made to the circuit from the free end of the condenser, the instrument will now show either peak A.C. voltage values or r.m.s. voltages. To secure true r.m.s. values from peak-voltage readings multiply the peak-voltage indications by 0.707, although this need not be done in measuring gain, as all readings are proportional.

(1) GAIN MEASUREMENTS IN GENERAL

A typical set-up is illustrated in Fig. 1A, wherein a signal generator is connected to a

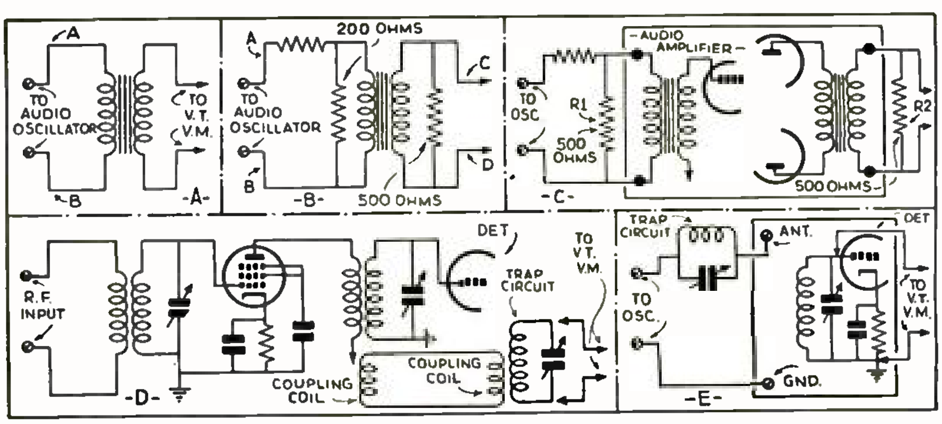

Fig. 2. Circuit connection details for various applications.

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tube circuit. The same procedure would hold for a multi-stage circuit if desired to measure its gain as a unit.

(a) Connections. Fig. 1A is a typical circuit, and is the basis for the specialized measurements described in later paragraphs. Units R1 and R2 are resistors, either fixed and of known value, or variable and of known calibration. For low intermediate radio frequencies and audio frequencies, these may be small commercial units of the variable or fixed type. For higher intermediate frequencies, broadcast and short-wave frequency measurements, it is necessary to use resistors of such construction that capacity and inductance effects have been reduced to a minimum.

The effect of the internal capacity and inductance of any resistor may be determined by applying to the circuit of Fig. 1A a voltage of the frequency at which it is desired to take the gain measurement, and comparing the value of voltage indicated on the vacuum-tube voltmeter at point B with the voltage at point C. This ratio of voltages should correspond accurately with the ratio of resistances R1 and R2 if the capacity and inductance effect is negligible at this frequency.

(b) Audio-Frequency Circuits. For testing such, it is necessary to have as a voltage source, an audio signal generator of the continuously-variable-frequency type. Set this instrument to the desired frequency and the actual gain in the circuit can be evaluated in two ways. One is to read the voltage at point B, Fig. 1A, and transfer the vacuum-tube voltmeter to read the voltage at point A, in which event, the gain of the circuit will be given by the formula.

$$\text{GAIN} = \frac{(\text{R1 plus R2})\ (V_A)}{(\text{R2})\ \ (V_B)}$$

The other method is usable only on circuits where it is permissible to vary the value of R1 and R2 without upsetting bias and load matching. In this case, the voltage at point B is first measured, and resistors R1 and R2 are then adjusted to bring the voltage at point A to the same value. When this has been done, the gain of the circuit will be given by the formula

$$\text{GAIN} = \frac{(\text{R1 plus R2})}{\text{R2}}$$

As stated above, these procedures are general in nature and more specific procedures will be outlined in following paragraphs.

(c) Radio-Frequency Circuits. Here a radio-frequency signal generator is used as voltage source. If the circuit is tunable, adjust it to resonance with the oscillator, or if untunable, adjust the oscillator to resonance. The measuring procedure will then be identical to that described above for audio-frequency circuits.

(2) CHECKING R.F. GAIN IN RECEIVERS

It is not always convenient to remove the inter-stage transformer or coupling unit in order to check its gain. For this reason the following procedure is frequently employed. In the case of an intermediate-frequency transformer "T", the operation of which is in doubt, Fig. 1B may be taken as representing the typical condition.

Connect an R.F. signal generator to the antenna and ground posts of the receiver as shown, and the vacuum-tube voltmeter to the control-grid of the tube preceding the transformer in doubt (at point A in Fig. 1B). Tune the receiver to the test oscillator output frequency and adjust the input to the receiver by means of the attenuator on the signal generator until a small reading, say 0.5-V., is obtained on the vacuum-tube voltmeter. If the receiver has automatic volume control, all operations should be made at a signal level that is below the A.V.C. actuating voltage.

Should point A be located in a tuned circuit of the receiver, and such will usually be the case, it may be necessary to slightly re-adjust its resonance after the vacuum-tube voltmeter is connected to compensate for input capacity of the vacuum-tube voltmeter.

After taking the reading at point A, transfer the voltmeter to point B and adjust the trimmers in both circuits A and B until the greatest voltage is indicated on the meter. The ratio of the voltage read at point B to the voltage read at point A, is the gain of the amplifier stage under test.

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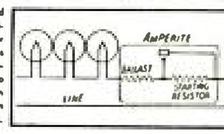

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(3) CHECKING PRESELECTORS

Ordinary methods of alignment do not readily solve the problem of adjusting preselector or tuned-radio-frequency ("T.R.F.") stages of the superheterodyne receiver. Difficulty is frequency encountered in correcting the alignment of the receiver to agree with the printed dial scale calibration.

Figure 1C shows a typical circuit, to which an R.F. signal generator should be connected at the antenna and ground binding posts in the usual manner. The vacuum-tube voltmeter is then connected (voltmeter tube control-grid directly, without long leads) to the tuned circuit which normally connects to the control-grid of the 1st-detector or frequency changer tube (Point A). In making this test it is advisable to short-circuit the control-grid coil of the oscillator circuit.

It will now be possible to adjust the preselector or first R.F. stage as one would handle an ordinary T.R.F. receiver.

(4) MATCHING OF COILS

A typical set-up for such tests is shown in Fig. 1D. A small coil (A), consisting of about 10 bundled turns, of a diameter approximately equal to that of the coils to be tested, is made up and connected to the highest voltage output that is available from the R.F. signal generator at hand for the tests. This inductance is for coupling to the coils under test. It should be coupled to coil B only as close as needed to get a satisfactory reading on the vacuum-tube voltmeter. Unit C is a variable condenser with small vernier (Ct) in parallel, such as is used in any radio receiver. The vernier condenser should be fitted with a pointer and dial, reading zero at one-half capacity. If a 3- or 4-plate condenser is used, it will have a range of roughly 10 mmf. each way from the half-capacity setting, making it easily possible to distinguish 1. mmf. each way!

The coil B (under test) is connected to the vacuum-tube voltmeter and to the condensers C and Ct as shown in Fig. 1D. The small condenser Ct should be set at zero on the scale (approx. half-capacity). The circuit is then tuned to resonance with the R.F. signal generator output which is of that frequency at which it is desired to match the coils by means of the condenser C.

The coil B is now removed and a second coil substituted, with as little disturbance of the connecting leads as possible. The condenser C and the signal generator are left with their settings unchanged and resonance re-established by adjustment of the condenser Ct.

When matching a coil that is coupled to another coil, such as in the case of an antenna coil with the primary "E" wound on the same form, it is necessary that the circuit of this second inductance be closed through a capacity "F" similar to that which is present in the actual circuit. In this case, it would be that of the dummy antenna recommended for use when aligning the receiver, usually 100 to 250 mmf.

(5) IMPEDANCE CHECKING

It is frequently necessary to check the impedance of various devices such as chokes, condensers, voice coils, etc. A typical set-up for these tests is shown in Fig. 1E. An oscillator is used to supply voltage of the frequency at which it is desired to know the impedance of the unit under test. The variable resistor R2 should be non-inductive and have greater impedance than that of the impedance Z, and be calibrated in ohms.

The procedure of this test is to adjust resistor R2 until the voltage across R2, as indicated by the vacuum-tube voltmeter, is equal to the voltage existing from A to B. When this condition has been obtained, the value of R in the circuit is equal to the ohms impedance of Z.

(6) CHOKES CARRYING D.C.

Frequently, it is necessary to measure the inductance of chokes carrying direct current when employed in the circuit for which they are intended. Tests should then be made with a direct-current flow of this value as shown in Fig. 1F, which is an adaptation of the tests shown in Fig. 1E. Here a test voltage is supplied from the power line, although a test signal of any other frequency can be used if the choke is to be employed in circuits of such frequency. A 10 mf. condenser C is used to isolate the input transformer T from the direct-current circuit. The choke L1 should be of generous proportions and

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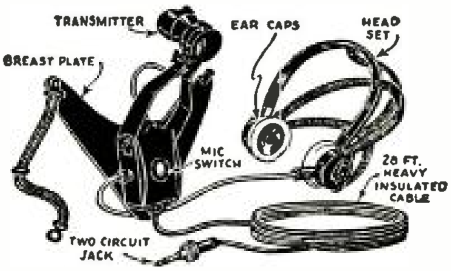

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preferably of inductance several times larger than the choke Z, being measured.

Adjust the direct current in the circuit by means of the control shown, to give the choke's normal current rating on the ammeter (the D.C. flow in the circuit to which Z is to be applied). Then employ the same procedure for measurement and calculation of the impedance of Z as given in the preceding illustration.

(7) SUPERHET OSCILLATOR STAGES

One of the most important uses of the combination vacuum-tube voltmeter and peak voltage indicator, is that of checking performance of the oscillator circuit in a superheterodyne receiver by means of the procedure outlined below.

The vacuum-tube voltmeter should be connected across the variable condenser in the oscillator stage of the radio receiver.

With the receiver turned on as shown in Fig. 1G, a voltage ranging from 5 to 15 V. will appear across the dial, its value depending upon the circuit constants and upon the type of tube used in the oscillator stage. As the receiver is tuned across the dial any variations in voltage output should be observed. Some variation will be due to the difference in sensitivity of the set at various frequencies within the same tuning band. However, the potential indicated on the vacuum-tube voltmeter should never vary more than 40 per cent from the highest value found on that band.

"Dead-spots" or points where the voltage drops abnormally low indicate defects, in the oscillator stage operation, and a careful examination of the receiver should be made to locate their cause and effect a remedy.

(8) A.F. TRANSFORMER RATIOS

A typical set-up for the determination of transformer ratios is given in Fig. 2A. Here an audio-frequency oscillator is used as a source of voltage to be applied across points A-B.

Check the A.F. voltage applied to the transformer input (which may be either the primary or secondary) and the ratio between it and the voltage indicated across the output of the transformer will then be the transformation ratio of the unit under test. The impedance ratio $= \frac{Ep^2}{Es^2}$ where $\frac{Ep}{Es}$ equals the ratio of primary turns to secondary turns.

The frequency characteristic of an A.F. transformer may be determined by loading each side of the transformer with its characteristic impedance and making use of a variable-output audio-frequency oscillator and the vacuum-tube voltmeter, as shown in Fig. 2A. Now by keeping the input voltage across the points A-B at a constant value we may vary the input frequency and obtain the output voltage.

(9) AMPLIFIER A.F. RESPONSE

This test requires the use of a variable-frequency audio-signal generator of good sine-wave output whose voltage output is uniform over the frequencies at which determinations are to be made.

In Fig. 2C there is shown a typical amplifier, having 500-ohm input and 500-ohm output. Amplifiers with other input and output impedances can be checked with suitable loading. For this amplifier, a 500-ohm-output A.F. oscillator may be directly connected without the resistor R1.

With the input voltage to the amplifier maintained constant either through the assumption that the audio-signal generator output is linear over the frequencies covered, or by checking with the vacuum-tube voltmeter and consequent adjustments, the frequency response of the amplifier can be plotted from the voltage read across the output at the various frequencies. Such the output at the various frequencies.

If the overall gain of the amplifier is desired, it may be secured by measuring the input voltage and determining its ratio to the output voltage at that frequency. Such gain measurements are usually made at 400- or 1,000-cycle points. The gain of the amplifier may be expressed in decibels when the input voltage and input impedance are known. First it is necessary to convert the input voltage to decibels by the following equation:

$$N \text{ (in db.)} = 20 \text{ Log. } \frac{V.1}{V.2} + 10 \text{ Log. } \frac{R2}{R1}$$

where V. 1 is input voltage and V.2 is the output voltage. Also R1 is input resistance and R2 is output resistance of the amplifier.

This article has been prepared from data supplied by courtesy of the Clough-Brengle Co.

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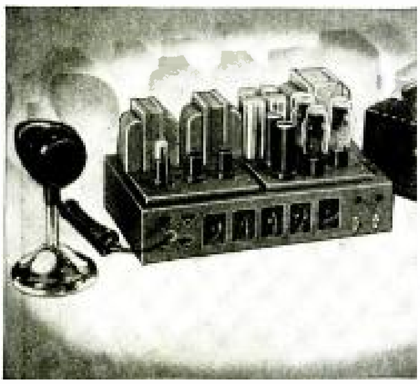

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THE ABC OF A.F.C.

(Continued from page 533)

circuit from a given signal.

In the older sets, a high inductance was used, with little or no capacity except that inherent in the wire coil used for an inductance (self-capacity). In early sets, such as those used with a crystal, tuning was effected by sliding a contact along the coil and cutting-in a greater or lesser number of turns. Then (Fig. 1A) a *variometer* was used; that is, a coil of two sections, one of which could be rotated inside the other, to assist or to "buck" it. Different inductance values, and consequently different tuning, were obtained by turning the variometer knob. Theoretically, the variometer method of tuning has advantages, which it has been impossible to realize in modern sets; and it has been supplanted by the variable condenser method (Fig. 1B) which lends itself better mechanically to control of several circuits at once. After the single-circuit set, the gang-tuned R.F. receiver became standard (Fig. 1C); its competitor was the superheterodyne in which, originally, one knob tuned the R.F. circuit to the incoming signal, and a second knob tuned the oscillator. If the first was a little off, the second could correct the condition (Fig. 1D.

But, ever since the days when radio reception was turned over from "hams" and set builders to the public, the demand has been for receivers which tune as automatically as possible. Improved manufacturing methods have made gang condensers increasingly accurate. The new A.F.C. development increases this, by making the set correct errors of setting (just as A.V.C. has overcome fading and similar conditions). What it amounts to is putting a *variometer* across the oscillator inductance, and raising or lowering the oscillator frequency as many as 7 kc.

The purpose of inductance is to slow up *the rate of change* in any current which is pulsating or alternating; that of capacity to speed it up. Suppose we had a coil of rubber hose—very elastic, attached to a water tap (Fig. 2B). When we turn on the water, the hose would oppose the flow of water (C). It would fill up before the full flow appeared (D). When we shut the water off again, the hose would keep squeezing water out of itself (E), and maintain the flow till empty. With a given pressure, we could get only so much water into the hose in a given time. With a given size of tap, if we kept turning it on and off, we could get a certain amount of water through the hose in even spurts, in equal periods of time. That is something like our inductance-capacity circuit. It might take 15 seconds to fill the hose, during which there would be maximum pressure in it, but very little water would run out; then, when the tap was shut off, water would stream out of the lower end till the hose was empty. The amount of water flowing into the hose at any instant would not necessarily be the amount flowing out; nor would the pressure at the top correspond to the pressure at the bottom. Flow (current) and pressure would vary, but not simultaneously—as they would in a large, straight pipe, corresponding to ohmic resistance.

It is not possible to carry the water analogy too far. (Electricity is more like compressed air, pressing in all directions, than like water, which presses down only by its own weight.)

If we put two inductances, side by side, in an electrical circuit, the two will present less obstruction (less *reactance*) to a current; just as two pipes will carry more water than one. Similarly, if we put a resistance in parallel across an inductance (Fig. 2G) we lower the *effective reactance;* just as though we had decreased the inductance.

If, instead of putting a variometer across our oscillator tube's control-grid inductance, in the superheterodyne which we are considering, we put a resistor across the coil, we draw current when the inductance should hold it back, thus weakening the effect of the inductance. But, on the next quarter-cycle, the resistor would pass current when the inductance was also forcing it along, instead of bucking the inductance. The same would be true, in the case of a vacuum tube uniformly biased (positively) which can also be considered a special form of resistance.

But the trick of the A.F.C. is to make the tube V1 alter the frequency at which the circuit of tube V2 (Fig. 3) oscillates, regardless of the setting of the oscillator circuit L-C1-C2-C3. By making the tube act either in opposition to, or together with, the tuned grid inductance L, the

(Continued on next page)

HOW TO MAKE A "JUNIOR" OSCILLOSCOPE

(Continued from page 551)

*One (special) cathode-ray-type transformer, P.T.;
*One resistor, 5,000 ohms, 2 W., R1;
*One resistor, wire-wound, 40,000 ohms, 20 W., R2;
*One resistor, 6,000 ohms, 1 W., R3;
*One resistor, 30,000 ohms, 1/2-W., R4;
*One resistor, 1,000 ohms, 1W., R5;
*One resistor, 1,500 ohms, 1 W., R6;
*One potentiometer, 50,000 ohms (with switch, Sw.2, attached), R7;
*One resistor, 10 megs., 1/2-W., R8;
*One resistor, 0.125-meg., 2 W., R9;
*One potentiometer, 50,000 ohms (with switch, Sw.1 attached), R10;
*One potentiometer, 25,000 ohms, R11;
*Two potentiometers, 3 megs., R12, R13;
*One potentiometer, 5,000 ohms, 2 W., R19;
*One resistor, 50,000 ohms, 1/2-W., R20;
One Cornell-Dubilier dual condenser, 8-8 mf., 450 V., C1;
One Cornell-Dubilier condenser, 8 mf., 200 V., C2;
Two Cornell-Dubilier condensers, 0.1-mf., C3, C7;
One Cornell-Dubilier condenser combination, 0.02- and 0.005-mf. (connected in parallel), C4;
One Cornell-Dubilier condenser, 0.005-mf., C5;
One Cornell-Dubilier condenser, 0.001-mf., C6;
One RCA Radiotron type 913 (cathode-ray) tube, V4;
One RCA Radiotron type 885 (sweep) tube, V2;
One RCA Radiotron type 6D6 (current-limiting) tube, V3;
One RCA Radiotron type 80 (rectifier) tube, V1;
*One 4-point switch, Sw.3;
One Terminal Radio Corp. basic kit: complete panel, cabinet and sub-base, all drilled and punched, ready for assembly; as well as all knobs, dials, binding posts, sockets, hardware, etc.).
*One resistor, 1,000 ohms, 1/2-W., R14;
*Three resistors, 1/2-meg., 1/2-W., R15, R16, R17;
*One resistor, 2 megs., 1/2-W., R18;
One Cornell-Dubilier electrolytic condenser, 10 mf., 25 V., C8;
Two Cornell-Dubilier condensers, 0.1-mf., 400 V., C9, C10;
One Cornell-Dubilier condenser, 0.5-mf., 400 V., C11;
One Cornell-Dubilier condenser, 8 mf., 450 V., C12;
One RCA Radiotron type 6J7 (voltage amplifier) tube, V5;
*One D.P.D.T. switch, Sw.4;
Misc. hardware.

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

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The copy is to be imprinted as follows:

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(Print carefully name of company or individual)

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(Slogan of six words)

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(Address) (Telephone Number)

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(Town or City) (State)

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effective inductance of the circuit is raised (lowering the frequency) or lowered (raising the frequency) so far as the R.F. voltage on the control-grid of V2, and its consequent voltage output, are concerned. And this, correspondingly, affects the I.F.

In order to do this, it is necessary to make the plate voltage of V1 oppose the oscillator control-grid voltage, set up in the oscillator tuned circuit, whenever the receiver's I.F. amplifier is getting signals "off peak." This is done by feeding the regulatory signals to V1 from the resistance-capacity voltage divider R-C, which is across the oscillator coil. The presence of the small condenser C "lags" the voltage behind the current (just the reverse of an inductance's action); and the output of the tube V1 thus opposes the action of the tuned coil (L), the voltage of which is also applied to the control-grid of V2. (If the amplification of V1 were sufficiently high, it would completely neutralize the oscillation; but it is not.) This carefully-made adjustment, and the action of the diode-detector of the receiver, biasing V1, change the frequency of V2; just as though we were turning the rotor of a variometer coil in parallel across L, as sketched in our first diagram (Fig. 1, at E).

SOURCE OF A.F.C. VOLTAGE

The next question is, where does the regulating voltage, for the grid of V1, come from? We turn to Fig. 4, which shows the standard double-diode detector of a receiver. As will be seen, the output of the I.F. amplifier is across the plates of this diode, which serves as a full-wave rectifier, one plate and cathode functioning on each half-wave. If the signal received is converted to the proper I.F. by the action of the oscillator, the waveform passed through the tuned I.F. amplifier comes out symmetrical (Fig. 4B); as it is a product of the signal carrier wave and the equally symmetrical wave from the oscillator tube. But, if these two waves do not blend to make one which the I.F. amplifier is peaked to handle, there will be distortion—as shown at Fig. 4C, which represents the figure shown in an oscilloscope.

The result when the 2 halves of the waves, rectified respectively by the 2 diodes P1-C1 and P2-C2 of the detector tube, are unequal, is to build up different voltages across their corresponding resistors, R2 and R3 (Fig. 4A). Now, when the waveform is symmetrical, these voltages are equal and opposite and therefore cancel each other; but if they are unequal, either a positive or a negative total voltage results, and this is fed by a lead from the upper end of R2 to the control-grid of the A.F.C. tube V1 which we showed in Fig. 3. We now reproduce the whole of this part of the receiver in Fig. 5.

When a positive R2-R3 voltage (as the result of the unequal detection of V3) reduces the bias on the control-grid of V1, the A.F.C. tube, V1 draws more current. This is equivalent to having a smaller inductance across the oscillator tube, V2; and the frequency of its oscillations will rise. This, in turn, will increase the frequency of the mixed signal which is passing through the I.F. amplifier.

If the I.F. signal frequency is instead, too high, the difference in voltage becomes greater on the negative side.

There are numerous details, in the adjustment of the A.F.C. circuits, required to give proper results; but the above presents a simplified explanation of the principle.

ORSMA MEMBERS' FORUM

(Continued from page 546)

servicing: General Electric (both U.S.A. and English makes), Atwater Kent, Philco, Airline, Philips, Telefunken (German), Scott, Majestic (last models), and several others.

I should like to mention that *Radio-Craft* is a good magazine, and full of "the goods" for fellows like myself. I wish you continued success always.

NORMAN KING,
30 Edinburgh Court,
Von Brandis St.,
Johannesburg, South Africa.

Since writing the above Mr. King has passed his tests, with flying colors, and been duly enrolled as a full-fledged ORSMA member.

It certainly is interesting to note the wide variety of radio sets a Service Man in such a cosmopolitan center as Johannesburg is called upon to recondition.

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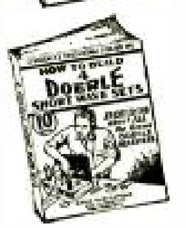

RADIO FANS! . . . Help yourselves to a radio education for the price of 40c, (10c per book). These books will give you a good foundation towards the study of radio. You'll be amazed at the wealth of information contained in them;—and you'll wonder how we can sell them at the low price of 10c each. Each book contains 32 pages written in simple, understandable language and profusely illustrated with circuit diagrams and illustrations. They are especially written for beginners but are useful review and reference books for the ol' timers as well.

ALL ABOUT AERIALS

In simple, understandable language this book explains the theory underlying the various types of aerials; the inverted "L," the Doublet, the Double Doublet, etc. It explains how noise free reception can be obtained, how low-impedance transmission lines work; why transposed lead-ins are used. It gives in detail the construction of aerials suitable for long-wave broadcast receivers, for short-wave receivers, and for all-wave receivers. The book is written in simple style. Various types of aerials for the amateur transmitting station are explained, so you can understand them.

ALTERNATING CURRENT FOR BEGINNERS

This book contains everything to give the beginner a foothold in electricity and Radio. Electric circuits are explained. Ohm's Law, one of the fundamental laws of radio, is explained; the generation of alternating current; sine waves; the units—volts, amperes, and watts are explained. Condensers, transformers, A.C. instruments, motors and generators—all these are thoroughly discussed. Housewiring systems, electrical appliances and electric lamps.

Here are some of the practical experiments which you can perform at home. Simple tests for differentiating between alternating and direct current; how to light a lamp by induction; making a simple electric horn; demagnetizing a watch; testing motor armatures; charging storage batteries from A.C. outlet; testing condensers with A.C.; making A.C. electro magnets; frying eggs on a cake of ice; making simple A.C. motors and many others.

HOW TO MAKE THE MOST POPULAR ALL-WAVE 1- and 2-TUBE RECEIVERS

There has been a continuous demand right along for a low-priced book for the radio experimenter, radio fan, radio Service Man, etc., who wishes to build 1- and 2-tube all-wave sets powerful enough to operate a loudspeaker.

This book contains a number of excellent sets, some of which have appeared in past issues of RADIO-CRAFT. These sets are not toys but have been carefully engineered. They are not experiments. To mention only a few of the sets the following will give you an idea.

● The Megadyne 1-Tube Pentode Loud-speaker Set, by Hugo Gernsback. ● Electrifying The Megadyne. ● How to Make a 1-Tube Loud-speaker Set, by W. P. Chesney. ● How To Make a Simple 1-Tube All Wave Electric Set, by F. W. Harris ● How To Build A Four-In-Two All-Wave Electric Set, by J. T. Bernsley, and others.

HOW TO MAKE FOUR DOERLE SHORT WAVE SETS

Literally thousands of radio fans have built the famous DOERLE Short Wave Radio Receivers. So insistent has been the demand for these receivers, as well as construction details, that this book has been specially published.

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HOW TO MAKE THE RADIO-CRAFT SET ANALYZER

(Continued from page 538)

Thus, knowing the capacity of one condenser, C, and the voltages across the two condensers, C (or C and C1) and Cx, it is an easy matter to determine by means of the following formula the capacity of the "unknown" (Cx). Substitute the readings taken from the voltmeter and substitute them in the following formula

$$Cx = \frac{Em \times Cs}{El - Em}, \text{ where}$$

Cx is the unknown capacity under test.

El is the line voltage (read with the terminals of Cx, Fig. 2A, shorted).

Cs is the capacity of the voltmeter shunt.

Em is the voltage read on the voltmeter with the unknown capacity connected to the test terminal.

While this circuit arrangement requires, and this may be an objection to its use, a certain amount of arithmetic to determine the value of the unknown capacity, the advantages of low cost and a capacity measurement range of 80 to 1 are well worth the simple calculation necessary. (The 0-250 V. A.C. scale is used for these measurements.)

The high-sensitivity voltmeter used in this instrument lends itself to a very satisfactory and simple set-up for peak-voltage measurements in filter circuits.

The circuit is shown in Fig. 2C. Here a 3-element tube, V, is used, as a half-wave rectifier, in series with the condenser C; which must be rated at a voltage greater than the possible circuit peak voltage. Tube V should be selected for its ability to withstand any possible voltage from the circuit under test.

In operation the circuit will permit current to flow in one direction only and the condenser C will become charged to the *peak* value of the voltage appearing across the test terminals. (As this particular voltmeter has a high internal resistance there will be a very slight discharge from the condenser during that time of the cycle when the voltage is less than the peak value. If condenser C is selected to have a capacity of 4 mf. then the error will be about 5 V. in 500.) Voltages will be read on the 750 V. D.C. scale.

The next time that you encounter breakdowns in filter circuits use this simple method to determine the "peak" voltage, in this portion of the circuit, *before replacing the defective units*. The only requirement for filament transformer T is that it deliver the correct voltage to tube V. (Most of the better filament transformers available today are well-insulated between windings and consequently the probability of break-down is slight.)

POWER OUTPUT METER

A circuit, that is familiar to most Service Men, showing the use of the A.C. voltmeter as an output meter will be found in Fig. 2D. Condenser C in this figure has a capacity of 2 mf. or larger and, rated at 600 V. (working) when used in radio receiver testing and 1,000 V. (working) for P.A. work, should be of the non-inductive type. This condenser eliminates the danger of D.C. flowing in the meter rectifier circuit. Any voltage scale may be used when the "A.C.-D.C." switch is in the A.C. position.

DB. METER

The A.C. voltmeter scales also may be used to determine the power output of audio amplifiers by reference to Table III, which lists Volts versus DB. The circuit of Fig. 2E shows the method of connecting across the meter a fixed resistance, R, of 500 ohms.

After connecting the resistor as shown, place the test prongs on the 500-ohm output winding of the amplifier, pass a signal and read the peak swing of the meter. Refer to the chart and, on the equivalent Volts line, read the value in Watts; and the level in "DB. above (or below) '0' level of 0.006-W. (6 milliwatts)." A range of —10 to +9 db. can be obtained on the 5-V. scale. Up to +29 db. on the 50-V. scale and over 40 db. on the 250-V. scale. Do not permit D.C. to flow through the meter when the rectifier is in the circuit.

This concludes the construction article on an efficient Set Analyzer.

RADIO-CRAFT FARM SET — ADDITIONAL DATA —

The original Lamb noise suppressor and our adaptation of it, suggest in effect a "rapid fire" A.V.C. system so adjusted that it will follow and attenuate especially brief noise impulses of the electric motor-auto ignition variety. In rural communities, where this type of noise does not become of appreciable importance, therefore, a suppressor system of the high-speed type and used primarily to control static interference, cannot be expected to perform as it would in an A.C. receiver installed in a noisy city location.

If the circuit as shown is used and static suppression is expected of it, efficient attenuation of only the briefest noises—or of noises made up of extremely brief impulses, may be expected.

Frankly, this and other noise systems where used in a farm receiver call for some timing adjustment particularly suitable to conditions and location. Sufficient lag should be introduced by means of trial and error resistor-condenser combinations connected (a la A.V.C. filter) into the suppressor line to the 6L7 second I.F. until we have good control of an "average" static crash. Of course the system in operation may disturb the quality of the signal desired to some extent, but if the timing is correct this effect will be negligible.

With lag introduced, some method of controlling the noise amplification is desirable if not definitely necessary so that adjustments may be made to suit conditions, and so that the gain may be turned down to prevent the desired signal itself from affecting the I.F. circuit. We already have one A.V.C. system. Another, speedy one working on the signal might have a nice "mince-meat" effect. Another, slow one might cause plenty of trouble.

Don't put in too much lag. The idea, let us repeat, is to follow the static, not the signal level.

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ADVERTISERS' INDEX

(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

MAKE THIS POCKET-SIZE MULTI-TEST UNIT

(Continued from page 539)

available in commercial pocket testers.

The ohmmeter portion of the tester is entirely self-contained and is designed to accurately measure values of resistance that are considerably lower and also higher than the ranges of any similar instrument available. The scales are not "forced" at the extreme upper and lower ends as is sometimes done for the purpose of claiming ranges that are available technically, but not practically. The low-ohm range is of the "reverse" type using a *back-up* circuit; the middle of the scale reads only 5½ ohms and the very first 10 divisions each read 1/10-ohm.

The complete instrument, which measures only 3 x 5⅞ x 2 ins. deep, can be conveniently slipped into a coat pocket for that hurry-up job. It will also be a very handy and useful tester in the shop.

The panel, which is made of 1/6-in. thick bakelite, is drilled and lettered as per Fig. 1. This layout gives symmetry and compactness. The meter is a D'Arsonval movement, bakelite case, 2¾ in. microammeter, range 0-500, accurate within 2 per cent.

To use as an ohmmeter the zero-adjust control is varied by means of a screw-driver for full-scale meter reading; it is unnecessary to short the test prods during this balancing procedure. Nothing else is necessary for high-range (H.O.) measurements. When the medium (M.O.) range is used, one of the contact leads (either 1 or 2) is inserted in the lower-right-hand jack. In order to use the low range (L.O.) both contact leads are used; one is inserted in the lower-left-hand tip-jack and the other is connected to the lower-right-hand jack.

Altogether the tester serves as 12 independent meters having the following ranges:

Ohmmeter	Milliammeter	Voltmeter
0-500 ohms	0-555 microamps.	0-5
0-50,000 ohms	0-5 ma.	0-50
0-1. meg.	0-50 ma.	0-500
	0-500 ma.	0-1,000
	0-5 A.	

LIST OF PARTS

One Radio City Products Co. engraved panel;
One "Dependable" meter, 0-500 microamps. (with special, No. 408 dial), M;
One Radio City Products Co. kit of 4 *shunt* resistors: 0.125-ohm, R1; 1.125 ohms, R2; 11.25 ohms, R3; 112.5 ohms, R4;
One Radio City Products Co. kit of 4 *circuit* resistors: 1,000 ohms, R5; 11,000 ohms R10; 5.25 ohms, R11; 5.92 ohms, R12;
One Radio City Products Co. kit of 4 *multiplier* resistors: 9,000 ohms, R6; 81,000 ohms, R7; 0.81-meg., R8; 0.9-meg., R9;
One tapered, zero-adjust potentiometer, 0-250/4,000 ohms, R13;
Two flat batteries (one 4½ V. and one 3 V.);
Thirteen tip-jacks, J1 to J13;
Two phone tips with flexible leads, 1, 2;
Three fibre strips cut as follows: 1 x 6¾ ins.; 1⅜ x 5½ ins.; 2 x 1⅜ ins.

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

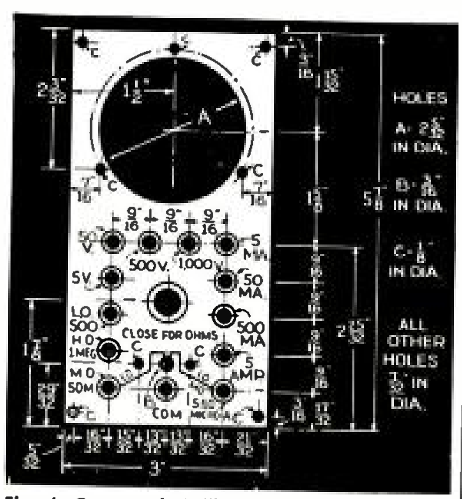

Fig. 1. The panel drilling and engraving details.

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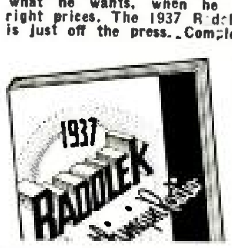

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Here's the New Book for Radio Men!

Official Radio Service Handibook
by J. T. Bernsley

HERE'S the new book on radio servicing that contains everything Service Men must know. The book, OFFICIAL RADIO SERVICE HANDIBOOK, is edited by J. T. Bernsley, foremost radio service authority. This 1936 service guide is the only book of its kind—its editorial material is so well prepared that the technical information can be understood by even beginners in radio servicing. Every page contains new material, new illustrations—no reprinted literature.

The OFFICIAL RADIO SERVICE HANDIBOOK covers thoroughly over 500 radio topics. It tells you how to analyze the latest commercial receiver circuits; how to really make money servicing midget sets; and, how aligning supers can be made easy. It stresses the many uses of different types of test equipment; it gives you short cuts in trouble-shooting and repairing; and, contains over 250 pages of operating notes on 1,000 manufactured receivers. So up-to-date is the OFFICIAL RADIO SERVICE HANDIBOOK that it explains thoroughly the features and innovations in the most modern of receivers.

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Whether it is a fading job, lack of sensitivity, noise within the receiver, aligning a chassis, poor A.V.C. action, a "cockeyed" Magic Eye tuning indicator or any other trouble that is usually the "bugaboo" of most Service Men, you will find the symptoms and remedy clearly described in OFFICIAL RADIO SERVICE HANDIBOOK. The exact procedure for repairing, as well as the characteristic trouble in almost all models of manufactured sets, will be found in this section on OPERATING NOTES—over 250 pages of this data, the most important information to any radio man in the servicing field. The auther takes nothing for granted. The procedure for aligning supers, whether one, two, three or more bands, is clearly and practically explained. You can quickly grasp the ideas and put them into successful practice. The material in this section has been arranged, as well as classified, so there is no difficulty in immediately locating the necessary information.

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