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RADIO'S LIVEST MAGAZINE

Radio-Craft

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September
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See Page 136

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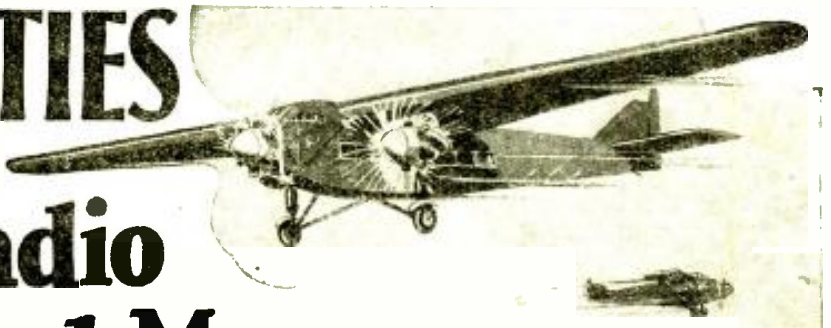

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Radio-Craft
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CONTENTS-SEPT., 1936, ISSUE

Volume VIII Number 3

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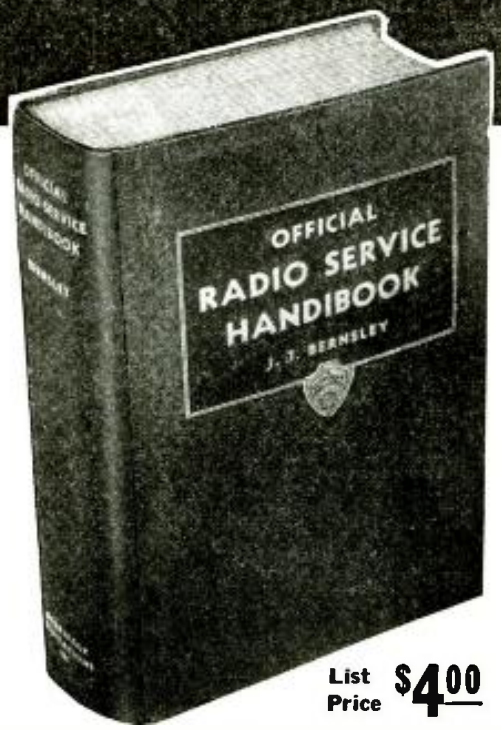

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Editorial Offices: 99 Hudson St., New York, N. Y. HUGO GERNSBACK, Editor Vol. VIII, No. 3, September, 1936

RADIO RECEIVER TRENDS

An Editorial by HUGO GERNSBACK

THOSE GOOD SOULS who always are under the impression, year in and year out, that nothing new is to be had in radio receivers are always surprised at the profound revolution which is going on in new radio design and in new radio receiver trends.

This year, particularly, shows a rich harvest in new ideas, many of which are sufficiently new to command the word, "startling."

To begin, the trend is unmistakably towards metal tubes. A greater and greater percentage of metal tubes are being used in the various sets. While the circuits show no revolutionary changes, there are a number of refinements and simplifications; and the sensitivity of the sets seems to be on the increase. Iron-core coils for radio frequency are coming to be more and more recognized because such coils make for a greater degree of sensitivity in the receiver.

American manufacturers have definitely forsaken the little receivers of the cigar-box type, and the trend now is unmistakably to the more expensive sets. The table models are becoming handsomer and are put out in better wood construction, while a number of manufacturers have even adopted beautiful bakelite sets, which latter are far more beautiful than wood, without impairing the sound quality.

But it is particularly in the new dials that the 1936-'37 receivers blaze forth in a shower of ingenuity, difficult to match with those of former years. The new dials are both larger and more complex, more serviceable and more beautiful than anything that has been shown before. We now have dials that work with finger holes, and are tuned the same as your dial-telephone is worked. To tune the set, you merely place your finger into the opening provided for a respective station and let go. You turn no knobs, the finger-hole dial does all the work. Then we have the *automatic color dial* which automatically changes from one to another color as the program comes into perfect focus. So when the dial flashes its special color, you know that the station is tuned razor-sharp on its correct frequency. Then there is the so-called "custom made" station identification where calls of a local station flash in a bright light when the proper frequency is reached.

In addition to this, we have the self-adjusting so-called *automatic, frequency control.* This was first shown last fall at the French radio show, and *Radio-Craft* described it first in its January, 1936, issue. This new automatic frequency control makes it particularly easy for women to tune in a station. It is a notorious fact that women are not good tuners as a rule, and they usually tune on either side of the peak. By means of the new automatic, self-adjusting control you can tune your receiver roughly, and the pointer will automatically move to its sharp, focused frequency position. Not only that, but it cuts tuning time in half.

Then we have the new "silent tuning" idea, whereby you can switch from one station to another without the usual fearful noises so annoying to sensitive ears. You pull out a control knob and the speaker is silenced. Then you tune in the desired station and you push the control knob back and the new program is on. Then we have the new *music speech control* which enables you to balance between treble and bass tones. This is a glorified tone control, but gives three stages of audible tone control namely, low, mellow, and brilliant.

In loudspeaker field, we find a distinctly new trend away from the electromagnetic dynamic to the magnetic dynamic. That is, instead of having a separate excitation for the magnetic field, the latter is purely magnetic—the new hyper-permanent magnets being used. This gives rise to an exceedingly strong magnetic field, and, of course, unlike the former electro-magnetic dynamic speakers, no current is consumed.

Of course, this is a return to the magnetic speaker of ten years ago, but with the difference that the new permanent-magnet dynamics are in many cases superior to many electromagnetic dynamics. Incidentally, they are also cheaper; they last longer because they have no coils to burn out or short to the frame of the speaker; and they take up less room. Often the quality too is better.

Inasmuch as the overwhelming percentage of the receivers being turned out now are all-wave sets, manufacturers have at last decided to give customers an efficient aerial to go with such sets. Up to last year it seemed to many observers that the manufacturers, while turning out all-wave sets, were not concerned that the public itself wanted very badly to receive short waves. Now, though, they realize that the public does want short waves and wants them so much that, if the set does not bring in short wave stations, there are immediate complaints.

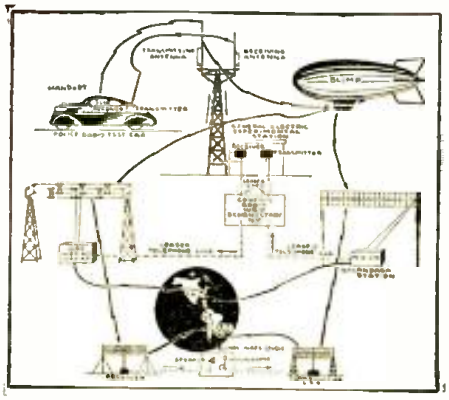
It has been proven that short-wave reception has its vagaries, and that you cannot tune in your set at any given moment of the day and expect that short-wave reception will be the same all the year around. Realizing this, the manufacturers have concentrated on the aerial design, and many of the large set makers are now putting out various forms of aerials, usually of the doublet variety, which are recommended to be sold with their particular sets. Usually, these new specialized aerials are well engineered and are sold in kit form with simple directions. If such aerials are used, the results are always a great deal better than if the old type of single aerial is used. These specialized aerials threaten to become an art by itself, as greater and greater output is expected of such aerials as time goes on.

The last word about short-wave aerials has certainly not been spoken. We still know comparatively little about the best aerial, but we are learning rapidly. Ten years hence, it may be possible to receive foreign stations the same as locals, at any time of the day. This may sound over-optimistic today. If you think so, just think back ten years, when you tried to tune in to KDKA or other stations notable for their fading. Today, this fading business on the broadcast bands has been forgotten. It will be so with foreign reception ten years hence.

I must not forget to speak of the tubeless radio set which makes its appearance through the daily press every so often. We have had the threat of a tubeless receiver ever since broadcasting started in 1921. It pops up every once in a while and is usually publicized in the daily press. When investigated, it is always found that such sets are either out-and-out frauds or otherwise but experiments in an art that was long ago forgotten. It is possible to amplify a crystal detector by means of transformers, microphones and the like, but so far such devices have been proved utterly impractical. It is our guess that, while it may be possible to construct a tubeless radio set sometime in the future, it probably will be by totally different instrumentalities than those available today. Incidentally, the tubeless set would probably cost far more to build than a simple tube set today! So, if you read about tubeless sets, just smile!

THE RADIO MONTH

Thomas A. Edison—inventor of radio!



The 6,000 mile dirigible, car, radio hook-up.

EDISON—INVENTOR OF RADIO

DURING the celebration, last month, of a Half Century of Electrical Progress, at Schenectady, N. Y., a unique radio conversation between the blimp "Resolute" and a police radio test car was tied in with station LSX in Buenos Aires in a three-way 6,000 mile tie-up. During this conversation, the work done by the late Thomas Alva Edison in 1886 with radio telegraphy was discussed.

An investigation of this date by *Radio-Craft* revealed that Edison was granted a patent on a wireless (radio) system for communicating between moving trains and the telegraph wires running along the right of way. He called this system the "grasshopper telegraph" and the patent (No. 350,234) is the first known radio patent.

This disclosure places the date of the first development of radio at 1886 instead of the date of 1901 at which time Marconi sent his famous "S" across the Atlantic and which most people consider as the beginning of radio. It also makes radio an American invention instead of a European one.

ATWATER KENT DROPS RADIO

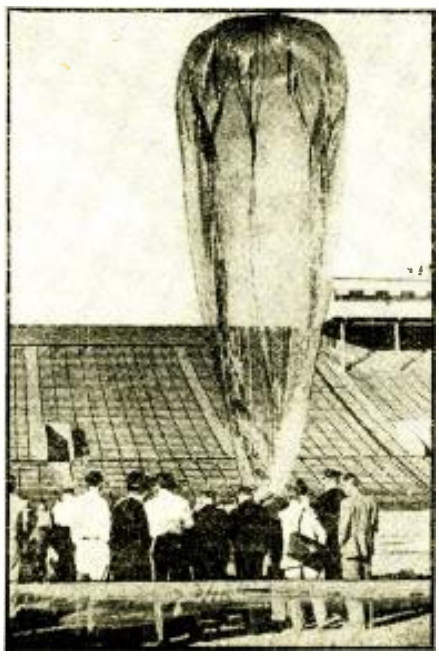
ACCORDING to a reliable report received last month, the Atwater Kent Mfg. Co., one of the oldest manufacturers of radio broadcast receiving equipment, has decided to discontinue the manufacture of radio equipment.

This is a surprising move on the part of one of the old timers in the industry, and while no definite information is available at this time as to what new lines of activities the company will enter, it is rumored that it will concentrate on the electric refrigerator business. However, from sources close to A. Atwater Kent, founder and president of the concern, it is learned that he may be preparing to retire from business, as he has already accumulated a large fortune.

RADIO AND THE CELLOPHANE BALLOON

LAST month, Professor Jean Piccard who is well known for his work in flying into the stratosphere to record cosmic ray activity, and other scientific phenomena, tried a new way to reach high altitudes by sending aloft a "pilotless" pink cellophane balloon which was equipped with recording devices and a radio transmitter which would automatically send records of the height, wind velocity, barometric pressure, cosmic ray activity, etc.

Unfortunately, the automatic transmitter failed shortly after the start of the flight which prevented a running record of the flight to be made.



AIR CRASH AFTERMATH

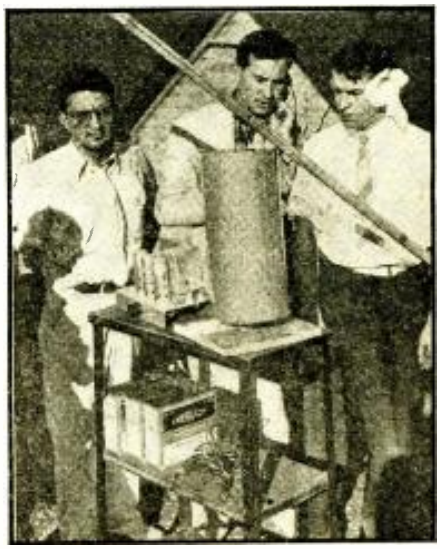
A SENATE committee report last month recalled an air catastrophe reported in these columns in August 1935 and again in January 1936. We refer to the tragic crack-up of the TWA air liner "Sky Chief" in which Senator Bronson Cutting and four fellow passengers were killed.

The Senate Committee, which has heard witnesses and taken testimony for many months, has finally issued a report which reads, in part:— "The pilot was dependent on three aids to navigation furnished by the Bureau of Air Commerce: dependability of the northeast leg of the Kansas City radio range; normal operation of the radio station MRL at Kirksville, Mo., and the best efficiency on the three rotating light beacons on the last 20 miles southwest of Kirksville airport." The report concludes tersely: "All three failed him."

The Senate Committee recommended to the Secretary of Commerce "That he thoroughly overhaul the Bureau of Air Commerce with a view to improving its administrative officials." Two specific instances of inefficient administration were cited with a suggestion that the two men in question be replaced.

This Senate report thus completely vindicates the Air Line, placing the entire blame on the Air Commerce navigation aids. Thus the situation parallels that of a lighthouse on a treacherous coast with the light out on stormy night —the responsibility for an accident would rest entirely with the lighthouse keeper and his superiors.

This fatal accident points out vividly the importance which radio is assuming in many diversified industries, only one of which is aviation.



Above, Piccard's automatic transmitter failed. Left, the pink cellophane stratosphere balloon.

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.

RADIO SIGNALS FROM THE SKY

SCIENTISTS from the California Institute of Technology started, last month, to attempt to decipher weird radio signals coming to the earth from the Milky Way.

The signals which were first discovered by Dr. Karl Jansky of the Bell Telephone Labs. are being picked up in the middle of the Mojave Desert because of the trouble encountered with interference in other locations.

Two theories are advanced for the hiss-like signals: the first that a high temperature agitates the electrons in the heart of the Milky Way just as heated electrons in a vacuum tube cause a hiss in the speaker; and second, the collisions of electrons and small fragments of stars in the Milky Way generate short waves which cause the intermittent hiss.

THE ELECTRONIC "NOSE"

THE development of an electronic "nose" having a sensitivity about one-fifth that of the human nose was announced last month, by the General Electric Co.

The device was developed for the purpose of detecting minute traces of mercury vapor in the air. It depends on the absorption by mercury vapor of certain portions of the light spectrum. The air to be observed is drawn into the device which consists of a source of light and a PE. cell having a peak sensitivity in the mercury absorption bands. The mercury particles cut off the light so effectively that one part of mercury vapor in 200,000,000 parts of air can be detected and caused to operate an alarm.

Above, the electronic "nose" disassembled. Right, the late D. McFarlan Moore.

RADIO SET WITH "FOCUSED TONE"

A NEW line of radio receivers is being introduced, according to a report received last month, by the General Electric Co., featuring what is called "focused tone."

When the dial is not tuned exactly on a station's wavelength, the entire dial is red, but when the set is accurately tuned the dial turns green. At the same time, the call letters of the station are illuminated on the horizontal-type dial.

These sets are also equipped with "automatic tuning control" (*Radio-Craft*, Jan. 1936, page 408) so that the set automatically compensates for poor tuning and thus provides the maximum quality.

IN MEMORIAM

LAST month, radio lost two of its most stalwart supports—two old timers who will be missed for a long time to come, by members of the radio fraternity.

D. McFarlan Moore, who was an associate of Thomas A. Edison in some of his early work, as far back as 1891 and who was connected with the G. E. Co. until a few years before his death, was shot by a crazed inventor, at his home in East Orange, N. J. Mr. Moore was the holder of over 100 patents on gas-discharge tubes and television subjects.

Col. Edward Howland Green who pioneered in radio broadcasting and was well known for his developments in high intensity sound, radio-controlled models, television and many other fields, died quietly, last month, at Round Hills, his estate at South Dartmouth, Mass.

While neither of these men has been active recently in radio circles, they were well known to the entire industry.

David Sarnoff—predicts radio's future.

"Every citizen will have his frequency."

DAVID SARNOFF LOOKS AHEAD

SPEAKING before the Federal Communications Commission's fact-finding hearing into the future of radio and television, last month, David Sarnoff, President of RCA made some startling predictions.

He said "television is an accomplished fact, although not yet ready commercially." He also stated that television would not replace sound broadcasting or make sound receiving sets obsolete.

Discussing experiments in "microwaves" Mr. Sarnoff stated "The finding of a new range of frequencies is of more importance than the discovery of a new gold field." He continued "When experiments have been completed there will be frequencies enough to make possible the establishment not only of an unlimited array of mass communication services, but of an unlimited number of individual communication services."

"In that day each one of our millions of citizens will have his own assigned frequency wherever he may be."

Facsimile service, he explained, would cover everything from "weather maps

(*Continued on page* 169)

BUILD THE "TALKING BRIEFCASE" RECEIVER—

NO AERIAL!—NO GROUND!

Here is an exceptionally sensitive, 4-tube "pedestrian" receiver that weighs only 11 lbs. A high-efficiency circuit is used.

HUGO GERNSBACK & J. T. BERNSLEY

THE NOVELTY and usefulness of this briefcase portable receiver has been well attested to by the hundreds of admiring and envious comments made by spectators and listeners who have seen and heard the set operating, in Brooklyn and Manhattan. Wherever it was turned "on," in the city streets or parks, it attracted curious hundreds who stayed to listen and marvel. Practically everyone has heard of car-radio sets, beach portables, universal-current midget receivers and other forms of portables, but no one had ever really seen and heard a real "pedestrian's" set until this receiver was demonstrated.

And lest the reader form any hasty conclusions that this set is too bulky, heavy or otherwise impractical (due, probably to previous experience with so-called "portables") let us immediately belay any such erroneous conclusions by citing actual facts and figures concerning this instrument. *Complete, it weighs less than 11 lbs.*—and this includes all batteries, briefcase and receiver chassis. This weight is less than that of any *really efficient* portable receiver which has ever been built. Its dimensions can be easily visualized, since the briefcase is a commonplace item seen everywhere. This particular case measures 16 x 11½ x 2 ins. deep. Insofar as tone quality, volume, sensitivity and tuning ease are concerned—we think so much of this set that we are preparing to feature it at the coming Radio Show in New York City, where all can see it and determine for themselves its practicability and amazing efficiency.

"STRAIGHT FORWARD" CIRCUIT

Frankly, there are no "tricks" to the circuit or any of the parts to which we might attribute the reason for its good qualities. On the contrary, everything is as simple and commonplace as possible so that the constructor who builds this set will find no great difficulty.

The circuit is of the ordinary "tuned R.F." variety. As shown in Fig. 1, it employs only 4 tubes of the 2-V. type and a 3-gang variable condenser to tune the 3 tuned circuits. The tubes are arranged as follows; one 1A4 as 1st R.F. amplifier one 1A4 as 2nd R.F. amplifier stage, one type 32 as a detector operating on the power detection principle, and finally a type 950 (or 1F4) as power audio stage. The first 3 tubes draw only 0.06-A., and the 950 or 1F4 consumes 0.12-A. filament current.

The coils are of the high-gain, shielded type of miniature dimensions, wound with litz wire and are really responsible for a good deal of the efficiency of the receiver. Volume is controlled by a 0.25-meg. potentiometer connecting from the "B-" to "B+" 45 V. (screen-grid) taps of the "B" voltage. This method of controlling the volume in this circuit results in not only satisfactory regulation of the intensity of the sound but also helps to keep all reception just under the circuit oscillation point. The oscillation is a result of some stray feedback caused by the wiring and somewhat congested layout of parts, but is a feature since it can be controlled by varying the screen-grid voltage and hence permits obtaining the maximum sensitivity which occurs just before the oscillating point.

The reproducer is one reason for the exceptionally good quality of the programs which are received. This speaker is the newest permanent-magnet dynamic, and employs the new "alnico" magnet iron in its construction. While the outside diameter of the cone is only 5 ins., nevertheless those who have heard its reproduction have been greatly surprised by its good tone. The speaker is sufficiently sensitive to give good volume even at low signal levels, and at maximum power reproduces without any sign of chattering.

Nothing could be simpler than the operating controls of this receiver. As can be seen in Fig. A (heading illustration), the controls are only 2 in number—one for tuning-in, the other for turning the power on and off, and regulating volume. The latter is accomplished by means of a combined volume control and switch. A translucent, airplane-type dial with indicating figures and an escutcheon plate, are permanently fastened to the exterior of the briefcase, and facilitate dialing or logging of the stations.

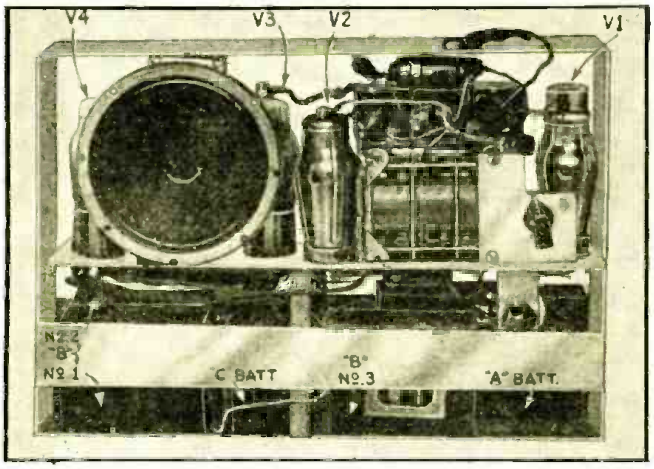


Fig. B. Front of "talking briefcase" chassis (complete, in Fig. A—see heading).

CONSTRUCTIONAL DETAILS

One of the best reasons for selecting the T.R.F. type of circuit is that it is so much easier for constructors to build and requires no lengthy or elaborate aligning procedure. With a superhet., not only is the alignment too difficult for the average constructor, but it also requires the facility of

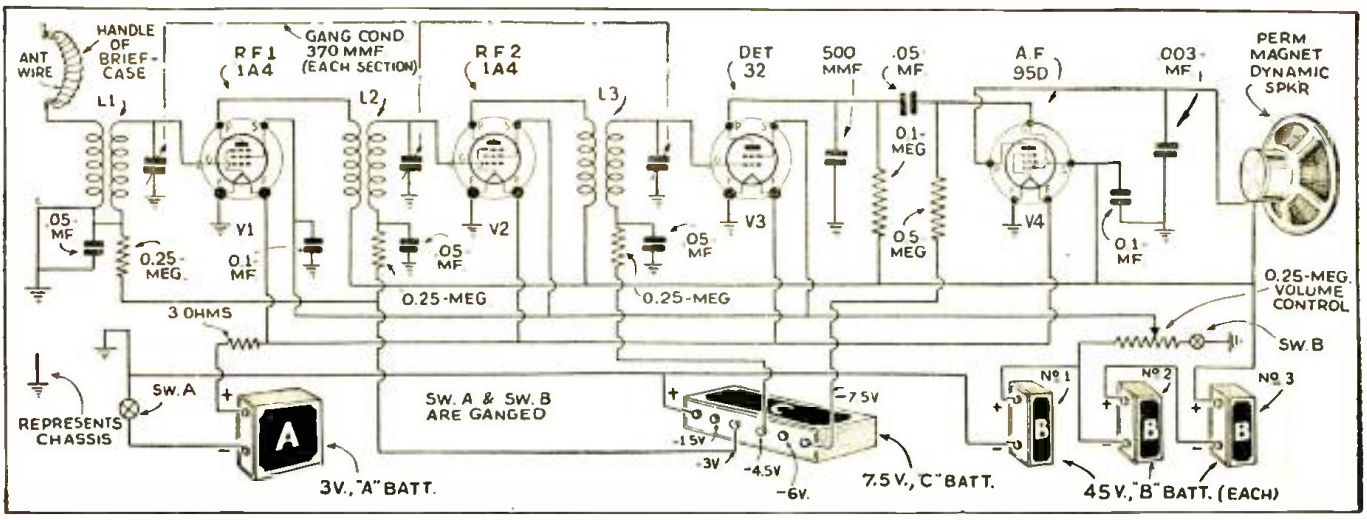


Fig. 1.—Complete schematic circuit of the "talking briefcase" receiver. A "human antenna" is afforded by the person carrying the set; a partial ground effect is afforded by the chassis.

a Service Man's signal generator. In addition, fewer components are required by the T.R.F. circuit which is a requisite when building a set of limited proportions.

In this particular receiver, the chassis consists of an aluminum frame, rectangular in shape and home-made, whose dimensions are 14 x 9½ x 2¾ ins. deep. A shelf (also aluminum) is stretched across the "long" side of the chassis (see Fig. B, view of chassis), 5⅝ ins. from the top. On the shelf are mounted the tubes, speaker, variable condenser and coils. These are plainly visible in the chassis views shown in Figs. B and C. The compartment or area below this shelf is utilized for mounting the "A," "B" and "C" batteries. Also, the volume control protrudes into this compartment, being suspended from the shelf by means of a bracket. The coil shields are fastened above the variable condenser, being soldered to the frame work of the gang so that all coil leads are as short as possible. Care must be exercised when mounting the coils so that the condenser trimmers are exposed and accessible for any alignment that may be necessary. Careful study of the photographs of the chassis should furnish the constructor with all essential facts concerning the layout of the parts.

The gear mechanism employed for rotating the variable condenser plates from the "front" is outlined in Fig. 2. This arrangement is made necessary as a result of the edgewise mounting of the variable condenser. The length of the condenser prohibits mounting it in any other fashion. At that, the condenser must be of exceedingly small dimensions, an idea of its respective size being obtainable from the photographs.

The constructor is urged to use his ingenuity when building this receiver. A close study of the diagram, sketches and photographs is recommended, so that problems in mounting and arranging the various parts can be easily ironed out. Please do not write in for dimensions or plans of the receiver. These figures cannot be specified, inasmuch as much depends on the parts used, and their dimensions.

WIRING

When wiring the receiver, *be sure to use heavy-gauge wire for the filament wiring* to avoid any drop in voltage due to the resistance that may be encountered in ordinary hookup wire. Use flexible wire for connecting to the control-grid caps of the tubes. Do not try to solder to the aluminum, but tightly bolt to the chassis each wire which must be grounded to it. Make each wire lead as short as possible, and avoid the practice of shielding any R.F. leads that may be too long. Use only the type of parts specified, if assurance of a minimum of trouble in layout and maximum efficiency is desired.

Note that the "aerial" for the set consists of a few turns of uninsulated wire wrapped around the briefcase handle. When the hand grasps this handle, *the body is employed as the antenna* and provides ample program pick-up. If the set is to be released and placed in some position remote from the body, then a 10 to 15 ft. length of wire connecting to the handle and stretched across the floor will be found sufficient.

Also, note the use of a volume control with a D.P.S.T. switch attached. Each switch arm is connected so that the "A" and "B" batteries are completely disconnected when the receiver is turned "off." This insures against leakage of current and consequent premature deterioration of the batteries.

FINAL CHECK-UP

When the receiver is completely wired and all batteries connected (and carefully checked for errors) then the receiver is ready for operation. Preliminary tests and alignment may be made by connecting a short length of wire to the set lead-in wire which later connects to the handle of the brief case. Alignment of the trimmers can only be performed when the receiver is out of the brief case, so do not install the chassis until this procedure is completed. Keep the volume control turned down low so that a few major stations can be received without oscillation. Adjust the trimmers with the pointer set at approximately 50 deg. or as reasonably close to this point as will permit some station to be tuned in. The trimmers are simply rotated for maximum signal strength. When this procedure is completed, rotate the variable condensers so that they are completely out of mesh (to the low wavelengths) so that a station is received at this point. Keep the volume control turned down as low as necessary to prevent oscillation. Readjust the trimmers for maximum signal strength heard on the loudspeaker.

When this process is completed, install the chassis in the briefcase, after removing any leather partitions that may exist and the tuning dial and speaker holes have been drilled. The lead-in wire from the receiver should then be soldered

(Continued on page 166)

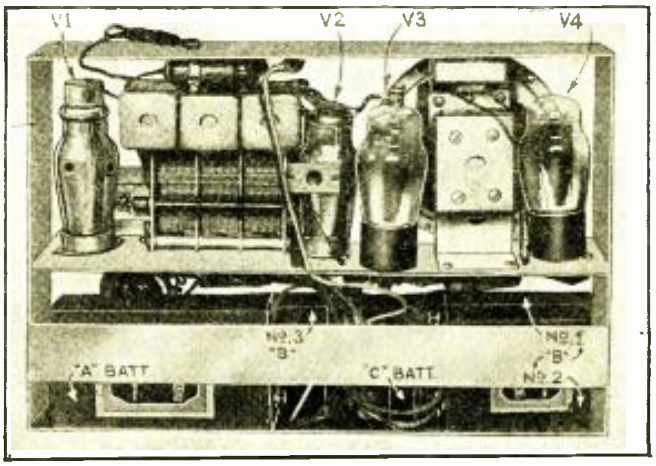
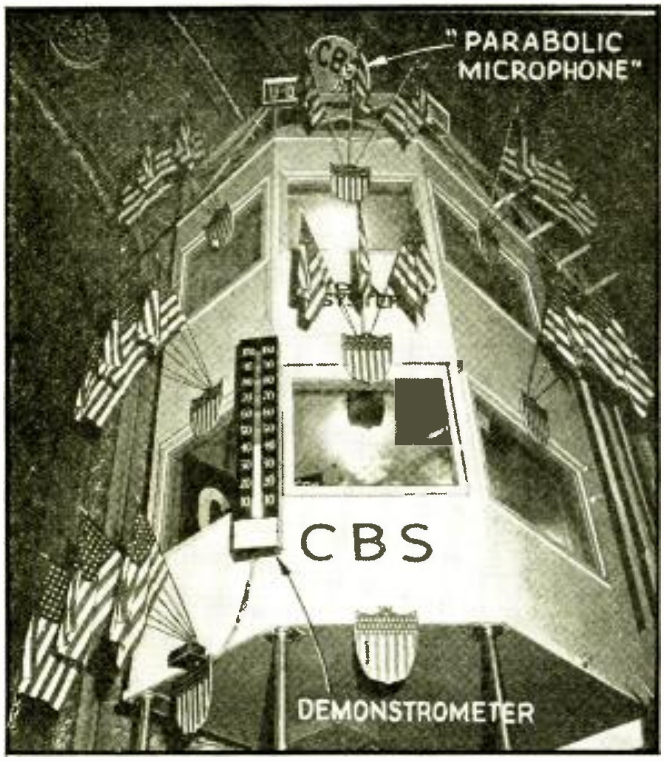


Fig. C. Rear of receiver chassis, showing location of tubes.



NEW RADIO AND P.A. PRESIDENTIAL

History will record that the Democratic and Republican National Conventions of 1936 served to introduce several new radio ideas.

R. D. WASHBURNE

ROOSEVELT topped Landon on the CBS "noise demonstrometer" (applause meter—Fig. A, the heading illustration at upper-left), by 11 points when the instrument registered "96 for Roosevelt," against 85 for Landon, as the delegates became proportionately vociferous at the respective nominations in Philadelphia and Cleveland, last month!

Whether such scientific check-up of human reactions can be said definitely to indicate political trends remains to be seen at the elections next November. During the interim, broadcast networks, short-wave and micro-wave equipment, and public-address apparatus of every description will be called upon to supplement the extensive use of these facilities as utilized at the recent Democratic and Republican Conventions.

The 6-ft. "demonstrometer," one of the most novel of these new political tools, incorporated a microphone in a special parabolic pick-up collector which is so placed as to receive equal volumes of sound from all parts of the auditorium. The amplifiers associated with this microphone amplify its output about 10 billion times, which raises the energy to the requisite level for operating motor-driven ink-recorders, and the thermometer-like neon indicator illustrated in Fig. A.

Engineers and others in subsequently checking the recordings made by this device pointed out that in all probability Steiwer of Oregon (R.) would have been swept into the Vice-Presidency had he hammered away on the themes that made the "thermometer"-scale light climb to 40—50—60 db. ("decibels"—or audio noise figure indicating the degree of loudness), as his listeners swayed to his oration. Another use of the instrument was in checking "ayes" and "nayes" verbally voted on various subjects.

But the applause meter was only one of the "innovations" that contributed greatly to the success of the 1936 Conventions of the two major political parties. In order to reach that great group—the "radio listeners"—that was 10,000 times larger than the group in the Convention hall, the NBC, CBS, and MBS broadcast networks were joined in one smoothly-functioning unit.

The nucleus of this unit of course was the microphone installation and monitoring system as set up at the respective halls; and at Franklin Field, Philadelphia, where President Roosevelt delivered his speech of acceptance. At Cleveland the entire microphone set-up was under the control of NBC, the 75 microphones and the associated equipment being installed in general accordance with the floor plan shown in Fig. 1. Substantially the same general arrangement was followed at Philadelphia, where CBS took over the reins and installed their own sound pick-up equipment, exchanging with NBC and MBC the return courtesy of using the equipment.

A technical high-light of these Conventions was the ultra-short and micro-wave apparatus introduced, and which permitted contacts to be made and places to be reached that ordinarily would have required an annoying, inconvenient trailing wire. One of the most interesting of these was the CBS "photo-mike," with a sending range of 4 to 5 miles.

This combination camera and ultra-short wave transmitting station, shown in Fig. B, incorporates 3 standard "battery"-type or 2-V. tubes, as illustrated schematically in Fig. 2. The assemblage at Cleveland was accustomed to seeing innumerable cameras, and not everyone realized that while they were holding an animated conversation with the "photographer" snapping their picture with a 13-frame "candid" camera mounted on the front board of a graflex-camera case, that their comments were being picked up by a microphone concealed in the "graflex" case, and the words sent to an ultra-short wave receiver located elsewhere in the hall, from whence the "program" was put onto the nation-wide radio network!

Not content to let the photo-mike suffice for spot pick-ups throughout the hall at Philadelphia, CBS developed a por-

Fig. B. The "photo-mike," and its creator, E. K. Cohan, of CBS.

EQUIPMENT AIDS NOMINATIONS

RADIO-CRAFT "points with pride" to the manner in which radio aided the nomination of candidates for presidential election next Fall, while nearly 100 million people "listened-in." Service Men, dealers, P.A. specialists and others throughout the country who benefited from this extensive use of radio facilities will reap a far greater harvest during the days that intervene until Election.

table transmitting station that utilized a *cane* as an essential component, as shown in Fig. C! According to reports, this diminutive radio station was made possible through the use of a tiny "acorn"-type tube (described in past issues of *Radio-Craft*), and a novel "concentric-line" oscillator.

Three 2-V. dry-cell (*not* "acorn") tubes are in the binocular case that slings from a shoulder strap. One of these is the modulator tube; the other is an A.F. amplifier that amplifies the output of a crystal microphone strapped to the "announcer-operator's" wrist. Batteries fastened around his waist are concealed under his coat. Battery power is fed to the single acorn tube in the walking-stick by means of a flexible lead that extends from the end of the curved handle, up the announcer's sleeve and so to the batteries. The "antenna" is the furthest metallic section of the cane (insulated from the adjacent portion by means of an insulating ring); the "concentric-line" oscillator system to which it connects affords one of the most stable oscillator systems possible, for operation in the "micro-wave" region of 1 meter, to which it is tuned. The range of the "walking-stick transmitting station" is about 1 mile. A general idea of the manner in which the components of this most portable transmitter are related is shown in the circuit sketch, Fig. 3.

Not to be outdone in facilities for catching gems of wit or wisdom from the lips of personalities at the conventions,

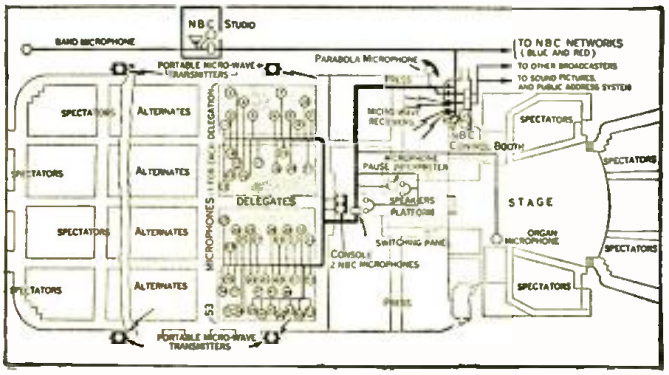


Fig. 1. Part of the set-up of 75 microphones employed in the NBC and CBS installations at the Republican and Democratic National Conventions last month. Note how the switching panel on the speakers' platform affords control.

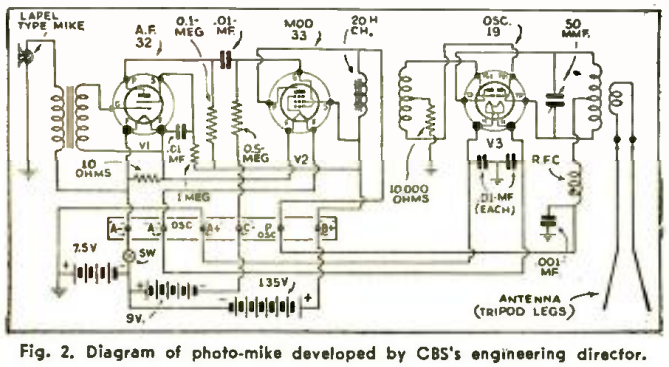


Fig. 2. Diagram of photo-mike developed by CBS's engineering director.

Fig. C. CBS's roving interviewer Bob Trout, and the cane transmitter.

NBC utilized the compact micro-wave portable transmitter (no bigger than a cigarbox) shown in Fig. D, and developed some 2 years ago. It has undergone numerous modifications, until now it is a highly perfected unit. As used at the convention, it was at all times under control from a central point at the convention chairman's desk.

Public address came in for its share of importance—at both Conventions. In Philadelphia, a P.A. control operator atop the Convention hall controlled traffic by means of loudspeakers placed about the grounds. Inside both Convention halls the P.A. systems were linked in various ways—for instance, on occasion, the programs going over the air would also be "piped" onto the P.A. system.

At Cleveland, an intricate switching panel adjacent to the Convention chairman's stand controlled the 54 microphones in the delegations' section on the floor of the Convention hall (1 microphone for each delegation; 48 states, 5 territories, and 1 spare), and linked them to the P.A. systems—and the broadcast networks. When the chairman recognized a speaker from the floor, an engineer would push a button connecting the microphone in that particular delegation. (Additional microphones placed elsewhere brought the total to 75.)

At Philadelphia, somewhat the same general microphone pick-up from the floor was employed; in addition, 10 lapel microphones, operating on a system of weights and counterweights were suspended from the ceiling, and were worn by pages who moved in a radius of about 100 ft., permitting coverage of all the delegations from the 48 states.

Public address came in for its share of important work, inside and outside the halls—in the latter case, for instance, in directing outside traffic. On occasion, too, programs going over the air would also be "piped" onto the P.A. system.

The final gesture of the P.A. systems occurred at Franklin Field after the President had delivered his nomination-acceptance speech, and was successful in its "safety" appeal. The P.A. announcer cautioned the milling crowd, 100,000 strong: "Let's have no accidents on the way home. Tonight is Saturday night and we have plenty of time to get home."

The extensive use of ultra-high frequency apparatus and of P.A. equipment as here described, will no doubt be completely overshadowed by their application in the coming campaign! Of course, P.A. equipment was used before, but the use of ultra-short wave equipment in political strategy is new with this convention and further use will undoubtedly

(*Continued on page* 171)

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.

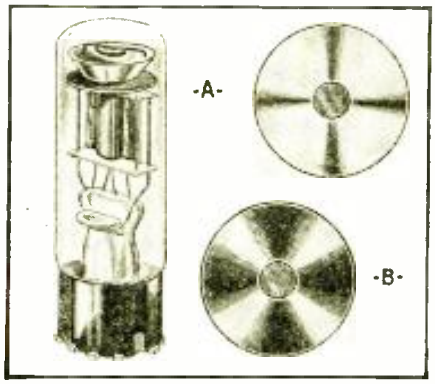


Fig. A. A new cathode-ray tuning indicator.

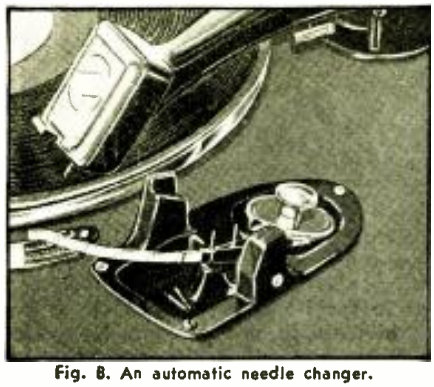


Fig. B. An automatic needle changer.

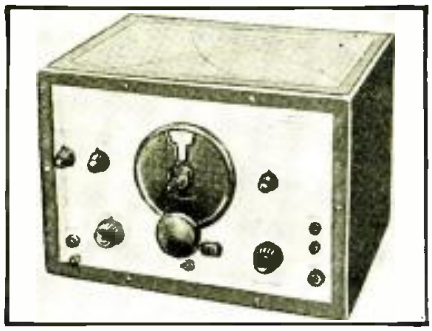


Fig. C. A test oscillator for 5-3,000 meters.

PHILIPS CATHODE-RAY TUNING INDICATOR

THE 6E5 and similar American-type tuning indicators have become an accepted part of many of the standard makes of radio receivers. Due to the instantaneous action in this type of tuning indicator device, it has advantages over most other types.

The superiority of this type of indicator is further proven by the fact that European tube makers have now set about to copy it. The type 4678 Philips tube operates on the same principle as the 6E5, but in order to make some little change in the appearance, 4 deflector or shadow elements have been included in its design. The result is that 4 shadows, instead of one, as shown in Fig. A, which appeared in the last number of *La T.S.F. Pour Tous* (Paris) are produced and these shadows become wide or narrow with changes in the signal intensity just as in the American tube.

AN AUTOMATIC PHONO. NEEDLE CHANGER

IN THE application of phonograph music to entertainment in the home and in restaurants, auditoriums, etc., one of the drawbacks has been the necessity to change needles after each record, which caused a delay between each number. In the case of a continuous program, for dancing, etc., this was an annoyance and as a result, it has become usual practice to include 2 turntables and pickups so that the music could be faded from one to the other. This is complicated and requires the services of a technician.

To avoid this delay and at the same time the need for 2 turntables, an inventor named Bosch has just introduced a device, according to our Marseille (France) correspondent, *which automatically changes the needle when the pickup is lifted to shift records!* This cuts the interval down to the time necessary to remove one record disc and insert another, when the new needle is in place.

A tiny "cartridge belt" holds the new needles and when the pickup is lifted to change the record, a new needle is fed from the belt to replace the old needle which has dropped into a receptacle provided. The mechanism is shown in Fig. B.

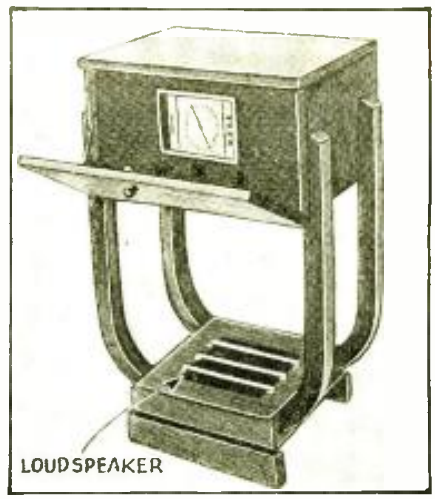


Fig. D. A 5-tube modernistic receiver.

AN ENGLISH ALL-WAVE OSCILLATOR

THE unit shown in Fig. C, which is reprinted from a recent issue of *Wireless World* (London) is a popular make of oscillator manufactured specifically for the use of Service Men. It

(Continued on page 166)

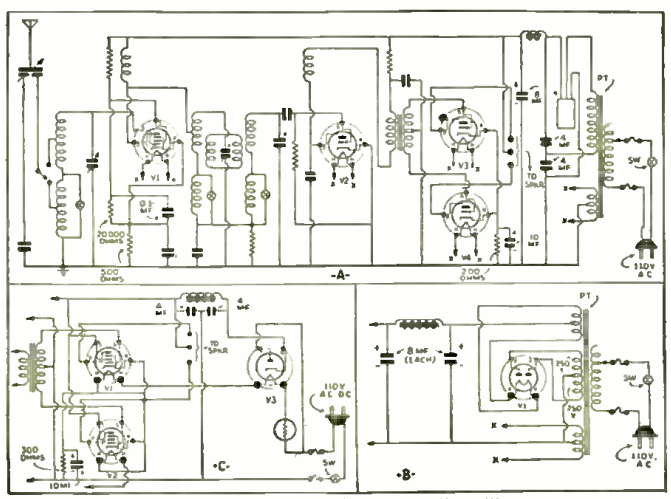


Fig. 1. An inexpensive, high-quality "local" set.

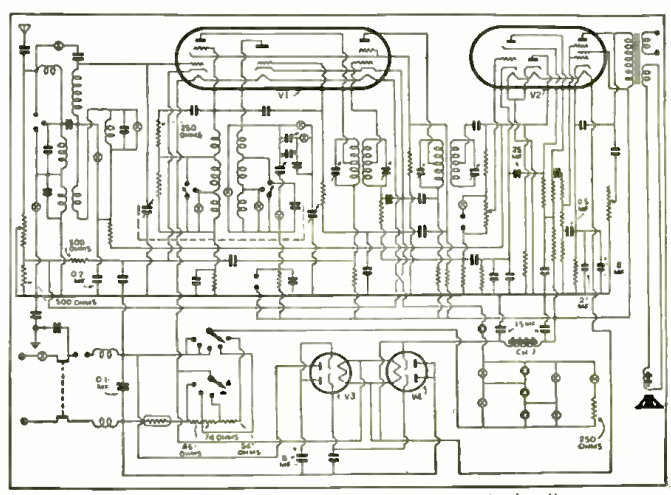


Fig. 2. A German superhet. set using "multi-tubes."

A "BEAM" AMPLIFIER WITH "ELECTRIC CHOPPER"

Here is a 32-W. high-fidelity amplifier with a gain of 127 db. An important article for P.A. men.

A. C. SHANEY

Another radically new idea in P.A. equipment circuit design will be found in this informative article. Don't miss it!

THE BREATH-TAKING rapid strides made in sound equipment during the past few months have primed P.A. amplifiers for the important role they will assume during the forthcoming presidential elections.

Both the portable and mobile (sound truck) type amplifiers will unquestionably be extensively employed for political campaigning. In selecting the ideal portable and mobile amplifier the following essential characteristics should be looked for:

1. **Adequate output power**, so as to easily cover the largest indoor or outdoor assemblages ever expected to be served. This portable amplifying system, with appropriately placed additional speakers, will fill 16,000 to 18,000 sq. ft. of outdoor area, and will easily be heard by 15,000 to 17,500 people gathered indoors.

2. **Universal power supply**, so as to be completely unrestricted in operating applications regardless of whether commercial power lines are available, or not. This feature is attained by incorporating a novel "electric chopper" which enables 6-V. D.C. operation of the entire system through the *same power transformer* and filter circuit as used for 110 V. A.C. operation!

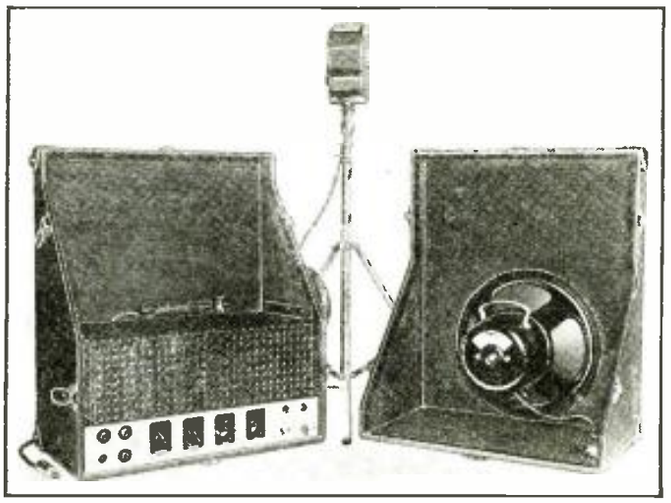


Fig. A. The appearance of the portable P.A. system.

3. **Simplicity of installation and removal**, for enabling the operator to quickly set up the outfit in his automobile as well as in any hall or auditorium.

4. **Flexibility of operation**, so that 1 or 2 velocity or sound-cell microphones may be *electronically* mixed with standard phonograph recordings. Of course, a tapped output transformer should be provided to enable any number of additional speakers to be efficiently coupled to the amplifier.

5. **Light weight**, to enable an average individual to easily carry the complete system without undue fatigue.

6. **Completeness.** This is an unusually desirable feature for dealers and sound technicians who rent, temporarily install, or hastily set up P.A. Systems. By combining into one compact carrying case a (a) velocity microphone, (b) collapsible floor stand, (c) a universal, electronic mixing input panel, (d) a combined preamplifier, voltage amplifier, and

(Continued on page 172)

A DUAL-SERVICE 3-TUBE 5-METER RECEIVER

A non-radiating, non-"blooping" receiver for the 5-meter ham and radio fan. Designed by a licensed amateur, W2AMJ.

FRANK LESTER

ALTHOUGH the *superheterodyne* has practically replaced other receivers for use on the short-wave bands above 20 meters, the *super-regenerative* circuit still remains a favorite for 5-meter use.

The reasons for this continued popularity are easy to understand. This type of circuit is simple sure-fire in action, and inexpensive to construct. It possesses the remarkable ability to reject ignition interference, a feature of extreme importance in portable-mobile service and also in fixed locations in heavily-traveled areas. However, the current forms of super-regenerative receivers suffer from one disadvantage which must be overcome in the general interests of 5-meter reception; that is, its strong tendency to radiate a signal of its own.

A new 5-meter receiver that overcomes these objections has been designed by the writer, and is shown in the accompanying illustration. It is the answer to the demands of 5-meter amateurs for a reliable, medium-

(Cont. on pg. 179)

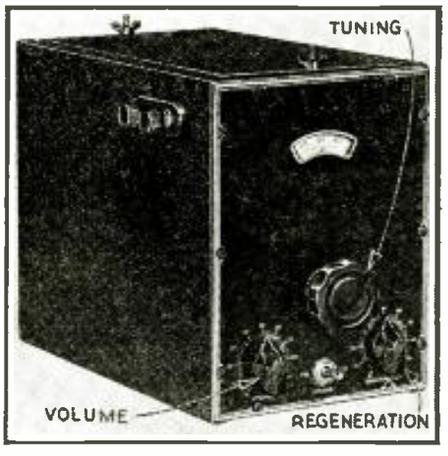


Fig. A. The complete 5-meter receiver.

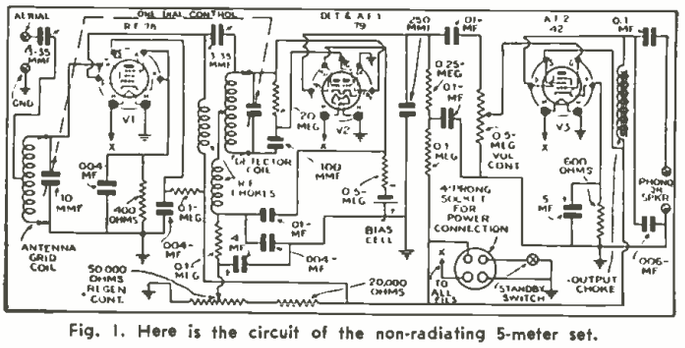


Fig. 1. Here is the circuit of the non-radiating 5-meter set.

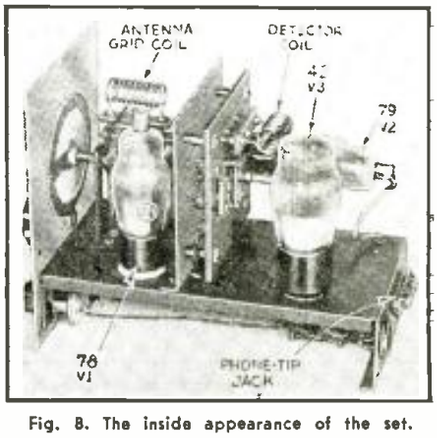


Fig. B. The inside appearance of the set.

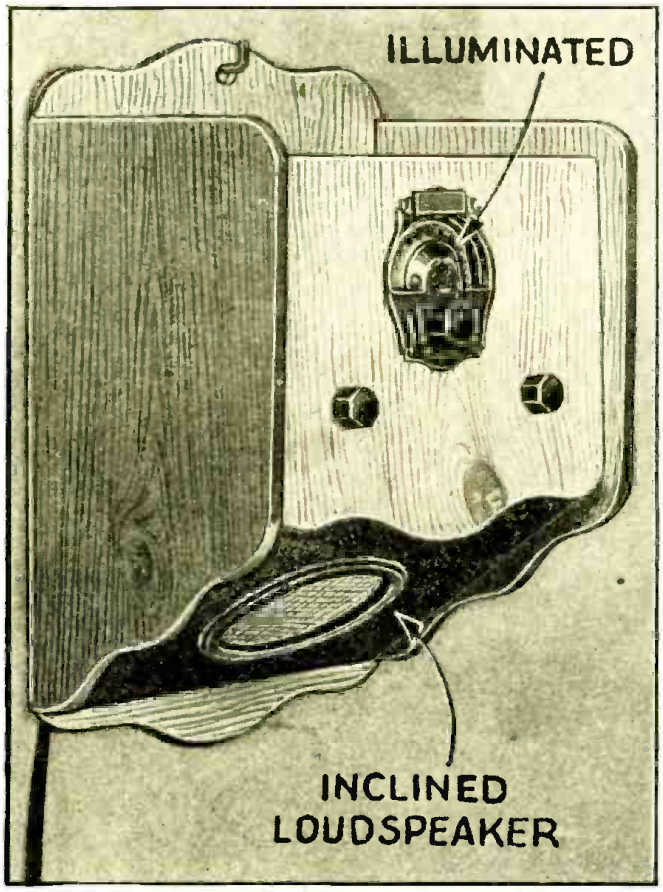


Fig. A. The set ready to hang over your easy chair.

INTRODUCING—THE RADIO-CRAFT "WALL SET"

Here is a fine investment for some of that Bonus money you ex-doughboys have just received:—an inexpensive, sensitive, up-to-date "home" set.

THE *Radio-Craft* wall set, developed for the amateur and professional set-builder on the look-out for radio receiver construction items of low cost, small size, and unusual design, offers 2 features which suggest it as an outstanding model for custom engineering.

The first is a distinctly different type of cabinet and method of mounting (see Fig. A); and the second, a simplified A.C.-D.C. superheterodyne circuit, Fig. 1, which under a desired limitation of 5 tubes yet provides an overall efficiency (in terms of sensitivity, selectivity, gain, volume, tone and last but not least image-frequency discrimination) meeting our rather rigid technical ideas as to proper superhet. performance. We have tried to keep the number of required parts at a minimum, without inviting the possibility of instability and other difficulties, and we feel that the published circuit may be exactly copied without change. Nevertheless certain refinements such as R.F. and A.F. plate decoupling resistor installation are in proper order and will suggest themselves to the builder as the business of actual construction proceeds.

THE CABINET HANGS ON THE WALL

The cabinet represents the practical application of an idea—that of a radio receiver which can be mounted against the wall, over one's bed or favorite chair, with the speaker slung beneath the chassis and tilted at the proper angle for ear-level direction of the sound.

It is of selected "knotty" white pine, carefully sanded for smooth surface, left unstained, then waxed and rubbed. The design is "Early American," and the selected dial for our model is a small, traveling-light type, chosen both because of its physical size and its escutcheon—which last seemed more in keeping with the desired effect than those of other available units. (Some constructors may prefer the more fashionable and newer airplane controls—and in this case, if the cabinet shown here is to be built and used, some care should be exercised in selecting a dial whose overall length from knob-shaft hub to unit top is not too great to permit easy installation and whose other physical dimensions are such that the control will not take up appreciable chassis space.)

We shall, later on, briefly describe the construction of the original cabinet. This job, however, is mainly offered as suggestive of the application of our idea. Radio builders will no doubt wish and are advised to develop designs meetings individual requirements as to size, appearance, and finish.

THE CIRCUIT

The circuit as given represents what we feel to be a workable and efficient compromise between (a) a desired high I.F. gain and (b) an adequate image-frequency discrimination—under the conditions, as previously noted, imposed by the necessity of strictly limiting the number of tubes to 5. Several working models were built in consecutive order, one leading into the other, the first having an air-core I.F. stage and no R.F. This particular circuit seemed at once the most logical for our purposes. Certainly it conformed to commercial practice. But the image-frequency factor entered in to prevent acceptance. We don't like and

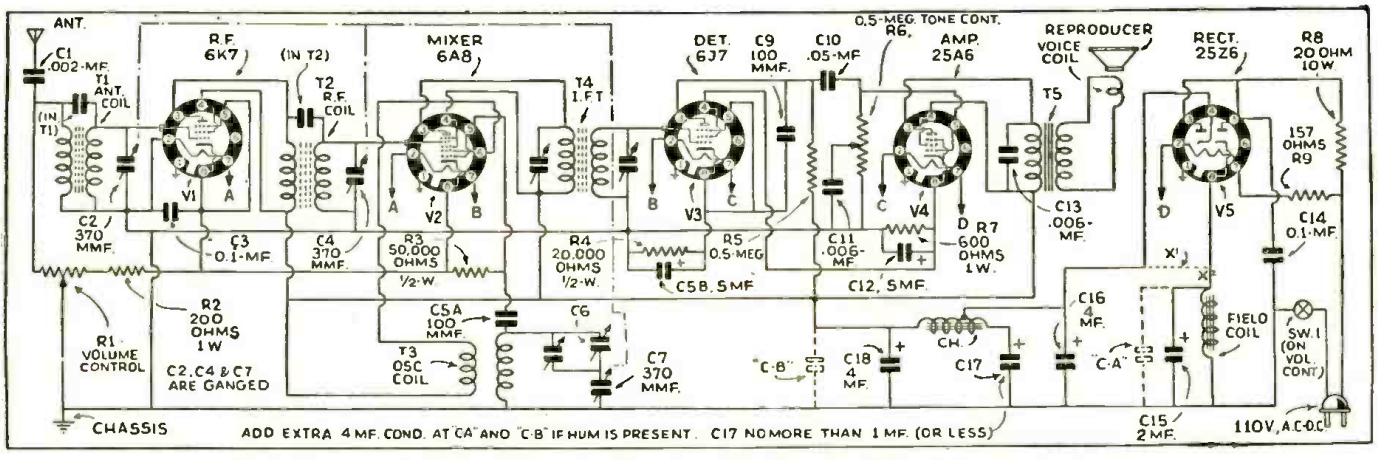


Fig. 1. The schematic circuit of the receiver. There is no I.F. tube, only a high-gain iron-core transformer.

have never liked the idea of a supposedly efficient superheterodyne without a good R.F. stage—or at least a tuned preselector circuit ahead of the first-detector circuit (Double-check!—*Editor*). Consequently, we built up another job with the preselector idea applied—and found the image problem adequately solved.

Unfortunately, however, the R.F. gain was not satisfying, especially with the converter or mixer tube operating under A.C.-D.C. limits of about 100 V. "B" supply. As every radioman knows, it is sound and sensible practice to *get as much gain as possible out of the first tube in a superhet. line-up*—and if no other reason to provide for a reasonably good signal-to-noise ratio. Gain must come from the *front end*—and if the conversion gain of the mixer tube isn't sufficient to meet requirements, then we must add an R.F. tube and put it to work at full efficiency. And so we added a 6K7 R.F.—and solved another problem. We increased the overall R.F. gain, too, by substituting polyiron-core transformers in both R.F. and mixer circuits in place of the more conventional air-core jobs originally used. All this served not only to afford the desired "soup" but to *balance the gain over the whole tuning range of the receiver*—making for proper alignment and sensitivity at the high- and low-frequency ends of the dial. Good! But we now had 6 tubes in our line-up—just one too many!

We now tried something which various manufacturers of A.C.-D.C. and inexpensive transformer-powered receivers have occasionally worked into some models—the idea of eliminating the I.F. tube and matching the mixer through a single I.F. transformer directly into the input circuit of the 2nd-detector. This worked in fair enough fashion—with our original two air-core I.F. transformers reduced to one and with our original 6Q7 diode 2nd-detector, but with appreciable loss in overall gain and selectivity. The 6Q7 was removed and a 6J7 with "plate detection" substituted. Much improvement in both gain and selectivity was noticed, but we were still not satisfied. And finally we pulled out the last remaining air-core I.F. transformer and substituted a copper-shielded, polyiron core-type. Now for once and for all the result pleased us. We had an A.C.-D.C. superhet. line-up which exactly met our requirements.

The 6J7 is resistor coupled to one of the new 25A6 octal-based metal power tubes (electrically similar to the glass 43), with a 0.5-meg. potentiometer in the control-grid circuit of the 25A6. The potentiometer acts as a fixed grid load, the variable tap connection through a 0.006-mf. condenser to ground affording control of the tone. (This tap may be connected through the 0.006-mmf. condenser to the plate of the 6J7, if desired, in which case the bypassing of audio frequencies takes place in the plate circuit of the 2nd-detector tube.)

Note that the 6K7 and 6A8 screen-grids are tied to the "B" plus terminals of the plate circuit transformer windings for full 100 V. operation. If the set is properly wired and the parts arranged for short leads and a minimum of intercoupling, no trouble will be experienced with screen-grids operating at this voltage—but if difficulties *are* met with (such as 6K7 oscillation), the screen-grid leads may be decoupled through voltage dropping resistors and the leads bypassed at the sockets through 0.1-mf. capacities to ground.

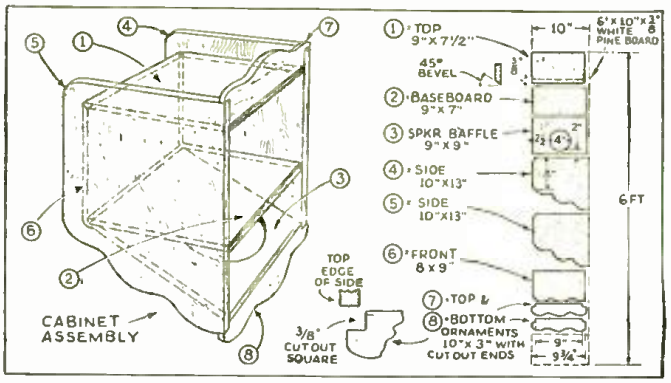


Fig. 2. The details of parts used in the construction of the wall cabinet. All the wood is "knotty" pine which is finished in early American style with wax rubbed to a velvet gloss.

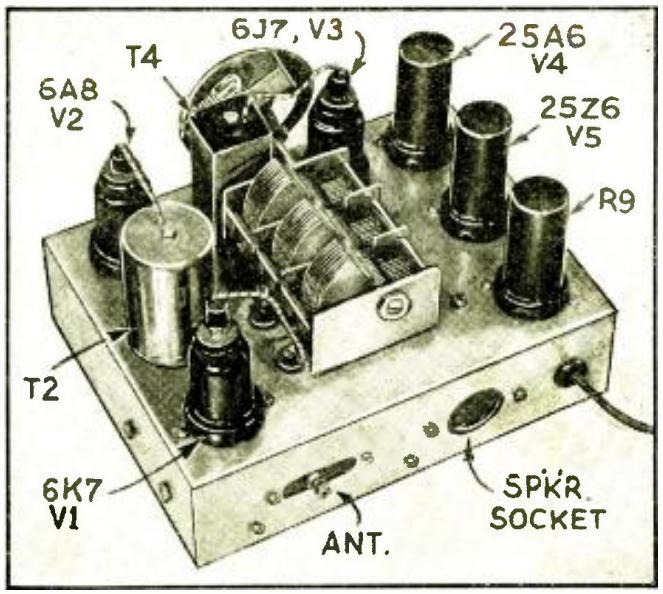


Fig. B. The top of the chassis showing parts layout.

Or the power lead to the transformer "B plus" terminals may be broken and decoupling resistors inserted, with similar bypassing. The screen-grid voltage for the 6J7 2nd-detector is taken from the cathode of the 25A6 power tube—the amount of voltage being determined by the drop across the cathode resistor, R7.

Both R7 and R4 (2nd-detector and power tube cathode resistors) are bypassed by 5 mf. electrolytics, of 25-V. rating. (These are advised in spite of the general practice of using 0.1-mf. filter capacities at these points.)

If the lead to the oscillator "B plus" is long, an additional 0.1-mf. might be wired from the oscillator transformer red wire to ground, with similar capacities bypassing from R.F. transformer "B plus" leads to ground if the connections from these transformers to the power are not direct and short. All these capacities may be of 200-V. rating.

The incoming antenna lead is isolated from the chassis, which is connected to the volume control (R1) at the variable tap, through a 0.002-mf. condenser. The volume control itself is so connected that as the 6K7-6A8 bias is increased and the mu of these tubes lowered for decreased gain, the resistance across the antenna coil primary is lessened and the incoming signal weakened. This is in effect dual-point gain control and certainly nothing new—as the system has been used since the very first days of variable-mu tubes. But it is not too popular right now, with audio control of volume the commercial practice, and needs a bit of rejuvenation. In the *Radio-Craft* wall set, it becomes the most sensible and effective means for manually determining matters of gain and for preventing R.F. overloading from

(Continued on page 174)

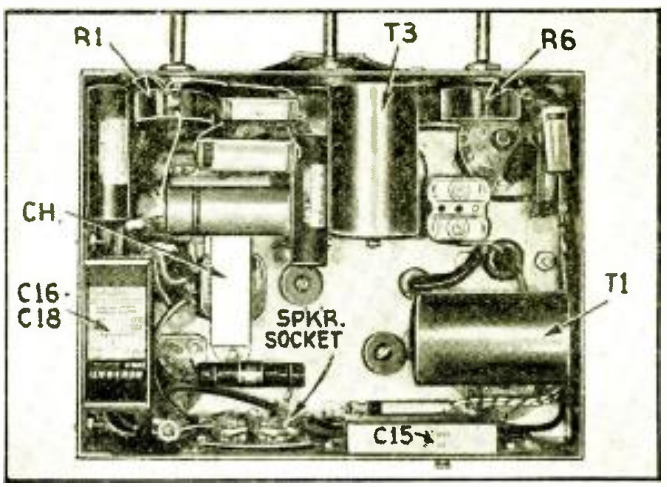
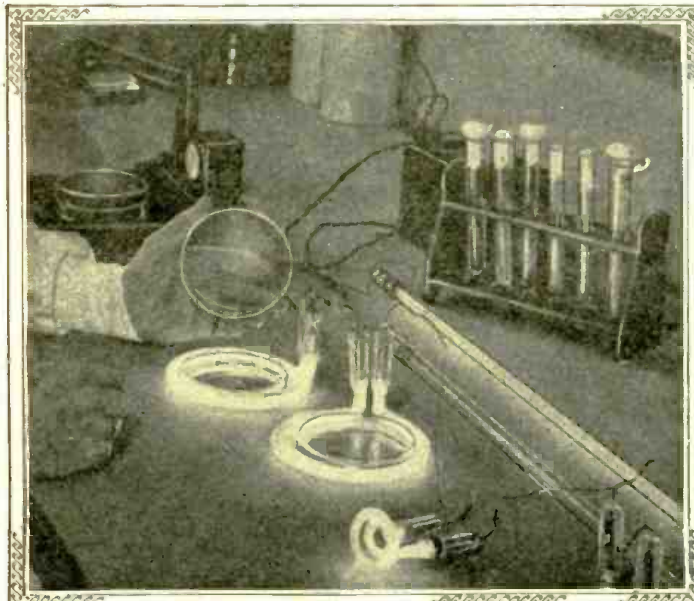
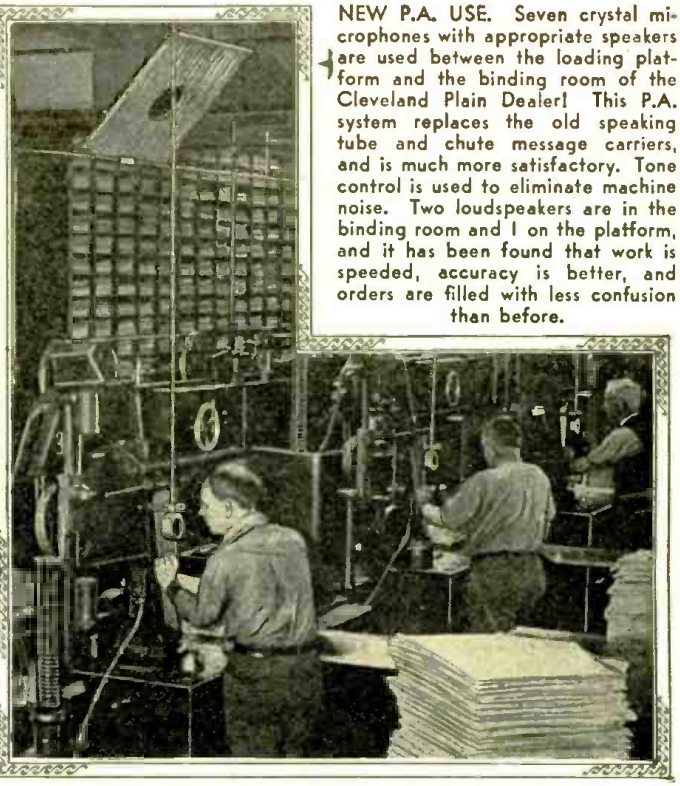


Fig. C. The under chassis view of the wiring.

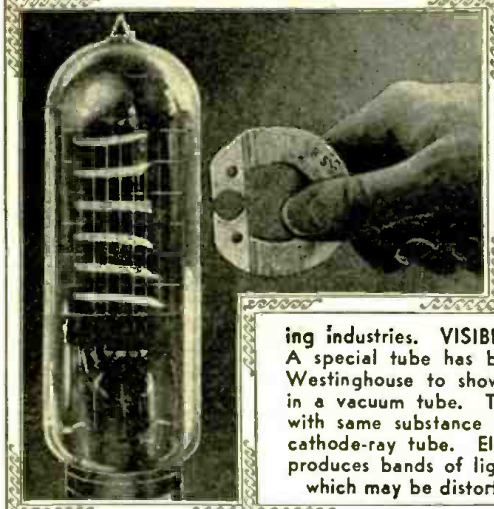
RADIO PICTORIAL

Newspaper uses P.A. system; New germ-killing lamp highly effective; A tube which enables study of electron action; Fleet of "Voice of Safety" cars to aid police.

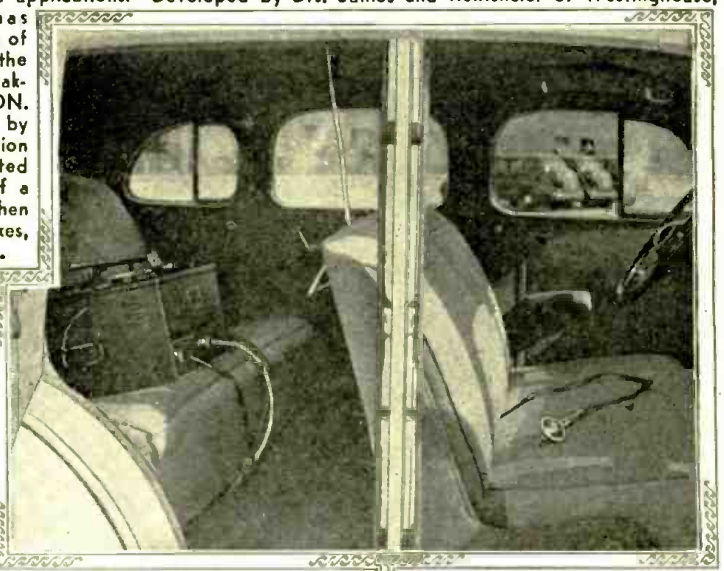


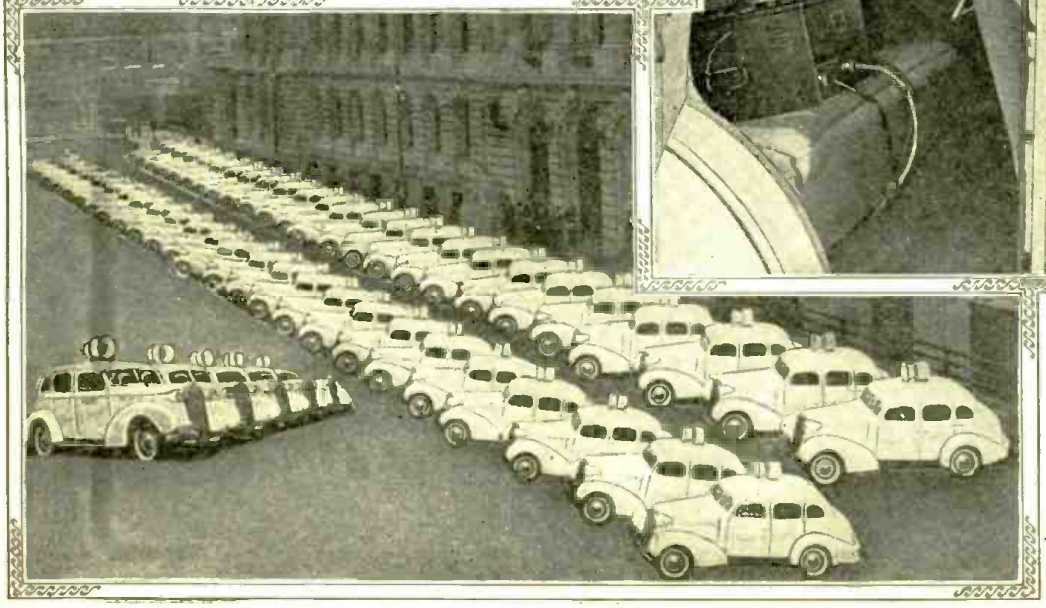


NEW P.A. USE. Seven crystal microphones with appropriate speakers are used between the loading platform and the binding room of the Cleveland Plain Dealer! This P.A. system replaces the old speaking tube and chute message carriers, and is much more satisfactory. Tone control is used to eliminate machine noise. Two loudspeakers are in the binding room and 1 on the platform, and it has been found that work is speeded, accuracy is better, and orders are filled with less confusion than before.



DEATH TO GERMS. A new gas-filled tube has been found to have exceptional germ-killing properties. It may be used in any shape, and is essentially cold in operation, a feature of marked advantage in some applications. Developed by Drs. James and Rentschler of Westinghouse, the lamp has already been of great aid to the meat and baking industries. VISIBLE TUBE ACTION. A special tube has been developed by Westinghouse to show electronic action in a vacuum tube. The plate is coated with same substance as the screen of a cathode-ray tube. Electron stream then produces bands of light where it strikes, which may be distorted by a magnet.





55 "VOICES OF SAFETY!" A fleet of 55 Oldsmobile cars painted white and equipped with sound apparatus has been turned over to the Police Departments of various large cities. Part of the 30 cars which appeared in the Safety parade in New York are at left. Above is an interior view, showing the compact P.A. equipment used in this latest campaign for more safe driving conditions.

A "TRAVELER'S COMPANION"

2-TUBE ALL-WAVE A.C.-D.C. SET

Drop this little set into your suitcase when you travel. It's sensitive—and works on A.C. or D.C.

H. G. CISIN

THIS TRAVELER'S Companion is ideal for those who require a small, light, but powerful radio receiver for portable purposes. The set is built within a compact metal carrying case and the entire outfit, including coils and phone, weighs less than 3 lbs.!

The "Companion" has plenty of power—in fact, enough to operate a fair-size magnetic speaker on strong stations. Although nominally a 2-tube set (1 glass and 1 metal), it is actually a 3-tuber since the 12A7 is a dual-purpose tube capable of functioning as a combined power output pentode and as a rectifier.

The radio circuit employed in this receiver calls for a regenerative detector. In this instance, a 6C5 metal tube is used. This is coupled resistively to the pentode portion of the 12A7 tube. The triode portion of the tube serves as the rectifier, as mentioned above.

The wide tuning range—from 17 to 560 meters—is attained through the use of plug-in coils. A single variable condenser, C2, shunted across the longer winding of the plug-in coil permits broadcast as well as short-wave tuning. (As a matter of fact, it is possible to cover a much higher range with this same tuning condenser through the use of specially-wound long-wave coils.) The unused coils may be fitted into cardboard receptacles cemented to the inside of the cover.

Regeneration is controlled by means of potentiometer R2, shunted across the tickler winding of the coil. For broadcast reception, a short indoor aerial, or a wire thrown on the floor will suffice. Naturally, a well-constructed outdoor antenna will produce best results in bringing in the distant

Fig. A. The small size of the set is evident.

short-wave stations. The antenna trimmer, C1, provides a convenient means of adjusting the set for varying lengths of aerials, aids in the separation of broadcast stations and also furnishes an additional tuning control for short-wave reception. Reverse the connections to tickler terminals B and P if the circuit does not oscillate ("squeal") when tuned almost to a station carrier.

Since this receiver uses the A.C.-D.C. circuit, it can be operated equally well from alternating or direct current. Filament voltage is reduced to the correct value by means of a 350-ohm resistor, R7, contained within the line cord. The filaments of both tubes are connected in series with each other and with R7. Make sure (by experiment) that resistor R1 has the best value for your particular set as it has a very great effect on the sensitivity of the set.

Adequate filtering is accomplished by means of the dual electrolytic condenser having two 8 mf. sections within a single container. One section is connected at one end of the 10,000-ohm filter resistor, R6, and the other at the other end of the resistor. To conserve space, an on-off switch, Sw.1, is combined with potentiometer R2.

In selecting tubes for this receiver the 6C5 was found to be extremely suitable as a detector, especially, because of the close shielding obtainable with a metal tube. Because of its improved mutual conductance and higher amplification factor this tube gives far better performance than the old-

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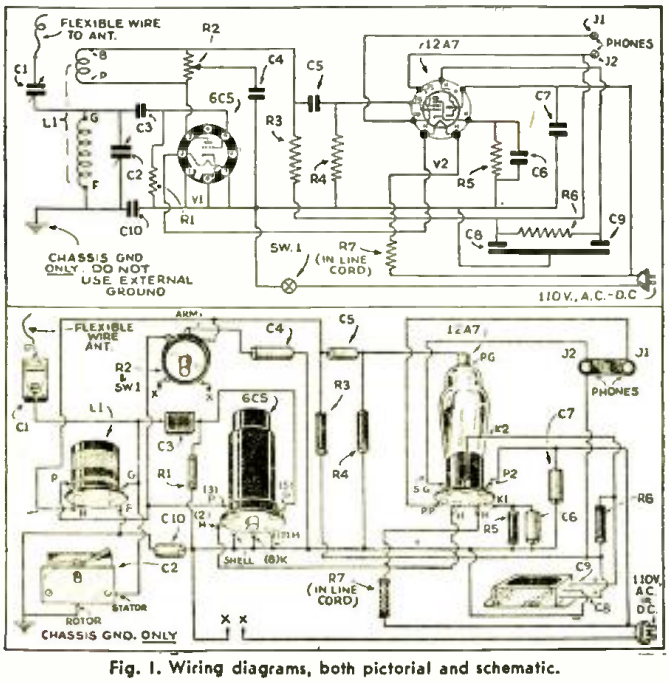


Fig. 1. Wiring diagrams, both pictorial and schematic.

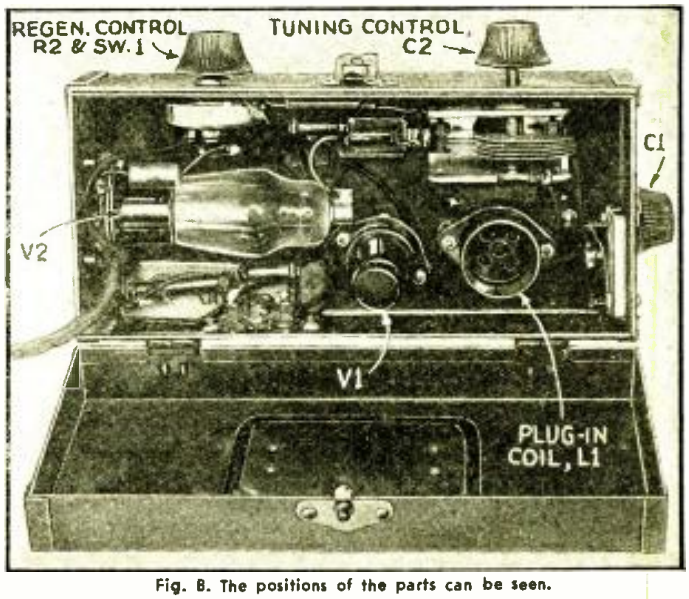
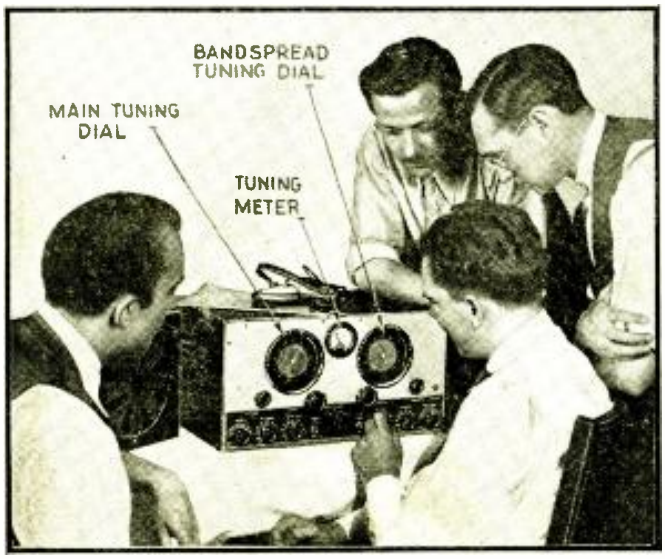


Fig. B. The positions of the parts can be seen.



HOW TO MAKE AN ULTRA-DX 12-TUBE ALL-WAVE SET

Described here is an advanced all-wave receiver for the short-wave listener or the amateur. It has all the latest features which make for outstanding results, yet is not difficult to build due to careful selection of parts, states the author — "W2FHP".

H. G. McENTEE

PART I

THERE HAS BEEN such a great variety of all-wave receivers dumped upon the market in the last year or so, that the prospective buyer is at a complete loss as to what will best fit his needs. Those that are undeniably "high-class," are just as undeniably high-priced—much more so than the average S.W.L. (short-wave listener) or "ham" can afford. And those more reasonably-priced often omit features the purchaser wants.

Then too, he quite often has his own ideas as to just what features he wants in such a receiver. The writer has gone through all this, and finally arrived at a list of features somewhat as follows:

(1) Band switching. While this is conceded to be slightly less efficient than various types of plug-in arrangements, it certainly makes up for this lack in its flexibility, compactness and convenience.

(2) Really high selectivity. The only way to achieve this is by the use of a crystal filter. In addition to this iron-core I.F. transformers are to be used, since their resonance curve is much more steep than the air-core type, neglecting for the time their other desirable characteristics.

(3) Noise suppressor. This development of Lamb (*Radio-Craft*, May 1936, pg. 669—*Editor*) is a help to those who live in noisy locations. Of course, the silencer cannot be expected to totally eliminate all noises, but it is usually possible to get a signal through in some sort of shape, even in very bad locations.

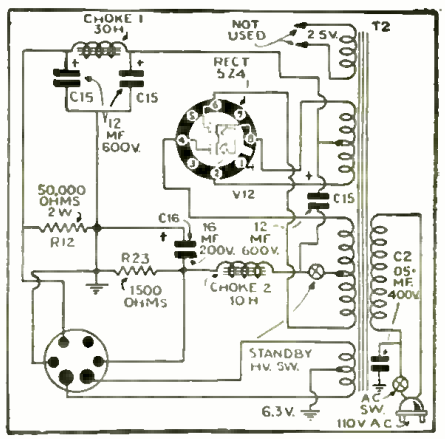
(4) A really effective A.V.C. system. The usual diode A.V.C. system as used in the great majority of commercial receivers is not very satisfactory from many points of view. To make it more effective an A.V.C. amplifier is needed, and this necessitates another tube and transformer. A review of countless practical A.V.C. systems brought to light a very likely looking scheme, originated by F. Offner.

This system is quite old, but the new adaptation of it is quite simple. An extra tube, but no extra I.F. transformer is required. Also, a triode detector must be used, but this is highly desirable, since it eliminates the high-gain A.F. stage, required when a diode is used. Moreover, the cathode lead of the triode detector gives us a fine place to put a tuning meter, this meter reading *upward* so it doesn't have to be stood on its head as do many tuning meters!

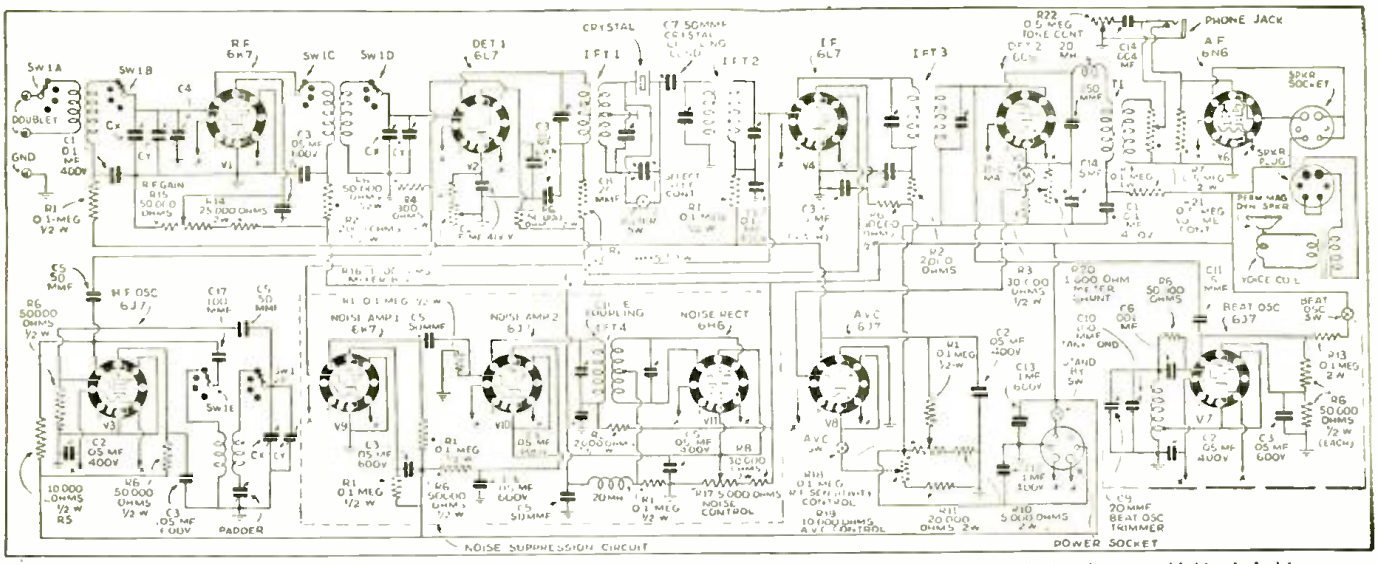
(5) Adequate band spread. This receiver is to be used for amateur band operation as well as general short-wave and broadcast work. The writer has always had a liking for that old standby, the parallel condenser system of band-spread. It is of the greatest simplicity, but still is highly effective. True, it has its faults, but what system hasn't?

(6.) Good tone quality and moderately

(Continued on page 170)



Circuit of the power supply. Note "C"-bias circuit.



Complete receiver circuit. The noise suppression circuit may be omitted if desired, as may the crystal filter circuit, but both are highly desirable.

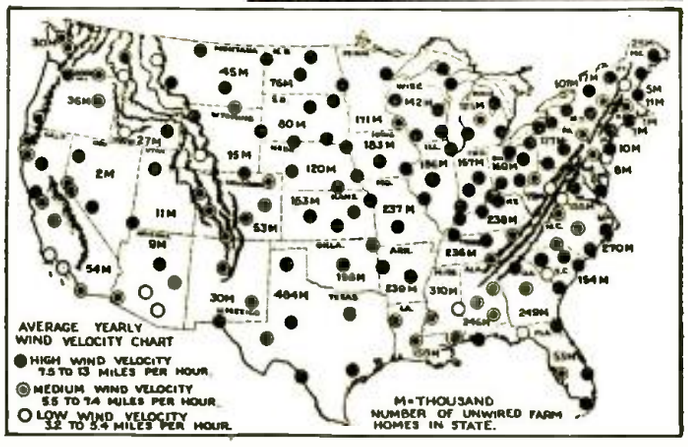
SERVICE MEN—
MODERNIZE FARM RADIO WITH WIND!

There is a big field for Service Men in rural districts installing sets powered by wind-driven generators.

MAURICE LASENSKY

Fig. A, right. A typical wind-generator installation on a farm. Raising the generator on a mast increases the effectiveness.

Fig. 1, below. How the wind blows. "It's F.O.B. the farm and sales tax paid," 'tis said.



A REAL STEP toward expanding the volume of radio sales and also toward allowing the farm more of the conveniences of the city owned homes has been made by the introduction of wind-powered generators to maintain the radio batteries, as shown in Fig. A. The extent to which adequate wind pressure is available throughout the entire United States is shown in Fig. 1.

Even before the advent of the A.C. sets, the farmer was handicapped with his set, because it was too far and troublesome to take the "A" batteries into town to be re-charged. With the coming of the A.C. set, the farmer again was far behind the average city resident in regard to having a modern radio receiver. He still had to fight the inconvenience of battery re-charging and replacing of "B" batteries. This continued until recently when the introduction of the vibrator eliminated the necessity of "B" batteries for a high plate potential. Here at last the farmer no longer had to replace his "B" batteries. But better than that—along came a wind-electric charger, which would even maintain the charge in his "A" battery through the use of the free wind. He, at last, had the radio comforts of the city resident in that he had no "B" battery to buy and the "A" battery no longer needed to be taken to town for re-charging. This unique device—the wind charger—immediately sprang into

(Continued on page 189)

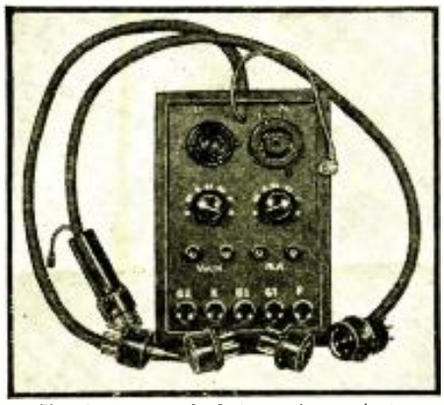


Fig. A. The panel of the analyzer adapter.

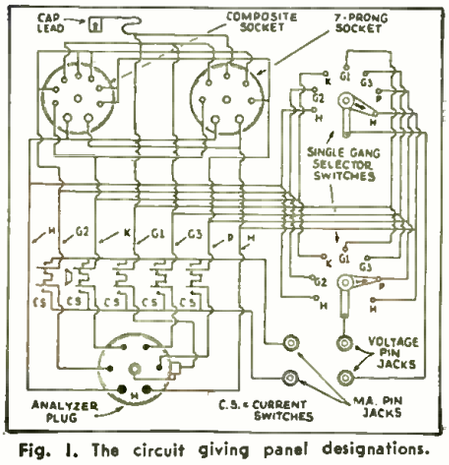


Fig. 1. The circuit giving panel designations.

A POCKET-SIZE ANALYZER ADAPTER UNIT

This unit, with a multi-meter, or individual voltmeters and ohmmeters will be extremely useful to Service Men.

LOWELL E. HINKLE

THE "ADAPTER UNIT" illustrated in Fig. A, is useful and speeds up test analyses. Its small size is due to the fact that only two sockets are used. These sockets accommodate 4-, 5-, 6- and 7-prong tubes, as shown in the schematic circuit, Fig. 1.

Current tests are speeded up by the fact that it is only necessary to plug the milliammeter into the pin-jacks and then depress buttons one after another in the circuits to be read.

Potential measurements are made in a similar manner, by plugging the voltmeter leads into the pin-jacks marked Volts; all voltage readings may be made by using the selector switches located under the tube sockets. These jacks and selector switches may be used for circuit resistance measurements; be sure the set is "dead."

A box for this unit may be made of metal or wood, and the depth to suit the builder.

LIST OF PARTS

*One 6-prong plug, 5-ft. 7 conductor cable, type 906 WLC;
*One adapter, type 964 DS;
One adapter, type 965 DS;
One adapter, type 967 DS;
*One 7-contact socket, type 6130;
*One composite socket, type 6127 (or 7-contact, large-small base socket, type 477E);
*Four insulated pin-jacks, type 1096-B;
*Two 7-point, single-gang switches;
*Five pushbutton D.P.D.T. switches;
One case (see text);
One bakelite panel, 4½ x 7 x ¼-in.

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

"WHAT'S WRONG WITH MY RADIO SET?"

When your customers ask you this question, show them the following chart—which lists the major sources of trouble in faulty radio receivers. Space limitations preclude listing all the detailed causes (short- and open-circuits, off-value components, etc.) of the various troubles here enumerated, which the Service Man must check before he is in position to quote an approximate charge for repairs.

ANTENNA, GROUND, AND LIGHTNING ARRESTER
- NO SHORT-WAVE RECEPTION
- INTERMITTENT RECEPTION
- POOR RECEPTION
- LACK OF VOLUME
- EXCESSIVE NOISE
- FADING

TUBES
- NO RECEPTION
- DISTORTION
- HUM
- OFF-CALIBRATION OF DIAL
- LACK OF SENSITIVITY
- LOSS OF SELECTIVITY
- MICROPHONICS
- INTERMITTENT RECEPTION
- FADING
- POOR A.V.C. ACTION
- NOISY RECEPTION
- CIRCUIT OSCILLATION

REPRODUCER
- DISTORTION
- TINNY SOUNDS
- SCRATCHING AND GRATING
- EXCESSIVE HUM
- INTERMITTENT RECEPTION
- NO RECEPTION
- LOW VOLUME

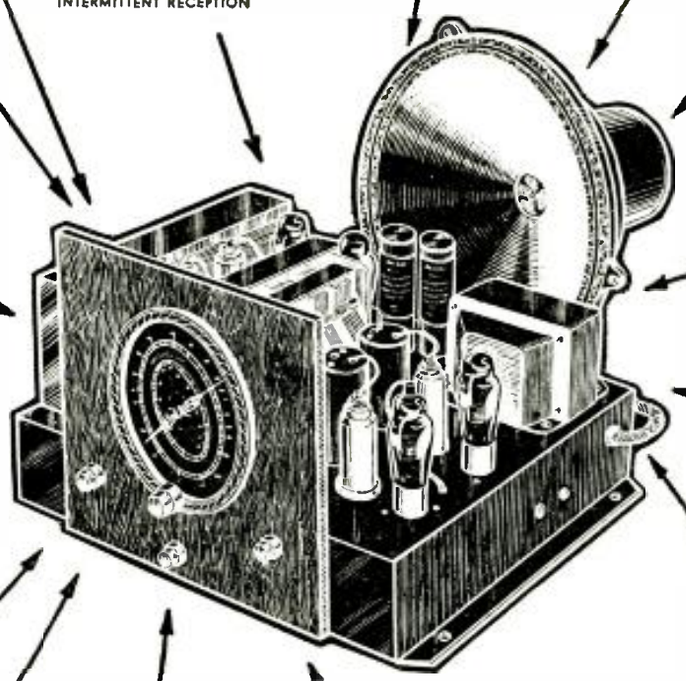
BYPASS CONDENSERS
- CIRCUIT OSCILLATION
- POOR TONE QUALITY
- CROSS-TALK
- INTERMITTENT RECEPTION
- POOR A.V.C. ACTION
- FADING
- LOSS OF VOLUME
- HUM
- EXCESSIVE HISS
- NOISY RECEPTION
- OFF-CALIBRATION OF DIAL
- NO RECEPTION
- SHORT-WAVE DEAD SPOTS

R.F. AND I.F. COILS
- INTERMITTENT RECEPTION
- OFF-CALIBRATION OF DIAL
- POOR SELECTIVITY
- SPOTTY SELECTIVITY
- LACK OF SENSITIVITY
- SPOTTY SENSITIVITY
- POOR FIDELITY
- NO RECEPTION
- FADING
- CROSS-TALK
- CIRCUIT OSCILLATION

I.F. WAVETRAP
- CODE INTERFERENCE
- INTERMITTENT RECEPTION

WIRING OF SET
- NOISY RECEPTION
- EXCESSIVE HUM
- CIRCUIT OSCILLATION
- LACK OF SHORT-WAVE RECEPTION
- NO RECEPTION
- CROSS-TALK

OSCILLATOR SECTION
- LACK OF SENSITIVITY
- EXCESSIVE HISS
- DISTORTION
- ERRATIC OPERATION
- DEAD SPOTS ON SHORT WAVES
- FREQUENCY INSTABILITY
- INTERMITTENT OPERATION



TUNING CONDENSERS
- NOISY RECEPTION
- DEAD SPOTS
- INTERMITTENT RECEPTION
- MICROPHONIC HOWLS
- OFF-CALIBRATION OF DIAL
- FADING

POWER TRANSFORMER
- NO RECEPTION
- INTERMITTENT RECEPTION
- EXCESSIVE NOISE
- EXCESSIVE HUM
- SHORT TUBE LIFE

RADIO CABINET
- RESONANCE
- TINNY SOUNDS
- RUMBLES

SHIELDING OF SET AND COMPONENTS
- CIRCUIT OSCILLATION
- MICROPHONICS
- NOISY RECEPTION
- LACK OF SENSITIVITY
- CROSS-TALK
- FADING
- INTERMITTENT RECEPTION

ALIGNMENT OF STAGES
- LACK OF SENSITIVITY
- SPOTTY SENSITIVITY
- POOR TONE QUALITY
- CIRCUIT OSCILLATION
- CODE INTERFERENCE
- OFF-CALIBRATION OF DIAL
- POOR SELECTIVITY
- SPOTTY SELECTIVITY

LINE CORD AND PLUG
- INTERMITTENT RECEPTION
- NO RECEPTION
- NOISY RECEPTION

WAVE-CHANGE SWITCH
- LOSS OF VOLUME ON SHORT WAVES
- INTERMITTENT OPERATION
- NO RECEPTION
- NOISY RECEPTION
- SHORT-WAVE DEAD SPOTS
- FADING
- LOSS OF VOLUME
- A.V.C. NOT FUNCTIONING

VOLUME AND TONE CONTROLS
- NOISY RECEPTION
- NO CONTROL OF VOLUME
- SUDDEN CHANGE IN VOLUME
- NO CONTROL OF TONE
- SUDDEN CHANGE IN TONE
- INTERMITTENT RECEPTION
- NO RECEPTION
- LOSS OF SENSITIVITY
- CIRCUIT OSCILLATION

HOUSE WIRING
- INTERMITTENT RECEPTION
- NO RECEPTION
- NOISY RECEPTION

A.F. TRANSFORMERS
- NOISY RECEPTION
- NO RECEPTION
- REDUCED VOLUME
- INTERMITTENT RECEPTION
- POOR TONE QUALITY

PIPES IN HOUSE
- INTERMITTENT RECEPTION
- NOISY RECEPTION

RESISTORS
- INTERMITTENT RECEPTION
- DISTORTION
- POOR A.V.C. ACTION
- FADING
- CIRCUIT OSCILLATION
- NO RECEPTION
- LOW VOLUME
- SHORT TUBE LIFE

FILTER CONDENSERS
- EXCESSIVE HUM
- NO RECEPTION
- LOW VOLUME
- INTERMITTENT RECEPTION
- CIRCUIT OSCILLATION

LOCAL MACHINERY AND APPLIANCES
- NOISY RECEPTION
- CLICKS
- SUDDEN CHANGE IN VOLUME

ATMOSPHERIC CONDITIONS
- FADING
- NOISY RECEPTION
- DISTORTION
- LACK OF SHORT-WAVE RECEPTION
- CROSS-TALK

(Original compilation courtesy Radio Today; modifications by Radio-Craft.)

ANALYSES of RADIO RECEIVER SYMPTOMS
OPERATING NOTES

Bosch Model 58. The power transformer smoked as soon as the set was turned on. A check also revealed that the filament windings supplying the 2 type 45 power tubes and the 5 V. winding for the type 80 tube were burned out. The power transformer was rewound and reinstalled. A complete check of all parts of the set failed to reveal the cause of the burnout. The set was turned on, a careful watch being kept on the rectifier tube at the same time. Sure enough, it immediately turned red hot. With the set still on and upside down on the bench, all parts were tapped to see if an unseen short was the trouble. While doing this, I noticed a small arc below the rectifier socket, from one side of the filament to ground. Inspection proved that the socket was cracked at the filament prong and was burned through. This socket is of the bakelite subpanel mount type as shown in Fig. 1A, and the crack would never have been noticed if the arc had not been actually seen. Since the set does not come equipped with a fuse, one was installed.

The receiver was then returned to the customer, who was well pleased with the results. The trouble was not over yet however, since after playing well for 10 minutes, the fuse blew. I had had the set working perfectly in the shop for several days, yet it went bad after it had been in the owners house a few minutes! Another fuse was put in and this also blew. Once more removing the chassis, it was found that the rectifier plate leads from the transformer were of poorly-insulated wire, and had crossed, blowing the fuses. The wire was replaced and the receiver has now been working for over 6 months with no trouble. Had it not been for the fuse I installed, the transformer secondary would probably have burned out again!

ANDREW M. WEIHL

Crosley Model 706 "Showbox." Intermittent reception. Examination showed the light of the type 26 tubes would go out and come on again at intervals. The trouble was finally traced to a loose lug on the terminal strip of the power unit, see Fig. 1B. This lug connects one lug of the 1.5 V. filament winding and it is riveted onto the bottom of the terminal strip. (All of the lugs are riveted onto the bottom of the strip and when they loosen it is almost impossible to tighten them.) The loose connection was repaired by taking out the screw which is on top of this rivet, and placing a new lug on top of the strip, holding it tight with the screw. Then the filament wire was disconnected from the loose rivet and connected to the tight one.

Any complaints of intermittent reception on these sets always lead me to first test the connections on this strip, since the lugs can and usually do come loose and it's one spot where trouble is least expected.

NELSON KAPPES

Philco Model 60. Set was reported "dead." A faint hum could be heard with the ear close to the speaker, which showed that the speaker field and voice coil were probably in good shape. A voltage check showed that the voltage was very low in the filter system and zero at the 6A7 and 78 tubes. This naturally pointed to a shorted condenser, No. 20, but upon removal and test this turned out to be perfect. The trouble was finally isolated in the I.F. padding condenser, No. 17, which was grounded, as shown in Fig. 1C. This condenser is across the primary of the 1st I.F. transformer, and is mounted on the chassis by means of a small screw and collar. The screw goes through a brass eyelet in the condenser, and in this case the screw was tightened too much. This squeezed the fibre insulation, allowing the eyelet to move so close to the terminal of the padder that the high voltage broke down the insulation and jumped to ground. When the nut was loosened, the trouble cleared, but it was thought better practice to replace the condenser.

HARRY W. MONEY

Philco 20. First offender used on others. Cut off and on, and all voltages checked OK. Snapping any light switch would bring reception back. After trying every trick I knew, I took a large condenser, about 0.1-mf., and placed it across each condenser in set. Every time, the set would start playing again until I came to the coupling condenser from detector to 1st audio and here it would not cause the set to play. Replacing condenser cured all troubles.

HENRY C. DEAN

Brunswick Model AC10. The power transformer was very hot and had been smoking. The tubes were taken out and tested, and when inserted again the set worked OK. All we could figure out was that the type 80 tube was put into the socket backwards as the owner had the tubes out to get them tested at a tube dealer. The high-voltage winding of the power transformer doesn't supply enough current to burn out the filament in the tube.

U. S. Radio & Television Model 26. This set would cut down in volume and then come in loud again. It was found that the detector cathode bypass condenser was open. We usually check the condensers for opens by connecting a good condenser across the ones in the receiver.

Majestic Model 120B Air-Cell Receiver. In this model, the volume cut down and then came back loud again. Look for a poor condenser in the coil shield cans. We checked everything else but these condensers before the trouble was found. We didn't suspect that they would put a bypass condenser in the coil shield cans.

Crosley 601 Model. The set was "dead," but the voltages checked OK. Finally the neutralizing condenser was found to be shorted. The set was neutralized and then worked fine.

Atwater Kent Model 67. This radio played fine when it did play, but at times it wouldn't go at all or it might stop dead if it was playing. Batteries, voltages and currents checked OK. We made a couple trips to the country where the set was, and finally had to bring the set to the shop. Trouble was finally found in the voice coil leads from the output transformer to the voice coil of the dynamic speaker. They were open, although shellac covered them where they were spliced. We soldered the splice.

Crosley Screen-Grid Battery Set. Didn't have any pep, and circuit oscillated when given full volume. All voltages checked and all parts checked OK, so we were baffled. Almost gave up the job. Finally resoldered all connections and the set worked fine.

Crosley Model 33. Distortion and low volume level. The coupling condenser between the detector and A.F. tube often develops a high leakage resistance but may test "good." The use of such a defective unit will cause the troubles noted and will place a high positive voltage on the grid of the A.F. tube. Replacement is the only cure.

RCA-Victor Car-Radio Model M34. The complaint was that the set didn't work. There was no plate voltage on the oscillator and 1st-detector tube. The leads from the I.F. coil were so close to the shield can that the insulation had broken down and burned the wire off. We re-soldered the wire and then aligned the set.

Sparton Model 931. Set played intermittently. Filaments in the push-pull audio stage would go out. Tubes checked OK. Trouble found as a bad connection on the hum balancer which is in series with the filament.

Sparton Model 410 Jr. "Set cuts down in volume," said the customer. Checked everything. Jarring the set wouldn't help any. Still it would work fine—then go weak. We discovered what was wrong by connecting a wire from the rotor plates of the variable condensers in one of the sections to ground. The set worked fine and kept on working. Evidently the variable plates weren't making connection with the shaft, although the plates weren't loose. Soldering the variable plates to the steel shaft cured the trouble.

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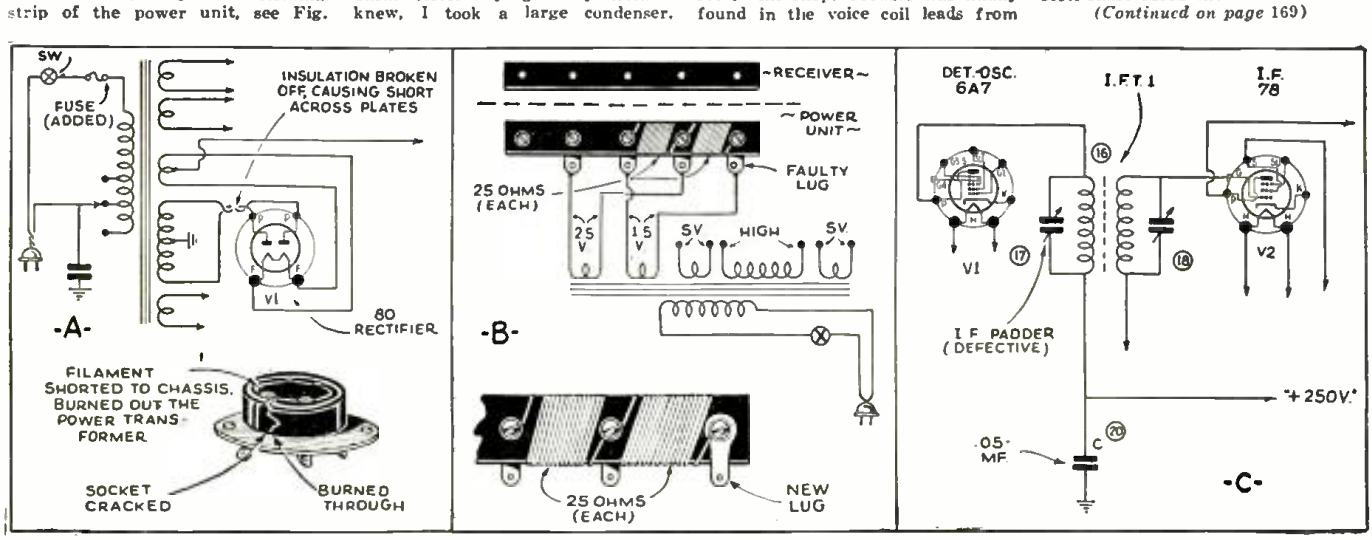
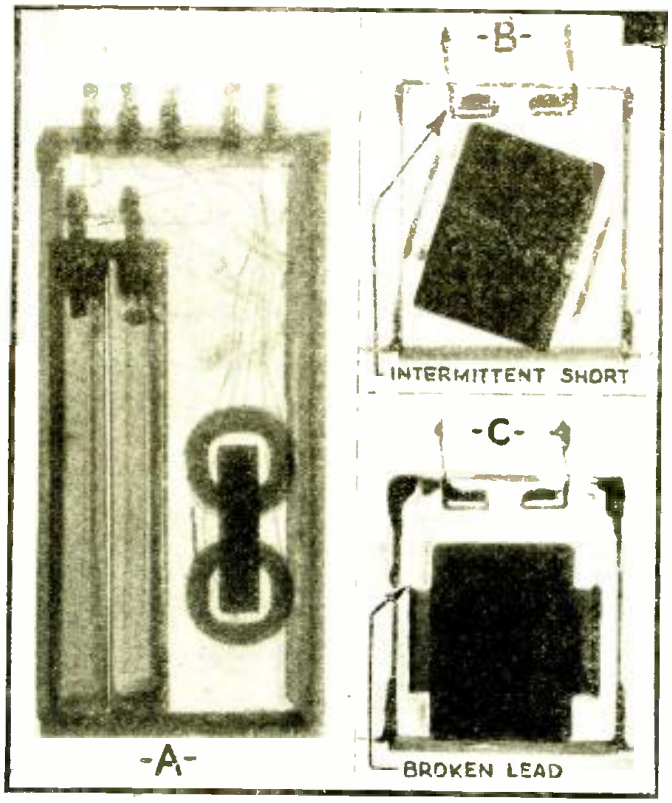


Fig. 1. Overheated power transformer caused by several troubles. Right, power supply shorted by a grounded padding condenser.



Three examples of X-ray analyses of electrical devices. At A is a shielded and impregnated assembly of coils, condensers and resistors. At B and C are shown 2 metal-case condensers having intermittent shorts between condenser and case, and open connecting lead.

CHECKING RADIO SETS BY X-RAY!

By means of X-rays, radio parts and sets can be examined without affecting their operation.

C. W. PALMER

X-RAYS, which only a few years ago were considered to be useful only in medical work have been finding many interesting and unique applications in industrial engineering.

The fact that it is not necessary to destroy the object to discover its internal condition is one of its outstanding advantages over other methods of examination. Thus, X-rays may be used to discover flaws and defects in metal objects, and they may also be used to detect defects in assembled apparatus, such as defective wiring, misalignment, etc.

In the radio field, this faculty becomes particularly advantageous. For example, in a power transformer, choke coil or A.F. transformer, broken leads or intermittent shorts in the device, which may be enclosed in a shield or can of considerable thickness as well as being impregnated in a "potting" compound or pitch can be seen in "radiographs" of the object.

In the radio engineering laboratory the X-ray permits devices on life tests or overload tests to be checked at regular intervals.

(Continued on page 169)

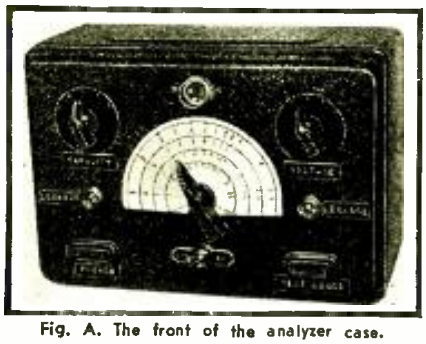


Fig. A. The front of the analyzer case.

A SIMPLE WHEATSTONE BRIDGE CAPACITY ANALYZER

This handy device will measure capacities between 100 mmf. and 50 mf.; it will also test circuits for "shorts."

MICHAEL BLAN

HERE IS A capacity analyzer that is a companion unit for the All-Wave Oscillator that appeared in the October 1935 and January 1936 issues of *Radio-Craft*. It not only measures the capacity of condensers in *microfarads* but also, tests for opens and shorts. In addition it will show visually the actual leakage of a condenser *at its rated voltage*. This device tests all kinds of condensers—mica, paper, electrolytic and air, from 100 mmf. to 50 mf. The polarizing voltage can also be used wherever an external variable "B" source is needed up to 40 ma. This is sufficient energy to power a 3- or 4-tube receiver, and due to the good filtering is quite noiseless and hum-free.

The circuit used for measuring the capacity is the well known "bridge" method, which is one of the finest in use today. In this arrangement the A.C. voltage is balanced across a known condenser and is made to equal the same value of voltage across the unknown condenser being tested. This is accomplished by adjusting the variable resistance R1 until there is no sound in the headphones. Now by calibrating this potentiometer it is possible to have a scale *reading directly in microfarads:* for the benefit of those desirous of duplicating this analyzer a 3½-in. scale (see Fig. 2) can be pasted to a piece of cardboard and then mounted on the front panel of their instrument. Of course it is essential that the same type of potentiometer be used as the one specified otherwise the calibration will not check.

The 5 standard condensers used in the bridge were bought on the open market and they tested quite close to their rated

(Continued on page 176)

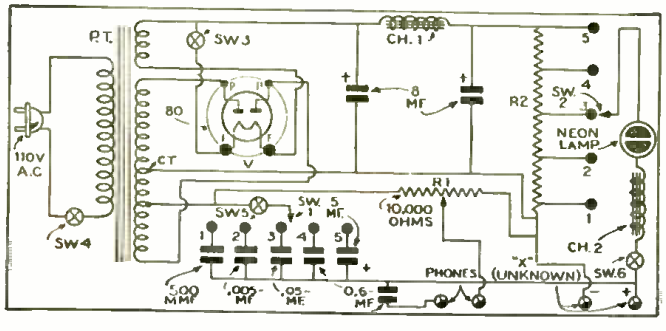
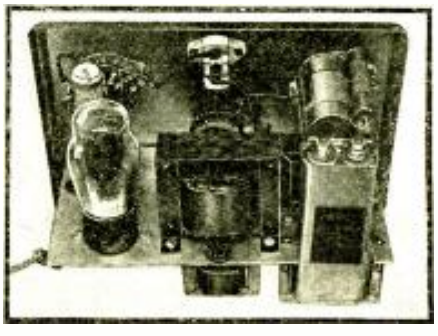


Fig. 1, left. The circuit of the tester, which uses a neon-tube indicator.

Fig. 8, right. The back of the chassis showing the positions of the parts, including the power transformer and filter choke.



HOW TO IMPROVE "TALKIES" FIDELITY

There is a big field for the wide-awake Service Man in modernizing theatre "sound" equipment.

LAWRENCE L. JOHNSON

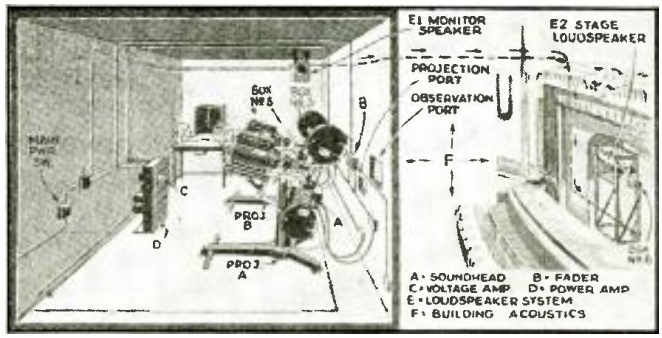


Fig. A. Details of the operator's booth and the projection and sound equipment.

SOUND AMPLIFICATION finds its highest point of development in the recording and reproduction of motion pictures. Here, we find an earnest effort to reproduce every iota of the original sound. The work of ERPI (Western Electric) and Photophone (RCA-Victor) is outstanding in this field of "extended-frequency operation." We find the present ultimate in perfect sound reproduction from carefully constructed sound stages at the producers, to beautiful sound-reproducing theatres, acoustically corrected. It is not our purpose to go into any details concerning the recording of sound as practiced in the studio since most of the readers of this article will make their contacts on reproducing apparatus.

ANALYSIS OF TALKIE SYSTEMS

All Talkie Systems can be divided into this rough classification:

A. Soundhead. (Fig. 1D.)
   1. Mechanical Drive or Filter.
   2. The Exciter Lamp.
   3. The Optical System.
   4. The Photoelectric Cell.
B. The Fader. (Fig. 1C.)
C. The Voltage Amplifier. (Fig. 2.)
D. The Power Amplifier.
E. The Loudspeaking System.
   1. The Monitor Loudspeaker.
   2. The Filter System.
   3. The Middle-Frequency Speaker.
   4. The Low-Frequency Speaker.
   5. The High-Frequency Speaker.
F. Acoustical Control.
   1. Building Treatment.
   2. Frequency Discrimination.

It is the purpose of this article to go into the subject of extending the audio frequency range of talking motion picture installations. This has been and is accomplished in 4 ways: (1) A—The use of an improved optical system to scan the sound track on the film and, B—insurance of smooth action on the part of the film passing the scanning device. (2) A—The addition of reserve power to the amplifiers, B—the extension of the frequency range to where it is only down plus or minus 1 decibel (or "db.") from 30 to 10,000 cycles per second (or "c.p.s.") and C—the elimination of all extraneous noise and hum from the amplifiers. (3) A—The installation of 2 or 3 loudspeakers and, B—a filter arrangement to allot only certain bands of frequencies to these units. (4) The improvement of the overall acoustics of the theater house.

FREQUENCY RANGE

The range of most of the original talkie amplifiers was substantially flat from 60 to 5,000 c.p.s. The public can excuse a lot in novelty if it is new but anything can get extremely old. Loss of the higher frequencies places a strain on the hearing since the ear is called upon to supply these missing components, and after 2 hours of this it becomes tiresome. An analogy is to be found in listening to a pipe organ as heard over "the radio"—it becomes extremely boresome. Sound engineers attacked the problem vigorously with the result that modern amplifiers are only down 1 db. over the entire audio range

(Continued on page 178)

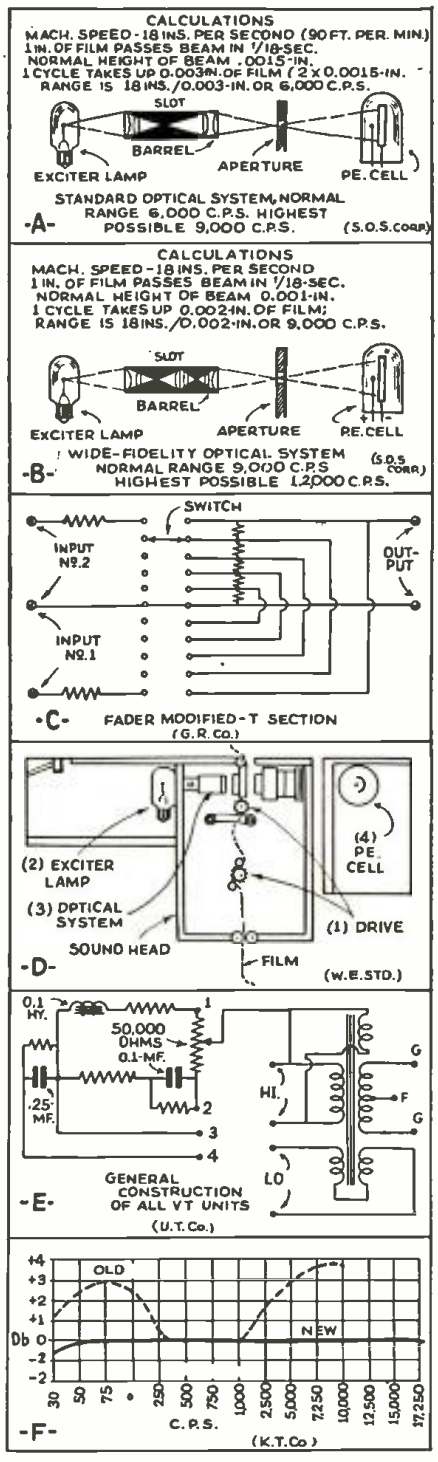


Fig. 1. Details mentioned in connection with "sound" improvements in the text.

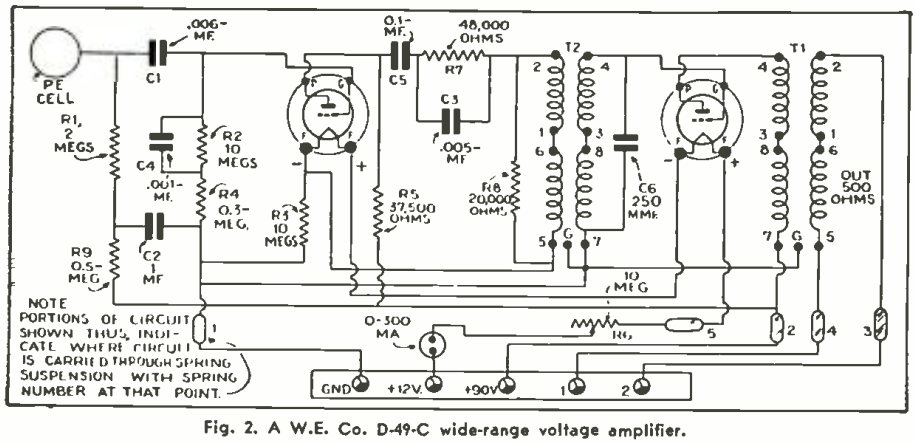


Fig. 2. A W.E. Co. D-49-C wide-range voltage amplifier.

USEFUL CIRCUIT IDEAS

Experimenters: Here is your Opportunity to win a prize for your pet circuit idea, if it is new, novel, and useful.

AWARDS IN THE CONTEST

FIRST PRIZE	$10.00
SECOND PRIZE	5.00
THIRD PRIZE	5.00
Honorable Mention	

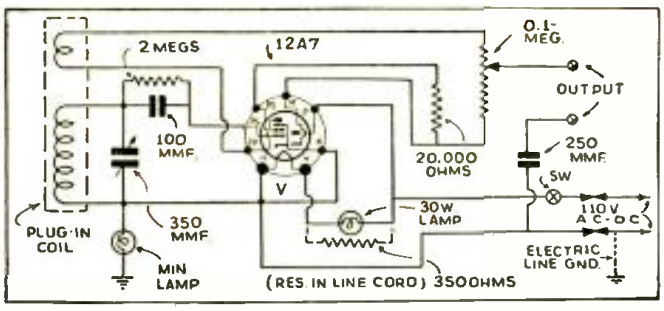


Fig. 1. Here is a simple A.C.-D.C. test oscillator with several novel features.

Fig. A. The completed oscillator.

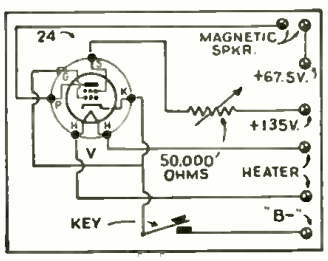


Fig. 2. A simple code practice unit.

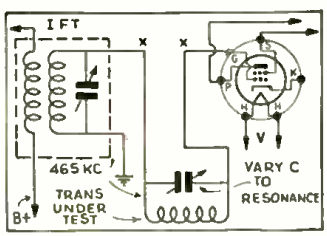


Fig. 3. Testing I.F. transformers.

FIRST PRIZE—$10.00

LOW-COST TEST OSCILLATOR. This simple instrument will give good results on either A.C. or D.C. Since it is intended for such universal use, the 5-W. miniature lamp is used as shown in Fig. 1. If the lamp lights when the plug is put in the socket, the plug should be reversed. Of course, a ground is needed on the oscillator for this test. This test should always be made, since if the plug is not inserted in the correct manner, the tuning condenser and some of the other parts of the unit will be "hot" and unless shielded may cause injury or damage. The rest of the circuit is very simple and may be followed from the diagram. Either a line cord resistor or a 30-W. lamp may be used as the series resistance to feed the heater of the 12A7. Standard plug-in coils of the desired band ranges are used for tuning.

The appearance of the completed unit in its case is shown in Fig. A. The use of the line cord resistance will enable the builder to construct a more compact unit, while the 30-W. lamp will be cheaper and will likely be easy to obtain. The cord should have a resistance of 350 ohms. The calibration chart may be fastened to the cover of the box, and the extra plug-in coils may be mounted there also. This oscillator is so simple that it cannot get out of order and it will be found extremely convenient to use.

LOUIS B. SKLAR

SECOND PRIZE—$5.00

INCREASING VOLTAGE. The usual full-wave rectifier circuit is shown at Fig. 4A. Occasionally a higher voltage than this affords will be needed while at the same time retaining the advantages of full-wave rectification. This may be accomplished by using the circuit at Fig. 4B, where the original equipment is all used, the changes allowing an increase in voltage of about 90 V. The resistors added should be of at least 5-W. rating, and may have a slightly different resistance value than shown, as for example 10,000 or 15,000 ohms, but both must be of the same value.

ROY HOCKIN

THIRD PRIZE—$5.00

COMPACT HIGH-VOLTAGE SUPPLY FOR OHMMETER. The high-resistance ranges of ohmmeters require a voltage of about 45 V. or so and this is usually supplied by batteries. These batteries are always dead when needed, however, and a powerline supply is much to be preferred. The circuit in Fig. 5 shows how a compact supply may be made that will give about 45 V. and up to 4 ma. current. The power transformer is a 2-to-1 ratio audio unit, over the existing windings of which is put a third winding of No. 26 enameled wire to supply the filament of the type 30 tube, which is used as a rectifier. About 100 turns will be needed and if there is not sufficient room for this winding, a few layers of the outer insulation may be peeled off to provide the needed space. The necessary apparatus is so compact and light that it may be added to almost any test set without overcrowding.

J. E. RYAN,
Cape Town, S. A.

HONORABLE MENTION

SIMPLE CODE PRACTICE OSCILLATOR. Although I had always wanted an audio oscillator to practice the code, I never made one as they were not simple enough. I finally came across the circuit shown in Fig. 2 which is extremely simple *and will work a speaker.* The tone is changed by varying the S.-G. resistor.

SATOSHI YUGUCHI

HONORABLE MENTION

TESTING I.F. TRANSFORMERS. Sometimes a transformer is suspected of having insufficient tuning range to reach a certain I.F. This may be due to shorted turns or any other cause. Testing such units is very simple if a workable receiver having the same I.F. as the suspected unit is at hand. The doubtful transformer is simply connected in the control-grid circuit of the I.F. stage of the receiver as shown in Fig. 3. If the transformer is in good condition a decrease in signal strength will be noted as its trimmer condenser is turned. If no change is noticed, the transformer is not capable of tuning to the desired range, or it is defective.

HARRY E. WESSEL

HONORABLE MENTION

A STABLE DETECTOR. Electron coupling and push-pull detection are quite well known. However, the particular combination shown in Fig. 6 in an excellent performer, as it is very stable. This means that the gain of the preceding R.F. stage may be pushed up higher, and also there is no fringe howl or noisy effects when the circuit goes into oscillation. Hand capacity effects are minimized. While the circuit is a bit elaborate, the use of triode tubes allows some simplification, and the results are equally pleasing. This circuit is not true push-pull, of course, since the plates of the tubes are in parallel.

TED PLASKIEWICZ

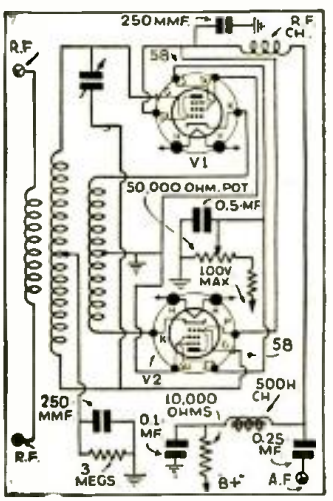


Fig. 6. Push-pull detector circuit.

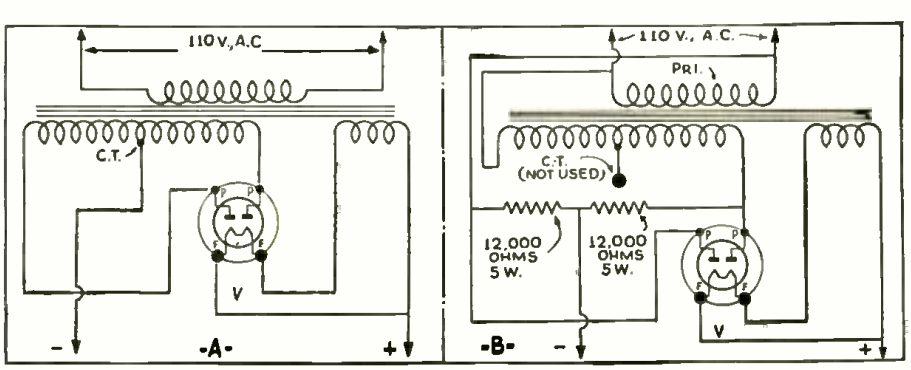


Fig. 4. The usual full-wave rectification circuit is at left, while the improved version is at the right.

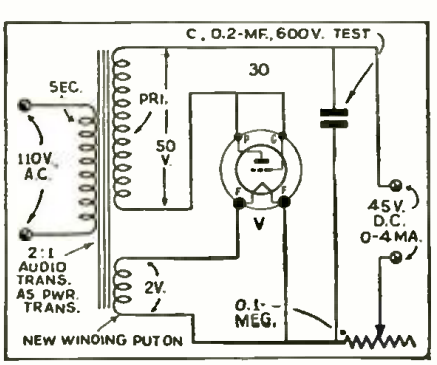


Fig. 5. A junk box high-voltage power supply.

CONSTRUCTING A 5-TUBE LOOP SET —INTERFERENCE LOCATOR

A 3-purpose set: (1) Tracking Man-Made Static; (2) Direction Finding; and, (3) Broadcast Program Reception!

E. L. RICHARDS

Fig. A. The loop points toward the station.

MANY SET builders and Service Men are on the lookout for a very economical and efficient circuit that can serve more than one purpose; the following radio circuit is for a receiver of the loop-operated portable type, which can be used for broadcast reception and also serve as an interference locater. The completed instrument is here shown pictorially, and in Fig. 1 by diagram.

The receiver can be used for entertainment while boating, camping, or motoring—that is, wherever A.C. is not available. It can be built very compactly and very light in weight.

There is quite a demand for such a portable receiver not only for broadcast reception, but they are also very useful in locating interference. Very

(Continued on page 177)

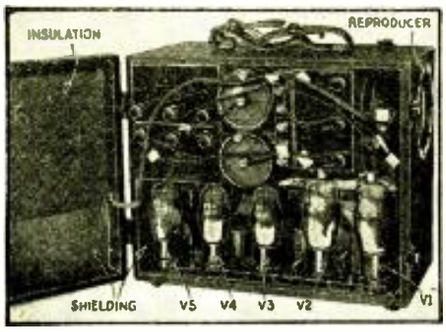


Fig. B. The inside of the receiver cabinet showing how the batteries are fitted into the available space. Note the shielding of the complete receiver compartment.

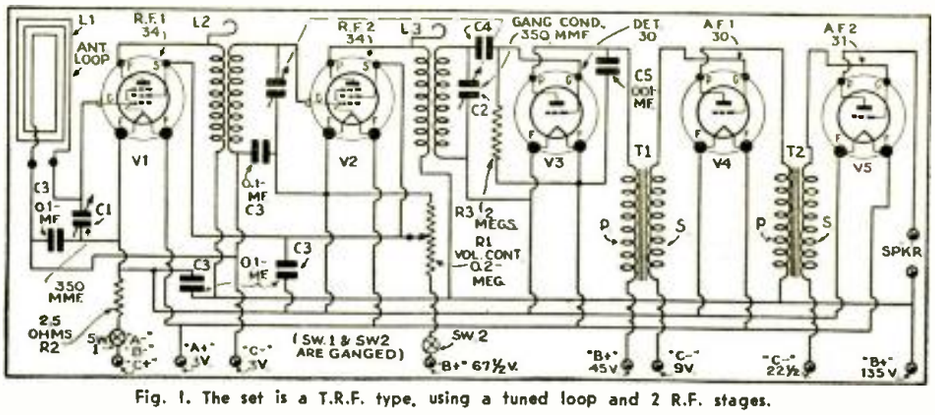


Fig. 1. The set is a T.R.F. type, using a tuned loop and 2 R.F. stages.

THE CORRECT USE OF FIXED CONDENSERS

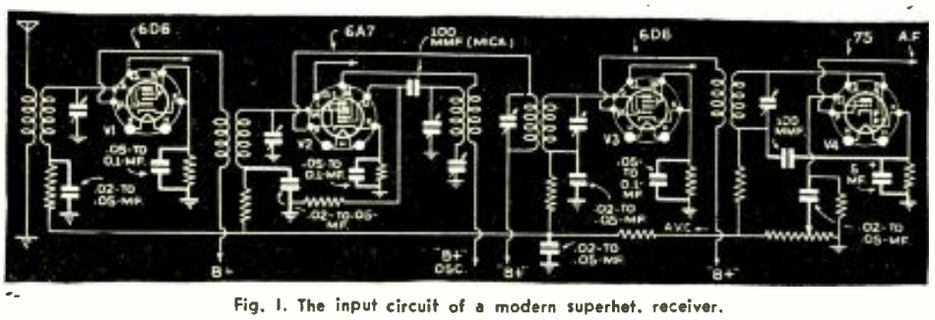


Fig. 1. The input circuit of a modern superhet. receiver.

The radio man will find in this article very important data on the application of all types of fixed condensers in modern radio receivers.

J. T. BERNSLEY

GLANCE OVER the shoulder of any busy executive of a large radio dealer or distributor when he is checking over the daily reports of the service personnel, and be amazed at the percentage of radio receiver troubles due to faulty condensers. "Shot bypass to R.F. screen voltage socket terminals. No Reception"—one report might read. "Open bypass condenser in 1st R.F. decoupling network causing oscillation and weak reception," another report will indicate. Still another might specify "open 8 mf. electrolytic filter, causing weak reception, hum and oscillation."

As a matter of fact an analysis of all the reports for each day or any week, or for a whole year, would indicate that the real cause for over 50 per cent of all service calls is attributable to defective condensers. But before we unjustly reason that all condenser manufacturers are making poorly engineered products, let us, to use the words of Al Smith, "look into the record" or history of condenser applications and design.

Years ago, when a radio receiver consisted of a long, box-like affair using a number of brightly illuminated bulbs and an array of assorted batteries which required frequent replacement, condensers were relatively unimportant and extremely few in the receiver. A single 1 microfarad paper unit connected across the "B" voltage terminals of the set; and a small mica unit, usually "triple-0-five" (500 mmf.), for the grid condenser were all that would be found in the most expensive and de-luxe sets of that day. The larger condenser was employed for the purpose of bypassing the "B" battery circuit so that any R.F. current in the return circuit would encounter no opposition in its flow to the ground. Of course when the batteries were fresh and their resistance low the bypass condenser was ineffective, but as the battery voltage commenced dropping and the resistance of each cell increased then the usefulness of the bypass condenser was proportionately increased.

Upon examining the circuit diagram of the tuning section of the average modern superheterodyne receiver (see Fig. 1), we see a great contrast in the applications of condensers as compared to the receiver of earlier days. The multiplicity of elements in the new high-gain tubes necessitates the use of bypass condensers as essential points in the circuit to permit attaining the tremendous gain that must be realized in each stage,

(Continued on page 180)

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 December, 1932, are available at 50c per copy; except the following issues: 7/'29, 1, 2, 3, 4, 6, 7, 9 and 11/'30; 5, 8 and 9/'31; and 7/'33, which are out of print. Succeeding issues 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.

PEAK V.T. VOLTMETER

(369) Jaros D. Weisner, Brooklyn, N. Y.

(Q.) I have need for a simple peak voltmeter to work from the A.C. lines. I have a 0-1 ma. meter that may be used in this equipment, this meter being part of my multimeter test set.

(A.) A diagram of a very simple peak V.T. voltmeter is shown in Fig. Q.369. The meter should not be used on a lower range than 100 V., since a resistance of less than 0.1-meg. across the electrolytic condenser will result in a slight error. It should be remembered that this type of meter will read 1.4 times the r.m.s. voltage, so that if a line reads 100 V. on an ordinary meter, the equipment described here will show a reading of 140 V. The electrolytic condenser must have a voltage rating as high as the highest voltage to be measured. There are no adjustments to be made.

(This information reproduced by courtesy of *Sutcrafa News.*)

A SIMPLE SCRATCH FILTER

(370) Sivert N. Glarum, Providence, R. I.

(Q.) Will you kindly supply me with a scratch filter circuit that ' suitable for coupling a crystal phonograph pickup to a high-fidelity amplifier?

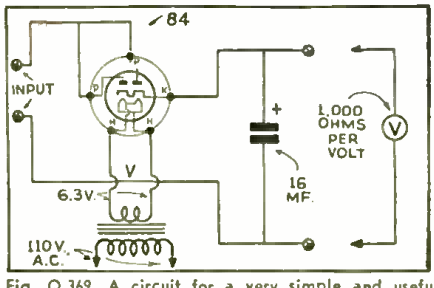


Fig. Q.369. A circuit for a very simple and useful "peak" V.T. voltmeter.

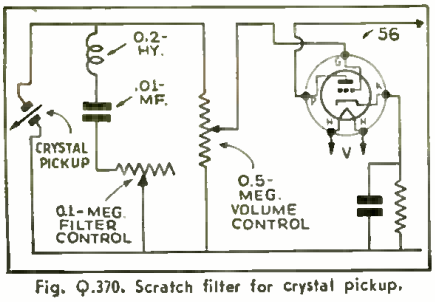


Fig. Q.370. Scratch filter for crystal pickup.

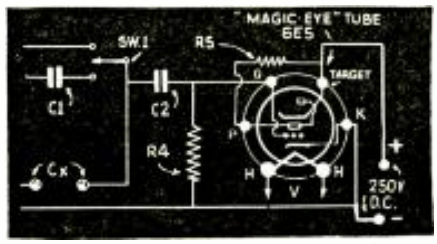


Fig. Q.371. Connection for "B" return lead.

(A.) In this connection we have been advised by the Astatic Microphone Lab., Inc., that the circuit in Fig. Q.370 is very efficient. With the values shown, the resonant period is about 4,000 cycles, the amount of attenuation being controlled by the 0.1-meg. variable resistor. Should it be desirable to shift this period to some other frequency, this may easily be done by changing the value of either the 0.01-mf. condenser or the 0.2-hy. choke.

CONDENSER ANALYZER (A CORRECTION)

(371) Max Nathans, Bronx, N. Y.

(Q.) I wish to try the circuit of the condenser tester described by William Robinson on p. 15 of the July, 1936 issue of *Radio-Craft*. However I find that there is no return lead for the high-voltage supply shown on Fig. 1. Where should this return connection be made?

(A.) The affected portion of Fig. 1 mentioned above is reproduced here at Fig. Q. 371. The remainder of the circuit is correct as shown. We have been informed by the author that the formula on page 15 was incorrect. It should have been as follows:

$$\% \text{ P.F.} = \frac{R}{\sqrt{R^2 + \left(\frac{1}{WC}\right)^2}} \div 100$$

RECEIVER DESIGNATION

(372) Johnson Latimer, Manchester, Vt.

(Q.) Can you tell me what the "Q" on the model designation of a Crosley Model 54Q receiver means? Also, do service data on the Model 54 apply to the Model 54Q as well?

(A.) We have been informed by the Crosley Radio Corp. that the "Q" is simply the designation of the cabinet of this particular receiver. The chassis number is 54, to which the service data apply.

THE TERM "SOUND CELL"

(373) Mr. S. T. Johanssen, Auckland, N. Z.

(Q.) What is the meaning of the term "sound cell" as generally used for P.A. equipment?

(A.) A sound cell is an assembly of 2 bimorph Rochelle salt crystal elements in a bakelite frame. The bimorph elements, in turn, are each made up of 2 crystal plates with electrodes attached, cemented together so that an applied sound will cause a bending of the assembly, and produce a voltage. The mounting is such that mechanical shocks have little effect on the unit. *No diaphragm is used, the sound impulses actuating the crystal elements directly.* An exceptionally wide frequency range, even into the super-audible band, and on down to zero frequency, may be achieved in this construction!

RMA "CONDENSER COLOR CODE"

(374) William Darlington, Chadron, Neb.

(Q.) I have been trying to find out if the RMA has a standard color code for mica condensers, but can find no mention of it.

(A.) The standard RMA color code for mica condensers uses the same colors to represent the various digits as the resistor color code. For those not familiar with this, the following

(Continued on page 181)

P.A. QUESTIONS & ANSWERS

Conducted by
CHARLES R. SHAW

PHASING SPEAKERS

(38) Leigh B. Eshleman, Lancaster, Pa.

(Q.) While one of my P.A. outdoor systems in which I use dynamic speakers is perfectly stable, I often encounter considerable feedback trouble with another system in which I use 2 units and horns. I tried bypassing and filtering every audio stage without any help. I use the same microphone in both systems.

(A.) Judging from your sketch, your speakers are placed symmetrically with relation to the microphone and it is therefore important to see that the 2 speakers are out of phase. Although it has often been pointed out how to change the voice-coil connections in order to change the phasing of the speakers, it should also be remembered that changing the field-coil connections produces the same effect. One of the most common reasons for audio feedback and resulting audio howl is the presence of a peak somewhere in the amplifier system. This condition can be easily remedied by the use of an absorption equalizer, easily placed externally and connected by means of adapters, as illustrated in Fig. 1A.

When the whole audio system has an excellent frequency response then the feedback will occur at a great number of audio frequencies at one time, resulting in a rich note. If there is a peak present anywhere in the system then the audio howl will take place at that particular frequency.

The formula for calculating inductance and condenser values for a filter to remove a certain frequency is: $f = \frac{1}{2\pi\sqrt{LC}}$

Audio feedback can also be reduced by the use of an automatic volume control which prevents any large signal peaks and therefore reduces feedback.

TUBES FOR HIGH VOLTAGE GAIN

(39) Frank A. Borden, Newark, N. J.

(Q.) I intend to build a very high-gain amplifier and wonder whether glass tubes or metal tubes will be better to use. What is your advice?

(A.) It is found from practical experience that the 6C5 and 6F5 tubes of certain makes

(Continued on page 181)

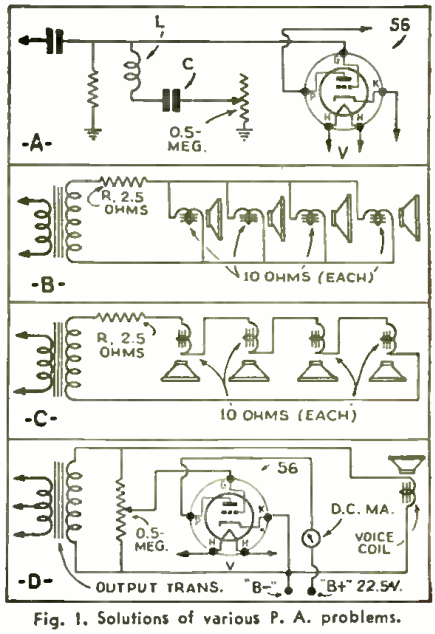


Fig. 1. Solutions of various P. A. problems.

MAKING A BEGINNER'S 2-TUBE PORTABLE RECEIVER

This complete self-contained little set works like a charm! The circuit has been carefully worked out for loudspeaker operation with only 22.5 V. plate supply.

H. D. OPLINGER

Fig. A. The completed receiver.

HERE IS just the thing for that vacation you plan to take this fall. It is a handy little portable "loudspeaker" radio set that you can take anywhere, since it is not dependent on an outside power source. The set, here illustrated, was designed primarily as a headphone receiver, but due to its tremendous volume on phones a small magnetic speaker can be used on loud signals. The volume probably will be sufficient for a small room or tent—just the thing for that camping trip, or fishing expedition. Take this portable wherever you travel; just uncoil a length of wire for an antenna, and clip a wire to the nearest ground or (metal) tent stake, and it is all ready to go.

The set measures only 6½ x 8 x 4 ins. deep, and weighs less than 5 lbs. The current consumption is only 100-120 ma. on the "A" supply consisting of 2 ordinary flashlight cells; and about 1½ ma. on the "B" supply, which is a 22½-V. unit. The set uses 2 tubes in a regenerative circuit, using a type 32 as a screen-grid detector-amplifier, and a 30 as an audio amplifier and output tube. The original set was designed for broadcast reception only, but if desired, it can be made to include short-wave police, amateur, and aviation frequencies by simply tapping the coil as shown in Fig. 1. By placing the coil over the type 30 tube much space is saved without in any way affecting the operation of the set.

SENSITIVITY ON THE LOW WAVES

The set is different from an ordinary broadcast receiver in that the broadcast range is divided into a high and a low band, both to save space by using a smaller condenser, and to boost the volume on stations on the upper or 600 kc. end of the band. The lower part of the broadcast band is covered by one sweep of the dial, then by snapping the toggle switch, the upper part is covered in the same way. In sets using this type of circuit, trouble is often encountered by the shifting of the station positions on the dial when different lengths of antennas are used; especially if the set is to be used in different localities and under different conditions. In this set, this is remedied by making C1 variable; serving very nicely to bring in the stations at the right place, and if once set for a certain antenna, it need not be changed. It is adjusted through a small hole near the antenna clip.

CONSTRUCTION

The first component to consider in making up this little receiver is the coil, shown in Fig. 2B. The form size specified is just large enough to fit over the 30 tube. The usual precautions should be taken in winding the coil: all windings should be in one direction; and the wire should be wound on evenly and *tightly*. Be sure the tickler coil is wound at the ground end of the tuning coil, or the circuit will not oscillate properly. The leads should be left long, so they can be soldered directly to their connections. As to number of turns follow Fig. 2B. The case is made of ⅛-in. composition wood (trade names are hardboard, masonite, and pressed wood, ob-

(Continued on page 182)

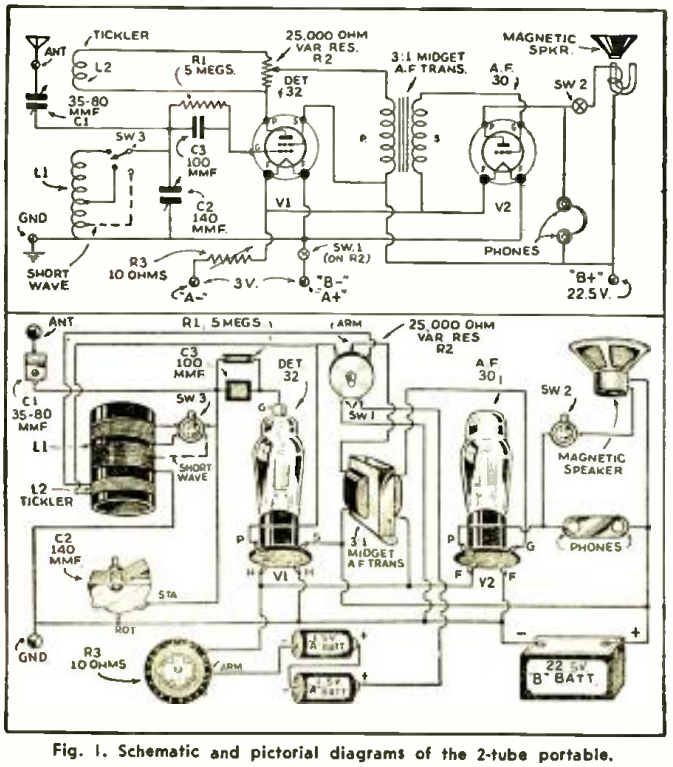


Fig. 1. Schematic and pictorial diagrams of the 2-tube portable.

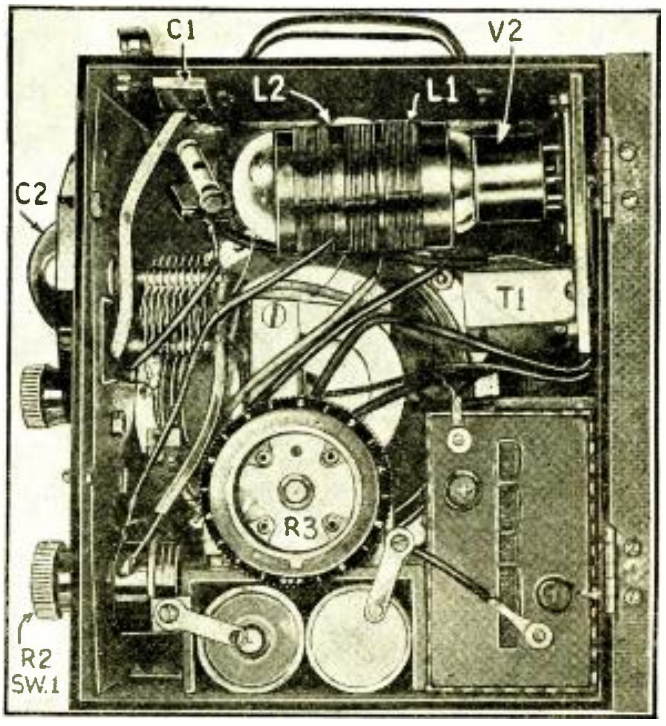


Fig. B. Portable set, with side panel removed to show the interior layout.

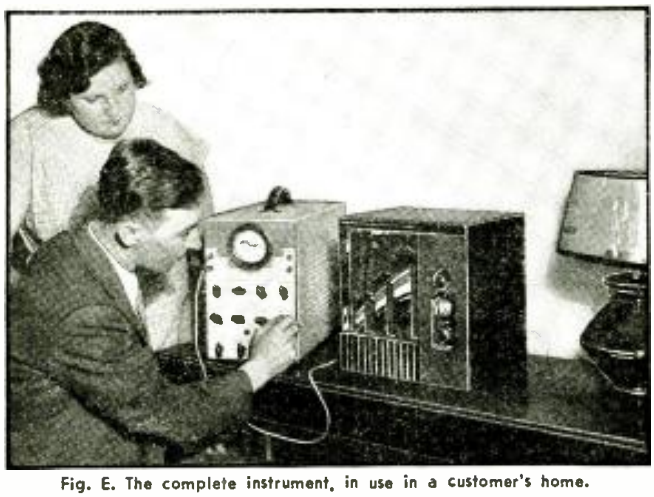


Fig. E. The complete instrument, in use in a customer's home.

HOW TO MAKE AN OSCILLOSCOPE

The author supplies considerable detail regarding mechanical problems, preparatory to describing some of the innumerable uses of this advanced tool for Service Men, etc.

CHARLES SICURANZA PART III

IN THIS ISSUE, we are going to put the finishing touches on the home-made Cathode-Ray Oscilloscope. (In last month's issue, we stated that the Vertical Amplifier could be omitted until later, if desired. However, the parts needed were included in the Parts List given in Part II. The addition of the Vertical Amplifier is very simple and should be accomplished at once in order that you may proceed with the next part of the program. The schematic in Part II gives all the necessary details.) We are now going to describe the function of each control on the completed instrument.

CASING DETAILS

The chassis is walled-in, on the left and right sides, by sheet aluminum (see Fig. 9, upper-left). It is recommended that the bends be made on a tinsmith's "brake." The sidewalls should have an ample number of holes drilled for ventilation purposes. The sketch shows that a geometric pattern was followed in our instrument. However, the builder may use whatever pattern he desires. Just be sure that at least 100 holes of ¼-in. dia. are drilled out.

Hexagon-head self-tapping screws, ¼-in. long, are used throughout for fastening the sides, top and bottom. The size of these screws is equivalent to the 6-32 machine screw. The self-tapping screws require a No. 28 drill hole for clearance and a No. 33 drill hole for the self-tap. The clearance holes (No. 28) are drilled in the sidewalls as shown on the figure. Then the side is placed in position on the chassis and the tap holes may be marked off with an ice-pick or other sharp pointed tool. In this way, the holes in the chassis will match perfectly with the holes in the sidewall.

When both sidewalls have been screwed into place, the top section (upper-right, Fig. 9) is prepared and the same procedure is followed.

The unit, when used in locations which have powerful magnetic fields, will require a galvanized sheet iron shield surrounding the 906, as detailed at lower-left in Fig. 9. In many cases, though, this shield may not be needed.

Stray images might be seen on the screen when test leads are plugged in and left free.

Last, but not least, the bottom plate is prepared. (See Fig. 9, lower-right.) This plate requires 2 right-angle bends, and should be lined on the side facing inward, with thick insulating paper. The right-angle bends are sandwiched between the chassis and sidewalls. Three self-tapping screws on each side hold the bottom plate in place. Four rubber feet are mounted, one in each corner on the bottom. A carrying grip handle may be added to the top section, but may be dispensed with, if the unit is to be used in one permanent spot. Three pairs of test leads should be made or purchased, as all 3 pair may be needed on certain tests. At least one of these test leads should be shielded with tinned copper braid and ½-in. thick insulation for use in R.F. tests.

The last item needed is an engraved front panel card, which shows what each knob controls. This may be made by the builder by referring to the front panel sketch in Part I, or may be obtained for you by the author.

On the front panel of the completed oscilloscope, there are 12 knobs and 3 pairs of tip-jacks. Each one contributes in some way to the ease of operation, or to convenience, or to the versatility of the instrument in its many applications. To many, this multiplicity of knobs may be a bit confusing at first glance. However, if the purpose of each control is studied and memorized in proper order, you will appreciate them

(Continued on page 184)

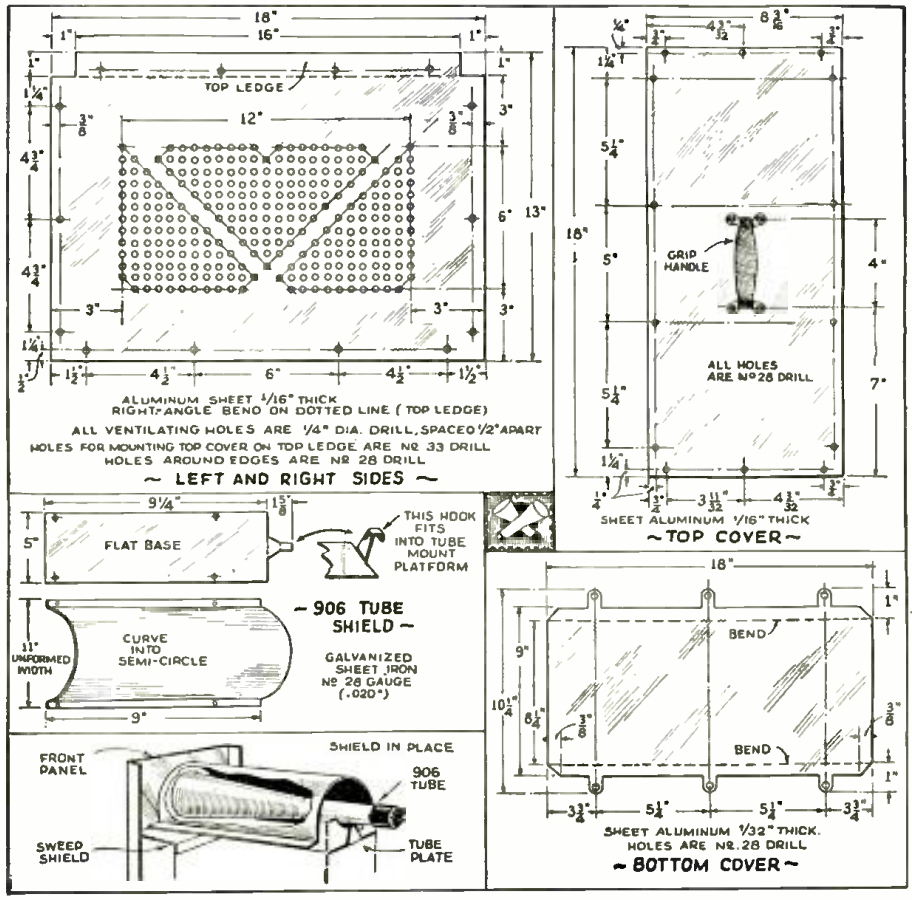


Fig. 9. Essential construction details that reduce the weight and increase the accuracy of the unit.

HOW TO INSTALL A WIRED AUDIO P.A. SYSTEM

In this part, the author describes the amplifier which he uses in the new P.A. system described last month.

E. A. DENNIS ..... PART II

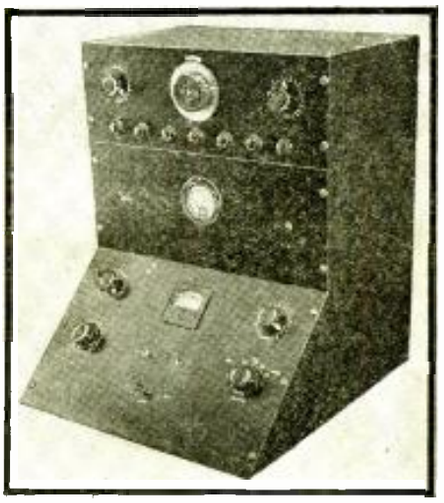


Fig. A. The amplifier and level controls.

TWO OLD AND RELIABLE principles in the radio and sound field are here combined for a modern public address system.

In the March issue of *Radio-Craft*, the writer described an amplifier of universal design. To build the P.A. system described in that issue, 5 stages of this amplifier may be used, utilizing push-pull type 48 output tubes. An amplifier of straight A.C. or D.C. design may be used with similar results.

The output transformer will have to be changed to one with a 50,000-ohm secondary (a 15-ohm winding will be useful for a monitor speaker or for earphones). The 50,000-ohm winding is fed to controls LC1 to LC5, which are hooked up in series (be careful not to ground any of these controls or the transformer winding).

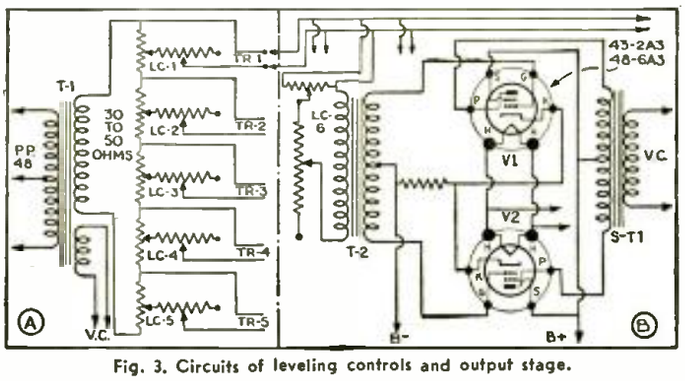


Fig. 3. Circuits of leveling controls and output stage.

Transformer and leveling controls shown in Fig. 3 are all mounted on the master control unit (LC1 to 5 should be mounted where they are readily available but not where they are liable to be moved during regular operation). Units LC6 and T2 in Fig. 3A, together with the type 48 output tubes (types 43, 2A3 or 6A3 tubes may be used) and the necessary rectifiers, should be mounted on the chassis with the speaker; and the complete assembly should be mounted in the baffle shell (or, the complete assembly may be mounted behind an ordinary baffle, in the rear of an exponential horn, a radio console or a small table-type cabinet). Many other uses will suggest themselves to the wide-awake Service Man or sound company engineer.

(Continued on page 183)

A NEW ALLOY FOR PERMANENT MAGNETS

Nipermag—the magnetic alloy which is said to have the greatest coercive force of any commercially available material.

HALTON H. FRIEND

"NIPERMAG" is a remarkable permanent-magnet alloy which has just recently been made available. To the American trade nipermag is new, but to Europe, it is a tried and tested magnet material which has shown its worth for nearly 2 years. Hundreds of thousands of loudspeakers have been manufactured in England using this alloy and the demand for nipermag excited speakers is constantly increasing.

There are many reasons why nipermag has had this success. It is the product of a research laboratory devoted exclusively to permanent-magnet development, the purpose being to provide a superior permanent magnet which would have high flux and coercive force but could be manufactured readily and consistently even in small sizes and odd shapes, and which could be supplied to the trade at a reasonable price.

An outstanding fact about nipermag is its coercive force (magnetic pull) of about 660 oersteds, which is substantially greater than the coercive force of any other commercially available magnetic material. Extreme variations of temperature, repeated and severe mechanical shocks and intense stray magnetic fields have no effect on nipermag. This one feature alone makes nipermag most valuable for meters which must retain their calibration, instruments on airplanes and ships, loudspeakers in hotels, farm- and auto-radio sets and hundreds of other applications where permanency is an asset.

From the curve shown in Fig. 1 it may be seen that the value of H at BHmax is 380 units, another outstanding feature permitting nipermag to have a shorter back to front length for a given flux in an air gap. This is an important factor where compact design is sought, such as for certain types of loudspeakers, headphones, microphones and so on.

With nipermag it is also possible to obtain a higher total flux and higher flux densities in an air gap and the flux densities of electro-excited units can be approached or exceeded, thus leaving no good reason for the further use of electro magnets in many applications.

Nipermag is formed by casting to

(Continued on page 183)

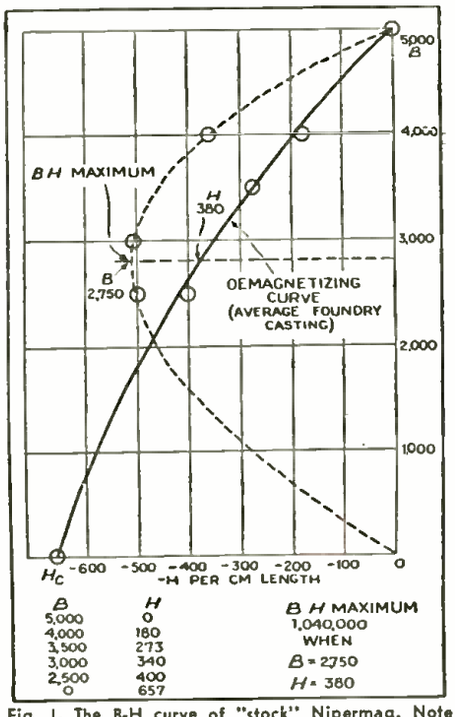
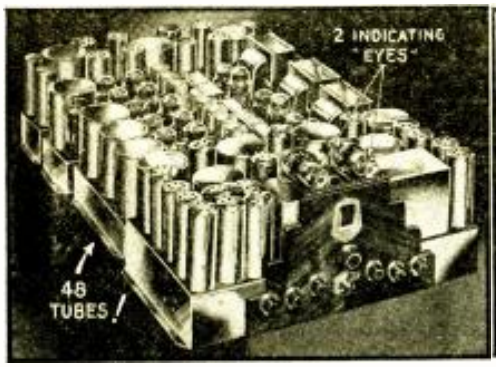


Fig. 1. The B-H curve of "stock" Nipermag. Note the steepness of demagnetization curve at its origin showing the high initial permeability of this material.

THE LATEST RADIO EQUIPMENT



An "exceptional" set in more ways than one! (1095)

Tiny "metals" offer best value. (1096)

A portable orchestra! (1097)

Three speaker groups needed. (1095)

THIS 48-TUBE PHONO.-RADIO SET HAS 5 SPECIAL SPEAKERS! (1095)

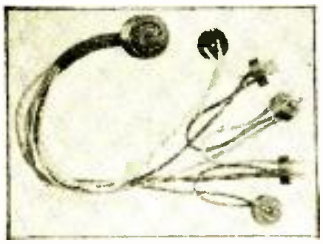
BUILT to a special order, this radio set establishes new standards for superlative sound reproduction in an instrument designed for home use.

Until the last year or two the home set builder has been able to construct radio sets incorporating features a year in advance of commercial sets, but lately it's been nip and tuck for first place. Now, it appears one manufacturer has jumped so far in the lead that both the home constructor and other manufacturers will have to step some to catch up.

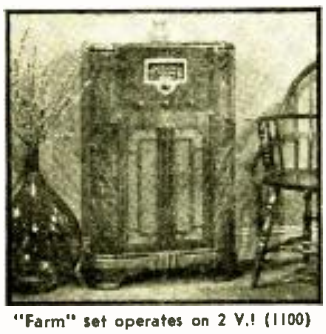
The new set that breaks all previous records for out and out "colossolness" is here illustrated. Its frequency range is 30 to 16,000 cycles, with individual audio channels for each of 3 portions of this range. The undistorted power output is rated at 100 W. (The power line current consumption? Don't ask!)

Additional features: all-wave reception, volume expander, cathode-ray indicator tubes, automatic record changer phonograph, home recording of spot programs, break-in P.A. operation, continuously-variable selectivity, and noise-suppression circuit; and all the lesser features we have come to accept as requisite in high-grade construction.

Tubes may be tested "hot." (1098)



A "harness" for quick connections. (1099)



"Farm" set operates on 2 V.! (1100)

COMPACT ELECTROLYTICS (1096)

(Aerovox Corp.)

AVAILABLE in 2 voltage ratings, 250 and 450 V., these small units are made in capacities of 4, 8, 12, and 16 mfs. The size varies from 2 3/16 ins. to 4 3/8 ins. high. The diameter is 1 in. for all sizes. These units make available the lasting qualities of metal-cased units with the small size of the cardboard types. A much cleaner-looking, more commercial-appearing instrument will result if these new components are employed.

UNIVERSAL-CURRENT PORTABLE PHONO.-RADIO (1097)

(Wholesale Radio Service Co.)

MEASURING only 10⅜ x 13½ x 27½ ins. long, this compact equipment is ideal for use in camp or for traveling. The receiver is a 7-tube all-wave superhet, with a 6-in. dynamic speaker. The phono. motor is also A.C.-D.C., and the outfit will play either 10- or 12-in. records. Record compartment in cover holds 12 large recordings. Fabricoid case has strong carrying handle.

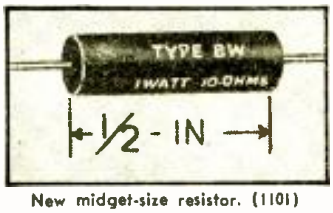
VERSATILE TUBE TESTER (1098)

(Weston Electrical Inst. Co.)

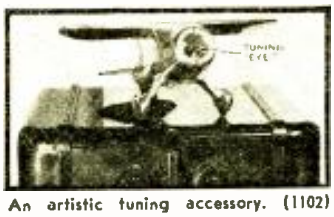
ALTHOUGH designed as a comprehensive tube tester, this portable and shop apparatus has facilities for checking voltages in 3 ranges, 0 to 10, 100 and 1,000 V., resistances in 2 ranges, 0 to 28,000 ohms and 0 to 2 megs.; and incorporates a condenser leakage tester. Direct meter-scale readings. The line voltage may be checked at any time; the power cord is fused.

BATTERY ADAPTER "HARNESS" (1099)

THIS "harness" consists of a socket to fit the receiver cable plug (as for instance in Philco battery sets), and various small plugs on the other end to fit into the sockets on top of the "B" and "C" batteries, thus adapting the plug type of battery to receivers not fitted for its use. Available in either 7- or 8-prong type.



New midget-size resistor. (1101)



An artistic tuning accessory. (1102)

HANDSOME "FARM" RECEIVER OPERATES ON 2 VOLTS! (1100)

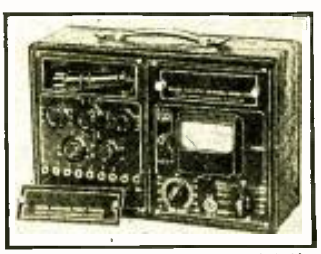
(RCA Mfg. Co., Victor Div.)

DESIGNED to compare favorably with its A.C. powered competitors, in performance, appearance, and tonal qualities, this outstanding farm receiver embodies all the latest improvements. It has an 8-tube superhet. circuit with class B output driving a 12-in. permanent magnet dynamic speaker; output, 2.2 W. The tuning range covers 530 to 22,000 kc., in 3 ranges; covers 5 "international" S.-W. bands. Such features as plug-in batteries, built-in "C"-bias cells, phono. connection, air-dielectric trimmers, antenna wavetrap, iron-core I.F. transformers, and a cabinet of the finest woods beautifully finished, assure the rural owner of the best to be had in "electric" radio performance, in 2 V. "battery" current supply.

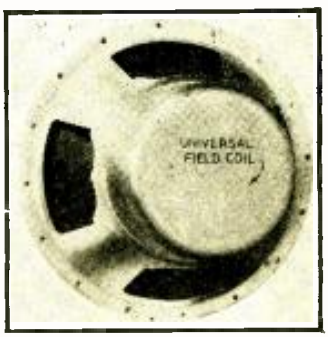
INSULATED WIRE-WOUND RESISTOR (1101)

MIDGET, fully-insulated *wire-wound* resistors are now made, the units being the same in physi-

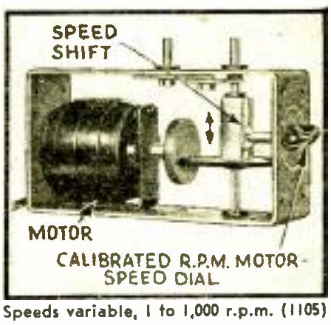
(Continued on page 186)



New wide-range test unit. (1103)

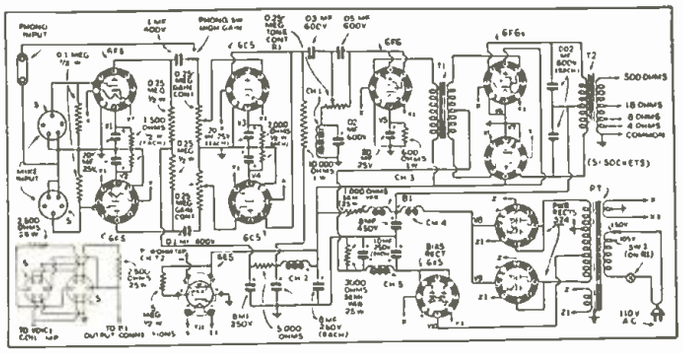


Universal-service reproducer. (1104)

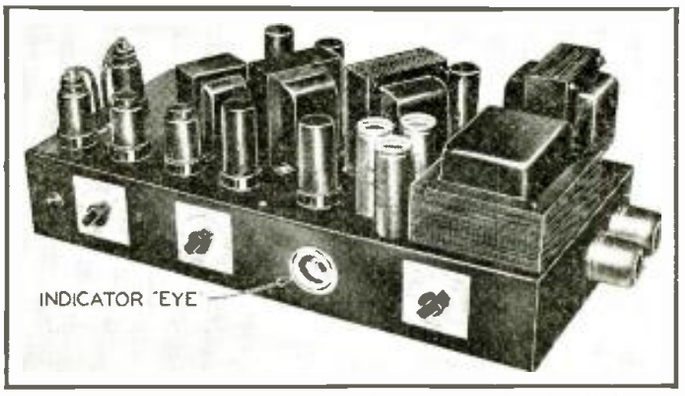


Speeds variable, 1 to 1,000 r.p.m. (1105)

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



Schematic circuit of the easily-built amplifier described in this item. The feature of this unit is its ready adaptability to nearly all types of service. (1116)



The complete amplifier represented by diagram at left. (1116)

AN UP-TO-DATE 18-W. POWER AMPLIFIER (1116)

(Standard Transformer Corp.)

AN AMPLIFIER, to serve present-day requirements, should be flexible as to use, as simple and compact as possible, sturdy and rigid of construction, and have high gain.

The accompanying schematic diagram, together with a photograph, show an 18-W. amplifier that has dual-channel input with accommodations for input devices that require either high- or low-gain circuits; that has a built-in power supply using the latest types of metal tubes; and that meets the requirements as set forth in the foregoing paragraphs. There is given below a description of the amplifier and a discussion of its characteristics.

Distortion and Frequency Response. Frequency discrimination and phase shift become negligible as a result of using resistance coupling and triodes in a preamplifier. Going still further, the transformers are mounted at such an angle that chassis currents and stray fields are cancelled out. In the grids' circuit of the 6F6 driver, a tuned circuit is used to raise low-frequency response of the amplifier. Fixed bias is accomplished by using part of the high voltage to a 6X5 in a voltage-doubler circuit and is filtered with 2 condensers and a high-impedance choke, and it is then fed to the control-grids of the power tubes through the input transformer. The 6F6 tubes draw very little control-grid current so that the direct current flowing in the input transformer secondary is negligible. The output transformer has a proper plate-to-plate load when the correct load is

(Continued on page 187)

5-IN. ALNICO-MAGNET DYNAMIC REPRODUCER (1117)

SMALL size and high efficiency characterize this unit. It is the smallest speaker of its type on the market and is just the thing for use in portable and other compact receivers. It may be had either with a very compact output transformer or with the voice coil leads terminating in pin-jacks. The voice coil resistance is 3.5 ohms, and the air gap is completely protected from foreign matter by means of a dust cover. The magnet is of special nipermag alloy and is said to be unharmed by rough treatment, etc.

"DUAL-IMPEDANCE" VELOCITY MICROPHONE (1118)

(Amperite Corp.)

"DUAL impedance" is a new idea in velocity microphones that permits the unit to be used directly with either a high- or low-impedance input. This is accomplished without any loss in efficiency by using a specially-designed transformer and a shielded, 4-conductor microphone cable. The cable is terminated with a 5-prong female plug.

The microphone is changed to low- (200-ohm) or high-impedance automatically by plugging in the proper male plug, which alters the circuit as shown diagrammatically. By the use of this method, no undesirable dead windings are left in the microphone transformer. For only high-impedance inputs, the standard high-impedance microphone should be used. The dual impedance, however, is very useful when both low and high impedance input might be encountered. Furnished with shock absorber.

NEW PHASE-ROTATION INDICATOR (1119)

(General Electric Co.)

A PHASE-ROTATION indicator, in which the outstanding innovation is the complete lack of moving parts, has just been announced. Weighing only 12 ozs. and having over-all dimensions of 5½ x 3½ x 3 ins. deep, it can be carried around easily. This instrument will be found very useful in 3-phase testing and installation work, such as the testing and installation of 3-phase meters and motors.

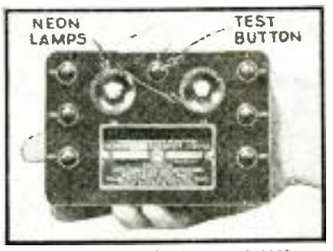
The new phase-rotation indicator employs 2 neon glow lamps and a simple circuit (here diagrammed) which requires no adjustment. Suitable terminals are provided for connection to 110-, 220, or 440- V. circuits. Operation 60, 50 or 25 cycles.

Operation is simple and sure. Pressing a centrally-located button lights both of the glow lamps. The button is then released—and phase-rotation, clockwise or counterclockwise, is shown by which one of the lamps remains lighted.

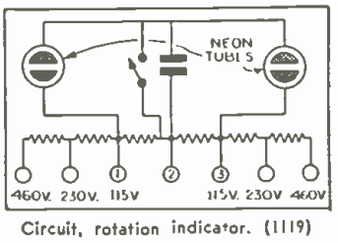
This indicator makes use of a small condenser connected in Y with 2 small neon lamps across the 3-phase circuit to be tested. An unequal distribution of voltages in the 3-arms of the Y network occurs and the voltage across 1 neon lamp becomes considerably greater than that across the other for a given phase rotation. In fact, the voltage across the latter lamp falls below its minimum breakdown or ignition value, and the lamp ceases to glow. Consequently, only 1 of the neon lamps glows at a time; the 1 that glows indicates the phase rotation of the applied voltage.

In order that the apparatus may be universally applicable, for use on any standard line voltage, a voltage divider is employed, with taps which enable the user to work on lines up to 460 V.

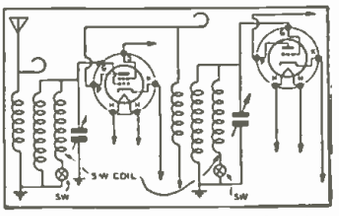
(Continued on page 192)



Phase-rotation indicator. (1119)

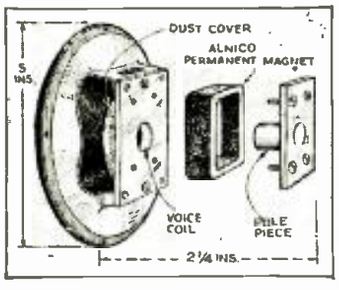


Circuit, rotation indicator. (1119)

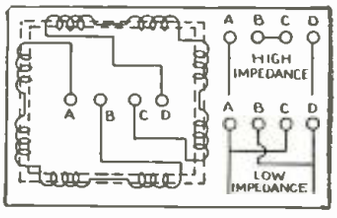


Circuit of "add-on" coil. (1120)

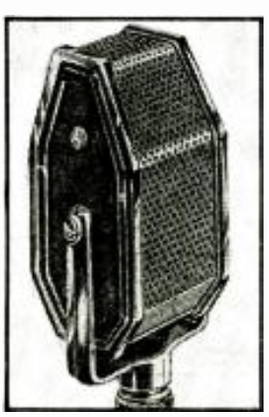
An "add-on" S.-W. coil unit. (1120)



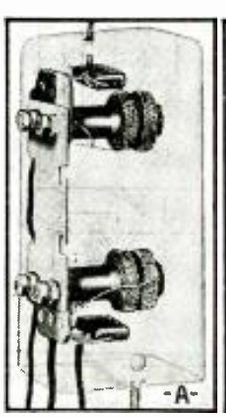
Small "alnico" dynamic. (1117)

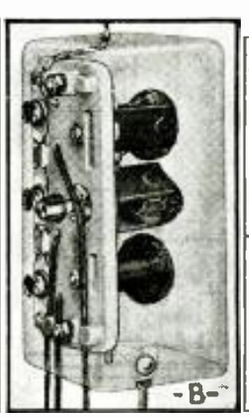


Dual-Impedance dynamic mike. (1118)

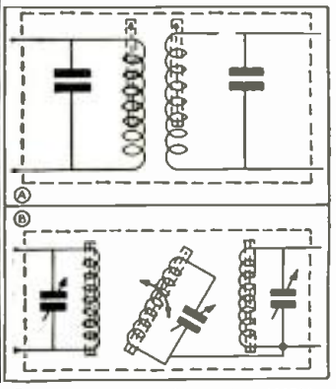


Mike. (1118)

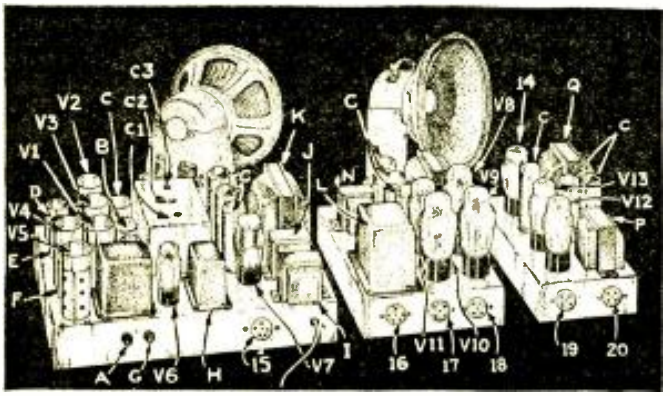




A 2-coil (A) and 3-coil (B) I.F.T. unit. (1121)



Circuits of new I.F.T. units. (1121)



DIRECT-IMPEDANCE AMPLIFICATION

Here is a larger set of the type described in the April 1936 issue — for advanced set builders.

PART II—A 14-TUBE SET

L. MITCHELL BARCUS

ALTHOUGH this receiver is only of medium size (see heading illustration, this is Fig. B), it possesses the valuable merits of superb tone and performance gained by circuit refinements lacking in the small receiver described in Part I (April, 1936—"a 10-tube set").

Unlike the other both the full range and the low-frequency outputs of the set are separately attenuated, permitting tonal balances which make possible many striking effects. Thus at low volume, when the bass response of a common set would be entirely negligible, the highs on this one may be cut down until the low notes are up to a satisfactory ratio, no matter how loud you may prefer them, and still the overall response will remain undistorted and clear. This characteristic is unique in receiver practice, but allows unheard-of flexibility.

Continuing the policy of previous articles on the subject of "direct-impedance amplification," no attempt will be made to present all-wave tuning systems. It is believed that the audio circuit itself is intricate enough, largely because of its newness, to make it preferable that the constructor's mind should not be further confused by unnecessary details. There is no objection to building up the R.F. end to any degree.

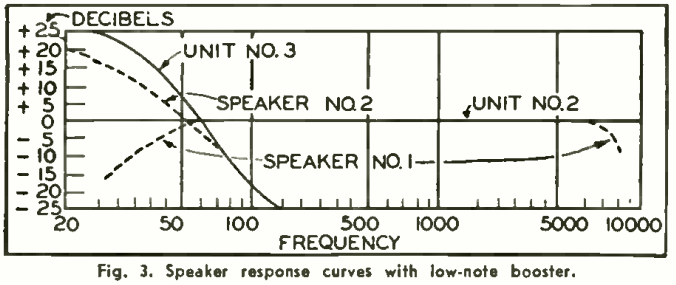


Fig. 3. Speaker response curves with low-note booster.

For high-fidelity performance, however, it should never be overlooked that the maximum of operating stability and quietness are the two most desirable features.

ELECTRICAL CHARACTERISTICS

For those unfamiliar with the circuit, the operation of direct-impedance amplification is sometimes a mystery. While some phases of designing such an amplifier are complicated, the method of obtaining plate voltages and grid biases is simple. It will probably be noticed by the careful reader that all bias resistors and bypass condensers normally found are missing! It is the absence of these disturbing factors as well as the direct coupling between stages which accounts for the remarkably wide frequency range and low harmonic content.

Referring to the schematic circuit, Fig. 2, it will be noted that tubes V5 and V6 are in series, with the cathode of V6 separated from the plate of V5 only by the choke, G. Since several milliamperes of current are flowing through them, there is a drop across choke G which provides the correct control-grid bias for V6. The plate resistance of V5 keeps the plate voltage at a satisfactorily high level. Being diode biased, the 55 tube (V5) has a varying plate resistance due to the changing signals. However, the plate potential is thus forced to vary in direct proportion, accordingly forcing more or less current through the tube.

The overall current variations of tubes V5 and V6 are therefore kept at a much more uniform value and may be kept practically constant within the operating limits of the tubes. Therefore the voltage drop across choke H provides a constant bias for the 59s (V8, V9 and V10).

The two tubes (V5) and (V6) and chokes G and H being in effect a resistance, the higher the voltage applied to the plate of V6 the greater will be the amount of current which

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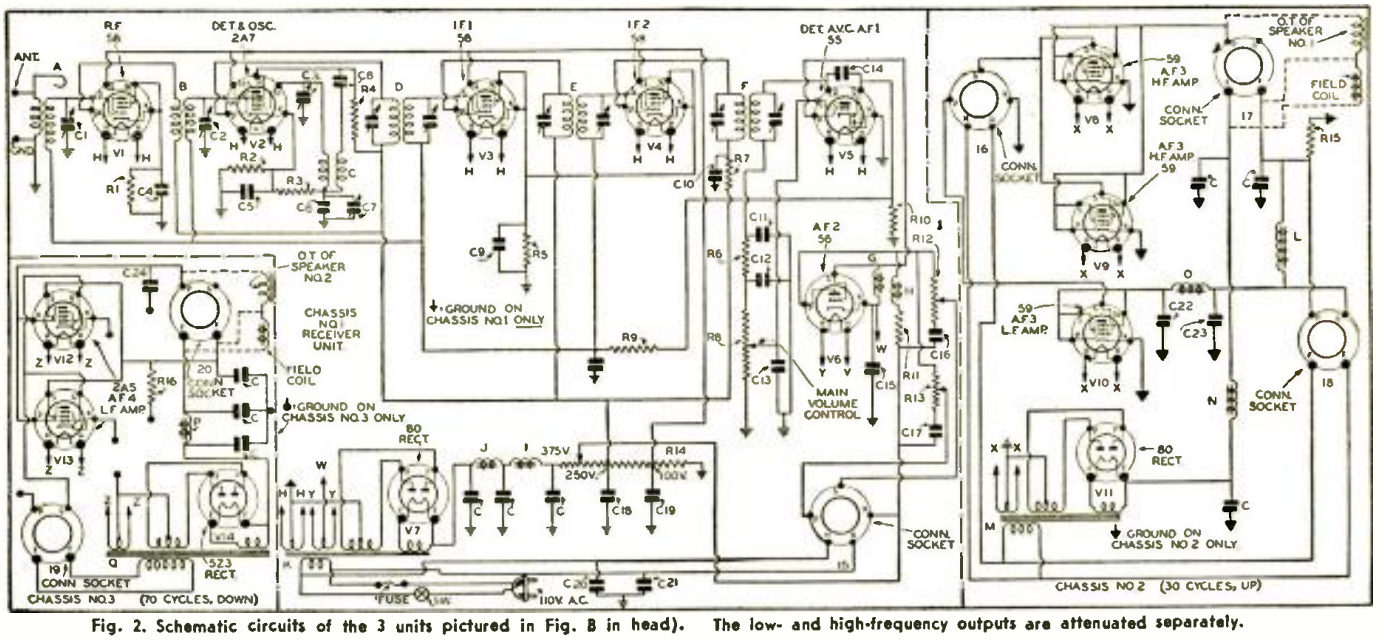

Fig. 2. Schematic circuits of the 3 units pictured in Fig. B in head). The low- and high-frequency outputs are attenuated separately.

CORNERSTONES OF RADIO —PHASE

The author, a well-known engineer, portrays in his simplest manner a fundamental action of alternating current.

E. W. SLOPE

PART III

AFTER WE have seen in Parts I and II of our series, "Cornerstones of Radio" (*Radio-Craft*, March and April, 1936) that the famous bugaboos of radiotechnique the "Ohms Law" and the "Wheatstone Bridge" involve nothing which cannot be understood by any beginner gifted with *common sense*, there is no reason why we should not try to discover what is actually meant by and involved in the expression "p-h-a-s-e", which often appears in articles dealing with the function of certain radio circuits.

SAYS "WEBSTER'S"

A well-known trick to be used in case we don't know what a word means is to consult a dictionary, and this very useful book tells us that "phase" is a word of Greek origin which means: "*to make*" or "*to appear*". In some dictionaries we find the additional explanation that "phase" means: "in uniform circular motion, simple harmonic motion, or in the periodic changes of any magnitude varying according to a simple harmonic law (as sound vibration, alternating electric currents, etc.), the point of stage in the period to which the rotation, oscillation, or variation has advanced, considered in its relation to a standard position or assumed instant of starting."

This explanation which is given by the newest Webster is one of the best and shortest descriptions ever written, but nevertheless, it involves too many functions and factors. It can confuse even a Professor of Physics, the poor beginner is left as wise as before he consulted our old friend, "the Webster."

The effect of this experience with the dictionary will only be an amplification of the widely held opinion among radio beginners that "Phase" must be something reserved for scientists only, or at least for people who read a heavy mathematical book instead of a newspaper each morning while having breakfast!

As the following description will prove, this opinion does not hit the mark since "that certain something," with the Greek name "phase" which puzzles our minds so much, can actually be understood by any one of us. "Phase" is not a factor governing electrical functions alone. It governs also the most simple happenings in our daily life. Of course we do not call it on such occasions by its Greek name, but we actually mean one and the same thing that engineers and scientists have in mind when they use the Greek word.

To begin with, let us forget entirely about the word "phase" and talk about something which is very familiar to all of us—for instance, let us speak about a city.

THERE IS "PHASE" IN CITY TRAFFIC!

The city which we shall discuss, and which we shall call "X," is shown at A in Fig. 10. We see there many broad avenues and smaller sidestreets, and also a very broad Main Street with a street car system which provides the inhabitants of this city with the necessary means of cheap transportation. As the map indicates, the business district with its great factories, etc., is located uptown, while the residential section is concentrated in the downtown part.

Each morning when the inhabitants of this city go to work a traffic rush in the *uptown* direction is created; a similar traffic boom, but in reversed direction, occurs in the hours after office closing.

Since the fluctuations of the traffic load are of great economical importance for the company which operates the street car system, no one will be surprised to learn that this company made a thorough census to determine the traffic load during different hours of the day.

Something about rush hours. As indicated in Fig. 10B, there are in the early morning hours (between 3 and 4 o'clock) only 1,000 persons who are using the street cars in an uptown direction. In the next hour (or between 4 and 5 o'clock, a.m.) the number of uptown passengers increases to 3,200

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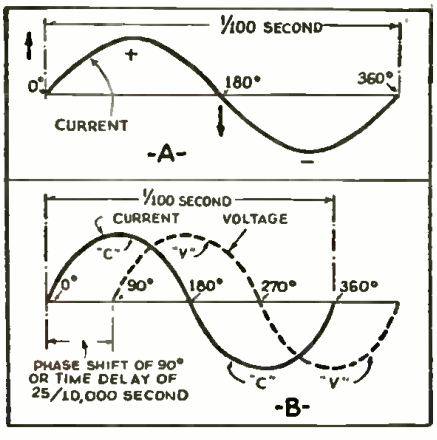


Fig. 11. The electrical equivalent of Fig. 10.

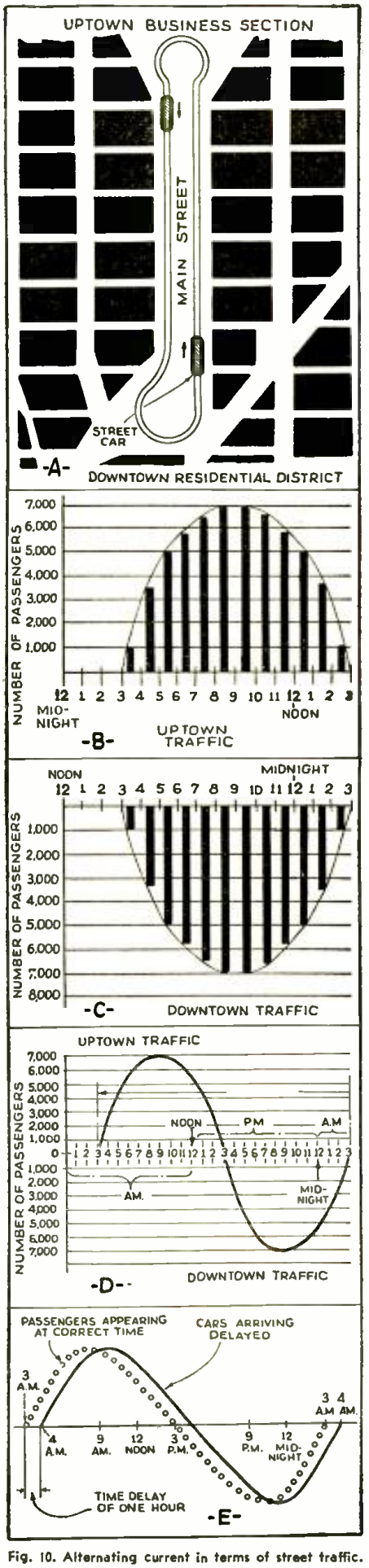
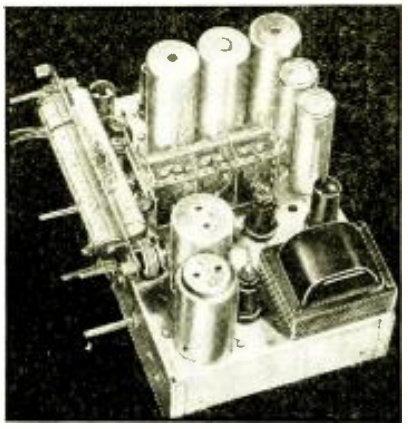


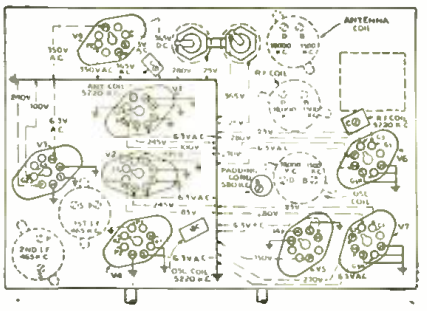
Fig. 10. Alternating current in terms of street traffic.

GENERAL ELECTRIC MODEL A-83 AND A-85 8-TUBE ALL-WAVE SUPERHETERODYNE

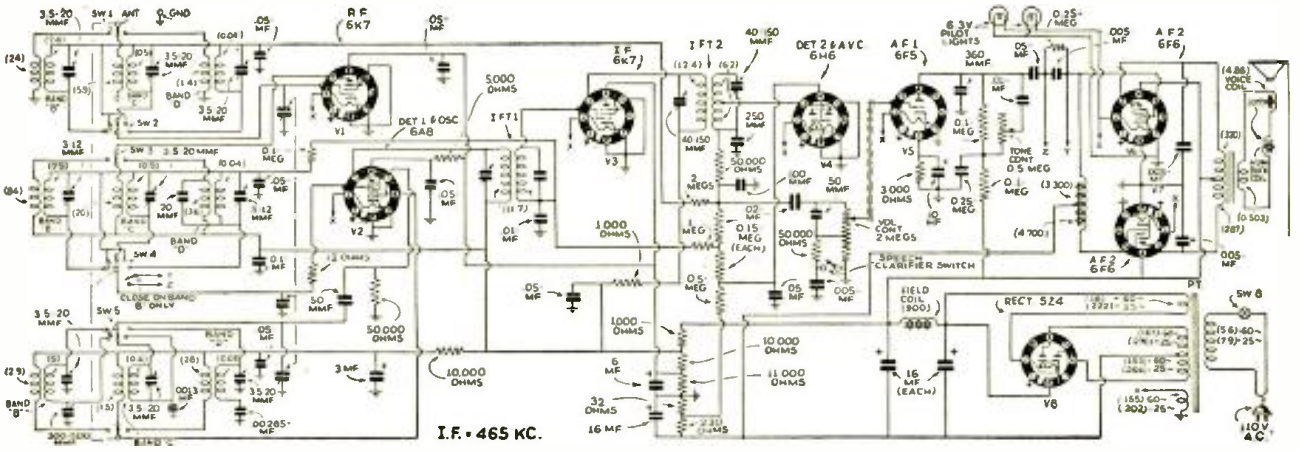
(Features: tuning range, 540 to 18,000 kc.; metal tubes; speech clarifier; push-pull output; special tuning dial.)



All socket voltages are given in the small detail drawing. These are measured with a 1,000 ohms-per-volt meter, and a 115 V. power supply. There should be no signal input. The cathode currents are as follows: V1, 8.7 ma.; V2, 10 ma.; V3, 8.7 ma.; V4, 0; V5, 0.5-ma.; V6, V7, 30 ma. each; V8, 87 ma. The power consumption is 100 W. for the 60-cycle model, and the power output is 6 W. undistorted and 11 W. maximum. The set is available with power transformers for 25 to 60 cycles and 105 to 250 V. The alignment of the receiver is accomplished at the following frequencies: I.F., 465 kc.; Band "B", 580 and 1,500 kc.; Band "C", 5,220 kc.; Band "D", 18,000 kc. A calibrated test oscillator is necessary, as well as an output meter which is attached to the output transformer. The lowest possible output from the test oscillator should be used that gives sufficient deflection of the output meter, in order that the A.V.C. action of the circuit will not



cause false readings. A tuning wand may be used to check the setting of the various trimmers before actual adjustments are started. *In this manner it may be found that some of the circuits do not need changing.*



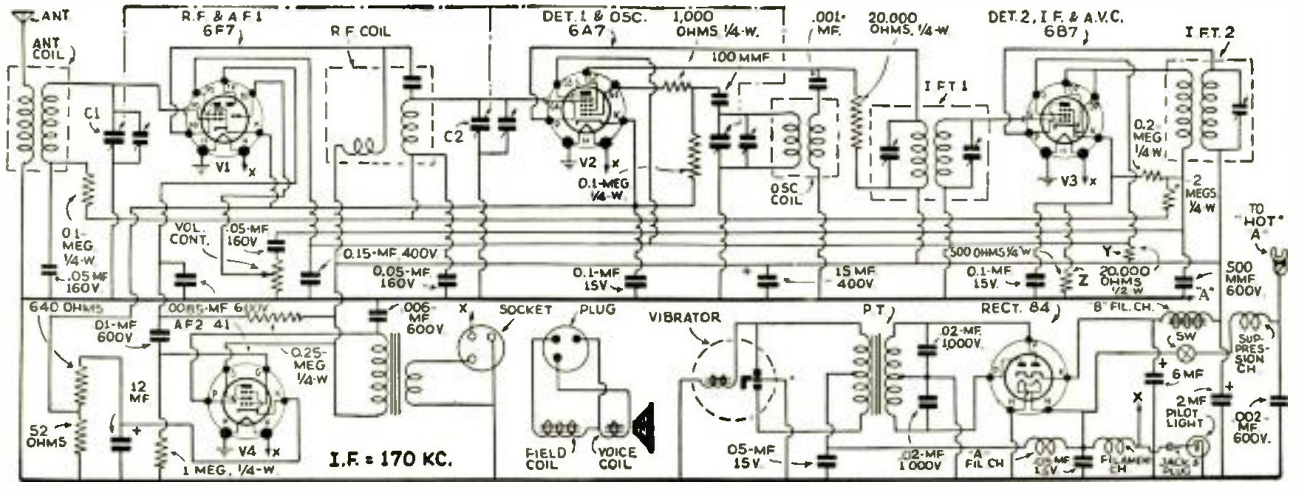
ARVIN MODEL 7 5-TUBE AUTO SUPERHETERODYNE RECEIVER

(Features: economical operation; R.F. stage; silent tuning.)

The operating voltages for this receiver are shown in the table herewith:

Tube	Plate	S.-G.	Cath.	Heater
V1*	220	100	2.3	6.0
V2**	220	100	2.3	6.0
V3	220	100	3.5	6.0
V4	205	220	18	6.0
V5	230 (A.C.)	—	230	6.0

*Triode plate, 50 V.; **anode grid, 175 V.; grid No. 1, 5 to 10 V., both at 1,500 kc. These readings are taken with a meter of 1,000 ohms-per-volt or higher. A tolerance of plus or minus 20 per cent on all readings is allowable. For silent-tuning action, disconnect the 0.2-meg. resistor from the cathode of tube V3 and connect direct to ground. No other changes are needed. Note that the I.F. of 170 kc. enables a high gain to be obtained with the pentode section of the 6B7 as the only I.F. amplifier tube. The fact that the first 3 tubes of the receiver are all used for multiple purposes makes it necessary to use care when servicing the set, as any long, unshielded leads will probably cause feedback and circuit oscillation. This is especially true of tube V1, which is used as a pentode R.F. amplifier and a triode A.F. amplifier. Do not radically change the location of the leads to the socket of this tube, or trouble will result. Resistors Z and Y may be varied from 200 to 500, and from 20,000 to 50,000 ohms, respectively, to change the sensitivity.



OFFICIAL RADIO SERVICE MEN'S ASSOCIATION, INC.

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.

MORE TAXES!

RADIO-CRAFT, ORSMA *Dept.:*

Recently there was proposed in the City Council an ordinance which, if it goes through, *will mean a tax of $25.00 per annum for an Electricians license!* The manner in which this ordinance is worded has given the Service Men in this area cause for fear lest they be included under the classification of Electrician.

Our organization has definitely declared itself against licensing of the Service industry, for we believe too much politics would enter and the entire system would then become worthless as far as protection is concerned. Then the tax would only become an extra burden of expense levied upon the already hard hit Service Man. At this writing the ordinance has not yet been acted upon, and we have worked diligently on members of the City Council to have them vote against it.

At an open meeting of PRSMA in April the attendance received a highly enlightening and exhaustive lecture covering Air-Cell and layer-built batteries. Mr. Fox of the National Carbon Co. knew his subject thoroughly and delivered it in a concise interesting manner. At the special meeting on April 14, the General Electric Co. sent us their ace lecturer on highly technical subjects, Mr. Shaw, who gave an explanation of the function of each part of the conventional superheterodyne receiver from a thoroughly practical standpoint. The information given by Mr. Shaw did not concern any specific make or model, but were applicable to practically any present-day radio. To cap this excellent presentation, everyone present was given a mimeographed copy of the entire lecture, so that he could take it home for study or reference.

The next lecture in the PRSMA Service Course schedule will be presented by Mr. John Brechner and will have to do with Magnetism, Self Inductance, and Mutual Inductance.

PAUL G. FREED

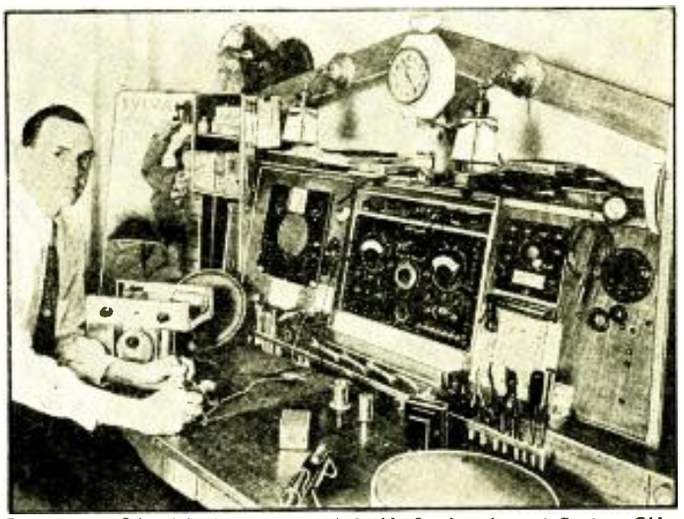


Fig. A. Mr. Clive W. Keemer at work in his Service shop at Dayton, Ohio, (a reproduction of which appeared in the Feb., 1936 "Sylvania News").

We wish other Service organizations would keep us as well informed on local happenings as does the Philadelphia Radio Service Mens' Association, through Mr. Freed, who is Chairman of the Publicity Committee.

A NOVEL TEST

RADIO-CRAFT, ORSMA *Dept.:*

For the first time since I have been accepted as an Associate Member of ORSMA, I am sending in a couple of ideas which may save time for other Service Men.

One is a test for the condensers of a receiver power pack. A simple and quick test for suspected units in those receivers which use heater-type tubes is as follows: with the receiver in operation, turn the volume control up to normal volume, then pull the power plug from its socket. If the sound from the re-

(Continued on page 185)

READERS' DEPARTMENT

An Exchange Post For Readers' Ideas

THE "LAZYMAN 4"

Spokane, Wash.:

Please advise me in regard to the diagram reproduced in Fig. 1, which is part of the circuit of the "Lazyman 4" receiver, which was described in *Radio-Craft* for October, 1935.

I thought perhaps there was a misprint on the diagram, but it may be merely my unfamiliarity with the circuit.

JIM ENGLISH

We print herewith, Fig. 1, a section of the original circuit with the correction noted.

A COMPLAINT

Delmar, Del.:

Enclosed find $1.00 for a trial subscription to *Radio-Craft*.

But if you people don't soon publish some information regarding farm receivers, 32 V., 6 V. battery, and 2 V. Air-Cell type, I'll be darned if I ever look at an issue again.

I belong to a Rural Service Men's Correspondence Club (I'm No. 87) and I could show you letter after letter saying that the writer had quit *Radio-Craft* or some other magazine because they refuse to give schematics and information on *farm-type* receivers. Why not publish a manual of Battery and Farm Radios? Also why not publish some data on vibrators giving fundamental circuits of the different types? And last but not least how about a treasure finder that really works. Three of us have built the one in the Oct., 1935 issue and can get no results of any kind. The other builders are licensed hams and have built their own transmitters and receivers, and both say the diagram is a dud.

H. L. PUGH

After reading the above letter, we wondered if we had really been neglecting the rural Service Men and others who have to depend upon batteries for all power. A hasty check of the 7 issues published so far this year revealed that there have been 6 data sheet diagrams on farm receivers, all types, 2 V., 6 V., and 32 V. being represented. Besides this there were over a dozen other battery receivers of all kinds described, most of these being construction articles! And all this does not take into consideration the large number of 6 V. auto receivers, which are ideal for rural use due to their high sensitivity. So we feel that Mr. Pugh is a bit hasty in complaining of the lack of material, as the field certainly appears to have been well covered.

An elemental article on the circuits and shortcomings of different types of vibrators appears on Page 278 of the November, 1935 issue of *Radio-Craft*.

Additional hints on the treasure locator are given in the May, 1936 issue, Page 692. The circuit has been checked and is known to be correct.

Future issues of *Radio-Craft* will take into consideration all the items mentioned by our discerning contributor, whose comments are deeply appreciated.

AMERICAN TACTICS!?

Bombay, India:

I was certainly glad to see that a fellow countryman had done the American Radio Manufacturers a good turn by stating the trouble he has been having from radio retailers in England. (P. 465, Feb., 1936 *Radio-craft.*)

It would probably surprise a certain 23-tube custom built radio maker to know that the retail price of his chassis is £155/-! The same in India with 50% customs duty and discounts retailed net for Rs.1,000/- when the distributors were The Automobile Co. Ltd., who are a well-known firm of repute. With the changing of the distributorship the rice is now Rs.2,000/-! In the same manner the Pilot set is sold here for Rs.700/- whereas the corresponding Philco 116B sells for Rs.420/-. (One Rs. = about 33c. —*Editor.*)

Very few dealers here know what real servicing means yet every petty shop has become a dealer in Amer-

(Continued on page 183)

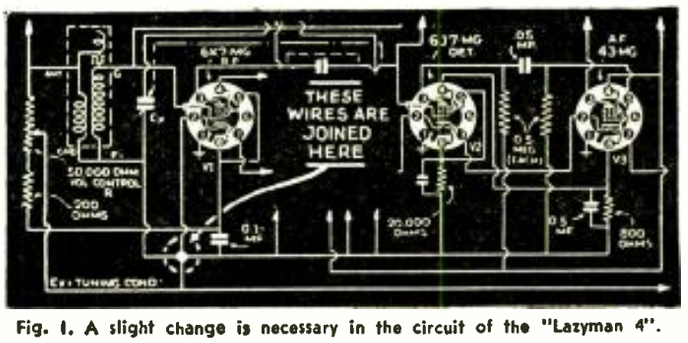


Fig. 1. A slight change is necessary in the circuit of the "Lazyman 4".

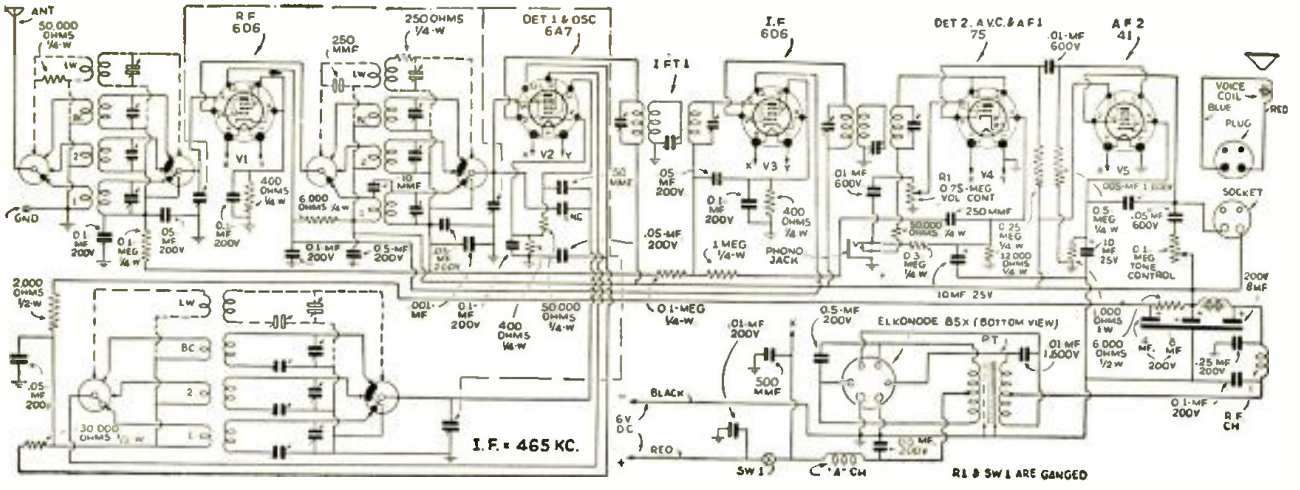
PILOT MODELS 253 AND 255 5-TUBE 6 V. RECEIVERS

(Features: range, 16 to 2,000 meters on Model 255; 16 to 550 on Model 253; synchronous rectifier; triple-winding I. F. transformers.)

The model 255 which has a long-wave band of 750 to 2,000 meters is sold in the European area only. The only difference in this set is that it has the coils and associated equipment for the extra band. These are shown on the circuit diagram in dotted form, to distinguish it from the circuit of the Model 253. These receivers are intended for use on farms and in any isolated locations where there are no commercial power lines available. A 100-A.-hour battery is recommended, and may be used with one of the wind-driven generators to keep the battery charged. The blue wire from the receiver is connected to the antenna, and the black, glazed wire to ground, although the latter may be found unnecessary in many cases. These receivers may be used with a phono pickup, and for this purpose a jack will be found located on the rear of the chassis. The pickup should be of the high-impedance type. The voltages in the set are as follows:

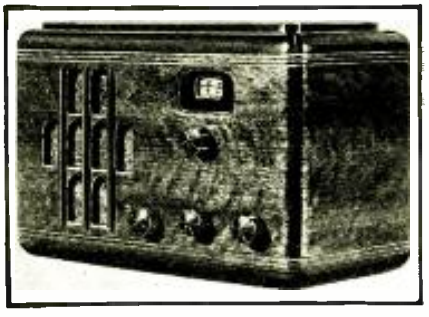
Tube	Heater	Plate	Cath.	S.-G.
V1	6.0	135	4	100
V2	6.0	135	1.8	50
V3	6.0	135	4	100
V4	6.0	60	1	—
V5	6.0	118	10	125

These should be measured at the tube sockets with a 1,000 ohms-per-volt meter. The power output of the receivers is 0.75-W. undistorted and 1 W. maximum. When connecting the set to the battery, make certain that the *red* lead from the set is connected to the positive terminal of the battery and the *black* lead to the negative terminal. Failure to take this precaution may result in damage to the set. To remove the chassis from the cabinet, proceed as follows: disconnect the battery from the set, remove the slip-on knobs and felt washers from the controls and loosen the set-screw from the tuning knob, remove the speaker plug from the socket at the rear of the chassis, remove the 4 mounting screws located underneath the cabinet. When aligning the I.F. transformers, all 3 adjustments of each are tuned in succession, instead of the 2 as in the more usual double-tuned units. Align Model 253 at 1,500 and 600 kc. on B.C. band, 6,000 kc. on band 2, and 18,000 kc. on band 1. Model 255 is aligned at 750 and 2,000 meters on High Band, 200 and 500 meters on B.C. band, 49 meters and 17 meters on S.W. Band. When making repairs on this receiver never use any but rosin-core solder.

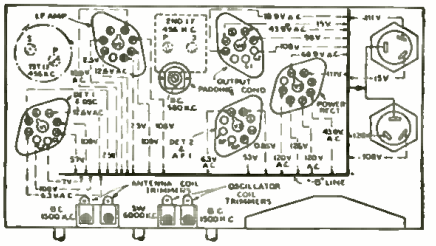


GENERAL ELECTRIC MODEL A-54 5-TUBE A.C.-D.C. SUPERHETERODYNE

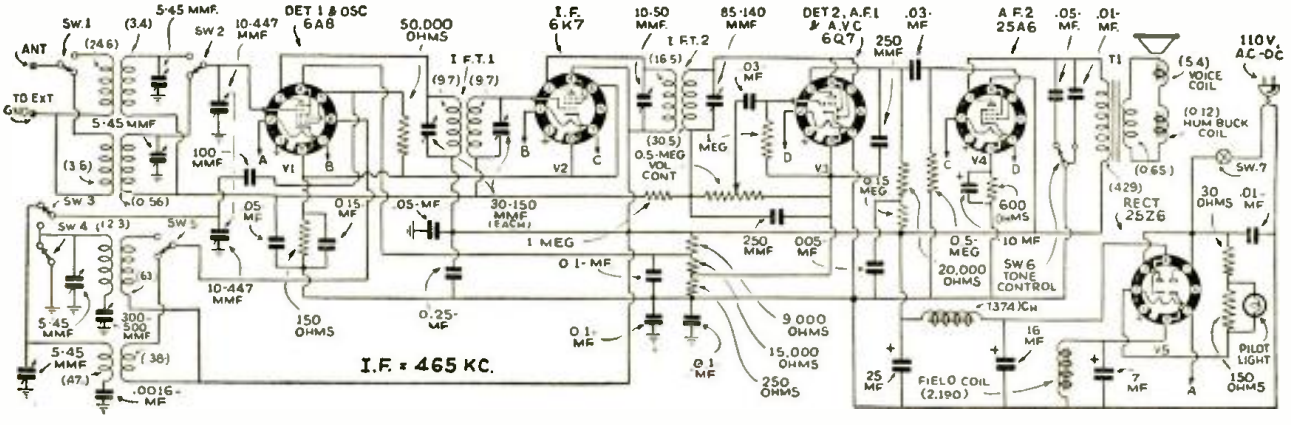
(Features: all-metal tubes; dual-band operation; tone control; 6½-in. dynamic speaker.)



All voltages for this receiver are shown on the small detail drawing. The power output is 0.4-W. undistorted and 1.1 W. maximum. The power drawn from the line is 60 W. The voltages shown are measured at a line voltage of 120 V. either A.C. or D.C. and dial at 1,000 kc. with no signal input. Plate currents on A.C. are: V1, 1.4 ma. for the converter and 1.9 ma. for the osc.; V2, 1.9 ma.; V3, 0.2-ma.; V4, 17.3 ma.; V5, "B+", 46 ma., speaker field, 44 ma. Values are slightly less on D.C., except for those on V5, which are slightly higher. Alignment frequencies are 465 kc. for I.F., 1,500 and 580 kc. for B.C. band, and 6,000 kc. on short-wave band.



For I.F. alignment the lead from the test oscillator is connected to the cap of V1.



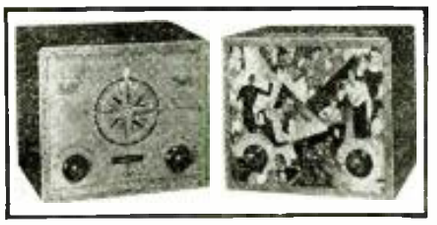
CROSLEY MODEL 2-C-1 2-TUBE T.R.F. A.C.-D.C. COMPACT RECEIVER

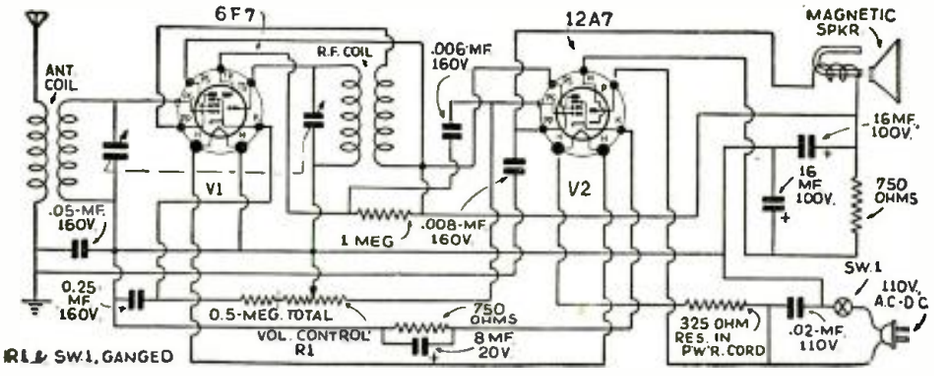
(Features: small size; 2 dual purpose tubes; speaker reception; regeneration.)

This novel midget receiver uses only 2 tubes, from which the results of 4 are obtained! The operating voltages are as follows:

Tube	Plate	S.-G.	C.-G.	Cath.	Heater
V1 (Pen.)	125	125	0	5-30	6.5
(Tri.)	30	—	0	same	same
V2 (Pen.)	115	125	0	10	12.5
(Rec.)	117.5	—	—	135	same

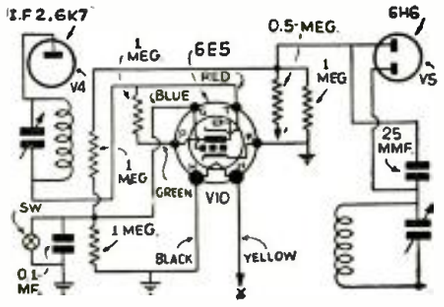
These values are taken with a line voltage of 117.5 V. and read on a 1,000 ohms-per-volt meter on the 250 V. scale. Values of plus or minus 10 per cent of the above table may be considered satisfactory. An aerial of from 35 to 50 ft. length should be used with the set, and is connected to the end of the aerial lead that comes out of the set. Never use a ground connection on the receiver as it may be badly damaged. Care should be taken not to bump the front panel of the case as this acts as a loudspeaker diaphragm, and a hard knock may ruin the speaker. Whenever the chassis is to be removed from the cabinet, the speaker drive pin must be unsoldered from the speaker motor. The pin should be unfastened at the lower end of the drive rod coming from the motor. Do not use common glue to fasten the front of the cabinet in place, as it should be held with Hydrolene. The back plate of the cabinet must first be removed by taking out the 2 screws. The detector is of the regenerative type in order that the receiver may have sufficient sensitivity. Regeneration is controlled by means of the volume control in the usual manner. Operation of the receiver near the point of oscillation will cause an increase in sensitivity and also the selectivity will be much greater. The power cord contains the series line resistor.





FAIRBANKS-MORSE MODEL 90 9-TUBE ALL-WAVE SUPERHETERODYNE

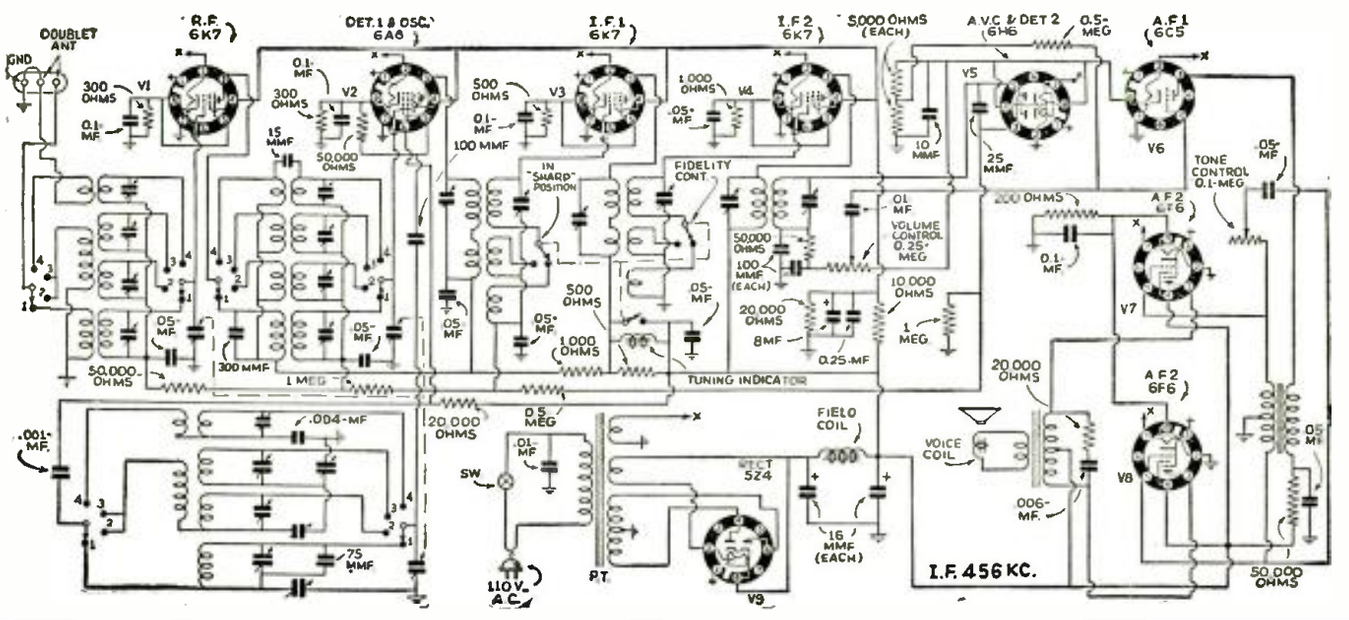
(Features: metal tubes; fidelity control; tuning meter; tone control.)



The Model 90 chassis is very similar to the model 82, except that the latter uses glass tubes of the 6 V. series. The Model 82 uses only 8 tubes since the double diode-triode type 85 is employed, while in the Model 90 separate tubes are in this position. All of the 82 chassis and some of the 90s have the "shadow line" type of tuning indicator. This meter is in the circuit only when the fidelity switch is in the "sharp" position, to encourage the use of this position for tuning. Some of the Model 90 chassis use the 6E5 tuning tube, the connections being made as shown in the small detail diagram. This tuning arrangement also works only in the "sharp" position of the fidelity switch. The *third dimension tone* which is a feature of this receiver is in effect only in the broad position. In the sharp position, the receiver is as selective as the ordinary receiver, and is not able to pass the broad band of frequencies needed for high fidelity. In the "third-dimension" position, the I.F. band width is increased to about 30 kc. Power transformers are made for any desired power supply, as well as a universal transformer which may be used on any A.C. power line. The operating voltages at various positions in the receiver are given in the following table:

Tube	Plate	S.-G.	Sup.-G.	C.-G.	Cath.
V1	240	125	3	0	3
V2*	240	120	—	0	3
V3	260	120	7	0	7
V4	260	120	5.5	0	5.5
V5**	0.2	—	—		
V6	170	—	—	0	13.5
V7, V8	255	260	—	0	15
V9	A.C.	—	—	—	335
V10***	20	—	—	0	0

*The oscillator plate voltage is 130 and the oscillator grid voltage is —8. **The plate voltage is on terminal No. 3. ***Target voltage is 250. When this tube is used the other voltages vary slightly from those shown above. The voltages given are exact for Model 90 with the shadow-type tuning indicator. The doublet antenna is used only on the shortest wave band.



BUILD THE "TALKING BRIEFCASE" RECEIVER

(Continued from page 137)

to the briefcase handle so that it is as inconspicuous as possible.

LIST OF PARTS

The following are the parts required for constructing and operating The Briefcase Portable Receiver:

One leather brief case, 16 x 11 ins;
One Wholesale Radio Service 3-gang variable condenser, smallest dimensions possible;
*Two high-gain R.F. coils, shielded;
*One high-gain Ant. coil, shielded;
*Three 4-prong wafer sockets;
*One 5-prong wafer socket;
One Electrad volume control, 0.25-meg., with D.P.S.T. switch;
Three Continental Carbon resistors, 0.25-meg., ½-W.;
One Continental Carbon resistor, 0.1-meg., ½-W.
One Continental Carbon resistor, 0.5-meg., ½-W.
One Electrad wire-wound fixed resistor, 3 ohms, for filament circuit;
Four Cornell-Dubilier tubular condensers, .05-mf., (600 V. type);
Two Cornell-Dubilier tubular condensers, 0.1-mf., (600 V. type);
One Cornell-Dubilier mica fixed condenser, 500 mmf.;
One Cornell-Dubilier tubular condenser, 0.003 mf., (600-V. type);
*One permanent-magnet dynamic speaker, 5 in. O.D., with output transformer to match a 1F4 tube;
Two Raytheon type 1A4 tubes;
One Raytheon type 1F4 tube;
One Raytheon type 32 tube;
*One 3 V. "A" cell, type X200;
*One 7.5 V. "C" Battery, type X204;
*Three 45 V. "B" batteries, type X203;
One Wholesale Radio Service airplane-style tuning dial, with escutcheon plate and 3-in. calibrated circular scale;
One Radio City Products lab. type knob, 1 in. size;
One plain knob for volume control;
Two Paragon bevel gears, 45 deg. type-1-1 ratio;
Miscellaneous parts, such as aluminum for chassis and shelf, brackets, screws, bolts, hook-up wire, solder, etc.

*Name and address of manufacturer will be sent upon request.

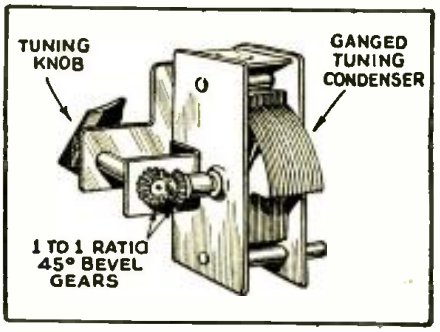


Fig. 2. The gear condenser drive mechanism.

INTERNATIONAL RADIO REVIEW

(Continued from page 140)

covers the wavelengths of 3,000 to 5 meters and can be extended to 2 meters if desired. Fundamental frequencies are used throughout. Hand calibrated scales are fastened in a frame on the top of the instrument. Note the interesting dial with its vernier adjustment knob at the side of the main tuning knob.

2 INTERESTING CIRCUITS

MANY interesting circuits have appeared in recent issues of the popular European magazines—a few of which we have published in past issues to show our American readers just what is taking place, technically, on the other side of the Atlantic.

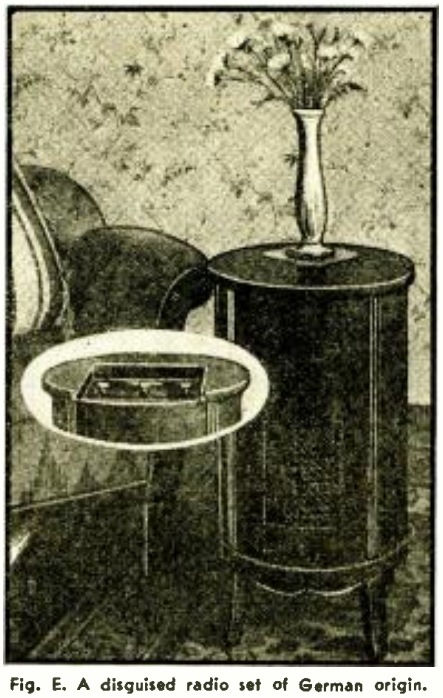


Fig. E. A disguised radio set of German origin.

The first (Fig. 1) is taken from the English magazine, *Practical and Amateur Wireless* (London), and gives the circuit of an inexpensive set designed particularly for high-quality reception of the local stations. It is a set which might be described as *approaching* high fidelity since the cost factor has been made an important one.

As shown, the set uses a single stage of tuned R.F. direct-coupled to the aerial; and coupled to the detector through a band filter. The detector uses the power-grid detection circuit incorporating a triode, since this detector has been shown to give high-quality detection (according to the author) and has the advantage over diode detectors of amplifying the signals. The detector is coupled through a high-quality push-pull transformer to the triode output tubes.

The quality of reception of this set depends, of course, on the fidelity of the speaker used as well as the parts used throughout. It can be made to supply good reception on nearby stations and should not cost more than a nominal amount.

The second circuit (Fig. 2), a superhet., is shown to demonstrate the trend in sets of a well-known manufacturer in Germany. This circuit, which appeared in *Rafa* (Stuttgart, Germany), uses the multiple-element tubes made by Loewe Company. With the combination used, there are actually only 3 tubes in the set!

NOVEL FRENCH SET

A NEW radio receiver in the modern mode was illustrated in *Toute La Radio* (Paris), recently. This set, which uses 5 tubes, is a superhet. which is housed in a novel cabinet, shown in Fig. D. In this cabinet, the speaker is located in the base, protected by a metal grille, and the receiver chassis is enclosed in the upper portion of the table, with a hinged front panel to cover the control panel. The set, closed, appears to be an attractive modernistic table.

A GERMAN SET

ANOTHER disguised receiver is shown in Fig. E. This set, which hails from Germany is made in the form of an incidental table to set beside your favorite chair. The controls are in the top and are concealed by a sliding panel as shown in the insert. The speaker is in the side of the table, back of the grille.

THE "TRAVELER'S COMPANION" 2-TUBE ALL-WAVE A.C.-D.C. SET

(Continued from page 145)

style glass tubes such as the 76s or 37s. The pentode portion of the 12A7 is ideal for the usage imposed upon it in this particular circuit. It has a power output of over ½-W. at 135 V., which makes it equivalent to a type 38 output tube. The D.C. load current of the rectifier section is limited to 30 ma., but this is more than sufficient to take care of this small receiver.

The construction of the Traveler's Companion is simplified due to the fact that the parts are few in number. The antenna trimmer is mounted on the left side wall of the carrying case. It has a short shaft soldered to the adjusting screw and a knob fastened to the shaft. The tuning condenser and the potentiometer-switch are mounted on the front wall. The twin phone jack is mounted on the rear wall. The 12A7 tube socket is mounted in a horizontal position on the inside wall by means of two ¾-in. insulated bushings. The coil socket and the 6C5 tube socket are mounted in a vertical position by insulated bushings on the base of the case. All other parts are fitted onto the bottom of the case. The antenna trimmer and jacks must be well insulated from the metal case. The potentiometer, also, must be of the type which will not short-circuit against the case. Be *sure* that both tubes are OK.

The wiring can be completed in a very short time. The socket connections are shown on the schematic diagram. These are to be followed with special care as an error in connecting up one of the 7 terminals of the 12A7 tube will prevent the set from operating properly. It is suggested that the grid circuits be wired in first, then plates, cathodes, bypass condensers and finally, the filament circuit. Solder a flexible wire to the antenna trimmer for the aerial connection. This set requires no ground connection and in fact, none is to be used.

LIST OF PARTS

One Hammarlund antenna trimmer, 10 to 70 mmf., type MICS-70, C1;
One Hammarlund midget condenser, 140 mmf., type MC-140-S, C2;
One Cornell-Dubilier mica condenser, 100 mmf., type 3L, C3;
One Cornell-Dubilier mica condenser, 500 mmf., type 1W, C4;
Three Cornell-Dubilier "cub" tubular condensers, 0.01-mf., type BA-4S1, C5, C7 and C10;
One Cornell-Dubilier "cub" tubular condenser, 0.1-mf., 400 V., type BA-4P1, C6;
Two Cornell-Dubilier dual-section dry electrolytic condensers, 8 mf. each section, type Ma-11260, C8, C9;
One Centralab carbon resistor, 1 meg., ½-W., R1, R4;
One Electrad potentiometer with switch (Sw.1), 75,000 ohms, type 202-S, R2;
One Centralab resistor, 0.17-meg., ½-W., R3;
One Electrad truvolt flexible resistor, ½-W., 1,000 ohms, type HG-1000, R5;
One Electrad vitreous enamel resistor, 10,000 ohms, 10 W., R6;
*One line cord with resistor, 350 ohms, 50 W., R7;
Twin Wholesale Radio Service earphone jacks, J1, J2;
One Sylvania type 6C5 metal tube, V1;
One Sylvania type 12A7 tube, V2;
One set of Hammarlund 4-prong short-wave coils, 17 to 270 meters, type SWK-4, L1;
One Hammarlund 4-prong broadcast coil, 250 to 560 meters, type BCC-4, L1;
One Wholesale Radio Service 4-prong wafer socket for plug-in coils;
One Wholesale Radio Service 7-prong wafer socket for 12A7 tube;
One Wholesale Radio Service octal socket for 6C5 metal tube;
One Wholesale Radio Service screen-grid clip for 12A7;
One Wholesale Radio Service roll push-back wire;
Three Wholesale Radio Service knobs;
One metal carrying case (cash-box), 9¼ x 4½ x 2¼ ins. deep.

**Name and address of manufacturer will be supplied upon request.*

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 1936 CATALOG. Contains 12 pages of specifications, illustrations and prices on the new line of Hammarlund variable, midget, band-spread and adjustable condensers; trimming and padding condensers; R.F. and I.F. transformers, coils and coil forms; sockets, shields, chokes and miscellaneous parts of ultra-short-wave, short-wave and broadcast operation.

4. THE "COMET PRO" SHORT-WAVE SUPERHETERODYNES. Describes the outstanding features of the standard and crystal-type Hammarlund "Comet Pro" short-wave superheterodynes designed to meet the exacting demands of professional operators and advanced amateurs for a 15 to 250 meter code and phone receiver, but which can be adapted by anyone for laboratory, newspaper, police, airport and steamship use.

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.

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.

59. THE EVOLUTION OF TUBE TESTING. This interesting booklet, published by the Supreme Instruments Corp., traces the development of tube testing equipment and gives a complete technical description, with wiring diagram and discussion of the technical points involved in the design and use of the Model 89 Supreme Radio Tester for testing all tubes, and also paper and electrolytic capacitors.

62. SPRAYBERRY VOLTAGE TABLES. A folder and sample pages giving details of a new 300-page book, containing 1,500 "Voltage Tables" covering receivers manufactured from 1927 to date, published by Frank L. Sprayberry to simplify radio servicing.

65. NEW 1936 LINE OF SUPREME TESTING INSTRUMENTS. This 16-page catalog gives complete information on the entire Supreme line of testing instruments, including the Model 385 Automatic Tube Tester and Analyzer, the Model 339 DeLuxe and Standard Analyzers, and other standard Tube Testers, Set and P.A. Analyzers and Signal Generators. Complete details of the Supreme Easy Payment Plan for purchasing testing equipment on the installment plan are given.

67. PRACTICAL MECHANICS OF RADIO SERVICE. Information, including cost, features and outline of lessons of the Frank L. Sprayberry course in Radio Servicing, and list of Sprayberry Data Sheets for modernizing old radio equipment.

69. YOUR FUTURE IN RADIO. With the development of Radio into many specialized fields, it has become increasingly important for anyone considering radio as a lifework, to investigate the opportunities offered in the various fields for a man of his particular qualifications. These opportunities are described in an interesting 32-page book, "Your Future in Radio" published by the Sprayberry Academy of Radio. It also gives complete information on the new Sprayberry Course in Radio Service Engineering which includes all standard equipment and supplies for the practical work required in mastering the course and going into business.

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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( ) Professional Set Builder.
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( ) Short Wave Work.
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RADIO MEN

Will find the descriptions of the 1937 model radio receivers and components which will appear in the October issue of RADIO-CRAFT to be indispensable in their work.

CHECKING RADIO SETS BY X-RAY!

(Continued from page 150)

In the radio factory and the well-appointed dealer's or distributor's service shop the X-ray can be used for many purposes which will in some cases soon pay for the cost of the X-ray equipment in reduced time, lowered costs, etc. Tubes, transformers, shielded R.F. and I.F. transformers, condensers, resistors, etc., can all be tested for breakdown, defects in manufacture, etc., *without destroying them*, and the information thus gained can be used to eliminate similar defects in later production—or in instances of subsequent servicing of similar types of equipment exhibiting the same symptoms.

While the X-ray machine is a rather expensive device for the Service Man to aspire to, its increased application by manufacturers will improve the general run of replacement apparatus, and radio receivers with which he has to work. And there is the possibility that sometime in the future, the X-ray equipment of these manufacturers will be made available for service checks which will directly aid the Service Man in his work.

To return to the actual mechanics of using X-rays in radio, it is common practice to take 2 "shadow pictures" of a device under question, the pictures being made at right-angles to each other so that a complete view of the interior can be made.

The illustrations which accompany this article show several examples of X-ray analysis made by the Bell Telephone Labs. in connection with the examination of telephone apparatus. At A is seen the interior of a unit comprising several pieces of apparatus (including several small resistors and a repeating coil) all enclosed in a metal shield and completely embedded in pitch. The positions of the small resistors can be readily seen and even the voids (holes or bubbles) in the potting compound are visible. At B and C are 2 views of condensers enclosed in metal cans. The unit at B is set in the compound at a poor angle which is likely to cause either a change in characteristics or an intermittent short between the condenser plates and the wiring terminal; while the unit at C clearly shows a broken lead.

To sum up the advantages of the X-ray method of examination—(1) it is *non-destructive*; (2) it may be repeated at regular intervals on apparatus on life or service test; (3) it is an excellent method of checking the alignment of parts in a complicated assembly (such as the coils and leads in a shielded R.F. or I.F. transformer); and (4) it furnishes a permanent record of the condition of the apparatus, at the instant of test and under normal internal conditions (as against removing a sealing compound, which might alter the characteristics of the unit).

THE RADIO MONTH IN REVIEW

(Continued from page 135)

to statistics, from educational data to comic strips." He added that these developments would not displace "existing media of information—particularly newspapers."

OPERATING NOTES

(Continued from page 149)

Open bypass condensers also responsible for intermittent reception on this same model.

IRWIN WEEKS

Philco Model 96. Receiver was playing very weakly when I arrived. I found that the detector-amplifier tube was not receiving plate voltage. The plate resistors were checked, and it was found that No. 32 was burned out; this is a white resistor the value of which is 0.25-meg. When this resistor was replaced full reception was restored.

Audiola Jr. Receiver. Another case of resistor trouble. The detector resistor was found to be burned out in this case; it is a yellow resistor, value 0.5-meg. Replacement of this resistor brought back normal reception.

JAMES L. HOARD

HOW TO MAKE AN ULTRA-DX 12-TUBE ALL-WAVE SET

(Continued from page 146)

high audio output. The so-called twin triode or direct-coupled tube, of which the 2B6 and 6B5 are examples, has always been noted for fine tone quality and high output. An examination of the latest tube releases showed that the 6N6 was of the same family, so this was immediately selected. Subsequent tests have shown this to be a very wise choice. Not only are an extra cathode resistor and bypass eliminated, but the tone quality of the receiver have been found surprisingly good, despite the fact that the speaker is in a small metal case!

ADDITIONAL FEATURES

There are of course other points to consider, such as sensitivity, overall flexibility, and last but by no means least, good appearance.

With these points in mind a tentative circuit was drawn up, and then was started a quest for the proper parts.

The "coronet" type of metal tube was chosen over glass tubes for several reasons, mainly because they are small and completely self-shielded. They offer a complete line, including the highly desirable 6L7, the 6N6 output tube and many others.

The tuner unit finally chosen is a very compact and well-designed job. It comes complete with switch tuning condenser, padding condensers and all. The tuning condenser was removed from the tuner and mounted on the receiver chassis, the change being made to reduce the overall height of the set. The original leads to this condenser are retained, as they are simply passed through holes in the set chassis and resoldered to the correct lugs.

CIRCUIT DETAILS

The set is so laid out that regeneration may be added to the R.F. stage simply by adding a cathode coil on the R.F. coils. The regeneration control is in the screen-grid lead of V1 and it acts as a very good sensitivity control, to prevent 1st detector overload when the A.V.C. is not in use.

The 1st detector is the 6L7, which has its injection grid tied through a condenser to the oscillator plate. A variable resistor in the cathode circuit of V2 provides exact control of its operating conditions, although it is not strictly necessary.

Next we come to the crystal filter circuit. Two air-tuned iron-core I.F. transformers couple V2 and V3 through the crystal. The selectivity control is a midget condenser operated from the front panel and which, when turned fully counter-clockwise, operates a switch to short out the crystal.

The 6L7 I.F. amplifier is coupled to the 6C5 2nd detector through another iron-core unit, the 6C5 being in turn connected to the 6N6 audio tube by a 3-to-1 ratio A.F. transformer.

The speaker used is of the permanent-magnet variety, which needs no field excitation, and thus operates with less hum than the usual speaker. The tone quality, as mentioned previously, is excellent. The speaker plug is so arranged that when removed, all voltage is removed from the 6N6. The phone jack cuts out the 6N6, although the audio volume control is left in the circuit, as is the tone control.

The beat oscillator has all its underchassis components in a separate shield, the beat note control being mounted on this shield and controlled from the front panel. This control, when turned all the way to the counter-clockwise position, cuts out the oscillator.

The A.V.C. tube grid and the grid and cathode circuits of the 2nd detector are about 100 V. more negative than the chassis. This voltage is obtained from a drop across the 1,500-ohm resistor in the power supply, and is also used through a potentiometer to control R.F. gain.

THE POWER SUPPLY

Due to the necessity for 100 V. of bias, the power supply must furnish a total of 350 V. under full-load. This is easily taken care of by the transformer selected, which is designed for use in receivers with class "B" output. Two filter chokes and 3 large electrolytic condensers assure very smooth D.C. so that hum can hardly be heard at full volume with the ear right on the speaker! Two switches are provided, one for the A.C. line and one to break the center-tap lead of the secondary, the latter making the entire high-voltage system "dead."

(The transformer has an extra 2.5-V. winding which is not used in this particular receiver, but might come in handy in other applications.)

The noise silencer circuit is complete and self-contained on its own little chassis. This affords good shielding and prevents possible feedback troubles. It may be left off and added at any future time, without spoiling the appearance or operation of the receiver in the meantime.

The entire circuit and List of Parts is given herewith. However, the next issue will contain all the construction hints and instructions on alignment and other procedure. In the meantime, all parts may be mounted and assembled, and the receiver made ready for the big "bug hunt," which will be made as painless as possible in Part II.

LIST OF PARTS

One Tobe Deutschmann all-wave tuning unit, complete;
*One 3-gang condenser, CY;
*One iron-core transformer, type G101c IFT 1;
*Two iron-core transformers type G101a IFT 2, IFT 3;
One Hammarlund transformer, type ST465CT, IFT 4;
One Hammarlund beat oscillator coil, type TB0465, T3;
Two Hammarlund shielded R.F. chokes;
Three Hammarlund condensers, type APC 25, C4, C5, C9;
One Hammarlund condenser, type APC 50, C7;
One Hammarlund condenser, type APC 100, C10;
* Nine octal bakelite sockets;
*Three octal insulex sockets;
*One electralloy panel, 18⅛ x 9¼ x 3 32-in. thick;
*One electralloy chassis, 11½ x 17 x 3 ins. deep;
*One electralloy chassis, 2¼ x 13⅜ x 7½ ins. long;
*One electralloy chassis, 9 x 12 x 3 ins. deep;
*Ten insulated flexible couplings;
*Two bakelite sockets, 6-prong;
*Two bakelite plugs, 6-prong;
*One connection strip, 3-terminal;
*Four S.P.S.T. toggle switches;
*One midget jack;
*Eight knobs, type 1166;
*Two knobs, type 1167;
*One knob, type 1155;
*Eight insulated grid clips;
*Five bakelite rods, ¼-in. dia. x 12 ins. long;
*One steel case, 9 x 12 x 18 ins. long;
*One bakelite socket, 5-prong;
*One mounted filter crystal, type BC3;
One UTC power transformer, type CS-52, T2;
One UTC choke, 30 H., type CS-41, Ch. 1;
One UTC choke, 10 H., type CS-40, Ch. 2;
One UTC audio transformer, type CS-1, T1;
One Electrad variable resistor, 50,000 ohms, R15;
One Electrad variable resistor, 1,500 ohms, R16;
One Electrad variable resistor, 5,000 ohms, R17;
One Electrad variable resistor, 0.1-meg., R18;
One Electrad variable resistor, 10,000 ohms, R19;
One Electrad variable resistor, 1,000 ohms, R20;
Two Electrad variable resistors, 0.5-meg., R21, R22;
One Electrad wire-wound resistor, 1,500 ohms, 50-W., R23;
*Seven carbon resistors, 0.1-meg., ½-W., R1;
*Four carbon resistors, 2,000 ohms, ½-W., R2;
*One carbon resistor, 30,000 ohms, ½-W., R3;
*One carbon resistor, 300 ohms, ½-W., R4;
*One carbon resistor, 10,000 ohms, ½-W., R5;
*Nine carbon resistors, 50,000 ohms, ½-W., R6;
*One carbon resistor 0.5-meg., ½-W., R7;
*One carbon resistor, 30,000 ohms, 2 W., R8;
*One carbon resistor, 0.1-meg., 1 W., R9;
*One carbon resistor, 5,000 ohms, 2 W., R10;
*One carbon resistor, 20,000 ohms, 2 W. R11;
*One carbon resistor, 50,000 ohms, 2 W., R12;
*One carbon resistor, 0.1-meg., 2 W., R13;
*One carbon resistor, 25,000 ohms, 2 W., R14;
Three Cornell-Dubilier tubular condensers, 0.1-mf., 400 V., C1;
Six Cornell-Dubilier tubular condensers, .05-mf., 400 V., C2;
Nine Cornell-Dubilier tubular condensers, .05-mf., 600 V., C3;
One Cornell-Dubilier midget mica condenser, 5 mmf., C11;
One Cornell-Dubilier midget mica condenser, .001-mf., C6;
Four Cornell-Dubilier midget mica condensers, 50 mmf., C5;
One Cornell-Dubilier midget mica condenser, 100 mmf., C17;

One Cornell-Dubilier metal-case paper condenser, 1 mf., 400 V., C12;
One Cornell-Dubilier metal-case paper condenser, 1 mf., 600 V., C13;
One Cornell-Dubilier tubular electrolytic condenser, 5 mf., 50 V., C14;
Three Cornell-Dubilier metal-case electrolytic condensers, 12 mf., 600 V., C15;
One Wright-DeCoster Nokoil speaker, 8-in. type;
One Wright-DeCoster speaker case;
One Triplett bakelite-case meter, 0-1 ma., 2 in. case;
*Two vernier dials, 3¾ ins. dia.;
Two Arcturus Coronet tubes, type 6K7, V1, V9;
Two Arcturus Coronet tubes, type 6L7, V2, V4;
One Arcturus Coronet tube, type 6C5, V5;
One Arcturus Coronet tube, type 6N6, C6;
One Arcturus Coronet tube, type 6H6, V11;
One Arcturus Coronet tube, type 5Z4, V12;
Four Arcturus Coronet tubes, type 6J7, V3, V7, V8, V10;
Wire, hardware, spaghetti, etc.

**Name and address of manufacturer will be sent upon request.*

RADIO AND P.A. AID PRESIDENTIAL NOMINATIONS

(Continued from page 139)

be found for it *as the campaign progresses!*

The ultra-portable transmitters illustrated, although distinctly in the novelty class, are quite workable, and others of equal interest will no doubt, soon follow.

The application of tiny portable transmitters for remote pick-up purposes, while not new, has developed considerably since the advent of ultra-high frequencies. Reporting such events as athletic meets, political rallies and conventions, spot news events such as strikes, etc., are all facilitated by the portable transmitter which permits the announcer to move from place to place without restricting wires and cables.

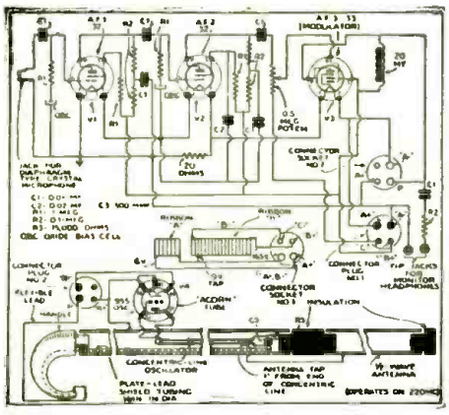


Fig. 3. Note Fig. C's error—only 1 acorn is used.

Fig. D. NBC's "beer mug" for table transmitter.

A "BEAM" AMPLIFIER WITH "ELECTRIC CHOPPER"

(Continued from page 141)

power amplifier, (e) universal power supplies, (f) a high-fidelity dynamic speaker, and (g) all necessary extension cables, the owner has in his possession a *complete* P.A. system that will undoubtedly surmount any emergency encountered in the P.A. field.

7. Economy of operation, by utilizing the new type of "electric chopper" previously mentioned a remarkable efficiency is obtained when operating from a 6 V. storage battery. In fact this remarkable unit in conjunction with a 7-prong plug and two 7-prong sockets enables instantaneous change-over from one mode of operation to the other, simply by removing the plug from one socket and inserting it into the other. No internal wiring changes are required. In fact, the dynamic speaker field continues to receive the same field excitation from either the 6-V. or 110-V. operation sources.

THE ELECTRIC CHOPPER

This device is composed of a high-speed, 3,600 r.p.m. 6-V. motor (requiring 0.9-A.) coupled to a cycling contact. A casual observation of the schematic diagram (Fig. 1) indicates that when the amplifier plug is inserted into the 6-V. socket, this cycling contact alternately throws the positive terminal of the storage battery to either extreme of the center-tapped 12.6-V. winding (which is now being used as the primary). Because of the speed of the motor, 60-cycle impulses are impressed upon the transformer. (This frequency simplifies the transformer design for universal operation.) Naturally, all of the secondary windings are of standard design so that an adequate high voltage is induced and subsequently rectified for the plate supply of all the amplifier tubes.

When contact is made between the cycling contactor and either extremity of the 12.6-V. primary winding, current flow is in each half of the primary during each half-cycle. Voltage is, of course, induced during both half-cycles into secondaries in the same manner as 110 V. A.C. (fed into the 110-V. primary) would induce voltage into the secondaries. The only difference being that the primary current resulting from the opening and closing of the chopper contacts results in a series of *rectangular impulses.* See Fig. 2A.

At a first glance the efficiency of the transformer would seem to be impaired with such rectangular impulses being fed into its primary. If the primary of the power transformer were devoid of inductance, capacity, and leakage, and if the circuit was assumed to consist of resistance only, then the current flowing in the transformer primary *would* be a series of rectangular impulses and the efficiency of the transformer would be materially impaired. Actually, the primary has a considerable amount of inductance and some capacity and leakage. These factors distort the "square topped" primary impulses and cause them to deviate considerably from rectangular impulses. It is accordingly necessary to apply alternating-current and transient-current theory to the consideration of the primary impulses produced by the chopper.

A.C. AND TRANSIENT-CURRENT THEORY

The relation between alternating-current theory and theoretically rectangular chopper impulses is illustrated in Fig. 2B. It is convenient to consider the successions of make-and-break as being composed of an infinite number of sinusoidal waves superimposed on a D.C. component. Pure rectangular waves as in Fig. 2B consist of the fundamental and a complete series of odd harmonics, the 3rd harmonic having an amplitude 1/3 of the fundamental, the 5th harmonic having an amplitude 1/5 of the fundamental, etc. Although in this figure, only the D.C. component, the 3rd and 5th harmonics are shown, it can be seen that the resultant wave closely approximates a series of rectangular impulses. These additional harmonics are a considerable aid in keeping the hum component of the filter supply exceedingly low, as these higher frequencies are more easily rectified and filtered.

Current for the filaments of all the tubes during 6-V. operation, of course is supplied directly from the storage battery. The rectifier filament however must be isolated from the battery terminals and is therefore connected to a suitable 5-V. winding on the transformer.

The filter system is of conventional design using a choke input; and voltage-dropping resistor for the 300 V. supply to the 6L6 screen-grids and the dynamic speaker field.

A master switch completely controls the amplifier during 6-V. operation. A standby switch opens the primary circuit during standby periods—with a subsequent saving of 9 A.!

110 VOLT A.C. OPERATION

By removing the amplifier plug and inserting it into the 110-V. A.C. socket, 110 V. A.C. is then fed into the 110-V. winding which now acts as the primary. Two jumpers in the A.C. socket bring 6.3 V. from one-half of the chopper primary over the filaments circuit. This ingenious arrangement provides for an isolated electrical center-tap on the filament winding without affecting its operation on 6 V. (when one side of the filament is grounded). Naturally the amplifier system is identical in operation from both sources of supply, since the induced voltages are exactly alike regardless of the input applied primary power.

It will be noted that the system is entirely fool-proof—no damage can possibly be done to the amplifier even if both the 110-V. A.C. and the 6-V. D.C. supplies are connected to the system at the same time, as the amplifier plug can only be in one of the sockets at any given time.

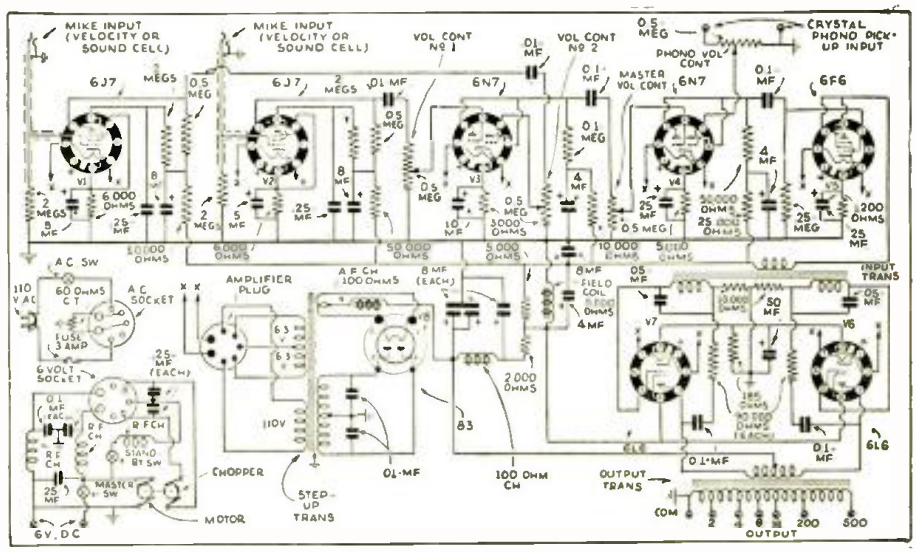


Fig. 1. Schematic wiring diagram of the 6L6 type amplifier which is equipped with a "chopper" for operation from a 6 V. battery. Note that the same power supply unit is used for 110 V. A.C. and 6 V. operation.

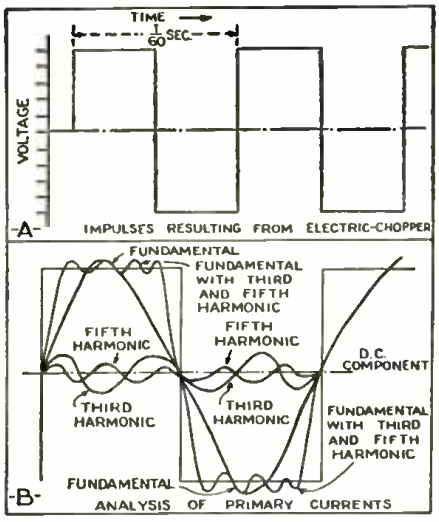


Fig. 2. At A is seen the wave form from the "chopper" power supply. B shows the effective wave form.

THE REVERSED-FEEDBACK OUTPUT CIRCUIT

By again referring to the schematic diagram, Fig. 1, it will be noted that a split-secondary, push-pull input transformer is employed to couple the 6F6 driver to the two 6L6 beam power output tubes. A portion (10 per cent) of the voltage developed in the plate circuit of the 6L6 tubes is fed back in reversed phase to the grids of the tubes by coupling the plates through a 0.1-mf. condenser and 90,000 ohm resistor to the low end of each half of the input secondaries (which is isolated from ground by means of a 10,000-ohm resistor). While this type of a circuit reduces the power sensitivity of the output stage, it materially decreases the harmonic content of the output signal.

As the voltage fed back from the plate of the grid circuit is out of phase it cancels an equivalent amount of grid signal, and therefore requires that the input grid signal be *increased* by an amount equal to the reversed voltage in order to maintain any given output or an equivalent power sensitivity.

By increasing the input grid signal *without increasing distortion* in the driver stage, the power output of the amplifying system is maintained, while the harmonic content is decreased in direct proportion to the decrease in power sensitivity of the output tubes.

DESIGN CALCULATIONS

Under the operating condition required to produce 32 W. of audio power from two 6L6 tubes with a plate-to-plate load of 6,600 ohms, the voltage developed across each half of the output transformer is equal to:

$$E \sqrt{WZ}$$

E = Voltage.
W = Watts output in ½ of the output transformer.
Z = impedance of ½ of the output transformer which is equal to $Z = \frac{PL}{4}$

PL = Plate-to-plate load.

The voltage developed across ½ of the primary of the output transformer is $E = \sqrt{16 \times 1650}$ or 165 V.

As the condenser (0.1-mf.) and resistor (90,000 and 10,000 ohms) voltage divider across the output plate circuit is arranged to feed back in reversed phase, 10 per cent of the output signal or 16.5 V. is fed back to the grid of each output tube through the lower end of each half of the input push-pull secondaries.

Inasmuch as the required peak grid-to-grid voltage is 57 V. or 57 x .707 = 40 r.m.s. V., each half of the secondary normally supplies 20 r.m.s. signal V. As 16.5 V. are fed back in reversed phase, an additional 16.5 V. must be added to the required 20 V., so that 36.5 V. r.m.s. are required in each half of the input secondary to maintain the desired 32 W. output.

As the percentage of original harmonic content is directly proportional to the ratio of original r.m.s. voltage required without reversed feedback, to the r.m.s. voltage required with reversed feedback, we can determine the percentage of harmonics present in this revised circuit by the following formula.

Harmonic content = per cent of original total harmonic content x

$$\frac{\text{r.m.s. grid voltage without feedback}}{\text{r.m.s. grid voltage with feedback}}$$

$$\text{Harmonic content} = 2 \text{ per cent} \times \frac{20}{36.5} = 1.099$$

per cent.

This reversed feedback circuit therefore has decreased the normal 2 per cent total harmonics to 1.099 per cent at 32 W. output—a condition rarely attained in any other type of high-fidelity amplifier.

ELECTRONIC MIXING

The new 6N7-type metal tube provides excellent means for electronic mixing throughout the amplifier. As will be noted, the first 6N7 electronically mixes the amplifier outputs of the 2 microphone preamplifier tubes (6J7s), while the second 6N7 electronically mixes both microphone signals with the phono. pickup signals.

The overall gain of the amplifier is 127 db. (two input channels). The gain at the phono. input channel is 64 db.

The entire amplifier is housed in a strong 2-piece leatherette-covered carrying case, so designed that the speaker section is entirely devoid of baffle resonance—an important consideration in the design of 6L6 amplifiers.

The author will be pleased to answer all questions relative to this new type amplifier. Address inquiries in care of *Radio-Craft*, and enclose a self-addressed and stamped envelope.

LIST OF PARTS

*Two resistors, 6,000 ohms, 1 W.;
*Three resistors, 50,000 ohms, 1 W.;
*Four resistors, 2 megs., 1 W.;
*Two resistors, 0.5-meg., 1 W.;
*One resistor, 3,000 ohms, 1 W.;
*Three resistors, 10,000 ohms, 1 W.;
*One resistor, 1 meg., 1 W.;
*Two resistors, 5,000 ohms, 1 W.;
*One resistor, 25,000 ohms, 1 W.;
*One resistor, 0.25-meg., 1 W.;
*One resistor, 1,200 ohms, 1 W.;
*Two resistor, 90,000 ohms, 1 W.;
*One resistor, 2,000 ohms, 1 W.;
One Electrad resistor, 185 ohms, 10 W.;
One Electrad resistor, 60 ohms, center-tapped;
*Four volume controls, 0.5-meg.;
Two Solar condensers, 5 mf., 25 V.;
Two Solar condensers, 0.25-mf., 400 V.;
Two Solar condensers, 8 mf., 350 V.;
One Solar condenser, 8 mf., 450 V.;
One Solar condenser, 10 mf., 75 V.;
Two Solar condensers, 4 mf., 350 V.;
Two Solar condensers, 25 mf., 35 V.;
One Solar condenser, 50 mf., 50 V.;
Two Solar condensers, 0.01-mf., 400 V.;
Four Solar condensers, 0.1-mf., 400 V.;
Two Solar condensers, 0.01-mf., 1,000 V.;
Three Solar condensers, 0.25-mf., 200 V.;
Three Solar condensers, 8 mf., 600 V.;
Two Solar condensers, 0.05-mf., 200 V.;
*One dynamic reproducer, 5,000 ohms, type G-12;
One Amplifier Co. of America basic foundation kit, with complete hardware (sockets, switches, fuses, etc.);
One Amplifier Co. of America kit of power and A.F. transformers;
One Amplifier Co. of America kit of A.F. and R.F. chokes;
One Amplifier Co. of America 2-section portable carrying case;
One Amplifier Co. of America rotary electric chopper;
One RCA or Sylvania type 6F6 tube;
Two RCA or Sylvania type 6J7 tubes;
Two RCA or Sylvania type 6H7 tubes;
Two RCA or Sylvania type 6L6 tubes;
One RCA or Sylvania type 83 tube.

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

DON'T FORGET

That all the new 1936-37 receivers will be described in detail in the October issue of Radio-Craft—on the newsstands September 1st—before the New York Radio Show starts!

INTRODUCING—THE RADIO-CRAFT "WALL SET"

(Continued from page 143)

powerful nearby signals.

The rectifier is a metal type 25Z6. One cathode feeds a D.C. voltage for the 3,000-ohm field of the speaker (If one of the new permanent-magnet dynamics is used the power-line current consumption will be slightly reduced. The only circuit change is to connect the first or field current supply cathode to the second or receiver power supply cathode as shown by dotted line X^1; components "C-A," C15 and the field coil are not then in circuit—a condition represented by the "break" mark, X^2.) and one supplies the rectified power for the tubes. The "B" power from this latter cathode is drawn through a smoothing choke of sufficient inductance and ampere capacity for our purposes (a midget choke will do the job). Such a choke should have a resistance of from 350 to 400 ohms and should have a hum-bucking tap permitting connection as shown in the circuit schematic. (The unit used in the laboratory model had such a tap, which in connection with a 1 mf. capacity afforded humless set operation.)

If such a tapped choke is not available and a standard 2-terminal unit is used, or if with the tapped choke installed hum remains appreciable in audibility, increase the capacity ratings of C16 and C18 to 8 mf., or more, each. Sometimes increase of C18 alone will do the job. Either 8-8 or larger "dual" (capacity) units may be substituted for the specified electrolytics, or additional condensers of 4-4 capacity may be bridged across those first installed. The 4-4 units are very small and there is space enough for several. Generally, the single 4 mf., across the speaker field coil will be found sufficient capacity at this point, but the constructor may substitute an Aerovox PBS-2 8 mf. unit if he prefers.

Two methods of dropping the line voltage to provide proper filament voltage are acceptable. Either a resistor may be installed within the set or a voltage-dropping 3-lead line cord used. In the one case, care must be exercised that the resistor has free air circulation, as it will heat up considerably, and in the other we must be prepared for the disadvantages of a "hot" cord and some delay in filament heating. In both, we must be satisfied with a fixed value of resistor which bases its voltage drop on an estimated average of line voltage.

The second method is accepted commercial practice, and several values of 3-wire cord in which one lead is actually the resistor are sold by all jobbers.

Lately, however, a resistor has been developed which has a metal-tube shield jacket and a standard octal base. Such units are easily replaceable, and the set here described has been built to permit installation of such a convenient item.

CONSTRUCTION

Obtain an 8 x 6 x (about) 2 in. deep chassis with closed ends and drill and cut it to the specifications given in the layout diagram. Be sure that the tube sockets used are arranged for short connections to associated components and then mount these sockets. Use lock-washers, by the way, under the machine screw heads or under the securing nuts. Wire up the filament circuit, using a heavy, well-insulated wire, beginning by connecting terminal No. 2 of the 6K7 octal socket to the chassis, and then proceeding from 6K7 to 6A8, to 6J7, to 25A6, to rectifier for series connection—point; or terminal 7 of the 6K7 to terminal 2 of the 6A8, and so-on. Wire the free filament terminal of the 25Z6 to the resistor tube or to a rigidly-mounted double lug terminal strip (if line-cord dropping resistor is to be used). Ground the tube shield terminals to the chassis.

Now mount the antenna post and the 2 potentiometers. Wire in all cathode resistors, then R3, and the 2nd-detector plate resistor—R5. Wire-in all R.F. and I.F. bypass and other fixed condensers. Test for shorts. If OK, proceed to mount the various transformers and the speaker output plug, wiring them into the circuit. Mount the oscillator pad and the tuning condenser—the first unit on an extended bolt, to prevent grounding to the chassis of the terminal lugs, the second on ordinary rubber faucet washers. If the washers prevent the variable condenser frame from grounding via the mounting bolts, properly ground the condenser through leads from the frame ground terminals. Wire the control-grid leads from the coils to the condenser sections, passing them through rubber grommets at the chassis. Make all necessary R.F., I.F., 2nd-detector, and power tube connections—and then check *and re-check* (!) for correct leads and no shorts.

Remember that TR-1 and TR-3 are mounted *below* the chassis and against the chassis wall, and should be extended sufficiently far away from the wall to permit free play of leads. Iron-core transformers T2 and T4 are mounted above the chassis, the former between the 6K7 and 6A8 sockets; the latter between the 6A8 and 6J7 sockets, and close to the variable condenser shaft. Remember, too, that the layout was designed for use with the components specified—including the particular dial shown. This dial is bolted to the front panel wall of the chassis and extends outward, in front, far enough to permit installation of the small poly-iron-core I.F. transformer. Transformer or dial substitutions may in some instances make necessary a complete re-design of layout—so use your judgement.

Now proceed to mount and wire the rectifier and filter system components. The under-chassis view of the laboratory model clearly illustrates the best possible arrangement. Lastly, wire in the line cord and filament-dropping voltage tube, also the 20-ohm vitreous enameled resistor and the 0.1-mf. line filter condenser. One lead from the cord will go across the width of the chassis to be soldered to one terminal of the switch on the tone control—which suggests

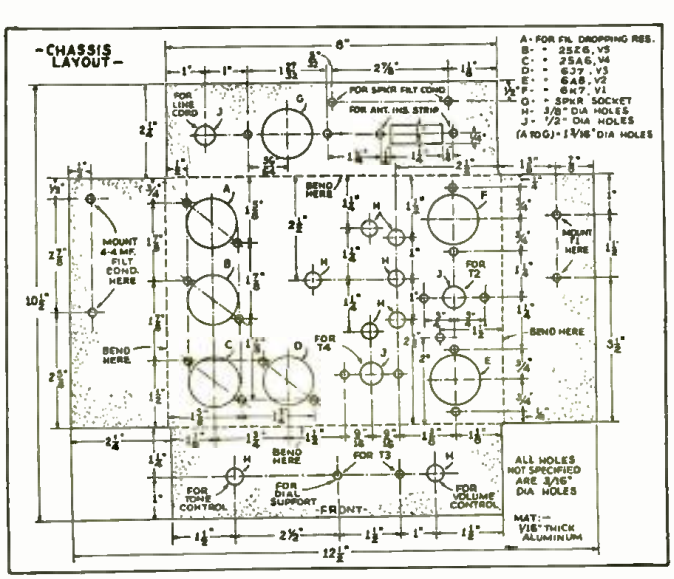


Fig. 3. The chassis size and drilling layout. The positions and size of holes are correct only if the specified parts are used. If other than specified parts are used, the constructor must change the drilling details to suit.

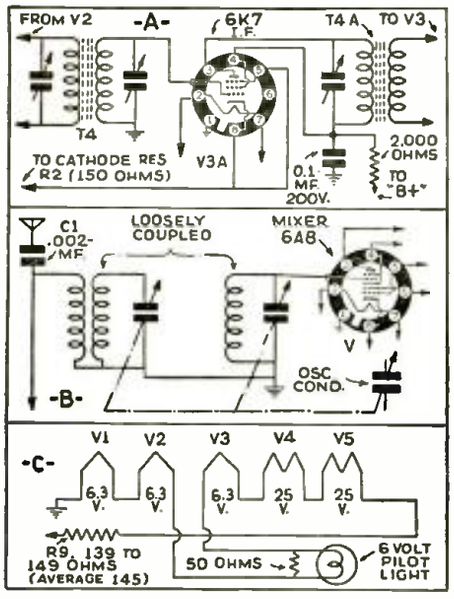


Fig. 4. Details of the I.F., aerial and filament circuits.

proper fastening of this lead to prevent its moving about and loosening other leads and components. The free terminal of the switch may be connected to the chassis directly.

The free terminal of the 5-prong socket, mounted on the chassis wall front for the speaker plug, is used to solidly moor the input lead of the vitreous enamel resistor of 20-ohm, 10-W. value and also serves as terminal lug for the proper line-cord lead.

Check once more before plugging in the cord. Use a volt-ohmmeter if possible for visual indication of opens and shorts. And then give still another glance at the filament and power circuit. If everything's OK, let 'er rip!

HUM

If any inherent hum is reduced with the speaker field removed from connection in the circuit increase the value of C15, as we have suggested, until no noticeable difference in hum value with field in or out is observed. If the hum component can be traced to the filter circuit proper, do what we advised in an early paragraph—increase filter capacities, the last in particular. If this action does not alleviate the condition, check the hum bucker connection on the filter choke. The 1-mf. condenser, which should not be changed in value unless the choke manufacturer's directions so specify, connects from ground to the input end of the choke.

The D.C. *filter* input to the choke connects to the tap.

TESTS

The total voltage from chassis to input of the line will naturally be the value of the input voltage—110. The drop in the filament resistor should be the approximate difference between 110 and the sum total of all filament voltages. This total will be 6*, with a required resistor drop of 42 V. As for the D.C. voltage to the filter choke this will depend to some extent on the value of the input filter capacity. It will be around 100 V. There will be a drop in the filter choke of course but this will not be great enough to seriously reduce the applied "B" voltage to the tubes. The screen-grids should have the full "B" voltage in the cases of the 6K7, 6A8 and the 25A6.

ALIGNMENT

Align the set in the ordinary manner—setting primary and secondary of the I.F. transformer to exactly 465 kc. and then adjusting the R.F. and Det. sections of the ganged tuning condenser for R.F. tracking. Adjustments of both the oscillator section padder and trimmer will now be necessary to secure tracking at this end at the 165 kc. difference frequency.

Remember—performance is a function of the completed set and the individual parts. This receiver, like others carefully engineered, uses and specifies parts which have a coordinating action in determining overall efficiency. *Substitution becomes definitely impractical and may result in unacceptable performance.*

CABINET

Obtain a 6-ft. white pine "knotty" board of 10-in. width. Have it shaved to the thickness desired, with ⅝-in. being suggested. Cut it as shown in the accompanying illustration, Fig. 2.

Top, panel or front, and chassis base should first be nailed or glued together, the jointing being clean and straight. Now scroll the sides with a coping saw and nail these to the formed box so that they extend below, above and out in front of the cabinet proper as illustrated in the heading photograph. Some extension may be advisable in back for flush-mounting of the ornamental top- and bottom-rear additions. The speaker baffle is mounted at an angle under the cabinet bottom, after the small dynamic speaker has been installed. This baffle may be left unfinished or covered with a brown cloth.

The cabinet is now sanded, waxed, and rubbed, and the front drilled and cut to permit access to both potentiometers and to the dial. The escutcheon is then mounted and the job called at least temporarily done.

LIST OF PARTS

*One iron-core antenna coupler, type 1501, TR1;
*One iron-core R.F. coil, type 3001, TR2;
*One iron-core oscillator coil to match, type 2001, TR3;
*One iron-core I.F. coil, 365 kc., type C101-M, TR4;
One Aerovox condenser, type 284, .002-mf., C1;
One Wholesale Radio Service or Radolek 3-gang variable condenser, 370 mmf., per section, C2, C4, C7;
One Aerovox condenser, type 284, 0.1-mf., C3;
Two Aerovox condensers, type 1468, 100 mmf., C5A and C9;
Two Aerovox condensers, type PR-25, 5 mf., C5B and C12;
One Aerovox condenser, type 284, 0.05-mf., C10;
One Aerovox condenser, type 484, 0.1-mf., C14;
One Aerovox single electrolytic condenser, type PBS-2, 4 mf., C15;
Two Aerovox dual electrolytic condensers, type PBS-2, 4-4, C16, C18;
One Aerovox condenser, type 284, 1-mf., C17;
One Wholesale Radio Service or Radolek dual trimmer oscillator padder, type CO-4, C6;
One Electrad potentiometer, type 997, R1;
One Electrad potentiometer with switch, type 203, R6;
One Continental Carbon resistor, type D2, 1. W., 200 ohms, R2;
One Continental Carbon resistor, type D2, 1. W., 600 ohms (or 625 ohms), R7;
One Continental Carbon resistor, type G4, ½-W., 50,000 ohms, R3;
One Continental Carbon resistor, type G4, ½-W., 20,000 ohms, R4;
One Continental Carbon resistor, type G4, ½-W., 0.5-meg. R5;
One Electrad vitreous enameled resistor, 10 W., 20 ohms, R8;
One line cord, ballast tube, or power resistor, 157 ohms, R9;
One Oxford dynamic speaker, 5 A., 3,000-ohm field, with transformer for use with a 25A6 tube;
One National Union type 25A6 tube;
One National Union type 25Z6 tube;
One National Union type 6A8 tube;
One National Union type 6K7 tube;
One National Union type 6J7 tube;
One traveling-light, airplane, or front zero panel dial;
One bronze escutcheon for speaker;
*Three knobs;
*One chassis, 6 x 8 x 2½ ins.;
*One 5-prong speaker plug;
One Centralab 5-prong socket;
Six Centralab 8-prong octal sockets;
*One roll push-back wire, R.F. type, stranded;
*One roll push-back wire, solid No. 16;
Two feet, heavy, well-insulated wire for series filament circuit;
*One smoothing choke, No. 1127, A.C.-D.C., 400 ohms, or D-21 with hum-bucking tap;
*Three metal-tube insulated grid caps;
Machine screws, nuts, rubber grommets and washers;
Knotty white pine board approximately 10 ins. wide x 6 ft. long x ⅝-in. thick. For shelving, ask for lumber that has clear knots which will take a saw without shattering or loosening.

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

TELEVISION IN JAPAN

The Japan Broadcasting Co. is considering the establishment of a collective research institute for television. A sum of 200,000 yen has been made available to bring practical television out as soon as possible.

The most successful researcher in Japan, Dr. K. Takayanagi, who will probably be the first director, believes they have a satisfactory scheme, although it is one that will have to be made practical. He also believes that Great Britain now leads the television world, and that television will never encroach upon the "movies" or papers.

A SIMPLE WHEATSTONE BRIDGE CAPACITY ANALYZER

(Continued from page 150)

capacity. These condensers should be a good grade of "paper"; of course, the wet type cannot be used. The circuit is straight-forward and of standard design, and as the general lay-out of the parts can easily be followed from the photographs no special comments on the construction are therefore necessary (providing all parts are mounted solidly and that connections are firmly soldered).

CALIBRATION

After the unit is wired, plug into the phone terminal a headphone set and obtain a known condenser of one of the following sizes: 500 mmf., 0.005-, 0.5- or 5 mf. Attach the selected condenser to the terminals marked X in the diagram and select the proper capacity range by rotating switch Sw.1 to the desired scale. If wired as shown the positions of the selector switch Sw.1 will be as follows: (1) 100 mmf. to 0.005-mf.; (2) 0.001- to 0.005-mf.; (3) 0.01- to 0.5-mf.; (4) 0.1- to 5-mf.; and, (5) 1 to 50 mf. Use a range such that the condenser being used for the preliminary test will have a null point in the phones when the potentiometer knob is almost pointing to the centre of the scale. When the hum disappears fasten the pointer knob securely, with the pointer indicating the capacity on the inner scale, and the tester is calibrated.

To test the value of unknown condensers connect the unit into the circuit at terminals "X"; then select a scale from the selector switch Sw. 1, and rotate the dial knob on the potentiometer until the hum disappears. The reading on the dial will be the capacity in mf.

While the above test applies to paper and mica condensers, it is necessary to apply a polarizing voltage to an electrolytic type of condenser. To do this proceed as follows, Close switch Sw. 3; this closes the filament circuit of the type 80 tube. Rotate selector switch Sw. 2 to the position marked No. 2. When used from this position a polarizing voltage of 100 V. is available. Care should be exercised that the electrolytic condenser is connected to the unknown terminals as shown, that is the polarity must be observed. The remainder of the test is then the same as if a paper or mica condenser were being tested.

To test for leakage, open switch Sw. 5 and rotate the switch Sw. 2 to the test voltage under which the condenser is rated. The voltages thus obtained, as drop values across R2, are as follows: 50, 100, 200, 300, and 400 V. Now connect the condenser to the unknown terminals and observe the neon bulb. A good condenser will light and immediately go out (the initial light merely indicates that condenser has become charged. If the light blinks, it indicates condenser leakage, and that the unit therefore is in all probability no good for radio work. If the neon is continually aglow, it indicates that the condenser is shorted. An open-circuited condenser will not light the neon on the initial charge.

To summarize, this analyzer will thoroughly test all types of condensers under actual operation, and show faults that are only apparent under these conditions. Many experimenters and radio Service Men have found that condensers tested with low-voltage meters may test OK (?), but when they are put back into the receiver the set would not work—due to the condenser having high leakage. Suitable test apparatus thus will eliminate a lot of guess work from radio, and will often help in clearing up some of those so-called radio "mysteries," in a very short space of time.

LIST OF PARTS

One Blan The Radio Man, Inc., power transformer, tapped for calibrated potentiometer (R1), P.T.;
Two Blan The Radio Man, Inc., filter chokes, Ch. 1, Ch. 2;
Two Cornell-Dubilier electrolytic condensers, 8 mf.;
One Electrad resistor, 50 W., 25,000 ohms, with 4 contact rings;
One Centralab potentiometer, wire-wound (with switch, Sw. 4), 10,000 ohms R1;
One neon bulb and socket;
Six Aerovox paper condensers, 1—500 mmf., 1—0.005, 1—0.05, 2—0.5, and 1—5 mf.;
One Blan The Radio Man, Inc., drilled and stamped metal cabinet 5 x 9¾ x 7 ins. high, and chassis (to fit);
*Two selector switches, Sw. 1, Sw. 2;
*Three on-off switches, Sw. 3, Sw. 5, Sw. 6;
Two bakelite phone-tip terminals.

**Name and address of manufacturer will be supplied upon request.*

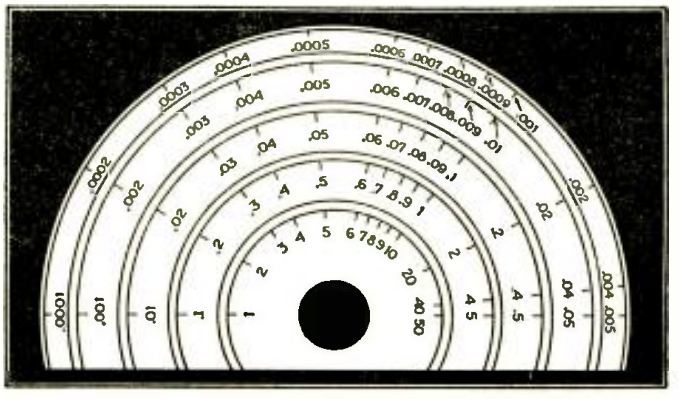


Fig. 2. The actual calibrated dial that may be cut out and used on the finished instrument, provided that the specified parts are used. Otherwise, an individual calibration will have to be made to fit the potentiometer used.

CONSTRUCTING A 5-TUBE LOOP SET INTERFERENCE LOCATOR

(Continued from page 153)

often a person wants a radio receiver other than the regular auto set in the car, and the receiver mentioned will serve this purpose and also serve as a means of locating interference caused by electrical apparatus. This set will locate the source of interference which can generally be eliminated by the proper use of filters or shielding. Interference elimination provides a very profitable field for Service Men as many types of electrical apparatus cause interference—the difficult problem is to locate the *source* of this interference. This is made quite simple with the aid of this unit.

The receiver is completely self-contained; nothing except the loop will be outside the case. The cabinet must be completely shielded, top, bottom, and sides with no joints or openings at any point. All voltages and specifications should be followed very closely.

This receiver being a loop-operated outfit the following instructions are very important to insure proper operation.

If a loop is turned so that it is pointed edgewise toward the transmitting station, radio waves from that station will travel the greatest distance between the two sides of the loop thus setting up the greatest voltage and consequently the signals will be strongest. When the loop is turned so that its flat side is toward the transmitting station, the signal strength will be least. In the latter instance the advancing radio waves strike both sides of the loop at the same instant, generating exactly equal and opposite voltages which balance each other out completely, leaving no signal for the receiver, except that due to loop capacity.

Due to this directional effect of the loop aerial it is possible to partially tune out an undesired station by turning the loop broadside to it. Pointing the loop will greatly increase the signal strength from a distant station. This is one of the advantages of the loop antenna.

In using a loop it will be found that the signal strength from a near-by station remains approximately the same until the loop is turned almost at right-angles to the station. The signal strength will then show a sudden and decided decrease during the last few degrees of loop movement as in Fig. 2A.

On the other hand, the signal strength from a distant station will show a very gradual increase as the edges of the loop are brought into line with the direction of the radio waves; but during the final few degrees of loop movement, which brings the loop directly in line with the station, a decided and sudden increase in signal strength will be noticed, as shown in Fig. 2B.

When used as a Direction Finder the operating principles are practically the same. A direction finder consists essentially of a receiver mounted in a completely shielded cabinet and equipped also with the directional loop. Due to the shielding the receiver will not be affected by radio waves or signals except those coming through the loop. By turning the loop it is possible to tell from which direction the interference signal is coming. A transmitting station or interfering device as in "A" in Fig. 2C may be located with the aid of such a receiver, by tuning in the signal from 2 or more positions and noting the bearing of the loop in each case. At the intersection of the bearings or lines such as those taken from B, C and D in Fig. 2C, the location of the transmitter or interfering device may be determined.

SHIELDING IS A PRIME REQUISITE

In constructing this receiver it is especially important that the coils and units be completely shielded, in many instances the receiver is built into a portable typewriter case (these cases can be purchased very reasonably). The parts used are those of an ordinary battery set, using regular broadcast coils and condensers. The values marked in the diagram should be used to insure best results. The 2 V. tubes are most practical because of the low current drain. The source of supply for the filaments consists of 2 dry cells. The "B" supply is furnished by small 45 V. "B" batteries especially designed for portable use.

We will now consider the design and construction of the loop as it is one of the essential parts. In building a loop for the receiver the safest method is to use an excess length of wire to begin with. A loop antenna usually consists of a rectangular or circular coil of from 10 to 15, or 20 turns of insulated wire (bellwire, or No. 20 D.C.C. enameled) on a supporting framework. The framework may range from 1 to 3 ft. in diameter, this being a matter of opinion. A small area is not as sensitive and a larger loop may be a little bulky. A loop approximately 2 ft. in diameter is recommended for this particular receiver. After the loop is wound, a high wavelength or low-frequency broadcasting station should be turned in. If the dial setting of the loop tuning condenser is much too low, that is, if too little of the condenser is used for this wavelength, wire should be removed from the loop. Take off one-half turn at a time. The loop should be retuned after each alternation, and wire should be removed until the dial setting is correct from the station being received.

LIST OF PARTS

One Wholesale Radio Service set of R.F. coils, L2, L3;
One Wholesale Radio Service 2-gang condenser, 350 mmf., C2, C3;
One Wholesale Radio Service single condenser, 350 mmf., C1;
*Two midget A.F. transformers, T3, T4;
One D.P.S.T. switch, Sw. 1;
One Centralab variable resistor, 0.2-meg., R1;
One Centralab wire-wound resistor, 2.5 ohms, R2;
One Centralab carbon resistor, 2 megs., ½-w., R3;
Four Solar condensers, 0.1-mf., 200 V. rating, C3;
One Solar mica condenser, 250 mmf., C4;
One Solar mica condenser, 0.001-mf., C5;
Two Tung-Sol or Hygrade Sylvania type 34 tubes, V1, V2;
Two Tung-Sol or Hygrade Sylvania type 30 tubes, V3, V4;
One Tung-Sol or Hygrade Sylvania type 31 tube, V5;
One special case with loop antenna (L1) in cover;
*Two No. 6 dry cells ("A" battery);
*Two "C" batteries, 7½ V.;
*Three "B" batteries, 45 V.;
One bakelite strip with five 4-prong sockets;
One Wright-DeCoster 5-in. magnetic speaker;
Knobs, wire, hardware, etc.

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

This article has been prepared from data supplied by courtesy of Coyne Electrical School.

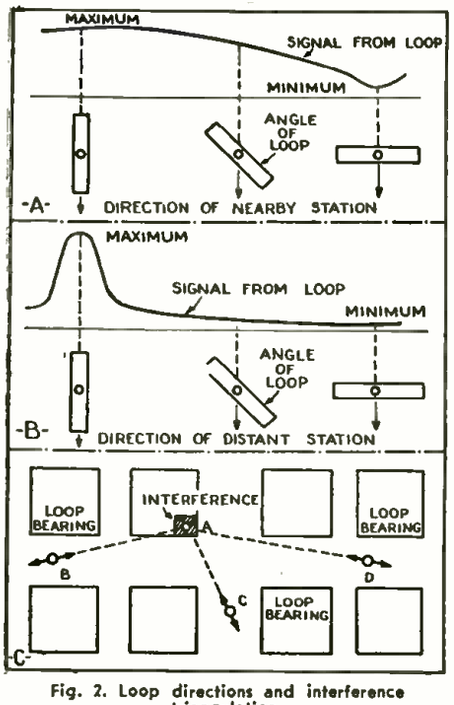


Fig. 2. Loop directions and interference triangulation.

SAVING SHOCK VICTIMS

At a convention of A.I.E.E., Dr. W. B. Kouwenhoven described an electrical method of saving the lives of victims of electrical and nervous shock.

It is said that there are 2 distinct kinds of electric shocks, those of low and those of high current; the former being the most apt to prove fatal, since the rhythm of the heartbeats is disturbed. The high current type paralyzes the lungs, but in this type artificial respiration is often effective, since the heart is not disturbed.

The most promising remedy has been found to be a counter shock. A current of 1 A. through the heart, or enough to light a 100 W. lamp has given good results.

HOW TO IMPROVE "TALKIES" FIDELITY

(Continued from page 151)

(for elderly people), i.e.: 30 to 9,000 c.p.s.

A second consideration was the elimination of all noise from the amplifier whether it be motor pick-up, "shot effect," hum, or whatnot. This resulted in greatly increased filtering made even more necessary by the drive to eliminate all batteries in order to achieve complete A.C. operation. Transformers are now available, thanks to the work of these companies, which are flat from 30 to 15,000 c.p.s. But let us pause here a moment—due to recording limitations, no frequencies over 9,000 c.p.s. are recorded on the film (but it is a wise man who looks forward to the future).

TYPES OF FILTERS

Most of the filters used in this type of work are of the resistance-capacity type; though often, in filament lines, we find inductances inserted to block motor noise. Both of the previously-mentioned extended-frequency systems have resorted to parallel feed in some places in order to segregrate the power and speech circuits. The wisdom of this is at once apparent.

System A still clings to a D.C. supply for their voltage amplifiers and exciter lamps. System B now uses A.C. on the exciter lamp filament with proper filtering to cut off everything below 120 cycles from going to the exciter lamp filament. Tubes, of course, are all indirect heater except in the power stages. Photoelectric (or "PE.") cells have been greatly improved not only from the frequency standpoint but from the amount of output per given amount of incident light. Notable for the latter is System A's type 3A PE. cell.

Where only one unit is used, the speakers themselves have been made better so that a good unit now responds equally well to all frequencies from 50 to 7,500 c.p.s. In extended frequency range systems the use of filter dividing networks in the output line and the use of separate speakers for high, low, and middle frequencies gives a flat output from the horns of 30 to 9,000 c.p.s. Generally, the middle-frequency speaker operates at a higher output level than the "low" and "high" units. Typical cut-off ranges—broad, not sharp—are: for the lows, 30 to 300 c.p.s.; for the middle register. 300 to 3,000 c.p.s.; for the high register, 3,000 to 9,000 c.p.s.

VARIOUS MECHANICAL DRIVES

First, let us take a look at the drive system which is used to bring the sound track smoothly past the optical system.

Improvements in drives have mainly been in the elimination of troublesome belts, so that the motor now is directly-coupled to the sprocket that pulls the film down and past the optical system. In one system, the motor coupling to the soundhead is by a system of multiple belts with a fly-wheel effect; this provides a very efficient drive that acts as a dampening device, and which takes the place of troublesome mechanical filters. It is claimed that this method absolutely eliminates flutter and wavering tone.

This subject, however, is beyond the scope of the average radio service engineer. Sufficient be it to say, that, if the drive system has been functioning satisfactorily until now, it is well to leave it alone. In most cases this will be found to be true. If it is not in the best of condition, it will not hesitate in making itself known on music—giving an "Over the Waves" effect to all types of music.

The transmission arrangement is designed to bring the sound track past the optical system at the rate of 90 ft. a minute. If the speed is more, the sound will be higher pitched; if the speed is less, it will be lower pitched. Increasing the speed 5, or 6, or more feet per minute is not necessarily detrimental to good talking and in the case of portable rigs, this is sometimes done in order to accentuate the higher frequencies.

It is the projectionists' duty, not yours, to see that there are no worn belts, sprockets, and gears in the drive transmission.

THE OPTICAL SYSTEM

There are two types of recording in general use at the present time; constant-width—variable-density (more commonly known as Western Electric), which consists of shaded lines of various thickness; and the other, variable-width—constant-density (RCA recording). The latter, when inspected, seems to be a facsimile of an oscilloscope curve.

In either type of recording, a definite narrow beam of light from an exciter lamp is passed through an optical lens arrangement, in the "soundhead." The film is moved along at a constant speed and the narrow beam of light which is focused on the sound track, will naturally vary in intensity in accordance with the variations in either the *density*, or the *width* of the sound track itself. This light, having passed through the film or sound track, falls onto a PE. cell, which changes light rays into electrical energy; and these variations correspond directly to the intensity at which the film was recorded.

Having changed the light beams into electrical energy, the cell then passes the current to the voltage amplifier by suitable coupling means such as a resistance drop or a special transformer.

The frequency in variable density recordings is determined by the distance between successive identical ladder rungs corresponding to some cycle; in variable area recording, it is determined by the distance between successive identical peaks. Note that the amount of light going through determines the *volume* not the *frequency*.

The wide-fidelity optical system (Fig. 1B) differs from the conventional (Fig. 1A) type, in the size of the scanning beam thrown on the sound track. In the ordinary system, this dimension approximates 0.001 x 0.08-in., and is accomplished by throwing a highly condensed image of the exciter lamp filament onto the track. The approximate dimensions (though they may vary greatly) of an exciter lamp filament are 9/16 x 1/64-in. This filament light is picked up by a set of condenser lenses which throw the light image onto a slot in the barrel (which is slightly larger than the size image wanted). The size of this slot is about 0.0015-in. This slot cuts off the jagged edges of light from the lamp, at the same time the light passing through is picked up by an objective lens, which recondenses it slightly, and throws it, highly concentrated, onto the sound track at the dimensions of 0.001 x 0.08-in. (Actually, about 0.0015 x 0.08-in.).

In the wide-fidelity lens system, a 3rd set of lenses has been injected with the result that a much shorter focal length is obtained and that the width of the scanning beam is no longer 0.001-in, but is now, roughly, 0.00075-in. This

assures a frequency "capacity" of 60 to 9,000 c.p.s. This shorter focal length at higher frequencies (9,000 cycles) insures perfect sound reproduction, greater flexibility in the amplifying system, and gives splendid results when using dense or colored film.

These lenses are easily installed in most systems. The tubes, or optical systems are ¾-in. in dia. and 3 ins. in length. Approximate installing dimensions: Distance of the P E. cell from the film or aperture if no condenser lens is used between cell—3 ins. (max.). Distance of exciter-lamp *filament* from end of barrel—⅝ to ¾-in. Distance of objective lens (end of barrel) from film or aperture depends upon focusing of system.

The shape of the light that strikes on the PE. cell is circular. In installing these lenses a means should be made to rotate the lens tube and to move it forward or backward, until the point of focus is determined. Once fixed at proper focus, they can be locked in place and forgotten, since all future adjustments will be made by altering the position of the exciter lamp. Regular holders, providing these adjustments, are obtainable.

The maximum quality of reproduction is secured in modern soundheads by the use of a resilient exciter lamp mounting. This feature eliminates transmission to the exciter lamp filament of any vibration from gears, motors, or any mechanical parts of the projector. The same can be said of the PE. cell, which should be well-cushioned and shielded. If a voltage amplifier is mounted on the projector it also should be well-cushioned. However, we recommend the use of a high-impedance PE. cell working into a transformer with a 500-ohm secondary. Both of these secondaries (from each projector) should go, through shielded cable, to a modified T-type fader (Fig. 1C). This fader should be of the step-by-step type, with no frequency discrimination.

TABLE I

Instrument or Sound	Sound Range in cycles (or vibrations) per sec Low	High	Per cent available by ave. without Distortion	Per cent available by High Fidelity
Cymbals	32-	13,000	39	77
Snare Drum	80-	15,000	33	55
Bass Drum	53-	4,096	99	100
Kettle Drum ..	48-	4,608	99	100
Violin	192-	8,192	62	100
Piano	72-	6,144	83	100
Cello	64-	8,192	62	100
Bass Viol	40-	4,608	99	100
Piccolo	960-	10,240	50	100
Flute	288-	8,192	62	100
Oboe	256-	16,384	31	63
Soprano Saxophone ...	213-	12,288	42	83
Trumpet	171-	9,216	55	100
Clarinet	160-	10,240	50	100
French Horn ...	85-	5,461	99	100
Trombone	80-	7,680	66	100
Bass Clarinet ..	80-	13,000	38	77
Bassoon	60-	7,000	71	100
Bass Saxophone	55-	8,100	61	100
Bass Tuba	42-	3,840	99	100
Female Speech .	160-	10,240	50	100
Male Speech ...	106-	8,192	65	100
Handclapping ..	106-	18,000	27	55
Footsteps	80-	16,500	30	60

Approx. figures used in above tabulations.

In Part II the subjects of amplifiers and acoustics will be considered.

A DUAL-SERVICE 3-TUBE 5-METER RECEIVER

(Continued from page 141)

priced, 5-meter rig suitable for fixed station use on A.C. with a regular power pack; and also for mobile use in a car, with 6 V. D.C. furnished by the storage battery.

A 3-TUBE CIRCUIT

Three tubes are used in a circuit that gives the results normally obtained from 4. As may be seen from the accompanying diagram, Fig. 1, the set uses a type 78 tube as an R.F. amplifier, with a complete antenna-grid tuning circuit consisting of a 10-mmf. variable condenser and a small plug-in coil. This stage not only eliminates detector radiation, but also increases the overall gain and selectivity. This works into one triode section of a type 79 tube, connected as a self-quenching ultraaudion super-regenerative detector. Parallel plate feed is used to the 78 R.F. amplifier, this arrangement being altogether practicable because of the narrow frequency tuning range of the receiver.

The second section of the 79 operates as a resistance-capacity coupled A.F. amplifier. This is followed by a second resistance-coupled stage using a 42 power output tube. A choke-and-condenser combination is used in the plate circuit of the 42 to keep D.C. out of the earphones or loudspeaker. A 50,000-ohm potentiometer acts as regeneration control in the detector circuit, while a 0.5-meg. potentiometer in the grid circuit of the 42 acts as an audio volume control. These adjustments are independent of each other, giving the operator complete control over the R.F. and A.F. actions of the receiver. A separate standby switch is provided in the "B" circuit, to "kill" the receiver during transmission periods.

ADDITIONAL DETAILS

The coils for the R.F. and detector tuning positions are of the space-wound, plug-in type, fitted with small plugs. While only coils for the 5-meter band (approx. 50-62 megacycles) are here considered as being used in the set, the plug-in feature permits easy experimenting with still smaller or larger coils for higher or lower frequency bands.

For battery operation, the instrument has its filaments working directly from a 6-V. storage battery; up to 250 V. of "B" battery can be used for plate supply. For A.C. operation the filaments are heated by a 6.3-V. secondary on a power transformer. Any small A.C. power pack of suitable output may be used.

Because of this convertible feature, amateurs contemplating summer automobile trips will find this perfected 3-tube receiver the ideal one to mount on the steering column or under the dash-board. After the trip is over, the set goes back to the operating table at home, and without a single change, becomes an A.C. outfit that drags in plenty of signals.

A sturdy, black-crackle finished steel case, measuring 5⅝ x 8¾ x 7¼ ins. high, houses the entire receiver. A full-vision type of vernier dial makes tuning easy. The top of the case is removable, being held in place by 2 quickly loosened thumb screws. Binding posts for antenna wires are on the left side; plug-in connections for power leads and loudspeaker are on the back of the chassis. Mycalex is used for R.F. insulation, making for truly low losses.

The signal output of this receiver under normal circumstances is more than sufficient for a magnetic-type loudspeaker. Earphones are really necessary only in bad locations when the receiver is used for mobile operation, or at fixed station locations when very weak stations are being received.

The readers of *Radio-Craft* may be interested to know that this highly efficient job was first shown in public at the Stamford, Conn. "hamfest" held in May, 1936, and attracted a great deal of favorable attention. A sample set was used by W2ISY in his service truck on the trip from Bogota, N. J. to Stamford, Conn., and back, and proved extremely satisfactory in every respect.

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

IN THE RADIO SHOW NUMBER READ ABOUT—

the teledial—local station personalizer—automatic flash tuning—the magic voice—focused tone—foreign tuning system—stabilized dynamic speaker—tri-focal tuning—vibracoustic sounding board—and the colorama dial!

THE CORRECT USE OF FIXED CONDENSERS

(Continued from page 153)

and at the same time without danger of instability due to feedback as a result of the high degree of amplification.

CIRCUIT BREAKDOWN ANALYSIS

A circuit breakdown analysis of the applications of condensers in a modern set is shown in Fig. 2. In A of this figure, will be noted a very common application of bypass condensers in the R.F. stages of a receiving circuit.

In series with the grid return lead of the R.F. inductance is a resistor which may connect to a biasing potential or to an A.V.C. stage. The purpose of this resistor is to decouple the grid circuit from the power supply (to which all plate and grid returns of a receiver terminate) in order to avoid that type of feedback which is a result of the common impedance offered by the power supply to all the returns. The high resistance prevents the R.F. currents from reaching the power supply, although it does not hinder or reduce any biasing potential which must be connected to the grid since the current which flows in this circuit is theoretically zero. The condenser shown *bypasses* the R.F. currents direct to ground.

Ordinarily, we would expect that a condenser connected in this circuit to last "forever," since no real or great potential exists across the condenser which might tend to break it down. Unfortunately, the experience of Service Men shows that quite a bit of trouble with condensers is encountered here. The trouble is not due to breakdown, but rather to poor construction, since the condenser "opens" and, thus removes the return circuit for the R.F. currents. Examination of defective condensers that have been removed from this part of a receiver will show that the trouble is usually due to the wire lead from one side of the condenser becoming disconnected from the foil.

This is the only cause for "open" bypass condensers, and source for much trouble in receivers. It can only be avoided by the use of condensers that are mechanically well constructed. Special precautions are taken in the well-designed bypass condenser to insure the wire leads remaining permanently fastened to the foil within the condenser.

In Fig 3 is illustrated a cross-sectional view of the construction of a very popular make of bypass which is known for its efficiency and long-life. Compare this construction, and the special method of removing the stress of the leads (when wiring) against the foil (which eliminates the possibility of the leads being pulled away from the foil) as against ordinary condensers of the cheaper variety which depend solely upon wax impregnation to keep the leads in place. Of course, manufacturers who pinch pennies in their production costs always use the inferior type of construction in their condenser units because of the slight economy it affords.

THE SCREEN-GRID BYPASS

In B of Fig. 2, is shown another application of bypass condensers. Here the unit is employed for grounding the screen-grid for any R.F. currents and also serves to reduce the grid-to-plate capacity that may exist within the tube. The size of the condenser that is employed here may vary from 0.1 to 1.0 mf., depending on the tube and circuit employed. Since a positive potential is applied to this element (lower than the plate voltage, and seldom in excess of 100 V. for R.F. tubes) the condenser should be able to withstand this voltage. Poorly-made condensers used in this part of a circuit will break down and not only eliminate the voltage applied to the screen-grid but also materially reduce the total plate voltage and endanger any series resistor that is used to reduce the total voltage to that required by the screen-grid. A shorted condenser here would make this series resistor carry more current than it is probably designed for. An "open" condenser might cause the circuit to oscillate, resulting in a drop in the operating efficiency of the tube.

In C and D of Fig. 2 we see the application of smaller values of capacity, usually and preferably of mica dielectric construction, employed for bypassing any stray R.F. currents in the A.F. output circuits of diode and power detector stages, respectively. When mica condensers are employed then trouble with these units is extremely rare. Tubular paper types of condensers of small capacities sometimes become "open" for the same reason described in connection with larger tubular condensers. Any defect of this type seldom seriously affects the operation of the receiver, although it may cause circuit oscillation—especially, of the audio type.

THE A.F. COUPLING CONDENSER

In E and F of Fig. 2 we see another common application of condensers. Here the condenser is employed as coupling unit, serving to carry over the A.F. output of one stage to the following without actual direct connection. As far as any D.C. potentials are concerned, the two circuits are isolated—as long as the condenser does not break down. Since the control-grid of the last tube connects to some negative potential of the "B" supply, and the plate of the preceding tube connects to a high positive potential, there is a voltage difference between the two terminals of the condenser which subjects it to some stress and danger. If the condenser has a sufficient safety margin (working voltage in excess of

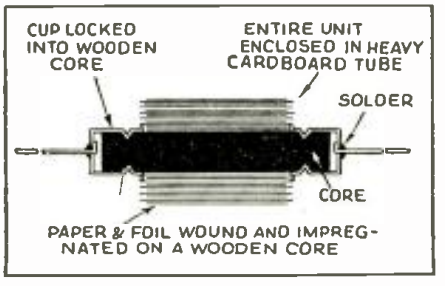


Fig. 3. The mechanical construction of a popular condenser.

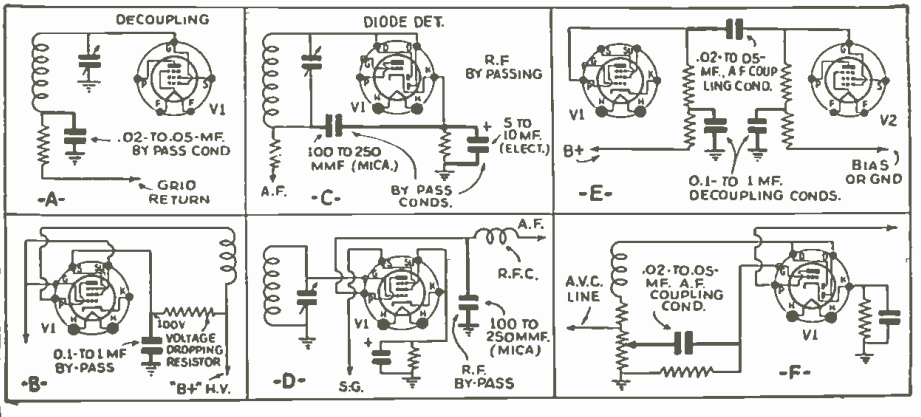


Fig. 2. A break-down of the use of fixed condensers in a modern radio receiver. The path of the high-frequency current can be seen through the condenser in each case.

the applied voltage) then the chances are that the condenser will stand up indefinitely.

In manufactured receivers, we will find the paper tubular type of condensers extensively employed for this type of application, although micas would be much more efficient since their dielectric resistance is much higher than that of the paper type. However, despite several faults that we could find with present practice of using paper tubulars for audio work, and the imminent danger presented by the high voltage of the "B" supply across the condenser's terminals, very seldom do we find these condensers unsatisfactory—or the victims of breakdown. Strangely, most trouble with audio coupling condensers has been due to "open"-circuiting of the condenser, due as mentioned before to the wire lead being pulled away from the foil. Again we see where good construction of a condenser is essential for a minimum of trouble from a receiver.

And now we come to that section of a receiver where the troubles due to condensers are most frequent, and where wise selection of a replacement will do much to eliminate the major part of these breakdowns. We refer specifically to the power supply section of a receiver, from which Service Men find more than 50 per cent of the service calls are attributable.

FILTER CONDENSER BREAKDOWN

Years ago, in the earlier electric sets when large paper condensers were employed for filtering the rectified "B" power, instances of "open" filter condensers were extremely rare. Paper filter condensers of course did break down and become shorted as a result of the high voltage impressed across them, but usually such defects were very easily located since the voltage from the "B" supply would then cease. However, since electrolytics became popular the servicing profession must now become familiar with the vagaries and varieties of symptoms that occur when such a condenser becomes open-circuited. In electrolytics, an open does not necessarily mean that the terminal lead has pulled away from any internal, integral part of the condenser. Instead, we find that an "open" is caused by evaporation of the dielectric material which reduces the capacity value of the condenser and thus renders it ineffective as a filtering unit.

The symptoms that are obtained when this type of defect occurs will vary with the design of the receiver. In A.C.-D.C. sets, where the filtering condenser is connected across the output of a 25Z5 or 12Z3 rectifier tube, any "open" or diminishing capacity results in a materially lowered voltage output being available for "B" supply. In such cases, either weak reception or no reception is obtained, depending on whether the condenser has suffered a slight reduction in capacity or has no capacity at all. In A.C. receivers, when the filtering condenser's capacity has become materially reduced the symptoms obtained are usually (a) very weak reception, (b) no sensitivity, and (c) circuit oscillation (sometimes motorboating). This is due to the increase in impedance of the power supply which is offered to the flow of R.F. currents from all R.F. grid and plate returns, and which the filter condenser serves to bypass—*when it is efficient.*

Obviously, when replacing any defective condenser in this part of a receiving circuit, the important thing to do is to choose an electrolytic that is rated "constant over a long period of time," and this is only obtainable in makes that are prominent and of proven efficiency. The use of surplus or job lot condensers at bargain prices should be avoided by Service Men and constructors, since they serve only to cause more grief than saving of the few pennies would warrant. Remember that the service job you do today, may mean repeats or recommendations tomorrow.

This article has been prepared from data supplied by courtesy of Cornell-Dubilier Corp.

P.A. QUESTIONS & ANSWERS

(Continued from page 154)

have a much lower hum and noise level than corresponding glass tubes. Their metal shields further help in preventing any coupling between tubes. However, in the case of the 6F5 tube, a metal cap should be used over the grid to prevent noise and hum pick-up.

VOICE COIL CONNECTIONS

(40) William Totino, Brooklyn, N. Y.

(Q.) When should speaker voice coils be connected in series and when should they be connected in parallel for best results?

(A.) From the point of view of convenience, it is best to connect the speaker voice coils in parallel. This simplifies the wiring in multi-speaker installations and also permits the use of 3-wire cables in which one side of the voice coil and one side of the field are common, while 4-wire cable is necessary for every speaker when the speaker voice coils are hooked up in series.

From the point of view of efficiency, however, the series system is preferable. Thus if four 10-ohm voice coils are connected in parallel as in Fig. 1B their total impedance is 2½ ohms, and if the entire transmission line has a resistance of 2½ ohms then 50 per cent of the total power is used in the voice coils. If these four 10-ohm voice coils are hooked in series their total impedance is 40 ohms and then the loss in the transmission line is only 2½ divided by 40, or roughly about 6 per cent. See Fig. 1C.

MEASURING OUTPUT WITH A D.C. METER

(41) A. D. Miller, Elmshurst, L. I.

(Q.) I would like to measure the output of my amplifier with a D.C. meter as I have some of these on hand. Is this possible?

(A.) This can easily be done with a vacuum-tube voltmeter using, for instance, a type 56 tube as shown in Fig. 1D.

POWER TRANSFORMERS IN PARALLEL

(42) Philip A. Boerrer, Pittsburgh, Pa.

(Q.) Can I connect 2 120 ma. 700 V. power transformers in parallel in order to furnish 36 W. of field current for my 2 high-fidelity speakers as well as take care of my amplifier proper?

(A.) It is, as a rule, a poor practice to connect small power transformers in parallel as the voltages are never absolutely equal and the resultant "cross currents" will produce overheating of the transformers. However, a separate power transformer can be used on each one of the rectifier plates.

INFORMATION BUREAU

(Continued from page 154)

chart from the *Radio-Craft* "Pocket Radio Guide" is reproduced:

First dot		Second dot		Third dot	
Black	0	Black	0		
Brown	1	Brown	1	Brown	0
Red	2	Red	2	Red	00
Orange	3	Orange	3	Orange	000
Yellow	4	Yellow	4	Yellow	0,000
Green	5	Green	5	Green	00,000
Blue	6	Blue	6	Blue	000,000
Purple	7	Purple	7	Purple	0,000,000
Gray	8	Gray	8	Gray	00,000,000
White	9	White	9	White	000,000,000

The capacity appears as 3 dots in a row and is read in micro-microfarads. Thus, a condenser carrying red, green, and brown dots, in that order, would have a capacity of 250 mmf.

WHAT IS Q?

(375) K. Wilkinson, Jackson Heights, L. I.

(Q.) What does the expression "Q" mean when mentioned with relation to a coil. I have seen this letter several times in books and magazines, but have never seen an explanation of what it means.

(A). The "Q" of a coil is a measure of its efficiency or merit and is used by engineers to determine the correct coil for a given purpose. Actually, the Q is the ratio of the reactance to the R.F. resistance of the coil. This factor is used instead of the R.F. resistance, since it is practically constant for a given coil over a wide range of frequencies which makes it more practical than the resistance for comparison purposes.

MAKING A BEGINNER'S 2-TUBE PORTABLE RECEIVER

(Continued from page 155)

tainable at any lumber yard), held together with the "liquid solder" available in hardware stores. The sharp edges and surplus paste can be taken off with a small file.

Next, temporarily place all parts in their proper positions in the box to see if they will fit. In this way, many of those little problems that are encountered during assembly, especially in a compact set, can be foreseen and avoided. Now you are ready to "spot" and drill all the holes. Before mounting the speaker, glue or shellac a piece of ornamental cloth on the inside of the opening and directly upon that as a protection put a small piece of ⅛-in. copper screen.

Next, two clips on top of the box that holds the "A" batteries are used to hold the batteries in place and serve also to make connections. The one cell is inverted, and the contact screws on the bottom of the box are tied together, thus connecting the cells in series. To make the battery connections fool proof, one connection screw on the bottom is put off-center so that only the can of the cell will make connection. Using this method of construction, the cells can be placed in only the required one way so they light the filament *and also have the correct polarity*. The battery box is simply glued against the wall of the set. The "B" battery is held in place by one side of the "A" battery box, and by two sides of the case. A small piece of wood can be glued in place to make the fourth side, keeping the "B" battery from sliding into the tube assembly. The tubes and A.F. transformer are mounted together as one unit on a small piece of wood, as shown in Fig. 2A.

ASSEMBLY

The next step is to mount the speaker and phone plugs. A switch beside the speaker was provided by the writer to cut out the speaker when the phones are to be used. (If desired, a jack can be substituted to automatically cut out the speaker when the phones are inserted, thus eliminating the extra switch.) The rest of the set is then built around the speaker. The band switch, regeneration control (with off-on switch attached) and condenser are mounted with a piece of sheet metal over the entire side of the case where the controls are located, between the controls and the inside of the case; this is to eliminate any hand capacity effect. The shield must be well grounded.

The batteries and tube unit are placed into the set and wired-in as shown in the circuit diagram. The tube unit can be held in place by 2 small bolts. The coil is placed over the 30 tube and if it is too large to fit tightly, small wooden wedges may be used. The leads can be connected directly from the coil to their connections, taking care that all wires are covered with spaghetti to prevent shorts. The gridleak-and-condenser unit is connected directly to the cap of the type 32 tube. When mounting the antenna trimmer condenser, it can be connected directly to the bolt that holds the antenna clip. A small hole drilled in the case makes the screw of the condenser available from the outside. A handle can be provided for easy carrying. Be sure in doing the wiring that all wires are well covered, using flexible wire throughout for connections. A lid can be made of the same material as used for the box, and fastened by small brass hinges and a suitable catch to keep it closed. In the original set, a variable resistor was placed inside the set, mounted on the battery box, and inserted in the negative "A" lead. It was a help when the batteries became weak, since all the resistance could be cut out gradually, making the batteries last longer than ordinarily. (A small 10-ohm fixed resistor can be substituted however, and requires less space.) Care should be taken in connecting the secondary of the A.F. transformer. One side connects to the control-grid of the 30 tube, while the other connects to the minus side of the filament, not the plus or ground. This gives the tube enough negative grid bias to considerably boost the volume and at the same time appreciably reduce the "B" drain.

OPERATION

To operate, connect antenna and ground to the fahnestock clips, insert phones, and turn the filament switch to "on," and advance the regeneration control. When station carriers (whistles) are heard, reduce the regeneration control setting until the program is heard clear and loud; and then adjust the trimmer condenser so that the entire broadcast band can be received by 2 sweeps of the dial. The set is then ready for hours of entertainment. Strong stations will soon be located and the speaker can then be cut in.

This set was tried out this summer at different localities and was found to be satisfactory in every way—an ideal battery set without the usual cumbersome battery arrangement.

LIST OF PARTS

One Hammarlund trimmer condenser, 35-80 mmf., C1;
One Hammarlund Star midget variable condenser, 140 mmf., C2;
One Cornell-Dubilier postage stamp condenser, 100 mmf., C3;
One gridleak, 5 megs., R1;
One S.P.D.T. switch, Sw. 3;
One S.P.S.T. toggle switch, Sw. 2;
*One midget A.F. transformer, 3: 1 ratio;
Two phone jacks;
One Wright-De Coster 5-in. magnetic speaker;
*Two 4-prong wafer tube sockets;
One Centralab resistor with switch, 25,000 ohms, R2, Sw. 1;
One National Union or Hygrade Sylvania type 32 tube, V1;
One National Union or Hygrade Sylvania type 30 tube, V2;
One 10-ohm fixed or variable resistor, R3;
One Wholesale Radio Service Co. 3-in. vernier dial, 0-100-0;
One coil form 2 x 2 ins. in dia., or smaller (to fit over type 30 tube);
No. 32 enameled wire;
Hookup wire and assortment of hardware and pressed wood;
One "B" battery, 22½ V., 3½ x 2½ x 2 ins.;
Two flashlight batteries, 1¼ V.
*Name of manufacturer upon request.

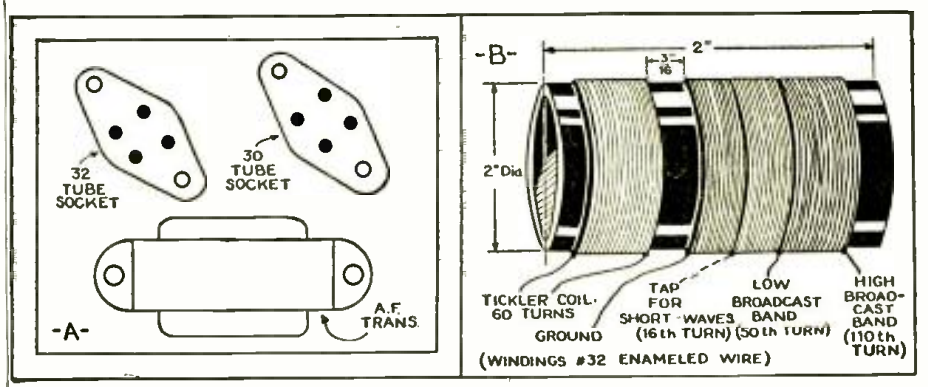


Fig. 2. The tube subpanel and coil winding details for the 2 tube set.

HOW TO INSTALL A WIRED AUDIO P.A. SYSTEM

(Continued from page 157)

The lines from the master control unit should be twisted pairs but need not be shielded; they may be run anywhere—under rugs, through walls, etc., without fear of damage, fire or other trouble. They may be run parallel with unshielded A.C. or D.C. wiring without hum pick-up. In certain cases, such as where cathode-ray machines, strong R.F. or other unusual electrical fields exist, it may be necessary to run individual lines enclosed in a shield. However, these occasions will be very rare indeed.

Be sure to follow carefully all rules laid down in the previous chapter for setting controls. Operation is extremely simple as individual speaker setups may be so adjusted as to give maximum permissible volume without distortion or feed-back.

Where this unit is to be installed as a permanent fixture, 2, 3 or 4, or as many master controls as desired, may be installed with output lines running from each master control unit to each speaker unit. If these lines are wired to a selector switch, it will be possible for the occupants of a room, hall or other place where the speaker unit is installed, to select the program they desire. In some cases, such as hotels where 56 or 60 speakers are to be used, it would be possible for the management to supply sound from the ballroom or grill, from 1 or 2 radio stations, or from phonograph records or electrical transcriptions over certain lines—while, for news bulletins for a hotel's commercial announcements (such as the daily menu, special concerts or other events in the hotel), all lines may be connected to a single speech amplifier and all rooms would receive these announcements (where the speaker unit is on at that particular time). Sports arenas, convention halls, etc., may use 1, 2, 3 or 4 of the master units as a means to transmit the speakers' addresses, results of events, etc., to the entire audience or to any particular section of it.

CONSTRUCTIONAL DATA

In mounting transformer T1, be certain that this transformer is not mounted within field distance of any other transformer—as the high-impedance secondary may, on occasions, carry several hundred volts; and, where input or interstage transformers are too near, coupling will result. In mounting T2, be certain that the speaker field is not too close to this transformer as this would cause deterioration of the low frequencies and introduce a certain amount of hum.

Units LC1 to 5 should be of the wire-wound L-type of control with no taper; they should be capable of carrying at least 1½ W. audio current. These controls are also inductive but have a very small field. Screen-grid or input tubes should be kept at least 4 ins. from the terminals. Units LC6 are non-inductive and no trouble will be experienced in mounting these controls.

In running lines for the various speaker units, the writer prefers to use a stranded twisted pair, rather than solid, as there is less liability of breakage and, furthermore, a lower noise transmission. Where the same wire is to be used over and over, it is better not to remove the insulation but, rather, to use an alligator clamp for contacts; in this way, a unit may be attached at any point along its length and, also, it is easy to move or remove the speaker units.

In locations where only A.C. is available, the constructor should use a straight A.C. system throughout—both for the master control and the speaker units. When this is done, it may be advantageous to ground the master control unit and the speaker units (the speaker unit may be grounded to any convenient water pipe, or, a 3-wire twisted line—properly coded—may be run from the master control unit). However, where the "universal" or D.C. system is used, a ground must NOT be used and only 2-wire twisted lines should be run. Where it is necessary to use a shield, the shield must be carefully insulated and grounded through a 1 mf. condenser to the "low" side of the power line. This can be done in the master control unit by connecting a condenser from the terminal strip to the "low" filament side of the power line.

LIST OF PARTS

One Aalloy output transformer, type 863, pri. for push-pull 48 (4,000 ohms, plate-to-plate); sec. No. 1, 50,000 ohms; sec. No. 2, 15 ohms, T1;
One Aalloy line-to-push-pull grid, pri. 0.1-meg.; sec. to push-pull grid (C.-T.), turns ratio: 1.38:1, T2;
One leveling control, type VM874 (L-type, 10,000 ohms each section), wire-wound line taper, LC1 to LC5;
One composition type volume control, type VM873, 0.1-meg. each section, LC6.

A NEW ALLOY FOR PERMANENT MAGNETS

(Continued from page 157)

shape in moulds, and after cooling and treating, can be machined only by grinding because of its hardness, and as with any other permanent-magnet materials, requires application of a sufficiently strong magnetic field to reach saturation at the time of magnetization. It is a non-corrosive alloy, with a specific gravity of about 7.0 as compared to 8.0 for cobalt steels, so that bulk for bulk nipermag is 12 per cent lighter in weight.

The demagnetization curve of Fig. 1 was made from an average foundry casting, and, therefore, it represents the normal casting which will be obtained in production. Published curves of other materials are often made on straight bar samples under laboratory conditions, and do not present any useful data. Tests are made on nipermag foundry castings to assure that each and every one is as good or better than the specified standard.

The design engineer should have a new field opened to him, now that a stable, reliable and relatively inexpensive permanent-magnet alloy is available, with such constants as to make possible new designs heretofore not attainable. Nipermag should find numerous applications in airplane generators and magnetos, headphones, microphones and loudspeakers, in meters of all kinds, in toys, certain types of relays, small motors and wind generators, and many other devices.

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

READERS' DEPARTMENT

(Continued from page 163)

ican radios and parts so that price cutting by these petty shops with no overhead is a scandal.

None of the American makers appear to see the sense of combining and forming an Association whereby those stores that cut prices will not be furnished with supplies and a fixed net cash price is maintained. As things are there is no doubt that America gets the business, and the Devil takes the hindermost, but isn't that a shortsighted policy from the manufacturers point of view? I am sure that if the manufacturers cooperated on forming a policy, the Distributors would be only too glad to follow. However, as things now stand, the Distributors have now had a sample of what is well known here as "American manufacturers' tactics" (greatly to their disrepute) by which I mean that some of the manufacturers do not care a dime for all the hard work and money sunk by a Distributor in pushing their respective lines, and as soon as the makers find some one else who will take a larger quota, the pioneer is chucked off without the slightest qualms!

To keep up the prestige of your country, why should not all radios, etc., to be exported be submitted to a Board of Trade to be passed as up to standard for export.

Perhaps my suggestions are too amateurish, but they are submitted in good faith and solely with an idea to promote the good will and custom between 2 great nations.

"AMERICAN FAN IN INDIA,"
c/o Marine Lines,
Fort Satya Sadan,
Bombay 1, India.

CLASSIFIED ADVERTISEMENTS

HOW TO MAKE AN OSCILLOSCOPE

(Continued from page 156)

more and more as you gain experience through practice.

USES OF THE CONTROLS

The top row of controls. Let us see what purpose the top row of controls serve; refer to Figs. 5, and 2 in the July, 1936 issue, pg. 13, for the control layout and ray-tube element arrangement, respectively, and to Fig. 7, in August, pg. 93, for the complete schematic circuit.

Taking one at a time, from left to right, we have first the vertical amplifier ("Vertical amp.") switch. Associated with this switch are the vertical input tip-jacks (Vert., red and black) on the extreme left of the panel. Let us assume throughout the discussion, that a sine wave of 120 cycles per second in frequency will be used as a "signal voltage."

With the Vertical Amp. switch set to "OFF" the signal voltage applied to the Vert. input tip-jacks will travel through the switch arms and through the blocking condenser C7 to the vertical deflector of the 906. In this case, the signal voltage must have an amplitude of 75 peak V. to cause a 1-in. deflection on the screen.

When the Vertical Amp. switch is set to "ON" however, the signal voltage is fed through a blocking condenser C20 and gain control R24 into the grid of a 57 amplifier, which has a gain of approximately 38. With 2 V. input to the control-grid of this tube an output of 76 V. will result, which is applied as before through C7 to the vertical deflector of the 906, causing a 1-in. vertical deflection. You can readily see that without the vertical amplifier, we would be unable to measure very low voltages.

The 2nd knob in the top row controls the sweep frequency range switch ("Sweep Freq.-Range") which has 8 taps.

The sweep oscillator generates a saw-tooth wave, the frequency of which is variable, from 10 cycles per second up to about 18,000 cycles per second. This total range is broken up into 8 smaller ranges by the tap switch.

The frequency limits for each tap are approximately as follows: No. 1, 10 to 40; No. 2, 20 to 60; No. 3, 50 to 200; No. 4, 120 to 450; No. 5, 350 to 1,400; No. 6, 850 to 3,500; No. 7, 2,000 to 7,000; No. 8, 5,000 to 18,000 cycles.

It is understood, therefore, that when the knob is set at any one of the 8 taps, you are "tuned" to a *band* of frequencies, which is why this switch is sometimes referred to as the "rough" frequency control. In order to reproduce 1 cycle of the sine-wave input at the Vert. input jacks, it is necessary to match the sweep frequency with the signal frequency. This can rarely be done with the "rough" control alone, but can readily be accomplished by proper use of the frequency vernier ("Sweep Vernier"), of which more later.

The 3rd knob in the top row controls the sweep-selector switch ("Sweep Selector"). Each of its 3 positions are important, therefore, we will describe the function of each. Before doing so, we want to state that the term "sweep selector" is used for convenience and it does not really select the sweep frequency as its name might imply. Strictly speaking, it enables us to select a synchronizing pulse from any one of 3 separate sources. The 3 sources mentioned are designated as "internal" or INT., 60 CYCLES, and "external" or EXT. (Note that the illustration, Fig. 5, designates this as "60 ohms." We apologize for this slip-up.—*Editor*)

With the knob set to INT. and the Vertical Amp. set to "ON" the signal voltage applied to the Vert. tip-jacks will be amplified through the type 57 tube. In the plate circuit of this tube there is flowing an amplified version of the original input voltage. Note carefully that this signal voltage together with the "B" supply voltage for the tube, flows through the 3 arms of the switch *only* when the switch is set to INT. AND the Vertical Amp. is set to ON. Note further that the synchronizing vernier ("Sync. Vernier") is permanently connected across 2 arms of the Selector switch. The movable arm and one side of the Sync. Vernier are, in turn, connected across the primary of the sweep input transformer.

With the controls set as mentioned, a certain amount of signal voltage will flow through the Sync. Vernier and through the transformer primary; thence through the secondary, onto the control-grid of the 885. The amount of signal voltage impressed on the primary can be controlled by the operator through the Sync. Vernier. The final result is, that the sweep oscillator starts its cycle in synchronism with the signal voltage.

With the knob set on the "60 cycles" position. The 60-cycle pulse is obtained from one of the filament windings in the unit. The Vertical Amp. may be ON or OFF, and in either case cannot affect the 60-cycle pulse. As in the previous case, the amount of voltage impressed on the control-grid of the 885 is controllable through the Sync. Vernier. The 60-cycle pulse is useful mainly when it is desired to study 60-cycle voltage or any multiple of 60 cycles, up to about the 10th, or 600 cycles.

The last position is the "External". The EXT. tip-jacks are now brought into play. In the other 2 switch positions these tip-jacks are completely out of circuit. Whenever the need arises, the synchronizing pulse from any desired external source is fed into these tip-jacks; but bear in mind that the impedance of the input circuit is very low.

It is necessary, therefore, to add a resistance of about 0.1-meg. in series, to prevent overloading of high-impedance circuits. Again, the Sync. Vernier controls the amount of voltage desired.

The horizontal amplifier switch ("Horizontal Amp.") is placed at the extreme right. This switch also has 3 positions. In practice, the position most used is the sweep tap, marked Sweep. In this position, a portion of the sweep oscillator output is fed into the horizontal amplifier grid, amplified and then fed into the horizontal deflector of the 906. The horizontal line across the screen may be lengthened or shortened by means of the Horizontal Gain control. In this position the Horiz. tip-jacks are out of circuit and therefore it is not possible to introduce any external voltage into the horizontal deflector.

When the switch is set to the "ON" tap, the sweep oscillator is disconnected and the horizontal tip-jacks are in circuit. Any external voltage applied to the Horiz. tip-jacks is now amplified and passed on to the horizontal deflector. In this position, it is possible to use an *external* sweep oscillator of different characteristics than the built-in sweep.

The "OFF" position is used mainly for high input voltages. In this position the internal sweep is disconnected and so is the horizontal amplifier.

The center row of controls. Now that we have disposed of the top row of controls, we will review briefly the function of the center row of controls. The positions of each are as follows: extreme left, Vertical Gain control; next, Sync. Vernier; next, Sweep Vernier; and extreme right, Horizontal Gain control. We already know that the vertical and horizontal gain controls are in use only when their associated amplifiers are "ON" and control the length of the vertical and horizontal deflection trace.

The Sync. Vernier, as we know, controls the amount of voltage applied to the 885 control-grid and serves to keep the oscillator locked in frequency with this grid pulse. This is not all, however. The position of the knob, controls, or at least exerts an influence on the following factors: distortion of the image; speeding up of the image; changing the frequency of the image and finally, stopping of the image. Practice is necessary, to avoid over- and under-synchronizing.

The Sweep Vernier control is used to change the sweep frequency in small steps until a suitable number of cycles appear on the screen. As a rule, 3 cycles on the screen are usually sufficient for most wave-form tests. However, when frequencies in excess of 50,000 cycles are to be tested, there will appear *no less* than 3 and possibly 4, 5 or 6 cycles on the screen. This is due to the ratio of viewed frequency against sweep frequency.

For example, a vertical voltage having a frequency of 90,000 cycles will rise and fall 90,000 times per second, while the sweep frequency is flashing horizontally across the screen at 15,000 cycles per second. The result is, that 6 complete cycles will appear on the screen, because the sweep frequency is 6 times *slower* than the viewed frequency.

The bottom row of controls. The bottom row of controls was described in Part I, but we are now going to add a few important hints to supplement the description given in the initial Part.

Do not connect *any* test leads to *any* tip-jacks before or during the process of focusing the spot on the screen. This precaution *must* be observed; any stray voltage picked up by the test leads will be amplified and applied to either or both deflector plates, causing the spot to blur. It is also advisable to have both amplifier switches set on their "OFF" positions, while the focusing process is on. When the spot has been properly focused, the amplifiers may be switched on and external voltages may be applied.

However, when the spot is set into rapid motion, it may become very dim. In such cases *only* the Intensity control should be moved, and then only enough to make the trace plainly, but not glaringly visible.

The beam shift potentiometers are connected to the voltage divider in such manner, that the cathode-ray beam is shifted at will, and to any part of the screen, by the operator.

D.C. voltages cannot be measured with this unit *unless* the input blocking condensers C7 and C8 are shorted out and both amplifiers are "OFF". An easier method would be to connect a wire at each socket prong directly to the vertical and horizontal deflector.

In a forthcoming issue of *Radio-Craft*, we will review several excellent articles; dealing mainly with practical applications, connections and possible uses of the Oscilloscope. We believe this forthcoming article will be of unusual interest to the builders of our instrument.

BOOK REVIEWS

PRINCIPLES OF RADIO ENGINEERING, by R. S. Glasgow. Published by McGraw-Hill Book Co., 1936. Size, 6½ x 9¼ ins., 520 pages. Price, $4.00.

Here is a comprehensive text book on Radio Engineering based upon experience gained by the author in many years of teaching. A knowledge of electricity and magnetism is assumed. Mathematical developments are used only where they are essential to an understanding of the principles involved. A list of problems is included at the conclusion of each chapter. Many footnotes give references to recent published papers, so that the student may secure more detailed information on any subject not completely covered in the text.

TELEVISION WITH CATHODE RAYS, by Arthur H. Halloran. Published by Pacific Radio Publishing Co., 1936. Size 5¼ x 7¼ ins. (looseleaf). Price, $2.75, including additional pages for 1 year.

The operating principles of the cathode-ray tube and its application to television are explained in terms which may be understood by those with a practical working knowledge of radio. An appendix is included which describes the use of elementary mathematics by the radio technician in such simple language as to be understood by almost anyone. The contents of the book are made up from notes of a lecture course on television given by the author. The looseleaf feature is of especial interest, since it enables the book to be kept up to date in this rapidly advancing art.

MATHEMATICS OF RADIO SERVICING, by M. N. Beitman. Published by Supreme Publications, 1936. Size, 8¼ x 11 ins., price, 50 cents.

The Service Man and experimenter often fails to put his knowledge of arithmetic and elementary algebra to work, when working out radio problems. This book was written in the attempt to clarify some of the problems of elementary mathematics and to interconnect them with radio and allied applications. This is a book that every so-called "practical man" should have.

SPRAYBERRY VOLTAGE TABLES, by F. L. Sprayberry. Published by F. L. Sprayberry, 1936. Size, 8½ x 11 ins., 300 pages. Price, $2.00.

Here is a book that will be of inestimable help to the busy Service Man. It is a compilation of the operating voltages of hundreds of commercial receivers. The first 16 pages cover the subject of voltage analysis of receivers, while a complete index is carried at the rear of the book. Over 160 manufacturers are included in the list with details for many receivers of each.

ADVANCED SERVICING OF AUTO RADIO, published by The Radiart Corp., 1936. Size. 11¼ x 9 ins., price, 50 cents.

This book is sent to those who enroll in a course in auto-radio servicing. It contains material of exceptional interest and utility to those who do this sort of work. Questions are given at the end of each chapter. The operation and construction of power supplies of the vibrator type are covered very completely with other chapters on general circuit considerations and installation.

ORSMA MEMBERS' FORUM

(Continued from page 163)

ceiver fades out instantly, the power pack condensers are poor. Good condensers in this position will provide sufficient plate voltage to operate the receiver until the tube cathodes cool to below operating temperature. The normal time for good condensers is about 1½ sec., or a count of about 3.

The other idea is a repair on a set which I found to have a "grounded ground post." This was an A.K.-61 D.C. receiver and the reception was very noisy. Since it was an old job almost anything might have been the cause of the trouble so I started replacing the tubes, most of which tested as having low emission. Five new tubes only made the noise sound louder so I next examined the volume control and the wiring, including the 2 antenna and 1 ground posts. I was able to take up a full turn on the ground post set screw, and I was sure I had cornered the trouble. With a certain satisfaction I turned the set on, but the noise was there strong as ever, with a definite loud crackle and hum. Again I referred to the wiring diagram, where I noticed that the ground post is insulated from the chassis, with a .004-mf. condenser between the two. Removing the post and cleaning the paper-like insulation effected a complete cure and stopped all noise.

CLARENCE F. HALE

THE LATEST RADIO EQUIPMENT

(Continued from page 158)

cal size as the usual carbon types of the same power rating. The ½-W. size may be had in resistance values from 0.25- to 500 ohms, while the 1-W. size runs from 0.5- to 2,000 ohms. The units consist of wire wound on a textile core of small diameter, moulded in a special phenolic compound. The terminals are very firmly fastened in place.

"AEROPLANE" TUNING "EYE" (1102)

HIGHLY-POLISHED aluminum forms the case of this new tuning unit, which utilizes a cathode-ray tuning tube. It is very simple to connect and may be used on any receiver that has A.V.C. It may be used on either 2½- or 6-V. sets, and is equipped with a 24-in., 5-wire cable.

NEW WIDE-RANGE COMBINATION TESTER (1103)

(Readrite Meter Works)

ANY VALUE of reading may be made at the tube socket or by the free-reference-point method with this combination tester. The meter unit covers values of 10-50-250-500-1,000 V., either A.C. or D.C., and 1-10-50-250 ma. The ohms readings are 0 to 300 ohms and 0 to 0.1-meg., with higher ranges made possible by the use of external batteries. The free-reference-point tester has 5 sockets for any type of tube and the necessary jacks for connections. The case is of sturdy metal with a carrying handle, the size being 11 7/16 x 7⅞ x 4¼ ins. deep.

"UNIVERSAL" INPUT AND OUTPUT DYNAMIC SPEAKER (1104)

(Wright-De Coster, Inc.)

HERE IS a truly universal speaker. It has a universal transformer to match any arrangement of output tubes, and in addition a universal field coil tapped at 2,500, 2,000, 1,800, 1,500, 1,000, 700, 300 ohms, and 1,800 tapped 300 ohms. The size is 7 x 12 ins. dia. The new "para-curve" diaphragm is used to attain a width of frequency response impossible with the ordinary conical diaphragm.

VARI-SPEED MOTOR FOR EXPERIMENTERS (1105)

CONSTANT speeds with a drift of less than 1% and variable from 0 to 1,000 r.p.m. are possible with this unit. The speed is controlled by a knob on the panel, and the apparatus is intended for use with the neon tube type of oscilloscope. The motor is a 1 100-h.p., 110-V. shaded induction type, and all bearings are of the oilless design. The size is 8½ x 3½ x 4½ ins. high. While designed for oscilloscope use, the unit may be used for many other laboratory and shop purposes.

SOUND ON FILM PROJECTOR (1106)

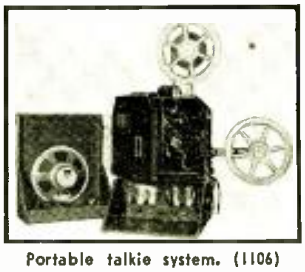
(S.O.S. Corp.)

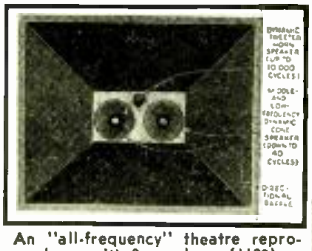
A CAST-ALUMINUM case assures light weight yet a maximum of strength in this new projector. It also acts as a silencer for the mechanism and as a fire shield. Forced ventilation, wide-fidelity sound lens; and automatic electric governor control are other features of this latest 16 mm. projector. The sound system has a power output of over 15 W. with 110 db. gain, and is provided with a 12-in. speaker and 60 ft. of cable. Ribbon, crystal or other standard mikes may be plugged into the amplifier without extra batteries or preamplifiers.

NEW "MULTI-TYPE" TESTER (1107)

(Radio City Products Co.)

THIS universally-adaptable instrument has a meter of 2,000 ohms-per-volt sensitivity on D.C. and 1,800 ohms-per-volt on A.C. When using


Portable talkie system. (1106)


An "all-frequency" theatre reproducer with 3 speakers. (1108)


Two new hearing-aid phones. (1112)

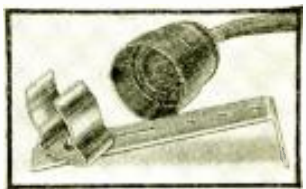

All-purpose test outfit. (1107)

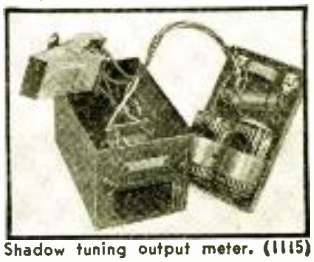

Portable volt-wattmeter of unusually high overall accuracy. (1110)


Simplified tube tester. (1113)


A 300-W. power plant. (1109)


Portable radio service laboratory contains all needed equipment. (1111)


Adjustable tuning-tube socket. (1114)


Shadow tuning output meter. (1115)

the capacity-measuring scale, line fluctuations are automatically compensated for, and no precautions need be taken against shorted condensers. The various ranges are as follows: A.C. and D.C. volts, 5-25-100-250-1,000; A.C. and D.C., 5-25-100-250 ma., and 500 microamperes, and 2.5 A.; capacity, .03-0.3-3-30-300 mf.; resistance, 1,000-10,000 ohms and 0.1-meg.; inductance, 25-1,000 mhy., and 0.25-10-1,000-10,000 hy.; db., —15 to +40. The apparatus is in a natural-finish wood box with removable cover.

THEATRE SPEAKER UNIT (1108)

FIVE UNITS comprise this speaker system. There are 2 large dynamic speakers used to reproduce the lower and middle registers, and a dynamic horn for the high frequencies. A voice line filter separates the incoming audio signal and sends the proper frequencies to the proper speakers. The 5th unit is the field energizing supply, which contains an effective hum filter.

A 300-W. PORTABLE POWER PLANT (1109)

(Kato Engineering Co.)

THE OUTPUT of this portable plant is 110 V. A.C. at 300 W., max. It is a 1-unit assembly, with fuel tank in the base. It may be operated without being bolted down and is free from causing any radio interference. The same design and general appearance is followed in other units of the same line, which have power ratings of 150 W. at 6 V.; 200 W. at 12 V.; and 300 W. at 32 V.

PORTABLE VOLT-WATT-METER INCORPORATES PERMALLOY (1110)

(General Electric Co.)

A PERMALLOY vane is used in this instrument, which is shielded from stray magnetic fields. Either the Volts or Watts scale may be selected by setting the switch on the panel. The overall accuracy of the instrument is ¾ of 1 per cent of full-scale value. The ranges are 750 W. A.C. and 150 V A.C. Magnetic damping is used. The case is of moulded material called "textolite."

Radio salesmen and Service Men can now "talk turkey" to customers when discussing the question, "What does it cost to operate?"; (in this connection, see "What does it cost to operate?"; July [Annual Service Number], 1936, issue of *Radio-Craft*).

PORTABLE SERVICE LABORATORY (1111)

(Triplett Electrical Inst. Co.)

COMPLETE service facilities are assured in this portable servicing laboratory. It contains a volt-ohm-milliammeter, a tube tester, a free-reference-point tester, and a direct-reading, all-wave oscillator. Each of these units is in a metal case 7⅞ x 6⅝ x 4⅝ ins. deep, with panels finished in silver and black. The units may be purchased individually if desired.

NEW HEARING AIDS (1112)

TWO NEW models have been added to the already popular line of crystal headphones. One is a single phone mounted on a light band, while the other is a phone unit on a lorgnette-type mounting, the handle of the latter being extensible from 12 to 17 ins. Both units are very light in weight, and have all the characteristics—of which high-fidelity reproduction is an outstanding attribute—of the previous crystal phones.

NEWEST ENGLISH-READING TUBE TESTER (1113)

(Readrite Meter Works)

IMPROVEMENTS have been made in this popular model to make it more easy to use. A shadow-type line voltage indicator shows correct voltage setting and acts as a pilot lamp also. The main meter is calibrated to read Good-Bad, and testing is very simple, requiring only 4 operations.

ADJUSTABLE SOCKET FOR "EYE" TUBES (1114)

HERE IS an adjustable socket for use in mounting the new cathode ray tuning tubes. It is equipped with a 5-wire cable and the socket may be moved in any position to get the tube at the desired angle.

SHADOW TUNING METER IN NEW ALIGNMENT UNIT (1115)

(Philco Radio & Television Corp.)

ALIGNMENT of receivers is made easy by the use of this output meter. The metal case holds a battery which illuminates the shadow meter when the toggle switch is operated, the shadow appearing on the screen at the end of the box. The meter is simple and accurate to use.

AN UP-TO-DATE 18-W. POWER AMPLIFIER (1116)

(Continued from page 159)

applied to the secondary. The secondary winding has 500 ohms A.C. impedance at 400 cycles and is tapped at 15, 8, and 4 ohms to accommodate a wide range of speakers or for a transmission line. It is large enough that it will carry the plate current without saturating and handle the necessary peak power without overloading. The output indicator uses a 6E5 as a V.-T. voltmeter connected across the 4-ohm section of the output-transformer secondary.

Hum and Power Supply. The hum problem which is always a difficult one to overcome in high-gain amplifiers, has been solved by using a large power supply unit mounted so that it induces the least possible amount of chassis current. Adequate filtering minimizes the hum output, and tests have shown the hum level to be as much as minus 13 db. from zero.

LIST OF PARTS

One Stancor foundation kit (including: 1 amplifier chassis No. MB-10, with 10 octal sockets, 2 output sockets with base covers, 2 input sockets with base covers, 1 resistor and indicator "eye" mounting bracket; 1 type MP-3700 power transformer, P.T.; 1 type MA-4605 input transformer, T1, 1 type MA-3650 output transformer, T2; 1 type MB-1641 tone control choke, Ch.1; 1 type MC-1003 filter choke, Ch.2; 1 type MC-1002 filter choke, Ch.3; 1 type MC-1640 filter choke, Ch.4; 1 type MC-1515 filter choke, Ch.5);
Two Centralab resistors, 0.1-meg., 0.5-W.;
One Centralab resistor, 1 meg., 0.5-W.;
Two Centralab resistors, 0.25-meg., 0.5-W.;
Two Centralab resistors, 3,500 ohms, 0.5-W.;
Two Centralab resistors, 2,000 ohms, 0.5-W.;
One Centralab resistor, 750 ohms, 1 W.;
One Centralab resistor, 10,000 ohms, 1 W.;
Two Centralab resistors, 2,500 ohms, 25 W.;
One Centralab resistor, 2,00 ohms, 25 W.;
One Centralab resistor, 5,000 ohms, 10 W.;
Two Electrad gain control potentiometers, 0.25-meg.;
One Electrad tone control potentiometer, 0.25-meg. (equipped with off-on switch);
Two Aerovox tubular paper condensers, 0.1-mf., 400 V.;
Five Aerovox tubular electrolytic condensers, 20 mf., 25 V.;
One Aerovox tubular paper condenser, .03-mf., 400 V.;
One Aerovox tubular paper condenser, .02-mf., 400 V.;
One tubular paper condenser, .05-mf., 600 V.;
Three electrolytic, metal-can condensers, 8 mf., 450 V.;
Three electrolytic tubular paper condensers, 10 mf., 250 V.;
Two tubular paper condensers, .002-mf., 600 V.;
One Radolek kit of miscellaneous parts (including: 1 S.P.D.T. switch; 2 gain control plates; 1 off-on tone control plate; 3 1½ in. bar knobs; 1 cathode-ray indicator tube escutcheon; 1 phone jack; 3 2-terminal-type strips; 1 6-terminal-type strip; 2 1-terminal-type strips; 2 ft. of 1-wire cable; hookup wire, nuts, bolts, etc.).

CORNERSTONES OF RADIO

(Continued from page 161)

persons; and from 5 o'clock, a.m., the traffic grows and grows until it reaches its peak load between 8 and 9 o'clock, a.m., with a total of 7,000 uptown passengers.

To the same extent as the uptown traffic increases in the morning hours, a similar decrease in uptown traffic takes place between 8.30, a.m., to 3 o'clock, p.m. There is in city "X" of course during all the hours after office opening demand for downtown transportation, but because of the special living and working conditions of this city we have chosen for our example it does not amount to a figure worthwhile to be considered in the traffic's balance sheet.

People go downtown in the afternoon. The important part of the downtown traffic starts as Fig. 10C indicates about 3 o'clock in the afternoon. This traffic load curve is of course a little bit different from the one of the morning hours, since some of the people like to walk home after office closing, etc. However, since the working conditions of our city "X" are influenced mainly by a few very great manufacturing companies, operating their plants in various shifts, *it is 3 o'clock in the next morning* before the downtown traffic reaches its economical zero point.

To determine how many cars, and how many street car conductors and drivers are required to meet the demand for transportation during the rush hours the manager of the street car company pasted together the diagrams of Fig. 10B and 10C, and obtained the combined diagram presented by Fig. 10D.

NUMBER OF STREET CARS vs. NUMBER OF PEOPLE

As Fig. 10D indicates, there are (a) 2 outstanding peaks in the traffic load of this city, and (b) a great deal of idle time in which the street car system is not sufficiently utilized. To combine, therefore, (a) the requirements of the inhabitants of the city for sufficient means of transportation at all times, even during rush hours, with (b) the desire of the stockholders to obtain satisfactory returns on their investments, the manager decided to put into use during the rush hours some older street cars, and to man them with employees from the repair shops and even from some of the offices, as emergency drivers and conductors.

One heavy snowfall, and trouble occurs. He considered himself as an excellent manager, and expected a substantial salary increase around New Year's, but his hope was suddenly destroyed when shortly before Christmas the winter with all its might arrived. No one could remember having seen such a heavy winter, and since the facilities provided for cleaning the snow and ice from the rails were totally inadequate to this sudden demand the complete street car system became disorganized, and all the nice diagrams about the uptown and downtown traffic load proved to be good for nothing!

The traffic situation had changed entirely, and everything went wrong as Fig. 10E indicates. The dotted line in the figure shows the number of passengers appearing at their regular time at the street car stop places, while the full line indicates the time at which the needed number of street cars eventually arrived.

As Fig. 10E indicates a delay of about one hour occurred. This delay caused not only heavy losses for the manufacturing companies which had to fulfill Christmas orders, but also for their employees who lost 1 hour's pay! The entire city was in an uproar about the "inefficient" manager of the street car company, and many asked for his "head"!

BUT WHAT IS THE MEANING OF THE TERM "PHASE SHIFT"?

Such a periodic change is shown in Fig. 10D in the form of the uptown-downtown traffic-load curve. Generally we will not use the expression *phase* in connection with traffic, but we may recall various occasions in which we have heard people say: "At this phase of traffic it is quite difficult to obtain a seat."

We know now what phase means, and there is no reason why we should not therefore understand another expression of similar meaning called "p-h-a-s-e s-h-i-f-t" this expression also frequently appears in articles describing the operation of certain radio circuits. If we understand what "phase shift" means, one of the most important factors of radio transmission and reception will no longer be a secret to us, because it explains to us how the resonance of a tuning circuit is obtained.

Let's speak about "time delay" instead of "Phase shift." We already had an actual case of "phase shift" in our discussion but the author purposely did not call it by this name but said in connection with Fig. 10E which shows a case of phase shift: ". . . . the street cars had a *delay* in their scheduled *time*." The author could have said as well: "The curve indicating the number of cars provided, showed a "*phase shift*" against the curve indicating the number of passengers waiting for transportation."

ELECTRICAL PHASE AND PHASE SHIFT

How an *electrical* phase looks is shown in Fig. 11A. This diagram is very familiar to all of us in connection with alternating current (or "A.C.") It shows us how an alternating current or voltage has an increase and decrease in magnitude (let's say during 1/100 of a second). And it shows us how this up and down variation is connected with a periodic change of direction; in one part of this illustration the current flows in one direction, and in the next part it reverses its direction. There is no "magic" about it—every one of us can readily visualize this action.

But sometimes we find in articles, diagrams which look like that of Fig. 11B. *The curve "C" represents an alternating current which has a phase shift amounting to 90° (°=degrees) against the voltage curve "V."*

This sentence (italics) sounds—after all the nice talk about street cars and passenger traffic—like the lecture of a university professor! But it only *sounds* this way. Thus, if we substitute the words "passenger traffic" for (current), and the words "street-car traffic" for (voltage) the picture changes quite a bit, and we immediately realize how simple it is to speak about the fact that the current has against the voltage a time delay (phase shift) of 90° (degrees)!

There remains only to explain the meaning of the funny-sounding expression, "90°". The more experienced readers have of course already guessed that it is only another method of writing down a very short time interval. That guess is correct. Engineers express the time delay (which occurs between the arrival of an alternating voltage) in degrees because the determination of phase shift in tremendously small parts of a second (not *minutes* or *hours*, as in the instance of traffic) would lead us to figures which are far beyond our horizon of conception.

How long is 25/10,000 second? How short is the "time delay" in electrical circuits will be demonstrated by the following example. Let us assume we are dealing with an individual "cycle" of alternating current having a given "frequency" of, let us say, "1 cycle per 1/100 of a second" as shown in Fig. 11A. (Generally we don't speak of single cycles, but give the *number of cycles per second*—which in this case would be a "frequency of 100 cycles per second.")

In Fig. 11B we see the same electrical current with a period time of 1/100-second but it has a "time delay" (phase shift) of 90° against the voltage "V," which flows also through this circuit. Now, instead of saying: "The phase shift (time delay) is 90° between current and voltage," we could, if we wished to, say "Between the arrival of current and voltage is a time delay of so-and-so-many split parts of a second."; as regards the time element, then we have a time delay of 25/10,000 of a second. This is such a short time that nobody can conceive it.

This is an amazing short time, but we have to keep in mind that the example of 100 cycles per second is after all very simple, because if we choose an alternating current having a frequency of 1,650 cycles, and had to figure out how much is the time-equivalent to a phase shift of 90°, we come to figures which would mean nothing even to Professor Einstein. Therefore let us stick to the determination of phase shift in degrees; it is much simpler, and since we know that it means a very short time, of inconceivably small dimensions the determination of a phase shift in 90 degrees cannot frighten us any more.

(This concludes our series on the 3 basic electrical actions. How did you like it?—*Editor*)

MODERNIZE FARM RADIO WITH WIND

(Continued from page 147)

prominence until now tens of thousands of these units are installed over the entire world. In the most isolated parts of the earth where it was formerly impractical to have a radio receiver, these wind chargers are performing their duty so well that thousands of radio sets are now being sold in these forgotten corners of the earth.

LOW WIND VELOCITY OPERATES A WIND CHARGER

There was no great demand for farm radio receivers as long as the "B" battery had to be replaced, but as soon as the vibrator eliminated this, the radio manufacturers looked toward the wind charger as the solution to the farm radio problem. Here was a vast market heretofore untapped. But again difficulties presented themselves, as *it was necessary to obtain a unit that would begin charging in a very low wind velocity.* A generator especially adapted for this purpose had to be designed. This presented a problem, which was later overcome, but the design of the propeller was even more difficult. Experimenters were imitating the aeroplane propeller and it was not until after they began designing a propeller modeled after the aeroplane wing that the desired results were obtained. It was found that for high speed, it was necessary to have a propeller which would have a perfect *air foil*, causing the propeller to revolve into the partial vacuum that was created along this air foil; similar to the lift of an aeroplane wing. Since this fact was discovered developments on the propeller design moved rapidly, with the result that at the present time units are now operating through the free power of the wind, which is bringing comforts and modern conveniences closer and closer to the farm home. (Just how much current can be developed by a representative type of wind-driven current generator, operating at various speeds of wind and generator, are appended in Tables I and II.—*Editor*)

BASIC CIRCUITS

The regular wind-electric circuit (Fig. 2A) basically consists of a 6-volt generator, 6-volt relay, ammeter and battery.

The generator is of the 3rd-brush automotive type. The armature, field coils and bearings, however, are designed for wind-electric use in order that the generator will begin charging at a low rate of speed. The armature bearings must take the back-thrust of the propeller, and the brushes must have lighter spring tension to eliminate frictional losses. The relay is necessary in order to open the circuit when the wind dies down, and the generator does not have sufficient speed to produce a voltage greater than the battery potential; thus by opening the circuit it prevents battery drain, *which would be created by the battery causing the generator to act as a motor.* The relay can not be an ordinary automobile relay, as it must be designed to close at a lower voltage (6.7) and to open the circuit when the generator voltage falls below this. In opening the circuit, this relay must have as small a discharge current as possible. Wind electric relays are now being used that open on a 1-A. reverse current or approximately 6 watts.

In such a circuit it is very important that the battery is never disconnected from the generator, as this opens the armature circuit producing a high field current, which results in an abnormally high voltage at the generator terminals. This voltage may at times amount to more than 3 times the normal operating voltage. The danger lies in the fact that this high voltage will ordinarily cause the field and armature coils to break down their insulation, resulting in a "shorted" armature. In order to prevent this, a switch can be installed, which when closed, will short-circuit the generator terminals. As long as the generator terminals are short-circuited, there can be no danger of high voltage, and no harm can ever result even though the battery is disconnected.

In order to prevent a burned-out armature due to an open circuit, the battery clips are sometimes connected together to short-circuit the generator terminals. However, this often causes a furious chattering of the relay points, which is noisy and may soon cause the points to arc and burn, therefore, it is best to install this switch between the relay and generator, as shown in Fig. 2C.

HOW TO ELIMINATE GENERATOR INTERFERENCE FROM THE RADIO SET

To eliminate most generator interference from the radio set, since the radio and wind charger are both connected to the same battery, a double 0.5-mf. condenser is inserted between the 2 generator terminals and ground. However, this condenser is not always sufficient to eliminate generator interference on short-wave reception, and a special short-wave interference elimination circuit is necessary. This circuit (Fig. 2B) consists of a 3rd wire, No. 12 B. & S. gauge, between the generator and instrument panel. The reason for this being, that in order to entirely eliminate the generator interference, both the armature and field circuits must be open. To open both circuits, this 3rd wire, which completes the field circuit, is connected to a S.P.S.T. switch; the positive armature wire between the relay and the generator also has a S.P.S.T. inserted in one of its wires. It is, however, important that the field switch be opened first and allow a short time to elapse (approximately a second) before the armature circuit is opened.

This is necessary in order to allow the relay contact points to open before the armature circuit switch is opened, for if the armature circuit is opened while the relay is closed, it will remain closed and drain the battery. This occurs because the relay is composed of 2 coils in parallel, a voltage coil having a large number of turns of very fine wire, and a current coil made of a few turns of heavy wire. The current coil is connected in the charging circuit in series with the contact points, and is energizing only when the contacts are closed. In this manner, the actual closing of the relay contacts is caused by the magnetism created by the voltage coil, and once the contacts are closed, they are held closed by the current passing through the current coil. When the double switch is installed, should the armature circuit be opened first the battery will still be connected to the 2 relay coils. However, these coils will no longer be connected in parallel with each other, but instead will be in series, and the current coil will tend to open the points and the voltage coil will tend to keep them closed. Although both carry the same amount of current, the voltage coil has many more turns, and its magnetism will be the stronger of the two, causing the points to remain closed even though the generator has dropped to zero.

It is necessary to have the circuit filtered against generator interference, which otherwise would prove very noisy if the radio receiver and generator were operating simultaneously. Such radio interference is generally created by a dirty commutator, or sometimes by having the 3rd brush moved too far ahead. Brushes that are not properly seated may also cause arcing. Such brushes can be properly seated by running a sharp metal piece between each commutator segment. This causes a small burr, and then by "motoring" the generator (operating it as a motor), these burrs will grind the bottom of the brushes for the proper curvature of the commutator. After the brushes have been properly seated, a fine grade of sandpaper held on the commutator will remove the sharp burr.

Another method to properly seat the brushes is to lay a fine grade of sandpaper (No. 00) on the surface of the commutator with the rough surface up. Allow the generator brushes to rest on the surface of this sandpaper, and gently rock the armature back and forth. This also will sand the bottom of the brushes so that they will be properly seated.

Care must be taken when rocking the armature, as these brushes are soft, and the sandpaper will sand them very rapidly, with the result that too much of the brush may be removed.

ELIMINATING RELAY INTERFERENCE

Relays, too, may sometimes cause interference with radio reception. This would be due to the arcing of the points when they open and close. There are several ways to eliminate this. One of these is the use of the latest improvement in wind-electric instruments, which is a special type of relay, which will open and close without any chattering. Chattering and arcing of the

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MODERNIZE FARM RADIO WITH WIND

(Continued from page 189)

points was created on the earlier type of relays when the generator voltage approximately equaled the battery voltage. This, however, has been rectified in the newer type of relay by using a coil tension spring instead of the former flat piece of spring steel, and also mounting the coil spring at a point so as to have greater leverage upon opening and closing. This causes the points to open or close *suddenly*, without any chattering.

Several filter circuits are available for filtering radio interference, chiefly created by the relay. Fig. 2D and 2E show the use of 0.5-mf. condensers between the ammeter and the relay terminals.

Lightning protection of a wind-electric plant is recommended by grounding either the wind-electric generator assembly itself or any portion of the tower. This may also help eliminate radio interference.

Developments in this field are progressing rapidly; *one of the newest developments in the wind-electric equipment is the design of a new 2-volt relay.* This relay is used for charging 2-volt batteries with a 6-volt generator. Until very recently, this was accomplished solely through the use of a resistor, which by dissipating part of the energy, reduced the potential of the 6-volt generator to the proper equivalent for charging a 2-volt battery.

This method, however, was not very satisfactory, as it was very inefficient; a high power in watts had to be produced by the generator for a proportionally small watts output for the battery. Then, too, the resistor causes the generator to work at a very high voltage, which in time might cause a burned-out armature. Such a resistor would necessitate the propeller producing a large power output, which would mean that a much higher wind velocity would be necessary, than if a relay were used to produce the same charging current.

It is such improvements as these that are making the science of wind-electric generation a rapidly progressing science—governors are being perfected, collector rings designed, vibration eliminated, and generator and propeller designs are being constantly improved.

The farm radio market—once a forgotten item, is now a very profitable item to the radio manufacturers—dealers—and Service Men. With the wind-electric units, not only are radio set batteries maintained, but lights are available, refrigerators can be used, as well as many other electric appliances.

Manufacturers of radio receivers were forced into this field by the incessant demands of people in rural districts. The result of these demands is a new line of receivers which rival the best A.C. receivers made!

There is power in the air! It has been used to carry the ships over the entire world, now it can be used to "play" your radio set and light your home—it is free to all who care to harness its enormous possibilities.

TABLE I

CHARGING RATE IN AMPS. AT VARIOUS WIND VELOCITIES

Miles per Hour	Output in Amps.	Miles per Hour	Output in Amps.
9	1	14	7.0
10	2	15	8.2
11	3.5	16	9.5
12	4.5	17	10.8
13	5.7	18	12.2

(The above test was made with a 5½-ft. propeller; the present propeller is 6 ft., therefore, the output will be somewhat greater. The above results were obtained from University of Michigan wind tunnel tests.)

TABLE II

CHARGING RATE IN AMPERES AT VARIOUS SPEEDS

(Revolutions per minute)

SPEED R.P.M.		
322—at this speed, generates	6.4	V.
340—at this speed, relay closes and generates charge of	1	A.
374 output of	2	"
442 " "	4	"
506 " "	6	"
606 " "	8	"
706 " "	10	"
860 " "	12	"
1064 "	14	"
1313 "	15	"

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

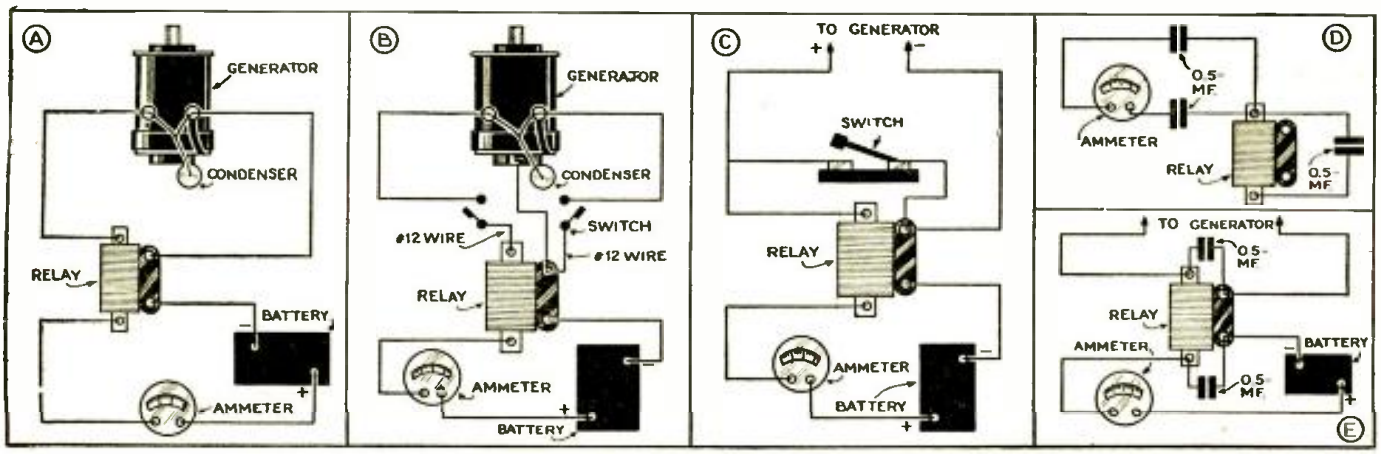

Fig. 2. Basic circuits of wind generator units, in A, B and C. Two filter circuits are shown in D and E.

DIRECT-IMPEDANCE AMPLIFICATION

(Continued from page 160)

passes. Thus the bias of the 59s may be adjusted by means of the sliding tap on the bleeder resistor, R14.

The bias for V8, V9 and V10 being already provided for, the construction of unit 2 is much simplified. It consists essentially of a 1-stage amplifier of very conventional design. The voltage drop across choke V in turn biases the final tubes V12 and V13.

The use of 2½-V. filament tubes has been adhered to in this receiver for several reasons, one of which is the lowering of the hum level due to the leakage from the cathode of V5. The low-frequency response of the set is so high that this source of hum cannot be overlooked. With the tubes specified, no trouble will be encountered.

As to induced hum arising from the audio chokes G, H and L, which would seem the most dangerous and susceptible points, the constructor will find these parts to be only a little affected by external fields. This fortunate characteristic is largely due to the current carried by each. An inductance under no-load conditions is vastly more susceptible to an external magnetic field, which fact explains why the secondary of an A.F. transformer usually proves "so annoying" in high-gain systems. The hum level is further reduced by the filtering action of tube V6 and condenser C15 on the current feeding the first A.F. stage V5.

AUDIO CONSIDERATIONS

In order that the action of the low-frequency booster unit No. 3 may be better understood, a typical response chart has been prepared in Fig. 3. The heavy lines show the input curves to the respective speakers. These responses undergo moderation through the effects of the speaker input transformers and actual speaker response. If the speakers are properly "baffled," the true sound output as umes a condition fairly close to that represented by the 2 dotted lines.

In an analysis of the installation in which these results were obtained, it was found that speaker No. 2 was mounted in a wall of the music room with the concealed opening leading into an adjacent closet. The face of the baffle hole was covered with copper screen set flush with the wall and painted to match, being thus quite unnoticeable. Such a baffle will hold up response clear down to 16 cycles, which is ideal.

Speaker No. 1, on the other hand, was mounted on a small sheet of celotex some 2 x 3 ft. in size, and allowed to rest on the floor upheld by the reproducer. The floor became an extension of the smallest dimension and the size accordingly equalled a 3-ft. square. The speaker output then was maintained down to about 80 cycles at which point speaker 2 began to take hold.

CONSTRUCTION

To avoid complications due to the 3 power supplies which are in series and therefore generate a high overall voltage, the receiver is built in units, intereonnected by cables. Sockets mounted along the rear of the several units provide easy means of plugging in the speakers and the 2 cables, at the same time making for convenience and portability.

While a plain 4-wire cable is satisfactory for use between sockets 18 and 19, the use of a 5-wire cable must be avoided between the receiver chassis and unit 2. To avoid hum due to the capacity of the wires, it is necessary to run a *separate* 2-wire lead for the 110 V. A.C. supply. This is wired to the same cable plugs as the 3-wire cable carrying the signals between sockets 15 and 16, but is allowed to hang loosely from it.

The mechanical layouts shown are not empirical. Of the almost unlimited variety of placements, any number are satisfactory and are used in the several models of these receivers. The chief considerations are the arranging of the components so as to achieve a desired compactness and shortness of leads while at the same time keeping separate such parts as interact with one another. Thus the power transformer K is a satisfactory distance from A.F. choke G and no hum will be had from that source. Choke H, operating at a higher level, may be mounted closer to transformer K and still keep the hum level at minimum.

It is the general policy of the author to construct these instruments unit by unit, placing the receiver in operation first. This may be done by connecting a magnetic speaker or earphones across choke H. Unit 2 may then be built and placed into use with speaker No. 1. This arrangement constitutes a complete set in itself with excellent tone. Those who want a small radio instrument may leave out the low-frequency volume control (R13, C17), tube V10 and its associated apparatus (L, O, C22, 23), change the 2 type 59 output tubes (V8, V9) to conventional power tubes such as 2A3s, and thus have a complete receiver capable of splendid performance.

LIST OF PARTS

Two Centralab carbon resistors, 400 ohms, 1 W., R1, R2;
Two Centralab carbon resistors, 50,000 ohms, 1 W., R3, R6;
One Centralab carbon resistor, 30,000 ohms, 1 W., R4;
One Centralab carbon resistor, 300 ohms, 1 W., R5;
One Centralab carbon resistor, 1,000 ohms, 1 W., R7;
Two Centralab carbon resistors, 1 meg., 1 W., R9, R10;
One Centralab potentiometer, ½-meg., R8;
Two Centralab potentiometers, ¼-meg., R12, R13;
One Centralab carbon resistor, 2,000 ohms, 1 W., R11;
One Electrad voltage divider, 15,000-ohms, 50 W., 3 taps, R14;
One Electrad fixed resistor, 15,000 ohms, 20 W., R15;
One Electrad fixed resistor, 5,000 ohms, 50 W., R16;
Nine Aerovox electrolytic condensers, 8 mf., type GM, 525 V. peak, C;
One Aerovox mica condenser, 370 mmf., type 1467, C6;
One Aerovox mica condenser, 0.001-mf., type 1467, C8;
Three Aerovox mica condensers, 100 mmf., type 1467, C11, C12, C13;
One Aerovox mica condenser, 0.001-mf., type 1467, C14;
One Aerovox electrolytic condenser, 8 mf., type P-5;
Five Cornell-Dubilier condensers, 0.1-mf., C4, C5, C9, C10, C16;
Three Cornell-Dubilier condensers, 0.25-mf., C17, C18, C19;
Two Cornell-Dubilier condensers, 0.01-mf., C20, C21;
Three Cornell-Dubilier condensers, 0.5-mf, C22, C23, C24;
One Hammarlund trimmer condenser, C7, type EC-35;
*One 360-mmf., 3-gang variable condenser, C1, C2, C3;
*One airplane dial;
*One antenna coil, type 242-A, A;
*One R.F. coil, type 242-RF, B;
*One oscillator coil, type 242-OSC, 465 kc., C;
*One I.F. input stage, type 312-C-1, D;
*One I.F. coil, type 312-C-2, E;
*One I.F. "diode" transformer, type 312-C-4, F;
*One audio choke, type L-245B, 650 hy., 3,180 ohms, G;
*One audio choke, type L-244CB, 350 hy., 4,000 ohms, H;
Two Thordarson filter chokes type T-1607 15 hy., 85 ma., I, J;
One Thordarson power transformer, type T-5602 supplying 700 V., 70 ma. C.-T., 5 V., 2½ V., 2½ V., K;
*One audio choke, type L-241-B, 40 hy., 674 ohms, L;
One Thordarson power transformer, type T-5604, supplying 720 V. C.-T., 105 ma., 5 V., 2½ V., M;
One Thordarson filter choke, type T-5754, 9.5 hy., 110 ma., N;
One Thordarson audio choke, type T-1892, 22 hy., at 35 ma., O;
One Thordarson filter choke, type T-1700-B, 8.75 hy., 130 ma., P;
One Thordarson power transformer, type T-5822, Q;
*One high-fidelity concert-type speaker, model A-12 D.C., 110 V. field, input impedance approx. 2,500 ohms, speaker No. 1;
*One ortho-dynamic speaker, model L-70, 110 V. field, input impedance approx. 3,500 ohms, speaker No. 2;

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Index to Advertisers

(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.)

DIRECT-IMPEDANCE AMPLIFICATION

(Continued from page 191)

*Seven 4-prong wafer sockets;
*Three 5-prong wafer sockets;
*Six 6-prong wafer sockets;
*One small 7-prong wafer socket;
*Three large 7-prong wafer sockets;
Five type 58 tube shields;
Three Sylvania type 58 tubes, V1, V3, V4;
One Sylvania type 2A7 tube, V2;
One Sylvania type 55 tube, V5;
One Sylvania type 56 tube, V6;
Two Sylvania type 80 tubes, V7, V11;
One Sylvania type 5Z3 tube, V14;
Three Sylvania type 59 tubes, V8, V9, V10;
Two Sylvania type 2A5 tubes, V12, V13;
One chassis, 10 x 20 x 3 ins., unit 1;
One chassis, 10 x 9 x 3 ins., unit 2;
One chassis 10 x 7 x 3 ins., unit 3;
*Two 90-series plugs, 5 prongs;
*Four 90-series plugs, 4 prongs;
*One fuse block, grid clips, cable, etc.

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

THE LATEST RADIO EQUIPMENT

(Continued from page 159)

COIL ATTACHMENT ADDS SHORT-WAVES TO ANY SET (1120)

ADDING this little coil to a T.R.F. broadcast receiver as shown in the schematic circuit enables receivers designed only for the regular 200 to 550 meter band to include the 75 to 200 meter short-wave band. The coil measures only ¾- x ⅞-in. dia. One coil is required for each tuned circuit, in a T.R.F. receiver.

NEWEST IRON-CORE R.F. COILS (1121)

A NEW 2-coil I.F. transformer has been developed as a remedy for the instability of alignment and mechanical shifts of capacity which have been inherent in many previous designs of condenser-trimmed I.F. transformers. The new transformer (designated Type P by the manufacturer) is here shown in phantom and schematically at A. The iron cores of the primary and secondary coils of the transformer are adjustable with a screw thread, and the inductance values are not affected by vibration, humidity, or temperature changes.

Fixed sealed condensers are permanently connected across the inductances. High-gain and narrow band width characterize these transformers.

A NEW 3-circuit continuous flat-top band-expansion I.F. "transformer" is the latest development for obtaining selective band expansion in an economical and efficient manner. (The unit is designated as the D-101, and is shown in phantom and diagram at B.

The new transformer uses iron cores in all 3 coils. The center inductor of this 3-circuit transformer may be rotated with respect to the other 2 inductances, varying the selectivity while retaining a flat-topped, steep-sided characteristic through all degrees of band-width expansion with no appreciable loss in gain.

The selectivity may be controlled by a knob on the panel of the receiver, by attaching a suitable link mechanism to the center shaft which projects through the shield can (which measures 2 x 2 x 4 ins. high), as shown.

While this transformer has 3 trimmer condensers, the initial adjustment is made in the same manner as in the case of an ordinary transformer, that is, merely by peaking each tuned circuit at the intermediate frequency. The user is then given the option of high fidelity or split-channel selectivity by manipulation of the selectivity control on the panel. So effective is this method of selective band expansion that audio tone controls can be dispensed with in 1937 receiver designs, since high A.F. attenuation may be secured through this means of control of side-band amplification.

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These two fellows had the same chance. Each clipped and sent me a coupon, like the one in this ad. They got my book on Radio's opportunities.

S. J. Ebert, 104-B Quadrangle, University of Iowa, Iowa City, Iowa, saw that Radio offered him a real chance. He enrolled. The other fellow, whom we will call John Doe, wrote that he wasn't interested. He was just one of those fellows who wants a better job, better pay, but never does anything about it. One of the many who spend their lives in a low-pay, no future job, because they haven't the ambition, the determination, the action it takes to succeed.

But read what S. J. Ebert wrote me and remember that John Doe had the same chance: "Upon graduation I accepted a job as serviceman, and within three weeks was made Service Manager. This job paid me $40 to $50 a week compared with $18 I earned in a shoe factory before. Eight months later I went with station KWCR as operator. From there I went to KTNT. Now I am Radio Engineer with WSUI. I certainly recommend the N. R. I. to all interested in the greatest field of all, Radio."

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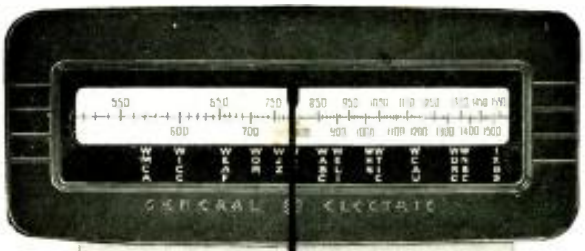

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