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37

HUGO GERNSBACH EDITOR

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**JUNE RADIO-CRAFT  
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This forthcoming issue of RADIO-CRAFT instead of being called the CAR-RADIO NUMBER will be known as the PRIVATE-ADDRESS NUMBER and will feature this new application of radio equipment. The issue will contain, for instance, one article that alone is worth a year's subscription—namely, complete constructional details of an inexpensive carrier communicator for talking back and forth (between offices, etc.), over the electric light lines, WITHOUT STRINGING WIRES BETWEEN STATIONS!

In addition to telling you all about the many types of inter-office phone systems now available this June issue (on the newsstands May 1) will give you constructional details and practical information regarding the newest developments in the car-radio field.

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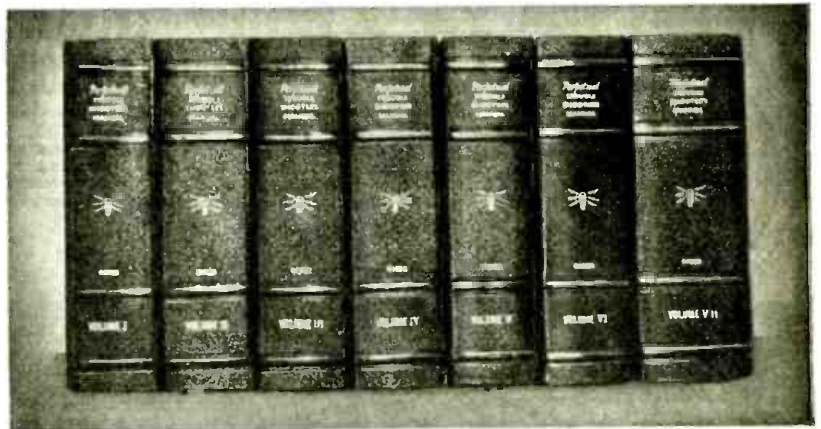
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"Takes the Resistance out of Radio"

Editorial Offices: 99 Hudson St., New York, N. Y.

HUGO GERNSBACK, Editor

Vol. VIII, No. 11, May 1937

## PRIVATE-ADDRESS BOOM

An Editorial by HUGO GERNSBACK

**H**ISTORY which has repeated itself in radio ever since the days of the crystal detector, is now staging another one of its cyclic booms. The first great radio boom during 1921 to 1923 is, of course, still the one that has not since been surpassed in magnitude. Subsequently, we had a good-sized boom when the enclosed radio set first made its appearance. Then in rapid succession we had booms in console radio receivers; then, the depression made the cigar-box-model boom, followed by that of radio sets for cars, and later the all-wave radio receiver craze, and many other minor boomlets, all of which ran their course.

One of the major developments of the radio industry was, of course, the field we now call "Public Address" which while never developing into a real "boom" still produced a tremendous amount of business and is today one of the most important branches of the radio industry.

Public Address now is splitting itself into another industry which for want of a better term I designate as "Private Address," as distinct from the Public Address system.

Public address is, strictly speaking, a form of audible broadcasting whereby the spoken word is carried through a large hall or through an open-air meeting so that thousands of people who actually see the orator may hear his words, even though they are out of actual earshot and could not hear him unless the speaker was bellowing through a megaphone. Indeed, public address is but an overgrown electric megaphone.

In contra-distinction to this, we now have *private address*, whereby the spoken word of one man may be carried to another, in a remote room or office and made plainly audible only in that office (in certain instances a number of rooms or offices, simultaneously). In other words, private address, as the term indicates, is relatively confidential and semi-personal conversation, and not to be confused with large-group address work.

Curiously enough, private address, strictly speaking, is not a new development. It is older than even the present radio loudspeaker. As long ago as 1908, in my former publication *Modern Electrics*, I described such a system, where, by means of a microphone, batteries and a special loudspeaker, you could transmit your voice to another room and make your voice heard there. This was the forerunner of the present private address and the former is distinguished from the present, solely by the radio instrumentalities which are used. To be sure, inter-office communication by means of sensitive microphones and magnetic loudspeakers has been pretty well developed and many such systems are in use throughout the country.

One of the earliest systems of the new private-address technique was described in the November, 1933, issue of *Radio-Craft*, where two units operated with vacuum tubes, loudspeaker, and sensitive microphone were used. Here, too, for the first time, a revolutionary idea was employed.

This improvement did away with all wires between offices or rooms in the same building or on the same floor, simply by making use of the existing electric light wire lines—using these as carriers of the radio-frequency currents. This was a distinct and new improvement unknown in the art, and with one stroke eliminated the most difficult, as well as the most expensive obstacle of inter-office audio communication. All systems up to that time found it necessary to employ expensive as well as heavy and cumbersome cables. Holes had to be drilled through walls, and the cables were of unsightly bulk making it difficult to hide or disguise them.

The present development of private address has done away with all this and installation of the new system becomes child's play. Indeed, there is no "installation," properly speaking. All you need to do is place the small box which looks like a radio set, on the executive's desk, run an ordinary electric cord connected to it to the nearest electric outlet—and that is all. In another room somewhere in the same building (as long as the current is from the same electric meter) the other set is similarly installed on someone else's desk, to complete the "installation" of a 2-way private-address system. Then the executive has nothing further to do than press a button or key lever on the front of the set and simply talk, whereupon his voice is heard in the distant office, maybe a thousand feet away. Here the shipping clerk, let us say, hears the official's voice clearly and loudly, and (by suitable circuit arrangement) to reply he does not even have to go near his instrument—all he has to do is talk into the air and the official will hear his answer, even though the shipping clerk is 15 ft. away from his set.

There are, of course, many variations to the new private-address system, and it is becoming more flexible each day. If the president of the company wishes, he can have a little set with a dozen keys, each labeled for a different office, and merely by pressing the designated lever, he can talk instantly to the selected office.

The uses of this new system are, of course, myriad. Banks, particularly, find this system of tremendous importance, because each teller can instantly talk to the bookkeeping department, thus saving himself not only many steps but much time. Restaurants, factories, and, in fact, every commercial institution will find the new private-address system a distinct boon. The cost of the instruments is negligible if you consider the amount of time and effort saved that can be used for more productive purposes.

Private address is also invading the American home, special sets are already being made for home purposes to match the existent furniture—special sets for bedrooms, etc. Thus the mistress of the house can speak to the servants' quarters instantly without first ringing a bell and summoning the cook or maid. Where the apartment is large and where children sleep in another room some distance away, parents can speak to their children day or night.

New uses are found almost every day for the new system which threatens to become as common as radio before we get much older. At the present time, the system quite properly is private. That is, the radio-frequency currents do not pass through the electric meter on the premises, so that if an organization in a large skyscraper occupies an entire floor, there need be no worry that someone else in the same building on the floor above or below will be annoyed by another private-address system.

It is of interest technically, that the loudspeaker is now also the microphone. In other words, the modern private-address system has no separate microphone, but the loudspeaker diaphragm also catches the sound waves of the voice directed against it. This is a distinct improvement and makes for economy because it does away with the need for an expensive microphone.

There are more than 50 manufacturers engaged in building private-address systems of various types, and last month brought the announcement that one of the largest radio manufacturers has also gone into the new business. Service Men particularly will be reaping a harvest in this new boom.

# THE RADIO MONTH



The appearance of the "amplifying tube" stamp.

## COMMEMORATES TUBE INVENTOR

IN A postage stamp released last month, the Austrian government commemorates the work of a little-known Austrian inventor who developed an amplifying vacuum tube at about the same time as deForest in the U. S. and Fleming in England.

His name is Robert von Lieben—and the date of his invention is 1906. While the date is somewhat later than the two other inventors of amplifying tubes, the fact that independent work in Austria resulted in almost identical results as the American and English scientists is of interest.

## HARVARD CLASSES ON S.-W. RADIO

INTERNATIONAL broadcasting of classroom lectures—the first time university courses have been broadcast internationally—will be started in the spring from Harvard University over short-wave station W1XAL, according to an announcement last month. Courses include literature, music, philosophy, government, economics, history and sciences.

## P.A. AND RADIO AS FLOOD AIDS

IN the recent devastating floods of the Ohio and Mississippi Rivers and the subsequent clean-up, electronic devices in the form of public-address equipment and radio—broadcasting, amateur, army and commercial—played important parts in relieving distress, obtaining supplies, locating flood victims, warning of danger, etc.

Amateur communication was considered so important that the F.C.C., in Washington, ordered all amateur communication to be curtailed to actual relief work in the affected areas, in order to prevent interference with important messages.

Broadcast stations in the flood districts, notably WHAS, WLW, WBBM, and others staged a heroic struggle to keep on the air, aiding the Army and police in rescue work, warning of drinking water conditions and in telling the remainder of the country of the conditions by means of spot broadcasts from points of greatest interest.

Sound trucks and mobile radio-equipped trucks and cars also played important roles in "shouting" warnings about polluted water through those towns and districts which were not inundated but were affected by the flood waters. These cars were also useful in maintaining order in traffic congestions resulting from the flood relief work, in helping to locate officials and flood victims and bring together families separated by the rampaging rivers.

The work of the Red Cross, particularly was helped by radio facilities. Red Cross workers were directed by radio—amateurs, and Army broadcast station equipment being used for this purpose. The broadcast stations too, helped by sending wide-spread appeals for money, clothing and supplies.

The usefulness of radio and electronic equipment can, perhaps, only be appreciated under such trying conditions as those just passed through in the mid-west.

## TELEVISION THIS MONTH

IT was pointed out, last month in *Wireless Retailer and Broadcaster*, an English trade magazine, that if the full facilities of the Marconi-E.M.I. television transmitter in London were taken advantage of, 2,000,000 homes could be supplied with television reception. This figure is based on the service area of the Marconi-E.M.I. transmitter of 25 miles around London.

The Fundamentalist Baptists of the Pacific Coast appointed a committee, last month, to investigate television progress for the purpose of establishing, as quickly as possible, the world's first television church in Los Angeles.

The British Post Office decided last month, to discontinue the transmissions of the Baird Television Co. in Alexandra Palace, London. The Baird system was alternating with the Marconi-E.M.I. transmitter, previous to this decision. It was said that the decision was a great disappointment to John L. Baird. This sets a standard for England of 405 lines interlaced—50 frames per sec.

As an outcome of the reaction following the abdication of King Edward, Westminster Abbey authorities have refused the B.B.C. permission to install television apparatus in the Abbey for the purpose of radiating the full coronation ceremony. The B.B.C. however, is going ahead with plans to televise the coronation procession and wires are now being laid all along the route for this purpose. It is said that the cost of wiring alone is \$5.00 per yard.

Of interest to men working on television are the reports being published by the Electrical Division of the Bureau of Foreign and Domestic Commerce, at Washington, D. C. These reports cover the television situation in Foreign countries—reports on England and Italy were issued during the past month.

Don E. Gilman, vice-president of NBC's western division stated, last month, that television is from 3 to 5 years away!



Three flood views—as seen by radio men. Left, WLW men with a pack transmitter; center, WBBM temporary headquarters; right, NBC commentators in flooded streets of Louisville.



# 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.

## P.A. SYSTEM BROADCASTS SPANKINGS

PARENTS of the pupils of St. George's Public School in London, Ontario, were incensed, last month, by "an experiment in school management" conducted by the principal.

Youngsters in the various classrooms of the school were forced to listen to spankings broadcast over the school's P.A. system—and, incidentally, added their weeping to that relayed by the loudspeakers, in sympathy with the "culprits."

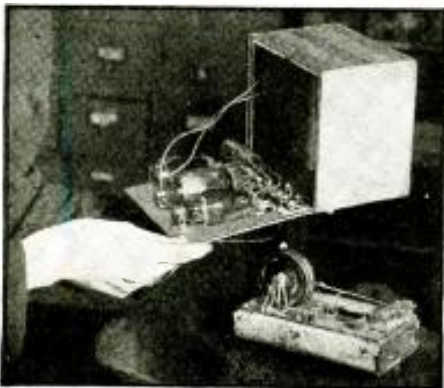
In answer to floods of protests from outraged parents, the School Board promised a "full investigation" of the "spanking programs."

This is a new use of radio and P.A. in education!

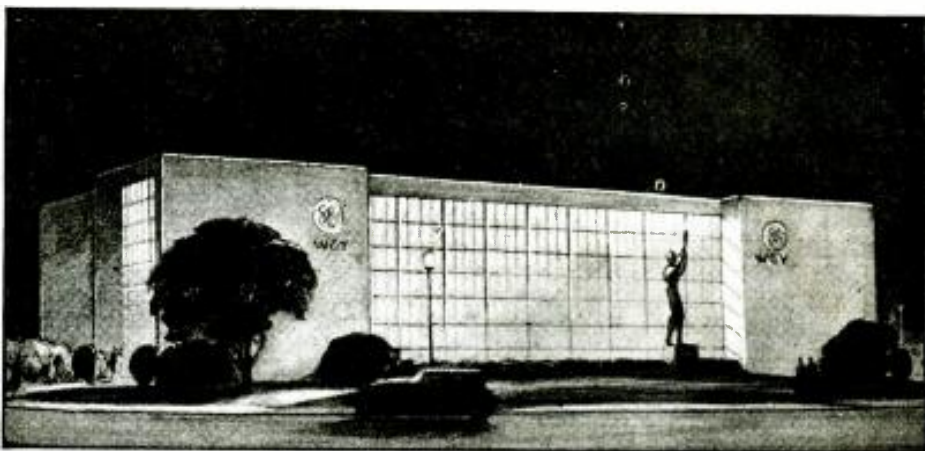
## RADIO BALLOON MEASURES CLOUD THICKNESS

THE NATIONAL BUREAU OF STANDARDS announced a new instrument designed to increase safety in aviation, last month. It is a new device which enables men on the ground to learn the height of clouds, their thickness and the altitude to which an airplane must climb to "come out on top" in the terminology of pilots. In addition, by means of directional receiving aerials, it is possible to tell the direction and strength of wind at different heights, as the balloon ascends.

The "works" consists of a tiny 3-tube transmitter and photoelectric cell which is attached to a small free balloon. A barometrically-controlled commutator switches the signals from temperature to humidity alternately. This latter device is a distinct improvement over previous (motor-driven) switches in that no battery is needed to actuate it. The entire transmitter, PE. cell unit, commutator switch and batteries weigh less than 2 lbs.



The PE. cloud measurer opened up for inspection.



An artist's conception of the new WGY studio building which will be built this spring.

## S.-W. RECEIVER CAUSES ARREST

ONE day last month, a truckload of gendarmes backed up to the home of J. S. Jordon in Tokyo, Japan, and dragged him off to jail. Mr. Jordon, an employee of the Standard Oil Co. of Yokohama, was charged with possessing a short-wave transmitter without having an official permit.

The Jordons' home was then thoroughly searched for the offending device and after questioning, Jordon was released.

It seems that the police had been suspecting that some foreigner was communicating with "a certain country" by short-wave radio. Mrs. Jordon in a recent visit to the U. S. had brought back a fine radio receiver and the authorities had suspected that messages were being transmitted on it.

Question: When is a receiver not a transmitter?

## NO SETS IN OSHKOSH?

IF one could believe an old ordinance in the city of Oshkosh, Wisconsin, which was dug up last month by an attorney working on a WPA project, there are officially no radio receivers in that city.

The city ordinance which was passed in 1922 "for the protection of life and property" provides that—"no firm, person, or corporation within the city shall erect a radio set without having a permit from the city electrical inspector."

The ordinance has long since been forgotten by everyone except the electrical inspector who never tried to enforce it. "An examination of ordinances since 1922 has failed to show that it was repealed," the WPA attorney said.

Theoretically, every citizen of Oshkosh who owns a radio set is liable to a fine of \$10 to \$50, or imprisonment of not longer than 90 days!

## BROADCAST SHORTS

STATION WGY announced last month that a new studio home will be built early in the spring. The new structure will be 2 stories high and will be of gray stone finish with glass blocks on the front and two ends. The building will contain 5 studios including one which will be 2 stories high and equipped with a balcony for spectators.

One of the ultimate results of President Roosevelt's reorganization of Federal departments will be the abolition of the Federal Communications Commission and the transfer of its functions to the Commerce Department, it was revealed last month.

Chairman Wheeler of the Senate Interstate Commerce Commission made the statement, last month, that he will introduce a bill to bar newspapers from owning radio stations. He said the purpose was to prevent monopoly of the channels of public information. Over 150 stations are owned or controlled by newspapers, at present.

With a view toward the day of "high-fidelity," a group of some 30 engineers and lawyers at an informal discussion before the F.C.C., last month, registered in favor of changing the present 2-to-1 ratio of adjacent-channel signals, in order that receivers of lower selectivity and, therefore, better frequency-response may be used.

In rebuilding the German Embassy in London, a report circulated in official circles that the Nazi emissary, Joachim von Ribbentrop, intended to install a radio transmitter in the Embassy. The British Government, apparently, was not prepared to consent to such a step—and a broad hint to this effect was given in the House of Commons, last month, without actually referring to the reports about the German plans.

A radio fan in Corona, California, had reason to thank his radio set for  
(Continued on page 680)

# "THE ETERNAL ROAD" INTRODUCES A NEW ERA IN THEATRE "SOUND"

This spectacular "music-drama" introduces to the theatre the use of talk-back direction; and a high-fidelity, "perspective" sound system as the major source of music, choral and sound effects.

ANDREW HALBRAN

**M**AX REINHARDT'S stage spectacle, "The Eternal Road," introduces two electronic developments—(1) nearly all-sound performance and, (2) talk-back direction—that open new vistas in theatre technique.

In an audience of thousands watching this amazing presentation, only a few know that this production has a background of the greatest scientific importance; for the music, sound effects, chorals, lighting and, as well, the entire direction, are handled and produced electrically through the medium of a radically-new type of sound system secretly developed, by RCA Photophone, for this new "music-drama" at the Manhattan Opera House, New York City. Innumerable difficulties were surmounted by an installation crew under the expert direction of G. A. Toepperwein; while credit goes to W. A. ("Woodie") Woodfin for perfect coordination of the entire sound system during the performances.

An acre-size stage of concrete-and-steel accommodates a cast of nearly 250 persons; and majestic scenery (designed by Norman Bel Geddes) that cascades downward, in 5 steps, right down to floor-level with the audience! Old Testament scenes with modern connotations are depicted; passages from the Bible are reenacted, on the 4 upper levels, as worshipers in a modern synagogue exhibit religious fervor during reading of the Bible, under conditions of oppression,

on the first or lowest level.

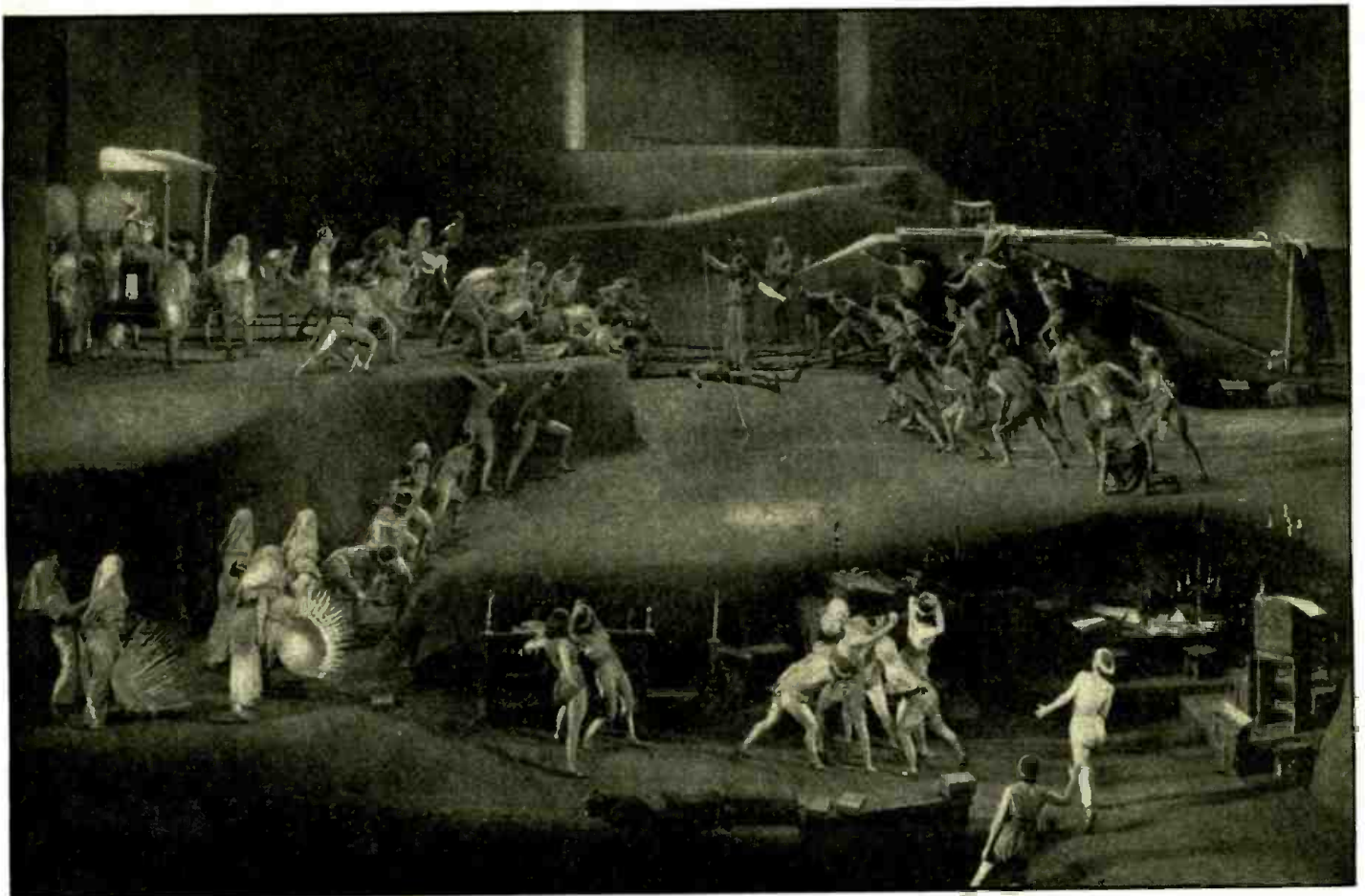
Viewed from "back stage," however, a scientific spectacle even more amazing is visible, the features of which are entirely new, involving the use of a large orchestra housed in a concealed soundproof chamber backstage, an electric organ, sound-film machines the recordings of which have been made by a new method, sound-effect gallery, and 28 giant loudspeaking units so placed that the sound is sprayed and bounced all over the stage and theatre in such a manner that the audience can be made to believe practically anything.

Supplementing this is a "whispering" loudspeaker system using 28 small speakers which go to every part of the stage—underneath the stage, dressing rooms, electrical switchboards, sound-film room, amplifier room, light bridges and towers, etc. All of this is coordinated through the controls in (1) the prompter's box immediately in front of the stage, (2) the orchestra leader's desk, and (3) the main console located in a box in the second balcony.

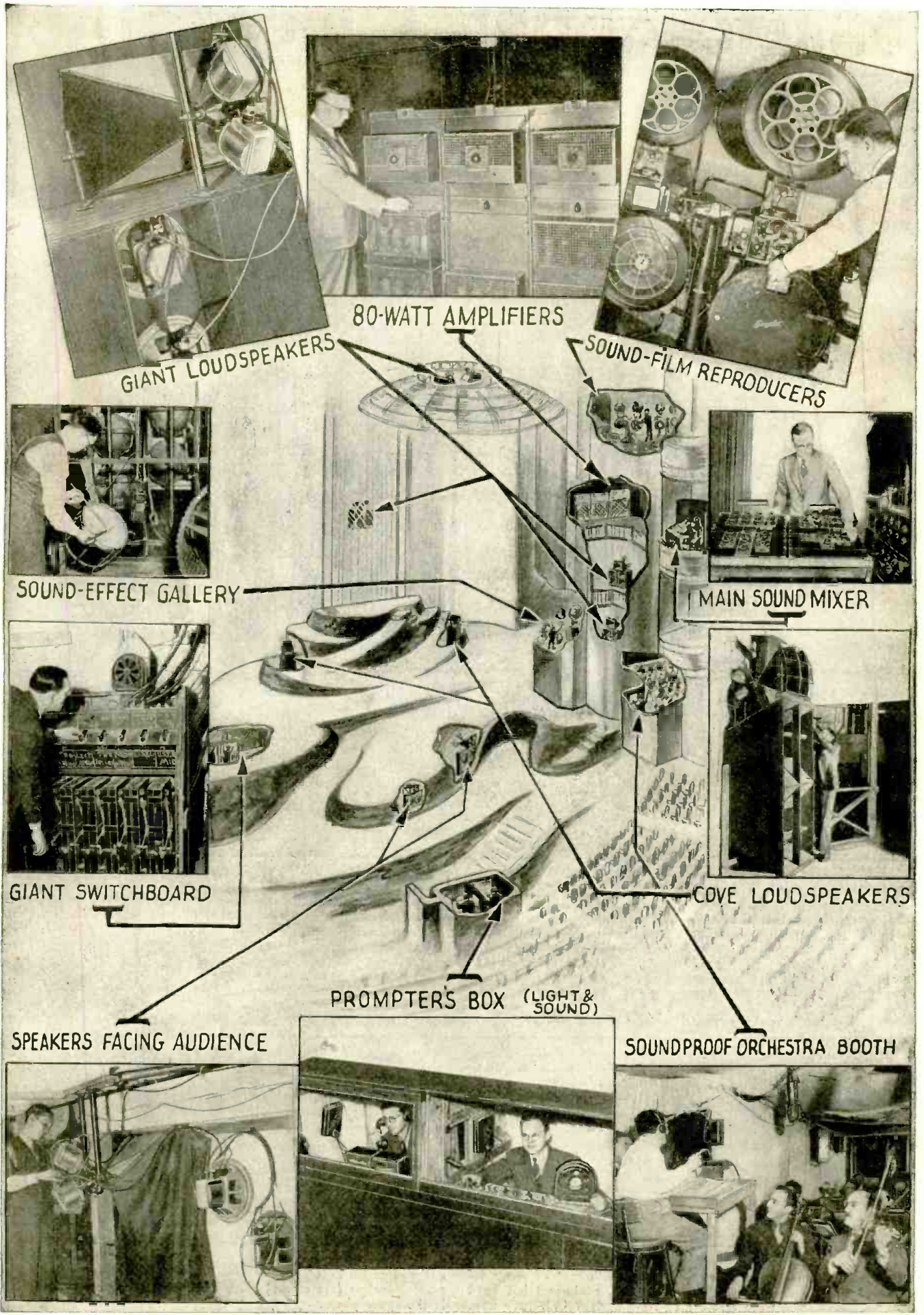
#### ORCHESTRA LEADER IS KEY MAN

The orchestra is concealed in a soundproofed chamber backstage. The audience hears the orchestra through the sound system alone.

*(Continued on page 677)*

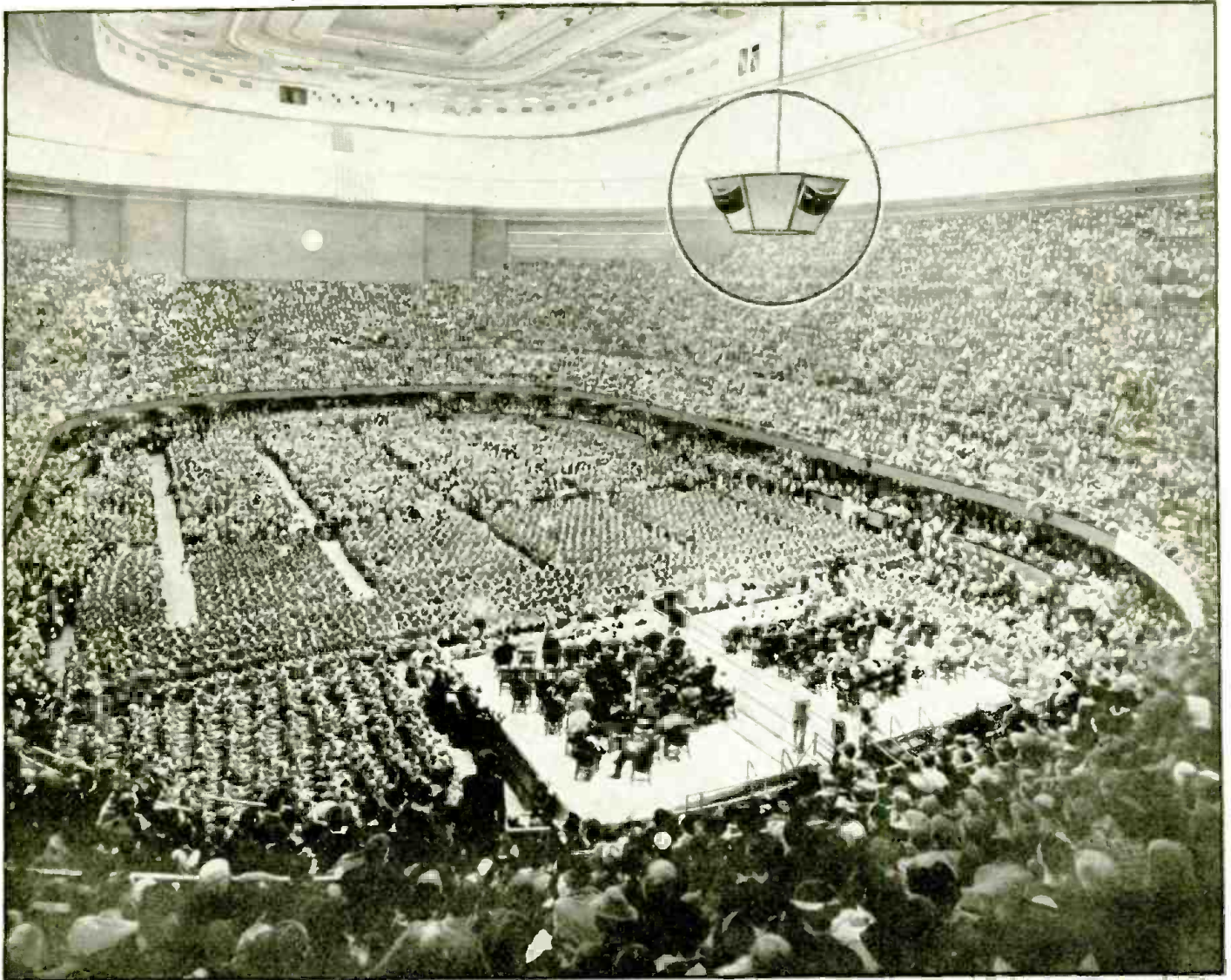


Scene: Moses in Egypt. Elaborate scenery conceals the many loudspeaker units. Continuity is controlled by a "whispering" or private-address system.



# PUBLIC-ADDRESS PICTORIAL

A 300-W. dual-channel amplifier and 12 high-power speakers in a "projectolier" provide sound distribution for 13,000 people in an auditorium space of about 4½ million cubic feet.



W. E. photo

**O**UTSTANDING among recent large public address installations is the comprehensive W. E. system supplied to the Kansas City Auditorium. The vast main arena has a seating capacity for 13,000 persons within a space of 4,469,500 cubic feet.

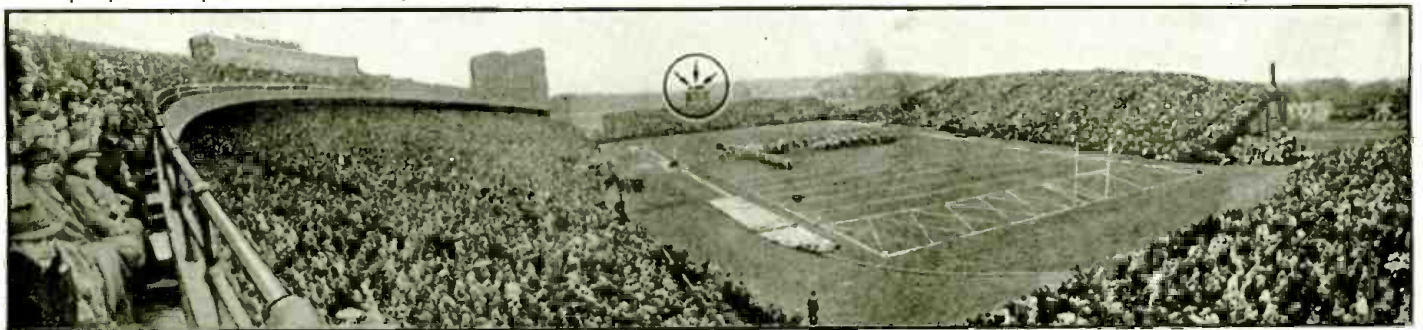
In order to avoid the annoying result of interference from several smaller-powered

sound sources at various points throughout the main auditorium, the engineers who planned this installation employed a central sound source in the form of a high-powered group of loudspeakers in a "projectolier" (circled, in photo), suspended from the center of the ceiling. This large unit, which includes several low-frequency and several high-frequency

sound projectors, so as to cover the entire audio-frequency range, literally sprays sound throughout this large auditorium from its central vantage point in such a manner that there are no difficulties resulting from time-lag interference or echo effect. Every word of the speaker at the microphone in the

*(Continued on page 680)*

Bowl projector speakers flood Dyche Stadium at Northwestern University with sound from one end of the field.



Operadio photo

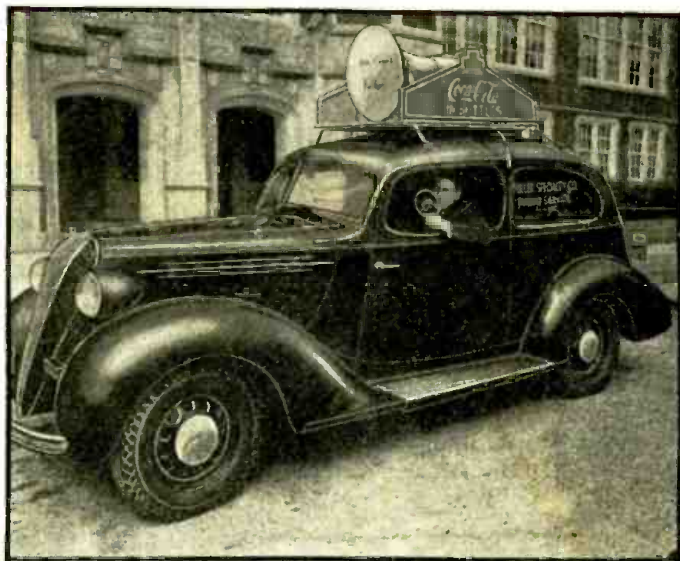
By means of bowl-type reflectors which cast a "wave" of sound instead of a "beam," one manufacturer of P.A. equipment has been able to "flood" the huge stadium of Northwestern University from

one end of the field as shown in the above photo. Three such high-power speakers (see arrows) are used. Contrast this system with that in the upper photo.

# HOW A SOUND CAR FOUGHT "OL' MAN RIVER"

In this exclusive article to RADIO-CRAFT Mr. Fuller tells how a Public-Address car aided flood-stricken Parkersburg, West Virginia, when the Ohio River rampaged.

W. L. FULLER, JR.



Mr. Fuller in his sound car which assisted public authorities.

**T**HE OHIO RIVER started on its yearly rampage and Parkersburg, West Virginia, as well as the whole Ohio Valley section, was stricken with the worse flood in its history. Parkersburg, which had not had a serious flood since 1913, was completely isolated from the rest of the world. Western Union had only 2 operating lines and Postal Telegraph and the telephone company fared about the same. Every means of communication known were brought into effect to help alleviate the flood situation.

With the turbulent flood waters rapidly rising, Captain Watson of the City

Police instructed the writer to drive through the business district and through the use of his sound car warn all car owners to move their cars from the flooded areas unless they had legitimate business in that district. This sound car also worked with Sergeant Ware of the State Police and Mr. McMillan, President of the Wood County Safety Council in directing both boat and automobile traffic in the different flooded areas.

After the crest had been reached, the sound car was used by Captain Layman of the Fire Department to inform the residents of Parkersburg of the hours

the water supply would be turned on for a limited period so they could draw enough water to last them until it was again turned on.

The flood water here reached a stage of approximately 55 ft. and covered most of the business district.

I feel that this is the first time that a sound car has been brought into use in Parkersburg other than for advertising and ballyhooing on the streets. *It brings back the days of Paul Revere!*

In the broadcasting of danger warnings the use of newspapers is fine and the people could not do without them. They have made their marks and have been accepted by the people. But at last the sound car too has made its mark, and has been accepted:—where the newspapers and broadcasting stations can't reach, the sound car can! This was proven here in the flooded area of Parkersburg by our sound company

(Continued on page 680)



The equipment used in the car, shown above consists of a crystal pickup, battery-operated turntable, a preamplifier using a type 30 and a 185 tube and a power amplifier using 3 6A6 and 2 type 76 tubes. Two 6-V. dynamic loudspeakers complete the mobile installation. The reproducers are equipped with bell-type horns to aid in sound distribution.

This car was used to warn cars away from danger zones as well as inform residents of the flood conditions.



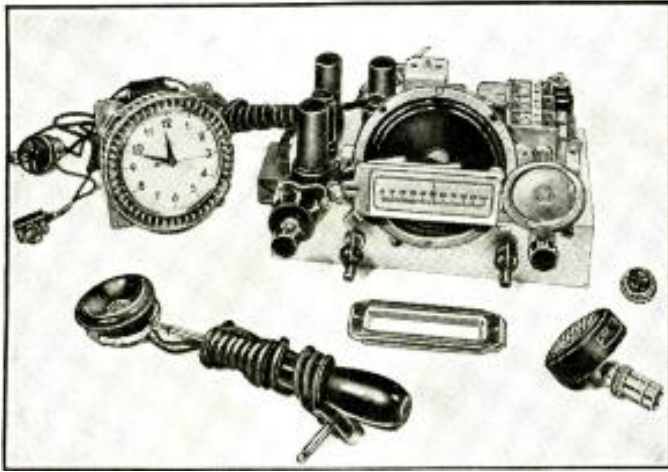


Fig. A. The equipment ready to be mounted in a cabinet.

# HOW TO MAKE THE RADIO-CRAFT DELUXE CARRIER INTERPHONE

Here is a 3-way talk-back executives' radio-interphone system that utilizes existing power wires instead of requiring special inter-office wiring. Designed by R. D. Washburne and R. P. Adams, and built under the direction of Mr. Adams, it includes a radio set for important programs.

## PART I

**A**N INTER-OFFICE communication system has been designed to meet the needs of the modern, busy executive who, tied down to his desk, must have at his instant service an effective, simple, and insofar as possible automatic means of contacting key offices; and of obtaining pertinent extra-office data (market and weather reports, statistical data, and other relevant information—most of which is conveniently available via radio). The following description of the *Radio-Craft Carrier Interphone* or "Communicator" discloses the design of this deluxe private-address system.

The instrument is presented with only a suggested cabinet design primarily because the individual builder of a similar system will prefer to exercise his own initiative in the matter of designing a suitable housing to suit his preferences as to shape, color-harmony, and so-on.

### A SELECTIVE CARRIER COMMUNICATOR

Almost without exception, currently-available interphones use a *wire* connection—for the voice frequencies—between stations. That is, it is necessary to "string" at least a pair of wires from inter-office phone unit No. 1 to unit No. 2, and from unit No. 1 or 2, or both, to unit No. 3, etc., etc. The *Radio-Craft Carrier Communicator*, however, requires only the existing house-wiring or electric light lines, that supply the power required by the instrument, as the voice or "talking" circuit; the power line, therefore, serves a dual function. Thus, merely by plugging into the current-supply socket, the executive has instantly available a means of conversing with anyone similarly equipped at any other point on that individual power supply.

This is accomplished by modulating with the voice a radio-frequency carrier current that is fed onto the power-supply wiring. The frequency of this carrier current is so chosen as not to interfere with any radio receivers operating on the same electric power circuit; and the strength of the carrier current is held to a level sufficiently low to prevent radiation even to wires only a half-inch away. (The principle involved in this method of "wire-less" inter-office communication was disclosed, for the first time in any magazine, in the November, 1933, issue of *Radio-Craft*.—Editor)

Until now, though, only the types of communicators that utilize inter-station wiring afforded the facility of selective communication with any one of several stations in the system. It has remained for the new *Radio-Craft Carrier Communicator* to point the way to an instrument design of the *wire-less type* for talking to whomever is desired, without the inconvenience of other persons in other offices being compelled to listen-in. To demonstrate the selective feature the new unit has been designed on the basis of a 3-station system; the design is conveniently alterable to suit individual requirements.

### ADDITIONAL FEATURES

A cursory analysis of the carrier-type communicator reveals that, almost completely, the same tubes and components are used for listening as for talking; and that, by the addition of another tube and a few more components, a complete local-station radio receiver may be had.

By providing an efficient off-on time control clock it is no trick at all to turn the radio set off or on at any desired time, in 15-minute intervals or multiples thereof, during

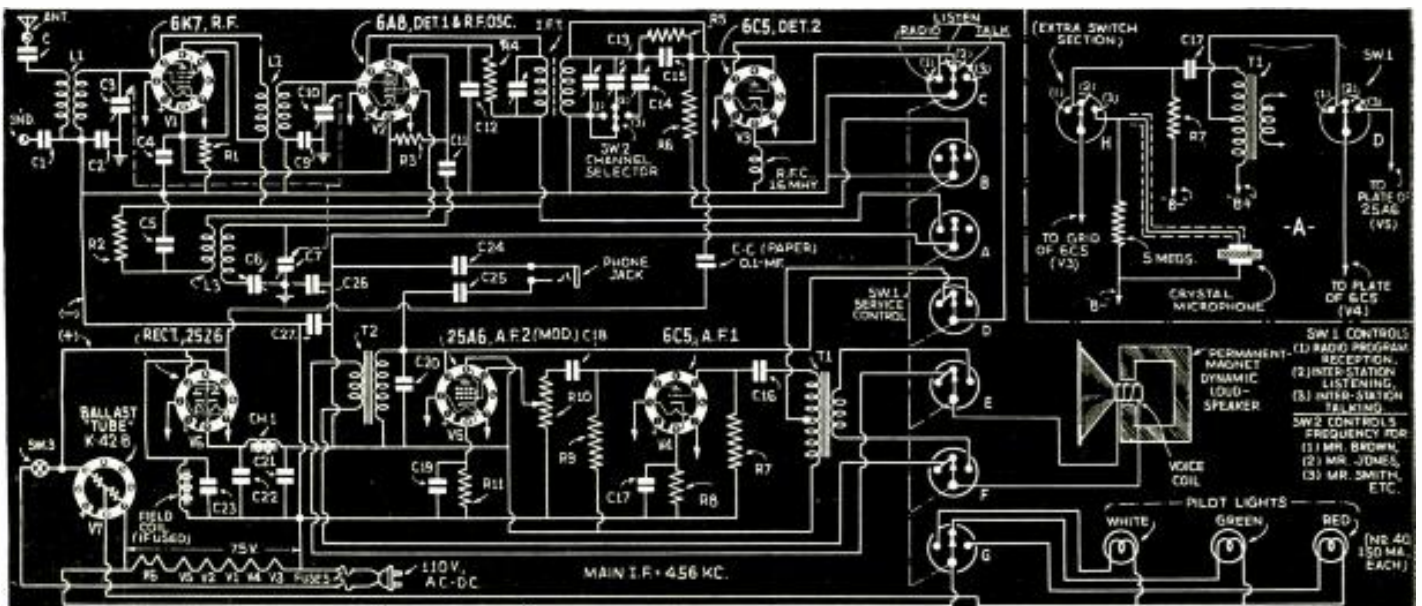


Fig. 1. Diagram of the executives' deluxe Carrier Communicator, Switch Sw. 1 controls "Radio", "Listen", "Talk"; Sw.2 selects Messrs. Jones, Brown, Smith, etc.

any period of 12 hours. The same convenient facility may be applied to the communicator service, instead.

Other refinements that may be added, if desired, include the use of an earphone for more confidential transactions or to prevent annoying others in the room; and the use of a crystal microphone, for achieving higher voice fidelity, in place of using the loudspeaker reversibly—as in the present design—as a microphone.

Let us now break the design of this combined midget radio receiver and modern "private-address" system into its component elements, and analyze each of them, so that there need not remain any questions as to why or how the *Radio-Craft* Carrier Communicator functions.

We make use of a multi-pole 3-way switch, Sw.1, for the shifting, from radio-to-receive-to-send, operation. (Substantially the one set of tubes and components is utilized for all 3 services.) For ease in identifying leads, however, each section is treated separately in the circuit diagram.

#### "RADIO" CIRCUIT

Let us first consider the unit simply as a radio receiver. (The No. 1 position of master switch Sw.1.)

The circuit is quite elementary and follows fairly closely the general set-up of that used in the *Radio-Craft* Wall Set (September, 1936). It is A.C.-D.C. powered, uses 6 metal tubes in superhet. hook-up, employs an "octal" (metal) ballast, and is designed for either dynamic or permanent-magnet speaker operation.

The R.F. stage affords both gain and a highly desirable image selectivity, and is quite the conventional thing. The mixer represents nothing less unusual. Note that no I.F. tube is used, however; the 6A8 mixer simply feeds the resulting 456 kc. beat through the single I.F. transformer (ferrocarr iron-core for selectivity and gain) to the 6C5 2nd-detector, which is gridleak biased. The 6C5 is, of course, unusually sensitive, and even without the I.F. tube the set develops sufficient signal power to block the 2nd-detector unless every precaution is taken to prevent such an undesirable effect.

A 1st A.F. stage is employed and mainly because it is required for voltage gain when the unit is transmitting. It might have been so wired into the circuit as to be in operation only when the operator switches to send but was placed in the receiving line-up for simplification. It feeds into the usual 25A6 output pentode.

The power supply circuit employs the familiar 25Z6, one section of which energizes the speaker field (unless a "P.M." type of reproducer is used) and one of which feeds "B plus" to the unit proper. If, instead, a P.M. reproducer is used, both sections may be connected in parallel, with the field-bridging electrolytic eliminated. A single A.C.-D.C. choke and an 8-16 dual electrolytic provide humless "B plus" output in either case.

#### "TALK" CIRCUIT

On "transmit" the switch control is moved to point No. 3 (No. 1 being for radio reception). The moment this move is effected several changes in the wiring are automatically made.

First, the "B plus" lead to the input section of the receiver is broken. Second, a low value of grid resistor is connected into the 2nd-detector circuit (from control-grid to cathode) to permit more effective operation of this tube as an R.F. oscillator at the intermediate frequency. Third, a choke is wired into the 2nd-detector (now the oscillator) cathode to "B minus" circuit to afford the circuit oscillation desired. (The control-grid circuit is now floating with respect to "B minus," electron coupling providing feedback.) Fourth, and fifth, the voice coil leads from the loudspeaker are shifted from output transformer (in the 25A6 plate circuit) to input A.F. transformer (a universal-output job in the plate circuit of the 6C5 2nd-detector) connection. Sixth, the plate lead for the 2nd-detector is shifted from A.F. input transformer to A.F. output transformer to permit both "B plus" feed to the oscillator, and plate modulation. Seventh, the white pilot light connection for "radio reception" indication is broken and the red pilot connection indicating "communicator transmit" made.

(Continued on page 700)

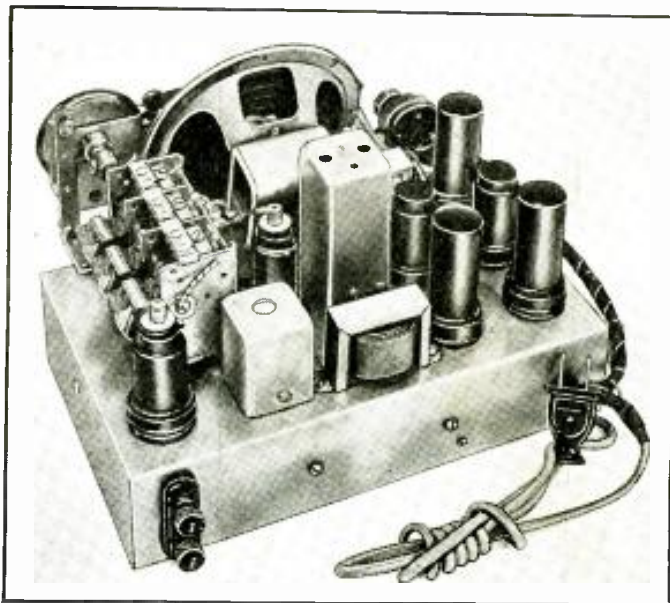


Fig. B. The positions of parts on the chassis are seen.

## INTRODUCTION

The new private-address systems or "intercommunicators" afford (1) 1-way call service, (2) person-to-person conversation, or (3) "party-line" group private telephony. Some of the systems require separate wire-connection between the one or more remote stations; while others, as for instance the new RADIO-CRAFT Carrier Communicator unit here described, utilize the existing electric power supply wiring and thus require no time or materials for installation.

In addition, the RADIO-CRAFT Carrier Communicator affords the busy business man a convenient means of listening-in to certain key radio programs (market, news and weather reports, etc.).

Finally, the RADIO-CRAFT Carrier Communicator introduces a means of obtaining, for the first time in a unit of this type, SELECTIVE carrier conversation between any two of several persons.

Both of these features (1—incorporating radio reception with intercommunication, and, 2—selective carrier intercommunication) are inventions by Messrs. Washburne and Adams that conveniently add considerable utility to carrier-type communicator design.

#### Optional Features

Additional, optional features, for the executive who desires a deluxe "master" unit, include an automatic off-on time-control clock, high-fidelity crystal microphone for voice pick-up, and a high-fidelity crystal earphone for privacy.

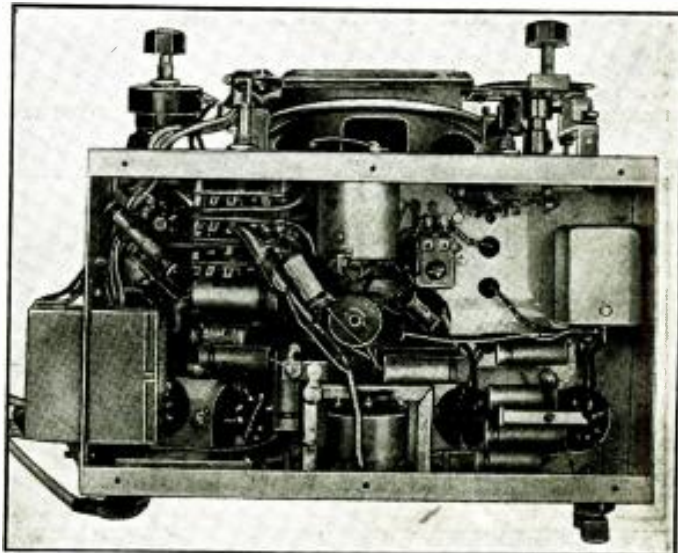


Fig. C. This under-chassis view clarifies parts mounting.

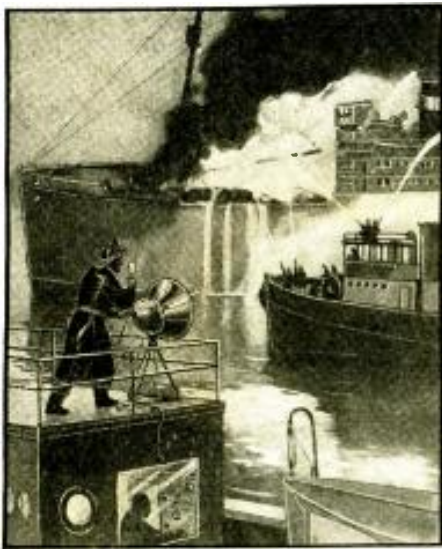


Fig. A. Using super-power P.A. in fire fighting.

# NEW USES FOR SOUND EQUIPMENT

Fire-fighting, as suggested by the cover illustration of this issue of RADIO-CRAFT, is only one of innumerable applications of sound equipment. This article describes some of the more recent developments in this line—including the new inter-office or "private address" field. Of interest to the technician is the use of a transmission-equalizing network, in "conference" systems, to reduce feedback.

R. D. WASHBURNE

**"PLEASE** do not swear in the presence of the amplifier," read a sign next to the driver's seat in a sound truck, according to a writer in a recent issue of the house-organ *The New Yorker!*

It is a far cry, from such "microphonic" amplifiers, to the super-power installation suggested in the cover illustration of this issue of *Radio-Craft*, and in its reproduction, Fig. A.

Cutting through the roar of a floating inferno the fire-chief's orders, sent hurtling through space at the speed of sound waves, almost instantly are heard on board fireboats hundreds and even thousands of feet away; a slight motion

(Continued on page 679)

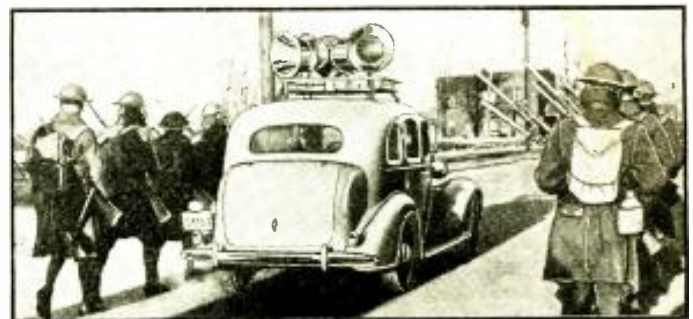


Fig. B. Sit-down strikers at the Flint, Mich., plant of General Motors were instructed via sound truck—until the National Guard said "get moving!"

## NEW DIRECTIONAL MIKE HAS "INFINITE BAFFLE"

An "acoustical labyrinth", in conjunction with a velocity microphone with the ribbon fastened in the middle to secure pressure-microphone operation, solves many problems of the sound engineer—including live-, dead-end studio characteristics. These problems, and their solution, make interesting and profitable reading.

S. MINSKER

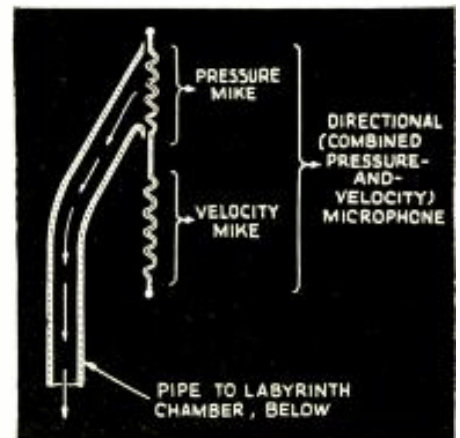


Fig. 1. A labyrinth absorbs back wave.

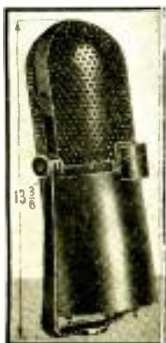


Fig. A. The completely-assembled view, left, of the new directional-type ribbon microphone shows it to be more than 1 ft. long. The lower-half of the case encloses the rod-aligned labyrinth sections (see view at right).

**W**HEN classified according to pick-up properties it will be found that there are 3 distinct types of microphones. First, of course, is the pressure-operated diaphragm types, which, while providing satisfactory pick-up from only one direction, are, nevertheless, non-directional insofar as low frequencies are concerned, and hence pick up reverberatory and other extraneous noises from all directions. Second, is the so-called "non-directional" type which, while affording response of fair quality from all directions in the horizontal plane—and thus having some advantage for a small group of applications—nevertheless, has the same disadvantage of picking up undesirable noises from all directions.

Third, and finally, there is the standard velocity microphone which, with its figure-8 pattern, identical in the vertical and horizontal planes, allows practically as much floor



# A STABILIZED FEEDBACK 6-W. 25L6 A.C.-D.C. AMPLIFIER

Careful application of the principles of reverse feedback in the low-level stages of this amplifier give ideal characteristics.

RALPH KENYON

PART I

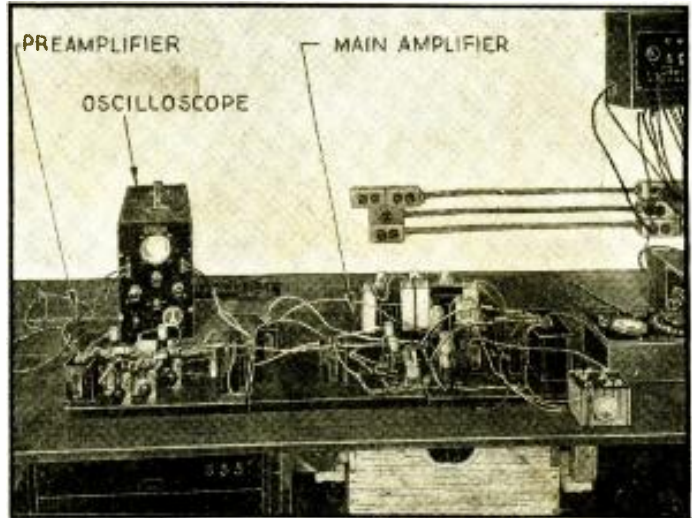


Fig. A. A breadboard set-up of the amplifier described.

**T**HE INVERSE feedback (degeneration) principle for driver stages is fairly well known, since it has been recommended for some time to reduce distortion in output tubes of beam-power amplifiers. This type of feedback partially attacks the problem, but does not give an entirely suitable amplifier. Feedback as described in this article gives the builder complete control of the characteristics of the amplifier as to frequency response, distortion, etc., *without the use of expensive parts.* Feedback may also be used in low-level stages to flatten out the frequency characteristic of an amplifier and reduce the noise caused by shifting line voltage, which is particularly troublesome in an A.C.-D.C. outfit such as the one described here. It also tends to reduce hum and other circuit noises.

If, in a single stage, a fraction of the output voltage is fed back into the input circuit, it will (because of the tube action) be exactly 180 deg. out of phase with the input voltage. Thus, if a (normal) stage has a gain of 10, and 1/10 of the output voltage of 10 V. is fed back in the input, 2 V. (in a degenerative stage) will be necessary to produce this 10 V. output, or the (degenerative) stage will have an effective gain of 5. Now suppose that the stage has a frequency characteristic such that the gain drops from 10 at 1,000 cycles to 5 at

10,000 cycles. Thus, if the same 10 V. output is desired *overall*, an effective 2 V. must be applied to the grid, and the total input will be 3 V. (2 V. plus 1 V. feedback), so that the effective gain of the stage is 3.33, not 2.5 as would be indicated by halving the true gain of the stage.

### MULTI-STAGE FEEDBACK

By the same token, distortion will cancel to a great extent, although the feedback ratio should be greater than indicated in the preceding example. Moreover, the feedback becomes much more effective if it takes place across not one stage, but (1) across several stages, and (2) across the coupling of these stages. The only limit to this effect is that for any frequency to be passed by the amplifier the phase shift shall not exceed 180 deg. across the stages to be fed back. Otherwise the feedback voltage at the input, instead of canceling, will be positive and oscillation will occur. This will usually occur only in the case where there are interstage transformers whose secondaries are not resistance-loaded, or where extremes of frequencies are used. Two-stage feedback as exemplified in this article offers no difficulties. A typical breadboard preamplifier set up in the laboratory will now be discussed.

(Continued on page 681)



### FEATURES

Stabilized feedback offers:

1. Controllable response over entire A.F. spectrum.
2. Elimination of hum.
3. Reduction in tube noise.
4. The best possible frequency characteristic hitherto obtainable only with the highest-quality amplifier components.

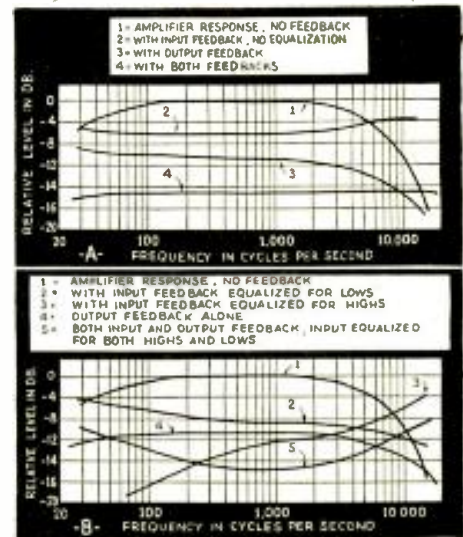


Fig. 2. Response curves of the amplifier.

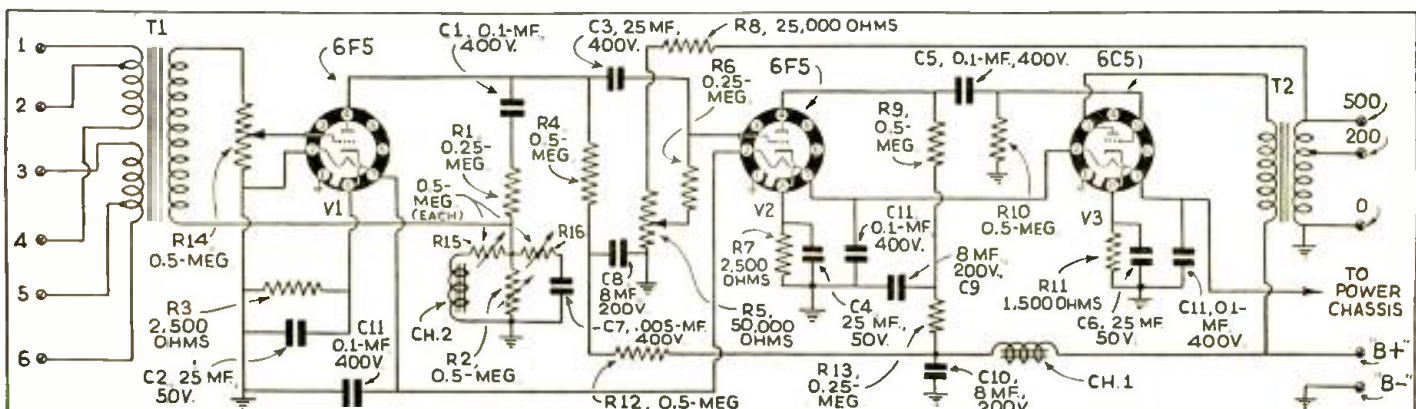


Fig. 1. The schematic circuit of the preamplifier or threshold stages using controlled reverse feedback, which is in two parts, input and output.

# CLAIRVOYANT DR. FOX

Do you like radio fiction stories? If so, write and tell us how you like this one, and maybe we'll print more!

RALPH URBAN

**M**Y school friend Jessner is back again. He has bushels of money, and spends his time traveling from one resort to another, and appears to have nothing else to do than to enjoy the thirty or forty years that still remain to him before old age settles on him.

Little by little I got his story cross-examining him. "You must have worked very hard in America, to be able to retire at so early an age," I said to him casually one day.

"Don't talk nonsense," answered Jessner. "I washed a hundred thousand dishes, heaved sacks of coal on my shoulders, and did all kinds of hard work, without ever managing to save even a hundred dollars. Over there in America you can only get hold of money if you are a bigger thief than all the others. But as for me, I am engaged in business. I am a partner in a large commercial undertaking."

"Wouldn't it be more partner-like for you to stay there and take care of the business?"

"No—in fact my presence here and my absence from the business is the principal condition of my silent partnership. I am the very model of a very silent partner."

Then he made a complete confession to me.

"One day, I was again on the hunt for a job. With my last dollar in my pocket, I was strolling through 74th Street in New York. A wet snow was falling, and the streets were slippery, so that one slid at every step. I was just going to cross the street and stood at the curb when an automobile turned the corner going at a good speed. The car skidded, and I watched with in-

terest the traffic jam and accident. *The car skidded broadside, continued sliding backwards, hit a nail, and blew out a tire. I jumped to one side, but not far enough, and I was bounced in the air and then rolled like a frog in a muddy pool of snow and water. I was ready to get up and start a fight with somebody, but instead I lay still and began to groan loudly. My artistic sense told me that the car that had skidded up on the curb was worth at least \$10,000.*

The driver of the runaway car lifted me, with the help of a few bystanders, into his car. "A thousand dollars," said the man, taking his place next to me at the wheel, "a thousand dollars if you agree not to make any further demands."

"Two thousand," I groaned.

"You are a robber, my dear friend," observed my neighbor, stepping on the gas. "Fifteen hundred, and not another penny."

He stuck under my nose a piece of paper which I was to sign as a receipt. It was a prescription blank, by which I could see that I was dealing with Dr. Sanford, president of the Medical Association. I signed, got his check for \$1,000 and \$500 in cash, and that's how I got rich and happy. A sudden impulse struck me—and I gave the cash back to the doctor, saying, "The check is enough to pay me for my fright. There isn't anything the matter with me."

"Hm," grunted Dr. Sanford, and put the bills back in his pocket. "You either have concussion of the brain, or else you are no American. I take back a third of the robber I called you."

"I am a European," I answered modestly.

The doctor took me under his care, to treat my scratches. Then I cashed the check at the bank, and turned into a gentleman. I had to do something with my \$1,000. I talked it over with Dr. Sanford the next time he treated my scratches.

"Hm," said the doctor thoughtfully, "you might be just the right man for the job I have on hand. You could earn some money, and enjoy a good rest at a first-class sanatorium, at the same time. You aren't nervous, are you?"

I denied it vehemently, whereupon the doctor explained the position to me. It concerned the sanatorium of Dr. Fox—sanatorium for melancholia and other nervous ailments. His patients were all of the upper ten thousand. Within 2 years Dr. Fox had killed all



"I jumped to one side, but not far enough, and I was bounced in the air . . . ."

medical competition as far as rich patients were concerned. People told such remarkable things about the powers of this doctor, that medical circles became suspicious.

"I'm going to send you to Dr. Fox as a patient," said Dr. Sanford. "As soon as there is room in his sanatorium, you are to go there and act like a rich patient. Our Medical Association will of course bear all the expenses. All you have to do is to keep your eyes and ears open, and give me a report when you come home."

I promised my help in the conspiracy. A few days later everything was arranged. I had the necessary instructions, and started out on the trip, and on the evening of January 23rd, I arrived at the sanatorium. It was a large estate, in a lonely neighborhood.

Dr. Fox was a man of medium height, and his eyes were far apart, like those of a hippopotamus. He spoke to me briefly when I entered. Then a nurse came into my room, and made me swallow a few drops of some liquid, before her eyes. To quiet my nerves, she said. I slept like a log. When I awoke, it was late in the morning, and I was starving. I ate three breakfasts. Then I was called to Dr. Fox, and told him the terrible story of how I was supposed to have become melancholy: unhappy love, two unsuccessful attempts at suicide. At the end of my story, the doctor gazed at me and then he spoke: "You will be healed spiritually, Mr.

(Continued on page 682)



"Tonight there will be a railroad accident in Canada. Seven persons will be killed . . . ."



"Last night the Montreal Express collided with a freight train. Seven dead . . . ."

# A 60-W. PUSH-PULL PARALLEL BEAM AMPLIFIER

An amplifier using 4 6L6 tubes in a push-pull parallel class AB prime circuit to provide a full 60 W. of power with less than 5 per cent harmonic content.

JEROME H. KLEKER

**T**HE 6L6 beam-power tubes undoubtedly lend themselves to a greater variety of circuit arrangements than any other output type. This amplifier uses 4, in a push-pull parallel class AB prime circuit, and is capable of delivering 60 W. of audio power with less than 5 per cent distortion.

One might ask why it is necessary to use 4 6L6 tubes to obtain 60 W. output when 2 are rated to deliver this much power. If reference is made to the manufacturer's rating of the tube (class AB sub-2), it will be noted that 60 W. output can be obtained only when plate, screen-grid and bias supplies have

perfect regulation. Also the driving signal must have zero impedance. These conditions are impractical, if not impossible, to attain with present methods of amplifier design.

#### WHY "PARALLEL PUSH-PULL"?

Under class AB prime conditions, 32 W. output is delivered from 2 tubes operating with self-bias. Four tubes in push-pull parallel are therefore capable of delivering somewhat more than 60 W. Under these conditions the difference in plate and screen-grid current from zero signal to full output is not too  
*(Continued on page 685)*

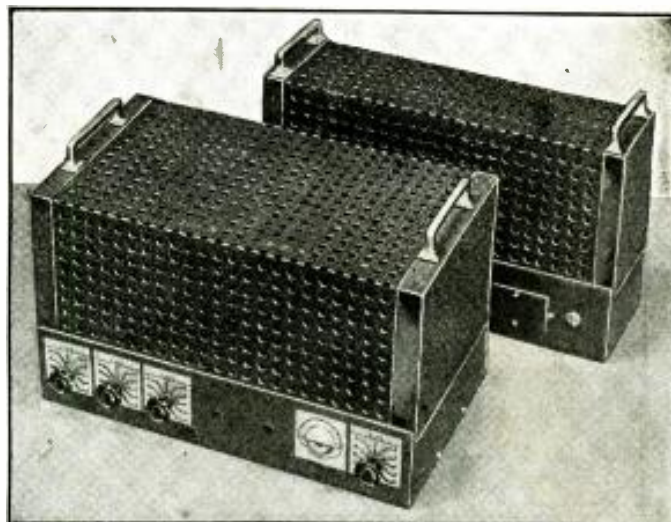


Fig. A. The appearance of the amplifier, with shields in place.

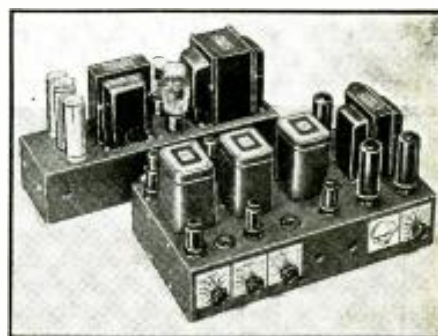


Fig. B. Amplifier chassis—shields removed.



Fig. A. Mobile P.A. using 6 ft. aluminum demountable horns.

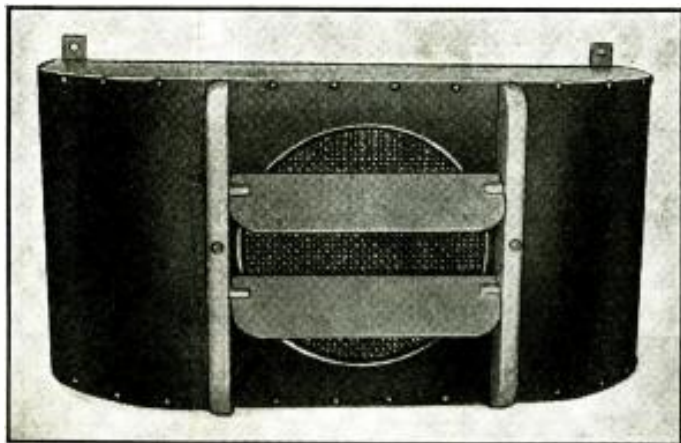


Fig. B. A new baffle—using hi-freq. deflector baffles.

## HOW TO SELECT LOUDSPEAKER BAFFLES AND HORNS

The problems of baffle selection are legion. This article gives the basic facts, clearly.

G. J. SAND

**T**HE SELECTION of a suitable baffle or trumpet for a loudspeaker is fraught with so many factors that it is indeed rare to find a P.A. installation provided with the most desirable acoustic reproducers. Most of the difficulty is due to popular misconceptions concerning the operational behavior of speakers with various types of horns. To dispel these notions, and in general, point the way towards better sound reproduction is the prime purpose of this article.

#### 4 VARIETIES OF BAFFLES

Although the varieties of baffles are legion, they may be divided into 4 general classes: (1) the flat baffle, (2) the enclosed baffle, (3) the directional baffle and (4) the trumpet.

**Flat Baffle.** Most familiar is the flat baffle. This type is usually no larger than 4 ft. square and does not enjoy much popularity because of the cumbersome size necessary for high-quality reproduction. The directional and enclosed baffles have practically displaced the flat baffle board for public address applications.

**Enclosed Baffle.** The "square mouth" directional baffle increases the overall acoustic efficiency by "air loading" the speaker diaphragm and directionally concentrating the  
*(Continued on page 687)*

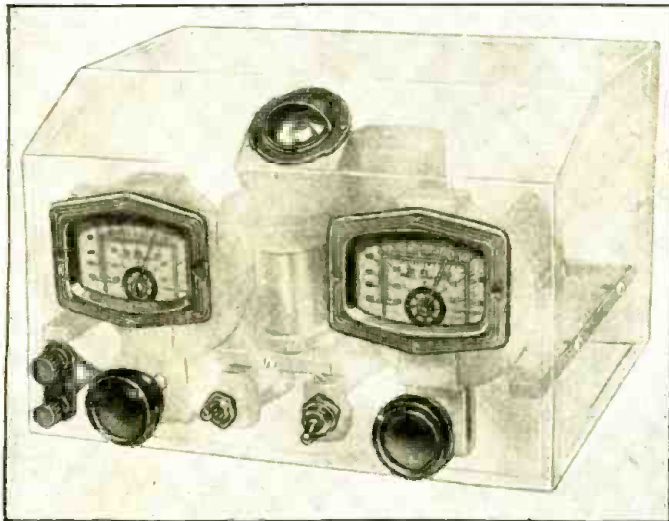


Fig. A. The plexiglas cabinet is more transparent than window glass!

# BUILD "THE CYCLOPS" A BEGINNER'S 1-TUBE "MAGIC EYE" SET

A novel set for the radio builder, in which a "magic-eye" tube accomplishes a dual purpose. The cabinet is transparent.

HAROLD MUELLER

**F**OR THE BEGINNER or for those who wish to tackle something quite out of the ordinary, this little regenerative receiver is the real thing. It not only is very attractive in appearance but works exceptionally well!

### GLASS-LIKE CABINET

The circuit of this 1-eye or "Cyclops" (in Greek mythology, a race of 1-eyed giants) set is exceedingly novel, and with it we are able to get "magic eye" operation, yet there is only one tube in the set! The triode of this tube makes a very fine regenerative detector, and besides this, the "eye" action is very pronounced when tuning!

The cabinet, made entirely from a new material called "plexiglas"—which is, as the name suggests, quite-flexible "glass"—is another novelty. This remarkable material is very easy to work, and can be drilled, sawed, tapped, and worked with ease. It is somewhat the same to work on as celluloid. It is not as highly inflammable, however, as the latter; in fact, it burns but slowly, or about like hard wood. Unlike celluloid, it is extremely clear even in pieces of considerable thickness. The chassis piece is of 1/4-in.-thick stock, while all the other pieces are 1/8-in. thick. The

(The unusual transparency of the material, for purposes of reproduction, has been purposely diminished in the illustrations.)



top and front are in one piece and are fastened, with the sides and bottom, by means of special cement.

The chassis with all parts mounted is held in by screws through the sides and front. These screws run into holes drilled and tapped edgewise in the 1/4-in. piece. Thus the chassis with all parts mounted may be pulled out easily for repairs or changes.

It is suggested that all parts be mounted on the 1/4-in. chassis and this then fitted to the case, before any wiring is attempted.

The necessary holes are first cut with a coping saw, then mounting holes

drilled, and the variable condensers mounted. The dials are held only by a single bracket and by the condenser shafts, but are very rigid.

### OPERATION

Strong locals will cause the shadow angle of the 6E5 or "magic eye" tube to close up 1/4-in. or more. The louder any station is tuned in, by increasing regeneration, the wider will be the shadow movement. Of course, this control should never be advanced to the point where each station produces whistles—which would show that the tube circuit was in an oscillating condition—for not only will the tone quality of incoming signals be impaired, but interference with other receivers in the neighborhood will result.

Modifications of several of the parts will be necessary before they can be used. First, the iron-core inductance must be removed from its can. Note from the circuit diagram which terminals connect to L2, this coil being the one nearest the base of the assembly. About 2/3 of the turns must be removed from this coil, starting from the outside. This is not a critical operation, and 25 turns more or less will make no noticeable difference. Carefully solder the new end of the coil back to its lug. Also remove the wires attached to the G and P terminals which are wrapped

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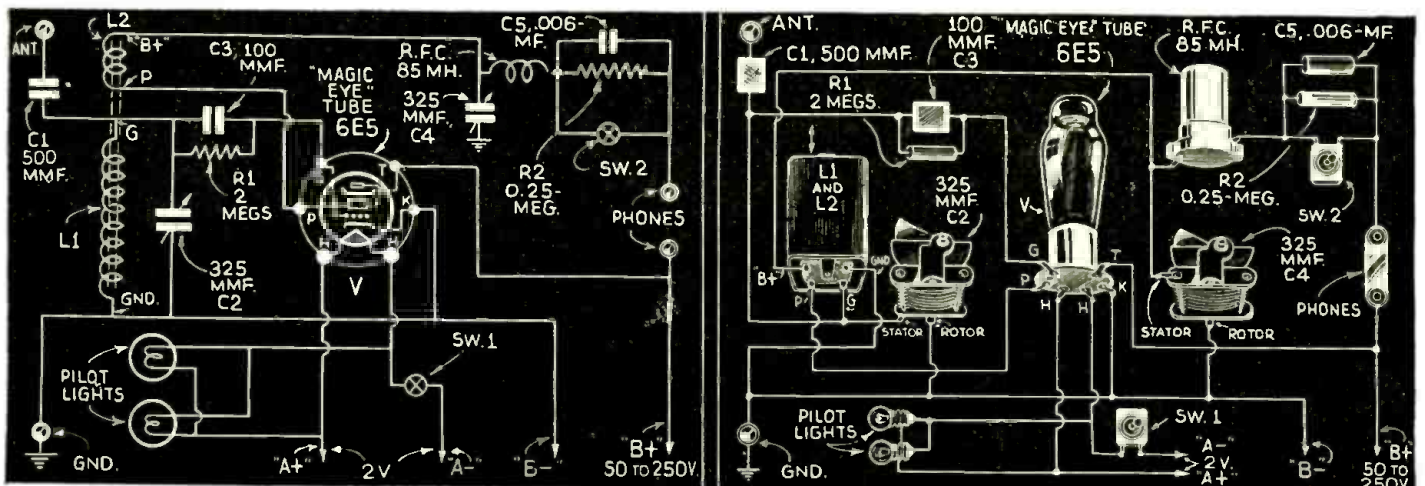


Fig. 1. Schematic and picture diagrams of the 1-tube set. The set is a regenerative unit—with the "magic-eye" as tuning indicator.

# AN EASILY-BUILT 4-TUBE BROADCAST SET

Small sets with improved fidelity are rare. Here is one which should please radio builders. Service Men can do a nice "side" business supplying sets of this design to customers who insist upon maximum tone quality from a receiver of smallest convenient proportions. This article includes data for the expert technician.

H. G. BLEUER

THE MUCH-ABUSED term "high fidelity" has been applied to everything from a 2 tuber, up, and as the set to be described has tone quality considerably above the average midget radio or small console, we also shall call it "high fidelity." Very little thought has been given to obtaining better than ordinary tone from a small number of tubes, but it can be done.

This set has bass amplification which is especially responsive to a bull fiddle—an emphasizing of the variations in music—a feature lacking in so many receivers, and plenty of power. The cost of parts and trouble of building will be greater than for an ordinary 4-tube radio set, but the results will be worthwhile.

## THE CIRCUIT

The schematic diagram is conventional in many respects. Glass type tubes were used instead of metal because of lower cost and simpler wiring connections.

High-gain shielded R.F. coils of good quality should be used. Since circuit oscillation tends to increase selectivity, which effect is detrimental to tone, low-impedance coils are recommended. The variable condenser should have a low minimum capacity to enable the receiving of police calls and possibly some amateurs. The one used in the List of Parts is very good for this purpose. Resistor values may appear to be off the "standard," but they should be closely adhered to. Generous bypassing, which never harmed any radio set, is used to increase stability and to eliminate hum. Hum will be a problem to some because of the excellent low-frequency amplification. The 2-mf. condenser and 50,000-ohm resistor in the plate lead of the 6C6 help to eliminate motorboating and to decrease hum. Two 1-meg. resistors and 1/2-mf. condenser supply a separate screen-grid voltage to the detector. This method increases sensitivity and

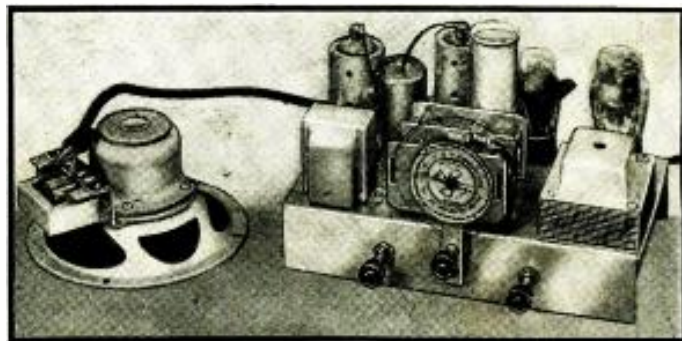


Fig. A. The 4-tube chassis and loudspeaker—complete.

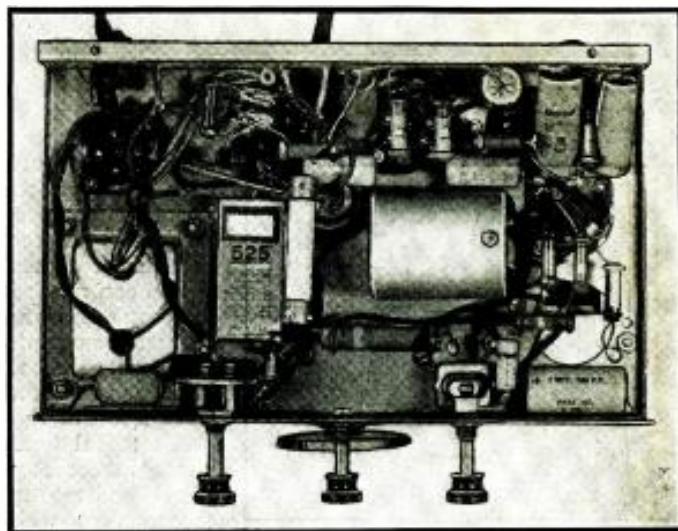


Fig. B. Note the neat placement of parts—under chassis.

also reduces hum. It will be noticed that the 90 V. screen-grid of the R.F. pentode 6F7 is used to supply voltage to the triode plate of the 6F7 through resistor R4.

The high-impedance tuned choke in the plate lead of the 6C6 is a novel feature and possibly used the first time in this manner in a small set. This choke-condenser combination resonates near 100 cycles, in reality a "bass booster." A switch, Sw.1, is used to cut out the choke and use resistor R11 as plate load. This serves as an excellent tone control. The choke should have a resistance which falls between 5,000 and 8,000 ohms. Do not use the secondary of an A.F. transformer. Several values of condensers from 0.006- to 0.02-mf. may be shunted across the choke for best results although 0.01-mf. will usually be the right value. A smaller condenser will tune the choke to the hum frequency (120 cycles), which is a smooth, "zooming" (and very annoying) hum.

Tone condensers are noticeable by their absence because the high notes are cut off when they are used. A 250 mmf. condenser is used as detector plate bypass, but in some cases values down to 50 mmf. may be used if no high-

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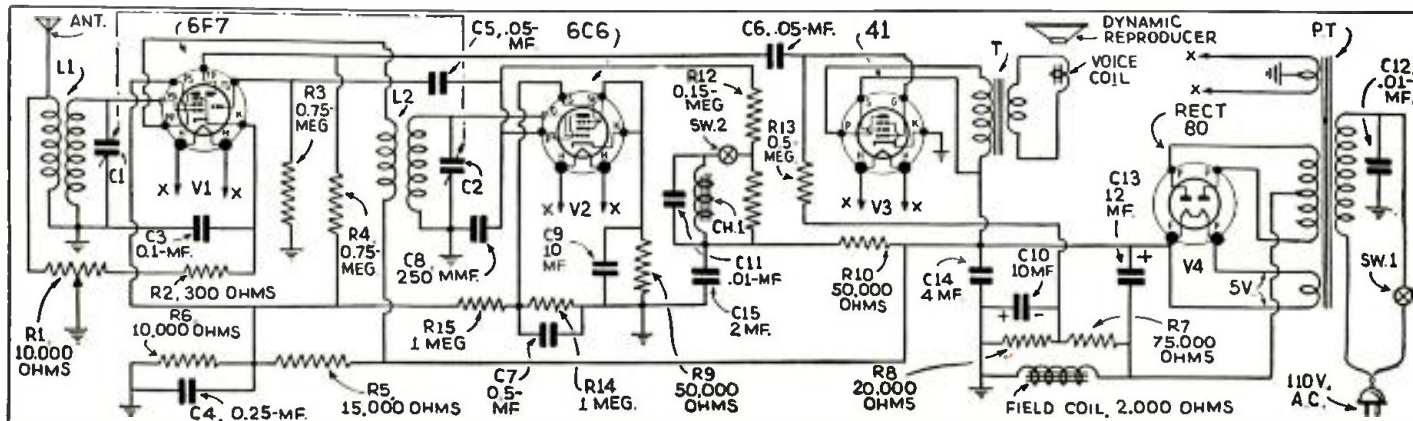


Fig. 1. Schematic circuit. The 6F7 is used as both R.F. and A.F. amplifier; the 6C6 as detector and the 41 as output A.F. stage.



Fig. A. A velocity microphone installed in the Hotel New Yorker high-fidelity system.

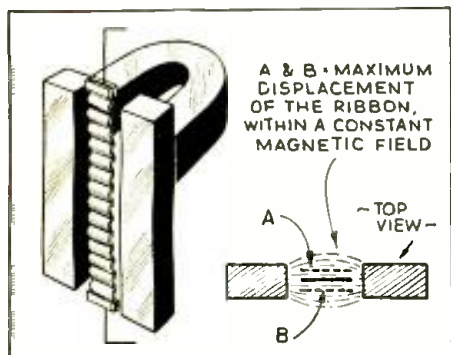


Fig. 1. Motion of the ribbon does not change the flux density of the magnet field.

## FIDELITY VS. HARMONICS

The importance of harmonic content in high-fidelity reproduction is pointed out.

S. RUTTENBERG

RECENT auditorium tests have shown that only a small percentage of a listening audience will notice or even

miss the absence of 2 full octaves on either the high or low end of the audible-frequency range. The very same audience, however, will immediately notice a change of 1 per cent in harmonic distortion—5 per cent will be very noticeable and a higher value intolerable.

miss the absence of 2 full octaves on either the high or low end of the audible-frequency range. The very same audience, however, will immediately notice a change of 1 per cent in harmonic distortion—5 per cent will be very noticeable and a higher value intolerable.

You can now readily understand why in many cases where high harmonic distortion is encountered, it is much better to actually limit the frequency response in order to obtain more pleasant if not more truthful reproduction.

A musical tone consists of a fundamental frequency that determines its pitch—and multiples of that frequency (harmonics) which determine its timbre. It is the harmonics that give the

different instruments their individual characteristics. For faithful sound reproduction, we must, therefore, not only reproduce the fundamental frequency but even more important, all the harmonics—without adding to or subtracting from their intensity.

### HOW "HARMONIC DISTORTION" BECOMES ACCUMULATIVE

Let us consider the case of a fundamental tone of 2,000 cycles per second. The reproduction of this tone is easily within the range of any modern reproducing system. Suppose the fundamental sound contains 3 per cent of the 3rd-harmonic—6,000 cycles. If the microphone, amplifier, or loudspeaker introduces 5 per cent of harmonic distortion, the final sound reproduced will have a harmonic distortion value of 8 per cent of the fundamental and will make the original practically

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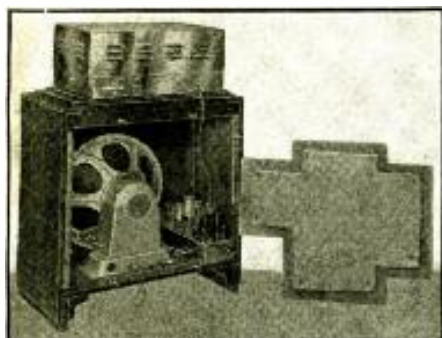


Fig. A. The "bass-reflex" principle is used in this baffle. Note the odd-shaped back.

THE LIMITATIONS in the low-frequency fidelity of sound reproducing systems, particularly in radio broadcast receivers, have for many years past

## A NEW BAFFLE SYSTEM EXTENDS FIDELITY RANGE

Two new methods of increasing bass response—"bass-reflex" and "peri-dynamics"—are described, with examples.

McMURDO SILVER

been well recognized. The first of these is the lack of available baffle area for customary dynamic loudspeakers. In radio consoles, particularly, the physical limitations in the baffle provided by the console are such that it is seldom indeed that such a system will ever reproduce below 130 cycles, except

through the questionably desirable aid of rather unpredictable resonances due to the size of the speaker compartment and the volume of air contained within it. In table models and midget radio sets the situation is considerably less satisfactory, and the cut-off frequency

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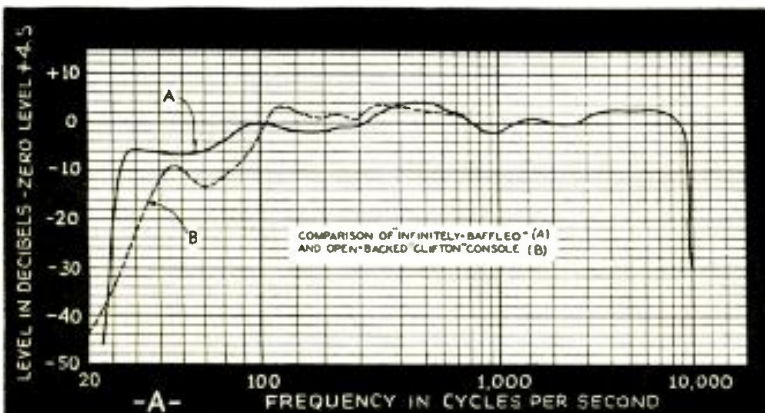
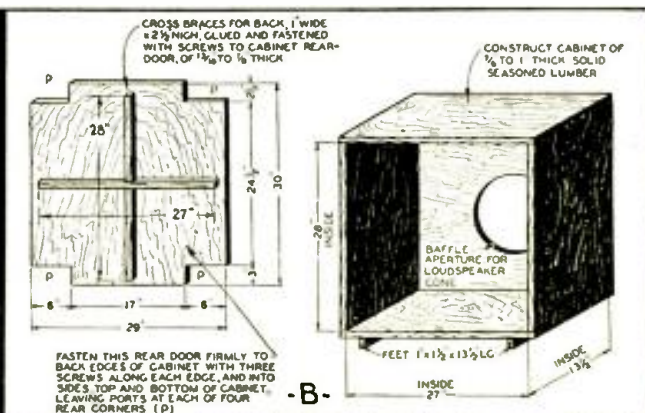


Fig. 1. A—Comparison of infinite-baffle and bass-reflex systems. B—Dimensions for the bass-reflex baffle; these dimensions are important.



# INTRODUCING— A CATHODE-DRIVE HIGH-FIDELITY 32-W. BEAM AMPLIFIER

Universal operation from either 110 V. A.C. or 6 V. D.C. is made possible by a special transformer and "chopper."

A. C. SHANEY

PART I

FOR MORE than a decade the design of universal-operated (6 V. storage battery and 110 V. A.C.) public-address amplifiers has progressed but little, experiencing no fundamental improvements excepting the "absorption" of developments gradually brought about in general-purpose amplifiers.

As no concentrated and intense engineering has been applied to universal amplifiers, this phase of the P.A. field has been sadly neglected by amplifier engineers.

Successful design of an efficient high-fidelity universal amplifier for all practical P.A. applications depends upon 5 fundamental factors, each of which must be carefully considered and properly incorporated in the finished amplifier. (It is, of course, taken for granted that the modern "universal" amplifier should be designed around the new beam-type power output tubes.)

1. Economical operation from 6 V. D.C.
2. Equivalent performance from 110 V. A.C. and 6 V. D.C.
3. Fixed voltage power sources for supplying 6L6 plate (400 V.) and screen-grid voltage (300 V.) without the use of voltage-dropping resistor.

4. Adequate audio power output with minimum distortion (2 per cent total).
5. Permanent and trouble-free performance from 6 V. power sources.

## THE MOTOR-DRIVEN ALTERNATOR

Economical operation from 6 V. D.C. is entirely dependent upon the type "inverter" employed.

One of the most efficient units ever developed was completely described in the September 1936 *Radio-Craft* (page 141). This type of chopper (or pole-changer) has since been considerably improved and redesigned, for increased efficiency and greater power handling ability. The "heart" of this new alternator is of unusual interest—particularly its 4 adjustable contactors which provide for perfectly synchronized voltage alternations impressed across the special alternator primary of the power transformer. Because of limited space, the operation of this novel unit will be completely described in the forthcoming issue. Suffice it to say, however, that this motor-driven alternator provides for equivalent performance of the amplifier from both a storage battery and commercial

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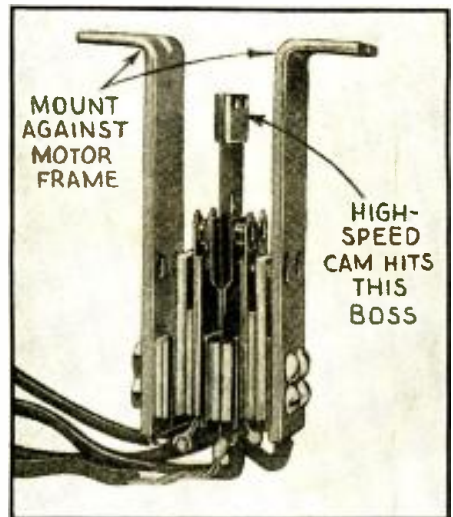


Fig. A. The contactor section of the alternator.

Three major amplifier developments are discussed in this series of articles:

1. Motor-driven alternator for economical and efficient operation from a 6 V. storage battery.
2. Stabilized 2-phase fixed-voltage bridge rectifier.
3. New cathode driver for high power audio output with low distortion.

Every P.A. technician should study these ingenious innovations.

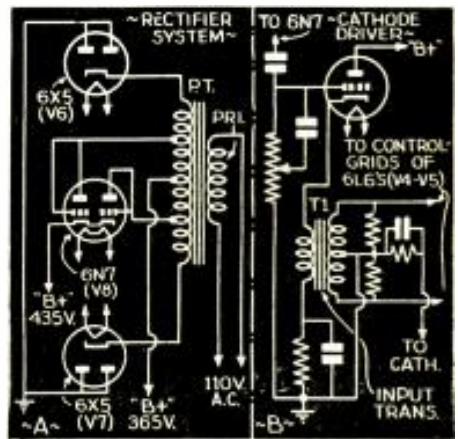


Fig. 2. The rectifier and driver feature details.

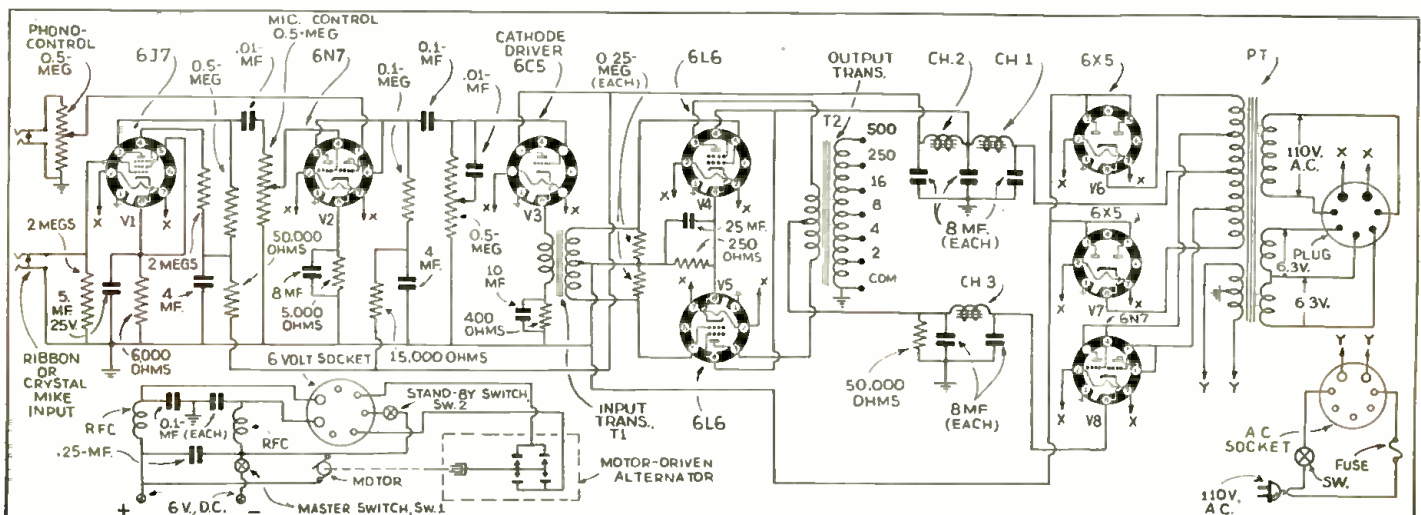


Fig. 1. The schematic of the 32-W. beam power amplifier showing how the operation from either 6 V. D.C. or 110 V. A.C. is accomplished.

# MAKE THE RADIO-CRAFT MIDGET OSCILLOSCOPE

Portable operation of an oscilloscope, in servicing in the field, is made possible by this new instrument. It is the smallest, lightest-weight "complete" visual aligning tool so far offered to the Service Man!

## PART II

**A** COMPLETE description of this new type of oscilloscope, using the 913 type cathode-ray tube, yet having all the facilities available in larger oscilloscopes, was presented in Part I. In this concluding Part, the actual construction details including the details for forming and drilling the chassis are given.

Actual construction should start with laying out the chassis, which is made of 1/16-in. aluminum, and cutting all necessary holes therein. Wherever possible the holes should be tapped so that hold-down screws for the various parts will need no nuts to fasten them. This is a great time and "cuss word" saver in a compact and crowded assembly such as this.

The holes in the front panel may now be laid out and drilled, and then the panel and chassis assembled. Assembly of all parts is a straightforward job and should take little time, once the correct holes are cut.

### ASSEMBLY

The socket for the type 913 midget oscilloscope (metal) tube comes mounted on a metal plate, the two holes in which are just about far enough apart to allow the 913 to fit into the socket when the 2 brass mounting rods are in place. Be sure it will fit before starting to wire. The bakelite socket is held to the metal plate with a bent strip of spring steel so that the socket is easily removable. It should be taken out and the metal tongue on the plate filed off. This will allow the socket to be turned around when it is back in place,

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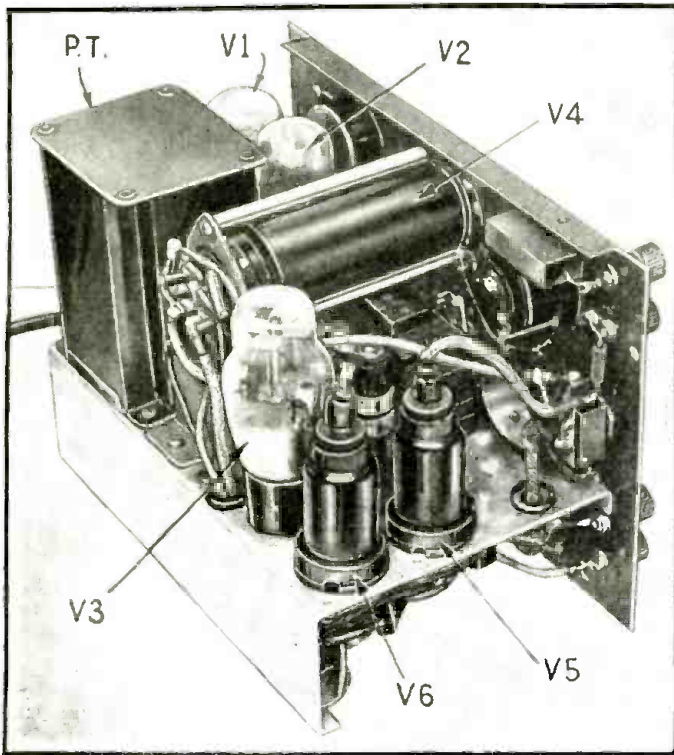


Fig. B. The back view of the chassis removed from its cabinet. The 913 tube is shown "inside" the case.

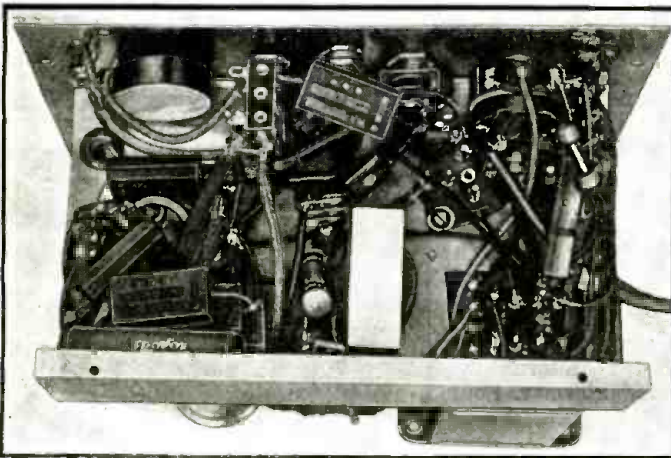


Fig. C. The compact layout of small parts permits the oscilloscope to be enclosed in a small metal box.

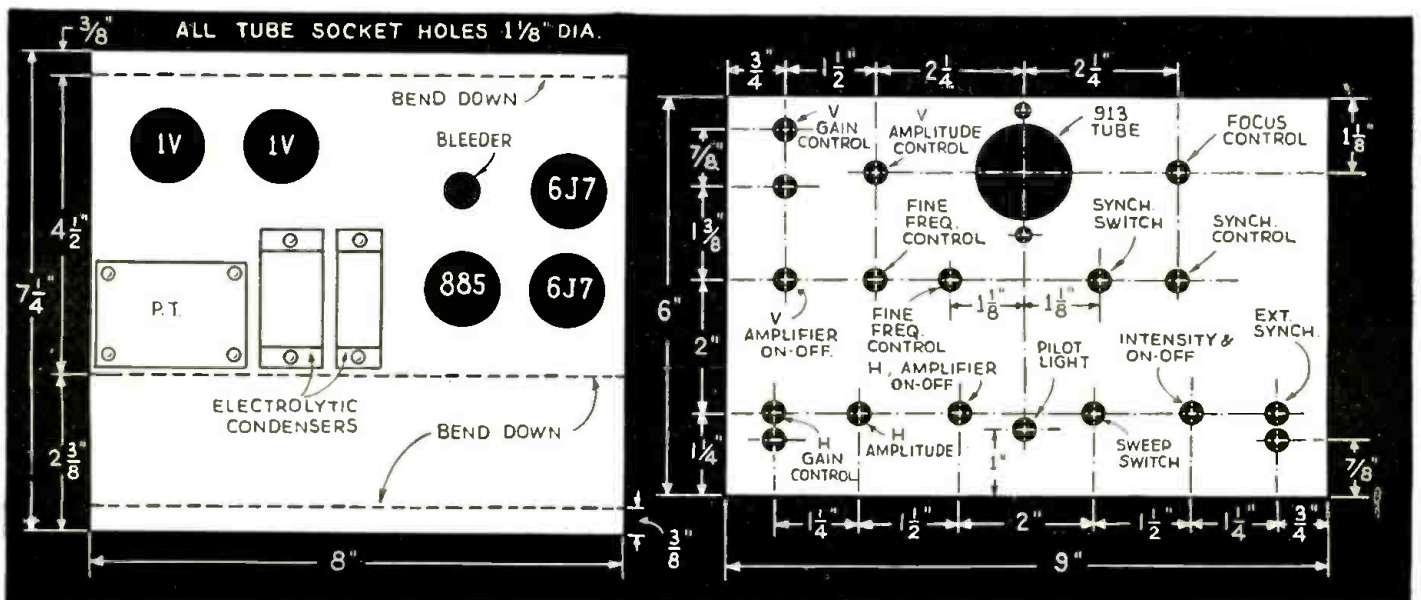


Fig. 2. Forming and drilling details of the chassis and the front panel of the instrument. The panel engraving is also given.



# SERVICING P.A. WITH A MIDGET OSCILLOSCOPE

An oscilloscope can be used for many amplifier tests which are otherwise quite difficult.

J. P. KENNEDY

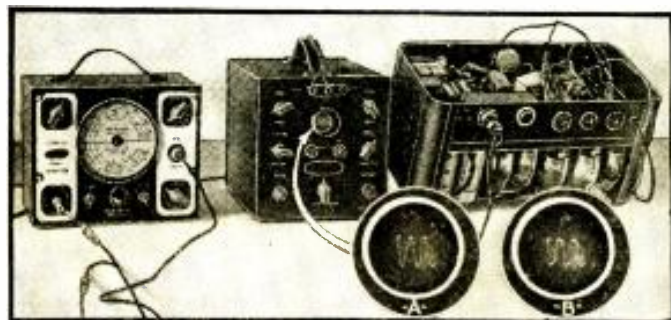


Fig. A. A typical amplifier test set-up. Note oscillograms.

**A** METER you can't burn out! The twinkling green eye of the new midget oscilloscope is one safe instrument for heavy-duty P.A. service. *Squirming lines on the fluorescent screen will tell you more about what goes on inside an amplifier than all the rest of your service equipment put together.* It is the safest and most simple instrument to use in testing an amplifier. After preliminary adjustments for sweep, focus, intensity, horizontal and vertical gain, most of the tests on an amplifier require only slight adjustments of the vertical-gain or vernier-sweep controls.

A good, clean audio tone either from your signal generator or a beat-frequency audio oscillator is an essential element in amplifier analysis with the cathode-ray oscilloscope.

(Continued on page 695)

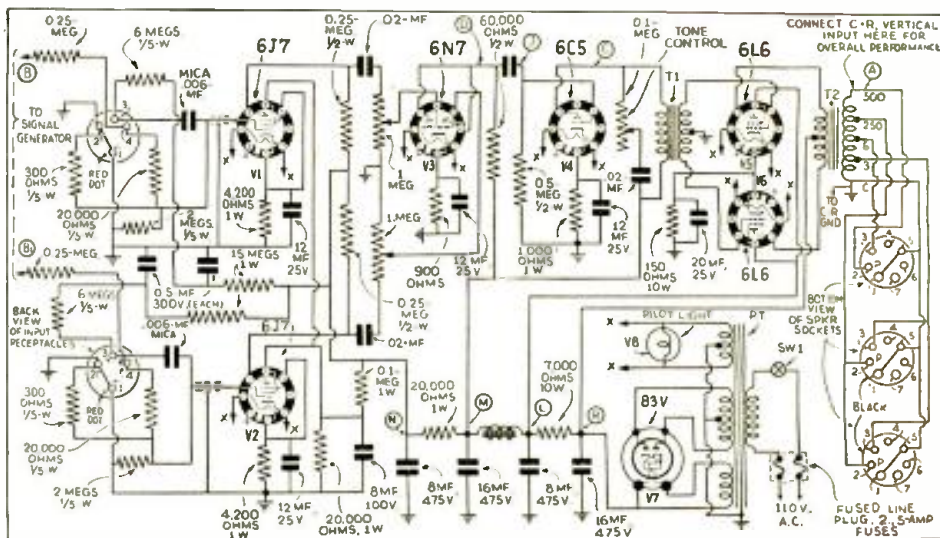


Fig. 1. A typical amplifier with the test points indicated.

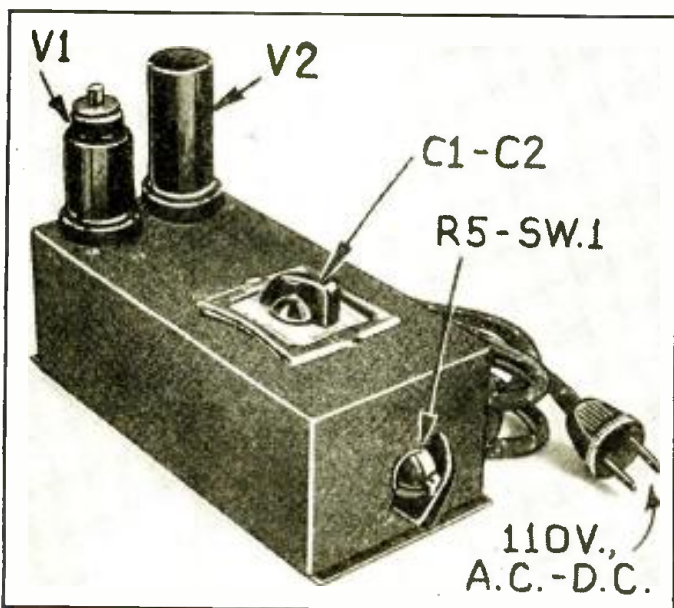


Fig. A. The "Long Arm" ready for use with a set.

## MAKE THE "LONG ARM" — A REMOTE SET CONTROL

"Twiddling" the dial of the easily-built Long Arm tunes the radio set in the next room!

CLIFFORD E. DENTON

**T**HERE HAVE been many complicated remote-control units described in the past. Most of them were costly to construct and never quite satisfactory in operation. Here is a simple form of remote control—a veritable "Long Arm"—that is low in cost, easy to construct and will give years of service with any receiver.

It is interesting to check over some of the applications of such a unit particularly when the low cost of construction helps to widen the field of possibilities. Service Men should find additional sources of income from the construction and sale of such units to restaurants, grills, hotels, lodges, schools, etc., where control of a radio receiver is desirable from a remote point. In most public places the radio set must be located in another room, or in a corner that is not easily accessible. The remote control unit can be placed on a counter or desk where it is easy to tune and will provide, as well, accurate control of the tuning.

Invalids, confined to their beds will appreciate the pleasure of operating such a device as it provides complete control

(Continued on page 702)

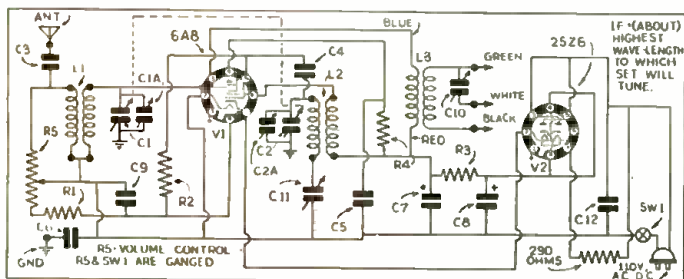


Fig. 1. The circuit of the remote set tuner unit.

# OPERATING NOTES

## ANALYSES of RADIO RECEIVER SYMPTOMS

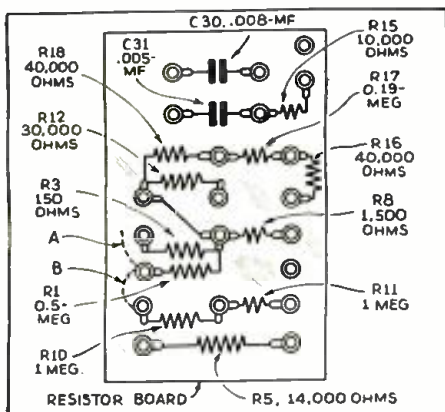


Fig. 1. The connections at the resistor board caused loss of volume and fading.

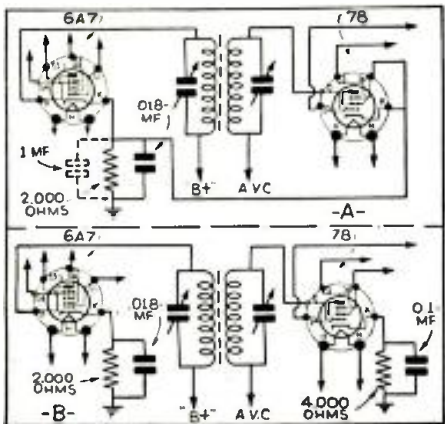


Fig. 2. Instability in Philco 60 can be cured by either method shown above.

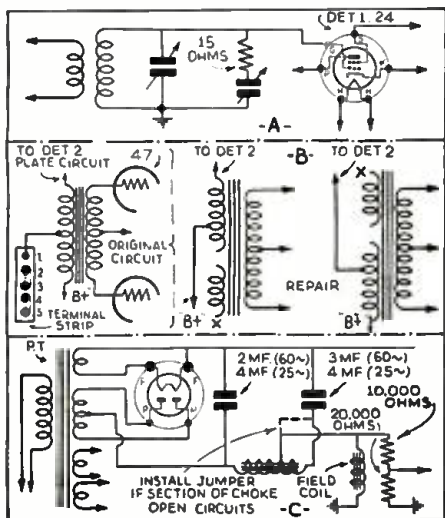


Fig. 3. Troubles in RCA-Victor R-50, R-55, RAE-59 and RE-20 sets are detailed.

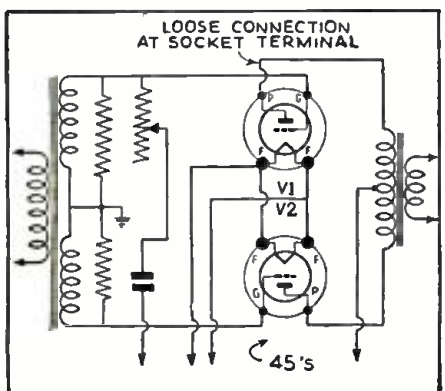


Fig. 4. Peculiar noises in a Victor 32 set were caused by a loose connection in the power unit.

General Electric K-62. Fault: Loss of volume, and fading. A very peculiar way this set acted:— it would run well for 3 hours; then it would drop suddenly in volume about 75 per cent and fade in and out. Even with the volume control advanced fully the set would not play any louder.

The trouble finally was located in the resistor board. See Fig. 1. The 0.5-meg. resistor, R1 (see A) had 2 leads where only one should have been, while, the 1-meg. resistor, R10 (see B), had no lead connected to its terminal.

Majestic Model 35. The type 80 rectifier tube of this set became red hot. All filter condensers were tested and found to be OK. This particular model uses twin dynamic reproducers and after checking the power supply a short was located in the loudspeaker field supply.

I disconnected both speakers; that is, I disconnected the cable on each one of them and the speakers checked OK. (Both the speaker cables enter the set from beneath the chassis and are clamped down within the set by means of a terminal strip of bakelite having a terminal lug on one end and two clamps on the other which hold the two cables in place, one on each side of the strip.) Next I checked one end of each cable, from where the speakers had been removed, to chassis. The field indicated a dead short to ground. After tracing the field wires, it was noted that the blue wire of each cable, being one side of the field, was connected to that terminal lug on the terminal strip. Looking closer I noticed a piece of solder lying across from the clamp on one side to the terminal lug, shorting the field to ground.

Removing that offending piece of solder remedied the trouble.

(Although this is not "officially" an Operating Note, since it is not a commonly-found fault indigenous to a particular receiver model, it is here printed for its interesting circuit analysis. Editor)

ANDREW M. WIEHL

Philco 60. Inoperation at the low-frequency end of both the broadcast and short-wave bands in these models is invariably due to a short-circuited end plate segment of one of the two condenser gang sections. Since the plates are very closely spaced, it takes little to produce the failure which, however, is just as easily remedied by simply bending the offending plate or segment to clear the short-circuit. The shorting plate should not be bent too far, especially in the oscillator tuning section, or dial calibration error will result and realignment will be necessary.

When inoperation is experienced at one or more points of the tuning range, not particularly the low-frequency end, in addition to noisy tuning, most likely the difficulty is caused by flakes or burrs on the condenser gang plates. The coil leads may be disconnected from the stators and high voltage applied, with the gang condenser rotated throughout its full range. Arcing at the shorted points will burn away the burrs.

The condition of weak and distorted reproduction when a low plate voltage reading is obtained on the type 75 tube, is usually traced to a leaky 0.5-mf. plate filter condenser, connected from the junction of the two 70,000-ohm carbon resistors in the plate circuit of the 75 tube to chassis. This condenser is one section of a 4-section bypass block mounted between the sockets of the types 6A7 and 80 tubes.

Intermittent reception or fading on several occasions has been found caused by oscillator coil connections wherein coil leads snap at the terminal lugs and make intermittent contact. A faulty volume control will produce similar symptoms which are easily disclosed by manipulation of the control. Should the fading occur only on the short-wave band, it may be necessary to solder or secure a second flexible pigtail between the tuning-gang assembly and chassis.

Where the condition of oscillation and general

instability is encountered with this model, it has been found that by connecting an additional bypass condenser of 1 or 2 mf. across the common 6A7 and I.F. cathode bias resistor, the trouble may be overcome. Another method of accomplishing the same result, which is both less expensive and more effective, is that of employing a separate bias resistor of 4,000 ohms bypassed by a 0.1-mf. condenser for the I.F. stage. See Fig. 2A and B.

RCA Victor R-50, R-55, RAE-59, RE-20. The complaint of weak reception encountered on these models, with all voltages correct and the additional symptom that signal strength is increased appreciably by placing a finger upon the control-grid of the 1st-detector, indicates sufficiently that the 15-ohm flexible pigtail resistor connected in series with the 1st-detector trimmer condenser across the 1st-detector section of the gang condenser, as shown in Fig. 3A, is open-circuited. This condition can be checked quickly by tuning the receiver to a weak high-frequency station and endeavoring to peak the 1st-detector trimmer. Should no difference be noted in signal intensity, there can be very little doubt that this receiver is open-circuited.

An inoperative receiver with the attendant circumstance of no plate voltage on the 2nd-detector tube, is often the result of an open-circuited primary winding of the push-pull input transformer. Since this component is housed within the same block as the push-pull output transformer, replacement requires an entire new block. This procedure is not necessary, as a very satisfactory repair may be accomplished in the following manner.

The primary of the push-pull input transformer is center-tapped, this lead being brought out to terminal No. 1 of the terminal strip located on the power amplifier chassis. With a continuity meter or ohmmeter, measure each side of the primary, using the center-tap as the reference point, to determine which side is open-circuited. As shown in Fig. 3B, the end of the open-circuited portion of the primary may be disconnected and the center-tap connected in its place. Despite the fact that only one-half the primary winding is used, thus cutting the impedance in two, very little, if any, change in tone quality or output can be noted. More than a dozen of these models have been repaired in this way with no complaints or trouble of any kind upon this score.

A strong "60-cycle" hum on these models is often the result of the open-circuiting of the tapped section of the first filter choke as shown in Fig. 3C. This failure, as can be seen, removes the 3-mf. filter condenser from the circuit. Although some advantage is gained through this tapped filter arrangement, and although it is better to replace the choke, the receiver may be repaired by connecting a jumper across the open-circuited portion of the choke.

The symptoms of distorted reproduction, weak and fading reception are frequently due to a carbonized voltage divider network, composed of a 2-W., 14,000-ohm, 1-W., 10,000-ohm and a 1-W., 170-ohm resistors, carbon units, all mounted on the terminal strip fastened to the rear wall of the tuner chassis. The 14,000-ohm screen-grid voltage-drop resistor carbonizes due to excessive current and lowers in value, sometimes as low as 1,000 ohms. This lower value causes the 10,000-ohm resistor to carbonize likewise. The failure will be evidenced by very low plate voltages on all tubes. An ohmmeter check between R.F. or I.F. screen-grid to chassis will show up the carbonized condition. The screen-grid voltage-drop resistor (14,000 ohms) is best replaced with a 5-W. wire-wound unit to prevent recurrences.

Distortion upon resonance on the more powerful broadcasting stations is frequently due to insufficient A.V.C. voltage, as a result of leakage of the plate-cathode bypass condenser in the A.V.C. stage.

Fading or oscillator drift and intermittent reception, and the condition wherein stations are received below their assigned frequencies or original dial settings, are caused by the snapping of the connecting tabs of the leaf clamp type oscillator series condenser which is connected across the oscillator padder. If the break can be seen and is not too close to the condenser jacket it may be soldered, or a new unit should be installed.

BERTRAM M. FRIED

Victor 32. The complaint in this case was noisy reception. Due to the peculiar and various noises heard in this receiver it might be of some interest to others to relate this case.

To begin with, when the line switch was snapped on, the noise emitted from the set sounded very much like motor-boating, with its familiar putt-putting sound. This noise would last for perhaps 2 or 3 minutes, when it would suddenly disappear only to be followed by another and totally different type of a noise.

This type of a noise which was now heard can best be classified as being "birdies" of varying pitch. This type of a noise display would last only for a short time, then it in turn would disappear; this time it was a sizzling and frying sort of a noise. In our experience with many good, bad and indifferent types of receivers, we have run into many rather queer problems, but we have to admit that the actions displayed by this particular receiver were a little out of the ordinary.

In this particular case 3 distinct and different kind of noises were heard, one type of noise following another in quick succession.

Before commencing any actual tests on the receiver, the detector tube was pulled out to see what would happen. Pulling out this tube did not stop the queer performance of the set. Then all the tubes in the chassis were removed, one at a time. Even now with all the tubes out of the chassis, the various noises could still be heard, which gave us an indication that the trouble might possibly be found in the power pack, which is in a separate unit.

After a considerable amount of testing the cause of the trouble was finally discovered. A wire lead connection which to all outward indications appeared to be held solidly, was in reality only loosely held in place. A quick operation with the soldering iron to this defective joint, at once cleared up the trouble to our great satisfaction. Figure 4 shows the location of the loose connection which caused the peculiar noises heard in this receiver.

R. F. LAMBERT

Goldentone or Fordson Models F, FX, X, 46 and 52. This chassis utilizes 4 tubes, 1-80, 1-42, 1-6C6, 1-6D6. Trouble arising in this chassis model quite commonly is due to a burned-out antenna coil. A convenient remedy is to place a condenser in series in the antenna lead and realign the receiver. The correct capacity, to be determined by experiment, will range between 0.001-mf. and 100 mmf., 400 V. Another cause of the trouble may be a grounded antenna (thus completing a circuit through the electrical power system, from the ground back through the antenna system to the antenna coil). See Fig. 5.

Now if this condenser becomes shorted and one side of the A.C. line is grounded (which is the usual condition), and the set's power-line plug is plugged into the wall outlet with the set's antenna condenser connecting to the high side of the house wiring, the antenna coil will "blow." Note that this is the first R.F. coil connecting to volume control and antenna, the other end or tap ending the first section of the coil is at ground potential and connects to the rotor plates of the first R.F. section of the tuning condenser and cathode circuit or cathode condenser.

GEO. F. BAPTISTE

Crosley 706-60. This receiver played well for about 2 minutes; the reproduction then became distorted. I replaced the 1,100-ohm bias resistor with a 10-W., 1,000-ohm resistor and the trouble was gone.

Atwater Kent 55. When the rubber on the brass shaft of the tuning knob is worn so much that the dial slips, making it impossible to tune in stations, remove the brass shaft and after taking the rubber off place a couple turns of friction tape around it. Then replace the rubber over the tape and put the shaft back into the set after which the rubber will grip the dial

and again make it possible to tune over the whole band.

Airline 326W. Low volume and noise along with smoke coming from the power transformer is usually due to the 2,460-ohm section of the speaker field coil being open. Replace the field coil.

Airline 62-14. This radio set would tune in stations only at the high-frequency end of the band. After checking all voltages I checked resistors and found that the 40,000-ohm resistor between the control-grid of the type 27 oscillator tube and ground had changed to about 8,000 ohms. Replacing this resistor with a good 40,000-ohm resistor made the set operate normally.

Chevrolet 600565. This auto-radio receiver was "dead" although the vibrator was buzzing. However there were no plate voltages at the sockets and a check of the power supply revealed a bad 0.04-mf. vibrator condenser.

Silvertone 1926. All voltages were normal in this receiver and tubes checked OK but no signal could be heard. I tried a new 1C6 mixer tube and the receiver worked like new.

Philco 37 and 80. When there are no plate voltage readings in either of these models check the compensating condensers before removing filter condenser connections as these condensers sometimes touch the chassis causing a direct short.

WAYNE STORCH

Philco 16, 16B, 16X (Codes 121, 122). The complaint of intermittent reception wherein volume drops to a decidedly low level, with the attendant symptoms of lack of plate voltage on the 2nd I.F. type 78 tube and widening of the shadowgraph indication, is invariably due to an open-circuited 250-ohm resistor in the plate circuit of the 2nd I.F. stage. This resistor is contained within the usual small black bakelite condenser for this stage, and is located adjacent to the 2nd I.F. socket. The open-circuit often consists of broken terminal connections at the lugs on the block, which are easily soldered, although in some instances the break occurs internally. In this case, either a new block or an external resistor of the same value should be installed.

When intermittent reception is encountered and the shadowgraph operates normally, indicating station resonance (and thus eliminating the R.F. portion of the receiver as a possible cause for the condition), check the 0.01-mf. audio diode-coupling condenser connected between the bottom terminal of the volume control and the junction of the two diode-load resistors. This condenser is a tubular unit and produces trouble through poor internal contact of the pigtail leads.

When the complaint of distortion and hum is received on any one of these models, the grid-bias voltage for the driver and output stages should be checked immediately. Lack of normal grid bias on either of these stages is usually recognized by the fact that the control-grids of the type 42 tubes glow red, although a low-emission 42 will produce the same result. Distortion occurring in the driver stage due to a low control-grid bias or lack of grid-bias voltage has been traced

## ATTENTION—SERVICE MEN!

You will note that the OPERATING NOTES department this month is greatly augmented in size. This is for your special benefit—and in appreciation, the Editor expects cooperation in the form of contributions. These Notes (typed, and double-spaced) must concern commonly-found receiver defects—AND THEY MUST BE ACCOMPANIED BY SUITABLE ILLUSTRATIONS OR SKETCHES! (Published contributions will be paid-for at space rates.)

to a leaky or short-circuited 0.15-mf. grid filter bypass condenser for this stage.

Distorted reproduction and hum are more generally due to either low control-grid voltage or lack of control-grid bias on the output-stage type 42 tubes. In the majority of cases, this failure has been traced to the grounding of the push-pull input transformer secondary return to the case or laminations of the transformer, internally. Although a more efficient repair may be effected through replacement of the transformer, one that is equally as good or which can be used in an emergency, is that of insulating the entire transformer from the chassis. This is easily accomplished by supporting the assembly on insulated washers and placing short lengths of spaghetti tubing over the portions of the self-threading screws used to mount the transformer on the chassis, which contact the rivets on the base of the transformer.

On other occasions, the distortion and attendant symptoms have been caused by the leakage of the paper insulating the electrolytic filter condensers from the chassis, resulting from leakage of the same condensers and the formation of oxides at their bases. In some cases this corrosion and leakage may be cleared, but more often either one or both condensers must be replaced.

When signals are choked and reception is weak, with the noise suppressor tube in or out of circuit, check the screen-grid voltage applied to the 1st A.F. type 77 tube. Screen-grid voltage for this stage is supplied through a 1 meg. carbon resistor which increases in value, consequently lowering the screen-grid voltage which should be approximately 50 V. This same effect is secured when the silencing tube is in the circuit, and the silencing adjustment located in the rear of the chassis is turned too high, thus increasing the plate current, producing a greater voltage drop across the 1 meg. resistor which is in the plate and screen-grid circuits of the

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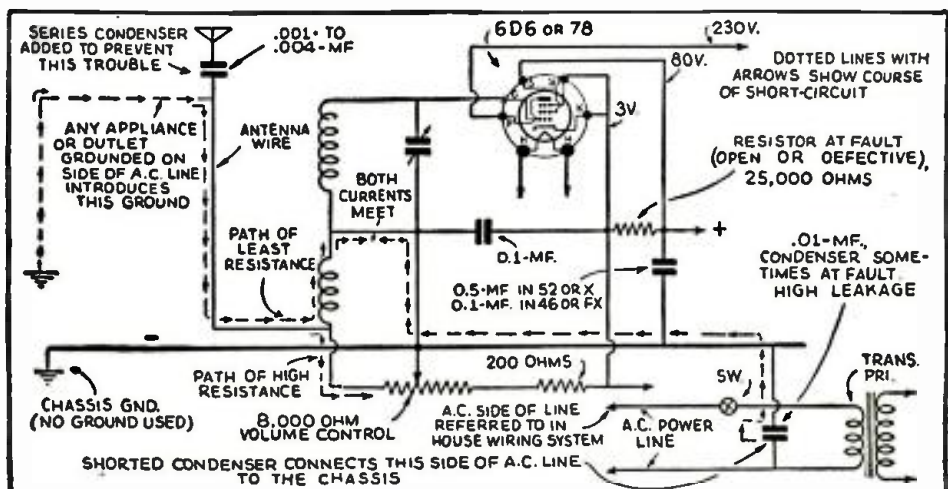
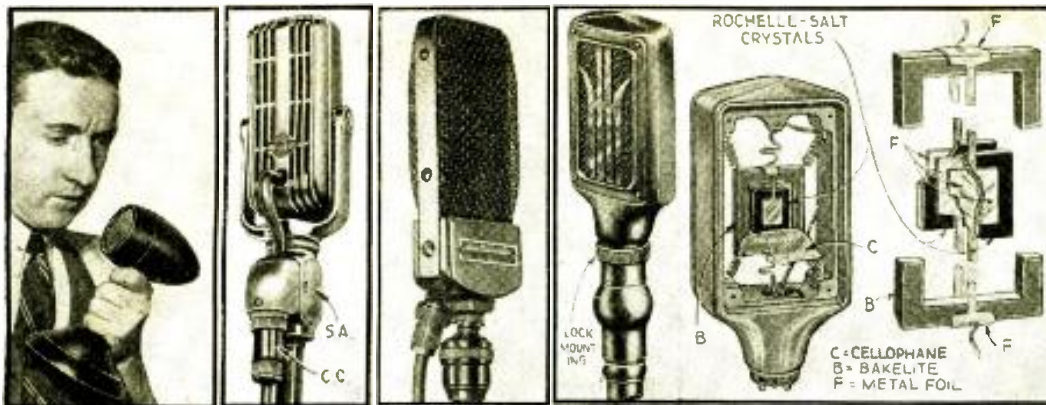


Fig. 5. Burned out antenna coils in Goldentone or Fordson models F, FX, X, 46, and 52 are caused by a power-line short—as shown by the dotted lines in this circuit detail.

# THE LATEST RADIO EQUIPMENT

This department brings to you each month the newest developments in electronic, radio and public-address equipment. Aggressive technicians use this department to keep posted on the newer and better ways of doing things.



Transducer. (1325) Connector. (1326) "Velotron". (1327) A crystal mike with built-in suspension. (1328)

## SMALLER-SIZE "TRANSDUCER" (1325) (Transducer Corp.)

A NEW semi-directional dynamic unit that works reversibly as a microphone or loudspeaker, a description of which in *Radio-Craft* created such a furor in the technical field, is here illustrated in a new model of considerably smaller dimensions: overall length 5 ins., and maximum dia., 3 ins.; net weight, 2 lbs. Frequency response is relatively flat within 3 db.  $\pm$  from 20 cycles to about 7,000 cycles, according to the graph submitted to *Radio-Craft*. Output level, -43 to -45 db. Available impedances: 10, 50, 200, 2,500 and 50,000 ohms.

## IMPROVED MICROPHONE CABLE CONNECTOR (1326) (Amperite Corp.)

IN ORDER to obtain improved performance with his product a well-known manufacturer has redesigned the cable connector to improve the serviceability of his new velocity microphone; both are here illustrated. The extra-length body of the connector prevents the leads from shorting. Putting this 3-pin, lock-ring cable connector C.C. on the shock absorber S.A. and not on the microphone itself prevents mechanical noise, caused by moving the cable, from reaching the microphone.

## VARIABLE-FREQUENCY "VELOTRON" MIKE (1327) (Bruno Laboratories)

VARYING the polarizing voltage, of 150 to 350 V., of this new-type, highly directional microphone permits either the bass or treble response to be accentuated (average response said to be 30 to 14,000 cycles). The unit incorporates a "fixed" element—a perforated metallic plate heavily and thoroughly insulated; and a "movable" element consisting of 8 ribbons of duraluminum 0.0002-in. thick. In general, this new-type microphone incorporates the characteristics of the velocity type—with the added feature of variable-frequency response. Output is approximately -50 db.

## CRYSTAL MIKE HAS BUILT-IN SUSPENSION (1328) (The Brush Development Co.)

NEWEST in non-directional crystal microphones in a sound-cell type, with an internal capacity of 0.01-mf. and -72 db. output; spring suspension contained within the metal frame. Case dimensions: 3½ x 1¼ x ¾ ins. thick; weight, complete with locking-type plug and socket, 11 ozs. A wire mesh, permitting the sound to pass through, eliminates the heavy bass and distortion of pressure doubling, and permits close-talking.

## VACUUM-GRIP SPEAKERS FOR TURRET-TOP CARS (1329)

A NEW INNOVATION in public-address equipment now makes it possible to almost instantly install requisite loudspeaker combinations, on turret-top cars, without drilling mounting holes! A section hose connected at one end to rubber cups on the loudspeaker mounting board, and at the other to the windshield wiper or other vacuum-operated unit or direct to the intake manifold, does the trick. Sound men probably will "go" for this item in a big way.

## NEW "REMOTE" SPEAKER (1330) (Wright-DeCoster, Inc.)

HOUSED in an attractive, black-crystalline steel cabinet is a 5-in. permanent-magnet dynamic reproducer that conveniently lends itself to innumerable services. Since it requires no field current it is often possible to operate it at a remote point by running only a single wire and using any available metallic structure, piping, etc., for the return circuit.

An excellent reproducer for use in inter-office communicators; since the communication wiring carries only voice currents it is not necessary to run the transmission line (which may terminate directly into the voice coil) in conduit.

## ADJUSTABLE-IMPEDANCE REPRODUCER (1331)

A NEW IDEA new to the domestic loudspeaker field (but described some time ago in *Radio-Craft* in the International Radio Review department) is a loudspeaker incorporating a multitap matching transformer with terminations wired to a terminal board. Available, center-tapped impedances: 4,500, 7,000, 10,000 and 14,000 ohms. Available in 2 types, one to match conventional "plate" impedance values and the other to match conventional "line" impedance values.

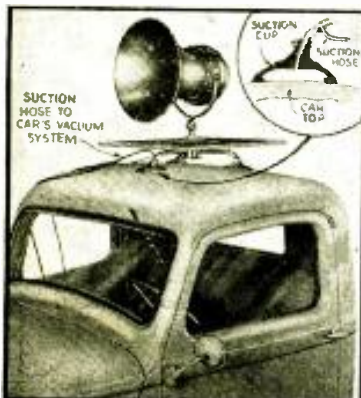
## NEW SELENIUM CELL IS RED-SENSITIVE (1331A)

HERE is a high-resistance, high-sensitivity, long-life selenium cell (metal or plastics case, ¾-in. dia.) for commercial photoelectric control (with amplifying tube and relay). The active surface is elemental selenium on platinum, and sensitized in accordance with new activation processes. Sensitivity peak, deep red; operates on 50 V. through 1 meg. (safe current, 20 microamps.). Has 5 to 1 change at 10 foot-candles.

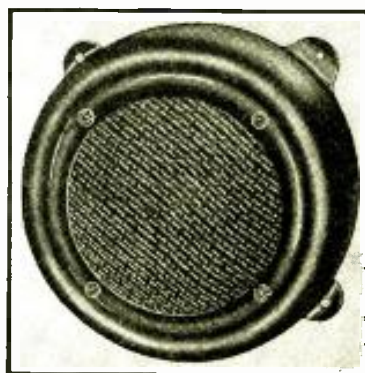
Due to peak sensitivity to deep-red wavelengths, and inverse non-linear response to light intensity, this cell is particularly suitable for use with low-intensity and low-temperature light sources. (Do not expose to direct sunlight.)



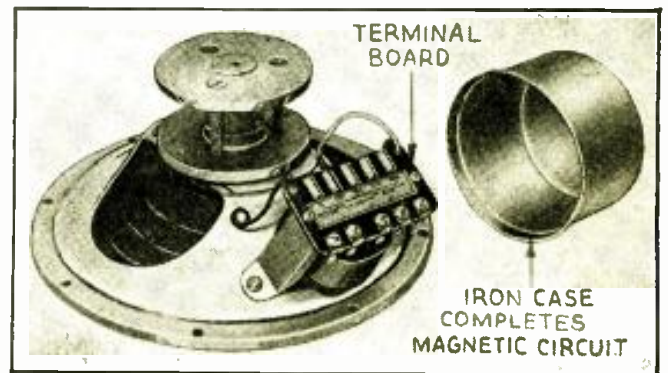
Light-sensitive cell designed for amplifier relay service. (1331A)



"Vacuum-gripped" speaker. (1329)



This permanent-magnet dynamic reproducer is designed for remote use. (1330)

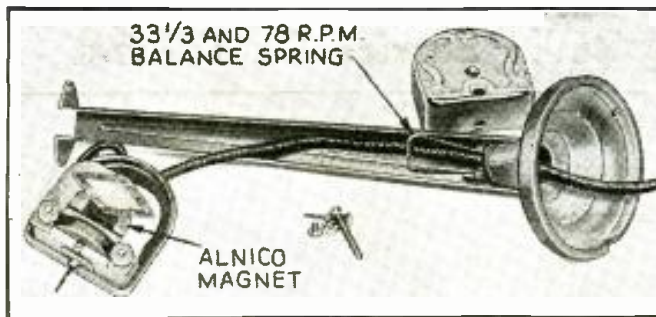


This reproducer's terminal board provides for tip-jack variation of the impedance value to match either into plate circuits or various transmission lines. (1331)

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

## NEW DUAL-SPEED MAGNETIC PICKUP (1332)

BY MEANS of a built-in spring this new magnetic unit adapts itself to the demands of either 78 or 33 1/3 r.p.m. operation. Output is approximately 1.5 V. (coil: D.C., 1,500 ohms; A.C., 10,000 ohms at 1,000 cycles). Utilizes an alnico magnet. Frequency response approximately flat within  $\pm 3$  db. from about 80 cycles to 4,200 cycles.



Alnico "dual-speed" magnetic pickup. (1332)

the export trade for which it was exclusively developed.

## 50-W. RACK-AND-PANEL SOUND SYSTEM (1336) (Amplifier Co. of America)

SCHOOLS, hospitals, hotels, theatres, etc., will be able to use the new rack-and-panel type of sound system illustrated. It is designed for universal application under all conditions requiring the pickup, amplification, reproduction and distribution of voice, recorded music or radio programs through appropriately placed loudspeakers to groups of people.

Tube complement: 1—6C6, 6—6A6s, 2—42s, 1—83. Operates up to 2,000 headphones, 200 magnetic speakers, 50 dynamic speakers and 10 horn units. Turntable is dual-speed with crystal pickup.

## 25-W. HIGH-FI PORTABLE SOUND SYSTEM (1337) (Transformer Corp. of America)

THE OUTPUT of this amplifier is said to be conservatively rated at 25 W. normal; peak output, 35 W. Provides for mixing, fading, etc., and adequately meets the specific demands of high-fidelity microphones including velocity, dynamic, diaphragm-crystal and sound-cell crystal types.

Output terminal impedances: 0.35/0.6/1.35/2.4/6/8/15/30/50/250 and 500 ohms, with provisions for connecting additional speakers. This amplifier is particularly recommended by the manufacturer as an "ideal system" for orchestras, radio stars on tour and others performing in the larger theatres, ballrooms, etc., in the major cities of the country. System includes microphone and floor stand, amplifier, and two 12-in. electrodynamic reproducers. Output utilizes two 6L6 beam tubes.

## DELUXE 35-W. AMPLIFY- ING SYSTEM (1338) (Radolek Company)

ESSENTIALLY this system consists of a high-gain power amplifier featuring the new beam power tubes, 2 giant high-fidelity reproducers and a choice of 2 latest-type

microphones mounted on floor stands, and all necessary cables, plugs, tubes and instructions.

The power section of the unit supplies 30 W. for excitation of three 1,000-ohm speaker fields. One control permits mixing of the 2 microphone outputs. The high-low tone control affords partial compensation for acoustic conditions. The controls are mounted on brilliant chrome; the steel chassis is finished in baked-on black enamel. This amplifier provides polarizing voltage for the new velotron microphone which may be used with cables 7 to 500 ft. long.

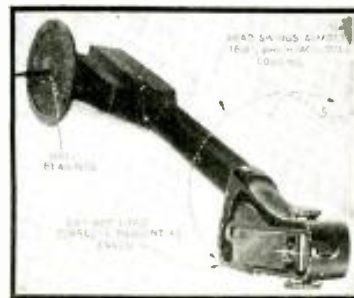
The 2 microphone inputs are connected to 2 individual type 6C6 tubes in a high-gain circuit. The output of one 6C6 is combined with the phono-input by means of a special center-tapped, 1-meg. volume control. A type 79 tube serves as an electronic mixer and is resistance-capacity coupled to a 6A6 connected with the elements in parallel as a single triode. This tube is used to drive a pair of 6L6s, in the final stage. The rectifier uses a type 83 tube.

## SCHOOL-TYPE SOUND RECORDER (1339)

THIS recorder makes records that can be played with steel needles on any phonograph. Also it "plays" any standard phonograph record. Finally, it is a complete portable public-address system.

Applications: recording students' voices for later correction; foreign language instruction; dramatic instruction with special emphasis on requisite sound effects; music instruction, to provide a means of checking renditions; recording special school radio programs; supplying sound effects and interpolations in school dramatics, etc.

The instrument comes complete with microphone, and operates on A.C.; a converter is required on D.C. The device both makes and plays 6-, 8-, 10- and 12-in. records at 78 r.p.m. This speed permits recording radio programs that utilize phono. records, and at the same time record your own accompaniment, on violin, piano, etc., as a "background." This composite recording may be immediately played-back. (Continued on page 691)



New crystal pickup. The off-set head results in better tone quality and longer record life. (1333)

## TANGENTIAL-HEAD CRYSTAL PICKUP (1333) (Astatic Microphone Lab., Inc.)

LONGER life for the records, better reproduction and easier needle loading are claimed for this new pickup. The offset head corrects the excessive tracking error of the straight-arm pickups; the error never exceeding 1.5 deg. from true tangency as compared to 10 to 15 deg. for straight types. Has ball-bearing base. This pickup is said to be free from resonance throughout the audible frequency range. A swing of nearly 180 deg. of the offset head permits the needle to be dropped in from the top. Length, from needle point to center of swivel pivot, 10 1/2 ins.

## METAL-TUBE RECTIFIER IN NEW METER (1334) (Radio City Products Co.)

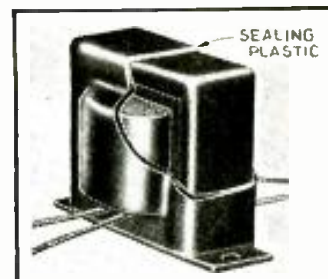
SEVERAL valuable improvements in test equipment have been achieved by the use of a metal-tube rectifier; instrument withstands heavy overloads, has no appreciable temperature, frequency or waveform errors, and the rectifier is easily replaced. This design supersedes the use of copper-oxide rectifiers. The A.C. voltages are just as accurate at 20,000 cycles as at 60 cycles! (Copper-oxide error: 25 to 60 per cent at 20,000 cycles.) The A.C. voltage scale is linear, and just as on D.C. Sensitivity, 2,000 ohms/volt on D.C. and 1,800 on A.C. D'Arsonval meter. Ranges: A.C. and D.C. volts 0/50/500/1,000 V. (4 ranges). D.C. micro A. 0—500, D.C. milliamps. 0/5/50/500 ma. D.C. Amps. 0.5 A.; 0/100/7,500/75,000 ohms (no external batteries are required), and 7.5 mega. Size, 5 3/8 x 8 3/8 x 3 ins. deep. Weight, 2 1/4 lbs.

## MOISTURE-PROOFED TRANSFORMERS (1335)

A PLASTIC coating of high melting point, black moisture-proof compound seals all exposed surfaces of a new line of audio and output transformers and chokes. The base is left clear of compound for firm mounting. Identifying numbers appear on this surface. Available in all the usual characteristics for components of this type, the new design should meet the approval of



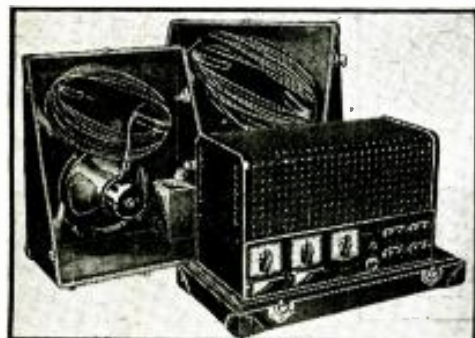
Improved meter. (1334)



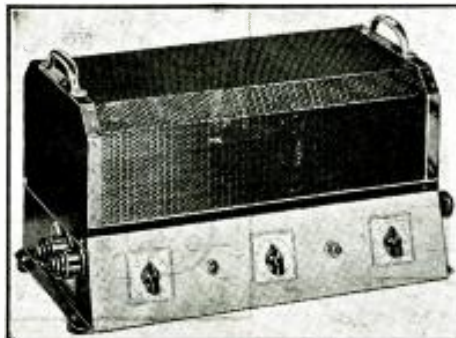
It's moisture-proof! (1335)



Panel amplifier. This 50-W. set-up will drive 50 dynamics. (1336)



New portable sound system. (1337)



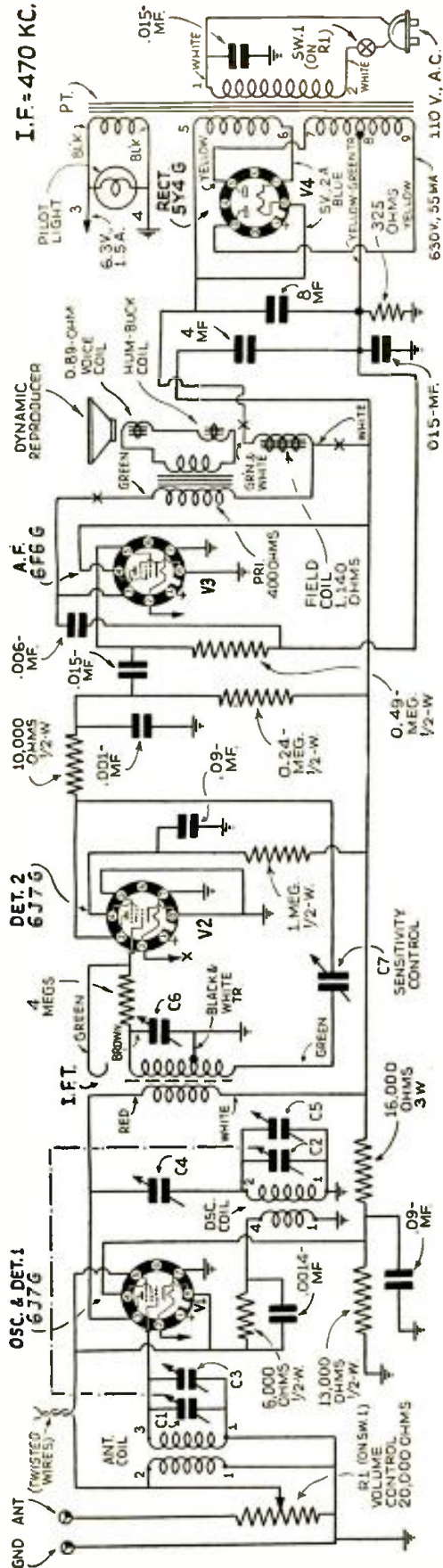
Deluxe 35-W. hi-fi P.A. system. (1338)



A tri-service recorder for school use. (1339)

## PHILCO MODEL 37-84, Code-122 (Used in Receiver Model 37-84B)

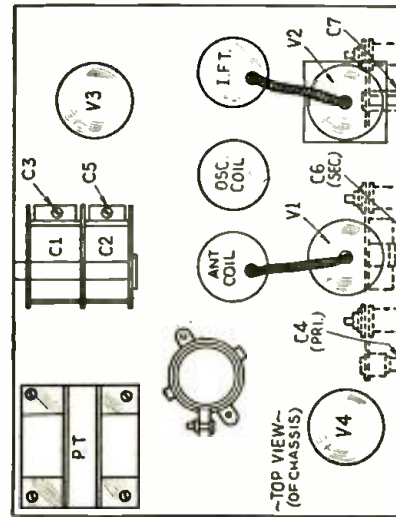
4-tube A.C. Superheterodyne, broadcast band 540-1,700 kc., regenerative 2nd Detector, Manual volume control, 1/2-W. output.



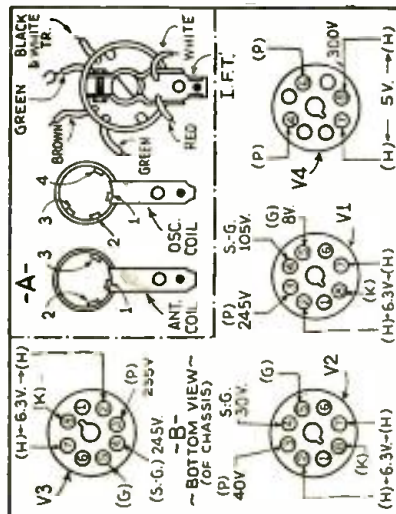
Circuit diagram of Model 37-84 Philco, showing resistances and color scheme of leads. Power consumption, 45 W.



Philco Model 84-B. This is the Baby Grand Cabinet (used also in Model 33-B, which is a battery-type receiver). There is only one control (volume and switch, below) in addition to tuning knob (center of dial). There are only 5 service adjustments for lining up.



Positions of compensating capacitors of Model 84. C7 is the regenerative feedback capacity.



A, coil connections; B, voltages (socket to chassis, read with 1,000 ohms-per-volt meter.)

stator and rotor; turn plates down till they touch gauge. Remove gauge carefully. Apply signal from test generator, at 850 kc., through a 100-mmf. condenser to aerial post. Using 2nd-harmonic (1,700 kc.), adjust C3 and C5 for max. output reading. Turn generator to 1,400 kc., tune gang on output meter. Turn sensitivity control C7 clockwise until a hiss is heard, showing V2 is in oscillation; turn it back counter-clockwise till hiss ceases, and then a quarter-turn more.

To adjust R.F. circuits, turn gang condenser to minimum capacity (extreme clockwise) and place a 6-thousandths-inch gauge (0.006-in.—just less than No. 34 wire gauge) between

wise to maximum capacity; then backward (counter-clockwise) 1 1/2 turns. Set signal generator to exactly 470 kc. (the set's intermediate frequency) and adjust compensators C4 and C6 (with insulated-handle tool) for maximum reading on the output meter. Turn sensitivity control C7 clockwise until a hiss is heard, showing V2 is in oscillation; turn it back counter-clockwise till hiss ceases, and then a quarter-turn more.

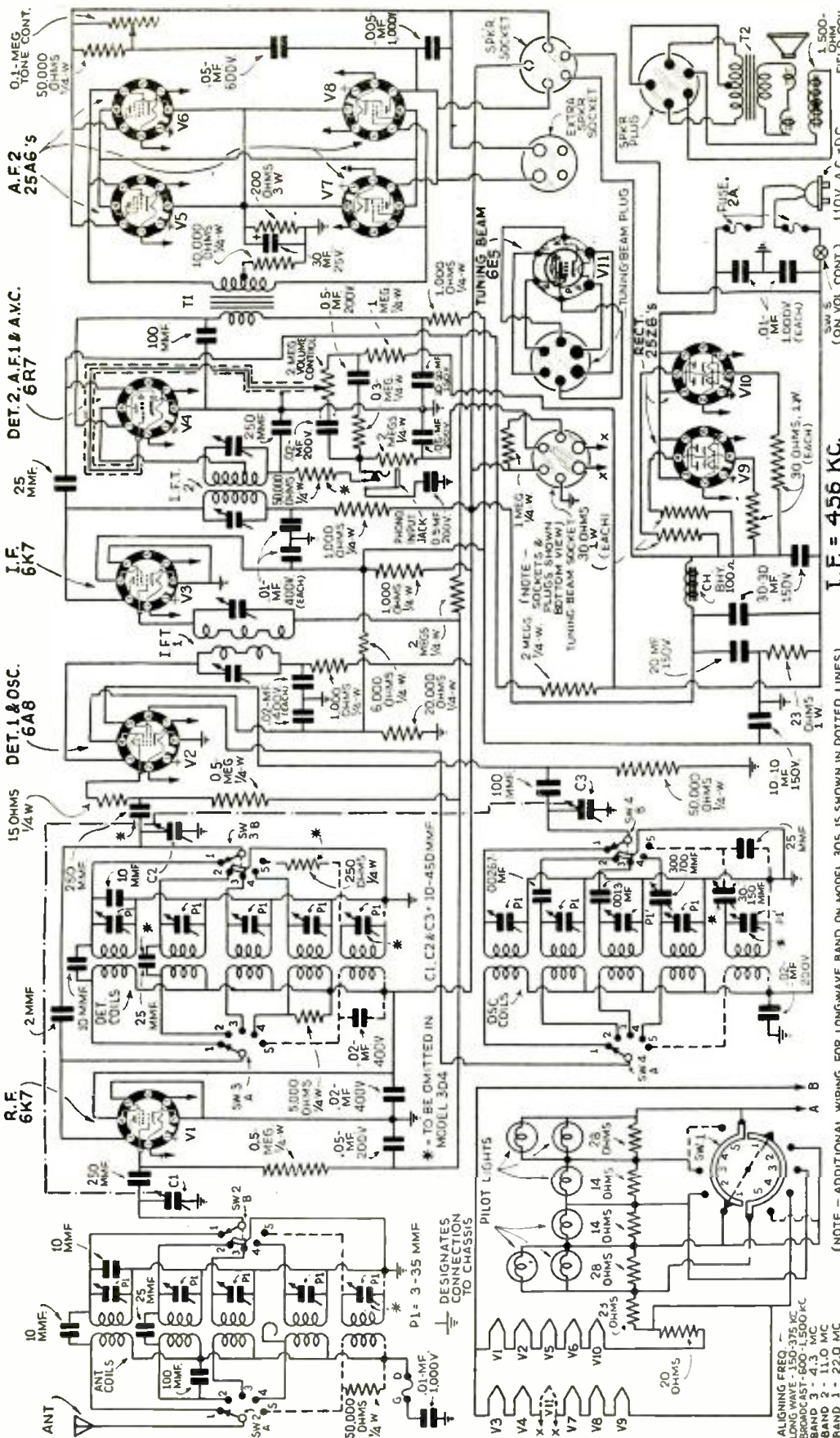
To adjust R.F. circuits, turn gang condenser to minimum capacity (extreme clockwise) and place a 6-thousandths-inch gauge (0.006-in.—just less than No. 34 wire gauge) between

To adjust Philco Model 84 accurately, a test signal generator of high-fidelity is needed, together with sensitive output meter. This should read up to 30 V., A.C., and be connected across plate and cathode (terminals 3 and 8) of V3. Set signal generator's attenuator to give approximately quarter-scale reading on output meter before commencing adjustment.

To adjust I.F. circuit, turn gang condenser to maximum capacity (counter-clockwise) and volume control to maximum (clockwise). Connect test signal generator to grid lead of V1 through a 0.1-mf. condenser, and generator ground to set chassis. Turn sensitivity control C7 (below V2) clock-

## PILOT MODEL 304 (Domestic) and MODEL 305 (Export)

11-tube A.C. Superheterodyne, 4- and 5-band (see below), vernier and cathode-ray tuning, A.V.C., A.C.-D.C. 110 V., double (parallel) class A push-pull, 4-W. output extra speaker socket, phono pickup.



least possible input, to avoid broadening peaks. The I.F. trimmers are on top of transformers; turn screws on I.F.T. 2 to max. output; connect external oscillator to control-grid of V2, and similarly adjust for max. gain. Repeat with I.F.T. 1. The R.F. alignments are made with 200-mmf. condenser connection from test generator to "Ant." beginning on the broadest band at 1,500 kc. first on oscillator trimmer, then interstage trimmer, then antenna section. Adjust the 600 kc. padder condenser (located in the lower rear partition of the band switch, under the chassis) for highest peak, with a 600 kc. signal. The 1,500 kc. trimmers are then readjusted. Band 1 adjustments must be made with care. In this model, on Band 1 only, 1st-Dea. and T.R.F. circuits remain on the high-frequency side of the oscillator.

**I.F. = 456 KC.**

beam connector cable. Voltages to ground, follow:	V1	V2	V3	V4	V5-A	V9-10
Plate	91	80	83	73	80	
S-screen-grid	91	49	40	0	90	
Cathode	0	0	0	0	12.5	00
Fil. (across)	46.3	6.5	6.3	6.3	2.6	26

\*On terminal 3 of V2. On terminal 4 there is 48 V.  
 †Filament series connections shown at lower left of schematic circuit.  
 ‡V11 has 6 V. between its plate and ground, measured through 1 meg. resistance; 6.3 V. on the filament; 90 V. from tuning-beam target to ground. Across speaker field, 90V.  
 The I.F. amplifier is aligned with test signal of 456 kc.

This receiver has 4 R.F. bands: from 12.7 to 570 meters (23,600 to 525 kc., continuous). In the Model 305 there is added a band, from 740 to 2,150 meters (405 to 136 kc.) for the reception of European long-wave broadcast stations. This model is not sold in the United States, but additional coil connections are shown here in dotted lines.

The 6E5 tuning neon tube appears in the center of the loudspeaker grille; whenever this set is serviced outside the chassis, a 6E5 should be plugged into the front socket on the set, to which this tube is normally connected by cable.

Removal of chassis from cabinet is in this order: remove line cord; dismount knobs and washers at front; remove cabinet back, take out speaker plug, remove 4 mounting screws under chassis, pull out chassis, and remove tuning

# 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.



A new Telefunken transportable 20-W. P.A. system in operation. All the components of this device are contained in 2 ordinary-size trunks. Darn clever, these Germans!

### NEON SIGN INTERFERENCE

RADIO-CRAFT, ORSMA Dept.:

Recently I was called upon to filter a neon sign, which was causing such interference that even local reception was impossible.

A line filter increased the noise still more! I then noticed that by touching one end of the tube a shock could be felt. Also an arc to the suspension chain could be seen when the area was shaded from light.

The remedy was simply to move the chain

over, an inch, which cleared up all the trouble.  
UNIVERSITY RADIO & KEY SHOP,  
Minneapolis, Minn.

### LESS BEGINNERS' ARTICLES?

RADIO-CRAFT, ORSMA Dept.:

I am a member of the ORSMA. In looking over some back issues of *Radio-Craft*, I ran across the letter of Franz C. Wells of Massena, N. Y. in the Dec., 1935 issue, in which he brings up a very interesting point. We have the same trouble in our town, and I thought you might be interested in an idea I have in mind.

If the radio publications on the newsstands would refrain from entering in their pages simple articles for beginners, such as "A Beginner's Sectional Test Panel" in the March, '35 *Radio-Craft*, there would be fewer greenhorns "gumming up the works" for the fellows who have spent a lifetime and a small fortune in trying to make a comfortable living. There would also be a lot more satisfied customers. By eliminating these articles, the greenhorns would have to resort to textbooks just as we did. If they haven't ambition to buy and study a textbook they have no business buying an instrument and gumming the works for someone who has.

Another thing that would help to clear up this situation is for these wholesale houses spread all over the country to stop sending catalogues to every Tom, Dick and Harry and selling parts at wholesale prices to them. The local dealers should be entitled to that part of the trade (I am not a dealer). There are a lot of kids in



The mike may be clipped into the back of the 4-unit loudspeaker or may be used at a distance. All power is obtained from a 12-V. storage battery. It's hard to duck this word barrage!

this town who don't know a condenser from a coil of wire, but they see a 1-tube diagram and buy the parts through a catalogue and then come in and ask me where this part and that part goes. They do this a few times and begin to think they know enough about radio to repair anything that comes along.

I think that *Radio-Craft* is a very good magazine, but please forget about the tinkerer and give us a Service Men's magazine with a few more Service articles.

EDWARD ROSMARIN,  
Hamilton, Ohio.



Fig. A. A 2-mf., 1,000-V. unit, Dykanol-insulated.

**D**URING the past year there has been a rapidly increasing trend toward higher power and better fidelity in high-grade receivers, transmitters and public-address systems. This improvement has been made possible by advances in the manufacture of component units.

The greater power-supply voltages required for maximum performance from apparatus employing such output tubes as the 6L6 beam-power types have accelerated the demand for high-voltage, high-capacity filter condensers capable of withstanding indefinitely the terrific strains under which they must function. Even the finest electrolytic types should not be employed in circuits where peak surges in excess of 570 V. may possibly be encountered. While high-voltage paper condensers have of course been available for many years, the size, weight and assembly difficulties of ordinary types have proved severe handicaps to designers, construc-

## WHY OIL-FILLED CONDENSERS FOR SOUND EQUIPMENTS?

The reliability necessary in P.A. work requires the use of condensers which are dependable under all conditions!

### WILLIAM BAILEY

tors and users when installed in apparatus where bulky, ponderous construction is objectionable.

#### OIL DIELECTRIC SOLVES PROBLEMS

Research laboratories have devoted years of intensive study to the problem of producing high-capacity, high-voltage condensers combining the excellent characteristics of the bulkier types with compactness and assembly simplicity of the can-type electrolytics. This research, by one organization, has culminated in the development of a line of "Dykanol"-insulated condensers that meet these qualifications. (The type shown in the photograph is rated at 2 mf., 1,000 V.) They have extremely high insulation resistance, and exceedingly low power-factor rating (As told, in detail, in recent issues of *Radio-Craft*—Editor).

The low power factor, being about 1/20th that of a dry electrolytic or 1/40th that of a wet electrolytic condenser, is one of the points of success in using this (non-poled) paper condenser.

#### IMPORTANT CIRCUIT CONSIDERATIONS

A choke input filter is always recommended when using electrolytic condensers in order to reduce the violent ripple produced by the rectifier which in turn is harmful to the condenser. It is for this reason that low-power-factor condensers should be used for the output of the

filter in conjunction with such tubes as the 6L6. This tube draws a high audio current from the filter.

This high audio current is taken from the output condensers; as the average frequency of the audio current is in the neighborhood of 1,000 cycles, the loss in the electrolytic condenser may be considerably more than it would be, 60 to 120 cycles, and hence could cause deterioration of the "litic."

Since moisture is permanently excluded, they cannot deteriorate from disuse (such as shelf life); as they are not electrolytic types, they may be used in any circuits without regard to polarity and they cannot dry out from heat.

#### AN "ASIDE" TO SERVICE MEN

In general service work dykanol-insulated condensers fill a long-felt need. Where high line voltages are prevalent, failure of the filter condenser immediately following the rectifier tube is most common. Since the peak voltage reached in this portion of the power-supply circuit often exceeds the voltage rating of any electrolytic type, replacements may have but a short life resulting in loss of time, money and prestige for the Service Man. This is particularly true of some of the smaller receivers in which small power transformers having poor voltage regulation are so often installed. When the radio set

(Continued on page 697)



**SPECIAL NOTICE**

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

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

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

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

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

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

**A.V.C. FOR A HI-FI RECEIVER**

(385) Nelson W. Kappes, Atlantic City, N. J.  
(Q.) Kindly print a diagram of an A.V.C. circuit that uses a separate A.V.C. tube (not the detector) and which is suitable for use in a T.R.F. "high-fidelity" tuner.

My tuner is somewhat like the tuner in the Radio-Craft High-Fidelity Set which was described on page 461 in the February 1936 issue of Radio-Craft. But, the A.V.C. in your set is not suitable for the type of amplifier I am building.

I am using 2 detector tubes in my set. What is the answer to this problem?

(A.) We are printing here, Fig. Q.385, an A.V.C. scheme which was used in one of the Atwater Kent receivers (type 310) with a few revisions. A type 56 tube (a 76 can be used if desired) is connected as a diode. The signal is fed to the grid of the control tube through a 250 mmf. fixed condenser connected to the plate of the last R.F. stage in the set. A portion of the R.F. signal is thus applied to the control tube which develops a voltage across the resistor R1. Since variations in the amplified signal will vary the voltage-drop across the load resistor, a varying negative voltage is available to be applied to the control-grids of the R.F. tubes, through suitable filters to suppress any A.C. component that may be present.

The filter resistor R2 feeds to the 1st R.F. grid-return circuit, while subsequent decoupling resistors R3, R4, etc., are used for the 2nd, 3rd, etc., R.F. grid-returns, depending on the number of R.F. stages used.

**LOW-VOLTAGE SUPERHET. OSCILLATOR**

(386) A. G. Halsberg, Scranton, Pa.  
(Q.) A few months ago, in the January 1937

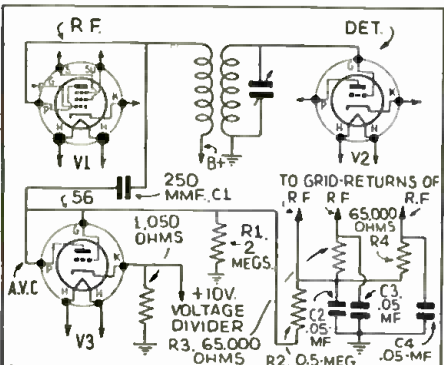


Fig. Q.385. A.V.C. circuit using a separate tube for the A.V.C. voltage development.

**RADIO-CRAFT'S INFORMATION BUREAU**

issue of Radio-Craft, you described a new "Current Saver" circuit for a new 18-tube all-wave receiver. In this article you mentioned a modified form of Colpitts oscillator which permits the set to run with reduced plate voltage.

Can you supply me with the circuit of this Colpitts oscillator? I am building a "custom built set" on a special order and would like to incorporate a tapped power transformer and special oscillator of this type in the set.

(A.) We are printing, in Fig. Q.386, the circuit you request, as furnished by the manufacturer—Midwest Radio Corp. The values of all condensers and resistors used in this commercial set are given, but the optimum values of these parts, as well as the coil details will have to be determined experimentally for your set.

You will note that a double tuning condenser is used—in other words, 2 sections of the gang tuning condenser will be required for the oscillator. This must be planned for, in designing your receiver. The cathode of the mixer tube is connected to the cathode of the oscillator, thus injecting the local oscillations into the mixer cathode stream. Only one coil winding is used for each tuning band—in contrast with the usual type of oscillator circuit which requires 2 coils coupled to each other.

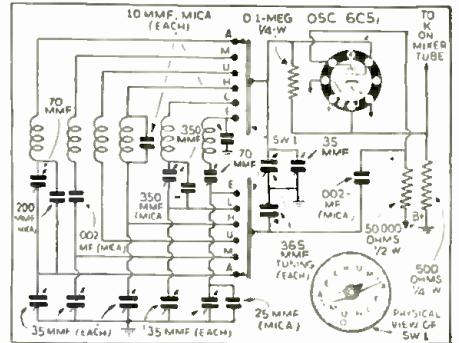


Fig. Q.386. Modified Colpitts oscillator which will function with only 30 V. on the plate.

Impedance is the combined effect of Resistance and Reactance. The kind of reactance depends upon whether the load is in the form of inductance or capacity.

Inductive reactance =  $2\pi fL$   
where:  $\pi = 3.1416$   
 $f$  = the frequency in cycles per second.  
 $L$  = the inductance in henrys.

Capacitive reactance =  $\frac{1}{2\pi fC}$

where:  $\pi = 3.1416$   
 $f$  = the frequency in cycles per second.  
 $C$  = the condenser capacity in farads.  
1,000,000

The latter equation becomes  $\frac{1}{2\pi fC}$  when the capacity is expressed in microfarads.

After the reactance of the load (in most cases it is a transformer winding and may be considered as an inductance—the capacity may be neglected with only a small error, except at high frequencies) has been calculated from one of the above equations, the impedance,  $Z$ , at the desired frequency can be figured from the formula:

$Z = \sqrt{R^2 + X^2}$   
where:  $R$  = the D.C. resistance.  
 $X$  = the reactance.

It is common practice to match lines for P.A. work at 400 cycles. Thus the factor  $f$  in the reactance equations becomes 400. The load can be matched at any desired frequency, however, by substituting the desired frequency for this figure.

It is a comparatively simple matter to substitute figures in the formulas given, thus determining, first, the reactance at the desired frequency, and second, the impedance.

(Continued on page 682)

**POWER LEVELS OF P.A. COMPONENTS—DETERMINING LINE IMPEDANCE**

(387) Floyd Hassell, Bellport, N. Y.

(Q.) Will you please do me the favor of explaining something about P.A. that I cannot find the answer to in past issues of your magazine?

(1) What is the difference between a "high-level" and a "low-level" input to an amplifier?  
(2) When should either of these be applied or used?  
(3) How can one determine the impedance of a "line" for a particular application?

(A.) The answer to your first question will be found in the clearest form in a chart prepared by Harold D. Weiler of the Fisher Distributing Corp., and printed for the first time on this page—Fig. Q.387.

This chart gives the comparative levels both in watts and in db. (decibels) for all the units employed in modern public-address work. For example, it will be noticed that a power level of 600 watts is equivalent to 50 db. plus (or as it is sometimes stated 50 db. up). A 15-W. amplifier will give a gain of 34 db. up, at full output, etc.

On this chart will be found such devices as carbon microphones, magnetic phono pickups, velocity microphones, etc. Each of these is at a certain power level on the chart. Those high up on the db. scale—only a few db. down—are high-level appliances and those at the lower end of the scale are low-level devices.

If an amplifier has a high- and a low-level input, this means that for low-level inputs or appliances such as mikes or pickups, an added stage or two of amplification is provided to make up for the loss in the appliance, so that the main part of the amplifier can be driven to full output. Such high-level devices as crystal pickups, magnetic pickups, carbon mikes, etc., provide a much stronger signal to the amplifier than those at the bottom of the chart, and thus need less amplification to drive the output tubes of the amplifier to full output.

In answer to your second question, we would advise a study of the chart mentioned above.

Your 3rd question is one which puzzles many radio men who have not delved deeply into the subject of alternating current electricity.

For practical purposes, you can measure the resistance of the line with an ohmmeter or a Wheatstone bridge and then calculate on the basis of the D.C. resistance thus indicated being approximately 2/3 of the impedance at 400 cycles. This is a "rule of the thumb" method which is sufficiently accurate for matching the output of an amplifier into a line and a loudspeaker, or to match a speaker transformer to a line, and such common problems.

If you wish a more accurate method, you must study the basic formulas governing the impedance. From a textbook on A.C. we find that

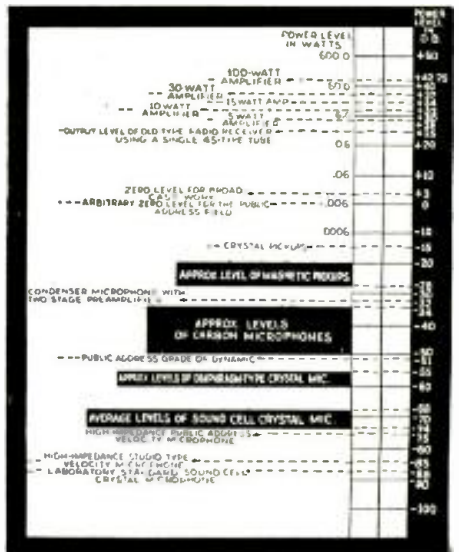


Fig. Q.387. Chart of the relative power levels of P.A. components in watts and db.

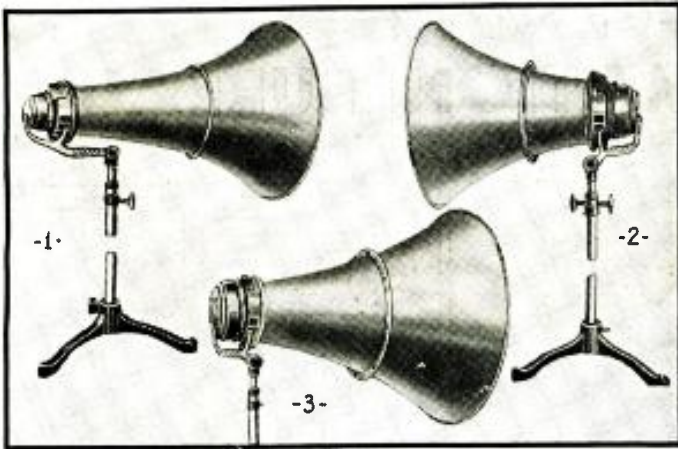


Fig. A. Three sizes of permanent magnet units.

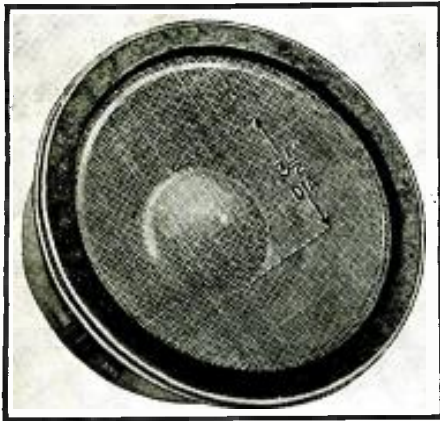


Fig. B. Quartz voice-coil form is used.

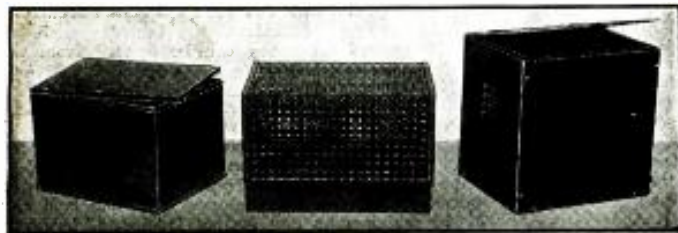


Fig. A. Amplifier cases of different sizes.

**A** QUESTION frequently asked by Service Men and other radio technicians is, "Does it pay to build your amplifier, or is it better to buy one ready made?"

Of decided aid to the P.A. builder is the availability of many special parts designed to make his job easier. No longer does he have to improvise chassis, transformers and other things picked out of the spare-parts box in the back of the store. While the actual P.A. circuits are simple, they involve much more power than radio receiver amplifiers and therefore require heavier components.

#### THAT "FACTORY" TOUCH

One strong argument in favor of ready-made amplifiers is their appearance—an important factor in selling or renting. Even that can be duplicated by the individual builder. Figure A shows 3 representative types of all-steel enclosures, which, when dressed up with appropriate name plates, shown in Fig. B, for the various controls will pass for factory jobs anytime. The center item is particularly recommended. This is an ordinary steel chassis, with a perforated cover. It is amazing to see what a difference the mere addition of the cover makes. The parts inside are concealed, scratches and uneven layout don't show, and the whole instrument takes on that much-desired professional look.

The box on the left in Fig. A has a removable cover, and is useful for preamplifiers and the like. The cabinet on the right has a hinged top, which permits storage of the micro-

## NEW P.A. SPEAKERS FOR OUTDOORS

Permanent-magnet air-column speakers which survive any weather find ready application by the sound specialist.

LIONEL B. CORNWELL

**P**UBLIC Address specialists will be glad to know that permanent-magnet (or "magneto dynamic") cone-type dynamic reproducers have been improved in design to the point where it is now practical to use them in P.A. services of all types.

Heretofore, the sound man has had to depend upon field-coil (or "electro dynamic") type dynamic units—and their attendant dependence upon a field-energizing unit of some sort connected to the power line or else provision in the amplifier for field-current supply—as being the only practicable types.

Permanent-magnet "dynamics" have been available in the radio set field for some time, but they are unsuited to the

rigorous, all-weather demands of outdoor P.A. set-ups, and the high-level operation in both indoor and outdoor usage.

#### "SET" AND "P.A." UNITS DIFFER

Just what are the constructional elements that differentiate the P.A. loudspeaker from the type designed for domestic operation in radio receivers? Let us analyze the set-up of the new permanent-magnet horns systems, designed for the sound specialist, with special reference to the "nipermag" (high-coercive magnet) type of one well-known pioneer in the new cast-alloy-magnet dynamic loudspeakers.

(Continued on page 701)

## MAKING HOME-BUILT AMPLIFIERS LOOK "PROFESSIONAL"

Cabinets and trimmings improve their appearance as well as their salability.

ALEX G. HELLER

phone, spare tubes, etc., if a small semi-portable amplifier is built inside. A wide assortment of sizes of these chassis and cabinets, suitable for all amplifier requirements, is

(Continued on page 684)

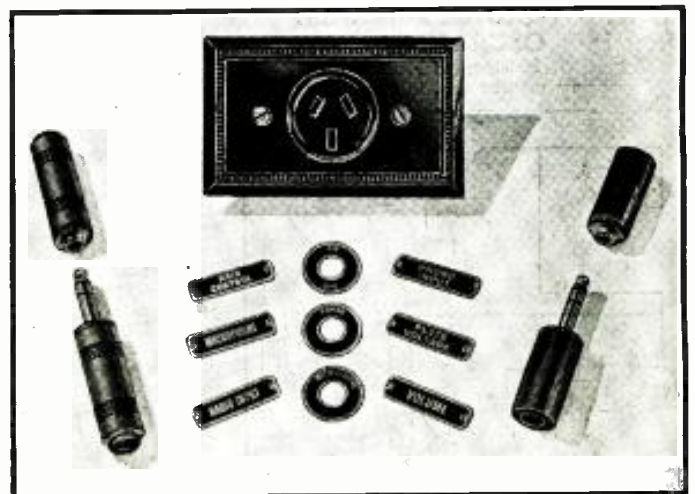


Fig. B. Some of the available accessories.

# "THE ETERNAL ROAD" INTRODUCES A NEW ERA IN THEATRE "SOUND"

(Continued from page 614)

The musicians see nothing of the performance but the orchestra leader observes the presentation through a desk-side window.

Instead of this "live" orchestra, a second orchestra, recorded on sound film, may be used where greater volume (and "color") is required; simultaneously, a second sound-film recording, consisting of choral and sound effects, may be superimposed on the first. Also available, but as "live" pickups, are an electric organ and the sounds created in a special sound-effects gallery.

Both the alive, and recorded, sound portions of the program are molded as to volume and other characteristics to suit the mood of the action, and then projected through the theatre-address system to the audience.

The director starts everything by pressing a button; and then monitors the combined output by means of headphones connected through a small amplifier to a microphone located above the audience.

The heart of the new sound system—the control console—is located in one of the boxes on the side of the second balcony. Seemingly magical results are secured through the manipulation of the controls of this console. In one part of the play, for instance, Moses supposedly talks with God. God seemingly replies to him, in a voice of stentorian proportions, through the medium of giant loudspeakers installed in the ceiling of the theatre thus creating the illusion that the voice is coming from Heaven. The dimensional and perspective effects of the sound system are also controlled from this console.

## HIGH-FIDELITY SOUND SYSTEM

Four sound-film machines are located in an enclosed chamber above the stage. They are operated by remote control. Using a new system of recording, known as "push-pull ultra-violet," the music reproduced from this sound film is superior to anything heard heretofore; too, this is the first installation of its kind. (See *Radio-Craft*, May 1936, pg. 616.—Editor). One machine substitutes a 60-piece symphony orchestra for the theatre's regular orchestra; a second sound-film unit contributes the requisite choral and sound effects.

RCA Photophone advises *Radio-Craft* that the frequency range is about 40 to 10,000 cycles, ± 5 db., at 32 acoustic watts output!

In the background of the stage, located on either side, are 2 semi-circular "coves" extending to a height of 80 ft. At the base of these concavities and facing them are 2 groups of loudspeakers each containing 4 units. Each group consists of a multi-cellular or honeycomb-like high-frequency trumpet and a giant medium- and low-frequency exponential horn. The sound system is so designed that the output of these loudspeakers is made to strike the coves which thereby conduct the sound upward and outward to the audience.

This effect is extremely valuable, for instance, in reproducing the music of the electric organ which, of course, has no reverberation as in the case of a real pipe organ. These coves help to provide a lag to make up this deficiency. They are not, however, used for the organ alone but also for certain sound effects as well.

Several banks of reproducers are concealed in structural parts of the scenery and are trained straight at the audience. Large baffle-type reproducers also occupy the boxes, which were formerly graced by jewel-bedecked women, and crown the dome of the theatre.

The "sound" for this gigantic theatrical performance, including the voices, music and sound effects, is provided by 2 high-fidelity, 80-W. amplifiers (though an output of 40 W. has been found adequate), and a 40-W. (reserve) amplifier. Occasionally, this 40-W. panel may be used for supplementary services.

The control of the giant electrical switchboard located in the basement under stage is, like other activities in this theatre, accomplished through the "whispering" ("private address") loudspeaker system. Its operators, guided entirely by commands from the prompter's box and by careful timing, see nothing of the show.

The dual prompter's box is hidden in a recess that faces and offers a clear view of the stage. The operator in the left-hand compartment con-

(Continued on page 678)



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

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

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

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

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

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**"THE ETERNAL ROAD" INTRODUCES A NEW ERA IN THEATRE "SOUND"**

(Continued from page 677)

controls the sound effects while the operator in the right-hand compartment supervises the lighting. Both accomplish this through the "whispering" loudspeaker system and manual control. Loudspeakers become "mikes" at the flip of a switch.

Altogether, this unusual collection of "new" P.A. devices opens up a new era in sound work. The unusual type of film recording in the talk-back communicating system which permits instantaneous control of lighting, cueing and

scene shifting; the unusual acoustical devices resorted to, in producing the difficult effects required for this extraordinary theatrical performance; the combined use of live and recorded orchestras, voices and sound, projected through an unusual high-fidelity system; and the careful engineering in permitting complete flexibility in all controls, make possible this classic example of neo-theatre technique—which everyone should make it a point to see.

Please Say That You Saw It in RADIO-CRAFT

## A STABILIZED FEEDBACK 6-W. 25L6 A.C.-D.C. AMPLIFIER

(Continued from page 659)

### THE PREAMPLIFIER

The preamplifier is a simple arrangement of 3 triodes, for use in an A.C.-D.C. circuit using two 6F5s for the low-level stages and one 6C5 for the output stage. Except for the feedback the circuit is conventional, and any existing preamplifier with sufficient gain may be similarly changed over. The feedback is in two parts, the first being from plate to input of the first tube to compensate for the input transformer characteristic, and to provide for equalization. The second is across the last 2 stages, from output to input of the 2nd tube, to minimize distortion in the 6C5 and to compensate for the slightly dropping characteristic of the output transformer. This feedback is also effective in reducing hum and tube noise. So far as distortion is concerned, with the feedback in, the final tube could be overloaded without serious distortion to the ear, although this is not recommended.

The 1st feedback may be varied by changing the amount of resistance in R2, thus varying the feedback ratio; furthermore, a choke and condenser are connected across this resistor so that it is effectively shunted at high and low frequencies, increasing the effective gain of the stage at these frequencies. The 2nd feedback is on the same principle except that no equalization is used. It is imperative that the feedback resistor R4 be connected to the correct side of the output transformer and the other side grounded. Should it be connected to the wrong side, oscillation will occur and the connection must be reversed.

### CONTROLLING OVERALL FIDELITY

Now we will tie-in the various controls on the amplifier with the response curves shown.

In Fig. 2A-1 we have the response of the amplifier with no feedback. Figure 2A-2 shows the amplifier with an input feedback, but minus the equalizer choke and condenser. Figure 2A-3 shows the output feedback all in, the input feedback being zero—that is, R2 = 0. The output feedback is controlled by R5; when R5 is a maximum the feedback is a maximum. Figure 2A-4 shows the amplifier with both controls and also the feedback at maximum. This response is

essentially flat except for the very low end. This may be equalized as we will show next.

Figure 2B-1 again shows the amplifier response with low feedback. Figure 2B-2 with input feedback alone and equalized for low frequencies; that is, R16 is at maximum and R15 is zero. Figure 2B-3 is the same except that the amplifier is now equalized for highs; that is, R15 is a maximum and R16 is zero. Figure 2B-4 shows the effect of the output feedback alone, with R15 and R16 both at a maximum. It is well to note that this response differs slightly from Fig. 2A-3 due to the fact that the latter was taken without the L2—R15—R16—C7 network connected. Figure 2B-5 shows the response of feedbacks in, and R15 and R16 at zero, allowing for maximum equalization.

Thus, by variation of the 4 controls any response within these limits may be obtained. It is not necessary to have variable feedback as fixed resistance may be used in place of R2 and R5, and 2 controls eliminated. The equalization may then be adjusted by varying R15 and R16, raising or depressing either the high- or low-frequency response. Note that changes in R2 and R5 will change the volume of the output, since they change the overall gain of the preamplifier. However, with R2 and R5 fixed, R15 and R16 may be varied to change the response without appreciably affecting the gain. For sake of comparison, the preamplifier has the following gains at 1,000 cycles:

- 1—with no feedback—68 db. (Fig. 2A-1 and 2B-1)
- 2—with input feedback—62 db. (Fig. 2A-2)
- 3—with output feedback—57 db. (Fig. 2A-3 and 2B-4)
- 4—with both feedbacks—51 db. (Fig. 2A-4).

It is well to realize that these are voltage ratios of 2.5, 1.25, 1.0 and 0.26, which perhaps more clearly illustrates the effect of feedback.

### A PRACTICAL APPLICATION

In the succeeding Part the writer plans to present the complete circuit with the main amplifier using 25L6 tubes in a new way that permits an output of 5 to 6 W. to be secured, in A.C.-D.C. operation, at low hum level and with almost perfect power-supply regulation.

## INTERNATIONAL RADIO REVIEW

(Continued from page 658)

A.G. television receiver which appeared in a recent issue of *Fernsehen und Tonfilm* (Berlin) is shown in Fig. B.

Because of the massive dimensions of the individual chassis which make up this set, a frame of steel tubing is used to support the set as well as the front panel, and 3 wheels are mounted on the base of this frame to permit moving the set from place to place. The weight of the set and the necessity for careful handling because of the large cathode-ray tube make this method of construction necessary.

### ALPHABETIC TUNING DIAL

A NEW LINE of radio receivers, described in a recent issue of *Wireless World* (London) is equipped with unusual tuning dials.

The dial consists of a rotating cylinder marked with a series of lines terminating in small circles at points corresponding to the station wavelength. The stations are listed alphabetically, according to location, and all that is necessary when a certain station is desired is to watch the corresponding leading line and tune until the terminating circle is bisected under the stationary index line. Wavelength scales are also provided at the top of the dial drum to assist in finding stations not included in the list. See Fig. C.

The stations, being listed alphabetically, are easily located by this novel means.

### A 4-TUBE PORTABLE

AN INTERESTING portable receiver—small in size and light in weight—was described in a recent issue of *Wireless Retailer and Broadcaster* (London). The set is a 4-tube regenerative T.R.F. set using a screen-grid tube as R.F. amplifier; a triode as regenerative detector; a triode 1st A.F. amplifier and a tetrode output

tube feeding into a permanent-magnet speaker.

The set covers two bands, the regular broadcast band and the long-wave European broadcast band, having a tapped loop aerial for pick-up, enclosed in the cabinet.

The appearance of the set is shown in Fig. D. The set is operated from small-size dry batteries.

## A COURTROOM P.A. SYSTEM

(Continued from page 655)

excellently.—Editor)

In most of the courtrooms, the amplifier is placed under the judge's bench. Each amplifier has a (a) volume control, (b) high-frequency control, (c) low-frequency control and (d) medium-frequency control. These frequency controls compensate for the high-pitched or low-pitched voices of the various judges. (An Amplifier Co. of America product is illustrated, in insert, on page 655.)

One of the larger courtrooms utilizes a total of 8 speakers, 6 of which are mounted on columns (similar to one shown in one of the photos). One of the speakers is out in the corridor and the amplifier is equipped with a special selection switch which provides for shutting off this outside speaker. The remaining speaker of the 8 is placed on the front wall directly over the jury's box and therefore volume control is provided-for on the amplifier which enables complete control of the sound level of this one speaker so as to avoid audio feedback.

The success with which this P.A. system has been used in the busy New York Court points the way to many such installations in all the large courtrooms throughout the country. Progressive P.A. specialists will find this tip a profitable one.

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## CLAIRVOYANT DR. FOX

(Continued from page 660)

Jessner, if you believe in me. And you will believe! But my soul was as strong as an ox's, and I didn't believe a thing.

Later I met my fellow-patients, all terribly nice people, but they thought Dr. Fox was more than an earthly being. One man explained to me, when I expressed doubt about this opinion: "From him comes all salvation, for he alone knows the future. You will soon be convinced of it yourself."

No communication was permitted with the outside world. But we could read all the newspapers we wanted to, and the radio was turned on for one hour each day, at noon.

We all ate our meals at one large table. When Dr. Fox entered, I noticed at once the deep respect that his patients felt for him. After the meal, a deathly silence fell, everyone looked at the doctor, who appeared to stare into the distance, with wide-opened eyes. The strained silence began to become intolerable. Finally the doctor passed his hands across his eyes and got up.

"How are things today, Doctor?" asked the thin, frightened voice of an elderly lady.

"Ah, my friends," said Dr. Fox, seriously, "tonight there will be a railroad accident in Canada. Seven persons will be killed and twenty-three injured. Tonight the French cabinet will be overthrown. In Boston, the eleven-year-old son of the banker Smith is being kidnaped, and in New York, a drunken man will kill a policeman at midnight." With lowered head, Dr. Fox left the dining room.

"What kind of ridiculous nonsense is this?" I said, breaking the intense silence.

"Good heavens, man, don't talk that way—it's a sin!" answered my neighbor, and angrily walked away from me. All this happened the day after my arrival—that is, the 24th of January. It was the next afternoon. The doctor had treated me psychically and had wasted his powers of suggestion on me. I was terribly bored. The morning papers did not arrive from New York until afternoon, so I went into the library and dozed over a learned book. A gong sounded to notify the patients that the hour of radio broadcasting was about to begin. When I entered the room in which the radio was, the other patients had already assembled there. The familiar voice of a New York announcer identified itself, and began the noon news report.

"Last night, there occurred a serious railroad accident. The Montreal Express collided with a freight train at Winnipeg. Seven dead and twenty-three injured were found in the wreckage."

I wiped the cold sweat from my forehead.

"The French cabinet resigned last evening," continued the voice of the announcer, and then one after the other, all the prophecies were fulfilled.

"Doctor," I said later, meeting the doctor in the hallway, "perhaps you could tell me who will win today's baseball game in New York?"

"You should not ask that kind of question," answered the doctor. "These things are too serious for you to apply to such frivolous subjects. You must believe in me, Mr. Jessner! But this time, I will make an exception and tell you: The Philadelphia team will win, with a score of eleven to one."

The next day, I heard it over the radio, and read it in the papers. Philadelphia had actually won, eleven to one!

And so, quite often, the doctor would utter his prophecies while we all sat at the table, and always the prophecies were fulfilled. Once I asked him: "Why don't you warn people if you foresee their catastrophes with your unbelievable powers?"

"God does not will it so," sighed the doctor. "It does not lie in any man's power to interfere with destiny."

One day I wanted to telephone to New York, but I was not permitted to. They reminded me of the rule of the establishment, which I had committed myself in writing to obey.

"You have made good progress," Dr. Fox said to me one evening. "Now we come to the end of your cure. I shall give you another injection. You will sleep long and soundly, and when you awake, go back to New York, and you will find yourself cured of your psychic suffering."

I went to the laboratory, where the injections were made, just as the doctor was filling a hypodermic syringe with a clear fluid. At that

moment, the doctor was called to the telephone and left the room. He came back a minute later, but I had time enough to put water in place of the liquid in the syringe.

"Go right to bed," said Dr. Fox, after injecting the water. "You will sleep very soundly."

I went to my room, put my watch on the table, and sat up all night, without sleeping a single minute. I did not lie down in the bed until 3 o'clock in the morning, and when the doctor came into the room, I pretended to be very sleepy. I let him shake me a long time to wake me, and made the stupid face of a person just waking up, rubbed my eyes at the same time. The doctor spoke to me, and I let him have his say and acted astonished. Then I jumped out of bed and said, "That's enough, you old thief. Either you give me half of the profits, or that's the end of your swindle. I've been in need of a secure income."

Jessner interrupted his story at this point and emptied his glass.

"A swindle, I suppose," I said. "but still, how was it possible, and how did you find out about it?"

"Very simple," explained Jessner. "When the doctor came to wake me up that morning, he said to me, 'Do you know how long you slept?'"

"I have no idea," was my answer.

"Almost 36 hours," said Dr. Fox, "the sleeping potion worked well."

"Naturally this made the whole thing clear. When I came into the place I had been given a sleeping potion, and I had really slept 36 hours then, without knowing it. That's why I was so terribly hungry when I woke up. That's how all the patients were handled, and even the servants, except the old housekeeper and one nurse, who know the scheme. The servants were well paid, but they could not leave the premises or get visitors while they were employed there. By means of this sleep of 36 hours, a whole day was stolen from us, and we knew nothing of it. That's how the doctor had a 24 hour advantage over us and when we got the newspapers they were a day old."

"And what about the radio?" I interrupted Jessner.

"Very simple. Each day, Dr. Fox would record an hour's broadcast on a phonograph record, and we got the canned news dished up to us 24 hours later. The loudspeaker was connected with the suitable apparatus in the next room, by means of wiring. And when the cure was at an end, the patients would be given a light dose of sleeping potion, so that they would be slightly drugged when they awoke, and willingly believed that they had slept 36 hours. That adjusted them to the correct date, and the patient was then brought directly to the station, without giving him the opportunity to see or speak to any of the other patients, who were remaining. Since then the clairvoyance of Dr. Fox has been giving me an income of \$500 a month," concluded Jessner, and looked quite pleased about it.

## INFORMATION BUREAU

(Continued from page 675)

### HOW TO "PHASE" MICROPHONES!

(388) Mr. Arthur B. Schultz, Olympia, Wash.

(Q.) Why is it that when I use one microphone with my amplifier on the stage I get very nice results, but when I use 2 microphones, I get most unsatisfactory results? I use electronic mixing, feeding each microphone into separate tubes and cannot understand why one microphone should have this effect on the other one.

(A.) There is just as much importance in phasing microphones as there is in phasing speakers. Otherwise, the voltage generated by one microphone will be balanced-out by the voltage generated by the other microphone. The phasing relation is very simple to test by turning one of the microphones 180 deg. around while placed close to the other microphone. When they are in phase the volume will be much greater than when they are out of phase.

Incidentally, when two speakers are thus phased, this phasing is only effective at certain angles, cancellation continuing from certain directions. Read "New Directional Mike Has Infinite Baffle" on page 654.

Please Say That You Saw It in RADIO-CRAFT

## INTRODUCING—A CATHODE-DRIVE HIGH- FIDELITY 32-W. BEAM AMPLIFIER

(Continued from page 665)

110 V. A.C. power lines. The construction of this alternator is most unusual; its detailed description, in Part II, will interest the sound specialist. (A view of the alternator contactor is shown in Fig. A.)

### THE POWER SUPPLY AND RECTIFIER

The problem of efficiently providing high D.C. voltages from a storage battery has always been an acute one. Many attempts have been made to produce the desired results by employing vibrators, dynamotors, motor-generators, inverters, rotary converters, etc., but all of these units have always been characterized with some inherent disadvantage such as low-efficiency, high-cost, unreliable operation, limited power output, poor regulation, high hum level, low safety factor, large bulk, or excessive weight.

The high efficiency of a well-designed power transformer is generally recognized; efficiencies ranging from 95 to 98 per cent are easily attained in commercial practice. It is for this reason that this type of voltage step-up is employed. A cursory examination of the schematic circuit will reveal the presence of 2 "primaries" on the power transformer, one for conventional 110 V. A.C. operation and one for 6.3 V. use. This latter primary is of course connected to the motor-driven alternator which changes the direct current of the storage battery to alternating pulsations corresponding to a frequency of 60 cycles. It can readily be understood how this current when fed into its appropriate winding will produce corresponding high voltages in all of the secondaries. Of course, during 6 V. operation, all of the filaments are connected directly to the storage battery. This is one of the major improvements over the unit previously described (September 1936 issue) as the latter chopper (or pole-changer) system dissipated 15 W. in isolating the 83 tube from the storage-battery circuit.

By referring to Fig. 2A it will be noted that an unconventional system of rectification is employed in this novel amplifier system. A detailed description of its design, and operation will be found in Part II of this series.

Another important circuit innovation has been incorporated in the design of the degenerative driver which provides for proper operation of the output tubes under true high-fidelity conditions. See Fig. 2B.

Although the power output tubes are characterized by low inherent distortion the performance of the driver is of the utmost importance as this stage is the usual source of excessive distortion. The degenerative driver employed utilizes the famous reverse-phase feedback principle by the degenerative effect introduced in the cathode circuit of the 6C5.

The theory of operation and the advantages of this type of circuit will be described in Part II of this article.

In the meantime, however, the author will be pleased to answer all inquiries addressed to him in care of *Radio-Craft*, relative to this or any other type of amplifier or public-address sound system.

### RADIO TRADE GUIDE

Dealers and Service Men in the New York area will find this handy card (listing radio, electrical and music companies, their trade names and products, as well as New York distributors, their addresses and phone numbers) an invaluable aid in their work. The card 14 x 22 ins., and printed on both sides, was originated by Sidney S. Risser. Write to *Radio-Craft* and ask about No. 1349A.

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**INVESTIGATE - GET THE FACTS**

**MAKE THE RADIO-CRAFT MIDGET OSCILLOSCOPE**

(Continued from page 666)

which is quite necessary to make the pattern on the 913 screen come out on the correct plane. The socket should be wired in with pin No. 1 uppermost, and any slight correction may then be made after the tube is in operation by simply turning the socket in its plate.

Wiring should start with all A.C. leads, that is, the power transformer primary and all heater leads. A good deal of shielded wire was used in the original model, all leads in the input circuits and "hot" amplifier plate leads being so covered.

All resistors except the two in the voltage dividers are of the insulated, 1/2-W. size.

All fixed condensers of over 0.005-mf. except electrolytics are of the newly-developed "molded paper" type. These are about the size and shape of dominoes and many can be packed into the small space available.

It is suggested that the complete high-voltage circuit for the 913 be hooked up first and the tube tried. If it is possible to obtain a small round spot by manipulation of the focus and brilliancy controls, then the rest of the apparatus may be wired.

If all wiring is correct, the oscilloscope should work perfectly at the first try. It is suggested that the builder connect an A.C. source of about 2.5 to 5 V. to the "V" input terminals and experiment with the various controls to become acquainted with their action. Do not worry if the controls appear to "interlock" or affect one another. This is quite correct and will be found to be usual in other oscilloscopes as well.

The "trench mortar" or "cannon" mentioned previously is not a necessity, but is a great convenience. The large tube may be of any metal, but steel is to be preferred for its magnetic shielding qualities. If a magnifying glass is to be used, the tube may be obtained of a size to fit it. The mounting should be of "universal joint" type—flexible both in a circle and vertically—and may be made in any convenient manner, the one shown being built up of aluminum strip. A ball and socket joint (as used on some mike stands) is another good bet.

No attempt will be made to describe the use of this instrument since such use is now quite widely known. There are several excellent books on the subject which cover the field thoroughly. Also, recent issues of *Radio-Craft* have gone into the subject rather extensively, and from both the theoretical and practical or application angle.

So go to it, you Service Men, and let the motto be "Two oscilloscopes in every shop!"

**MAKING HOME-BUILT AMPLIFIERS LOOK "PROFESSIONAL"**

(Continued from page 676)

available at reasonable prices.

Practically all of the small parts that were considered "special" only a few years ago are now obtainable everywhere. Many a Service Man who made his own amplifiers used to wrap friction tape and tinfoil around his mike cables to shield them, and had to make friends with a local telephone repair man in order to get 3-contact plugs and jacks. These parts and many others are common items today. Gone is the day when the constructor made his own connectors out of tube bases and sockets, and always had trouble with the lines pulling apart just as the town dignitary stood up to make a speech!


A big help in enhancing the appearance of shop-built amplifiers is the use of etched panel plates for the various control knobs, switches, input and output terminals, etc. See Fig. B, which also shows shielded and unshielded 3-contact plugs and jacks and a 3-contact polarized connector. More than 70 different markings, shapes and finishes are on the market—enough to fill any need. Their cost is insignificant, their effect valuable. Often the simple addition of a grille cover and a handful of little name plates transforms an obviously home-made amplifier into a factory-looking job.

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## A 60-W. PUSH-PULL PARALLEL BEAM AMPLIFIER

(Continued from page 661)

great, and satisfactory power-supply regulation is easily attained. Also, grid current does not flow, which simplifies the driver stage; this results in improved frequency response, less waveform distortion and greater overall gain. The total cost of the amplifier is about the same as when using two 6L6s in class AB sub-2 and better than 60 W. output is delivered with negligible distortion.

Although self-bias is used, inspection of the circuit diagram will show that only the plate current of the final stage passes through the bias resistor. This method is possible since a separate type 83 rectifier tube is used for the 6L6 plate supply. A type 80 rectifier supplies the 6L6 screen-grids and balance of the amplifier. Improved bias regulation results inasmuch as the plate-current change from zero signal to full output is only 14 per cent, whereas the combined plate and screen-grid current would vary 21 per cent. Since one pair of tubes will deliver 32 W. with 2 per cent distortion using conventional self-bias, the distortion is even less with this self-bias system.

The driver stage is not designed to supply power to the 6L6 grids and therefore is similar to one used with class A output tubes. A 6E5 electron-ray tube is employed to indicate when the 6L6s draw grid current which occurs at 60 W. output with properly adjusted tube

voltages. No distortion will develop in the driver stage if the amplifier is operated below the point of grid current as indicated by the 6E5.

In keeping with modern practice, the amplifier has high gain (122.5 db. from a crystal microphone) and is complete in itself. If high gain is not required, a single 6C5 input stage may be substituted for the preamplifier and mixer as shown between the dotted lines in the diagram, Fig. 1.

The mixer and fader circuit employed is new to the P.A. field. Input circuits are provided for 2 low-level, high-impedance crystal or velocity microphones, high-impedance phono or radio set, and low-impedance phono or line. Some of the mixer features are given in Table I.

TABLE I  
MIXER FEATURES

- (1) Individual level control of each input circuit.
- (2) Any 3 input circuits may be mixed together.
- (3) Two microphones may be faded against one another with 1 control.
- (4) One microphone may be faded against phono circuit with 1 control.
- (5) One microphone may be faded against line circuit with 1 control.
- (6) Two microphones may be faded against one another with phono mixed in.
- (7) Two microphones may be faded against one another with line mixed in.
- (8) One microphone may be faded against phono with line mixed in.
- (9) One microphone may be faded against line with phono mixed in.
- (10) One microphone may be faded against phono with other microphone mixed in.
- (11) One microphone may be faded against line with other microphone mixed in.
- (12) Phono may be faded against line with 2 controls.

This article has been prepared from data supplied by courtesy of Thordarson Electric Mfg. Co.

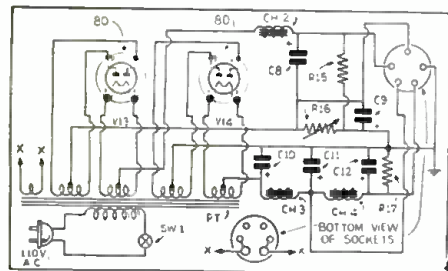


Fig. 2. Schematic circuit of the power supply.

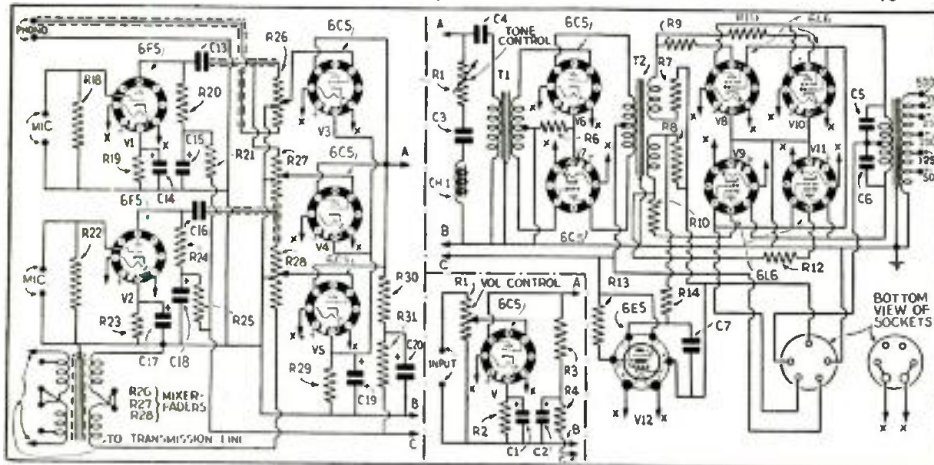


Fig. 1. The schematic circuit of the amplifier and two preamplifiers:— 1 channel and 3 channel.

### OPERATING NOTES

(Continued from page 669)

silencing 78 and 1st A.F. (77) tubes, respectively. The shadowgraph tuning indicator employed on those models although not subject to breakdown or failure due to burnout as was common with former models, is definitely the cause of the condition whereby 2 resonant peaks are indicated when the receiver is adjusted to resonance. By this is meant that as the receiver is slowly tuned to station resonance, the shadowgraph which normally indicates resonance by the narrowing of the shadow on the translucent screen upon the point of resonance, indicates 2 such points of resonance just before and just after the true point of resonance with a slight widening of the shadow between these 2 peaks. This condition is caused by either a bent vane shutter within the shadowgraph or by the binding of the vane shutter. Although the shadowgraph may be repaired when the proper instruments or tools are employed and the operator is familiar with its mechanical and electrical construction, the job at best is tedious and often does not warrant

the time expended, considering the cost of a replacement.

Fading on the short-wave bands or oscillator drift is frequently caused by poor bonding of the tuning-condenser gang to the chassis. Heavy flexible pigtails which will not interfere with the action of the gang or its floating upon the rubber supports should be soldered or mechanically secured between the condenser assembly and the chassis in such manner that perfect electrical contact is secured. The rotor-shaft contacts occasionally produce the same complaint. These are easily cleaned with a stiff brush and carbon tetrachloride.

Very weak reception, if any at all, on the lowest short-wave band, which is the 5th band on these models, where such condition is not occasioned by poor alignment or some circuit failure, may be improved considerably by increasing the plate voltage on the type 76 oscillator tube. This is most easily done by changing the

(Continued on page 690)

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TAVELLA SALES CO., 21 West Broadway, New York, N. Y.

**AN EASILY-BUILT 4-TUBE BROADCAST SET**

(Continued from page 663)

frequency whistle is present on the station carrier.

Semi-fixed bins on the control-grid of the type 41 tube was found to be preferable to self-or cathode-bias due to less change in plate current with variations in grid signal voltages.

The power transformer should be larger than the common run of midget transformers. One that usually would be used with 6 tubes and supplying about 60 ma. will suffice. Voltages in the set are 250 V. "B+" and 90 V. on the R.F. screen-grid. Grid voltage on the 41 tube should be about -18 V. This should be read from the midpoint of the two resistors across the speaker field to ground with a high-resistance voltmeter. The rest of the voltages will adjust themselves to the proper values. A station signal near 1,300 KC. may be used to adjust the variable condenser trimmers for maximum gain without oscillation.

**LOUDSPEAKER DATA**

The speaker used with this set determines to a large extent whether there will be bass. No doubt some who build this set will think that it is not possible to obtain high quality from a 6-in. speaker, but here is how.

Select a speaker that has a 1-in. voice coil, a large field coil, and a large output transformer. The purpose of the large field coil is to create greater magnetism at the pole piece. At normal operation, the field coil should become warm. It is for this reason that a larger power transformer and bleeder if necessary, is specified. A small output transformer, especially the pee wee type so prevalent on many reproducers, will obviously not allow good tone.

The movement of the cone should be extremely flexible and springy, with a large excursion of the voice coil. To those who know how to rebuild speakers: use a soft paper cone with double corrugations at the edge, or better yet, make a free-edge cone with soft leather strips. A large outside spider of thin material is best for flexibility. If the voice coil will remain centered without a spider, it will be to the advantage of bass notes. A larger speaker may be used, but the same specifications should be followed in regard to the easy movement of the cone which is very important. An absence of bass indicates that some of this data on the speaker has been lightly regarded or overlooked. The loudspeaker pictured is an \*F5 series, manufactured about two years ago, although the current model F5B is not of the same type.

Theory and practice has told us that a large baffle is essential to good low-note reproduction, and this set is no exception, so that banishes any midget cabinet. Use a console cabinet, a

large one being the best, and do not deceive people as to what is inside of the cabinet.

**CONSTRUCTION**

No special layout of parts is necessary. The constructor may drill his own base or use a base which is already punched and will permit an intelligent layout. A large chassis base to eliminate crowding is desirable and may be the means of decreasing hum. The 6C6 detector tube and the tuned choke should be placed far from the power transformer and all leads around this plate choke circuit kept short. Beyond the necessary precautions of keeping the control-grid leads short and doing a good soldering job, little is left to say about construction.

**A TIP TO SERVICE MEN**

A good tip to Service Men (the writer also being of the brotherhood) is to install this chassis in old consoles in which the radio receiver has become inefficient due to old age, etc. Thousands of these old radio sets are waiting for modern tone and an up-to-date airplane dial.

The cost of such an installation need not be in competition with price slashing of midgets, which is so prevalent in this city (Chicago) where the writer is located, or any other large city.

The writer will be pleased to answer any letter, addressed in care of *Radio-Craft*, if a stamped return envelope is enclosed.

**LIST OF PARTS**

- Two Meissner shielded coils. 1 ant., 1 R.F., L1, L2;
  - One Radolek 2-gang condenser, 365 mmf., C1, C2;
  - One Aerovox condenser, 0.1-mf., 200 V., C3;
  - One Aerovox condenser, 0.25-mf., 400 V., C4;
  - Two Aerovox condensers, 0.05-mf., 600 V., C5, C6;
  - One Aerovox condenser, 0.5-mf., 200 V., C7;
  - One Aerovox mica condenser, 250 mmf., C8;
  - Two Sprague electrolytic condensers, 10 mf., 35 V., C9, C10;
  - Two Sprague cond., 0.01-mf., 600 V., C11, C12;
  - One Sprague electrolytic condenser, 12 mf., 500 V., C13;
  - One Cornell-Dubilier electrolytic condenser, 4 mf., 500 V., C14;
  - One Cornell-Dubilier electrolytic condenser, 2 mf., 500 V., C15;
  - One Centralab potentiometer, with switch, 10,000 ohms, tapered for ant. "C bias" control, R1-Sw.1;
  - One Continental Carbon Co. resistor, 300 ohms, 1/2-W., R2;
  - Two Continental Carbon Co. resistors, 0.75-meg., 1/2-W., R3, R4;
  - One Electrad wire-wound resistor, 15,000 ohms, 5 W., R5;
  - One Electrad wire-wound resistor, 10,000 ohms, 5 W., R6;
  - One Continental Carbon Co. resistor, 75,000 ohms, 1/2-W., R7;
  - One Continental Carbon Co. resistor, 20,000 ohms, 1/2-W., R8;
  - Two Continental Carbon Co. resistors, 50,000 ohms, 1/2-W., R9, R10;
  - One Continental Carbon Co. resistor, 0.25-meg., 1/2-W., R11;
  - One Continental Carbon Co. resistor, 0.15-meg., 1/2-W., R12;
  - One Continental Carbon Co. resistor, 0.5-meg., 1/2-W., R13;
  - Two Continental Carbon Co. resistors, 1 meg., 1/2-W., R14, R15;
  - \*Two wafer sockets, 6-prong;
  - \*One small wafer socket, 7-prong;
  - \*One wafer socket, 4-prong;
  - One Meissner high-impedance choke (see text), Ch.1;
  - One Kenyon power transformer to supply 250 V. D.C. at 60 ma., T1;
  - Four Raytheon tubes, one each types 6F7, 6C6, 41, and 50, V1, V2, V3, V4;
  - One Radolek S.P.S.T. rotary switch, Sw.2;
  - One Radolek airplane dial;
  - \*One dynamic speaker, 2,000-ohm field, output to match type 41 tube (see text);
  - One Allied Radio Corp. chassis base;
  - Two Radolek tube shields with bases, A.C. cord, knobs, wire, hardware, etc.
- \*Names of manufacturers will be sent upon receipt of a stamped and self-addressed envelope.

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- Simpson Roto-Ranger Tube Tester No. 220—with 950 tubes; deposit \$33.00.
- Simpson All-Wave Signal Generator No. 210 (AC)—with 800 tubes; deposit \$28.00.
- Simpson Roto-Ranger Volt-Ohm-Milliammeter No. 201 —with 500 tubes; deposit \$15.00.
- Simpson Roto-Ranger Volt-Ohm-Milliammeter No. 202 —with 550 tubes; deposit \$17.00.

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Please Say That You Saw It in RADIO-CRAFT

## HOW TO SELECT LOUDSPEAKER BAFFLES AND HORNS

(Continued from page 661)

sound waves. Acoustic feedback difficulties are alleviated and the low-frequency response emphasized by the fully-enclosed speaker housing. The bass tones may be decreased by providing a number of "air release" holes at the back of the housing. About 24 holes, 1/4-in. in dia., equally distributed, have been found to be very helpful with speakers having excessive bass or apparently insufficient highs.

**Directional Baffle.** A widely-used type of directional baffle having a large variety of uses is of the "knockdown" construction that is quickly and easily assembled with a small spintite socket wrench. Many P.A. technicians use the flared section only for indoor installations and report that it has a sound projection superior to an equivalent flat baffle. The utility of this directional baffle is enhanced by the fact that the speaker box may be used for portable applications or the flared horn added to existing speaker cabinets.

Public address operators are leaning towards the enclosed type of baffle for permanent indoor installations. A new design, recently announced, loads the back radiation of the cone speaker with acoustic materials and devices to give results equivalent to a square, 40-in.-wide flat baffle board. Dual adjustable deflector vanes afford a measure of useful sound projection control. The excellent frequency-response characteristics, and modernistic appearance make this type of baffle especially suited for use in cabarets, restaurants, dance halls, factories, hotels, and theatre lobbies.

The most popular sound projector is the versatile aluminum "parabolic baffle deflector." This comparatively recent development in speaker horns uses an acoustically-designed parabolic speaker housing with a short, wide flaring horn. The rear section is provided with a number of "back pressure" air release holes. Many technicians find that high-fidelity, high-power reproducers require more breathing holes than are usually provided. The additional relief apparently increases the "highs" by decreasing excessive low-frequency response. The short exponential flare contributes to higher speaker efficiency and projects sound towards the desired "service area." Several sizes are available; the most popular being the 17-in.-bell model. For

high-power dynamics, a larger version having a 22-in. mouth will afford considerably better quality, power, and "throw."

The acceptance of the aluminum "parabolic deflector" is in a large measure due to its versatile installation possibilities. Ornamental picture cord or wire is used for ceiling suspension. A mounting fixture attached to the rear housing offers a simple method of attaching the baffle to the ceiling, side walls, floors, automobile running boards, roof, etc. A standard threaded plumbing pipe and inexpensive pipe fittings afford a variety of mounting positions. For portable and rental applications, collapsible floor stands are available and so further enhance the utility of this modern sound projector.

**Trumpet.** Outdoor P.A. installations are admirably served with long exponential horns equipped with dynamic driver units or small power-cone dynamic speakers. This combination has an acoustic efficiency exceeding other arrangements. The substitution of a 6-ft. horn and dynamic horn unit is equivalent to doubling the output power of the usual amplifier. Furthermore, the crispness of speech, "speaking presence," sound coverage, and musical fidelity is far superior to other equivalent methods.

Particular care should be exercised in selecting the exponential horn. The rate of flare, mouth diameter, and length must be in proper acoustic relationship. The smooth exponential flare makes for efficiency, quality, and undistorted peak power handling capacity at low audio frequencies. An incorrectly-proportioned flare seriously alters the frequency response, lowers the efficiency and because of improper air-column loading results in ruptured diaphragms, as well as burned-out voice coils.

### HOW TO TEST TRUMPET FLARE

Fortunately, a simple test can check the flaring of the trumpet. Place the palm of the hand on the outside of the throat or small end of the horn and lightly sweep the entire length. Several tests of this kind on a horn known to be properly designed will enable the technician to detect irregularities in expansion as well as inefficient and useless conic or "megaphone" trumpets.

(Continued on page 689)

# THOUSANDS HAVE SELECTED THIS TUBE TESTER



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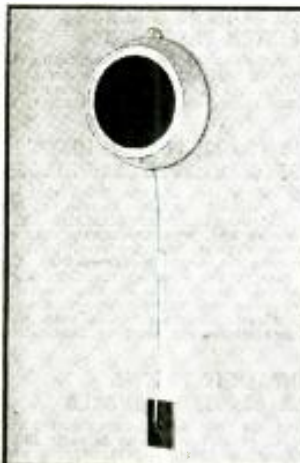
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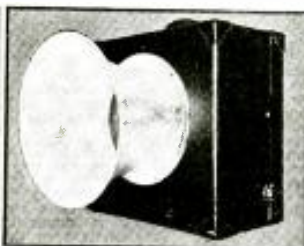
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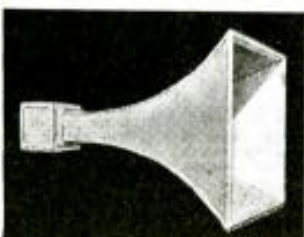
A wall-type aluminum baffle for schools, etc.; permanent magnet unit. This unit is portable, plugging into special wall receptacles.



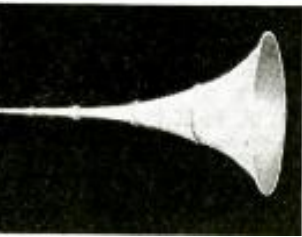
Flare part of parabolic baffle. This is built into the amplifier carrying case.



A giant parabolic reflector.



A square-mouth exponential horn.



A round-mouth 6 ft. exponential horn.



parabolic aluminum sound projectors.

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since the sets covered are those manufactured during the latter part of 1936, all in 1937 and many in early 1938. The second year (starting March, 1938) of this new monthly service will begin with sets manufactured during 1938.

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RC537

## BUILD "THE CYCLOPS"—A BEGINNER'S I-TUBE "MAGIC EYE" SET

(Continued from page 662)

around one another.

The other alteration is on the tube socket assembly. Snap off the rear metal cover, and remove the tiny resistor connected between 2 of the prongs. The prong then open is the plate and a wire should be brought out from it so that there will be 6 leads instead of the original 5. The other wires are coded as follows: blue and green, heater; black, cathode; red, target; yellow, grid.

### WIRING

The wiring may now be started and is very simple. An aid to neatness will be found in the terminal strip, which is simply a series of lugs fastened to thin bakelite. Parts C5 and R2 are mounted directly on the strip.

The heater circuit is controlled by Sw.1 so that if the set is battery-operated it may be turned off by this switch. The pilot lights connect directly across the heater of the 6E5.

The set is very simple to put into operation. It is only necessary to apply the proper voltages and tune-in. Any voltage from 50 to 250 will give strong signals, but a voltage over 100 or so will give the most usable glow on the target. The glow can be seen, however, with only 50 V. The heater may be supplied from any source, A.C. or D.C., that will furnish 5.5 V. to 7 V.

By turning the screw in the top of the shield can of L1, L2, the band may be shifted somewhat since this screw moves the iron core and so changes the inductance.

If switch Sw.2 is closed, somewhat louder signals will be obtained, but the variable shadow effect cannot be obtained.

All in all, this novel little set is surprisingly efficient, and if carefully made will be, as well, an object of beauty.

### LIST OF PARTS

- One Meissner coil No. 7413, L1, L2;
- Two Hammarlund 325 mmf. midge variable condensers, C2, C4;
- One Hammarlund 85 mhy. R.F. choke, R.F.C.;
- Two Wholesale Radio Service dials;
- Two Wholesale Radio Service switches, Sw.1, Sw.2;
- One Aerovox condenser, 0.006-mf., C5;
- Two Aerovox condensers 100 mmf., C1, C3;
- One Continental Carbon resistor, 0.25-meg., R2;
- One Continental Carbon resistor, 2 megs., R1;
- \*One magic eye socket assembly;
- One RCA type 6E5 tube, V;
- Two double bindingpost strips;
- One plexiglas case—(see text);
- Wire, hardware, pilot lamps, etc.

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

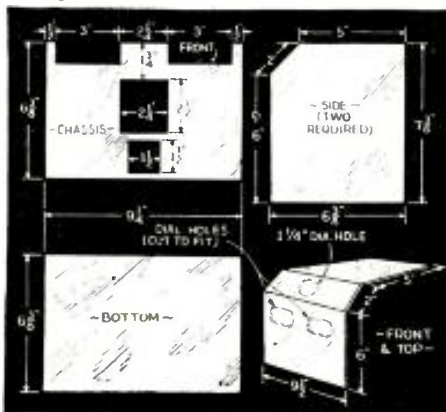
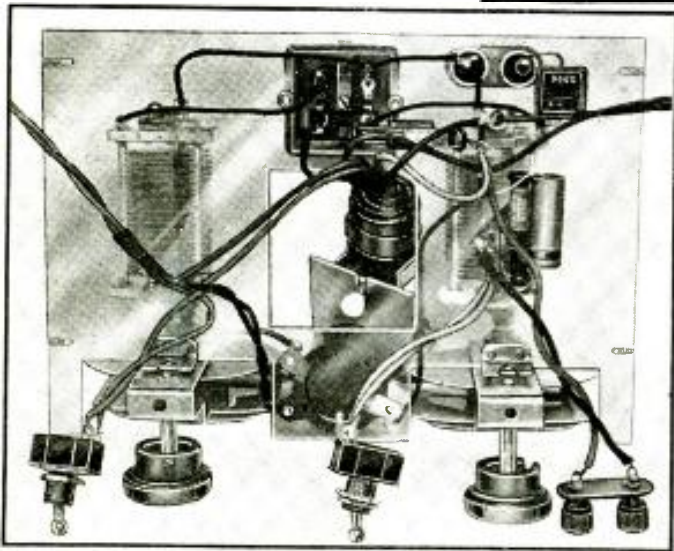


Fig. 2. Above, the chassis and cabinet details of the Cyclops set—these parts are made of plexiglas.

Fig. 3. The chassis of the set, looking through at the parts on the other side. This shows the positions of all the important parts.



## HOW TO SELECT LOUDSPEAKER BAFFLES AND HORNS

(Continued from page 687)

Wherever it is possible, the longest horn should be used; for a large air-column load imposes a desirable acoustic load on the diaphragm that prevents excessive diaphragm excursions at high power levels. In addition, the low-frequency response, power-handling capacity, and output power are much better than shorter horns. When physical conditions prevent the use of a 6-ft. horn, two 3½-ft. horns with a 2-way driver unit adapter will give equivalent results.

The mouth area is the criterion by which similar trumpets should be compared; for the larger the area, the lower the bass frequency cut-off. Consequently, a square-mouth horn is to be preferred to a "bell" when the side length is equal to the bell diameter. However, the appearance, and easy handling of the round horn finds preference with many operators.

Although the preceding points have dealt with the use of exponential horns, and dynamic driver

units, the facts hold equally well when high-power 5 in. dynamic cone speakers are used.

Trumpets are highly desirable for outdoor P.A. where high-quality music and easily understandable speech must over-ride high noise levels and provide long sound projection with low and medium power audio amplifiers. The dynamic driver unit in conjunction with a 6 ft. horn is recommended for installations at athletic fields, race tracks, swimming pools, carnivals, steamers, stadiums, mobile P.A. on automobiles, speed boats, airplanes, and trains.

While the most pertinent factors governing the selection of baffles and trumpets have been discussed, there may be readers whose loud-speaker problems may be more involved. The author will be pleased to answer any inquiries provided a stamped, self-addressed envelope is enclosed for a reply.

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

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Model T-37 All-Wave Signal Generator, wired in shielded cabinet with carrying handle and calibrated. **\$12.40** tested; complete with 2 Tubes & Neon Tube, instructions (shipping weight 7 lbs.)

**SUPERIOR INSTRUMENTS COMPANY,**

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## OPERATING NOTES

(Continued from page 685)

50,000-ohm oscillator plate carbon resistor to one of a lower value. Usually a replacement of 15,000 or 20,000 ohms is sufficiently low to accomplish this purpose.

Intermittent reception on the short-wave band has been found due to the low-frequency condenser, a 0.003-mf. "postage stamp" type fixed condenser. When replacing this component, re-arrange all leads adjacent to it in the exact position occupied formerly to obviate the necessity to re-align the short-wave band.

When dial calibration on any of the 5 bands is made essential through one cause or another, it will be found that unless the chassis is held in such position that the gang condenser is not forced out of line, calibration will be incorrect when the chassis is restored to its position in the cabinet. Since the adjustments for the broadcast band and one each for the 2nd and 3rd bands are located under the chassis it becomes necessary either to invert the chassis or place it on its side, to make the trimmer condensers accessible. Adjustments should not be made, however, with the chassis in either of these positions, since the tuning gang will shift out of line because of its weight when the chassis is on its side, and because the chassis will be resting upon the shadowgraph which is mounted to the gang when the chassis is inverted. In the case of console models, the chassis may be moved back but not entirely removed from the cabinet and adjustments made with one hand, with the chassis balanced with the other.

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## FIDELITY VS. HARMONICS

(Continued from page 664)

unrecognizable. If the harmonic distortion cannot be reduced, it would be much better to limit the frequency response of the system so that it is down several db. at 8,000 cycles—reproducing the harmonics only to a degree which is tolerable.

Cutting the frequency response is of course not solving the problem. For both "high-fidelity" and "wide-range," each individual part of the system should be improved so that it will cover the entire audio frequency band, and the harmonic distortion introduced should be less than 5 per cent over all. In the case of sound reinforcement the microphone or pickup, amplifier and speaker must be considered. The microphone or pickup of course could easily be the worst offender because any imperfections are amplified so many thousand times, resulting in magnification of defects.

As is generally known, the ordinary phono-graph pickup due to its unusually high harmonic distortion, is one of the worst offenders.

"I get tired when I listen to more than two records at a time" is a common remark. The person seldom realizes just what it is that makes him feel that way about the reproduction.

### RIBBON "MIKE" HAS FUNDAMENTAL ADVANTAGES

With the recent introduction of the velocity microphone to sound reinforcement, it was noticed that when used with a well-designed system, reproduction could be obtained of which the audience was not aware. It merely appeared as if the performer had tremendous volume. It did not seem to tire the audience.

The reason for this can be seen from a study of the construction of the velocity or ribbon microphone. A duraluminum ribbon less than .0002-in. is free to vibrate in a magnetic field of constant intensity. See Fig. 1. All sound waves

hitting the ribbon vibrate it—thereby cutting the lines of flux of the magnet and generating a current. The important thing to note is that irrespective of how much the ribbon is vibrated the flux density remains the same and nothing is introduced which tends to hamper or exaggerate its motion.

### MAGNETIC PHONO UNITS FUNDAMENTALLY UNSOUND?

In the case of the magnetic-type phono-graph pickup, as the armature gets nearer to the pole piece, it is attracted much more strongly and therefore when in this position will exaggerate reproduction—Fig. 2. Harmonic distortion is similarly introduced in most types of microphones and pickups, due to the fact that the current variations are not always proportional to the amount of motion of the moving element.

Because the ribbon of the velocity microphone has no period of its own, it reproduces all frequencies without peaks. But more important, it is because the flux in all positions of the ribbon remains constant that the velocity microphone introduces no harmonic distortion whatsoever. Figure A shows a standard velocity microphone being used in a high-fidelity system of the Hotel New Yorker, New York City.

A microphone without peaks or without harmonic distortion is the proper beginning of a reproducing system for "high-fidelity" and "wide-range." In other words, instead of designing a "hi-fi" system around the premise that "canned music" (requiring a phono pickup unit) is the best source of entertainment, why not utilize the inherent advantages of certain microphones in conjunction with "human" music for best entertainment value.

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

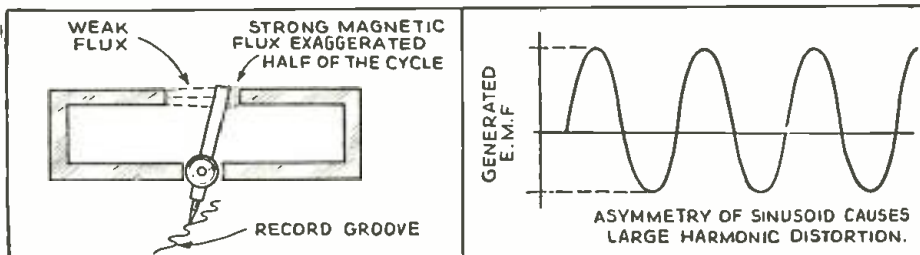


Fig. 2. The non-linearity of magnetic flux in a magnetic phono pickup is seen.

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## THE LATEST RADIO EQUIPMENT

(Continued from page 671)

### LIGHTNING CALCULATOR (1340) (Tavella Sales Co.)

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### PORTABLE 12-W. P.A. SYSTEM (1341)

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### 30-W. BEAM AMPLIFIER (1342)

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### ELECTRO-MECHANICAL OSCILLOSCOPE (1343)

FOR analyzing amplifier or radio receiver circuits there is now available an oscilloscope that utilizes an inexpensive neon tube and rotating mirror in place of the more expensive cathode-ray tube and complicated oscillator circuit for the horizontal sweep; the test signal supplies the requisite vertical voltage. The input amplifier is suitable for crystal or other high-impedance pickups.

### POWER-TYPE SYNCHRONOUS INVERTER (1344)

(Stor-Bat Power Devices Co.)

RADIO men are familiar with the light-duty types of synchronous vibrators that step low-voltage D.C. to high values of A.C. A heavy-

duty motor-driven design specially suitable for use in P.A. amplifiers is now available. Connected to the step-up transformer and tube-type rectifier (and 6-V. motor) that comprise the unit, and output of 65 W. at 6, 12, 32 or 110 V. A.C. may be secured with input voltages of 6, 12, 32, or 110 V. D.C.

### INDOOR "ANTENNA" (1345)

RADIO men are familiar with the principles of operation of so-called indoor antennas. Perhaps the outstanding point of interest in the new unit illustrated is its eye appeal; and its design conveniences—a screw hook affords several easy means of hanging or otherwise mounting the unit inside the radio receiver cabinet.

### "KINK AIDS" FOR THE SERVICE MAN (1346)

(Akrad Products Co.)

EXPERT Service Men look for characteristic troubles when servicing radio receivers and it is to aid the technician unfamiliar with these recurrent faults that the "Kink-Aids" card index was developed. This convenient file in an enameled steel filing case includes faults and remedies relating to over 3,500 different set models. Every radio man should have this file at his finger-tips for instant reference—a single "kink" in connection with a perplexing service problem, may repay the entire cost.

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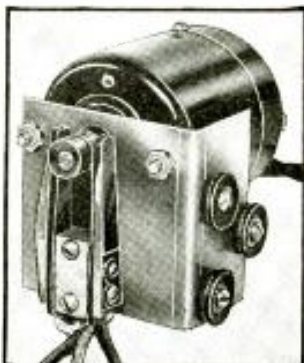
A 12-W. P.A. system. (1341)



A 30-W. amplifier. (1342)



This new oscilloscope, in contrast with more common types, operates on electro-mechanical principles. (1343)



Synchronous mechanical converter. (1344)



A semi-streamline indoor antenna. (1345)



A conveniently-arranged reference to radio receiver servicing aids. (1346)

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## NEW DIRECTIONAL MIKE HAS "INFINITE Baffle"

(Continued from page 654)

space for artists as the "non-directional" type and has the advantage, because of being "dead" on the sides, top and bottom, of cutting out 2/3 of the energy of reverberation and similar unwanted noises—and which, moreover, can be tilted or rotated to increase or decrease "liveness," or to attenuate a particularly objectionable noise source.

Nevertheless, the microphone field has lacked one possible type—perhaps the very best—viz., a microphone with good pick-up from one side and with no pick-up at all from the other side; a pattern equivalent to just one of the lobes of the velocity microphone pattern, has not heretofore been commercially available.

While developing the velocity microphone, Dr. H. F. Olson of the RCA research staff hit on an idea for a uni-directional microphone. Unfortunately this microphone, although quite simple in design and construction, turned out to be relatively expensive to build and, no immediate demand for it being evident, was not put into production. Before long, however, information of it trickled into the field, and sound engineers who knew what they wanted began to ask for it. Gradually, as recording engineers, movie sound men and broadcast engineers joined in, these requests became a demand.

### COMBINING TWO MICROPHONES IN ONE

The construction and operation of the uni-directional microphone is best understood by considering it as two separate microphones combined in a single case. One of these microphones is velocity-actuated while the other is pressure-actuated.

The idea of combining the action of these two different types of microphones has probably occurred to many engineers—and not a few have tried to carry out the idea by using the two types side-by-side, and combining the outputs. The difficulty with such an arrangement is that the space between the two, even when only a few inches, is comparable to the wavelengths of high-frequency sounds. Thus the outputs of the two microphones are out of phase, and the result—analagous to pressure-doubling in the diaphragm-type microphones—is a sharp, high-frequency peak.

In the new uni-directional microphone, illustrated in Fig. A, this has been overcome by making the two microphones the respective halves of a single ribbon. The main construction of the microphone is almost identical to that of the standard velocity microphone. However, the ribbon is rigidly clamped at the center, as well as at the top and bottom. The lower half is open in front and back, and hence operates as a regular velocity microphone.

### THE "ACOUSTICAL LABYRINTH"

In order to make the upper-half of the ribbon operate as a pressure microphone, it is, of course, necessary that the rear of this be enclosed. At the same time it is not possible to just block this off, as this would result in a response increasing with frequency. Rather it is necessary to present an acoustic impedance to the back of this part of the ribbon. An infinitely long tube would be the ideal impedance, but this, of course, is impractical.

An ingenious labyrinth has been designed which gives practically the same effect. While this has a finite length, the desired damping of reflection is obtained by very lightly padding it with absorbing material. The result is that the upper-half of the ribbon becomes an efficient pressure-actuated microphone with a very good response over the whole frequency range. And, since the two microphones are part of the same ribbon, the voltages induced in the two are, of course, in series, and the output is obtained from the ends of the ribbon precisely as in the velocity microphone. Since the dimensions of the ribbon are small, the two voltages are closely in phase except at the very high frequencies.

### CARDIOD DIRECTIONAL PATTERN OBTAINED

The advantage results from the manner in which the voltages generated respectively in the velocity-actuated and pressure-actuated parts of the ribbon add together.

It is possible to obtain a picture of the action from a consideration of the 3 patterns shown in Fig. 2A. In this illustration (a) is the (approx.)

directional pattern of a velocity microphone, (b) is the (approx.) directional pattern of a pressure microphone.

When these patterns are added the forward lobe of the figure-8 pattern adds to the circular pattern, while the rear lobe, which is 180 deg. out of phase, opposes. The result is added, viz., a "cardiod" results, as shown at (c). A 10-to-1 front vs. back response is illustrated; rated sensitivity is -69 db.

For all frequencies up to 6,000 cycles, the cancellation is very good. At higher frequencies a small "tail" occurs because of the slight phase displacement which begins to become noticeable in this range.

### FEATURES

This new microphone, known as the type 77-A, offers many advantages.

First, and perhaps most important, of these will be those pick-ups of the type which occur in the case of auditorium-type studios, and other large studios, where a sizeable audience is present in the studio—and in remote pick-ups at theatres, night clubs, and the like. In all such situations the audience noise presents a serious problem; it is solved by placing the new uni-directional microphone with its dead-side toward the audience, as shown in Fig. 2B. The wide pick-up angle of the new microphone is the second important feature. It is practically twice as wide an angle as that of the diaphragm-type microphones, and even wider than that of the lobes of the standard velocity microphone. As a result, one of these microphones will nearly always suffice for any type of pick-up, and will often take the place of 2 or 3 other types.

Another very interesting application of the new microphone is its use in relatively small studios. It can be placed much closer to the rear wall than any other type of microphone—since its pick-up from the back, and hence its pick-up of reflected sound, is so very much lower. Moreover, such pick-up as does occur from the rear is of frequencies over 6,000 cycles, and these are the frequencies which are almost entirely absorbed even by ordinary wall constructions. The same effect will also allow of a great reduction in the amount of absorbing material used on the back walls—and in many cases will probably allow the "dead-end" construction to be done away with entirely.

In addition to these advantages, this new microphone has all the inherent advantages of the standard velocity microphone. The sensitivity also, is of approximately the same order. For an output signal of 10 bars (10 dynes per sq. cm.) the output level, across a 250 ohm line, is -69 db. (zero level of 12.5 milliwatts). Because of these similarities the new mike can be used interchangeably with standard velocity microphones and can be conveniently mixed with these, if desired. The 20 db. discrimination—10-to-1 ratio—permits stage pick-up while attenuating audience noise.

The type 77-A instrument closely follows in size and general appearance the RCA type 44 velocity microphone. The finish is polished black nickel. A U-bracket that swivels also permits the microphone to be tilted.

This article has been prepared from data supplied by courtesy of RCA Manufacturing Co., Inc.

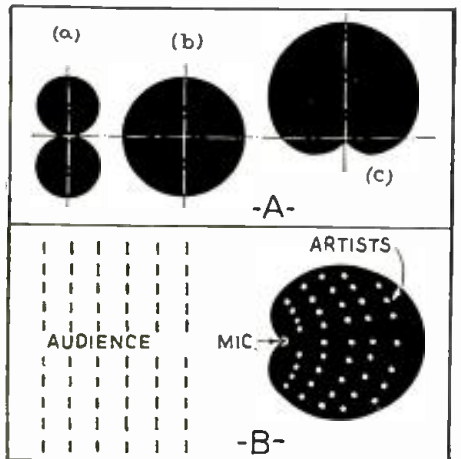


Fig. 2. The cardioid pattern in B, using the new mike, is particularly fine for large studios with "audiences."

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**A NEW BAFFLE SYSTEM EXTENDS FIDELITY RANGE**

(Continued from page 664)

at which the cabinet acting as a baffle ceases to aid reproduction is usually about 140 cycles. Loudspeakers are limited in the extent to which they will dip into the low-base range due to mechanical limitations inherent in their design and commercial production. The usual 12-in. dynamic speaker in an infinite baffle will seldom function below 50 to more usually 60 cycles, but even this response may not be had in customary consoles for an octave or more. Smaller reproducers will cut off at increasingly higher frequencies. (Remember, the average ear perceives the low-bass notes ordinarily only by virtue of their harmonics.)

Consideration of operational modes concomitant to such harmonic reproduction is interesting. In the reproduction of broadcast or recorded music, frequencies as low as 50 cycles and sometimes lower will be encountered. The customary inadequate radio-console baffle cutting off quite sharply at about 130 cycles, results in no appreciable air-load upon the speaker diaphragm or cone at frequencies below this, except for the resonance peaks due to the cabinet structure and air content. Upon frequencies below cut-off the unloaded loudspeaker cone develops excessive mechanical excursions, which though they do no useful work at their fundamental frequencies tend to develop excessively strong harmonics, those above baffle cut-off being heard. This is undesirable.

Resonances invariably present in the radio cabinet result in the "boominess" so destructive to speech, but often superficially beneficial on musical reproduction. In the main these impair rather than aid quality of reproduction.

A relatively large number of papers recently delivered by Hugh S. Knowles, chief engineer of a well-known reproducer manufacturer, before I. R. E. chapters and Engineering Institute of Canada have brought his developments of the "bass-reflex" and "peri-dynamic" principles to the attention of attending engineers. These developments are most interesting, permitting as they do in a radio console of practical size reproduction exceeding that possible through the same loudspeaker in an "infinite baffle."

**LABYRINTHINE BAFFLES**

A word on recent developments upon this line seems in order. One line of attack attempting to provide an approximation of an infinite baffle has been the labyrinthine or folding back on itself of the front-to-back air path within a radio receiver cabinet. Space limitations plus the need of considerable deadening of the folded path to avoid resonances mitigate against the benefits of this method. A second method has involved the sealing-in, by a closed back, of the loudspeaker compartment, with air vents in its bottom topped by tin pipes. It would be possible, were these pipes resonated in the bass range, for them to somewhat augment bass response through their coupling by the air in the console to the loudspeaker diaphragm. A third acoustic treatment in an open-backed console consisting of additional diaphragms disposed about the console, and relatively free to vibrate, seems hardly worthy of comment.

**"BASS-REFLEX" AND "PERI-DYNAMIC" OPERATION**

The "bass-reflex" and "peri-dynamic" principles go beyond these initial attacks on the problem in that in suitable combination, they provide reproduction exceeding that possible to an infinite baffle. The extent, however, to which their application may extend the bass range of a sound reproducer is dependent upon the size and design of the loudspeaker itself. With them the bass cut-off frequency may be determined by the loudspeaker itself rather than by its cabinet.

With the large and extremely efficient 18-in. reproducers this cut-off may be set as low as 30 cycles, while with ordinary 12-in. speakers it will usually be between 50 and 60 cycles. The benefits of elimination of harmonic distortion will be apparent in both cases, as will be the elimination of cavity resonances in a suitably designed console.

"Peri-Dynamic" Operation. The "peri-dynamic" principle involves complete enclosure of the loudspeaker in a sealed console of ample content (8 cubic ft. or more for the 18-in. speaker), of heavy non-vibratory construction

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to prevent spurious contributions through sound radiation due to vibrating panels acting as secondary sound sources. Resonance of the volume of air within this enclosure should be deadened by discreet amounts of Jute or other absorbants affixed to one or more inside panels.

"Bass-Reflex" Operation. The "bass-reflex" principle involves the utilization of the usually wasted or detrimental back radiation of the loudspeaker. It involves the provision of ports approximately resonant in the extreme low-frequency range in the console in such manner that in relation to the cubic content of the console, the phase of the back radiation is reversed. Thus back radiation at the ports appears in-phase with direct or front radiation and adds thereto in a most beneficial manner.

An example of such a sound reproducer, of relatively large size in comparison with the average radio console, is illustrated in the accompanying photos. (Clifton console for Masterpiece V receiver.)

The curves were taken with the back of the console 2 1/2 ins. away from a flat wall. The dotted line shows the cut-off frequency of this (fairly large) console, with the rise partially accounting for "boominess" at about 110 cycles and the secondary cavity resonance apparent at 50 cycles. The solid line shows the improvement resulting from application of the discussed principles. Here the bass cut-off is determined by the unusually excellent 18-in. speaker only.

Since the application of "bass-reflex" and "peri-dynamic" principles to sound reproducers will (a) extend the usual range of reproduction by several octaves, (b) eliminate harmonic distortion due to overload of inadequately loaded speaker diaphragms, and (c) eliminate annoying boominess of console cavity resonance, these principles should find wide application in sound reproduction.

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

## SERVICING P.A. WITH A MIDGET OSCILLOSCOPE

(Continued from page 667)

### ANALYZING DISTORTION OSCILLOGRAMS

The first operation is to examine the pattern of your audio tone which should be fed directly into the vertical input of an oscilloscope with a linear sweep circuit. Lock the sine-wave pattern on the screen with the vernier-sweep control; that is, make it stand still with about 2 complete cycles showing. On thin tissue paper trace the pattern of the wave or if you are using a fixed-frequency audio signal you may paint small black dots over the trace directly on the oscilloscope screen. This becomes your reference pattern (waveform A, in Fig. A).

For experience, practice on a good 20-W. amplifier. In order not to wake the neighborhood, connect a 25-W., 115-V. lamp on the 500-ohm output circuit of the amplifier as a suitable load. This bulb has a resistance of 530 ohms hot, so, the load will closely match the amplifier output and as it is pure resistance we won't be concerned about any peculiar reflected loads from a dynamic speaker.

To the grounded post of the amplifier output lead attach the ground of the oscilloscope and for a preliminary test, connect the wire from the vertical input of the oscilloscope to the 500-ohm tap of the amplifier output. (A) Next supply the audio tone to the input of the amplifier through a series resistance of 0.15-meg. to 0.25-meg. (B) This assures you of not loading the audio oscillator output to the distortion point and in turn presents a high impedance to the input of the amplifier. When the amplifier is turned on and its volume control advanced, the same pattern originally recorded should appear on the oscilloscope. If there is too much gain and the amplifier is overloaded, flat or ragged tops (waveform B, in Fig. A) will take the place of the original smooth sine wave. Any good amplifier can be overloaded with a strong signal but that overload should come in the last stage first and only after the output has reached its full watts rating!

Let's suppose we want to locate the point of overload. All that is necessary is to remove one lead—the vertical input line of the oscilloscope—

(Continued on page 696)

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## SERVICING P.A. WITH A MIDGET OSCILLOSCOPE

(Continued from page 695)

and connect it to the plate terminal of the driver tube preceding the last stage. (C) If the pattern is still distorted just as badly as it was on the last stage, the overloading is in the circuit ahead of the driver. If the pattern is a clean or almost clean sine wave, it indicates that the last stage overloads first—which is a characteristic of a good amplifier. If the overload is present in the driver tube, the stage preceding the driver should be checked, again merely moving the one lead of the oscilloscope to the plate (D) terminal of the preceding tube to make the test.

### CHECKING DEFECTIVE COMPONENTS

Distortion in an amplifier may be caused by failure of almost any part such as a bias resistor, bypass condenser, transformer, volume or tone control, tubes or the accessories. Distortion is evident in irregularities in the sine-wave trace on the oscilloscope.

The oscilloscope is an excellent device with which to check various components of an amplifier which might cause distortion. For example, cathode bias bypass condensers are a common source of amplifier trouble yet a faulty bypass can be located almost instantly with the exploring lead of the oscilloscope! Merely touch the vertical input lead to the cathode of each tube (E, F, G, H, I) in the amplifier with the signal input at a steady level. If a slight trace of the sine wave may be detected with the oscilloscope gain on full, the circuit is normal. An open bypass condenser will give a large signal deflection. In this case the condition should be confirmed by checking the signal in the plate circuit of the same tube where the wave pattern would be badly distorted if the bias circuit was shorted.

It is hard to locate a defective coupling condenser in resistance-coupled stages but the cathode-ray oscilloscope is practically equivalent to a sensitive vacuum-tube voltmeter and any slight leakage in a coupling condenser may be quickly located. Turn off the audio tone and touch the free lead of the oscilloscope to first one side of the coupling condenser (J) and observe the direction in which the cathode-ray beam deflects. Then touch the lead to ground momentarily to discharge any accumulated static current and touch the other side of the coupling condenser. If there is no leakage, the deflection of the beam will be in the opposite direction to the first test. If any leakage up to several megohms exists, both deflections will be in the same direction.

Faulty filter condensers cause a 120-cycle hum; evident in the oscilloscope patterns as a "floating crankshaft" pattern that will rarely stand still with steady tone signal applied no matter what adjustments are made. The oscilloscope's free lead may be poked around anywhere in an amplifier power supply, functioning both as a vacuum-tube voltmeter and wave-form analyzer. The section of the filter system which may be defective will be evident by the greater deflection of the cathode-ray beam. (Test at points K, L, M and N.)

The uniformity of both sections of the high-voltage winding of the power transformer may be checked (if under 400 V.), likewise the relative work each section of a push-pull stage is doing—that is, the pattern should have the same general amplitude for each side of the transformer winding being tested.

Volume controls may be checked for noise, and dual controls for uniformity of resistance for any given adjustment by watching the oscilloscope pattern while the controls are being adjusted.

In servicing P.A. equipment where the customer can see the tests being made, put on a little show after all the adjustments have been made and the amplifier is right in every detail. Leave the oscilloscope connected to the output and let the customer see the "pattern" of his own voice on the cathode-ray screen. It is visual proof that you are testing his unit just as the big demonstration oscilloscopes at the Chicago World's Fair checked the output of an electric phonograph. The test doesn't mean anything in particular but psychologically it is good for an extra \$5 on your service bill!

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

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### WHY OIL-FILLED CONDENSERS FOR SOUND EQUIPMENT?

(Continued from page 674)

is switched on it takes many seconds for the tubes to draw full current and in the meantime the only load is essentially a power loss, which reflects too-high a resistance to furnish protection against excessive voltages during the warming-up period. The resulting instantaneous surges cause condensers to break down. Dykanol condensers are designed to stand up under such strain and should be used if a permanently satisfactory job is to be done.

### HALVING CAPACITY MAY NOT DOUBLE VOLTAGE CAPACITY!

Hitherto many Service Men have recognized the need for higher-voltage condensers but have found it impossible to install the usual high-voltage types due to space limitations. Often, therefore, 2 lower-voltage types have been connected in series under the assumption that, though the capacity will be halved, the voltage handling ability will be doubled.

*This is a fallacy.* Across 2 condensers in series the voltage will be distributed in accordance with the ratio of their internal resistance.

For instance, let us assume that we connect across 1,000 V. two 500-V. condensers in series, one of which has an internal resistance of 100 megs. while that of other is 900 megs. In series, the total resistance will be 1,000 megs. But the voltage across the condenser having a 900-meg. internal resistance will be 900 V. while the other condenser will have to bear only a 100 V. burden. Small wonder then that this practice so often results in failures.

### P.A. DEMANDS ARE EXACTING

In Public Address work, condenser failures are not merely unfortunate—they constitute a major calamity involving far greater loss than the mere replacement cost!

Yet in perhaps no other field is apparatus subject to such severe abuse. Sudden changes of temperature, bound to result in transporting P.A. amplifiers from place to place during cold weather, cause expansion and contraction of wire-wound bleeder resistors. Occasionally these are unable to stand the strain and the wire breaks, leaving the bleeder open-circuited. When the unfortunate operator gets to his location and hooks up the apparatus, too often when the power is turned on a filter condenser "pops." There is no time to make replacements; he is out his time, the contract is lost and his personal prestige has suffered a severe setback. Public address amplifiers should always be equipped with condensers able to stand up under any and all contingencies.

Speakers fields, which so often are connected in series or across the power supply may become disconnected, either as a result of a break in the cable, or from inadvertently removing the cable plug from the amplifier when the power is on. This has the same effect as an open-circuited bleeder and often the same disastrous results.

A few other examples where dykanol-type condensers should be employed are in sound-movie amplifiers, transmitters, and receivers designed for operation in tropical climates. In all apparatus where dependability, compactness and a wide and conservative margin of safety are desired, these new products should receive first consideration.

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

### P.A. TECHNICIANS—

WATCH for the new P.A. radio tuner—a really new and unusually fine "radio end" for your amplifier—which will appear in one of the forthcoming issues of RADIO-CRAFT. You will need this unit to complete your line-up of "sound" equipment!

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**DO NOT FAIL**  
 to read the important announcement which appears on page 688 of this issue. It is important news to everyone who is in the radio business.

**NEW USES FOR SOUND EQUIPMENT**

(Continued from page 679)

W. Studebaker, U. S. Commissioner of Education, in speaking before the F.C.C., recently, for the Radio-Education Committee, to show the scope of the educational set-up, and its increasing need for various radio facilities. To quote: "The extent of the need for an adequate number of channels for local educational broadcasting is indicated by the fact that there are 239,000 schools in the United States, employing 1 million teachers to instruct over 28 million elementary and secondary school pupils, not to mention 2 other great groups: (1) persons involved in higher education, and (2) the general adult population. The school property of the country is valued at more than 10 billion. Approximately 3 billion dollars are expended annually for education below the college level . . . I can visualize a great variety of ways in which school systems will make regular full-time use of radio facilities in educational work, and in the routine and administration of schools . . . the possibilities of radio are innumerable and extremely important."

The principal of Oakmont School, Upper Darby, Pa., recently reported the use of U. S. Dept. of the Interior (Office of Education) "Educational Radio Script" in "mock broadcasts" over the school sound system to 20 classrooms.

Radio sets and phonographs, television and talking pictures, and other realistic and concrete devices will play a major role in the school of tomorrow, according to Dr. William H. Bristol, speaking recently on "Visual Education" before the Maryland Parent-Teacher Congress at College Park, Maryland. The Doctor points out that visual sensory aids (1) increase initial learning, (2) effect economy of time in learning, (3) increase permanence of learning and (4) aid in teaching difficult principles; substantially the same may be said for auditory sensory aids. The radio man who makes it his business to cater to the needs peculiar to educational institutions, of which there are tens of thousands in the United States, will find it profitable.

**INTER-OFFICE COMMUNICATION SYSTEMS**

The rapidly-expanding use of person-to-person communicators or "private-address" systems, as described in the editorial in this issue of Radio-Craft, has skyrocketed to proportions not realized by the average technician. It is for this reason that the forthcoming issue of this magazine will feature its newest developments—in a special PRIVATE-ADDRESS NUMBER.

One of the most interesting applications of public-address principles has been in the rapid development of a semi-private system of communication, by Bell Telephone Co., utilizing a unit known as the "conference aid."

As shown in Fig. D, the device, comprising a loudspeaker and vacuum-tube amplifier, is connected to the regular telephone instrument; at the flip of a switch 75 to 100 people can listen-in.

To prevent the howl that would ordinarily result due to feedback from the loudspeaker to the transmitter or microphone in the handset, a special "network" is installed in the subscriber set to be used with the conference aid unit. This network serves to equalize the transmission characteristics between the transmitter and the loudspeaker, and also to minimize disturbances of large magnitude but of short duration which would tend to build up to a continuous singing condition. To reduce maintenance costs, the control switch has 3 positions—off, intermediate and on—that in the intermediate position serves merely to keep the heater-type tube filaments warm (and inoperative) and in readiness for the third or full-heat (and operative) position.

**MISCELLANEOUS APPLICATIONS**

Several other items of interest occur to us, in connection with sound apparatus, that may be of interest to the reader. Massachusetts Memorial Hospital, Boston, Mass.,—among other modern hospitals—utilizes RCA public-address equipment in the (4) operating rooms and observation galleries. Speaking through the microphone, the surgeon performing the operation can explain each step to the audience of medical students assembled on the other side of a glass partition.

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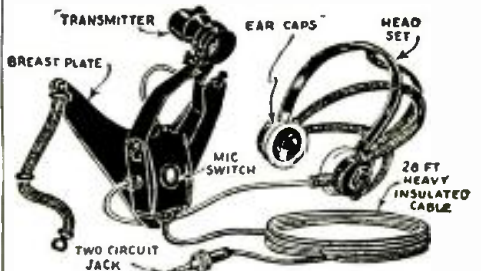


Shipping Weight 3 lbs.

THESE Motors are manufactured by the Westinghouse Electric Co. They are absolutely new. Specifications: 1/30 H.P., operates on either A.C. or D.C., 110 volts, 5000 R.P.M. Rheostat can be used to vary speed. Height 3 1/4", Length 3 3/4", Width 1 3/4", Shaft 1/2" one inch long. Can be used to drive Sewing Machines, Models, Buffing Lathes, Polishing Head, Drills, Grindstones, etc., etc.

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THIS Microphone and telephone headset outfit was built especially for the U. S. Navy Aviation Corps. The Hiltner-Cabot Electric Company constructed the outfit to Government specifications.

The outfit consists of a low-impedance carbon microphone (transmitter), securely fastened to a metal breast-plate, and a set of heavy-duty, low-impedance earphones. A specially constructed switch on the back of the breast-plate controls the microphone circuit. The earphones are U.S.N. Utah type, attached to adjustable headband. Twenty-eight feet of very heavy weather and waterproof conductor cable is furnished. Current of not more than 10 volts should be used. A storage battery is the most satisfactory current supply.

U. S. Navy Airplane-type Microphone and Receiver as described . . . . . \$4.98

The shipping weight is 9 lbs.

**WESTINGHOUSE POWER GENERATOR**

Manufactured for U. S. Signal Corps  
 A.C. Electrical 200 Watt 110 V. AC Power



from a Windmill, from available Waterpower, from your Automobile, from your Motorcycle, from your Bicycle. Foot-pedals or Handcrank (for transportable Radio Transmitter, Strong Floodlights, Advertising Signs); do you want to operate AC Radio sets from 12 V. DC farm light systems; operate two generators in series to get 200 V. AC; obtain two phase and three phase AC, etc., etc. 1/4 to 1/2 H.P. needed to run generator.

There are Over 25 Applications, such as: A.C. Dynamo light from eight to ten 20 Watt 110 Volt lamps, Short Wave Transmitter supplying 110 Volts A.C. for operating "Ham" transmitter, Operating 110 V. AC 60 Cycle Radio Receiver in DC districts, Motor Generator, Public Address Systems, Electric Sirens on motor boats, yachts, etc. Camp Lighting, etc., etc.

Blue-Print 22 x 28 in. and Four-Page 8 1/2 x 12 in. Instruction Sheets. Generator, as described including four replacement carbon brushes . . . . . \$7.90

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All merchandise in original packages—never used. Money-back guarantee.

We will forward Shipments by Express Collect if sufficient postage is not included.

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The mos. complete catalog ever published with special illustrations, drawings, curves and a complete description of the famous 16 tube "Super-Pro." Write Dept. RC-5-37.

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**CLASSIFIED ADVERTISEMENTS**

Advertisements in this section are inserted at the cost of twelve cents per word for each insertion—name, initials and address each count as one word. Cash should accompany all classified advertisements unless placed by a recognized advertising agency. No less than ten words are accepted. Advertising for the June, 1937, issue should be received not later than Wednesday, April 7, 1937.

**BURIED TREASURE**  
 "HOW TO FIND BURIED TREASURE." BIG BOOK tells how to find gold, silver, buried treasure. Send 25c coin. Randall Laboratories, Rockefeller Building, Dept. B, Cleveland, Ohio.

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**RADIO REPAIR CEMENT**  
 "THE ORIGINAL SPEAKER CEMENT."  
 Used for replacing speaker cones, mending old, rattling, or torn cones, seating adjustments, cementing loose tube bases, grid caps, coils, leads etc. Dries fast. Vibration Proof. waterproof. Invaluable aid to Service men. See your jobber, if he cannot supply you, write us. List Price 50c for large bottle. Send for FREE circular of complete line.

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 Recognized Standard in Radio Instruction Since 1909.

use of the radio pillows and audio doctor's call system.

According to a *New York Times* editorial, the Far East has at last succumbed to the lure of public-address apparatus. Increased traffic noises made it practically impossible for the voice of one muezzin to be heard by his congregation of over 5,000 people inside the mosque. The installation of loudspeakers in the minarets of the mosque, however, enabled everyone to hear his call to prayer.

Perhaps the most ingenious application of sound equipment is the reported effort of a mid-west man to prevent being buried alive, according to a quote in *Operadio's* house-organ, *The Sound Advisor*. A microphone-equipped coffin has been purchased, and arrangements made to keep the equipment in operating condition, once it has been placed in the grave, for a period of a year; the microphone connects to a loudspeaker system located in the cemetery caretaker's cottage. It would be relatively inexpensive to equip all the new coffins in this cemetery with microphones and utilize the existing loudspeaker system in connection with them all.

**DECIBEL TABLE IS GRATIS (1347)**

Technicians may secure in full magazine-page size, and gratis, the db. table shown as Fig. Q.387, pg. 675. Write on your business letter-head, enclose return postage, and address your request to *Radio-Craft*.

**SOUND RECORDING LITERATURE (1348)**

**A Treatise on Practical Wax Recording.** Here is a highly technical and substantially working manual on the gentle art of making really fine sound records on wax. The subheads are descriptive: Theory, Wax, Shaving Machine, Studio, Mixing Booth, Monitoring, Recording Machine, Routine, "Line Bumps," Sapphires. Priced at 50c. this 34-pg. booklet, size 5 1/2 x 8 1/2 ins., contains valuable information not previously available at any price.

(1349)

**Advanced Disc Recording.** This 20-pg. booklet, size 3 1/2 x 6 1/4 ins., is an excellent companion to the one mentioned above, on wax recording. Subheads: The Amplifier, Hum Level, Recording Heads, The Turntable, Turntable Speeds, The Lead Screw, Mounting the Lead Screw, Mounting the Recording Arm, Types of Recording Material, "Dubbing," Playback of Recordings, Playback Needles, Inside to Out, Monitoring while Recording, Volume Level and, Discussion. (Price, 10c.)

Both booklets are available from Universal Microphone Company, and may be obtained by writing to the company directly, or care of *Radio-Craft*.

**OH, MA! THAT "'SUGGESTION' CONTEST" IS IN AGAIN**

Last year's award in this contest went to Mr. Stanley E. Bialkowski, Wayne, Alberta, Canada. Will YOU win this year?

Unless you let us know what you want in "our" magazine how can we give you what you want? Remember, we are not mind-readers. So if you or your friends have any ideas as to what in your opinion would greatly improve RADIO-CRAFT, either in appearance, method of presentation, or subject matter, why, "lay on, MacDuff!"

**WIN A 2-YEAR SUBSCRIPTION TO RADIO-CRAFT**

Rules: There are no "strings" attached to this contest. Merely write your suggestions on only one side of a single sheet of paper and mail it, for receipt at our offices not later than April 30, 1937, to Radcraft Publications, Inc., 99 Hudson St., N. Y. C. Everyone, except employees of Radcraft Publications, Inc., is eligible. Here's a tip that may help you win: note that RADIO-CRAFT is designed to interest technicians in every branch of radio!

It has been found that the original closing date of the contest did not afford sufficient time to many more distant readers and therefore the closing date has been advanced, as above, to April.

Please Say That You Saw It in RADIO-CRAFT



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A 1" Oscillograph with wide range linear sweep, and electronic sweep test oscillator all combined in one unit. Send for Diagram. Price to service engineers, F.O.B. Chicago, complete only **\$49.95**

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## THE RADIO "DOCTOR"!

Radio Repair Man to family physician:  
 "While it is impossible to make a positive diagnosis without extensive laboratory procedure, my partner and I are agreed that your radio set is probably suffering from a somewhat atypical form of Smith's disease. You will note the Jones-Brown syndrome of static and fading. We do not as yet quite know the cause of this condition. The prognosis is guarded. Meanwhile a complete rest will result in marked relief of the symptoms. I will drop in to see it again tomorrow. We must watch this carefully. Five dollars, please."  
 (From The Journal of the American Medical Association.)

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View with Self-contained Filter IDEAL FOR AUTO & SOUND TRUCK AMPLIFIER SYSTEMS

6 Volt Models		12 Volt Models	
D.C. Volts	Mills	D.C. Volts	Mills
250	200	250	400
300	166	300	332
350	142	350	284
400	125	400	250
500	100	500	200

110 Volts A.C., 60 Cycles, 65 Watts      110 Volts A.C., 60 Cycles, 130 Watts

- Motor driven mechanism provides ever dependable, fool-proof results!
- Provides Dual-Powered (110 volt AC) operation also for only a few cents additional cost!
- Permits use of 1 to 8 750-10,000 ohm field coil dynamic speakers with 6-12 Volt amplifier—same speakers can also be used for AC operation!
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Over 3000 pages—hundreds of illustrations—the most complete work of its kind ever published. Dynamos, motors, power stations, radio television, everything electrical explained clearly so anyone can understand them.

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Name .....  
 Address .....  
 City ..... State .....  
 Attach letter stating age, occupation and name and address of employer, and at least one business man as reference.

## HOW TO MAKE THE RADIO-CRAFT DELUXE CARRIER INTERPHONE

(Continued from page 653)

### "LISTEN" CIRCUIT

With the switching adjusted for No. 2 contact, the various connections for "radio" operation remain in service—except in the No. 1 section of the switch. Here we simply break the "B plus" lead to the R.F. and mixer tubes, thus throwing the input circuit out of operation. The "B plus" connection to the 2nd-detector is retained, and we may now pick up any signal being transmitted from another unit at intermediate frequency. At the same time, the green pilot lights, indicating "communicator receive."

The A.C., or D.C., power line is used for transmission and reception (other than radio) purposes, with the "B minus" side employed as a return, and with the control-grid coil in the 6C5 detector-oscillator circuit coupled through a suitable capacity to the "hot" side of the power line. This coupling condenser thus brings the desired signal to the detector (operating at or near 456 kc.) for reception, or sends the modulated carrier generated in the 6C5 oscillating circuit into the line for reception by some other unit, depending on whether the operator has switched for "send" (talk) or "receive" (listen) operation.

### STATION FREQUENCIES

We certainly must have some means for adjusting the I.F. circuit to permit at-will transmission and reception on any one of 3 frequencies (we are presuming that our complete set-up will employ 3 units for 3-way communication).

Mr. A must have his frequency, Mr. B, his, and Mr. C, his; and each operator must be able to tune his circuit to his own or to the other 2 frequencies.

In this design, the whole matter is made simple by merely adding 2 separate I.F. trimmers to the control-grid circuit, and selecting these trimmers and thus the desired operating frequency by means of an additional 3-way, single-pole switch, Sw.2.

### THE "MICROPHONE"

The microphone may be, as we have suggested here, simply the loudspeaker "in reverse." We then have a "speaker-mike" (or transducer).

In general, a reproducer, if it is a sensitive, high-quality one with reasonably high fidelity characteristics, will do a surprisingly good job as a mike. There are dynamics and P.M. types on the market particularly designed for this dual-service operation; but the average speaker may be thoroughly depended upon to give a reasonably high output when used as a microphone and to retain, in microphone service, such fidelity characteristics as it may have as a reproducer.

This concludes the design considerations of the system. In Part II, the actual construction of the unit, including chassis drilling and forming details, and a cabinet design, will be given. We'll also tell you about the clock, shown in Fig. A, that if desired may be used to automatically control the on-off operation, either as radio program receiver or as a communicator, of the instrument.

If you want to add the "privacy" feature of headphone operation when desired, read the details in Part II.

Also in this Part are the instructions for adding the crystal microphone, shown in Fig. A.

Please Say That You Saw It in RADIO-CRAFT

for really high-fidelity (for this type of instrument) voice characteristics; the use of such a "mike" is one of the features that contribute to the "deluxe" design.

Operating voltages for checking the performance of the completed instrument are given, as well as vitally-important information regarding reception of the other stations' signals when operating on 3-phase power circuits, in Part II.

### LIST OF PARTS

- One Meissner antenna coil, type 2436, TR1;
- One Meissner R.F. coil, type 2437, TR2;
- One Meissner oscillator coil, type 4243, TR3;
- One Meissner ferrocarril I.F. transformer, type 5742, 456 kc., TR4;
- One Meissner R.F. choke, type 1995, R.F.C.;
- One Meissner padding cond., type D-2500, C6;
- One Meissner 3-gang variable condenser, type 15117, C3, C10, C7;
- One Aerovox condenser, type PBS-2, 8-16 mf., C21, C22;
- One Aerovox single-type condenser, type PBS-2, 4 mf., C23;
- Two Aerovox electrolytic condensers, type PR-25, 10 mf., C17, C19;
- Seven Aerovox condensers, type 284, 0.05-mf., C1, C2, C9, C8, C5, C16, C18;
- Two Aerovox cond. type 284, 0.02-mf., C24, C25;
- One Aerovox cond., type 284, 0.002-mf., C-C;
- One Aerovox condenser, type 284, 0.006-mf., C20;
- Four Aerovox condensers, type 284, 0.1-mf., C4, C12, C26, C27;
- Two Aerovox mica condensers, type 1467, 250 mmf., C11, C15;
- One Aerovox type 484 condenser, 0.1-mf., C-C;
- One Meissner dual trimmer, type 13278, C13, C14;
- One Continental Carbon resistor, 1/2-W., 300 ohms, R1;
- One Continental Carbon resistor, 1/2-W., 10,000 ohms, R2;
- One Continental Carbon resistor, 1/2-W., 50,000 ohms, R3;
- One Continental Carbon resistor, 1/2-W., 10,000 ohms, R4;
- One Continental Carbon resistor, 1/2-W., 1 meg., R5;
- One Continental Carbon resistor, 1/2-W., 10,000 ohms, R6;
- One Continental Carbon resistor, 0.5-meg., R7;
- One Continental Carbon resistor, 1/2-W., 2,000 to 5,000 ohms, R8;
- One Continental Carbon resistor, 1/2-W., 50,000 ohms, R9;
- One Continental Carbon resistor, 1/2-W., 600 ohms, R11;
- \*One octal-base ballast tube, type K-42-B, R12;
- One Electrad potentiometer, type 203, R10 and switch, Sw.3;
- One Electrad poten. for tone control (optional);
- One Centralab 3-way, 8-pole, 4-gang switch, Sw.1;
- One Centralab 3-way single-pole switch, Sw.2;
- \*One open-circuit phone jack;
- One Wright-DeCoster (or, \*illustrated unit) 5-in. electromagnetic or permanent-magnet dynamic speaker;
- One Kenyon output transformer to match TR6;
- One Wright-DeCoster (or, \*illustrated unit) universal-output transformer, TR5;
- \*Seven 8-prong moulded sockets, type R8;
- \*One antenna post assembly;
- One Brush high-fidelity crystal phone, type A;

(Continued on page 701)



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Famous Remington Noiseless Portable that speaks in a whisper, only 10c a day, direct from factory. Standard keyboard. Automatic ribbon reverse. Variable line spacer and all the conveniences of the finest portable ever built. PLUS the NOISELESS feature. Act now. Send coupon TODAY for details.

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Registered Patent Attorney

1115 K St., N. W., Washington, D. C.

## HOW TO MAKE THE RADIO-CRAFT DELUXE CARRIER INTERPHONE

(Continued from page 700)

- \*One model 17 crystal mike (optional) head, less stand;
  - \*One connector (optional), type MC3M;
  - \*One chassis connector (optional), type PC3M;
  - \*One Kenyon A.C.-D.C. filter choke, Ch.1;
  - \*One speaker-type dial;
  - \*One Allied Radio Corp. basic chassis, 6 x 10 x 2½ ins.;
  - \*One National Union or Raytheon 25A6 tube;
  - \*One National Union or Raytheon 25Z6 tube;
  - \*Two National Union or Raytheon 6C5 tubes;
  - \*One National Union or Raytheon type 6A8 tube;
  - \*One National Union or Raytheon type 6K7 tube;
  - \*One 12-hr. (15-min. interval), self-starting "program control" electric clock movement.
- \*The names and addresses of manufacturers will be supplied upon receipt of a stamped and self-addressed envelope.

## NEW P.A. SPEAKERS FOR OUTDOORS

(Continued from page 676)

### STRUCTURAL DETAILS

The composition of the tough and pliant weatherproof diaphragm eliminates failures due to the crystallization of the flexing portions of the conventional brittle metal diaphragm. The ribbon voice coil is made of extremely dense quartz mineral possessing unusual strength and rigidity with a minimum of weight. Being non-hygroscopic and having a negligible coefficient of expansion, the voice coil is unaffected by either moisture or excessive variations of temperature caused by the high power surges encountered in the operation of exponential units.

The air-column units consist of 2 sub-assemblies—(1) the cone assembly, and (2) the magnet assembly—which are attached to each other by a coupling ring, thus forming the complete speaker.

The parts of the cone assembly are assembled on accurate jigs so that the voice coil is concentric with the formed collar on the chassis. The magnet assembly is machined to fit accurately into this collar, which serves as a single central dowel, assuring that the air gap and the voice coil must align.

One of the most important features incorporated in these air-column units is the use of the new powerful permanent magnets. Nipermag should not be confused with other alloys made in this country. This permanent-magnet alloy with its unusually high value of coercive force, is manufactured in the United States exclusively by one company. Nipermag permanent magnets, as described in recent issues of *Radio-Craft*, are used to obtain field intensities equal to or greater than those obtained with electro fields, and these high intensities are maintained indefinitely.

The use of such permanent magnets in these air-column units offers many advantages to the P.A. man, as expensive and unreliable field exciters are eliminated with a consequent saving in installation expense. The reduction in wiring expense is also a considerable item, since these field pot-less loudspeakers require only 2 wires, for the voice currents. There is a considerable reduction in hum and the possibility of field burn-outs is eliminated. The saving in electrical current which would be necessary to excite the fields if they were electromagnets is also a great talking point for the man selling P.A. jobs, for either portable or permanent installations. The SU unit, for instance, would require over 50 W. of electrical power continuously to obtain the same results as are given by the "magic magnet."

All the air-column speakers in the new line are designed to prevent the entrance of dirt and water to the working parts, and when properly installed will give years of trouble-free service under the most rigorous conditions.

Spun aluminum exponential horns are available for use with these air-column units. These horns are removable from the speaker units, and are demountable for ease of transportation. Ring bolts are provided so that the assembled units may be swung from overhead wires or ropes.

### TYPES AND USES

Refer now to Fig. A; numbers in parentheses identify the respective models.

(1) The smallest of the air-column speakers is known as the "FYA" model, which weighs 9 lbs. without the horn, and has a voice coil, of 6 ohms impedance, 1½ ins. in dia. The FYA unit is capable of handling a steady power input of 15 W., and surges of power up to 20 W. The frequency response is substantially flat from 100 to 6,000 cycles, which is a distinct advance over the conventional type of horn unit. The exponential horn for this model has an air column length of 28 ins. and a bell diameter of 24 ins. The horn as well as the speaker unit is finished in neutral grey.

(2) The model "HWA" air-column unit is the second largest size, weighing 26 lbs. without the horn, and has a 6-ohm voice coil 2½ ins. in dia. This model will handle 25 W. of power input continuously and 30 W. on peaks.

The HWA model has a higher efficiency than the smaller model, and an improved frequency response, which is substantially flat from 100 to 7,000 cycles.

Two sizes of exponential horns are available  
(Continued on page 703)

## FINEST FOR Every RADIO NEED



Because...

Famous Metallized Type Resistance Element.

Fully insulated—no shorting,

Sealed throughout—impervious to atmospheric effects.

Enclosed positive contact—will not break or become "open".

Small, sturdy, light in weight.

Both RMA color coded and imprinted with resistance value and wattage rating.

1/2 WATT, List 17c, NET 10c  
1 WATT, List 20c, NET 12c  
2 WATTS, List 30c, NET 18c

**INTERNATIONAL RESISTANCE CO.**  
401 N. Broad St., Phila., Pa.



**INSULATED METALLIZED RESISTORS**

## "BULLET" DYNAMIC MICROPHONES



EVERYBODY WANTS ONE . . . EVERYBODY CAN AFFORD ONE!

The All-Purpose "Bullet" Dynamic Microphone is sweeping the 1937 market.

T. R. 3 — New Model "Bullet" . . . smaller than TR 2 but with relatively the same characteristics. List price, any impedance . . . \$24.50.

T. R. 2 — Standard Model "Bullet" . . . the ultimate in dynamic microphone performance. List price, any impedance . . . \$39.50.

Write for circular "C" and technical data

**TRANSDUCER CORPORATION**  
30 Rockefeller Plaza  
New York, New York

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# EDUCATIONAL **10** CENTS RADIO BOOKS



**RADIO FANS!** . . . Help yourselves to a radio education for the price of 40¢, (10¢ per book). These books will give you a good foundation towards the study of radio. You'll be amazed at the wealth of information contained in them;—and you'll wonder how we can sell them at the low price of 10¢ each. Each book contains 32 pages written in simple, understandable language and profusely illustrated with circuit diagrams and illustrations. They are especially written for beginners but are useful review and reference books for the old timers as well.

### ALL ABOUT AERIALS

In simple, understandable language this book explains the theory underlying the various types of aerials; the inverted "L," the Doublet, the Double Doublet, etc. It explains how noise-free reception can be obtained, how low-impedance transmission lines work; why transposed lead-ins are used. It gives in detail the construction of aerials suitable for long-wave broadcast receivers, for short-wave receivers, and for all-wave receivers. The book is written in simple style. Various types of aerials for the amateur transmitting station are explained, so you can understand them.

### ALTERNATING CURRENT FOR BEGINNERS

This book contains everything to give the beginner a foothold in electricity and Radio. Electric circuits are explained, Ohm's Law, one of the fundamental laws of radio, is explained; the generation of alternating current; sine waves; the units—volts, amperes, and watts are explained. Condensers, transformers, A.C. instruments, motors and generators—all these are thoroughly discussed. Housewiring systems, electrical appliances and electric lamps.

Here are some of the practical experiments which you can perform at home. Simple tests for differentiating between alternating and direct current; how to light a lamp by induction; making a simple electric horn; demagnetizing a watch; testing motor armatures; charging storage batteries from A.C. outlet; testing condensers with A.C.; making A.C. electro magnets; frying eggs on a cake of ice; making simple A.C. motors and many others.

### HOW TO MAKE THE MOST POPULAR ALL-WAVE 1- and 2-TUBE RECEIVERS

There has been a continuous demand right along for a low-priced book for the radio experimenter, radio fan, radio Service Man, etc., who wishes to build 1- and 2-tube all-wave sets powerful enough to operate a loudspeaker.

This book contains a number of excellent sets, some of which have appeared in past issues of RADIO-CRAFT. These sets are not toys but have been carefully engineered. They are not experiments. To mention only a few of the sets the following will give you an idea.

- The Megadyne 1-Tube Pentode Loudspeaker Set, by Hugo Gernsback.
- Electrifying The Megadyne.
- How to Make a 1-Tube Loudspeaker Set, by W. P. Chesney.
- How To Make a Simple 1-Tube All-Wave Electric Set, by F. W. Harris
- How To Build A Four-In-Two All-Wave Electric Set, by J. T. Bernsley, and others.

### HOW TO MAKE FOUR DOERLE SHORT WAVE SETS

Literally thousands of radio fans have built the famous DOERLE Short Wave Receivers. No insistent has been the demand for these receivers, as well as construction details, that this book has been specially published.

Contains **EVERYTHING** that has ever been printed on these famous receivers. These are the famous sets that appeared in the following issues of SHORT WAVE (RADIO-CRAFT): "A 2-Tube Receiver that Reaches the 12,500 Mile Mark," by Walter C. Doerle (Dec., 1931-Jan., 1932). "A 3-Tube 'Signal Gripper,'" by Walter C. Doerle (November 1932). "Doerle 2-Tube" Adapted to A. C. Operation" (July 1933). "The Doerle 3-Tube 'Signal-Gripper' Electrified," (August 1933) and "The Doerle Goes 'Band-Spread'" (May, 1934).

Due to a special arrangement with SHORT WAVE CRAFT, we present a complete 32-page book with stiff covers, printed on an extra heavy grade of paper with numerous illustrations. Nothing has been left out. Not only are all the DOERLE sets in this book, but an excellent power pack if you wish to electrify any of the DOERLE sets, is also described.

Each book contains 32 pages, profusely illustrated with clear, self-explanatory diagrams. *It contains over 15,000 words of clear legible type.* It is an education in itself and lays the ground-work for a complete study of radio and electricity.

If you do not think that this book is worth the money asked for it, return it within 24 hours and your money will be instantly refunded.

**Radio Publications**  
99A Hudson St., New York, N. Y.

## MAKE THE "LONG ARM" —A REMOTE SET CONTROL

(Continued from page 667)

of the tuning and volume range of any set placed anywhere in the room. In many cases it is necessary to have the receiver in the next room. This will not offer a problem—simply lengthen the 2-wire cable connecting the remote control to the radio receiver.

Then, the remote control will be worth its weight in gold to "announcer haters." When you hear a "commercial" coming, reach out, turn the volume control to the left and enjoy peace and quiet. This can be done without leaving the old arm chair.

### THE ELECTRICAL CIRCUIT

The diagram of Fig. 1 shows the simplicity of the electrical circuit. Two tubes are used, one is the 6A8 pentagrid converter tube and the other is the 25Z6 rectifier tube used in a half-wave connection.

Due to the fact that all of the circuits involved in the operation of the unit are working at radio frequencies, adequate power supply filtration is obtained without the expense of iron-core chokes and large values of filter capacity. The power supply filter network thus consists of only resistor R3, and condensers C7 and C8.

The circuit of the 6A8 is conventional, with the triode section used as the oscillator and the pentode section used as the modulator or mixer tube. Note that the volume control is of the combination type, although a simple form of potentiometer, R5, is used. When the volume is reduced the bias on the control-grid of the pentode section is increased and the primary of the antenna transformer is shorted. An old, but effective means of volume control.

This remote control can be used with any type of receiver either T.R.F. or superhet., and due to the inclusion of the extra 2 tuned circuits, plus the conversion gain of the pentode section one can expect an improvement in the performance of the receiver. Generally this improvement will be noted in a slight increase in sensitivity and sharper tuning. There should be no loss in volume and sharpness in tuning, if the unit is properly adjusted and installed.

It is not necessary to make any internal connections to the radio set when the remote control unit is used, as, it is self powered. This is a very important feature, as the average radio set is designed with a power supply adequate only for its own needs, and the addition of extra tubes with the resultant increase in the filament and plate current drain may cause the receiver to overheat or change the plate voltages on the tubes. In many of the present-day receivers a change in the applied plate voltages can cause the circuits to become detuned. Thus, necessitating a re-alignment job that would take time and if the set is of the multi-band type expensive test equipment may be necessary.

### OPERATING INSTRUCTIONS

After all of the connections are made and checked according to Fig. 1, and the bottom cover-plate attached to the chassis (to prevent radiation from the wiring), and the tubes placed in their respective sockets, run 2 wires, in the form of a twisted pair, from the radio set to be controlled to the remote control unit. Connect one end of one wire to the antenna post and the other wire at this end to the ground post of the receiver. The remote free ends of this 2-wire cable are connected as follows.

If the radio receiver has a low-impedance antenna primary, connect the wire from the antenna post of the receiver to the white lead of the adapter. Connect the ground wire from the receiver to the black lead. Leave the green lead of the remote control unit unconnected.

If the radio receiver has a high-impedance primary, connect the antenna wire from the set to the green lead and the ground wire to the white and black leads. *If impedance is unknown try both connections for best results.*

The external antenna formerly connected to the radio receiver is now connected to the antenna post of the remote control and the ground lead is connected to the ground post. Plug in the power cord to a convenient receptacle and turn the unit on by rotating the volume control knob to the right. Turn on the radio receiver and tune to the low-frequency end of the tuning range (broadcast band) where no local station is being received. Set the volume

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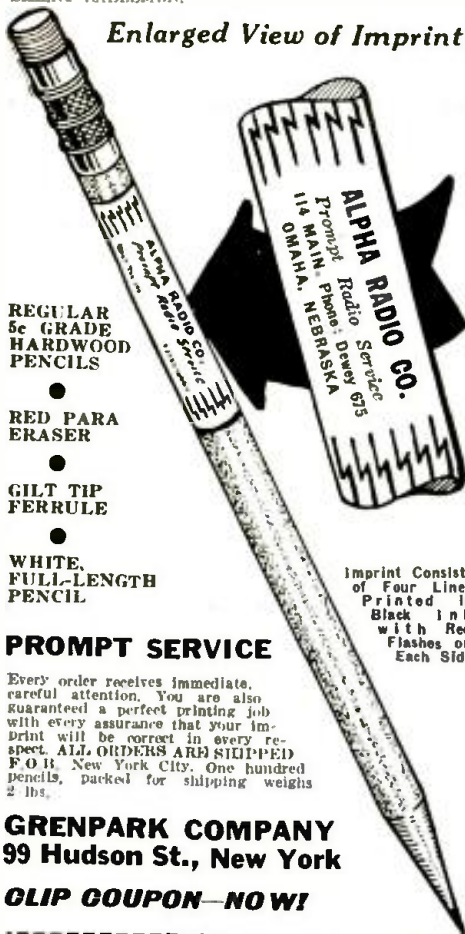
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control of the receiver to the loudest comfortable volume.

With the volume control on the remote unit turned well up tune in a station by means of the selector knob on top of the unit. Select a station near the high-frequency end of the scale (lowest wavelength). Adjust the 2 compensators, C1A, C2A, on the remote-control tuning condensers by means of a screwdriver inserted through the 2 holes in the side of the chassis. Adjust for maximum volume. Then tune in a station at the low-frequency end of the band and adjust the padder condenser, C11 through the single hole which is in the rear of the tuning condenser compensators. This setting should be made for maximum volume. Recheck the tuning condenser compensators at the high-frequency end and the unit is ready for operation.

If these adjustments are properly made the remote-control tuner should cover the broadcast band from end to end. No trouble should be experienced from interference from stations picked-up directly by the receiver if a good spot is selected for the fixed position of the receiver tuning dial. If a strong local station is located close enough to this selected setting there may be a whistle or birdie when tuning weaker stations on the remote control. These can be cured to a great degree by adjusting the compensator in the top of the round shield located near the tubes.

### LIST OF PARTS

#### Kit Components

- One Meissner output I.F. transformer, L3;
- One Meissner I.T.F. with C10, 7-80 mmf.;
- One Meissner antenna-oscillator coil, L1-L2;
- One 2-gang tuning condenser (with trimmers), 360 mmf., C1, C2;
- One selector dial plate and escutcheon;
- One volume control and power switch, 25,000 ohms, R5-Sw.1;
- Two small bar knobs;
- One isolantite padding condenser, 300 to 500 mmf., C11;
- One 3-terminal tie lug;
- One 3-lug terminal strip;
- One 2-lug terminal strip;
- One 1/2-in. rubber grommet;
- One 1/4-in. rubber grommet;
- Two octal 8-prong metal tube sockets, for V1, V2;

#### Miscellaneous Components

- One resistor, 500 ohms, 1/2-W., R1;
- One resistor, 50,000 ohms, 1/2-W., R2;
- One resistor, 20,000 ohms, 1 W., R3;
- One resistor, 30,000 ohms, 1/2-W., R4;
- One mica condenser, 0.002-mf., C3;
- One mica condenser, 100 mmf., C4;
- One paper condenser, 0.1-mf., 200 V., C5;
- Three paper condensers, 0.1-mf., 400 V., C6, C9, C12;
- One electrolytic filter condenser, dual-section, 4-4 mf., C7, C8;
- One power cord, with plug, 290 ohms;
- One metal-tube grid shield;
- One metal-tube grid clip;
- Six lengths of colored hookup wire for all connections;
- One lacquered steel base plate;

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

## NEW P.A. SPEAKERS FOR OUTDOORS

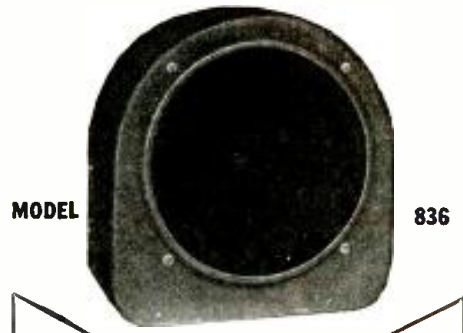
(Continued from page 701)

for this model, the IU with a bell diameter of 24 ins. and an air-column length of 20 ins., and the SW horn with a bell diameter of 32 ins. and an air-column length of 30 ins. The SW horn is preferable for outdoor installations.

(3) The model "SUA" air-column speaker is the largest and most powerful of the air-column series and is believed to be the most efficient reproducer ever manufactured for commercial use. This model is the ultimate in exponential speakers, with an exceptionally flat response up to 8,000 cycles. The model SUA, as shown in the close-up of the driving unit, Fig. B, has a 6-ohm voice coil 3 1/2 ins. in dia., and is capable of handling 30 W. of audio power continuously with peak surges of 40 W. Both the IU and the SW exponential horns will fit this model, but the SW horn is recommended for all applications.

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

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MODEL

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Write for literature and prices on other models. Also name of our nearest distributor.

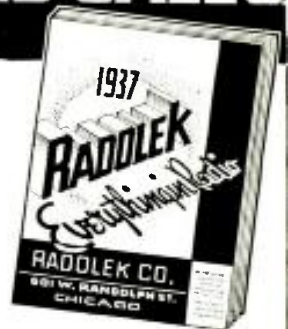
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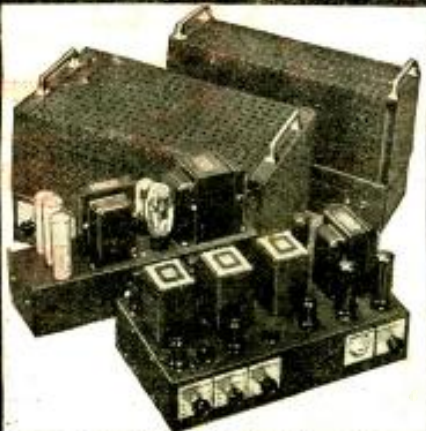
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## BOOK REVIEWS

**FUNDAMENTALS OF INSTRUMENTATION,** by M. F. Behar. Published by Instruments Publishing Co. Size 6 x 9½ ins., 109 pages. Price, \$2.00.

While not strictly a book for the radio man, this little volume contains such a world of data on measurements as applied to electrical circuits and mechanisms that it is being included in this review, for those radio men who are interested in the measurement side of the industry.

The book is divided into four parts—a general description of industrial instruments—properties and characteristics of industrial instruments—performance of automatic controllers—and a general description of how the instrument department of an industrial organization should be set up and run.

It is a fine reference for anyone associated with measurements as applied to industry—whether it is a radio or other plant.

**ELECTRICITY,** by W. L. Bragg. Published by The MacMillan Co., 1936. Size, 6 x 8¾ ins., 272 pages. Price, \$4.00.

Even advanced technicians will find that the material enclosed within the covers of this book will be intensely interesting, if only from the standpoint of brushing up on fundamentals.

Professor Bragg has covered a diversified field in a style of writing which makes the volume both enjoyable reading and yet exact in details and descriptions. All treatments have been made in an entirely non-mathematical way.

The book covers such subjects as—what is electricity—how electricity travels—motors and dynamos—our electrical supply—telegraphs and telephones—oscillating electrical circuits—etc.

**ELECTRON TUBES IN INDUSTRY,** by Keith Henny. Published by McGraw-Hill Book Co., 1937. Size 6¼ x 9¼ ins., 539 pages. Price, \$5.00. Second Edition.

The new edition of this well-known volume is even more complete than its predecessor, covering practically all phases of V.T. applications both as complete units and in conjunction with mechanical contrivances of divers types.

The book is divided into 7 chapters covering the fundamentals of electronic tube circuits, thermionic tubes, vacuum-tube amplifiers, gaseous triodes, light-sensitive tubes, applications of light-sensitive tubes, rectifiers, cathode-ray tubes, and miscellaneous tubes and circuits.

The author has endeavored to cover the very wide field without omitting important facts, yet with a minimum of mathematical or otherwise heavy descriptions.

**COMMUNICATION ENGINEERING,** by William L. Everitt. Published by McGraw-Hill Book Co., 1937. Size 6¼ x 9¼ ins., 727 pages. Price, \$5.00.

This is also a second revised and enlarged edition—bringing up-to-date, treatments on the theory and practice of electrical communication. Many new subjects have been added including a new chapter on equalizers; a new description of electromagnetic coupling; the treatment of class B and class C amplifiers is revised; new data on frequency and phase modulation, plus new information on detection and cross modulation and higher-order modulation effects; and a completely re-written chapter on radiation, antenna arrays.

This book is a standard work for the engineer's library and every advanced technician should have one for reference purposes.

**DICTIONARY OF TECHNICAL TERMS** by F. S. Crispin. Published by The Bruce Publishing Co., 1936. Size 5½ x 7¼ ins., 270 pages. Price, \$2.00.

The technician often encounters words in his studies which cannot be found or properly defined in ordinary dictionaries and encyclopedias. It is for this reason that this handy book has been prepared.

It contains all the words which are used in text books of mechanical, electrical, radio, and physical subjects—a useful volume.

Please Say That You Saw It in RADIO-CRAFT

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