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RADIO

ESTABLISHED 1917

SHORT-WAVE AND EXPERIMENTAL

OHM'S LAW

$E = I \times R$

$R = \frac{E}{I}$

$I = \frac{E}{R}$

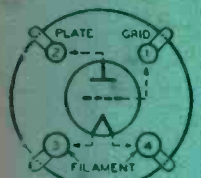
CONDENSERS IN SERIES

$C_{TOTAL} = \frac{C_1 \times C_2}{C_1 + C_2}$

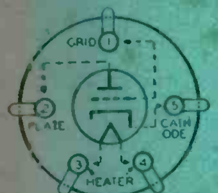
RESISTANCES IN PARALLEL

$R_{TOTAL} = \frac{R_1 \times R_2}{R_1 + R_2}$

BOTTOM VIEWS OF SOCKETS



4-PRONG SOCKET
50-201-A, 45, 210, 30, 31, ETC.



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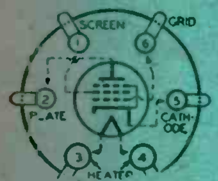

6-PRONG SOCKET
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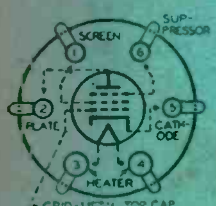

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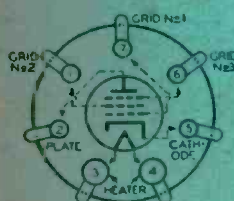
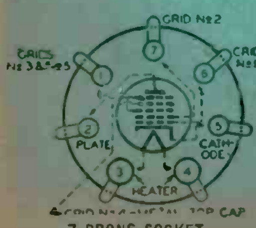


7-PRONG SOCKET 59



7-PRONG SOCKET
2A7-6A7

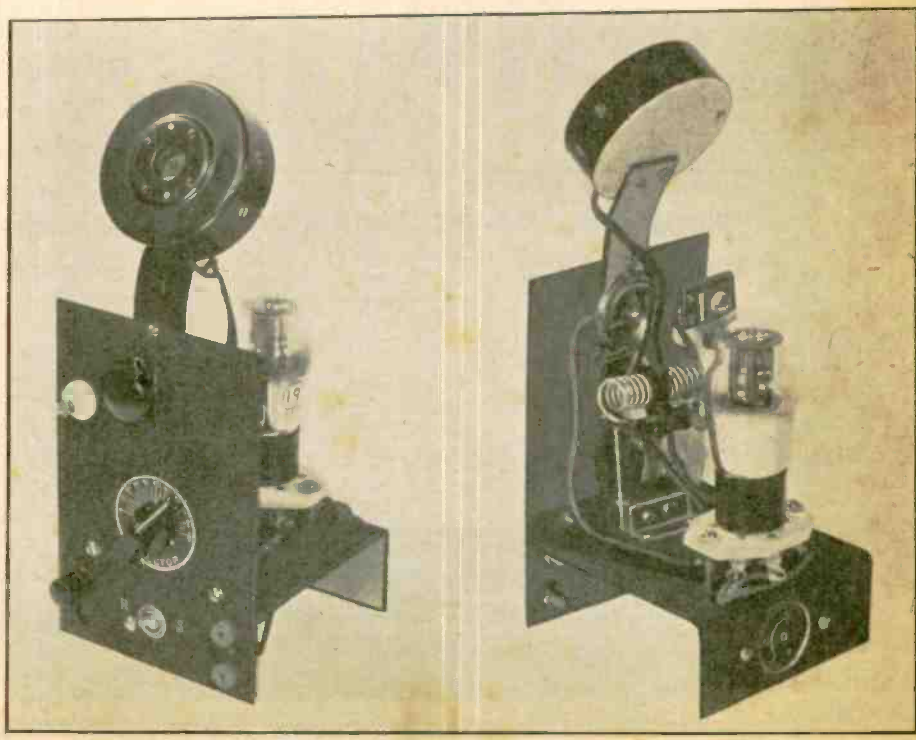
—IN THIS ISSUE—

★

The Illustration Shows Frank C. Jones' Latest One-Tube Transceiver. It Employs Some New Features and a Novel Circuit.

•

Complete Details in This Issue



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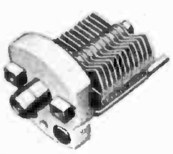

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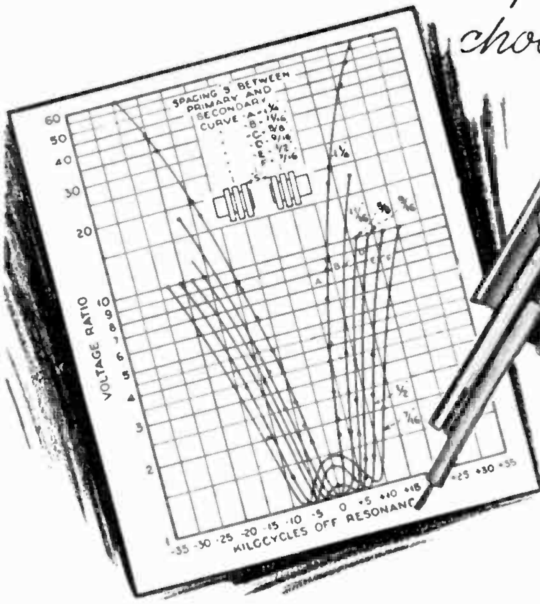

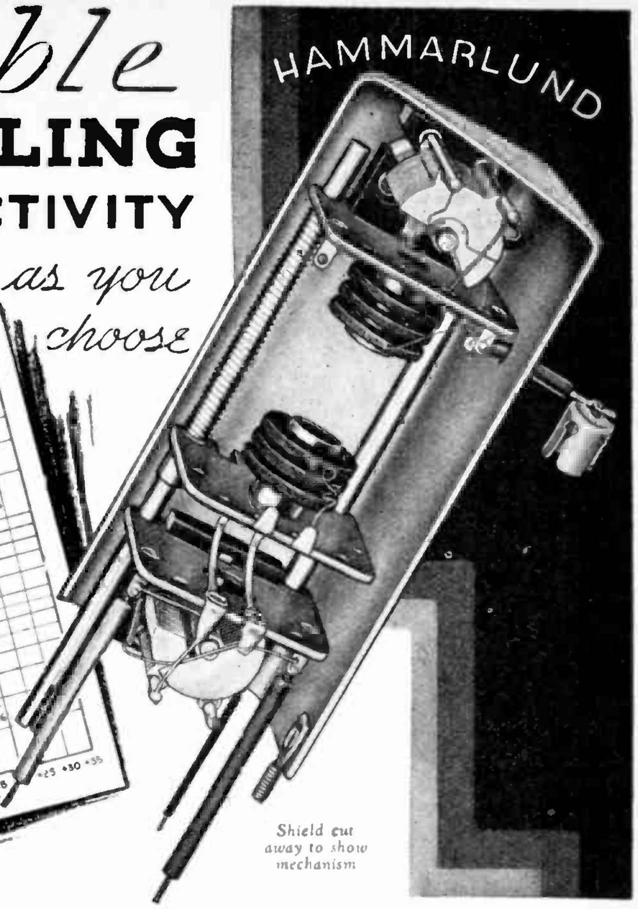

Shield cut away to show mechanism

NOW, the greatest single improvement in receiver *flexibility* in recent years. CONTINUOUSLY VARIABLE SELECTIVITY, from a needle-sharp peak to the flat top required for fidelity—*without affecting tuning*.

The transformer, basically, is the time-tested Hammarlund I.F.T. design, with new triple-type, pie-wound Litz coils and air-dielectric condensers. Plus the startling feature of *continuously variable coupling between the coils*.

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New LOW-LOSS COIL SETS *and* COIL FORMS

Get more stations, louder signals and sharper tuning with these low-priced Hammarlund Coils *(illustrated below)*. Users say they out-perform any other coils at any price. "XP-53", the new Hammarlund low-loss dielectric, has no artificial coloring to cause losses. The forms are ribbed for air-spacing, have easy-grip flanges and handy "Meter-Index" inserts for coil ranges. Set of four coils for 15-270 meters *(4 prongs, 2 windings)*, $3.00. Set of four coils *(6 prongs, 3 windings)*, $3.75. Extra 4 or 6-prong coil for broadcast band, $1.25 and $1.50 respectively. Coil Forms *(4 or 5 prongs)*, 35c each. 6-prong forms 40c each. *40% discount to experimenters*.

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Dr. Lee de Forest

Father of Radio, whose genius has enriched human knowledge and enhanced human enjoyment of life and whose inventions still form the basis of vacuum tubes and oscillating circuits as we know them today

APPROVES AND USES IN HIS OWN EQUIPMENT

AMPEREX CARBON ANODE TUBES

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Very sincerely yours,

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Vol. 17 MARCH, 1935 No. 3

Radiotorial Comment

Shot in the Patio

● The whispering campaigners have a new rumor afoot. "Colonel Foster shot in the war," they say. And this latest attempt to discredit the writings of the Colonel is used as a means to prove him of unsound mind. So the editor of this magazine made a request of the Colonel for the facts of his war injury. The following letter came in reply:

A RELIABLE citizen of New York has forwarded the remarks made to him by an amateur who is a supporter of the present regime at ARRL headquarters.

"This fellow, Foster, during his military service suffered some kind of an injury. As a result he goes through a peculiar cycle; first he is a great friend of someone but as time passes he goes into a period in which he quarrels violently with the erstwhile friend for no reason except things of his own imagination. You know he gave the ARRL a motor-generator set which is still being used at W1MK. The man is really mentally unsound and is to be pitied. That is the reason Warner does not feel like showing him up."

The source of the tale is readily recognizable. Pres. Maxim in his last annual report to the ARRL directors referred to me as that unbalanced but influential leader. I have been plastered with Hartford labels for years, until I now look like an old suitcase that has been on several Cook's Tours. One of the choicest of the collection is one provided by Budlong, Warner's assistant. He wrote one of the fine oldtimers in the East, "Foster would like to see the Headquarters spit in the faces of the commercials", and the oldtimer sent the letter to me. Budlong's intention was to spread the impression that while the Headquarters men were living up to their much-advertised "high standard of conduct", Foster represents the depth of ill-breeding.

But, for all I know, there may be something in this claim that I am mentally unbalanced. The crazy man is the poorest judge in the world of his own mental state. The crazier he is the surer he is of his own sanity, so I would best leave mine to the decision of others—which may be, for all I know, merely an insanely adroit way of making people think I am sane. At any rate, perhaps I would better relate the story of my war injury. It may give the judges some slant of my present mental condition.

During the war a detail of us men of the Corps of Engineers was assigned to help the British repair a bridge the Germans had dynamited. The Germans came back and drove us off with rifle-fire. In beating it back to the British lines I turned my ankle and was utterly unable to walk. I dragged myself into a shell-hole. A sergeant threw himself into the hole beside me and explained that I would have to get out of there—that the Germans would surely come this far and would finish me. I showed him my predicament, that I couldn't put my foot to the ground. He urged that I must get out somehow and that if I could get on his back he would carry me in. I put my arms around his neck and he legged it for the rear with me on his back. On the way in a bullet hit me in the posterior, but the sergeant made good time and we reached the British lines without further mishap.

Now, of course I don't know how much, if at all, a wound in that location may affect a man's mind. Some men carry the seat of their intelligence in the seat of their pants, but whether I myself am one of those men I have no means of knowing. But whether it affected my mind or not I know it affected profoundly my faith in the unselfishness of human nature. The sergeant some months later said the only reason why he had stopped to carry me in was that I was so big I would afford fine protection for him.

Anyway, I got a bullet in the patio and he got the Victoria Cross for it.

For years I have kept this story to myself. This is the first time I have ever told it, but it seems only fair to give the pitying Mr. Warner a break.

—Clair Foster, W6HM.

★ ★

"RADIO" Backs the League

A DISTINGUISHED servant of the League, peering into the narrow neck of an empty whiskey flask used as a substitute for the mystic ball of a crystal-gazer, informed the publisher of this magazine that the League would put "RADIO" out of business unless our campaign of criticism is brought to a halt. Like the man who predicts the weather reports for the newspapers, we don't always get the kind of weather the papers like to give us. And so it was with the League prophet, when he forecast our early doom. For we were supposed to have been out of business at 2:15 A. M., three Saturdays ago. By some strange turn of fate we are still in business today. The score—one to nothing.

Unlike those who are trying so hard to subdue the growth of this magazine, "RADIO" has no desire to see the League go out of business. Quite the contrary. It is our sincere purpose to help strengthen the League structure; our campaign has not been directed at the League, as a League—it is aimed fairly and squarely at those who have taken it upon themselves to administer the affairs of the League as they see fit, not in accord with the wishes of a vast number of amateurs who are trying so hard to make the League a better organization to belong to.

All the constructive suggestions offered by this magazine have been poo-poohed by the square-jawed, two-fisted fighters at Hartford. For fighters they are—fighting to hold their jobs!

Now we are told that Congress can do nothing to protect the future of amateur radio. The suggestion to solicit Congressional aid came from this magazine; consequently, it CAN'T be worth a whoop. If the suggestion were good, the League would have appealed to Congress years ago, you have been told. It is a matter of record that the amateur has fewer privileges at this time than he ever had before. Why? Because we did NOT solicit the aid of Congress. Running true to form, the criticism comes from those who are being criticised for not doing what they are paid to do. You, as amateurs, pay for protection; why not make it your business to get it?

The commercial interests go to Congress and get what they want. They hire fat-salaried lobbyists. The amateur stays away from Congress and gets what the commercials feel like giving him. We ask one simple question—why does not the League spokesman join with us in this campaign to solicit Congressional aid? The answer seems quite obvious—the suggestion did not come from him!

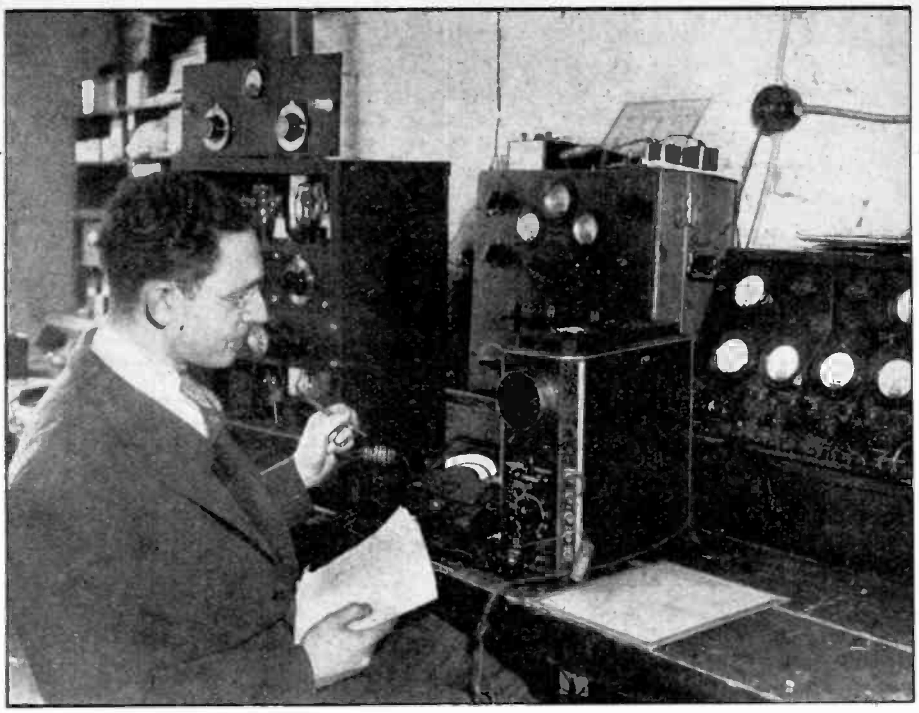
The radio amateurs of Northern California recently met in San Francisco for the purpose of forming an alliance of radio clubs. A delegate from one of the clubs suggested the alliance be politics-free. Asked to define politics, he replied—"Trying to get more frequencies is non-political; asking that we fire Warner is political."

To this writer it seems the reverse is true. In order to get more frequencies the greatest political drive in all amateur radio history must be waged; that drive is well under way.

Up stood another amateur from Warner's pet thorn-in-the-side radio club, San Jose, California. Said he: "I have recently been in conference with a former member of Congress. He tells me that in his 16 years of public service no request, to his knowledge, has ever been made by Mr. Warner for Congressional aid.

Every sane amateur KNOWS we must appeal to Congress at one . . . not two years hence! The wheels of government turn slowly. We must first acquaint our Congressmen with the deplorable conditions prevalent in amateur radio. Further delay can prove disastrous. Stereotyped letters should not be sent to Congressmen. Write a simple, homely, sincere message to your Congressman. Tell him what we have today, what we had years ago; tell him how we lost what once was all our own. Ask for his cooperation in getting a little more breathing space in which to operate. The amateur is not unreasonable.

(Continued on page 33)



Mr. I. A. Mitchell is here shown in his laboratory where tests are being conducted with controlled carrier modulation.

Controlled Carrier Modulation

Voice-Actuated Sub-Audible Carrier Control for Increasing Power Output From a Given Tube Capacity in the Final Amplifier

Minimizes Cross-Talk for Duplex Operation. . . Saves Power . . . Reduces Heterodyne Interference . . . Requires No Secial Modulator Tubes for High-Power Use

A Pair of 210 Tubes Gives the Same Signal at the Receiving End As Conventional Systems Using 50 Watters

By I. A. MITCHELL*

★ Many experimenters have long tried to find a way to cut down the carrier input and output during periods of low modulaion. Various methods have been proposed; none proved practical for amateur operation. Some systems called for the use of Thyratrons, or grid-control rectifiers; others used series modulation, with its attendant adjustment difficulties. The system here described by Mr. I. A. Mitchell is the first workable solution of this problem. It involves no important compromises.

● Controlled carrier modulation is to the RF end of a modern transmitter what class B is to the audio end. In addition to the advantages of increased power efficiency, extended tube life and the use of smaller tubes for high power output, controlled carrier modulation reduces interference between stations and increases effective working range of transmission. While all this may sound like the Utopia of a day-dreaming engineer, the data and explanations which follow will readily substantiate these facts to those who are interested in the theoretical side of transmitter design.

Controlled carrier modulation can be defined as a method of modulation in which the average carrier output varies with the audio level, instead of remaining constant as in conventional modulation systems. Fig. 1 illustrates the relation of RF power to AF power in a typical transmitter using the first really practical system of controlled carrier modulation. This experimental transmitter used four 59s in class B in the audio modulator and a pair of 801s with controlled class C input in the final. Before going into the technical details of this transmitter, let us examine more closely the various advantages of this controlled carrier modulation and the effects which produce these advantages. They can be enumerated as follows:

* Chief Engineer, United Transformer Corp.

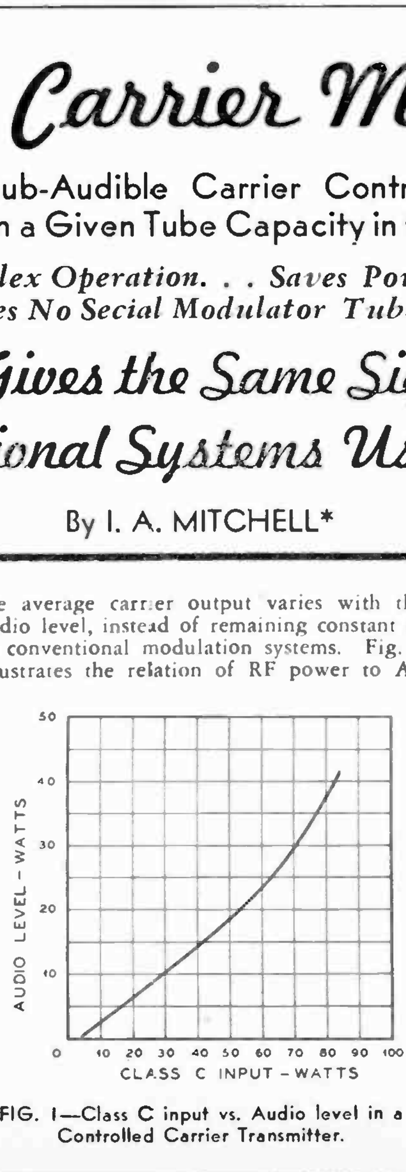


FIG. 1—Class C input vs. Audio level in a Controlled Carrier Transmitter.

1. Reduction In Power Consumption and Operating Costs

Fig. 2 illustrates the relationship of power measured at the primary of the plate transformer for the final as compared to different audio levels. Every amateur who has watched the wiggling of the plate current meter in a class B amplifier, or by means of an oscillograph used to check percentage modulation, realizes that speech and music are not of continuous level, but consist of a series of valleys and peaks representing different audio levels. Tests by the writer have indicated that if these valleys and peaks are integrated over a period of time, the average audio output is less than 20 per cent of the amplifier peak power handling ability. This is particularly true of the amateur phone station, because silent periods of short duration are extremely frequent. An approximate check taken on three stations indicated that the effective audio power was less than 10 per cent of maximum for 90 per cent of the time.

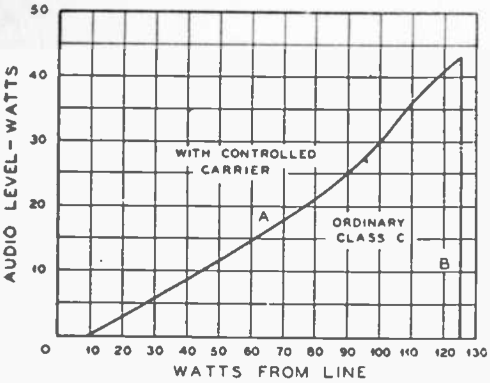


FIG. 2—Comparison Between Ordinary Class C and Controlled Carrier Class C as Referred to the Variation of Power Consumption from the Line vs. Audio Power.

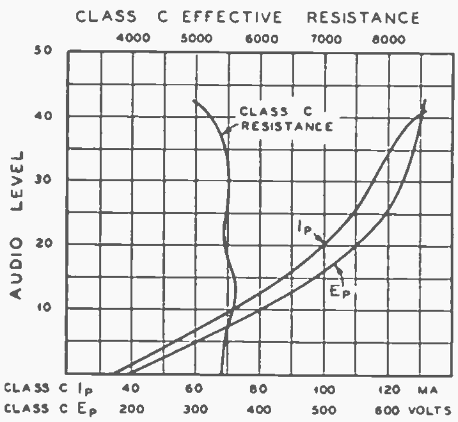


FIG. 3—Relation of Class C Operating Characteristics to Modulator Level in Controlled Carrier Transmitter.

Using this approximate check, the audio power taken 90 per cent of the time on the transmitter described above would be below 4½ watts. In an ordinary transmitter using 801s for the final, Curve B, Fig. 2 would indicate that a constant power of 125 watts would be taken from the line by the final plate transformer. Considering this with respect to Curve, Fig. 2, this means that for 90 per cent of the time the power taken from the line will be reduced to less than 24 watts. Furthermore, for a very considerable portion of the time the power taken from the line by the final plates will be only 10 watts. This saving in power is tremendous. If duplex operation is used, the operating cost is reduced still further, as negligible plate power is taken by the final during receiving periods.

2. Increase In Tube Life

Referring again to Fig. 1, it is seen that at low audio levels the class C input is very low. This is shown still more clearly in Fig. 3. It is seen from this latter curve that at zero audio input the class C plate current is only 36 milliamperes total, and the corresponding plate voltage 195 volts. The increased tube life at this low plate power is obvious. Using the previous approximation of 10 per cent audio level for 90 per cent of the time, the class C input to this pair of 801s is found to be less than 15 per cent its maximum value for most of the time. The resultant reduction in plate dissipation should increase the tube life many times over. At the moment, the writer does not have facilities to determine this increase and we must consequently wait for further data from the tube companies before an accurate measure of this replacement economy can be determined.

3. Use of Smaller Tubes For High Output

Most amateurs are familiar with the theory of class B amplification and realize why class B audio amplification made possible greater power from audio tubes. This is easily seen on the curve for plate current vs. power output of a class B system as in Fig. 4. Because the plate current swings through a wide range, the average effective plate current is much less than that at maximum output. An examination of Fig. 3 will show a striking similarity between the class C plate current vs. audio level and the class B plate current vs. audio level of Fig. 4. The effect of the curves is almost identical and consequently it is found that the available power output from a given pair of tubes used with controlled carrier modulation can be increased greatly over the output available from the same tubes in a normal class C amplifier. Tests conducted so far seem to indicate that an increase of almost 100 per cent can be obtained.

4. Reduction of QRM

Because the carrier magnitude is reduced for the greater part of the time, interference between stations is greatly reduced. This is of vital importance in broadcasting as the allocation of stations by the FCC is such that normal interference is comparatively small. The additional aid of reduction in carrier would eliminate this effect practically entirely. To the amateur this is of importance; using controlled carrier modulation the beat note between stations is reduced for a major part of the time and the consequent crowding of the ether which is present on the amateur bands today would be greatly reduced.

5. Increased Working Range

One of the first fundamentals in phone transmission is the formula which states that the carrier power required for a given field coverage varies inversely as the square of the

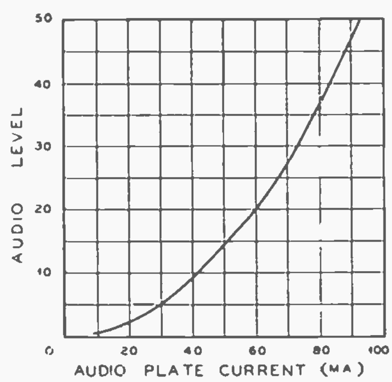


FIG. 4—Relation of Plate Current to Watts in a Typical Class B Amplifier.

modulation percentage. Assuming for ordinary speech a percentage modulation of 10 per cent for 90 per cent of the time, we find the following peculiar fact; since

$$\frac{\text{Power A}}{\text{Power B}} = \frac{\%\ B^2}{\%\ A^2}$$

and assuming 50% for "A" (controlled carrier) and 1.58% for "B" (regular class C): (See Fig. 8):

$$\frac{\text{Power A}}{\text{Power B}} = \frac{.25}{.00025} = 1000$$

This means that at 10 per cent audio level the same coverage (distance) could be obtained from a 10 watt transmitter using controlled carrier as from a very much larger transmitter using normal class C. This does not apply to the maximum audio level; at which well-designed transmitters of both types should give 100 per-cent modulation. However, as previously stated, the average audio

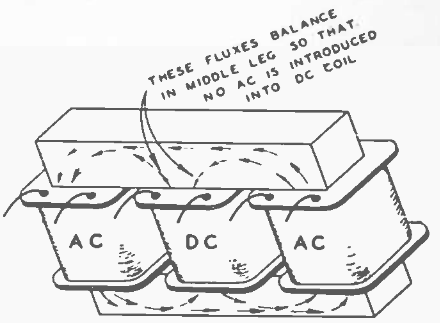


FIG. 5—Appearance of Saturable Reactor.

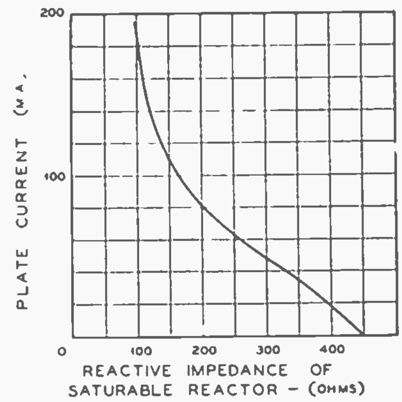


FIG. 6—This Curve Shows the Change in Reactarce of AC Coils in a Saturable Reactor as the DC Is Increased.

power is far below the maximum audio power. Putting it another way, let us say that if Joe Ham whistled code into his phone transmitter so that 100 per-cent modulation was obtained on all signals, he might contact New Zealand. On the other hand, if he spoke into the microphone, New Zealand could hear only the loud notes of his voice and would miss the lower intensity notes at which the percentage modulation is appreciably lower and the consequent coverage very much smaller. In this respect it might be remembered that broadcast stations have found that the minimum audio power range for good fidelity must be at least 30 DB. This represents a minimum audio power equal to .1% maximum audio power which is a much greater change in percentage modulation in the ordinary transmitter than in any of the examples referred to above.

6. Increased Fidelity

Broadcast stations have found it necessary to increase the range of audio levels they transmit very appreciably to take care of modern high fidelity requirements. Massa of R.C.A. claims that a range of 70 Db. in audio level is required for real high fidelity. One of the greatest stumbling blocks in the progress of broadcasting in this respect has been the fact that due to the decrease in modulation percentage, the corresponding effective coverage is reduced in accordance with a square law. However, using controlled carrier modulation, the major part of this effect can be eliminated and a much greater range in audio level can be obtained with the same maximum power output and the same coverage. Another important factor in fidelity is the tendency prevalent among broadcast stations and amateurs to overmodulate. If controlled carrier modulation is used, when the audio level rises to the point of normal overmodulation, the class C input is automatically increased sufficiently to minimize the effect.

Circuit Details

Numerous methods of obtaining controlled carrier modulation have been attempted in the past. The results have been, on the whole, not very encouraging. A system of this type was recently described in a contemporary publication where the class B and class C plate circuits were connected in series to obtain the desired control action. While this system is a great improvement over previous methods, it has a number of serious disadvantages. The plate voltage applied to the tube circuits connected in series is equal to the sum of the normal plate voltages of the respective circuits. At zero audio input, the audio plate circuit represents practically all the resistance in this series tube circuit. Consequently, the entire DC voltage is impressed across the audio tubes. In normal operation this necessitates the use of a tube having about twice the plate voltage rating of a corresponding tube used in a standard circuit. If standard tubes are used, they may break down. In addition, the nature of the circuit is such that major alterations must be made to a standard transmitter if it is to be used in this new manner. Adjustments are somewhat critical. High voltage condensers are necessitated for the filter circuit. The power supply regulation must be good even for the class C section. A tendency for overmodulation takes place if the audio level is changed rapidly as in normal syllabic speech.

All of these disadvantages have been eliminated in the modulation system outlined below. Here again the basis for control is the fact that as in Fig. 4 the modulator plate current in a class B amplifier varies practically linearly with the power output. This plate current is used to saturate a control reactor which in turn controls the plate supply of the class C final. If a class A modulator is used, other means of obtaining this control current are possible. Fig. 5 illustrates the general nature of a saturable reactor. A shell type laminated core of somewhat different proportions than that in an ordinary transformer is used for the magnetic circuit. Three coils are placed on the respective legs of this core, the outer two being connected in series with the AC line and so related in polarity that their respective magnetic fluxes are in accordance with the arrows shown. It is seen that the MMFs of the two AC magnetic circuits are opposite in direction in the middle leg and tend to neutralize each other. If the coils and magnetic circuit are perfectly balanced, these fluxes will be perfectly balanced and no AC flux will traverse the middle leg of the laminations. The control coil is placed on this middle leg and the plate current of the Class B modulator is passed through it. All radio men are familiar with the fact that as the DC current is increased in a filter choke, its inductance decreases. Exactly the same effect is produced here, except that by proper design a fairly linear relation and a wide range in inductance can be obtained. Fig. 6 illustrates this relation of saturating DC to AC impedance in the experimental reactor used in the transmitter previously referred to. The linearity of this curve can be increased still further.

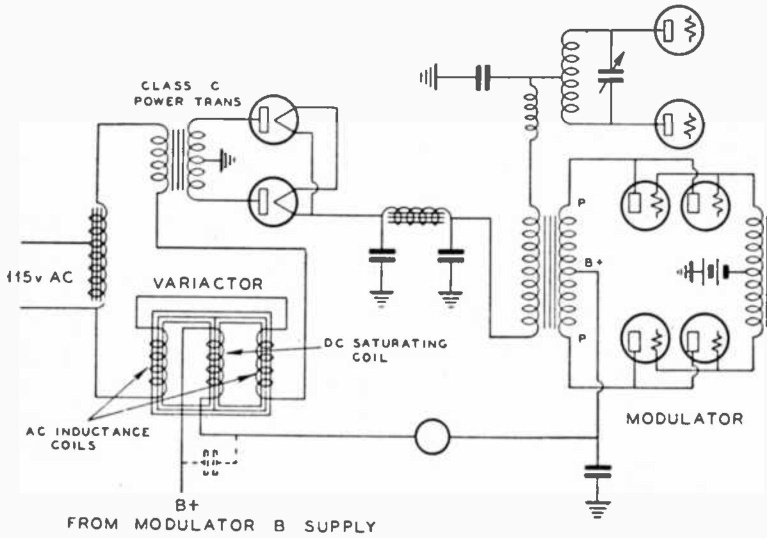


FIG. 7—Circuit of Controlled Carrier Transmitter

The saturable reactor is placed in series with the primary of the final plate transformer. It is seen from Fig. 6 that with no audio signal (minimum DC) the reactance of this reactor is quite high (450 ohms). This effects a great voltage drop to the primary of the plate transformer, as the effective impedance of this primary is quite low. However, as the saturating DC is increased, the reactance is decreased, and the consequent voltage drop is decreased. The primary voltage rises in accordance with this, and with proper design, reaches almost maximum at normal maximum audio output. Even with the reactor practically saturated, a small reactance and consequent voltage drop exists. To compensate for this, an autotransformer is used on the line side of the reactor which increases the total impressed voltage. This autotransformer does not have to be used if the plate transformer primary is wound or tapped for the reduced voltage obtained after the reactor drop. In either case, this voltage drop does not represent a power or efficiency loss, as the drop is almost entirely reactive and results primarily in a change of power factor; i.e., the ratio of VA/watts increases only.

It is apparent, on examining the circuit of Fig. 7, which shows the application of this reactor type controlled carrier modulation to an already existing transmitter, that the actual alterations necessary are quite small. Except for the autotransformer-reactor combination and a non-critical condenser, C, 1 to 8 Mfd., (if it is not already present in the modulator) no additional equipment is necessary. The circuit changes are extremely simple. The DC coil of the reactor is connected in series with the B plus lead of the modulator. The autotransformer primary is connected to the line and the primary of the class C plate transformer is connected across the output side of the autotransformer with the AC coils of the reactor in series. That is all there is to obtaining controlled carrier modulation from an existing transmiter.

The experimental transmitter set-up for this development was tested quite extensively to check the possibility of increased distortion. Using a sine wave of constant magnitude for the modulator input source, and an accurate harmonic analyzer fed from a demodulator coupled to the transmitter output circuit, no measurable increase in distortion was noted. Another form of distortion in controlled carrier modulation occurs if the class C input does not rise as rapidly as the audio power. If this occurs, overmodulation takes place. An intensive investigation was made into the causes for time lag in saturable control reactors and means of eliminating this lag were developed. Tests were conducted to determine the degree of distortion effected in this experimental transmitter when the audio level was changed through a wide range rapidly (syllabic modulation). Listening tests over the air showed no perceptible increase in distortion when the transmitter was switched over from normal class C to controlled carrier and a person spoke into the microphone. This was further corroborated by a series of photographs made in conjunction with a cathode ray oscillograph while a constant frequency input was rapidly varied in level.

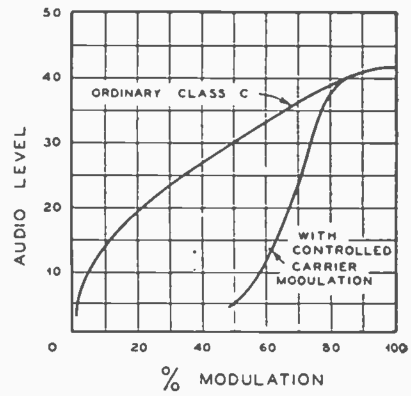


FIG. 8—Percentage of Modulation in Ordinary and Controlled Carrier Transmitters at Various Audio Levels.

A word of caution to those who, after reading this article, will start considering making their own saturable reactors. The saturable reactor for controlled carrier modulation is an extremely critical unit as to design. Both the AC and DC flux densities are critical and must take into account the exact characteristics of the grade of steel used. Offhand designs, if they work at all, will give highly unsatisfactory results. Commercial units combining both reactor and autotransformer for varied applications will be available in the near future.

A constructional article covering a complete 45 watt carrier transmitter incorporating controllable carrier will appear in the next issue of "RADIO".

EDITOR'S NOTE: *The circuits and details of the above control system are covered by patents applied for in the name of I. A. Mitchell. Broadcast stations and other commercial organizations are cautioned not to infringe.*

Colonel Foster's Comment

THE CONVENTION OF 1927

IT WAS at the Convention of 1927 that the amateurs of America first came under the sinister influence of the foreigners. After having voluntarily relinquished to the commercials all but some narrow bands the amateurs lost at this convention two-thirds of their space even in these narrow bands. They also had new international restrictions imposed. And yet K. B. Warner, manager of the organization that had assumed spokesmanship for the amateurs introduced his report of the convention with a glowing paragraph ending, (see QST for January 1928), "Those privileges in most respects are entirely adequate. We have achieved a great victory."

It was indeed a great victory for the commercial members of the ARRL. Warner knew the trimming the amateurs got was a disaster for the amateur members but it seems there were business reasons why we must be kidded into thinking it was a victory and that we must be stopped from appealing to Congress for a reservation in behalf of the amateurs. So the directors of the ARRL were individually beseeched to back up the astounding myth in the following disingenous letter:

Hartford, Dec. 2, 1927.

ALL DIRECTORS:

Vice-President Stewart and I were in attendance at the International Radio Conference at Washington for the seven weeks of its duration. Upon my return, as the quickest and most effective way of conveying a report to the Directors of our activities there and the results obtained, I have had some advance copies struck off of an article and editorials prepared for January QST, and attach same. I feel that this will explain the subject matter more clearly and at much greater length than I could hope to in a letter.

The Executive Committee and the A. R. R. L. Headquarters staff are of the opinion that the facilities afforded by the provisions of the new convention are adequate for amateur operation. We have felt the necessity of expressing immediately, in broadcasts and in QST, the opinion that our results at Washington must be viewed as successful and that the privileges secured there are quite sufficient to insure the continued happy existence of amateur radio. Immediate expression of this viewpoint was deemed essential in view of the pessimism rapidly being disseminated through amateur ranks, the false reports that we had lost all territory between thirteen and fifty meters, the general loss of faith in the League and amateur radio that the public would display if it were felt that we had been beaten, and to offset any unfavorable action by QST advertisers based upon the fear that amateur radio was about to experience a tremendous setback. We do not share that view; we believe in fact that the restrictions which will become effective in 1929 will serve as a tremendous spur to a new and healthy amateur activity. We recognize, however, that official A. R. R. L. views on such matters are to be expressed only by the Board of Directors and that it cannot be said that the League accepts and embraces the results of this convention if the Board is of a contrary opinion.

In several quarters of the country unofficial and unauthorized broadcasts have been started by zealous amateurs, calling upon all recipients to write immediately to their Senators and Congressmen to urge that the Senate make a reservation on behalf of wider bands for American amateurs when ratifying the treaty. We are doing what we can to suppress this movement at the present, as being futile and ill-advised. We are telling the amateurs concerned that any such action depends upon the decision of our Board of Directors which has not yet had time to examine the results. It is the opinion of your Executive Committee that it would prove highly embarrassing for us to attempt to secure a Senate reservation to increase the size of the American amateur bands. It may be possible to secure such a reservation, particularly with respect to an extension of the 40-meter band downward, but we believe that the radio people of the United States government would be highly opposed to such a move. If we care to risk their disapproval by seeking political support for a reservation it is possible that we can secure it. However, we feel that we will be able to operate well enough in the bands authorized by this convention, and in view of the disrepute into which the amateur would be brought, both nationally and internationally, by forcing or even attempting to force a reservation in the United States, the Executive Committee earnestly recommends that no such attempt be made.

It seems very desirable that Headquarters, for its government, receive an expression of opinion from each Director as to whether the League accepts the provisions of the Washington Convention, or whether it should commence now in an endeavor to secure a reservation to extend the 40-meter band downward and, if the latter, to what extent. The Executive Committee recommends to the Board that it approve the Convention and make no attempt to seek a reservation.

(Signed) K. B. WARNER,
Secretary.

It was Warner in QST and in correspondence, and headquarters representatives at amateur meetings, who continued to spread among both commercial people and amateurs the same perverted propaganda that the amateurs got all they needed at the Washington convention.

And it was President Maxim himself who advertised to the whole world, (see it in QST for August, 1929) that the amateurs had to be further restricted at the 1927 convention since the public interest required it. He said that restrictions were attendant upon progress and that it is of no avail to buck them—that the amateur cannot stop the progress of the world—that it would do the amateurs just as much good to buck restrictions as it did the red Indian to buck the coming of the white man. Surely a vicious philosophy, for if courageous and upright man had not bucked injustice throughout history the world would not now be a fit place in which to live.

These published statements of President Maxim, like those of its general manager, went far and wide. Maxim says of QST in his last annual report to the directors, "It passes across the desks of nearly every important figure in the radio world". He was well aware of this when he virtually put all of the commercial people and the radio men of foreign nations on notice that he, the president of ARRL, was agreeable to the restrictions of the Washington convention and that he proposed to do no bucking over still further restrictions. After all the published avowals of men recognized as spokesmen for the amateurs just how much chance had the amateurs to regain at Madrid any of their lost rights and frequencies! And if the same men still speak for the amateurs when the next convention comes along just how much assurance have we amateurs that we shall have anything left at all!

So let nobody be deceived with the thought that the ARRL neglects the interests of its commercial members—regardless of whether such members vote or do not vote. Throwing the ARRL open to them back in 1920 was the amateurs' major disaster but the results of it need not obtain forever. The effects of every disaster can be overcome in some measure. The Congress of the United States is the one agency for setting aside the injustices of this one. It should be the duty and the purpose of every American amateur to carry the amateurs' case to the court of public opinion through his Senator and his representatives in Congress.

Clair Foster, W6HM.

LEST WE FORGET

THE ARRL was formed specifically as an association of transmitting amateurs. It remained just that until a year after K. B. Warner, its present manager, took charge under an employment contract that provided a salary of $30 a week, plus 25 cents out of each yearly paid dues, plus 25% of the net profits of the magazine, "QST". That contract was a bad mistake of the directors. Paying a man commissions is all right in a commercial undertaking but is wholly out of place in a fraternal organization. It has been tried in other fraternal organizations and in every case has worked disastrously, for it puts such employees in the class of promoters and inevitably leads to their bending their efforts towards increasing their commissions.

Let us see how it worked in Warner's case. There were no net profits from QST at that time. There are not today, for that matter. It was unlikely that Warner would realize much if anything from QST, so he concentrated on increasing the membership of the ARRL. It is seen from a reading of the QSTs of that day that immediately a drive was started for new members. Month after month the drive proceeded, spread in print with all the characteristic appeal of the drive-promoter. The first year of Warner's employment his rake-off besides his salary was $898, making his total compensation for the year $2,458, which was big pay in those days for a young fellow with little previous business experience. It was far more, I'll venture to say, than he had ever made before. But there is no fault to be found with it if the accounting was correct; the payment was in accordance wih the prospect held out to him by his contract.

However, the money was not coming in fast enough to suit Warner. So a new scheme was devised and put into operation. At that time, 1919, there were members of the ARRL and there were subscribers to QST who were not members. The scheme was simplicity itself—provided the directors did not see through it and object. It was to call all subscribers, whether amateurs or not, "mem-

(Continued on page 17)

The Single Tube 35-19 Transceiver

By FRANK C. JONES

● There is a demand for the simplest possible circuit which is suitable for phone transmitting and receiving on five meters. Simple circuits, such as this 1935 model of the original 19 tube transceiver described last year, are not as good as two or three tube sets. However, for the beginner, or for extreme portability, this new type 19 single tube set has its place.

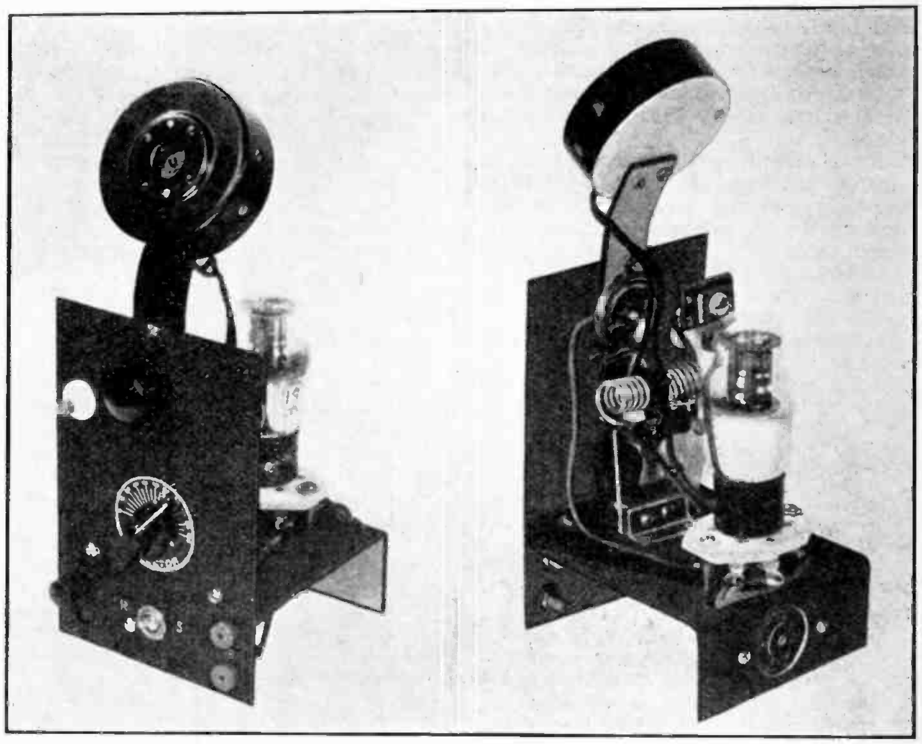
The circuit has been so simplified that the number of parts in the set is a minimum. This makes it easy for the newcomer to the 5 meter band to get on the air on phone. The type 19 tube acts as a modulated oscillator for transmitting and as a super-regenerative detector and audio amplifier for receiving. The change from transmit to receive is accomplished by means of a single-pole, or On-and-Off snap switch.

The set acts as a transmitter when the switch is on the closed ("on") position, performing the following functions: (1) The tuned circuit causes 5 meter oscillations in one of the triode units of the 19 tube. (2) The oscillations are radiated either by an 8 ft. antenna connected directly to the antenna post, or by means of a one or two wire matched impedance RF feeder line. (3) The tuned circuit is capacitively coupled to the antenna by means of a trimmer condenser coupling capacity. Normally the adjusting screw is taken out in order to obtain lower capacity. This capacity may be varied by bending the movable plate.

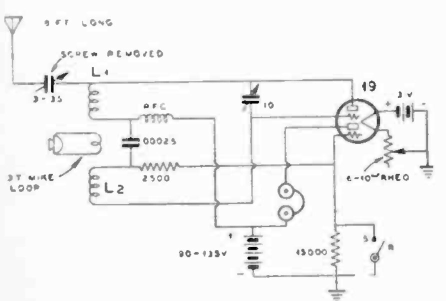
Modulation is obtained by the old familiar method of loop modulation. The microphone is connected in series with 3 or 4 turns of wire, coupled to the oscillator coil. When the mike is spoken into, its resistance varies and the current through it and the loop pick-up coil varies, thus giving modulation. The system is an absorption method and consequently the output usually drops when the mike is spoken into. However, by proper adjustment of the loop coil coupling, a fair amount of understandable modulation is obtained. This coupling is critical and should be as close as is possible to use and still maintain super-regeneration while receiving. More satisfactory modulation is obtained this way than in the grid modulation method used in last year's circuit. The mike should preferably be mounted on the transceiver in order to keep the leads short.

The 19 tube is a good oscillator and the carrier is greater than can be obtianed from a type 30 tube. The oscillator circuit shown has proved to be much more efficient than the unity coupled circuit shown in last year's set. Super-regeneration can be obtained with somewhat less than 80 volts with this circuit, while the one of last year required at least 135 and often 180 volts of B battery. Super-regeneration gives a high degree of sensitivity for 5 meter reception and is used exclusively in the more simple 5 meter receiving circuits. This set will function with only 90 volts of B battery, but the power output is only about half that obtained with 135 volts. The antenna coupling can be greater with the latter value of voltage without pulling the detector out of super-regeneration, denoted by a loud hiss when not receiving a signal.

The second triode unit of the 19 tube is used as an audio amplifier when receiving. The oscillator section merely super-regenerates and only the grid circuit rectified signal is used across the grid of the other

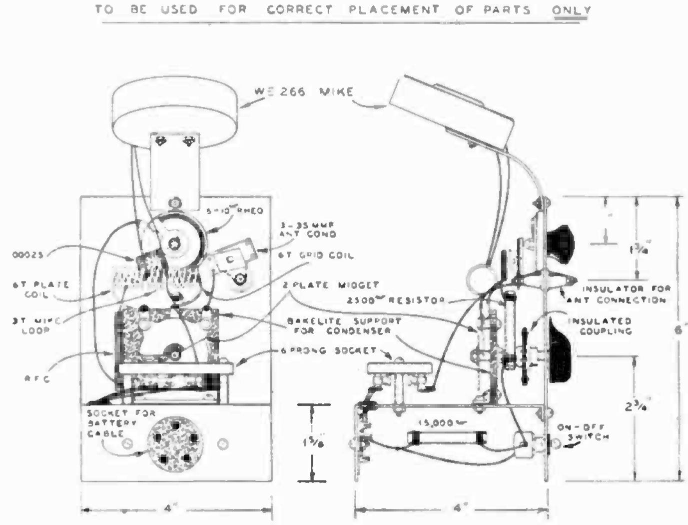


Front and Rear Views of the ultra-compact 35-19 Transceiver. The microphone is secured directly to the front panel. A mouthpicce can be attached to the mike. A toggle switch is used to change from send to receive. The rear view illustration does not show very clearly how the mik coupling loop is placed between the two coils, L1 and L2 (see circuit diagram). This mike loop coil is merely suspended between the two coils; it is made of insulated push-back wire, the loop is self-supporting and its coupling is easily varied. The RF choke is barely visible in the photo. It is supported on the bakelite support piece which holds the tuning condenser.



CIRCUIT DIAGRAM OF THE 35-19 TRANSCEIVER
Coils L1 and L2 each have 6 turns of No. 12 or No. 14 bare copper wire, ½-in. diameter, ¾-in. long. The Mike Loop Coil has 3 turns of insulated push-back wire, ½-in. diameter, placed between coils L1 and L2. The RF Choke Coil has 50 turns of No. 22 DSC wire, 3/6-in. diameter, air supported.

TO BE USED FOR CORRECT PLACEMENT OF PARTS ONLY



Detail drawings, side and rear view, showing proper arrangement of parts.

triode unit. This simplifies the circuit and gives ample volume for headset operation. The headset or telephone receivers should be of the high impedance type, any value from 1,000 to 5,000 ohms. When transmitting, this triode unit acts as a monitor, giving sidetone of the speech in the headset. A person can tell easily whether the mike is functioning properly because the modulation should be audible in the telephone receivers in the send position. Receive position of the switch should give a strong hiss, unless the tuning circuit is adjusted to a carrier of some other transmitter or oscillator. Too-close coupling of the microphone loop coil will pull the detector out of super regeneration.

The tuned circuit consists of a two plate tuning condenser, two similar coils and a small mica grid-blocking condenser. The latter, plus the grid leak, causes super-regeneration in the receive position. When transmitting, the receiver grid leak is shorted-out and only the 2,500 ohm grid leak is left in the circuit. The two coils can be wound with No. 12 or No. 14 copper wire on a 3/8 inch rod as a winding form. The turns are removed and spaced to occupy about 3/4 inch to 1 inch length for each coil. These two coils make a continuous winding with the mica condenser in the center and the tuning condenser across the outside. The latter must have an insulated coupling on its shaft in order to prevent hand-capacity and short circuit to the metal front panel.

The radio-frequency choke consists of about 50 turns of No. 22 DSC wire, 3/16 inch in diameter. This coil is made by winding the wire on a 3/16 inch diameter rod and slipping the coil off when enough turns are wound. The coil is rigid enough so that its two ends will hold it in place, as shown in the diagrams.

The filament rheostat should only be turned up high enough to cause good super-regeneration when receiving with a reasonable amount of antenna coupling capacity. If no super-regeneration is obtained, and if the circuit has been carefully checked, the trouble may be in a faulty tube. Connections to the batteries are important for correct polarity. Too much antenna coupling may cause trouble and first adjustments should be made without an antenna. All connections should be soldered and the leads kept as short as possible. The two plate tuning condenser can be made by removing one plate from a standard 3-plate midget condenser available on the market. If the grid condenser is too small in actual capacity due to incorrect rating, super-regeneration may not be obtained.

It should be remembered that any transceiver radiates receiver whistles strongly over a distance of a mile or two and thus consideration in its operation should be given to other nearby amateurs. In transmitting, a strong carrier will be radiated and the only trouble one is likely to have is in obtaining sufficient modulation of a good character. The two principal adjustments are the coupling between coils and the filament rheostat setting.

For 5 meter work the antenna should be a half wave vertical rod or wire about 8 feet long. It should be as high as possible. In some cases it may be necessary to use a RF feeder. A simple feeder is a single wire attached to the 8 foot antenna, 14 inches below its center. This wire can be any length up to a hundred feet and should run off for at least 3 or 4 feet at right angles to the antenna. A two wire feeder is more efficient; in this case one wire connects to the antenna post and the other to the aluminum chasis.

In adjusting the transmitter it is desirable to have another receiver nearby in order to

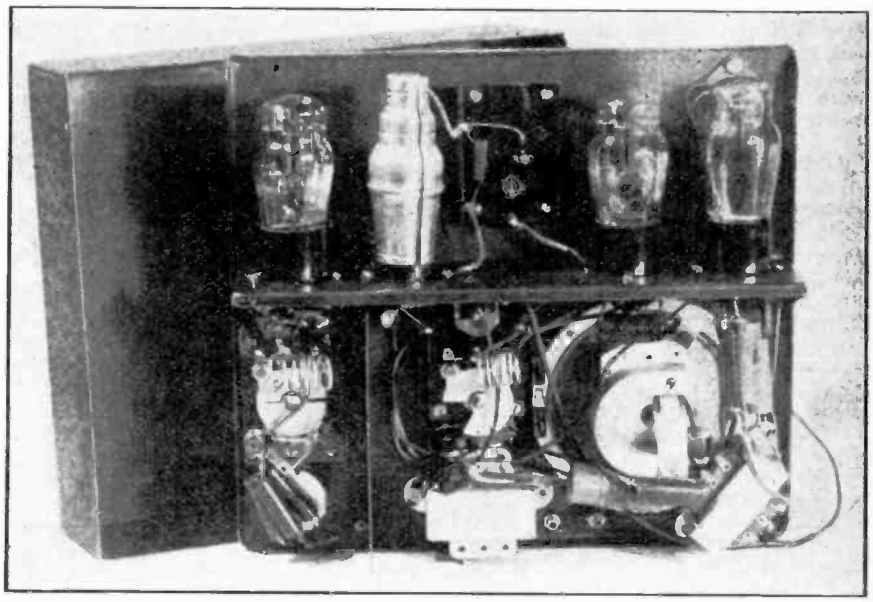
(Continued on page 28)

A Compact 5-Meter Auto Set

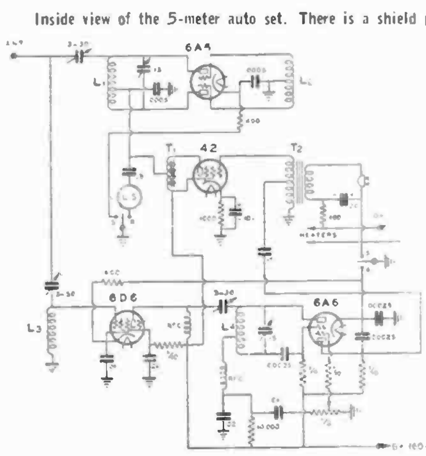
● The circuit and set here shown were designed for use in an automobile where a carrier output of about two to three watts is desired. Class A modulation, driven quite hard, is used to modulate one of the new 6A6 tube oscillators. The ordinary transceiver has insufficient power output to transmit over flat country from a moving car, such as is necessary for some types of amateur work or police operations.

The receiver has a stage of tuned RF in order to give a slight increase of sensitivity and to prevent radiation from the super-regenerative detector. The latter uses a 6A6 tube in order to reduce the number of tubes in the set because the 6A6 can also be used as the first stage of audio amplification. The 42 tube modulator acts as the second stage of audio for loudspeaker reception when the send-receive switch is on receive position. The 6A6 detector has another advantage in that it will take a strong signal without audio distortion to better value than a 37 or 76 super-regenerative detector. The second triode unit in the 6A6 acts as a high mu resistance-coupled audio stage. The mike transformer gives a step-up ratio in receive position for the audio amplifier. This additional audio gain is not usually needed but the center-tap also prevents the 6A6 plate circuit and 100,000 ohm resistor from loading the modulator down too much in the transmit position. If the 6A6 plate is

The container for this 5-meter auto set is only 3 inches deep and will easily find a place for itself in almost any car.



Inside view of the 5-meter auto set. There is a shield partition between the coils. The four tubes are all on one shelf.



CIRCUIT DIAGRAM

L1—6 turns, No. 12 wire, 5/8-in. dia., 7/8-in. long.
L2—15 turns, No. 14 wire, 1/2-in. dia., 1 1/2-in. long.
L3—18 turns, No. 22 DSC wire, 3/4-in. long, 1/4-in. dia.
L4—6 turns, No. 12 wire, 5/8-in. dia., 1 1/4-in. long.
T1—Center-tap 30 henry choke, 100 MA rating.
T2—Mike transformer with secondary center-tapped.
RFC—60 turns No. 30 DSC wire, 3/8-in. dia.
Send-Receive Switch is a D.P.D.T.

connected across the entire secondary of the mike transformer it would be necessary to have an additional switch to cut this load off while transmitting.

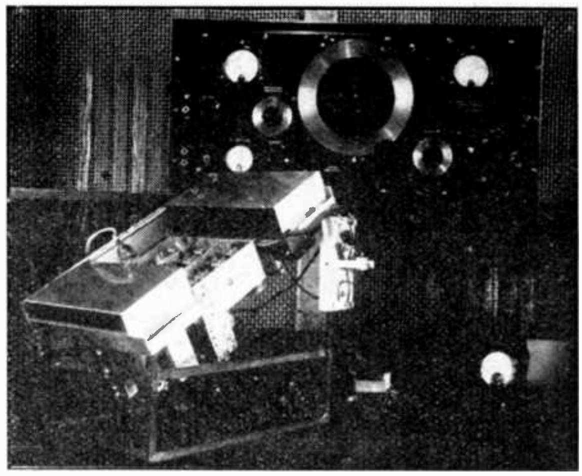
The tuned RF uses a resonant grid coil. The latter resonates with the tube and antenna coupling capacities to the low frequency end of the amateur band, or preferably just outside of the band if the transmitter is to be used near that end of the band. This stage must be detuned by 2 megacycles, from the transmitter, if no power is to be absorbed from the transmitter. It was found that if the usual condenser and coil arrangement was used, some power would be absorbed up to 3 MC off resonance. By using a very low C, semi-tuned circuit, the RF gain is fairly good over the entire amateur band—about two points on the "R" scale over that of a receiver with an untuned RF stage. This grid coil is made by winding 18 turns of No. 22 DSC wire on a quarter-inch diameter rod to cover a length of 3/4 inch. The coil is slipped off the rod and supported by its ends soldered to a pair of

(Continued on page 24)

The Browning 35 With Tobe Tuner

PART II

By GLENN H. BROWNING*



THE February issue of "RADIO" has already described the fundamental principles involved in an all-wave superheterodyne especially designed for the set-builder, experimenter, and amateur. The receiver consists essentially of a tuned-antenna circuit followed by a stage of RF amplification on all bands; an electron-coupled oscillator, a double-band pass intermediate stage, an automatic volume control which may be switched on or off at will, and a beat-frequency oscillator for CW reception. The antenna, RF, and oscillator coils are all mounted in a catacomb which shields the individual circuits. In this same catacomb is the switch for changing coils on the four separate bands provided. This switch has silver-plated wiping contacts and is so arranged that all coils not being used are short-circuited, thus insuring no dead spots in the tuning range due to absorption in resonant circuits. On top of the catacomb is mounted a gang of three tuning condensers which are designed to have an extremely low minimum capacity, so that the inductance of the coils may be maximum and the tuning range improved. The receiver is absolutely single control. Band spread is accomplished by a micro-vernier dial with a ratio of 40 to 1. Stations are logged by reference to two pointers, one rotated on the main shaft of the tuning condenser, and the other on the vernier shaft. The complete coil, condenser tuning assembly is made in one unit, and wired and accurately tracked in a completely assembled receiver so that the set builder has only to make seven connections to this Tobe Tuner in constructing his receiver.

The receiver covers a range of frequencies of from .55 to 22.6 megacycles, and, due to the extreme care in design, layout, and selection of parts, has a sensitivity of 1. microvolt or less all over the tuning range. In fact, the sensitivity is greater than can be used except under the most favorable atmospheric conditions. Fig. 1 shows sensitivity

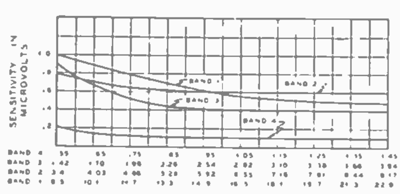


FIG. 1—Sensitivity Curves.

curves on the four bands. It will be noted that the response is almost uniform on any one band.

A great deal of design study was given the intermediate amplifier for it was desired to have the highest quality response which was possible without allowing station overlap. This work resulted in the use of three high Q circuits in each of the two intermediate transformers. Each of the six inductances which are tuned are in turn made up of a series of three pie windings, which results in lowering the distributed capacity of the coils and materially sharpens the individual tuned circuits. The resultant resonance curve for the IF amplifier has already been shown in "RADIO" so that it remains to picture the overall selectivity of the receiver which is due to the tuned antenna circuit, RF, and intermediate amplifiers as a whole. Fig. 2 shows such curves taken at 600 and 1000 KC. It will be noted that the "nose" of these curves is very broad, but that the sides are relatively steep. This means that the high audio frequencies in the received music which are so necessary for high quality reception are attenuated very little, but that 10 KC selectivity is assured. For example, a note of 2500 cycles in the received music would be reduced only 37 per cent or about 4 decibels while the interference of a station operating on an adjacent channel 10 KC away would be reduced some 99.2 or about 40 decibels. This broad "nose" tuning curve is actually noticeable in operating the receiver for the micro-vernier tuning control may be rotated several degrees on broadcast without a noticeable change in signal level, however rotating it a fraction of a degree farther entirely tunes out the signal. This may readily be seen to be the case from the selectivity curves. For the operator in tuning the micro-vernier in effect slowly slides the whole tuning curve to the right or the left of the signal's carrier which remains stationary and when he reaches the steep portion of the curve the signal decreases very rapidly.

Great care has been taken throughout in the selection of parts, for the completed receiver is no better than its components. The set is put out in kit form. The base and panel are drilled and finished so that the assembly

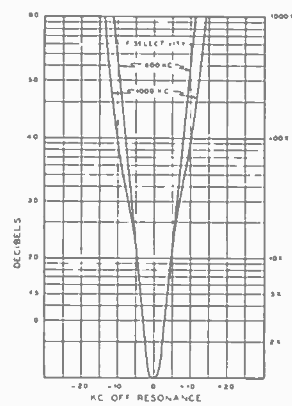
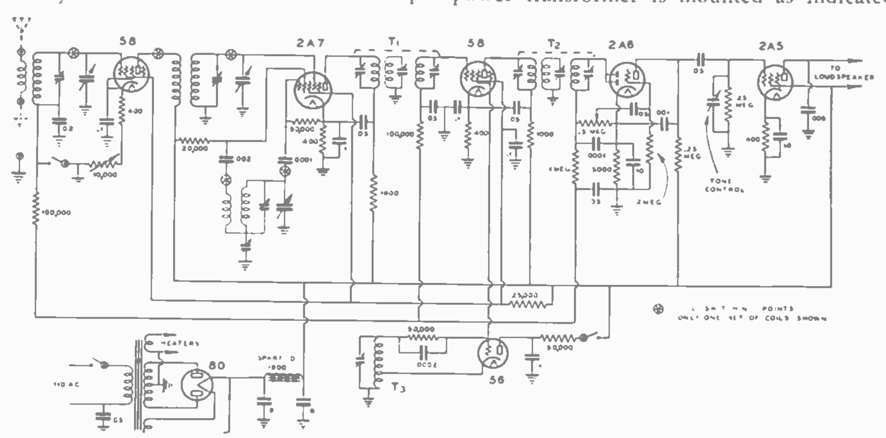


FIG. 2—Overall Selectivity.

of the parts is relatively simple. Fig. 3 and the pictures show a top and bottom view of the apparatus mounted on the chassis. It is advisable to mount all of the tube sockets and shield bases first. The same mounting screws are used for both, the tube socket being held below the chassis and the tube shield base above. It is important to have the tube socket contacts in the position shown on the diagrams, for care has been taken to make all leads carrying radio frequency current as short as possible. The insulating straps should then be fastened in the positions shown on the drawing. The power transformer is mounted as indicated,



1—Tobe-35 Tunr.—Consists of four sets of coils L1, L2, L3, L4, L5, L6 with * tuning and trimmer condensers and change-over switch for the four bands all mounted within one container.
2—X—Points where coils are switched. (Diagram shows only one set of coils.)
3—Resistors all ¼ watt unless otherwise specified.

* Chief Engineer of the Tobe Deutschmann Corp.
(Part III will follow in the next issue)

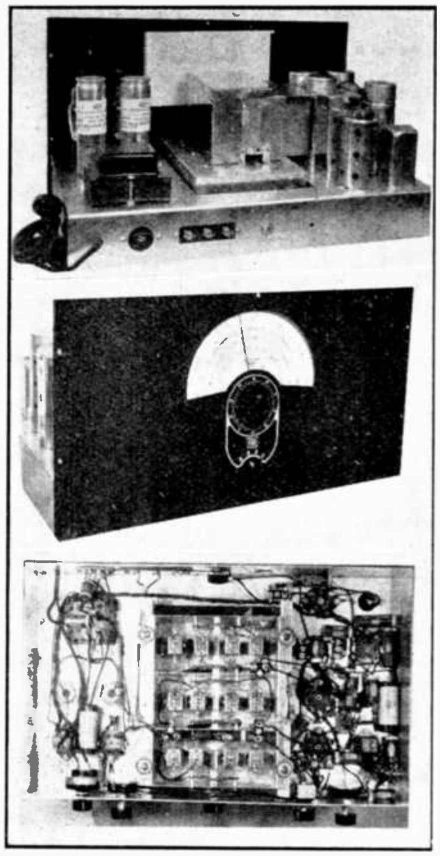
and the filament wiring done. As will be noted the transformer has a 2.5 and a 6.3 filament winding so that either 6.3 or 2.5 volt tubes may be used according to the set builder's desire. The 2.5 and 6.3 volt tubes are identical in their electrical characteristics even to having the same input and output capacitances and fit the same sockets, that is, the 58 equals the 6D6, the 2A7 qeuals the 6A7, the 2A6 equals the 75, the 56 equals the 76, and the 2A5 equals the 42. The transformer has an electrostatic shield between the primary and secondary windings which helps to eliminate any noise being fed into the set from the lighting circuit and at the same time eliminate a modulation hum sometimes encountered. However, even with this electrostatic shield it was thought advisable to place an .05 mfd. condenser across the primary, for in some cases this further reduces line noise. With this condenser across the lighting circuit, one side of which is usually grounded, a voltage may be obtained between the metal chassis and a ground wire attached to a water pipe or radiator. This is not harmful, but a slight shock will be obtained upon taking hold of the ground wire and the chassis at the same time. Reversing the plug in the 110-volt outlet will eliminate this voltage in practically all cases. The writer simply mentions this effect and its cause and cure so that the set builder will not think he has made a mistake in wiring.

The IF transformers should be mounted so that the adjusting screws on T2 face the side of the chassis. These IF transformers have been carefully adjusted at the factory to the intermediate frequency of 456 KC and care should be taken not to change their adjustments. After the filaments are wired, the screen grids, power supply, and plus B leads should be connected. These leads should be run along the bottom of the chassis out of the way. The IF transformer leads are then soldered in place. These leads are cut to length and if they are not long enough to reach the proper connections some of the parts must be mounted incorrectly. The resistors and by-pass condensers should then be soldered into place. The placement of these has been worked out so that they mount either on the tube sockets themselves or on the insulating straps provided for that purpose. This placement is shown on the drawing and should be followed. Be sure to follow the wiring diagram in by-passing, for a number of the condenser leads return to the cathode of the tubes and not to ground.

The volume controls and switches on the front of the chassis may be temporarily mounted and wired. (This temporary mounting will have to be removed when the front panel is put on as these controls hold the front panel to the chassis.)

The last apparatus to mount is the tuner which carries the gang of three tuning condensers together with the coil and switch assembly. This is mounted on soft rubber grommets which should be placed between the main chassis and the tuner. Besides the grommet an insulating washer is furnished which is placed on the other side of the tuner chassis before the metal washer is put in place. The nuts which hold the complete assembly should be just slightly tightened so that the tuner cannot slide around. Under these circumstances the rubber grommets will give a cushion effect which tends to reduce mechanical acoustical feedback caused by the actual vibration of the condenser plates due to the sound waves from the loud speaker.

Great care should be taken in handling the tuner for it is completely wired and very carefully tracked at the factory. This tracking is done in a complete receiver identical



Rear, Front and Under-Chassis Views of Browning 35 With Tobe Tuner

to the one the set builder has constructed. This exact alignment is obtained by means of an all-wave signal generator with a calibrated attenuator so that absolute sensitivity of the tuner is measured after the tracking is done. There are three connections leading into the tuner which should be as short as possible. One is from the plate of the first 58 tube which is used as a radio frequency amplifier. This lead should be flexible and run directly from the plate to the terminal provided in the middle compartment of the tuner. This lead should be kept as far as possible away from all other leads and also a reasonable distance away from the metal chassis. It will be noted from the wiring diagram that grid No. 1 of the 2A7 or 6A7 is connected to the tuner through a .0001 mfd. condenser. This is one of the small mica condensers furnished in the kit and should be mounted on the tube socket of the 2A7 in a vertical position. A flexible lead is connected to the proper terminal which will be found in the rear compartment of the tuner. The anode, or grid No. 2 of the 2A7, also connects to the tuner through a .002 mica condenser. This should be connected on the tube socket similar to the one just described, and flexible leads run over to the tuner as previously stated. These three leads carry high frequency current and their capacity should be kept down to a minimum which means that they should be as far away from the chassis and other leads as reasonably possible and at the same time short. The other connection to the tuner on the left goes to the automatic volume control .1 meg resistor. The three connections on the right of the tuner go to the doublet antenna and plus B supply. In running the doublet leads into the tuner from the binding posts provided in the rear, care should be taken not to have these leads directly over any of the coils in the tuner. Otherwise, some feedback between circuits might be encountered.

It will be noted that the tuner has a flexible metal lead soldered to it. The other end of this lead should be well soldered to the main chassis. Grounding the tuner in one point only is essential for the elimination of chassis currents.

The receiver is now ready for assembly of the front panel, and the dial. Before the front panel is put in place be sure to assemble the long pointer with collar and set screw attached on the main shaft of the tuning condenser. As will be noted, the two volume controls, the automatic volume control switch, and the tone control and power supply switch hold the panel in place. When the panel is mounted by means of these, the coil switch and tuning condenser shaft should extend through the holes in the panel. These holes are amplpe in size and and the shaft should not touch the front panel. Otherwise, some chassis current might be introduced into the tuner, setting up feeddacks and possibly an AC hum.

A short pointer with spring collar attached is provided. This should be slipped over the vernier tuning shaft which extends through the front panel. This should not touch the front panel itself. The dial card may then be slipped into the dial holders in the rear of the front panel. When this is in position, the long pointer should be free to rotate over this card without touching the front panel. A slot has been cut in the dial card which fits over the pointer's collar. The adjustment of the dial is made by this rather than the dial holders as their relative position may change slightly according to the mounting of the rubber grommets. Therefore, the slot in the dial card should fit over the pointer's collar and rest gently on it if the correct calibration is to be maintained.

After carefully checking the wiring of the receiver it is ready for trial operation and if correctly constructed should, when an intenna and ground are connected, bring in signals. If it does not, do not change any alignments on either IF transformers or trimming or padding condensers in the tuner itself. Look for wrong connections elsewhere. In turning over the chassis after the tuner has been assembled care should be taken not to rest it on the three-gang tuning condenser, for the alignment of this condenser might be thrown out even in spite of its rugged construction. After checking the wiring, if no signals are heard the tubes used in the receiver should be checked. (The wirter uses RCA standard tubes). In all cases the receiver should receive signals before any changes of alignment are made. Too much cannot be said on this point for if either the band-pass intermediate frequencies or the padding or tuning condensers on the coils are thrown badly out of alignment it requires a rather experienced man to adjust them properly on a sensitive single-control receiver such as this.

As previously stated, every precaution has been taken in the manufacture of the tuner and the IF transformers to have them perfectly aligned. However, tube capacitances differ slightly and it may be necessary to make slight adjustments on both the tuner and the IF transformers. However, it would be well to try out the receiver thoroughly before any adjustments are made on these parts. For final slight adjustments, the following directions are given to the set builders who do not have available either an output meter or an all-wave service signal generator:

Instructions for Final Adjustment of Receiver on Noise in Case This Is Found Necessary

Lining up IF transformers:

(1) Remove antenna lead.

(2) Turn both volume controls to the

(Continued on page 34)

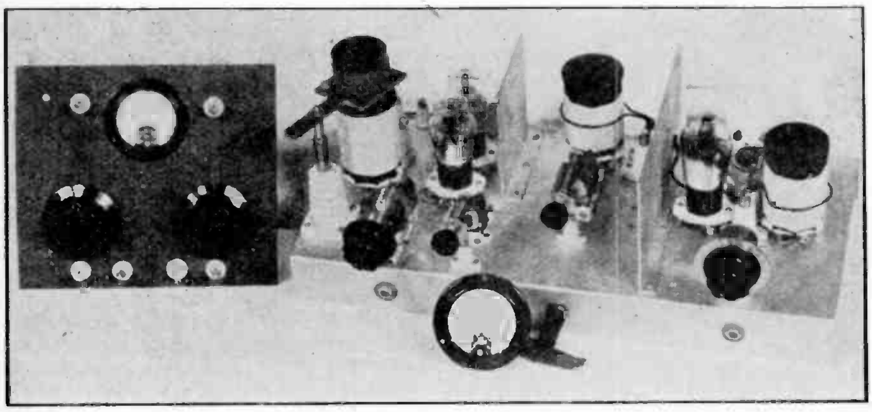
10-Watt 160-Meter Phone Using Low-Cost Tubes

By the LABORATORY STAFF

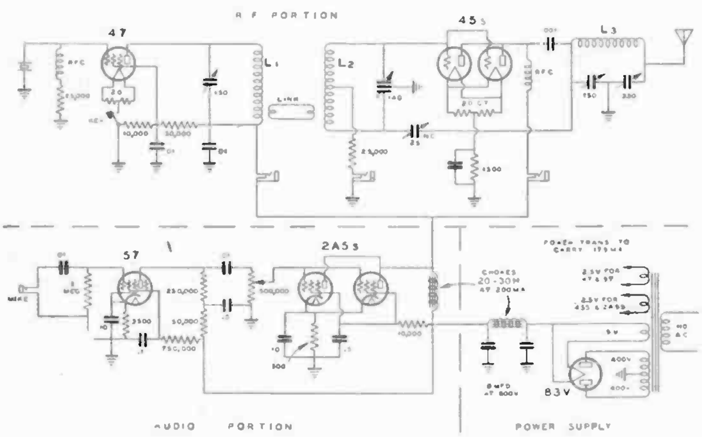
● Many CW amateurs have found it too costly to change to phone operation. The cost of the audio equipment is one of the factor which keeps many a would-be phone operator on CW, not to mention the cost of tubes in the speech equipment.

A 160-meter phone of good output, and using the most inexpensive types of tubes has been designed by the technical staff of "RADIO". The RF portion uses a single '47 in the crystal oscillator stage and two type 45 tubes in parallel in the RF amplifier stage. 15 watts of output can readily be secured from this tube line-up. The crystal oscillator stage uses the "chirpless" keying feature for optional CW operation. The key is in the center-tap resistor of the filament circuit of the 47 oscillator tube, and the value of the center-tap resistor is 20 ohms.

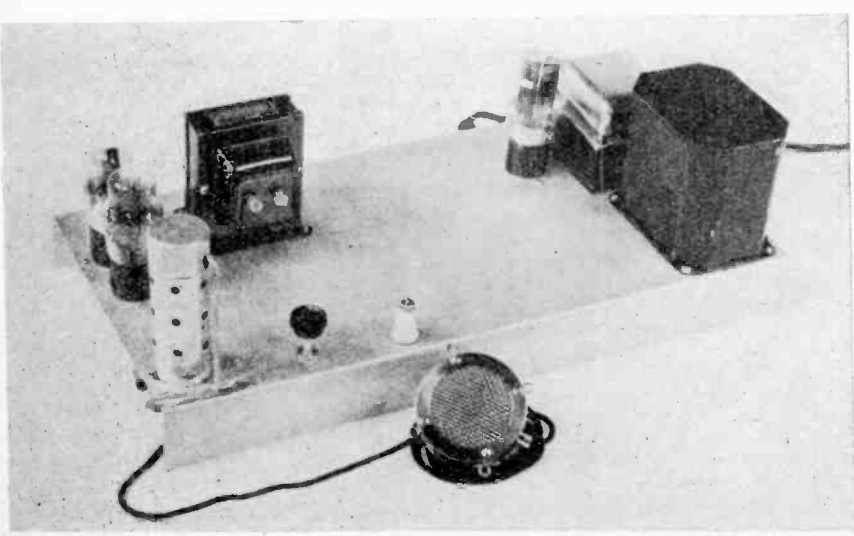
A 15,000 ohm resistor is large enough in value for the crystal oscillator grid leak, and this resistor is in series wiht an ordinary HF radio-frequency choke of the conventional small size.



'47 Oscillator, Link-Coupled to a pair of '45s in parallel. Antenna Condensers and RF Ammeter are Mounted on the Panel at Left.



Circuit Diagram of the Entire Transmitter.



The Power Supply and Audio Channel. Wide separation of parts prevents hum pick-up. The crystal microphone feeds directly into the 6C6 tube.

160-meter crystals are not "tricky" or "cranky", as a general rule, and thus the use of a 15,000 ohm grid leak resistor is entirely suitable. A 150 mmf. midget variable condenser is used to tune the plate tank coil of the crystal oscillator stage. The conventional 100 mmf. midget variables are a bit too small for conveniently tuning a 160 meter coil. Of course, a condenser larger in value than 150 mmf. could be used, if desired. For ease of tuning and adjustment, it is better to wind the 160-meter coils on large-diameter coil forms. The ceramic or Bakelite forms, 2¼ inches in diameter and 3½ inches long, four-prong type, are ideal for 160-meter work. Coil forms of this size are made by various manufacturers, or the constructor can use ordinary bakelite tubing for coil forms. The convenience of factory-made plug-in coil forms is evidenced when multi-band operation is desired. The oscillator plate coil is wound with 55 turns of No. 20 or No. 22 DCC wire, close wound. The winding space is approximately 2½ inches.

A .01 mfd mica condenser, 1000 volt rating, is connected from the bottom of the oscillator plate coil to ground, as the circuit diagram shows. The screen by-pass condenser is .01 mfd. and an ordinary 600 volt paper condenser can be used here, although it is far more desirable to use mica condensers throughout. The slight extra cost is worth the added protection they give.

The crystal oscillator stage is link-coupled to the grid coil of the '45 amplifier stage. Link coupling calls for the use of a grid coil and a grid-coil-tuning condenser. The cost of these items is offset, in great measure, by the marked increase in efficiency which is secured when link coupling is used in place of capacity coupling. Link coupling also practically eliminates 99 per cent of the "bugs" inherent in capacity coupling systems.

The grid coil is wound with 52 turns of No. 22 DCC wire on a 2¼-in. dia. form. However, a tap is taken from the grid coil at the center of the winding. This is the grid-leak tap, to which the 25,000 ohm, 5 watt resistor connects. The grid coil is tuned with a two-section midget variable condenser, 140 mmf. each section. The rotor of this two-section condenser is connected to ground. A closed-circuit jack in series with the grid leak and ground enables grid-current reading to be made by use of a 0-100 MA DC milliammeter. In this circuit, neutralization is also indicated, as explained later. The meter can be plugged into the plate circuit of the oscillator stage for reading plate current, or it can be plugged into the plate circuit of the final amplifier stage to read its plate current. Thus only one meter is required. It performs the following functions, in the order named: (1) oscillator plate current reading; (2) grid current reading and neutralization indication; (3) plate current reading of the final amplifier stage.

Two type 45 tubes are used in the final amplifier. These tubes are connected in parallel. A 20 ohm center-tap resistor is connected across the filament leads and the center-tap is then connected to a 1300 ohm resistor. The latter is shunted with a 4 mfd. condenser. The lower side of the resistor and condenser connects to ground. A .001 mfd. 1000 volt mica condenser is in series with the plates of the 45 tubes and the final tank coil. Plate current for the final stage is fed to the plates through a 200 MA RF transmitter choke. The final plate coil is wound on the same size form as used for the oscillator and grid coils. The final plate coil has from 55 to 60 turns of No. 20 DCC wire, close wound, covering a winding space of about 3 inches. A 150 mmf. wide-spaced condenser is used to tune the final plate coil.

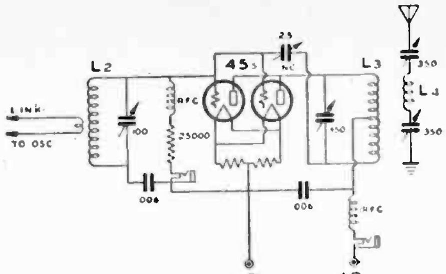
Such a condenser can be a .0005 receiving type variable condenser with alternate plates removed, or a standard double-spaced 150 mmf. condenser of any good grade. The plate tuning condenser used in the final amplifier illustrated in the photograph is a dual-section, 35 mmf. per section, wide-spaced Hammarlund. The two sections are connected in parallel and thus a 70 mmf. wide-spaced condenser is the result. The diagram shows the method of coupling the final amplifier to the antenna. This method is quite novel, in that it is the acme of simplicity, yet gives very good results. Any kind of a single wire antenna can be used, from 55 to 150 feet long. A good earth ground (not water pipe) is connected to the rotors of both tuning condensers, as the diagram shows. Such a ground can be had by driving several pieces of pipe into moist earth and connecting the pipes together with ground clamp connectors. This type of ground tends to reduce interference with BCL reception in the immediate vicinity where the phone transmitter is in operation. The 350 mmf. variable condenser in series between the bottom of the final plate coil and ground can be of the ordinary receiving type. The antenna is tuned by adjusting both condensers simultaneously until maximum resonance is indicated by a lamp in the antenna circuit but, at the same time, when minimum mills are drawn by the plates of the final amplifier tubes. The indicating lamp should not be left in the antenna circuit after the transmitter is tuned. The final plate coil should be tapped, for best results. A tap is taken at the 5th, 10th, 15th and 20th turns from the bottom end of the coil (end nearest ground) and the antenna connected on the tap which gives best results.

Power Supply

The power supply is somewhat novel; only one power supply is needed for the entire transmitter. It uses a heavy-duty power transformer, 400 volts each side of secondary center-tap, at 175 MA. It must have two separate 2½-volt filament windings; if it has but one 2½ volt winding a separate 2½ volt filament transformer can be added. The 45 tubes in the final amplifier must not operate from the same filament winding that lights the filament of the 47 oscillator and the audio tubes. An 83V rectifier tube is used. This is a comparatively new tube. It uses a cathode heater. Two 8 mfd. 600 working volt condensers are required. Make sure that they will stand 600 volts. The choke is a 200 MA, 20 to 30 henry size. The power unit should deliver 400 volts at the output terminals when the transmitter is in operation.

The Audio Amplifier

The audio system is simple. A 57 tube drives two 2A5s in parallel. These tubes are in the low-price group. A crystal microphone can be connected to the input, or any other type of good microphone can be used. The .01 mfd. condenser in series with one of the mike leads and the grid (cap) of the 57 tube must withstand 1000 volts, and thus a mica condenser is recommended. A 3 megohm resistor is shunted from grid of the 57 tube to ground. The cathode bias resistor of the 57 tube has a value of 3,500 ohms and it is shunted with a 10 mfd. 25 volt paper condenser. The screen of the 57 tube derives its voltage from the plate supply through a 750,000 ohm resistor, and another resistor of 500,000 ohms is connected from the screen to ground. At the junction where the 750,000 ohm and the 500,000 ohm resistor connect together, a .1



This transmitter can be made more simple if a very slight reduction in efficiency is acceptable. The circuit above shows an alternate final amplifier for greater simplicity. A 100 mmf. midget variable single section condenser, instead of a split-stator condenser is used to tune the grid coil, L3. This grid coil is wound on a 2¼-in. dia. form, with 50 turns of No. 22 DCC wire, close wound. The coupling link from the oscillator stage is placed near the center of the grid coil. The plate tuning condenser in the final stage should be double spaced to prevent flash-over. A different form of antenna coupling is also shown. The antenna coil, L4, is wound with 45 turns of No. 22 DSC or DCC wire and this coil is placed on top of the plate coil, L3. The coupling of coil L4 must be variable. .00035 mfd receiving type variable condensers are used to tune coil L3. One condenser is in series with the antenna, the other in series with the ground or counterpoise.

mfd., 400 volt paper condenser connects to ground.

The plate of the 57 tube feeds the grids of the two 2A5s through a .01 mica condenser, 1000 volt rating. The gain control is a 500,000 ohm variable resistor (potentiometer). The center arm of this variable resistor connects to the grid of both 2A5 tubes. The cathodes of the 2A5s are in parallel, and a 300 ohm resistor is in series with cathodes and ground. This resistor is shunted with a 10 mfd., 25 volt paper condenser. The screen of the 2A5s get their voltage from the power supply through a 10,000 ohm, 10 watt resistor. A ½ mfd. 600 volt paper condenser is connected from screens to ground. The audio choke is a 200 MA, 20 to 30 henry size.

Tuning

The oscillator is tuned first. The tank condenser across the oscillator coil is rotated until resonance is indicated by a pronounced dip in the reading of the milliammeter which is plugged into the jack in the plate circuit of the oscillator stage. When this resonance point has been found, change the variable condenser setting very slightly, so that approximately 20 to 30 mills are drawn by the oscillator tube. The oscillator stage is tuned with the final stage disconnected, and the coupling link removed from the grid coil.

Now place one end of the coupling loop over the grid coil; the loop should encircle the center of the grid coil. Place the other loop of the coupling link around the bottom of the oscillator coil. Disconnect the plate supply from the final stage, but light the filaments of the two 45 tubes. Turn the oscillator on. Now tune the grid coil condenser until the meter in the grid coil circuit reads MAXIMUM current. Make sure the oscillator stage is oscillating when the grid circuit is being tuned.

Usually, about 10 to 12 mills will be the reading of the grid current for the amplifier stage. If less than 10 mills is had in the grid circuit, raise the coupling loop around the oscillator coil so that it is near the center of the oscillator coil.

When the grid coil is tuned to exact resonance, as indicated by maximum reading of the milliammeter in the grid circuit, it is often found that the oscillator stage stops oscillating just previous to the time that maximum grid current is indicated. This proves that the coupling is "too tight". Change the position of the coupling loops on the oscillator and grid coils until maximum grid current is secured. While tuning the grid coil, occasionally plug the milliammeter into the oscillator circuit jack to make sure the oscillator is oscillating. A more convenient method for tuning the grid circuit would be to place a small flashlight globe and loop over the oscillator coil (very loosely coupled to the oscillator coil) and keep one eye on this flashlight globe to see that it remains lighted at all times while the grid coil is being tuned with the aid of the milliammeter. Some slight retuning of the oscillator plate condenser is always necessary while tuning the grid coil. The coupling link between oscillator and grid coil can be an ordinary twisted pair of No. 22 push-back wire. Do not use lamp cord. The loops around the oscillator and plate coils can also be push-back wire, and these loops are simply wound around the coils (one turn used for the loop) and held securely in place by standoff insulator supports or by merely tightening-up on the loop itself. Unusual precautions need be taken, because there is but little power transferred from oscillator to grid in this small transmitter.

RF Chokes

For 160 meter operation it is desirable to use two RF chokes in series; one an ordinary short-wave type, the other a standard broadcast band receiving type RF choke.

Neutralizing

With the oscillator oscillating, with the grid circuit tuned to resonance, with the filaments of all RF tubes lighted, but with the plate voltage disconnected from the final amplifier stage, the neutralizing process is ready to begin. Plug the milliammeter into the grid circuit. Place the flashlight tuning lamp over the oscillator coil. Keep your eye on both. Rotate the 25 mmf neutralizing condenser slowly. Begin neutralizing with minimum capacity in the 25 mmf neutralizing condenser. Then rotate the plate tuning condenser of the nal amplifier over its entire radius. As you rotate this condenser you will find that the milliammeter in the grid circuit will take several pronounced dips with various settings of the final plate tuning condenser. This is an indication that the neutralizing condenser is not properly adjusted. Slowly increase the capacity of the neutralizing condenser; swing the final stage plate condenser back and forth over its entire radius. Repeat this process, very slowly, adding or decreasing capacity in the neutralizing condenser. You will find one setting of the neutralizing condenser that will enable you to rotate the final plate tuning condenser through its entire radius without any variation of grid current whatsoever, as indicated by the milliammeter in the grid circuit. The process is made extremely simple by merely remembering that the milliammeter in the grid circuit will show absolutely no variation in reading, no matter where the final plate tuning condenser is set, when the stage is completely neutralized.

After the final amplifier is neutralized, plug the milliammeter into the plate circuit jack and connect the high voltage plate current to the final amplifier. The final amplifier is tuned to resonance by finding a setting of the final plate tuning condenser at which the milliammeter shows a very pronounced dip. The resonance point is indicated by a reading of about 10 or 12 milliamperes on the meter, with the antenna disconnected from the plate circuit.

Now couple the antenna to the plate coil. Tune the antenna condenser and also slightly retune the plate condenser of the final stage

(Continued on page 32)

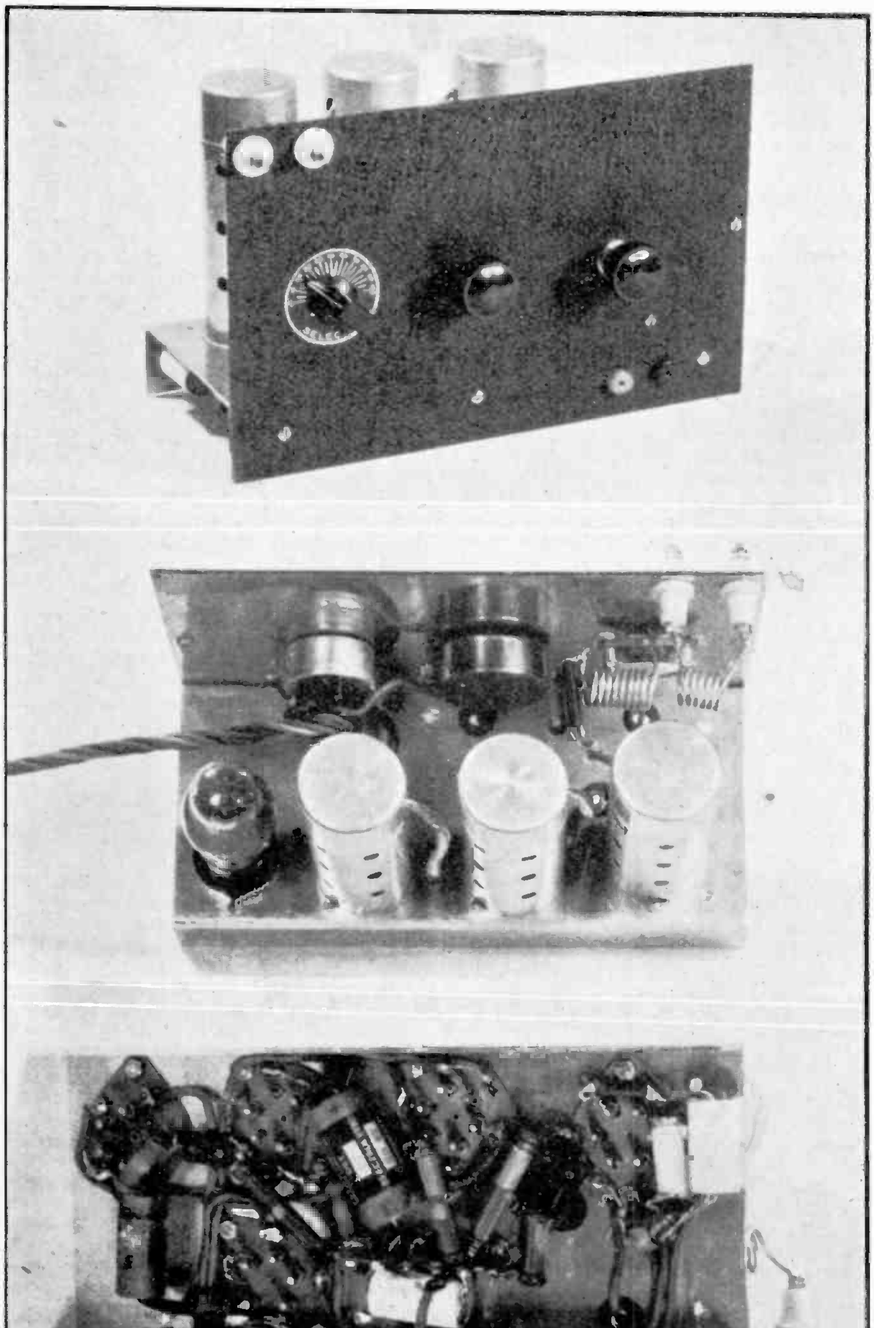
A Simple, Inexpensive 4-Tube, 5-Meter Superheterodyne

It Uses No I. F. Transformers

By FRANK C. JONES

• A simple superheterodyne which anyone can easily build in a few hours has at last been developed for use on the short wave bands below ten meters. The circuit is not at all complicated and no special parts or alignments are necessary in order to put one of these sets on the 5 meter band. The receiver is much more sensitive than a super-regenerative type and has none of the usual loud hiss so common in the latter type.

Briefly, the circuit consists of an autodyne first detector, a "tuned" resistance coupled two stage I. F. amplifier, and a second detector. Four tubes give real results on five meters. It tunes easily because the I. F. amplifier passes a wide band of frequencies. The parts cost very little more than those needed for a super-regenerative receiver. This super does not radiate nearly as much as a super-regenerative set. Several of these receivers ca be used in a neighborhood without causing interference with each other because it is not likely that the oscillating first detectors would be tuned to the same frequency within 5 KC even when all sets are tuned to the same sation. The tubes are oscillating weakly, anyway, and only on one frequency to which the circuit is tuned, instead of over a band of 100 to 200 KC as in a super-regenerative detector.



Three Views of the 4-Tube 5-Meter Super. It is the Acme of Simplicity

The first detector tunes like a regenerative, oscillating detector used for 40 meter CW reception. That is, there are two points very close together on the dial where each station will be heard. In this receiver these points are so close together that the dial is merely set to either side of he exact cener of any station by about a half degree or so at which points the quality is best, and the signal loudest, due to its being heterodyned properly into the IF amplifier. The first detector uses a RF choke in series with the cathode to obtain oscillation because this is simpler than finding the exact point on the tuned circuit for the cathode tap, as in the usual electron coupled oscillator. This form of oscillator gives good stability even on 5 meters.

The IF amplifier is the really interesting part of this receiver. It gives good amplification over the band of frequencies desired, from 10 KC to a little over 100 KC, and is quite stable. The secret is in using the proper values of resistors and condensers to obtain this resonance characteristic. By using low values of grid resistors, ¼ megohms, and small coupling condensers, .0001 mfd., the response to audio frequencies is practically nil. There is no tendency to motorboat since it is such a poor audio amplifier. This also prevents the rectified audio signal component in the first detector from being amplied all the way through the receiver. This value of coupling condenser (.0001 mfd.) and a grid leak of ¼ megohm does not tend to attenuate the higher frequencies such, as for example, 50 KC. This means that the first detector can be of the autodyne type and act as its own oscillator. By having it oscillate weakly, the tube is in its most sensitive condition, which accounts for the excellent signal to noise ratio obtained in this receiver. It also eliminates the need of tracking two tuned circuits, such as used in most superheterodyne receivers.

The relatively low values of plate resistors of 50,000 ohms tend to even-out the amplification of the IF amplifier for the range of 50 to 100 KC in order to be able to receive modulated oscillators. Probably 98% of the phone transmitters on 5 meters use modulated oscillators, so it is necessary to have a receiver tuned broadly enough to receive these signals. Even if all transmitters were temperature and crystal controlled types, it would still be desirable to have the IF amplifier broadly tuned in order to take care of oscillator drift in the receiver. Two stages of moderate gain per stage give more than enough amplification to bring up the man-made noise level into audibility in the output of the second detector. Automobile ignition is the worst offender, although neon signs and other electrical appliances cause plenty of interference up to a hundred feet or so from where the receiver is located.

Volume control is obtained by means of variable cathode bias on the IF amplifier because variable mu tubes are used. Tubes such as the 6C6 or 57 would give too much audio rectification or detection, with resultant distortion and cross-talk, if variable bias were used. In one experimental circuit these tubes were used and the volume control was connected as a variable potentiometer for grid input variations on the second IF stage, just as in an ordinary audio amplifier. Variable mu tubes such as 6D6 or 58 are better and allow the use of cathode bias adjustment for volume control.

The second detector consists of a grid-leak type which is satisfactory for this purpose and gives comfortable volume in a pair of headphones. The .01 condenser across the phones by-passes the I.F. component and increases detector output and efficiency. If loudspeaker output is desired, the detector could be connected through an audio transformer to a pentode power tube. The loudspeaker should be mounted in a separate case or cabinet in order to prevent microphonic feedback on strong carrier signals. For this reason, if an AC power pack and loudspeaker is to be used, the power audio stage may as well be built into the loudspeaker unit. The way the receiver is now designed it can be used with batteries for portable use, or from an AC power pack at home. If an AC supply is used, the 45 volt tap should be by-passed with 8 mfd. and this voltage maintained at about 40 or 50 volts so as to prevent the screen voltage from exceeding the effective plate voltage on the IF resistance-coupled amplifier. The B voltage is not critical and can be of any value up to 250 volts.

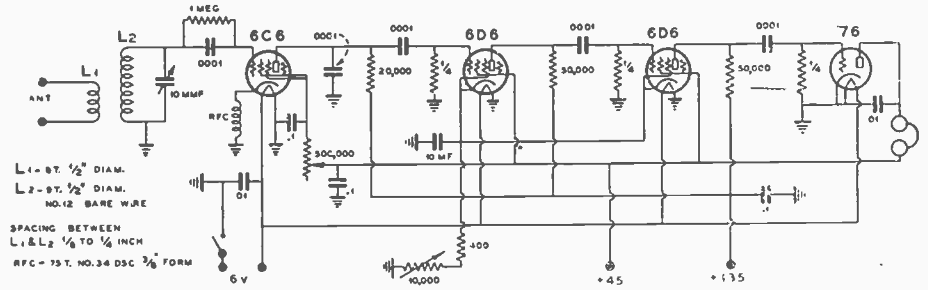
The grid leads on the IF amplifier are shielded to prevent capacitive coupling and a tendency to oscillate on high IF frequencies. This shielding also tends to limit the response of the amplifier to very high intermediate frequencies.

The ground connections in the first detector circuit should be grouped as much as possible. The heater circuit should be grounded on one side at this point and the other side of the heaters by-passed to ground with a small .01 mfd. paper condenser. All leads should be kept short; thus it is desirable to solder the coil to the midget tuning condenser lugs. Pin jacks could be used so as to use plug-in coils for 2½, 2, 7½ and 10 meter bands.

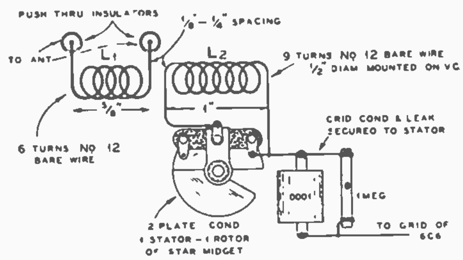
The 10 mmfd. tuning condenser has its rotor grounded to the metal front panel and thus there is no mechanical difficulty of insulated shafts and mountings to worry about. This 10 mmfd. condenser can be made by breaking off one plate of a three plate standard midget condenser. The antenna uses inductive coupling in order to use a balanced two-wire feeder to an 8 ft. vertical antenna mounted on the roof. In some locations a Faraday screen would be desirable between the two coils to minimize capacitive pick-up from the feeders. A great deal of auto ignition interference is picked up in the down leads from the antenna and this can be balanced out if no capacitive coupling is allowed to reach the first detector circuit.

The cathode RF choke is not critical and the one shown is suitable for use at from 2 to 10 meters. It consists of about 75 turns of No. 34 DSC wire wound on a ⅜ inch diameter bakelite rod. The ends are soldered to two pieces of bare wire which are run through holes near the ends of the rod and then twisted together to give an effective soldering lug for external connection. A suitable RF choke for 5 meter operation only, can be made by winding 50 turns of No. 22DSC wire on a ¼ inch form, slipping it off and let it be self-supporting by the connections to the two ends.

When first testing this receiver, the regeneration control should be turned up high enough to insure good oscillation in the first detector. The IF volume control should be turned on full if 180 volt B supply is used, or back just slightly if 135 volts is used. Auto ignition will be heard if an indoor antenna of any convenient length is used—provided cars are passing within a block or so. Below the point of oscillation in the first detector the auto ignition and other noises drop out. It will be found that sensitivity is greatest when the detector is oscillating weakly but on very strong signals, stronger oscillation is desirable to prevent overloading distortion. Coupling between the antenna coil and first detector coil should be adjusted for best weak signal reception, although this is not critical. Too much coupling to a resonant antenna will pull the detector out of oscillation. It will be found that every 5 meter signal will have two points close together where the audio quality is clear since an autodyne first detector is used.



The Extremely Simple Circuit Diagram of the 5-Meter Super.



Simplified Sketch Showing Coil Winding Data.

In building this receiver, good .0001 midget mica condensers and good quality resistors should be used. A noisy resistor or leaky coupling condenser will cause plenty of noise, especially if it is in the first detector or first IF stage. In one receiver built in our laboratory, a noisy plate resistor in the first IF stage caused trouble until it was replaced. Several of these circuits have been wired-up and tested. The IF units have always performed satisfactorily and there is no alignment of tuned circuits to worry about. ± 10% accuracy of values of condensers and resistors has proven satisfactory.

It will be noted that the screen and suppressor grids of the first detector are connected together. This gives smoother regeneration effects and better conversion gain for 5 meter work. The screen by-pass was made as large as .1 mfd. in order to prevent noise from variation of the regeneration control. Needless to say, this condenser, as well as the heater .01 mfd. by-pass, should be non-inductively wound in order to act as a by-pass for 5 meter purposes.

Lest We Forget

(Continued from page 9)

bers". Warner's contract was not re-adjusted to meet the new set-up, so he thereupon commenced to draw commissions far beyond what had been contemplated by it. Besides his commission out of each yearly dues and his 25% of the profits of QST he commenced to draw an additional commission of 25 cents out of each subscription to the magazine—all because by arbitrary dictum subscription money became "yearly dues". If the amateurs themselves were ever given the opportunity to pass upon this new scheme it does not appear of record. It gave Warner thousands of dollars yearly beyond what his contract had provided. In the first year of its operation Warner's rake-off in addition to his salary jumped from $893 to $3,715, over 400%. A part of the excess came legitimately from an increase in the number of members who were amateurs but the bulk of the excess consisted of 25 cents from each QST subscriber that the scheme had made a "member".

And yet it does not appear that the Treasurer or any officer or any director ever took steps to protect the treasury of the ARRL. At any rate it is certain that at any time within the statutory limit Warner and the directors could have been forced to restore to the treasury all monies taken from it by the unauthorized renaming of all QST subscribers "members".

The operation of the scheme resulted in a complete upset of the ARRL as a league of transmitting amateurs. It changed utterly the fundamental conception of the ARRL as a fraternal organization; for the commercial people and other non-amateurs who had been mere subscribers to QST soon became the majority owners of the ARRL and all its assets; they and not the amateurs became the employers of Warner and the headquarters staff. There is no such thing as the employees of a corporation ignoring the interests of the majority owners. In this case as in all others the interests of the commercial members were not ignored. It was the commercial "members" who coveted the amateur frequencies, and they got them. When the commercials again coveted amateur frequencies they took at the 1927 Convention two-thirds of the amateurs' already meagre space on the air. And Warner exulted over it in these words, (see them in his report of the Convention in QST for January, 1928), "Those privileges in most respects are entirely adequate. We have achieved a great victory."

Supporters of the present regime at headquaters will respond to this article with the cry, "Oh, that's ancient history; why not let by-gones be by-gones?" That's a fair question; I for one should be glad to. But the truth is that they are NOT by-gones; the conditions of old are right here with us today. Lest we forget, I'll repeat that the fortunes of the amateurs are today in the same hands and manipulated in the same old way.

Clair Foster, W6HM.

Adding R. F. to the "222" Receiver

By FRANK C. JONES

THE demand for a simple receiver, such as the original model 222 Communincation receiver, but with a radio frequency stage ahead of the detector, prompted the design and construction of the superheterodyne herein described. Adding the usual tuned RF stage means complications because of the need of complete shielding and circuit isolation between the RF and regenerative detector stages. For this reason a semi-tuned RF stage was chosen and thus the receiver is no more complicated than the original 222 receiver.

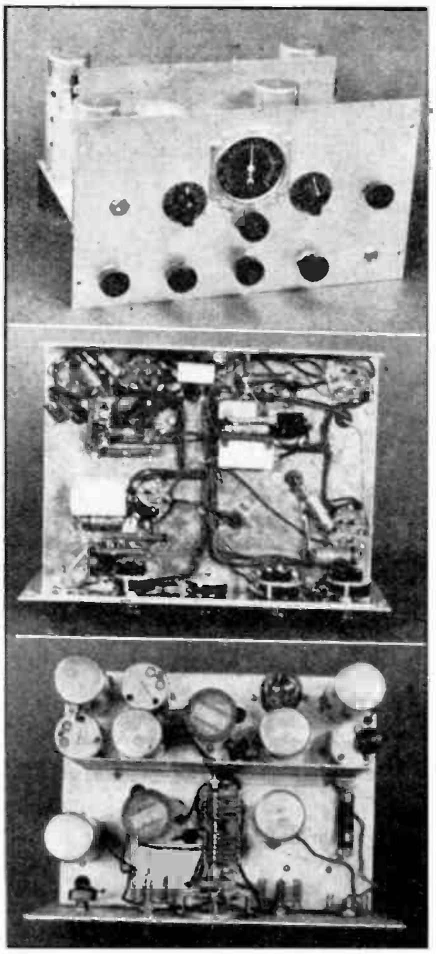
The form of RF stage used here is self tuned over a narrow band, which is an ideal condition for amateur reception but would not be satisfactory for an all-wave broadcast receiver. The input circuit uses a resonant RF choke or tuned circuit which has a high L over C ratio. This means real amplification where it is needed and not very great selectivity in this stage. The antenna trimmer condenser will actually tune this stage to resonance any place within the amateur bands. One RF coil or choke is needed for each band, as shown in the coil table. The really beautiful part of this type of RF stage for amateur use is that no special amount of shielding and no three-gang condenser is required. No alignment difficulties or circuit reaction are encountered.

The RF chokes can be wound on old burned out Amperites, such as were used with the 201A tubes to drop their filament voltage from 6 down to 5 volts. There is just a little over 1 inch of winding space on these glass tubes which are about 7/16 inch in diameter. The ends of the wire can be soldered to the end clips and the whole unit plugged into the original clip mounting. This makes a fairly convenient method of changing these RF coils for each amateur band. Another possibility would be the use of burned out cartridge type fuses, preferably those having glass instead of fibre cylinder walls.

The antenna condenser, about 25 mmfd. maximum capacity, should be insulated from the front panel. The antenna is connected to the rotor. Probably a doublet antenna could be used by coupling 10 to 20 turns of wire around the tuned RF choke on a form large enough to slip easily over the choke coil. In this case the antenna condenser should connect to ground in order to resonate the input circuit. The actual resonance curve of a high L over C ratio tuned circuit on 20 or 40, or even 80 meters is wide enough to cover the amateur bands without retuning for each station received. This only holds true where the capacity across the tuned circuit is extremely small and where the coils have a certain amount of resistance to help broaden out the selectivity curves.

The RF stage increases the signal to noise ratio, as shown by tests on the 40-meter band by means of an all-wave signal generator. The image rejection of this set is extremely high when considerable regeneration is used in the first detector. When using as much regeneration as possible the image rejection was 68 DB using a non-resonated input circuit, and nearly 80 DB with a resonant input circuit. One of the most expensive commercially-made all-wave receivers using an RF stage measured only 47 DB image rejection on 40 meters.

Analysis of the above shows that very efficient plug-in coils, plus isolantite insulation on condensers and coil sockets and no dead end losses, increase the selectivity for purposes of image rejection. Regeneration in the first detector increases the selectivity against unwanted signals 900 KC off resonance, especially as the regeneration is increased. In this receiver a 100 mmfd. band-setting condenser is at maximum capacity for the 40-meter band to aid image rejection. 80 DB means that the undesired commercial station signal would have to have a field strength at the receiver of 10,000 times that of the amateur signal in order to be as loud.



A beautifully-compact and neat appearing receiver is the new 222. Here are the front, bottom and interior views.

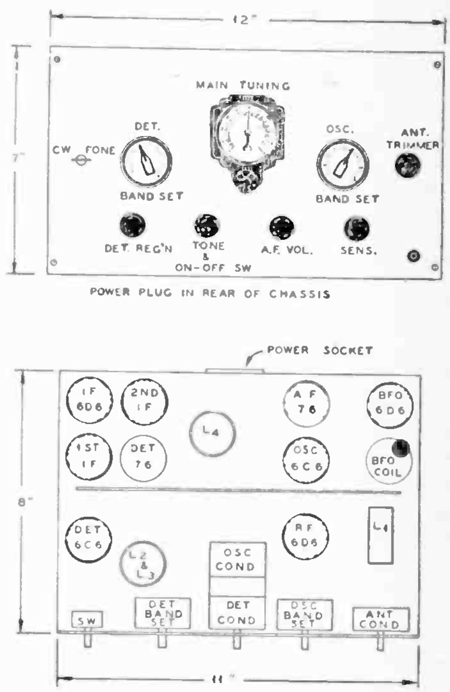
The receiver uses a regenerative detector, one stage of IF, detector and one stage of audio amplification for headset operation. If loudspeaker reception is desired an additional audio stage can be used, or the present stage can be transformer coupled to the power detector, with a pentode tube such as a 42 instead of the 76 tube now used in the audio stage.

A separate BFO tube is used for CW work, and a separate Dow electron-coupled first oscillator is used to provide good stability. The first detector is similar to the one used in the original 222 receiver except that less regeneration is needed and consequently less turns are required between cathode tap and ground. The conversion gain of this detector is quite high, due to the suppressor being coupled to the oscillator and having a positive potential on it of about 90 or 100 volts. Running the suppressor at DC cathode or ground potential required a great deal more regeneration coupling to hear the same weak signal from a signal generator.

Both AF and RF plus IF bias volume controls are provided because a good balance between these will often allow the reception of extremely weak signals through local noise conditions. A tone control is provided for the same purpose.

The IF transformers are of a type used in broadcast receivers. They are modified somewhat to the detriment of the symmetry of the coils. The spacing between coils must be increased about 1/4 or 3/8 inch in order to give better IF selectivity. The spacing between coil centers is now slightly over an inch and the particular coils used in this receiver tuned to 432 KC.

The layout of parts in this receiver is quite simple. Only one partition shield is used. The front panel, chassis and cabinet are all made of No. 12 gauge aluminum. It would be desirable to have a shield between the two sections of the band-tuning condenser in order to prevent a slight amount of interlock between the detector and oscillator. The constructor is advised to add



Front Panel layout and parts arrangement.

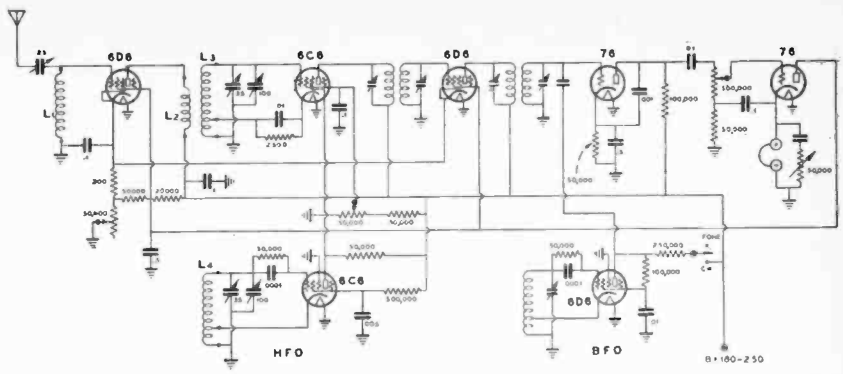
this shield. It would further be desirable to have a flexible coupling between the dial and this tuning condenser in order to prevent dial binding and CW note "drag." The oscillator section of this condenser has one less rotor plate than the detector section in order to make tracking easier over the amateur bands.

Lining up a superheterodyne receiver is always a problem unless a modulated test oscillator is available. It can be done by using signal noise level if the front end of the set is working properly. The IF transformers can be tuned until the noise level or some commercial signal is loudest. A far more satisfactory method is to use an ocsillator to line up the IF. Use the harmonics of the oscillator to line up the front end of the set. The oscillator should first be capacitatively coupled to the grid of the IF tube, and the second IF transformer tuned for maximum signal in the telephone receivers. As these circuits are brought into line, less coupling can be used to the modulated oscillator. After the second IF transformer is tuned properly, the oscillator should be capacitatively coupled to the grid of the detector. This is best done by disconnecting the detector coil grid clip and running the grid to ground through any resistor of from 200 to 10,000 ohms. The oscillator should be coupled directly to the grid through a small capacity, such as a twist of wire, unless there is an attenuator built into the oscillator. The resistor acts as an impedance to the IF signal and thus the detector acts as an IF amplifier, and the plate coil as well as the grid coil of the first IF transformer can be properly aligned. It is desirable to have the RF volume control set at maximum during these tests.

After the IF amplifier is properly aligned, harmonics of the oscillator can be used to align the front end of the set. This alignment is done by properly adjusting the two band-setting condensers on the front panel so as to catch the high frequency end of each amateur band at the low capacity end of the 2-gang tuning condenser. When the coil inductances are just right, the detector band-setter will not have to be adjusted as the main dial is tuned across the amaeur bands (with the exception of the 160-meter band). These coil inductances can be varied by sliding turns along the coil forms before cementing them into place with Duco cement.

Each signal will have two points on the oscillator band-setter, and in every case the high frequency one should be chosen. First detector regeneration should always be used below the oscillating point. If this tube or the RF tube oscillates, spurious signals will usually be heard which are heterodyned into the IF amplifier.

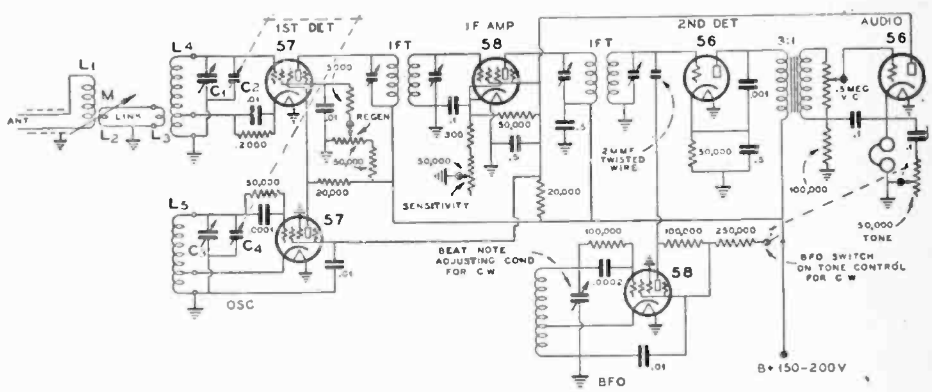
Adjustment of the BFO knob is simple. The knob is set for about 1000-cycle beat note on a carrier signal which has been tuned in with the switch on phone position. The amount of BFO coupling to the second detector can be easily adjusted by adding or subtracting a capacitative coupling turn around the grid lead to the second detector. One turn wrapped around this lead, from the oscillator plate, seems to be sufficient for most signals. In this set the BFO frequency is adjusted by means of a kob on the coil shield inside of the receiver.



Circuit diagram of the 222 Receiver with RF stage. Data for L1, L2, L3 and L4 given in table below.

Coil Winding Table for Frank C. Jones' 222 Communications Receiver With R.F. Stage

	L1 (R.F. Grid Coil)	L2 (Plate Winding)	L3 (Detector Coil)	L4 (Oscillator Coil)
For 10 Meters	20 Turns No. 18 DCC Wire. Winding space 1 inch long on a $\frac{7}{16}$ inch dia. tube.	3 Turns No. 36 DSC Wire, interwound with L3.	$4\frac{1}{4}$ Turns No. 22 DSC Wire, space wound to cover a winding space 1 inch long on a $1\frac{1}{2}$ inch dia. coil form. Tapped at $\frac{1}{3}$ turn.	4 Turns No. 22 DSC wire, space wound to cover a winding space 1 inch long on a $1\frac{1}{2}$ inch dia. coil form. Tapped at $1\frac{1}{4}$ turns.
For 20 Meters	35 Turns No. 22 DSC Wire. Winding space 1 inch long on a $\frac{7}{16}$ inch dia. tube.	7 Turns No. 36 DSC Wire, interwound with L3.	10 Turns No. 22 DSC Wire, space wound to cover a winding space 1 inch long on a $1\frac{1}{2}$ inch dia. coil form. Tapped at $\frac{1}{2}$ turn.	$8\frac{3}{4}$ Turns No. 22 DSC wire, space wound over a winding space 1 inch long on a $1\frac{1}{2}$ inch dia. coil form. Tapped at $2\frac{1}{4}$ turns.
For 40 Meters	60 Turns No. 26 Enameled Wire. Winding space 1 inch long on a $\frac{7}{16}$ inch dia. tube.	7 Turns No. 36 DSC Wire, interwound with L3.	10 Turns No. 22 DSC Wire, space wound to cover a winding space of 2 inches long on a $1\frac{1}{2}$ inch dia. coil form. Tapped at $\frac{1}{2}$ turn.	$8\frac{3}{4}$ Turns No. 22 DSC Wire, space wound to cover a winding space 1 inch long on a $1\frac{1}{2}$ inch dia. coil form. Tapped at $2\frac{1}{4}$ turns.
For 80 Meters	160 Turns No. 36 DSC Wire. Scramble wound on a $\frac{7}{16}$ inch dia. tube, 1 in. long.	16 Turns No. 36 DSC Wire, interwound with L3.	30 Tuns No. 22 DSC Wire over a winding space of $1\frac{3}{8}$ inches long on a $1\frac{1}{2}$ inch dia. coil form. Tapped at $\frac{3}{4}$ turn.	$26\frac{3}{4}$ Turns No. 22 DSC wire over a winding space of $1\frac{3}{8}$ inches long on a $1\frac{1}{2}$ inch dia. coil form. Tapped at $4\frac{1}{4}$ turns.
For 160 Meters	300 Turns No. 36 DSC Wire. Scramble wound on a $\frac{7}{16}$ inch dia. tube, 1 in. long.	30 Turns No. 36 DSC Wire, interwound with L3.	60 Turns No. 28 DSC Wire over a winding space of $1\frac{1}{2}$ inches long on a $1\frac{1}{2}$ inch dia. coil form. Tapped at $1\frac{1}{4}$ turns.	53 Turns, No. 28 DSC wire over a winding space of $1\frac{1}{2}$ inches long on a $1\frac{1}{2}$ inch dia. coil form. Tapped at 7 turns.



THE ORIGINAL FRANK C. JONES' 222 COMMUNICATIONS RECEIVER

This is the circuit of the original 222 Receiver WITHOUT RF stage. The circuit as published in January "RADIO" was not correct in that there was no plate voltage connection to the oscillator tube.

CALLS HEARD

Calls Heard at W2ESK

180 West 135th St., New York, N. Y. Room 302
Jan. 3 to Feb. 8, 1935
(Ann on 7 MC)

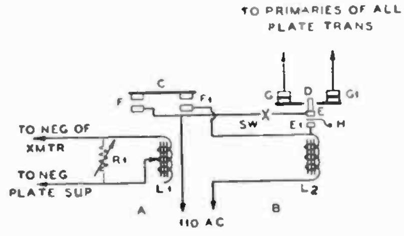
VK2ED, VK2RX, VK2IF, VK2DA, VK2EL, VK2LA, VK2YO, VK2OJ, VK2UP, VK3EG, VK3OV, VK3UH, VK3PV, VK3NP, VK3DZ, VK4AP, VK4CK, VK4FM, VK5LB, VK5LP, VK5LX, VK5GX, VK5BK, VK5GW, VK6LY, VK6MA, VK7JB, VK7CU, EA1EA, EA3EG, EA4AV, EA4AO, EA4VB, EA5LB, EA7AO, EA7BC, EA7BE, EA8AE, F3CM, F8AG, F8EX, F8EO, F8PZ, F8PQ, FXFM4AA, CT1AZ, CT1AZ, CT1CB, CT1IO, CT1ZZ, CT2ZC, CT2AZ, CT3TM, LU2JE, LU2EG, CU2XF, LU3BB, LU4DC, LU5BL, LU6JB, LU7UZ, LU9BV, K4RJ, K4AF, K4BRN, K5AA, K5AM, K5AG, K5AI, K5AC, K6EWQ, K5CFQ, K7DC, KA1CS, KN3X, EI8B, ZT1R, ZS1Z, ZS6AM, U1USK, AC8ASR, XU2ES, XU3ST, ON4IJ, ON4JB, CE5AA, D4BBU, D4BBR, G2BM, G2DO, G6VP, G5ZX, ZI1LI, ZI2JM, ZI2NT, ZI3GM, ZI3AN, X1AY, X1DC, X1DV, X2BX, X2BC, X2N, X5AY.

Overload Protective Device
By W6GEA

As a safeguard against tube overloads and to prevent damage to other equipment in radio transmitters, the device shown in the illustration has been used successfully at station W6GEA. The system is indeed a simple one, has no intricate mechanical holding devices nor springs.

A Cutler-Hammer No. 600 relay is used for the normal open circuit, (A), another for the normal closed circuit, (B). E, E1 are the special holding-coil contacts.

The winding (L1) is in series with the TOTAL negative plate current. It consists of 1500 turns of No. 30 B.S.G. Enameled wire, and is tapped at 500, 750, and 1000 turns. Finer adjustment is made with the variable resistance (R1) which shunts the coil (L1). The winding (L2) is for normal 110 volt AC operation, causing the break in the primary of all plate transformers, and is also the holding coil.



For example, let us assume that the final stage starts drawing excess current, which may be due to many reasons. The additional current in (L1) would attract the armature (C), completing the circuit through (L2) which breaks the primary of all power transformers, formerly completed through contacts (G, G1); if it were not for the holding contacts (E, E1) the process would perpetually run on and off.

After the plate power is off, the holding relay will run until the normal closed switch (Sw) is opened for a moment. (H) is a contact spring to prevent "bumping" of the armature (D).

This relay will quickly pay for itself, and should be considered an integral part of every transmitter. The circuit is self-explanatory.

Disturbances in Radio Transmission

By A. M. SKELLETT
Radio Research, Bell Telephone Laboratories

ALL radio waves which traverse long distances over the earth's surface make use of the upper atmosphere. Indeed were it not for the electrical properties of these high regions*, by reason of which the waves are bent back toward the earth, radio transmission over distances greater than a thousand miles or so would be impossible. Short waves, at least, would simply pass out into space instead of following the curvature of the earth.

These electrical properties are due to the ionization of the gases; that is, the breaking up of the atoms and molecules into electrons and ions by ionizing agents. It is believed that the most important of these agencies is the ultra-violet light from the sun. Others which are believed to contribute to the ionization are the ultra-violet light from the stars, cosmic rays, meteors, and electrons, ions or neutral particles from the sun. None of these, except possibly cosmic rays, acts in a steady continuous manner, and in consequence the electrical state of the ionosphere varies continually. Some of these variations are fairly regular and give rise to disturbances in long distance radio transmission.

One type of such disturbance occurs at the time of a "magnetic storm," and is very detrimental to short waves traveling over high-latitude paths. In fact, radio pulse experiments have shown that the ionosphere in polar regions completely absorbs short waves at such times. Coincident with the magnetic and radio effects other phenomena are observed, the most prominent of which are the abnormal electric currents in the earth's crust and the appearance of the aurora in unusually low latitudes. Since the magnetic aspect of these disturbances has received by far the greatest amount of study, the term magnetic storm is used in the discussion of any of these phenomena.

Theoretical considerations indicate that the variations of the earth's magnetic field have only a minor effect on radio transmission in general, the changes in the ionization of the ionosphere being responsible for the major effects. The latter deviations appear to be of two kinds, a general increase in the amount of ionization and an increase in the turbulence. In the daytime the resultant effects on radio transmission vary greatly with the wave length: long distance transmission by long waves (5,000 meters or more) is better, but transmission by short waves (10 to 100 meters) may be severely disturbed or completely wiped out. During the night hours, the effect on the short waves is of the same kind as in the daytime, whereas the long waves experience a relatively mild depression in the strength of the received signals.

Apparently the general increase in ionization during disturbed periods enhances the "reflecting power" of the ionosphere for long waves during the day, while an opposite effect is produced on short waves. It appears that the layer of ionization which is intensified by the disturbance acts both as a reflector for the long waves and as absorber for the short, so that the increase in ionization affects the two ranges of frequency oppositely. These facts imply that the short waves are reflected at a higher level than the long, and such is known to be the case.

The study of magnetic storms has furnished strong evidence that the fundamental cause of these various phenomena is to be found in the sun. This is indicated by the appearance, in the magnetic records, of the two major solar periods; the eleven-year period of sun spots and most other forms of solar activity (Fig. 1), and the approximate twenty-seven-day period of the sun's rotation. There are now also enough radio data to show this twenty-seven-day period. In Fig. 4 the size of a dot on the radio chart corresponds, roughly, to the relative intensity

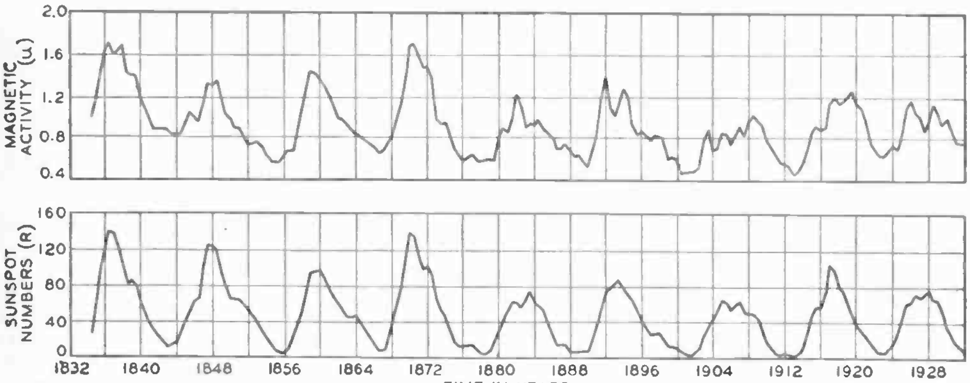


FIG. 1—Magnetic and sun spot data show an eleven-year period of variation. These data were compiled by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

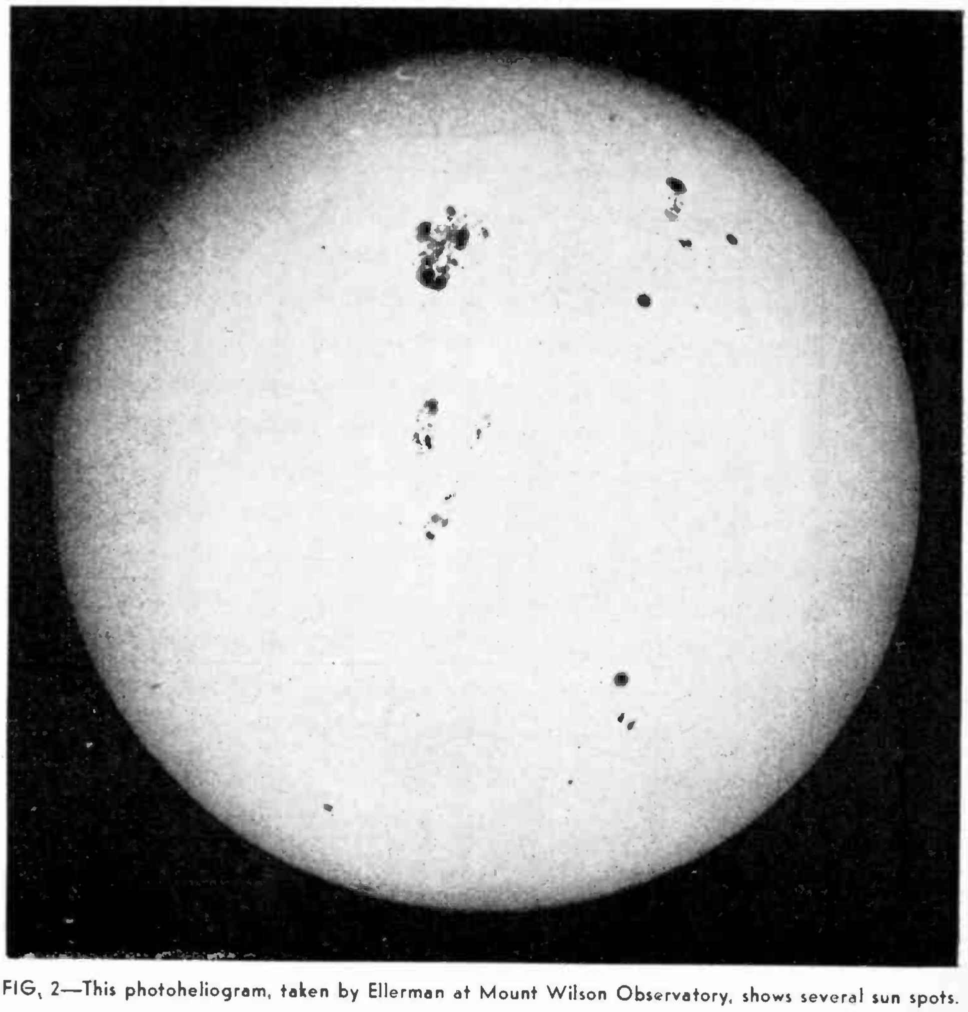


FIG. 2—This photoheliogram, taken by Ellerman at Mount Wilson Observatory, shows several sun spots.

* The atmosphere may be divided into four parts: (1) the troposphere, extending to a height of about 7 miles; (2) the stratosphere or "isothermal region" from 7 miles to about 25 miles; (2) the ozonosphere from about 25 to about 45 miles and (4) the ionosphere above about 45 miles. The ionosphere is the region which is important in radio transmission.

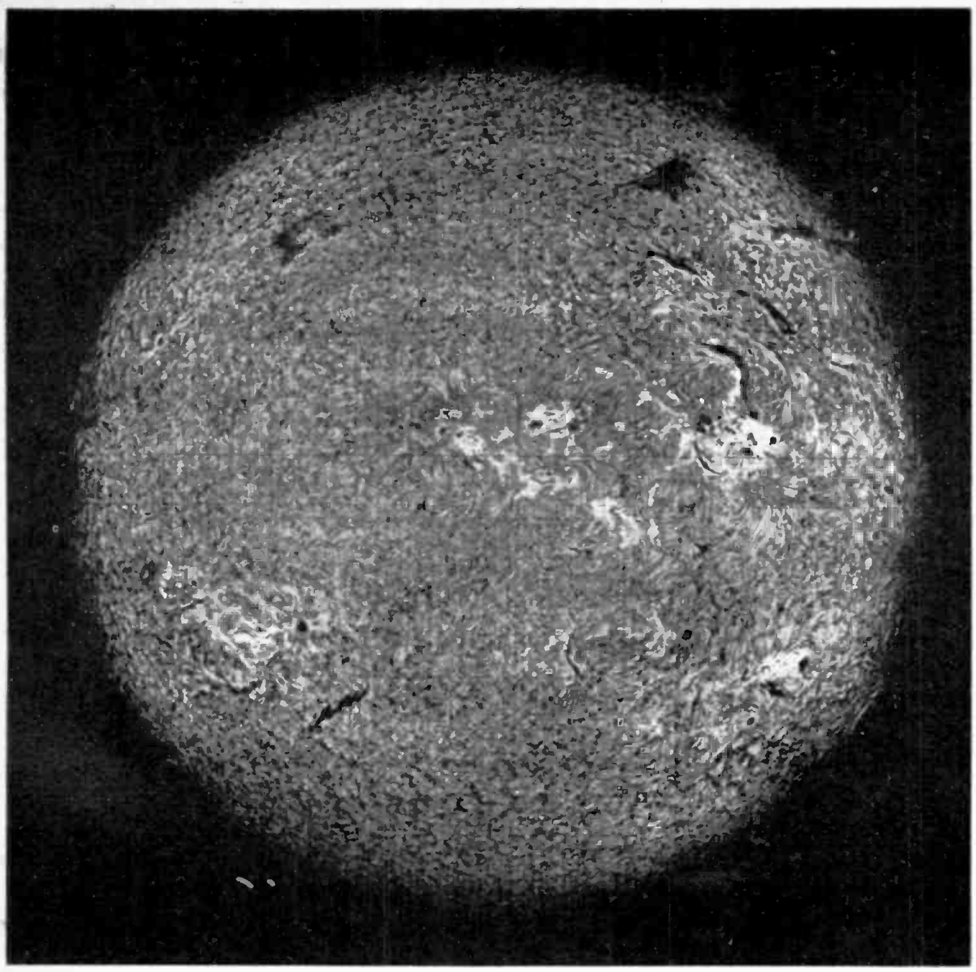


FIG. 3—This spectroheliogram (in the H^{a} line) showing flocculi was taken at Mount Wilson at about the same time as Fig. 2.

from day to day of the disturbances of the short-wave telephone circuits between New York and London. The tendency for these to recur time after time at intervals of approximately twenty-seven days is apparent. There are also enough data on the long waves to show an eleven-year period of variation over more than one solar cycle.

At the time of each of the nineteen great magnetic storms that occurred from 1875 to 1903, E. W. Maunder, an English astronomer, found that there was a large sun spot on the visible side of the sun. For storms of lesser magnitude the relation did not always hold. Magnetic disturbances sometimes occur when no spots are visible on the sun, and large spots are at times observed when no disturbances occur. Evidently the cause of the terrestrial disturbances must be sought further.

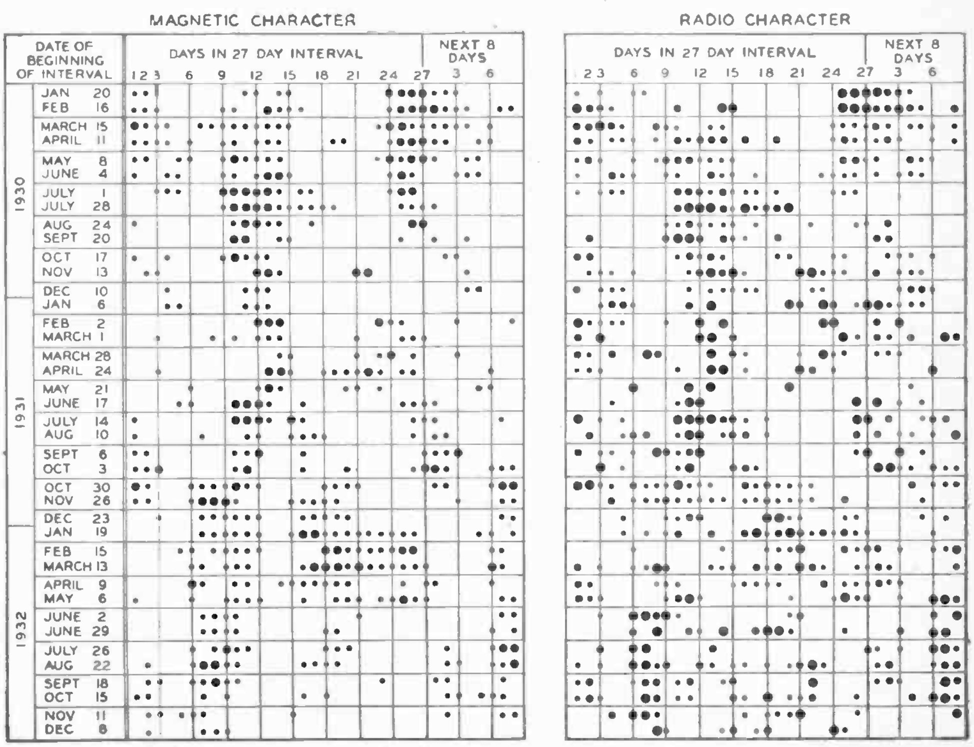
An instrument which makes such a study possible is the spectrohelioscope, which discloses phenomena entirely invisible in the ordinary telescope. As its name imples, it enables one to observe the sun in the light of any particular wavelength in the solar spectrum. If the instrument is set for one of the absorption lines of hydrogen, the distribution of this element over the solar surface may be seen. In this light the appearance of the sun is strikingly different from that given by white light (Fig. 2). The granular structure is much coarser, and clouds of hydrogen are usually seen over the surface, while around the edge such clouds may often be observed as prominences or ruddily hued flames projecting out from the sun.

The prominences are sometimes seen to blow off into space with great velocities (Fig. 5), and such observations strongly suggest a mechanism by which a disturbance may be transmitted from the sun to the earth. A number of bright eruptions have been observed to occur on the solar surface, usually near large spots, which were followed by magnetic storms on the earth after an average interval of about twenty-six hours. Theoretical considerations indicate that the speed of a particle ejected from the sun by radiation pressure would be a thousand miles per second, at which velocity the particle would take twenty-six hours to traverse the 93,000,000 miles from the sun to the earth. The conditions are not as simple as this would imply, however, and recent studies of the motions of prominences cast some doubt on the generally accepted importance of the role which is played by radiation pressure in ejecting them.

Regarding the means by which the disturbance is transmitted between the sun and the earth, it appears likely that the actual carriers are electrons or ions or a combination of both. The fact that the disturbance on the sun can be seen before electrical effects are experienced on the earth, implies a carrier other than light. Moreover, the form and position of the aurora produced at such times have been reproduced in the laboratory by bombarding a magnetized iron sphere with electrons.

One may picture the origin of a magnetic storm in this way. First a solar eruption emits a stream of electrons and possibly ions into space; then some time later these charged corpuscles arrive at the earth and are so guided by its magnetic field that most of them enter the atmosphere around the polar regions. As they strike the outer atmosphere they ionize and disturb it, and as a direct result radio transmission through these regions is poor and a brilliant aurora appears. It has been suggested that electric currents would be set up in these high regions which would give rise to the magnetic and electrical effects observed at the earth's surface.

The durations of these great solar eruptions are very brief, astronomically speaking, usually a matter of hours or less, and since the sun can be observed only intermittently, the record of their appearance is necessarily



FIIG. 4—Both magnetic and radio data show a twenty-seven-day period of variation.

very incomplete. It is probably significant that almost all of those observed have been followed by intense magnetic storms. At times long distance transmission is disturbed when there is no magnetic storm. The question naturally arises: are there other means by which the normal behavior of the ionosphere may be altered. Is it possible, for example, that the haphazard bombardment of the upper atmosphere by meteors is one such cause of disturbance?

The average shooting star has a velocity many times that of the fastest rifle bullet. When it strikes an atmospheric molecule, the energy of impact is great enough to break up the molecule into ions and electrons. Often a bright meteor will leave a glowing train which floats in the upper atmosphere for some time after the meteor has disappeared and which may be a mile or more in diameter. It seems likely that such night-time trains are one of the phenomena accompanying ionization. They seem to occur exclusively in the lower layer of the ionosphere.

More direct proof of meteoric ionization was obtained at the Laboratories at Deal during the Leonid meteor shower of 1932. Measurements of ionization by the radio pulse method indicated increases in ionization directly overhead coincident with the passage of bright meteors through this region. For the brightest observed, the ionization increased by an amount in excess of that which is found at noon in summer. These observations, as well as others made by J. P. Schafer and W. M. Goodall during other meteor showers, furnish direct evidence of the ionizing effects of visible meteors in the lower layer of the ionosphere.

A conservative estimate of the number of meteors which hit the atmosphere each day is one billion, averaging about five per square mile of the earth's surface. If each meteor spreads ionization around its path to a distance of a fraction of a mile, a radio beam which travels a long distance through the ionosphere will be subjected at normal times to a continuous bombardment. This brings up a question which has not as yet been answered: does this bombardment produce sufficient turbulence to cause fading?

It is in the general region of the lower layer, fifty to seventy-five miles above the earth, and in that neighboring to it, that most of the shooting stars observed by the naked eye are seen. The telescope, however, reveals many more whose paths apparently lie in or near the region of the upper layer (175 to 190 miles high). These are much more difficult to observe since they are much fainter and traverse the field of the telescope in a very small fraction of a second. It is not unlikely, therefore, that the upper layer may experience meteor showers which are never seen. Whether or not they are the cause of unexplained interruptions of long distance transmission cannot be determined from present data, but that they constitute a possible source of such disturbances as these is evident.

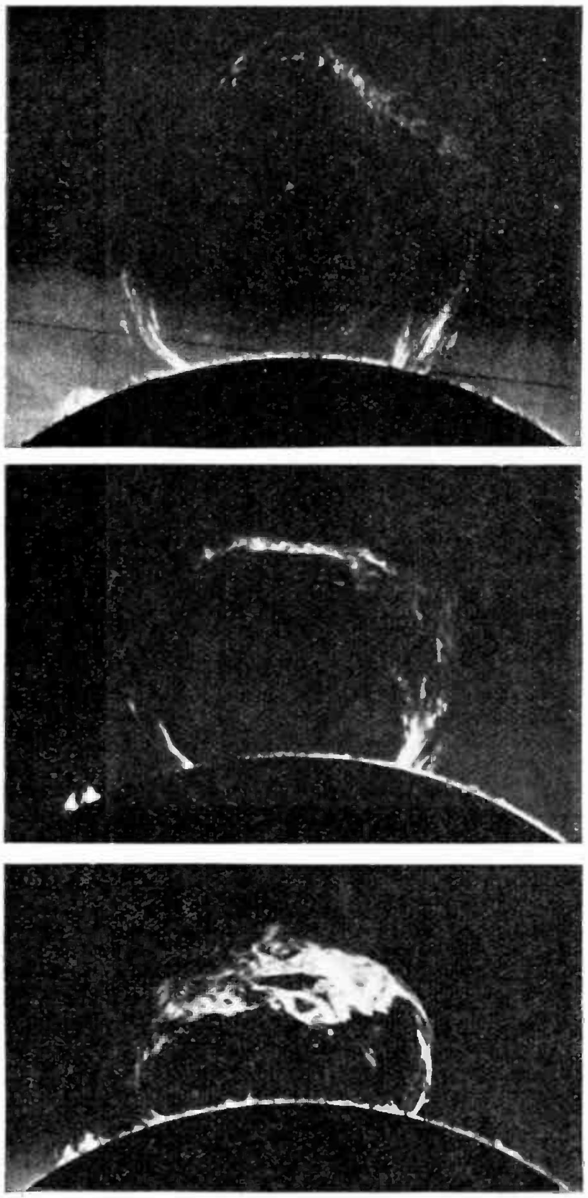


FIG. 5—These spectroheliograms show three successive stages of a prominence blowing off the sun. The time interval between 1 and 2 is about forty-four minutes, and between 2 and 3 about fifteen minutes. The pictures were taken by Pettit at the Yerkes Observatory.

CALLS HEARD

Calls Heard at W3OP, Allentown, Pa.

Jan. 15, to Feb. 15, 1935, on 7 MC

CN8SEG, CT1AG, CT1BQ, CT1ED, CT1ET, CT1OI, CT1KN, CT1KR, CT1JW, D4BJL, D4BKU, D4BUK, D4BWM, EA1AM, EA4AP, EA4BF, EA4B, EA5BG, EA5BS, EA5BM, EA5BA, EA6AM, EA7BD, EA8AG, F8GV, F8JI, F8JJ, F8TQ, F8EO, F8GS, F8RI, F8IM, F8TM, FM3FB, FM8CR, FM8JO, FM8PW, G2FM, G2MV, G5CW, G5FN, G5YV, G6NJ, G6CT, G6VP, G6OX, G6RH, G6NF, G6KU, G6WY, HB9J, MC1FS, HC2HP, HP1A, LU2EG, LU2EN, LU2RC, LU5BL, OK1PK, OK2LK, PAφIR, PAφXF, ON4AU, ON4MT, ON4ZA, ON4ZQ, PK1BO, PK1BO, PY1AW, TI2TF, VQ4CRH, VQ4CRL, VK2HF, VK2QP, VK2YO, VK3XW, VK3XQ, VK3FB, VK7HL, VP4JL, VP4AA, ZL1DI, ZU1D, HJD2.

●●●

Calls Heard at W1FET

14 MC—Oct. 31 to Dec. 31, 1934

CM6AW, CX1CX, F3SMI, FC4CJJ, FM8BG, HAF8D, HC1JW, HI7G (fone), HP1A, J2GX, K4BTL, K4KD, K5AA, K5AC, K6HLP, LA3R, LA4U, LU5FV, LU6AP, LY1J, NY1AB, OE3FL, ON4CSL, ON4CJJ, PY1AW, SP1DE, SP1CO, SU1EC, SU1SG, TI2TAO, TI3WD, VK3MR, VP2AT, VP4AA, VP4JR, VP5AB, VP5AC, VP5JB, VP5PZ, VQ4CRL, VQ4CRP, VQ8A, X1AG, X1AM, X1AY, X1BB, X1D, X1DC, X1Y, ZE1JF, ZE1JJ, ZS1D, ZS1H, ZS1P, ZS2A, ZS2J, ZS4U, ZS6M, ZS6V, ZT1H, ZT1R, ZT1Z, ZT2F, ZT6A, ZT6J, ZT6N, ZU6P.

7 MC—Oct. 31 to Dec. 31

CM2AD, CM2AF, CM2DO, CM2FA, CM2FC, CM2IP, CM2NA, CM2MG, CM7CX, CM7JP, CM8PQ, CN8MR, CN8ALC, CT1AA, CT1BG, CT1CB, CT1CC, CT1ED, CT1FI, CT1JW, CT1KR, CT1LZ, CT1ZZ, CT2BK, D4BBT, D4BFH, D4BGK, D4BHH, D4BKU, D4BLU, D4BNN, D4LBV, EA1AE, ET1AN, EA1AR, EA1BA, EA2AD, EA3AN, EA3EG, EA4AO, EA5BS, EA7AH, EA7BC, EA7BE, EA8AF, EA8AH, EI8B, F3CX, F3DM, F3EY, F8EO, F8JJ, F8PLM, F8WO, F8ZE, F8ZF, FM3JZ, FM4AB, G2AO, G2DU, G2IC, G2NM, G2TR, G2VV, G5BJ, G5CV, G5FN, G5HC, G5LI, G5PJ, G5WP, G5US, G5YV, G6GM, G6IY, G6KP, G6NJ, G6RS, G6TM, G6UF, G6US, G6RV, G6VK, G6WY, G6XB, G6YL, GI5MZ, GI6TK, HB9Aφ, K5AA, K5AF, K5AG, K5AM, LU1AB, LU7AZ, NY1AA, NY1AB, NY2AB, OE7JH, OK1CB, OK1FF, OK1JC, OK1LN, OK2MS, ON4AP, ON4AU, ON4CJJ, ON4DS, ON4FE, ON4GRX, ON4GU, ON4GW, ON4PA, ON4VC, PAφASD, PAφDC, PAφHG, PAφLR, PAφMR, PAφQL, PAφYG, PAφZM, PAφZP, PY1AW, SP1AR, SP1DB, SP1HN, SP1KX, TI2RU, U3EN, VK2OA, VK2FD, VK2KJ, VK2KM, VK2OJ, VK2SK, VK2XJ, VK2YO, VK3MR, VK3YU, VK3XQ, VK3ZF, VK4KY, VK4RY, VK5HG, VK5MH, VK5WG, VK5XU, VO8Y, VP5PA, X1AX, X1D, X1DA, X2C, X2N, XZN2C, YR5AA, ZL2BZ, ZL4CK, ZS6AM, ZU6B.

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Calls Heard at W9SOW

Jan. 1, 1935, to Feb. 12, 1935
Chas. B. Kindred, (EX9FDJ) Atlanta, Ill.
14,000 KC

AX7RH, CM2IP, CM5JD, CM6AA, CM8PQ, CX1FB, CX2AM, F3MTA, F3SMI, F8WK, HJ3AJH, HP1A, K5AA, K5AC, K5AN, K5AT, K5AY, K7DVF, LU4DQ, LU5AQ, LU5EW, LU5FV, LU7EF, NY1AA, NY1AB, OA4AA, OA4J, ON4AU, ON4CJJ, ON4CSL, PY1AW, PY9AD, VO4Y, VO4Z, VP2AT, VP4AA, VP4FH, VP4JR, VP5AB, VP5AC, VP5PZ, VQ4CRP, X1AM, X1AX, X2H, ZD2C, ZE1JB, ZE1JJ, ZE1JN, ZS6AL, ZS6V.

7,000 KC

CE3EL, CE5AA, CM2AS, CM2DO, CM2OP, CM2ZN, CM6CR, CM6DW, CX1BU, EA3EG, EA4AO, EA7BE, EA8AH, J2CL, K5AA, K5AC, K5AF, K5AG, K5AM, K5AY, K6EWQ, K6GQF, K6HLP, K6JPT, K6KVX, K6MV, LU1AB, LU1JH, LU7AZ, NY2AB, OM1TB, OM2AA, OM2RX, PY1AW, VP4JL, VK2DA, VK2FK, VK2OJ, VK2YL, VK3AX, VK3BG, VK3FG, VK3ZB, VK5GL, VK6SA, VK7XL, X1CM, X1DC, X1FQ, X2A, X2BJ, X2V, ZL1AO, ZL1AR, ZL2CI, ZL2CY, ZL2FN, ZL2JA, ZL2LT, ZL2NC, ZL3AN, ZL3CM, ZL3FG, ZS1Z, ZS2A, ZT1H.

●●●

Calls Heard By W8DVS, Ambridge, Penn.

Between November 15 and December 6

Worked	Heard
8C	CN8MP
HB9N	GI6TK
HJ3AJH	HAF8D
J2HG	J2GX
ON4CUU	K7ZZK
ON4LX	KX3
SP1CO	LA4U
VQ3BAL	OH8NB
ZE1JF	SP1LM
ZS1C	U1BL
ZS2A	VQ8A
ZS6AA	ZE1JJ
ZT6A	ZS1H
ZT6N	ZS4U
ZU1X	ZS6M
ZU6M	ZT1Z

Amateur News

IRF Rehabilitation Plan

● The first of these plans was announced last month. Briefly, it consists of educating our law makers as to what amateur radio is and the true function of the amateur; this to be accomplished by actual d monstration of representative good amateur st tions and operators which IRF is equipped to provide. Amateur phone will be used to a great extent in this program.

Movements as great as this one cannot be duplicated in a proverbial day. It takes time and often too-rap d progress is detrimental. With this in mind, the coming year of IRF will undoubtedly see a strengthening of the lines and a perfecting of the gr t plan it has conceived. It does not seem unreasonable to be most optimistic as to the future of IRF and its promulgation of the New Deal in ama ur radio. Whether amateur radio is bettered and greatly improved directly, by the IRF plan, or causes others to accomplish the same purpose, makes little difference. As long as amateur radio is restored to its place in the sun, those who conceived the plan will feel that their work was not in vain.

IRF Contest

● A cont for the largest number of IRF QSO's will be in Test during the third week of April, startin A l 14th, Sunday, 10:00 a.m. PST, and finishin l 21st, Sunday, 10:00 p.m. PST. All IRF men urged to participate in the contest, in ord r how the radio world that IRF is a strong f nity and world wide. At the conclusion contest, contestants will send in their li QSO's to IRF headquarters, this list to be o out of the log, showing time, call, report, t Messages are unnecessary. A substantial pr will be awarded the winner as soon as the li are judged. IRF men will be sent further r of the contest.

The Mike and Key Club, Elyria, Ohio

The Fou Annual Hamfest sponsored by the Mike an y Club is to be held Sunday, February 24th t the Masonic Auditorium in Lorain, Ohio.

Reservat s are being made by radio amateurs from ll tions of Northern Ohio, and present indications that the attendance will reach two hundred, including the speakers and entertainers.

Second Annual "Ham Dance"

The Se d Annual Ham Dance and Entertainment spons d by the Mid-West Mart will be held in the Congress Hotel, Saturday evening, March 30th, and all indications point to a record crowd.

Master of Ceremonies will be John O'Hara, well known amat ur and station announcer.

David D y has arranged a most complete program in luding a very entertaining stage show.

Prizes a ounting to over $5,000 will be given to the holders of the lucky tickets.

A special prize will be awarded to the "Ham" coming fr the most distant point.

Her is o opportunity to meet all the QSLs you have made, but have never met personally.

Prizes h v been donated by the following:

Aerovox, Arcturus, Bliley, Allen D. Cardwell, Centralab, Cornell Dubilier, Raytheon, Electrad, Carter Motor Co., Hygrade Sylvania, Lenz Electric, Lynch Mfg. Co., Magnavox, McMurdo Silver, Ohmite, R dio, Crowe Name Plate, Sangamo, Thordarson, Burgess Battery, Continental Carbon, Universal Mi rophone, General Mfg. Co., Yaxley Mfg. Co., and many others.

Your local club can get full particulars by writing to the Mid-West Radio Mart of 520 S. State St., Chicago.

DX News

Feb. 14, 1935.

Editor, "RADIO"
Pacific Building,
San Francisco, California.

Dear OM:

Have a little DX news which may be of interest to you.

On February 12, 1935, I had the extraordinarily rare good luck to work Australia, South Africa, and Japan within a period of three hours. This was done on 14 MC, in the late afternoon. It is believed t this is somewhat of a record for these parts, speaking of the first and second districts. Districts to the west and to the south of the second are, of course, not affected by quite the same adverse conditions as are the first and second districts.

As you know Asia is our greatest stumbling block. Even to hear an Asian was something to talk about until a short time ago. It was only about a year and a half ago that any South Africans could be heard on 14 MC. Although Australia is easily worked on 7 MC, VK signals on 14 MC are about as rare as J's. Only a few have been heard at this station in several years, and then only in the early morning.

Conditions have changed greatly in the last two years. Now it is no trouble at all to work South Africans in the afternoon hours, on 14 MC. Lately J2HG, on 14 MC, has been coming in here almost every evening around 5:30 p.m., EST, with fair strength. He is generally good for only about 20 minutes or a half hour, but when conditions are exceptional he stays in for periods up to an hour and a half. Although we have no schedule I have been able to work him with fair regularity.

At 3 o'clock on the afternoon of Feb. 12, I was quite surprised to hear VK4GK calling "CQ". I had just turned on my receiver. I got him on the first call. He was quite strong, and was still coming in good over an hour after I worked him. Got him at 3:11. ZS6AL came next, at 4:43, and then J2HG, at 6:07. I think it very rarely happens that these widely separated countries come in here at the same time on 14 MC, and it is even more rare to have the good luck to hook them. Hi! Best wishes, 73.

Sincerely yours,
Arthur M. Braaten, W2BSR.

Macon's Radio Man Is Lauded In Senate

"Greater Love Hath No Man Than This . . ."

The affairs of government were cast aside on Capitol Hill in Washington as solemn visaged senators heard the story of a man who laid down his life for his friends.

The story of Ernest E. Dailey, radio operator, who, by his cool headed heroism, saved the lives of eighty-one officers and men when the Macon crashed into the sea off Point Sur, became, for a time, more important than all the politics and problems of the nation.

Johnson Speaks

The story was told when Senator Hiram Johnson asked Congress to insure the future of the widow of the heroic radioman. Senator Johnson introduced a bill to pay a pension of $100 per month to Mrs. Dailey instead of the $20 which she would receive under present regulations.

"Radioman Dailey," Senator Johnson declared, "met his death heroically in the performance of his duty and his widow should not be left in need."

Behind the story of Radioman Dailey is a story of wifely fortitude which is blazoned across the history of the naval service.

Tuesday Night

It is the night of Tuesday, February 12. At Sunnyvale the wives and sisters of the members of the crew are awaiting the return of the queen of the skies from maneuvers at sea with the fleet.

Suddenly, out of the dusk, comes a calm message from the Macon. It is brief, terse, but it is filled with tragedy. "Falling", it said. The message was being calmly transmitted on the Macon's radio by Radioman Dailey.

A moment later there is another message, like the first calm, terse, but complete, giving the exact position of the giant dirigible. The women of the air base rush to headquarters, among them Mrs. Dailey, an expectant mother.

Wives Talked

She converses with the other wives. They are told of conversation between officials of the naval district here and Admiral J. M. Reeves with the fleet. There is a hopeful message and they are buoyed up in spirit. Only two men have been lost.

Then, laboriously, comes the message containing the names of the survivors. Eagerly, Mrs. Dailey and the other wives scan the list. Then—tragedy for this wife. The name of her husband is not included among those saved. It was more than she could stand and she collapsed.

It was not until the next day that she learned of the great heroism of her husband. He had stuck to his post sending the Macon's position until it was too late to save himself and he had leaped into the water. In the plunge he turned over and struck on his back, breaking it.

Only last fall had she become the bride of Radioman Dailey. The future was dark for her. His pay had been small, for he was but an enlisted man.

That is the story which lay behind the action of Senator Johnson in the Senate. The future of a hero's wife must be insured.

—A.P.

Stockton Hamfest Writes New Chapter In Amateur Radio History

To the officers and members of the Stockton Amateur Radio Club of Stockton, California, goes the credit for conducting one of amateur radio's most lively and colorful hamfests.

It was the first of California's "free lance" hamfests, having no affiliation with any national amateur radio organization. Thus the political meeting was thrown open to all, and a red-hot debate was staged. No words were minced in telling the amateurs what must be done to safeguard their interests at Cairo. A plan was suggested for united effort by other free-thinking amateur radio clubs throughout the nation so that the unorganized majority can play an important part in the protection of amateur privileges. The Stockton Club welcomes communications from other groups of radio amateurs who are seriously interested in joining the great drive to carry the plight of the radio amateur to the floor of Congress.

Wild enthusiasm was displayed when Pacific Division's Director Culver scored interference by foreign powers with American amateur radio privileges. He called upon the American radio amateur to do his part to help make his own air a safe place in which to operate.

Highlights of the Hamfest

Largest attendance of any similar affair staged in a remotely-located city. Banquet hall filled to overflowing.

Out-of-state visitors.

Naughty burlesque show.

Blushing YLs and YFs who got an orful earful.

Colonel Foster's reply to the "gentleman from Sacramento".

Frank C. Jones' announcement that a new BFO and crystal filter circuit will be shown next month.

Expression of delight on face of brand new ham who won HK-354 Gammatron.

Embarrassing position of publisher of "RADIO" when his ticket was drawn as winner of capital prize complete National FBXA with speaker and accessories.

Sigh of relief by entire audience when publisher requested re-drawing for the prize.

Cruel twist of fate when same publisher draws another winning ticket later in the evening.

Sidelights

YL in the rear left corner who wrote down the jokes of the naughty comedian.

Jarenay's absence from the meeting because he heard that Jean Harlowe would be in Carmel on same night.

Look of disgust on Goodman's face when ham comedian swiped his favorite blindfold act.

Lack of invitations to take chorus girls home.

Calls Heard by W9FLM, W. A. Craig, Jan. 5 to Feb. 11, Prophetstown, Ill.

7 MC

CE3EL, EA1BB, EA3EG, EA4BM, EA8AE, F3AL, F8ZE, J2CL, J2GX, J2KA, J2KP, J2KS, J2LC, J2LO, J3FK, KA1SX, K6CGK, K6GQF, K6HLP, K6JPT, K6KTF, K6KVX, K6LBR, K6LEJ, K6MV, OM2AA, OM2RX, PY1(W, VK2NL, VK2NJ, VK2EL, VK2MY, VK3VL, VK3DM, VK3AX, VK3KX, VK6FO, ZS2A, ZS6AM, ZT1H, ZU6B.

14 MC

CT1BY, D4BAO, D4BHH, D4BBN, FB8C, F8WB, F2FC, F8RJ, F8EO, G2PL, G2RQ, G2BH, G2BY, G2DI, G2HG, G2SX, G5BY, G5BD, G5YH, G5SR, G6BS, G6HP, G6NJ, G6QP, G6QB, G6KP, G6NH, G6WU, G6RH, GI5MZ, HJ3AJH, K7DVF, OK1FK, ON4CMY, ON4CSL, ON4HM, ON4CJJ, PA0LU, PA0LR, PA0CE, PA0FP, PA0WR, VP4JL, VQ4CRP, VQ4CRH, VQ8A, ZE2AZ, ZS6AL, ZS6M, ZU6E.

Calls Heard by W9PAO Dec. 12 to Feb. 15

7 MC

B4UP, HJDA, CM2FA, CM2OP, CM2DO, CM8AA, CM2AS, CM2PW, VK2EO, VK2OJ, VK2HZ, VK2UO, VK2DA, VK2VQ, VK2XV, VK2AZ, VK2EL, VK2KN, VK2TA, VK2LA, VK2KO, VK2WU, VK3BQ, VK3DP, VK3OL, VK3ZQ, VK3NQ, VK3GU, VK3BS, VK3XF, VK3MR, VK3UK, VK4RN, VK4AP, KV5ML, VK5GL, VK6MI, VK6MN, VK6FO, VK7JB, VK7XL, X1CZ, X1D, X2O, X2T, X2F, X2L, Z2BG, K6LEJ, K6KVX, K6GQF, K6EWQ, K6KPJ, K6KFB (W6) K5AA, K5AF, K5AM, K5AT, K5AY, NY1AB, KA1HR, OM1TB, LU7AZ, LU1ZA, LU5BL, LU6DJK, LU1DA, ZL4CK, ZL2DW, ZL3ES, ZL1DI, ZL2FR, ZL2NC, ZL3AN, ZL2LG, ZL4AI, ZL3FM, ZL3CU, K7ZZK, EA4AO, EA1BB, TI2RC (FONE), PY1AW, CE5AA, CE3EL, ZU6P, ZU6B, Z52A, VP4JR, OA4O, D4CDA, J2LK, J2LO, HC1FG (FONE).

14 MC

ON4AL, ON4AU, G5YH, G2HG, G5TZ, G2BM, G2SX, G2HX, G6NB, G6AS, G2OA, VP4AA, VP5PZ, VP5AB, F8EO, YN1BX, CM2FL, K5AA, K5AG, K5AF, NY1AB, NY2AB, X1AM, X1W (FONE) HI7G (FONE), OA4V, OA4U, ZS1H, S2GX, HJ3ABK, ON4CSL, VQ4CRP.

Calls Heard by G6ZU

R. H. Jackson, 54 Prine's St., Stockport, Chesire, England.)

October to December, 1934.

W6ADP, W6BVX, W6BYU, W6BIP, W6CXW, W6ZL, W6GRX, W6HJT, W6LFL, W6RZ, W7AYQ.

The Lafayette B-46 Modulator Unit

A Companion Unit for the Model P-46 40-Watt Transmitter

By FRANK LESTER*

● The Lafayette Model P-46 30-watt transmitter, using the 2B6 exciter circuit and inexpensive parallel 46s in the output stage, as described in the previous issue, has already achieved popularity among amateurs because of its reliable electrical design and its simple, compact construction. Readers will recall that the circuit uses a 2B6 double-triode as crystal oscillator and buffer or doubler, 46 amplifier and parallel 46s in the final. The entire outfit, including power supply, is built into an attractive steel table style cabinet measuring 19 by 12 by 8¾ inches.

With the presentation of this transmitter came an immediate demand for a modulator unit for use on the 20, 75, and 160-meter phone bands. Accordingly, the same cabinet was used and several experimental circuits laid out for trial. The final layout, selected after thorough test in the laboratory and actual trial on the air, is shown in the accompanying diagram. The unit is known as the Lafayette Model B-46 Modulator.

Five tubes plus rectifier are used. The first is a 57 used as a high-gain pentode, resistance-capacity coupled to a 56. The potentiometer-grid leak R3, in the grid circuit of the latter, functions as gain or volume control. The 56 is transformer coupled to a 46 used as a triode, with the No. 2 grid tied to the plate. The plate of the 56 is shunt-fed through the resistor R7. The blocking condenser C5 keeps the DC out of the primary winding of the transformer T1, at the same time permitting the audio frequency component of the plate current (representing the amplified microphone current) to pass to the primary for further amplification.

The two 46s in the output stage function as class B amplifiers, the two grids being connected together in each tube. The secondary of the output transformer T3 connects merely to the two posts marked "MOD" in the transmitter; i.e., directly in the plate circuit of the final amplifier. A 0-300 MA milliammeter acts as a visual modulation indicator.

The power supply consists of the transformer T4, an 83 mercury-vapor rectifier, the chokes T5 and T6, the filter condenser C9 and C10 and the bleeder resistor R10. Filament current for the tubes is provided by two low voltage windings on T4. The 83 rectifier, with its low internal voltage drop of only 15 volts, gives the power pack the good regulation necessary for class B service, with its widely varying current requirements.

The 57, the 56 and the first 46 receive their plate voltage through individual series dropping resistors, R5, R8 and R9 respectively. These also function as decoupling resistors and completely prevent coupling effects through the common power supply. The bypass condensers C1, C2, C6 and C7 chase the AF plate current components back to cathode or filament. These simple precautions give the entire amplifier a rock-bound stability that is reflected in its beautifully-clean operation.

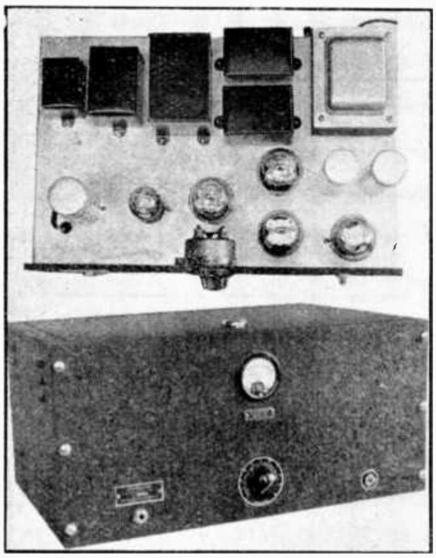
Because crystal microphones are now relatively inexpensive and their quality and convenience make them ideal for amateur purposes, this modulator unit was designed for them. The mike is simply hooked across the input posts and that's all there's to it; no messing with pre-amplifiers or anything else.

The overall gain of this modulator unit is 110 Db, with a hum level of minus 50 Db. The frequency response, as determined by test with the RCA beat frequency oscillator, is uniform to plus or minus 1½ Db. from 60 to 17,000 cycles. While this is in excess of amateur requirements, it assures the user of absolutely perfect modulation in the voice frequency stage. "Broadcast quality", the goal of every phone ham, is easily achieved with this outfit.

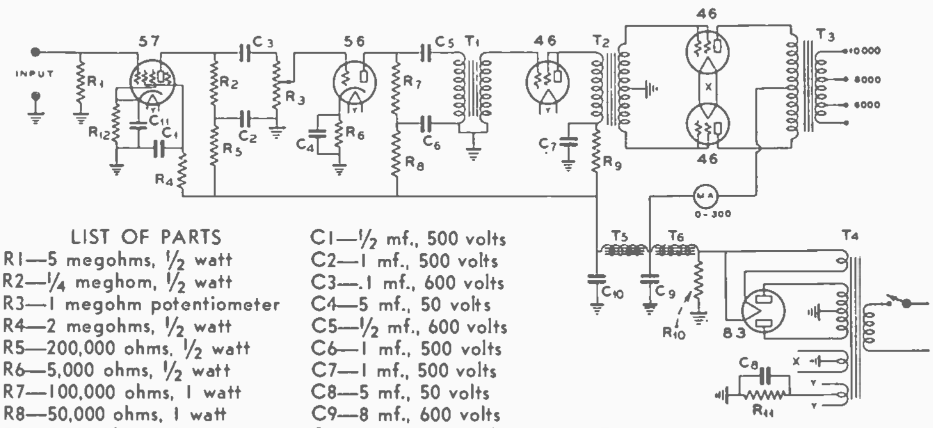
The mechanical construction of the modulator unit is made clear in the accompanying photographs. The heavy audio units, transformers and chokes, are lined up along the back of the chassis, with the tubes in front. Note that the 57 is fitted with a shield to cut down external noise pick-up, which can be serious with a high-gain amplifier.

In the center of the front panel are the plate milliammeter and the gain control. On the left, the microphone jack; on the right, the line switch.

The electrical values of all parts are given in the accompanying table.



Interior and Exterior Views of the Modulator Unit



LIST OF PARTS

R1—5 megohms, ½ watt	C1—½ mf., 500 volts	
R2—¼ meghom, ½ watt	C2—1 mf., 500 volts	
R3—1 megohm potentiometer	C3—.1 mf., 600 volts	
R4—2 megohms, ½ watt	C4—5 mf., 50 volts	
R5—200,000 ohms, ½ watt	C5—½ mf., 600 volts	
R6—5,000 ohms, ½ watt	C6—1 mf., 500 volts	
R7—100,000 ohms, 1 watt	C7—1 mf., 500 volts	
R8—50,000 ohms, 1 watt	C8—5 mf., 50 volts	
R9—5,000 ohms, 20 watts	C9—8 mf., 600 volts	
R10—30,000 ohms, 50 watts	C10—8 mf., 600 volts	T3—Class B output trans.
R11—1,500 ohms, 1 watt	C11—5 mf., 50 volts	T4—Power transformer
R12—5,000 ohms, ½ watt	T1—Interstage AF trans.	T5—15 henry filter chokes
	T2—Class B input trans.	T6—15 henry filter chokes

* Engineer, Wholesale Radio Service Co., Inc.

5-Meter Auto Set

(Continued from page 11)

soldering lugs. Once its correct length is determined it can be coated along one side with Duco cement to be sure that it will retain its proper inductance.

The semi-variable coupling condensers, marked 3-30 mmfd in the circuit, can be the small compression type condensers with mica spacers. The one on the transmitter (for maximum frequency stability), should be an air spaced plate variable condenser with screwdriver slot adjustment. The main oscillator tuning condenser can be either dial or screwdriver slot controlled. Since this circuit uses a TNT circuit with resonant untuned grid coil, it will give maximum results over only about two MC. The 15 turn coil specified is for use around 58 to 60 MC.

This set is to be used with a dynamotor for power supply from the car 6-volt battery. A microphone filter is built into the dynamotor and consists of a 100 ohm resistor and a 20 mfd 25 volt electrolytic condenser. The latter provides a return path for the voice frequencies, while the 100 ohm resistor acts as an impedance to noise from the common battery supply. The circuit is shown for use in a car with "plus" terminal grounded to the car frame. If the negative terminal is grounded, this 20 mfd electrolytic condenser would have to be reversed in polarity. 5-meter RF chokes would be necessary at the dynamotor to prevent excessive receiver noise also.

A built-in five-inch magnetic loudspeaker is incorporated so as to eliminate the need of wearing a telephone headset while driving. As can be seen from the pictures, the set was built into a very narrow steel can for the purpose of mounting it on the under side of the car roof. The outside dimensions of this can are 3-in. by 11-in. by 12-in. and the back cover fastens by screws to ribs in the car roof. The set can be mounted in back of the windshield, where the send-receive switch and controls will be convenient to the driver's right hand. This also puts the loudspeaker in a good position. The mike is a W.E. 266 watchcase type, which can be gripped in the right hand and still leave one's forefinger and thumb free for use in switching or tuning the set. This eliminates the need of a remote control tuning and volume control, as well as a send-receive relay.

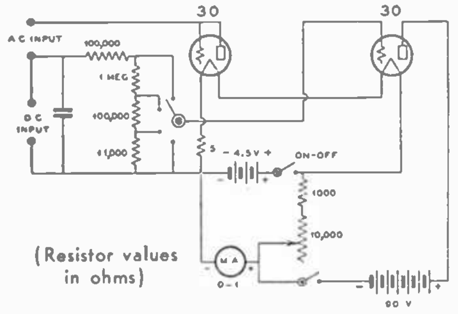
A Simple Vacuum-Tube Voltmeter

By FRANK C. JONES

● A vacuum tube voltmeter has many uses in an amateur or service laboratory. It can be used to measure AC voltages of any frequency from 30 cycles up, through the audio range, and also the RF frequency ranges. It is also useful for determining the audio response of an amplifier, a radio receiver, the gain of an audio or radio frequency amplifier. It can even be used to measure percentage of modulation of a phone transmitter or to run the frequency characteristic of the latter. Next month a simple full-wave linear rectifier will be shown which, when used with the peak voltmeter here described, can be used to measure both the "up" and "down" sides of a modulated carrier signal.

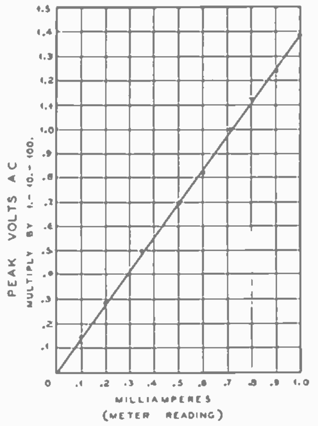
The vacuum tube voltmeter here shown uses a peak voltage rectifier of the diode type and a DC amplifier to enable the use of a 0-1 milliammeter for reading low voltages. The diode type has several advantages over the plate rectifier type. It is linear, not square law. Thus the meter scale can be direct reading. The diode measures peak voltage if the D.C. load is at least a megohm. This load can be divided-up into a resistance divider for multirange use. That is, the voltmeter can be used to cover from a small fraction of a volt to over a hundred volts by means of a multiplier switch which will not affect the input circuit. An ordinary milliammeter can be used instead of the costly miscroammeter, such as is used in the less sensitive plate rectifier type. Its one disadvantage is that it acts as a slight load on the circuit across which it is connected. For over 90% of all needs, this slight load is of no importance, and thus its other advantage can be utilized.

The circuit consists of two type 30 tubes connected as shown. One tube acts as a diode peak rectifier and the other as a simple, foolproof, DC amplifier. The latter by itself, through an extra binding post on the panel, acts as a DC voltmeter over the range



of from a fraction of a volt up to 100 volts. This DC connection draws less than 0.1 ma load for 100 volts impressed, and in the one volt range the load drawn is less than a microampere. This makes it useful in measuring DC voltages where no appreciable load can be allowed, such as the voltage developed by AVC in a radio receiver.

In the particular meter here illustrated, the resistances, tubes and battery voltages are such that for practical purposes the scale is direct reading. The multiplier can be marked 1, 10, and 100 and the scale deflection multiplied by those values for either DC or RMS voltage. The error is not over 6%. For actual peak values of AC voltage



the scale reading must be multiplied by 1.4. Over a period of time this form of voltmeter should not be relied upon for better than ± 10% accuracy because of tube and battery age. For any individual set of measurements a calibration can be made, although generally the relative ratio of voltages is the important thing. The voltmeter is accurate for this purpose.

The resistances used as a multiplier should be fairly accurate, certainly not less than 5% error can be tolerated in their values. Any form of rotary single-pole switch can be used for switching the grid of the DC amplifier tube along the points of the multiplier. This swich should have no dead positions between points, otherwise it will leave the grid circuit open. It should have good bakelite insulation so as to avoid leakage.

The 10,000 ohm resistor should be set so as to put the metal needle to zero when there is no impressed AC voltage. This resistor makes use of the 4½ volt A battery as a bucking battery to balance out the steady current drawn by the DC amplifier from the 90 volt B battery. This tube should operate as a linear amplifier in order to keep the calibration linear, or direct reading on the meter scale

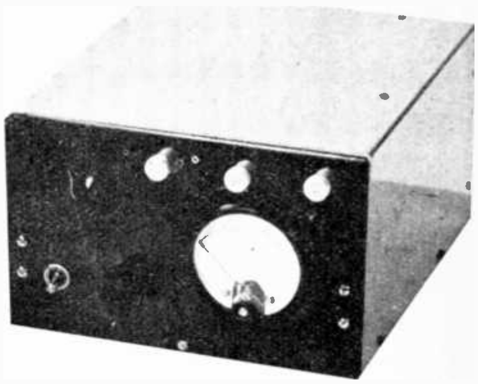
The 5 ohm filament resistor provides about a quarter volt negative bias on the diode to prevent current from flowing in the multiplier resistors when no AC voltage is impressed. This makes the 10,000 ohm resistor control setting practically constant for any step on the multiplier.

Needless to say, the polarity of the batteries and the milliammeter should be exactly as shown. If any trouble is had from inability to set the meter to exactly zero with the variable 10,000 ohm resistor, a vernier adjustment can be added by putting a 200 ohm variable resistor in series with the 10,000 ohm resistor. The battery switch should preferably be a DPST switch in order to open-up the plate circuit at the same time the filament and bucking battery circuit is opened. A 1000 ohm resistor in series with the 10,000 ohm variable resistor limits the current drawn from the bucking battery so as to prevent meter burn-out if this control is advanced too far for a short time.

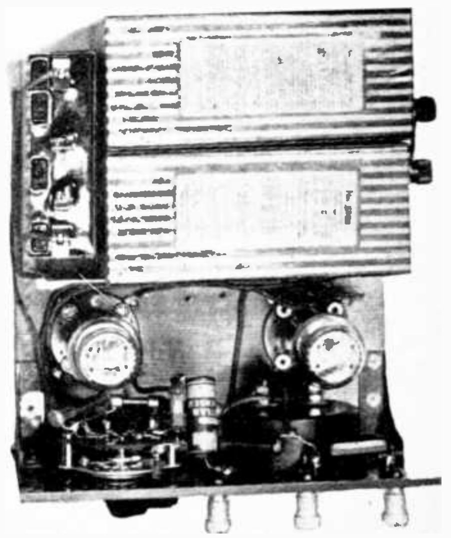
A bakelite front panel is used to simplify insulation problems. It measures 5x8x3/16 inches and is mounted at right angles to a wooden baseboard. The latter holds the tubes and batteries, as shown. The aluminum cover is 5x9 inches and serves to protect the instrument from dust and breakage.

In using this VT voltmeter it is necessary to have a DC path through the circuit under measurement. Most circuit measurements provide such a path, although occasionally a path must be provided by means of the secondary of an audio transformer for audio frequency measurements, or an RF choke for RF measurements. In such cases, the choke should shunt the AC input binding posts. The DC path resistance of the circuit under measurement can be as high as 50,000 ohms without affecting the calibration of the VT voltmeter.

This meter is useful in lining-up a radio receiver. It can be connected across the last IF coil or across the audio amplifier, and a modulated oscillator used as a signal generator. It is possible to check either stage of a receiver in order to locate trouble. The uses of such an instrument in connection with audio amplifiers has been covered thoroughly in most all radio books and it can easily be the most useful piece of equipment in an experimenter's possession.



Views of the Completed Instrument.



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SCRATCHI

Osockme, Japan.
January 23, 1935.

Editor of Free Prize
Department of "RADIO",
Dear Ed:—

This are hamfest seasons of year, and Scratchi find numerous and many invitations in male box for requests of presence at attendance at such. Cost for tickets very from two $ and reverse. Such hamfest each try to undo and outdo one and each other until time soon come when radio manufacturers will be asked to donate entire year production of parts to give away in form of free prizes. One manufacturer have writ me private personal letters some weeks hence in which he ask for my humbling opinion as to solution of problem. I make answer to him far better to go into automobile manufacturing business because people who go to automobile meetings are not given free cars as prizes every time crowd get together for hamfest and drinks.

It are beyond reason of Scratchi brain scope to see into dense scheme where radio manufacturers are required to give next year's dividends in form of radio parts to each of several hundred hamfests which are held about in all cities so often that special calenders are soon make publish to show with red circles each day of month on which some hamfest are not held somewhere someplace, at some time or in future.

Scratchi have make round about tour of radio shops to solicit prizes from store owners. I were make chairman goat for big hamfest here in Osockme. First dealer I go to tell me he cannot give me free prize because he are superstitious people and are afraid that prize winner will come back to his store and try to sell prize back to him for more than dealer paid for it.

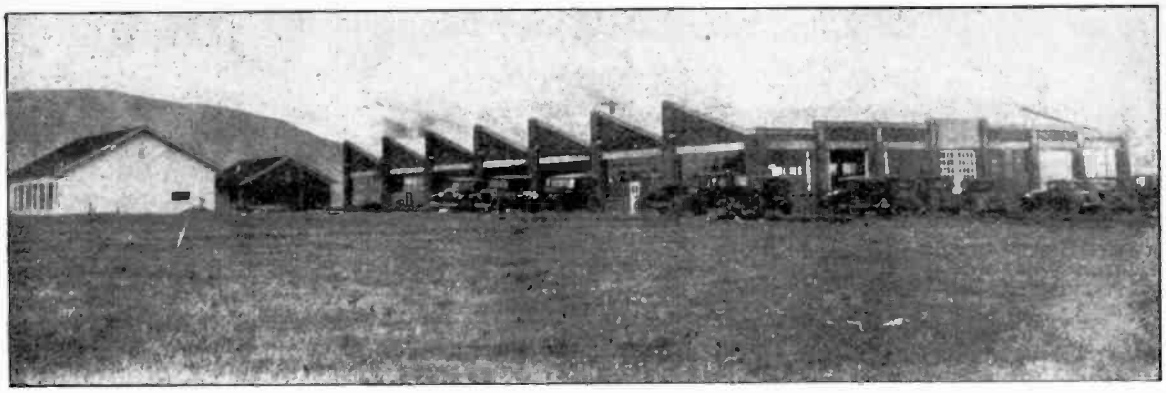
Next dealer I go to call me all kinds of names which I read once in my Bible, but which do not sound so good when come from husky lungs of angry dealer. Another dealer are more good friendly person. He take me into private office and ask me what I want. I give him long list of special prizes of great value and he tell me he will take matter up and under consideration. So he open up bottle of juice of the grape and we drink from such. We then drain contents from bottle of rare old Scotch, which his brother-in-law make in spare time at home. Next we make drink from long neck, false bottom bottles of eight star McIlroy and soon we begin feel pretty friendly. Dealer then bring out inventory sheets and show me how great are his business for month just past. Column on right of ledger show that eleven hundred dollars are taken in for sale of parts to radio hams, and column on left show that he give away twelve hundred dollars for hamfest prizes. So he ask me what are secrets of success in radio store business when it cost one hundred dollars more for prizes for hamfests than he take in in cash. To wich I reply with toothsome smile, such question are riddle for income tack collector to solve.

M think he are trying to give me bum's rush, so I ask him again for free prizes. He answer by opening up another bottle of spirits of corn. We drink from such. Scratchi are not drinking man. He have never have more than two drinks at one time together. He pour another. Scratchi make protest. But he hold beautiful $300 crystal microphone near my face and shake it in front of me. Such are great temptation, so Scratchi take another drink. He then produce huge carton of assorted high power tubes and shake them up in front of me. Scratchi take another drink. He next bring out magnificent assortment of AT-cut quartz crystals. Such are Scratchi's weakness. So Scratchi take another drink.

Hamfest are going to be huge and glorious success, methinks why not? So he pour contents of one more bottle into me. He tell me he will soon call express wagon to take hamfest prizes and me home together. By time that express wagon arrive, Scratchi are half way on road to Limbo. I are so full of happiness I bubble inside and outside. Dealer friend give rapid instructions to store clerk to carefully wrap up large assortment of prizes for Scratchi to take homeward. While clerk are wrapping such prizes, Scratchi hear sounds that are like glass clicking together. Ah, think I, such are assortment of large power tubes which dealer will donate. So Scratchi take another drink. Success are closer at hand.

Dealer friend walk in with huge package under his arm and hand to express-man. Scratchi are overcome with great happiness and chuckle forth

(Continued on page 28)



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Stubbs Electric Company, Park and Couch Streets

ST. PAUL, MINN.
Lew Bonn Company, 2484-2486 University Avenue, Midway

NEW YORK, N. Y.
Wholesale Radio Service Company, Inc., 100 - 6th Avenue

YOUNGSTOWN, OHIO
Ross Radio Company, 46 E. Federal St.

NEWARK, N. J.
Kalter & Romander, 62 Court Street

SAN FRANCISCO
I. S. Cohen's Sons, 1025 Market Street
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OAKLAND
Electric Supply, 51 - 12th St.
E. C. Wenger, 1020 Oak St.

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LOS ANGELES
Pacific Radio Exchange, 729 South Main Street
Radio Supply Company, 912 South Broadway

SEATTLE, WASH.
Seattle Radio Supply, 2319 2nd Avenue
Northern Radio Company, Joseph Vance Bldg.

SCRATCHI

(Continued from page 26)

and fifth with delirious words of kindness and thanks for dealer friend. So he give me another drink.

And when I wake up in my home several days thereafter and look around me, I make wonder where I have been in my past absence. I recall I have make visit to dealer store for hamfest prizes. Lo and be hold and be dropped, I see in corner of room huge package which dealer friend hand to express man when he take me and hamfest prizes home in company together. He are my pal, he are my pal, I shout with glee. He fill me full of liquor spirits, he send me home in express wagon, and he send along great package of hamfest prizes.

I quickly open large bundle to see what make and type of power tubes he give for prize. What do I find? Fourteen empty liquor bottles and a bill for $12 for liquor I consume in his store.

I make rapid foot to dealer store and demand explanation for such joke. Dealer friend say it are no joke and he inform me that he have long since gone out of radio business because he were forced to give away more prizes for hamfests than merchandise he sell in each year. He say he keep radio store sign on front door only as lifetime reminder to him to show him how much more profits there are in liquor business than in running radio store.

As I make say more previously, Hon. Ed., he are my pal, he are my pal. Hoping you will always be the same, I am,

Your Hamfest Prize Promotor,
Hashafisti Scratchi.

The Single Tube 35-19 Transceiver

(Continued from page 11)

monitor the speech. This circuit is so simple that two sets can easily be built for duplex operation, using one as a receiver and the other only as a transmitter. A 6.3 volt pilot lamp is a useful tool for testing this set. A single turn of wire about an inch in diameter enables this lamp to be coupled to the oscillator coil. It should light up when testing the transmitter; when the mike is spoken into loudly, the lamp should become somewhat dimmer. Too-loose coupling will give no modulation and too high coupling will cause the transmitter to stop oscillating due to excessive absorption modulation. A low resistance single button microphone should be used.

An Efficient Condenser Analyzer

By GLENN H. BROWNING

SOME time has been spent in making a survey of the serviceman's problem to determine what apparatus is the cause of most of his calls. The answer seems to be that condensers and resistors probably cause more trouble than any other of the component parts of the radio receiver. Most servicemen even though technically trained do not have apparatus which will quickly and conclusively give them indications of the actual conditions of various types of condenser. With these facts in mind, the Tobe Deutschmann Corporation started developments on an instrument which would give positive indications on various types of capacitors commonly employed and thus materially reduce the time taken in locating and repairing faults.

There are many simple tests for determining whether or not condensers are open-circuited or short-circuited, but in most of these tests, the voltage applied to the condenser is much below its operating voltage and, consequently, does not give conclusive proof as to whether or not the condenser is defective. The writer has tested many condensers at low voltage which appeared to be satisfactory though these same condensers when tested at oprating voltages had a resistance low enough to condemn them. The above statement holds true for either solid dielectric type—such as the ordinary paper impregnated condenser—or electrolytic condensers.

As most condensers have a DC voltage impressed across them, it would seem logical to employ a DC test voltage. A satisfactory test for most solid and electrolytics may be made by measuring the leakage current, or the resistance, at—or slightly below—their rated potential. If a condenser has too low a leakage resistance it means that the dielectric is poor and that either deterioration has set in due to moisture, chemical action or carbonization, or that the original materials were not high grade. The leakage resistance of a condenser itself, however, must not be confused with the leakage over the surface of the dielectric used to support the terminals. This on damp, humid days may be in itself a considerable amount compared to the leakage through the dielectric of a solid condenser. Figure 1 shows the two leakage paths. The capacity of the condenser we shall assume to be 1 Mfd. It is a solid dielectric condenser. Therefore, the leakage resistance through the dielectric itself (R2) should be over 25 megohms. On damp days R1, the leakage over the bakelite supporting the terminal lugs might be as low as 10 megohms, so that the total resistance of the cased condenser would be a trifle less than 10 megohms. However, on a dry day the resistance of the condenser would be 25 megohms.

If the resistance of the dielectric in a solid condenser as exemplified by R2 drops below 5 to 10 megohms, breakdown is almost sure to follow if the condenser is being operated at a voltage near that for which it is rated, and thus is a good criterion as to its condition.

This same argument holds true for electrolytic condensers, even though inherently the leakage of this type is very much higher and therefore the DC resistance a great deal lower. In testing for leakage resistance on this type of condenser, it is even more important to use a test voltage which is approximately the value at which it is being operated.

If this type of condenser has been out of service the leakage will be unusually high when voltage is first applied due to the fact that the anodic film has somewhat dissolved or disintegrated, the film will be reformed upon the application of potential if the condenser is satisfactory. The formation process, however, will take an appreciable length of time varying from a few minutes to a few hours. This salient fact should be kept in mind when testing electrolytic condensers by any method, for otherwise good condensers will be condemned.

There is another factor which will determine the worth of any capacity which is used for by-passing A.C. currents; that is, its power factor. Power factor is really the energy dissipated at a given frequency per unit voltage. It is defined as the watts loss divided by the AC voltage times the AC current through the capacitor. It is essentially an AC measurement and depends on the frequency and voltage applied. It is a very worthwhile criterion, but is difficult to measure at a rated voltage and at the frequencies which are being by-passed by the condenser. Serious consideration was given to this question before the apparatus described was designed.

The fundamental or direct method of measuring resistance is to impress a known voltage and measure the current produced. The resistance is then, of course, the voltage divided by the current. In measuring the DC resistance of a condenser by this method the condenser must first be charged, for at the instant the DC voltage is applied there is a considerable flow of current which is stored up in the condenser itself. In fact this charging current is many, many times the leakage current so that any sensitive current measuring instrument placed in a circuit such as shown in Figure 2 would have to be shorted to prevent its being damaged.

Let R be the leakage resistance of the condenser C which we will assume is 25 megohms. Let the voltage E be 500 volts. After the initial surge of current into the condenser, the total quantity of which is G, the meter key is opened, the current will then be entirely due to the resistance R and its value will be 20 microamperes. The average serviceman does not have, as a rule, either the 500 volts DC or the sensitive meter with which to measure these values. However, there is a much simpler and more effective means of determining these quantities.

Let us consider the circuit shown in Figure 3. E is again 500 Volts DC. R_0 is a limiting resistance of 100,000 ohms so that if the condenser C_1 being tested whose leakage resistance is R_1, is shorted no damage will be done the Neon tube T. C_2 is a condenser across the neon tube. When the voltage is first applied (C_1 and C_2 are in series) the total flow of charging current into the condensers is Q. This quantity of charge develops a voltage across C_1 equal to $E_1 = Q/C_1$ and a voltage across C_2 equal to $E_2 = Q/C_2$. If C_1 and C_2 are equal in capacity E_1 and E_2 will be equal and each will be half of the total voltage E. The action of the neon tube across C_2 will be as follows. As is well known a neon tube has essentially an infinite resistance until the voltage across it reaches a certain critical value whereupon the gas in the tube is said to breakdown giving rise to visible light. When this discharge takes place the resistance of the tube is lowered to a small value. If the potential to which C_2 is raised is above the critical value for the neon tube the tube will flash, thereupon discharging the condenser C_2 to a voltage below the critical value for the neon tube. It should be kept in mind that C_2 is not completely discharged. If there were no leakage in the test condenser the initial flash of the tube would be the final one. However, the leakage R_1 will charge the condenser C_2 to a potential sufficient to again flash the tube. The time taken for this second charge will depend upon the value of the resistance R_1, the larger R_1 the longer the time. By a proper choice of value for C_2 and a given neon tube one flash per second will denote a resistance in the test condenser of say 25 megohms. If the condenser under test is open,

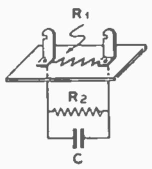


FIG. 1

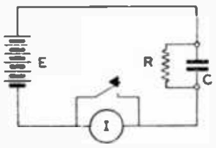


FIG. 2

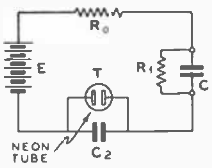


FIG. 3

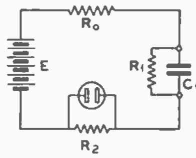


FIG. 4

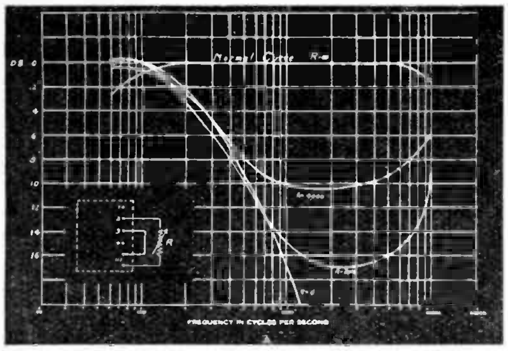
there will be no charging flash of the neon tube, while on the other if it is shorted the tube will glow brightly. If the leakage of the condenser under test is excessive, the tube may glow steadily or flash rapidly according to leakage value. Thus a neon tube and a condenser have been made to take the place of a sensitive meter for testing condensers and actually has a number of advantages over the meter, among which are ruggedness, ability to denote higher resistance than a very sensitive meter, and ability to test a shorted condenser without damage.

There are many details of design which have not been discussed, such as the effect of leakage in the condenser C_2 upon the period of flash, however, the general principles have been disclosed.

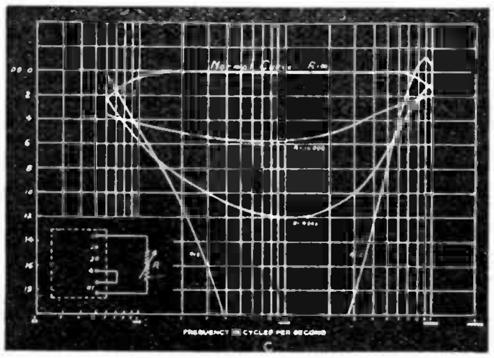
In order to test electrolytic condensers somewhat the same process is applicable, but the circuit arrangement must be changed in order to meet the comparatively high leakage requirements obtained in this type of capacitor. The condenser across the neon tube is replaced with resistance of appropriate values, as shown in Fig 4. When the electrolytic condenser C_1 with a leakage resistance R_1 is placed across the test terminals and the voltage applied as before there is a surge of current into the condenser. This current passes through the resistance R_2 and consequently builds up a voltage across it of R_2 I. This voltage will be higher than the flash voltage of the tube. The leakage in an electrolytic is high and decreases with time. If the leakage current is of sufficient value the neon tube will continue to glow until this leakage current has dropped below a certain critical value determined by R_2 whereupon the tube will be extinguished. Therefore, a good electrolytic condenser being tested in that type of circuit will cause the neon tube to glow for some time and then

(Continued on page 32)

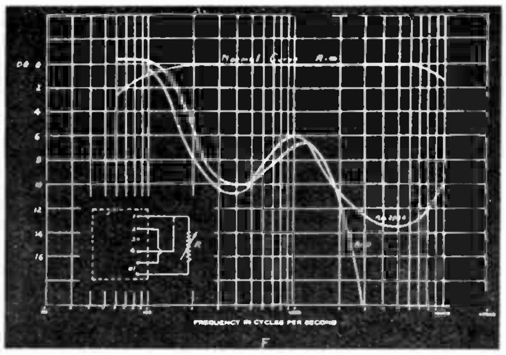
Response Curves Obtainable with the VT-1 or VT-2 Varitone



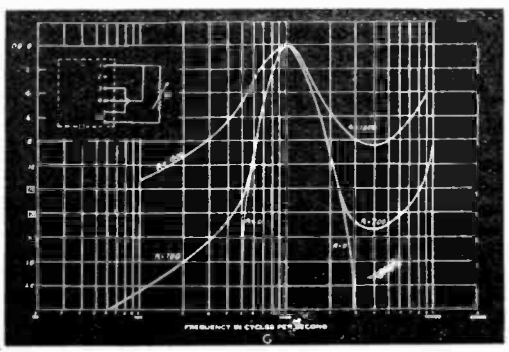
A—The connections and resultant response curve shown above are used where it is desired to bring up the low frequencies.



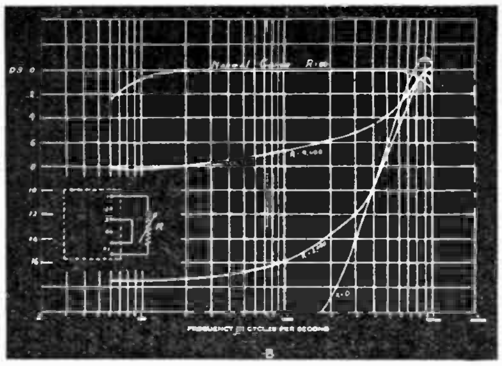
C—This system of connections brings up the low and high frequencies simultaneously.



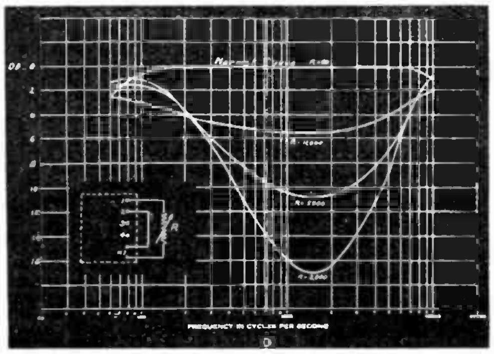
F—Many dynamic speakers, particularly when used with a poorly designed cabinet, have marked reasonance at the low and high frequencies, generally in the vicinity of 400 and 4000 cycles. The system of connections above will absorb these resonances, as shown in the response curves.



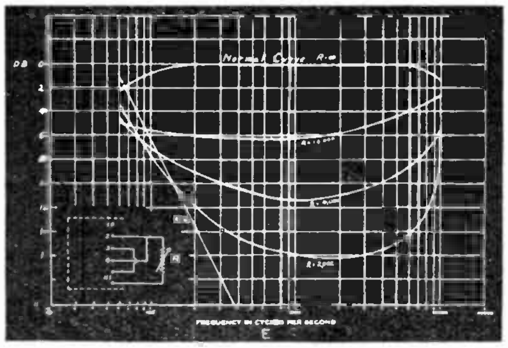
G—This system of connections is generally used with zero resistance. A sharp single frequency filter is effected which eliminates practically all frequencies but 1000 cycles. This is ideal for reception of C W, as static, heterodyne and other QRM are eliminated, affording greater intelligibility and accuracy. This sharp 1000 cycle circuit is also excellent for use with A C bridges. All harmonics, etc., are completely eliminated.



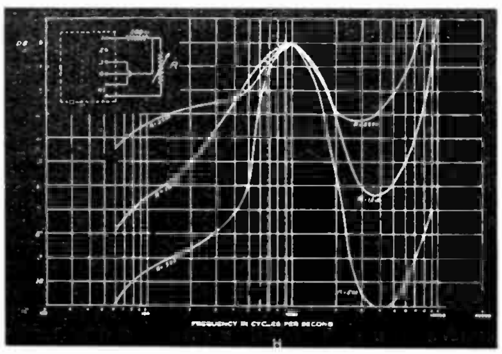
B—The connections and resultant response curve shown above are used where it is desired to bring up the high frequencies.



D—This system of connections brings up the low and high frequencies simultaneously. The equalization is appreciably sharper than in C, the slope of the curve being almost linear on both sides. This circuit is recommended only with an amplifier or receiver whose frequency response is unusually bad, such as a cheap midget radio.



E—This arrangement of connections brings up both highs and lows to a minor extent until almost all resistance is cut out, at which time the low frequencies are brought up sharply.



H—This circuit is ideal for the amateur, or short wave DX fan. The audio frequency range can be reduced to just the essential frequencies for intelligible speech. All extraneous static, whistles, etc., are eliminated. This arrangement of connection is also used frequently where it is desired to demonstrate poor frequency response.

10-Watt 160-Meter Phone Using Low-Cost Tubes

(Continued from page 16)

until the plate circuit draws about 100 milliamperes (50 mills for each tubes). If you are supplying 400 volts to the final stage, and if the meter reads 100 mills, the input is 40 watts. If your power supply delivers only 300 volts to the final stage, the input is 30 watts.

To modulate 40 watts, 20 watts of modulating power is required; 15 watts of modulating power is required for 30 watts of input, etc.

By loosening the antenna coupling, the power input to the final amplifier decreases. You can tell whether or not you are completely modulating the final stage if there is a slight increase in antenna current when you speak into the microphone. Tests with nearby amateurs will be of great help in properly adjusting the entire system.

There are no adjustments of the speech amplifier, other than the correct setting of the gain control for best results. Use a monitor or a nearby receiver to listen to your voice.

The amplifier originally used for this transmitter is designed for operation with a crystal microphone. If a double button microphone is to be used, a microphone transformer and batteries must be connected between the microphone and the first audio tube. If a double button microphone is used, it is always good practice to connect a 10,000 ohm variable resistor in series with the microphone battery circuit so that resistance can be introduced when the microphone is disconnected from the circuit. This resistor is omitted from the circuit diagrams for the sake of simplicity. Before you disconnect the microphone, throw in all of the resistance of the 10,000 ohm resistor; then disconnect the microphone. Thereby the microphone itself is protected because the introduction of resistance in the microphone circuit prevents the carbon microphone granules from arcing or packing. The 10,000 ohm resistor should have a full "OFF" position, so that when the microphone is fully disconnected no battery current will be consumed.

When the microphone is spoken into, the antenna ammeter should rise about 10 per cent for correct modulation. But there should be no variation in current at any other point in the set. The audio channel uses class A modulation and high quality speech is obtained.

In addition to showing the complete circuit diagram of the laboratory transmitter here described, a number of other speech systems will be shown next month. A simplified final amplifier RF stage for straight phone operation is shown on page 15.

The equipment is mounted on aluminum chassis. A beautiful satin finish can be had by buffing the aluminum on a motor-driven wire brush.

●●●

An Efficient Condenser Analyzer

(Continued from page 29)

be extinguished. If the tube continues to glow the leakage is higher than normal, (it is assumed that the leakage at which the tube is extinguished is properly adjusted for the condenser under Test.)

The serviceman and others having occasion to use numerous condensers will find the device described indispensible once having learned to use it properly. In fact continuity of circuits may be readily checked by using the lowest voltage tap; high resistance may be measured; and numerous other uses will be found.

Radiotorial Comment

(Continued from page 5)

But his bands are so overcrowded that the proverbial sardine-can has rooms to let, compared with the conditions in amateur radio bands.

Let us appeal to our Congressmen so that we will be assured of amateur representation on the next Delegation to the International Convention. Let us persuade our Congressmen to help us get amateur representation on the FCC. The FCC is an administrative body. Congress makes the laws, the FCC enforces them. So we must go right to the top—to the lawmakers themselves. And if Congress helps us in our plight, it is only reasonable to assume that there should be amateur representation on the FCC in order to help enforce the laws. We, as amateurs, are people; we are citizens of the United States. We help put Congressmen in office. They, in turn, are willing and anxious to serve.

"RADIO" will throw its support to the League officials in full measure, when its administrative branch is strengthened by the hiring of more-capable men, when the affairs of the League are no longer one-man controlled, when the amateurs are permitted to select their own leaders, by popular vote, just as is common practice among numerous other societies and fraternal orders.

Amateurs who have been active for the past 20 years know what happens when boss-rule and machine politics hold sway in an amateur organization. The bosses roll in wealth, the amateur holds the sack. The big-salaried bosses don't like to admit that Congress is more powerful than they are. So when this true-American campaign of ours is further ridiculed, when you are told it is unwise to hire a paid lobbyist to fight our cause in Washington, always remember that boss-rule goes down to defeat once the public learns that some other agency is more powerful than the bosses, more able to do for the amateur what must be done immediately . . . not next year or two years hence.

Browning 35

(Continued from page 13)

point of maximum response (rotate clockwise as far as possible).

(3) Turn tone control as far counterclockwise as possible without turning off the set.

(4) Set selector switch on either the second or third band. When this is done a hissing noise should be heard from the loud speaker.

The IF transformer which feeds the detector should be aligned first. Its location is given on the drawings as T2. It has already been mounted so that the adjustment screws face out from the chassis. Three of these adjustment screws will be found. The center adjustment screw is the link-tuned circuit and is not connected to either the 58 or the 2A6 tube. This circuit, as well as all the others, has been set at the factory for 456 KC intermediate frequency. The set screw that adjusts this link circuit is in the middle of the transformer. Do not change the the adjustment of this link circuit for tube or lead capacity has no effect on its frequency.

The top and the bottom adjustment screws may be rotated very slightly until the maximum hissing sound is heard. A similar procedure should be followed on T1 remembering not to change the tuning of the link circuit in this transformer which is adjusted by the middle screw. To align T1 the 56 beat-frequency oscillator should be removed from its socket. Then these transformers are brought into alignment a hiss will be heard even with the 58 tube used as an RF amplifier removed from its socket.

The receiver then should be tried out for sensitivity on all bands. On the 4th band a distinct reduction in noise, even with the

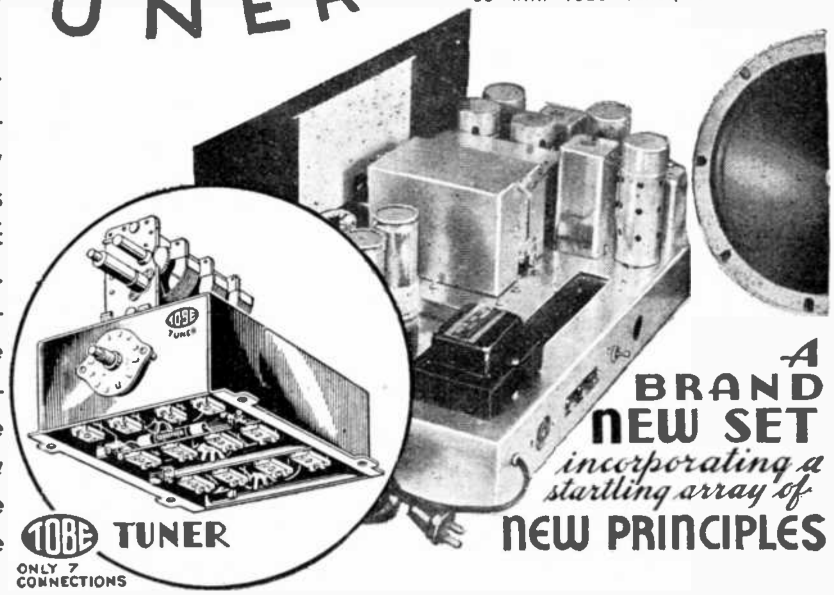
(Continued on page 36)

New ALL-WAVE SET
... EASY TO BUILD ...

Browning 35
WITH
TOBE TUNER

"Glenn Browning", the man who built the "Browning-Drake" in 1925, brings you his most outstanding achievement—the Browning-35 with Tobe Tuner, etc.

Here is the newest all-wave set that under actual tests by qualified authorities, has demonstrated its superiority over receivers costing several times as much. It includes the TOBE TUNER, the heart of the Browning 35. This tuner is a pre-adjusted unit including all R.F. tuning circuits. The TOBE TUNER comes to you completely wired and aligned ready to be set into the chassis with *only seven simple* connections. Below are some of the other outstanding points of the Browning 35 Receiver.



1. Triple-Tuned Double-Band-Pass Intermediates-Link Circuit. 2. Mechanical and electrical arrangement of Tuner permitting maximum gain and efficiency. 3. No plug in coils. 4. Pre-selection by means of R. F. stage. 5. Full vision dial accurately calibrated for all bands. 6. Sensitivity on all bands 1 microvolt or better. 7. Selectivity, 10 KC (absolute selectivity on all bands. Flat top tuning.) 8. Automatic and manual volume control. 9. seven tubes. 10. Antenna connections for doublet or straight antenna. 11. Frequency range—540 KC to 22,600 KC, 4 bands. 12. Microvernier dial with 40 to 1 ratio. 13. Absolute single tuning control. 14. Beat frecuency oscillator for C.W. reception. 15. Everything supplied in one container except tubes and speaker.

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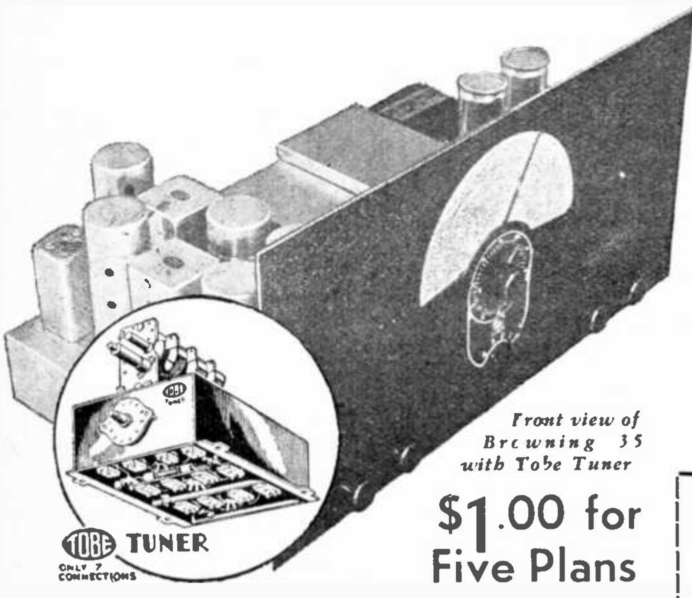

Front view of Browning 35 with Tobe Tuner

$1.00 for Five Plans

For you who want advance technical information, we offer four Progressive Picture Diagrams (all actual size) and the schematic circuit diagram for $1.00 plus complete information on Kit parts and price discounts. 5 plans include: 1. Schematic drawing. 2. Arrangement of parts equipment, top view. 3. Filament wiring. 4. Resistor wiring showing color code. 5. Wiring of condensers, arrangement of tuner showing 7 connections where attached.

TOBE DEUTSCHMANN CORP.,
Canton, Mass.

Gentlemen: Here is my dollar. Please send me the four full-scale Progressive Picture Diagrams (17" x 22") and the schematic circuit diagram with complete information on Kit parts and prices; also the 24-page treatise by Glenn H. Browning describing the design, construction and operation of his latest and most remarkable engineering development.

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City.. State..................

Browning-35

(Continued from page 34)

antenna connected, will be obtained at frequencies higher than 12 megacycles at night. This does not mean that the set is less sensitive on those frequencies for actually there is less noise in most locations at those very high frequencies at night. If, after thoroughly trying out the receiver, it is thought that the sensitivity could be improved, the following adjustments may be made: With the antenna disconnected, set the tuning condensers at maximum and the switch on the broadcast band position. In the rear compartment of the tuner will be found two variable padding or tracking condensers, the lower one controlling the tracking of the oscillator on band No. 4 (broadcast band) and the upper one controlling the tracking of the oscillator on band No. 4 (broadcast band) and the upper one controlling the tracking on band No. 3. By turning the tracking condenser on the broadcast band (be sure the switch is set on this band) a distinct peak of noise will be heard. This is the right position for this tracking condenser. Be sure no signal is being received when making these adjustments. If it is, set the tuning condenser to a slightly different position before making the adjustments. Set the coil switch on band No. 3 and repeat this process. The padding condensers on the other two bands are comparatively large and fixed mica condensers have been employed. These condensers have been accurately measured for capacity on a bridge before being installed and are of a proper size for correct tracking.

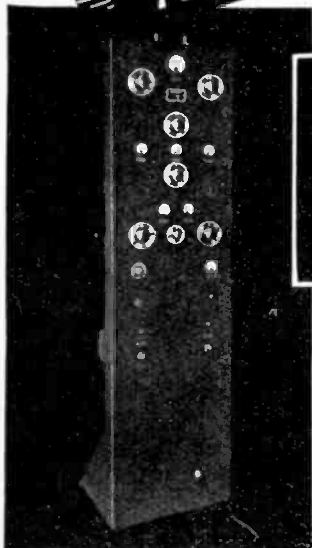
In order to line up the trimming condensers on each coil, the variable air condenser should be set near minimum. In the front compartment (compartment toward the front panel) are the antenna tuning coils for the four bands. Leave the trimming condensers on the oscillator strictly alone. The other two sets of coils may be lined up for maximum noise as follows:

With the antenna disconnected as before and the volume controls at maximum, set the switch on the broadcast band. Looking at the chassis from underneath the broadcast coils are the ones on the left, or row No. 4. The antenna tuning coil and the RF stage then may be lined up for maximum noise. With the switch on No. 3 position, again adjust the antenna and RF trimmers on row No. 3 for maximum noise. Repeat the process with the switch set on No. 2 position and adjust the trimmers on the antenna and RF coils on row No. 2. In adjusting row No. 1, the noise level, in most cases, is very materially reduced and consequently it is considerably harder to line them up.

There is a possibility on both rows No. 1 and No. 2 of adjusting the trimmers to the "image" frequency instead of the frequency for which they were designed. Sometimes it will be found that two maximums of noies are obtained, one with the trimmers at a lower capacity and one with them at a higher capacity (lower capacity with the moving plate farther away from the fixed plate). In this case, the true alignment will be the one with the maximum capacity. If these two sets of coils are lined up on the image frequency, the variable tuning condensers will not track correctly throughout the band and consequently there will be a loss in signal strength.

TRANSMITTING EQUIPMENT *for the* AMATEUR WHO WANTS VALUE FOR HIS MONEY

Here is a collection of outstanding NEW developments, hard to get parts and accessories as well as standard merchandise that will save money for Hams everywhere.



Left: Lafayette 30 watt type P46 Transmitter. An efficient job at $49.50 utilizing the popular Tes-tet Oscillator Buffer or Doubler with a pair of 46's in parallel. Write for details.

●

Right: Lafayette "19" Transceiver. Described in "RADIO", October, 1934. A job that Hams all over the East are talking about. Has power output about 10 times that of similar units. Price only $17.95. Write for details.

Left: Lafayette 100 Watt C W. and 30 Watt phone. Described in "RADIO", November, 1934. The most economical XMTR ever offered for its rated output. Write for details. ●

Right: Lafayette 30-watt type B46 speech amplifier Modulator. A companion unit for the P46 C W. unit. Designed for crystal mike, overall gain 110 Db. flat from 60 to 17,000 cycles ± 1.5 Db. Price $39.50.

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4-in. highly polished nickel silver, etched figures. 1⅛-in. intg. centers. Marked: Amplifier Plate, Amplifier Grid, Oscillator, Antenna, Buffer also Blank.
No. PXH9858, each 60c

2¾-in. Diam. Same as above but marked: NEUTRALIZATION also Blank. No. PXH9857, each 50c

2¾-in. Diam. with Aluminum figures on black. Marked; Tone, Volume, Mixer gain, Button Current.
No. PXH9859, each 10c

Be sure to specify markings wanted

INDICATOR PLATES

Rectangular aluminum plates, 1½x⅜-in. Black Background, aluminum figures. Marked: Filament—1st On—2nd Off; Plate—2nd On—1st Off; Oscillator Plate Current; Amplifier Grid Current; Buffer Plate Current; Amplifier Plate Current; Amplifier Screen Current; Antenna Feeder Current; Output Grd-Grid. No. PXH9898, each 10c

INDICATOR KNOBS

Black bakelite 2⅜-in. diam. for ¼-in. shafts. No. PXH9895, each 22c
Black bakelite 1½-in. diam. for ¼-in. shafts. No. PH9896, each 17c

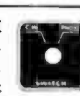
POINTER KNOBS

Black bakelite. Fine for test equipment, transceivers, etc. ¼-in. shaft with set screw. White engraved line.
No. PXM13055, 2¼-in. long, each .. 10c
PXM13054, 1¼-in. long, each 09c

CIRCULAR PLATES

Black background, aluminum figures, 1-in. diam. 7/16-in. hole. Marked: Mike-Phone, Cell Disc; Adjust-Cell Voltage; On-Off.
PXH9899, each 10c

INDICATOR PLATE



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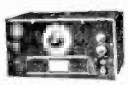
The New NATIONAL HRO



Receiver in stock. Complete with coils, less tubes, speaker and power supply.
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Type XR 10A, steatite; 2½x5"; 26 turns. No. PXN14347 .... 90c
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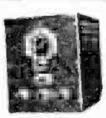

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PXH8604	147B	440	.070	4.12
PXH8605	T-199	330	.084	5.88
PXH8609	T-183	110	.171	5.29
Neut. Condensers				
PXH8611	511-B	23	.171	1.77
PXH8612	513-B	50	.171	3.53
Split Stator				
PXH8616	197B	*80	.070	2.94
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PXE5521 800 each side of center at 150 MA $3.75
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PXE5523 750 or 900 each side of center at 350 MA $8.50
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PXE5525 1600 or 2000 each side of center at 400 MA $21.75
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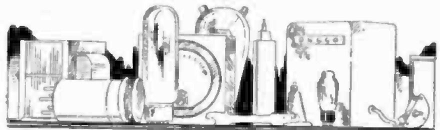
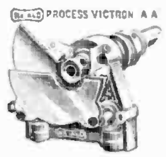


NEW PRODUCTS

Alden Victron "AA" Condensers



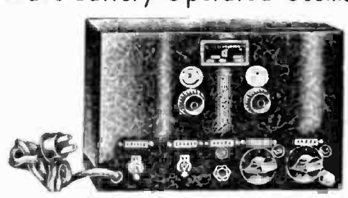
A Victron insulated Variable Condenser, the ideal short-wave condenser, whose **PF at RF** is **only 0.0002.** This condenser incorporates outstanding features, not found in any short-wave condenser on the market today: Silver pressure contact on the rotor. No grease or film, or oxide skin as in bearing contacts. Self centering, self tightening cone bearing cannot loosen or produce noise. Minimized metal gives extremely low minimum capacity. Most practically shaped plates for station separation. Soldered brass plates precision spaced. Universal mounting. Double solder tabs on both rotor and stator. Rotor insulated from mounting. Gangs in tandem simply with 1/8-in. Gang-Rod passed through hollow shafts.

Available in maximum capacitances of 15, 50, 100 and 140 mmf.

Alden Universal-Mount Chassis Plugs

The slotted holes will fit any mounting distance from 1½-in. to 1⅞-in. The prongs are molded in bakelite insulation. Very handy for use on auto-radios, short-wave receivers, amplifiers, etc. Eliminates dangling power supply cables. Plug is dead when connector is removed. Used with standard electrical wall plates for finished off appearance. The slots in the metal flange lock the 924FC series Shielded Connectors.

All-Wave Battery Operated Oscillator



EMBODYING all the features of their A.C.-D.C. operated All-Wave Test Oscillator, the new Model OD Battery Oscillator, just announced by the Clough-Brengle Co. of 1134 W. Austin Ave., Chicago, Ill., meets the needs of many servicemen for rural and auto-radio servicing applications.

The Model OD Test Oscillator is continuously variable from 50 k.c. to 30 m.c. (6000 to 10 meters), all on fundamental output. Extremely large battery capacity is provided to assure long life and consequent low operating cost.

Each instrument is hand calibrated over the entire frequency range and offers three separate outputs: 400-cycle modulated r.f., unmodulated r.f., and 400 cycle audio frequency voltage. A plug-in jack allows external modulation from a phonograph pick-up or variable frequency audio oscillator.

Dual attenuator controls afford unusual range of output, steplessly variable from ½ microvolt to 2 volts. Six separate inductor units are contained in a rotating unit to provide the frequency range which covers all short-wave and broadcast receivers and their intermediate frequencies.

Gordon Nameplates

57 VARIETIES of Name Plates for practically every amateur purpose, at 10 cents each, net, are announced by Gordon Specialties Co., 233 East Avenue, Park Ridge, Illinois. The radio constructor will welcome these beautiful, low-priced nameplates.

1935's MOST PROFITABLE WORDS

9 BRAND NEW MODELS

2 TABLE SHELVADORS

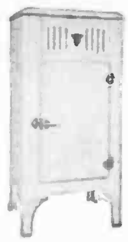
Table Shelvador

FR-20—2 cu. ft. NET Capacity. Semi-hermetic Rotary Compressor. Dimensions: 36" high, 23¾" wide, 25" deep. (Shown at left). $79.50

Table Shelvador

FR-30—3.1 cu. ft. NET Capacity. Rotary Compressor. Same dimensions as FR-20. $94.50

4 SHELVADOR MODELS



Shelvador Model FA-40

4.09 cu. ft. NET Capacity. 8.6 sq. ft. shelf area. 2 ice trays—42 cubes. Dimensions: 52¾" high, 23½" wide, 25½" deep. $112.50

Shelvador Model FA-50

5 cu. ft. NET Capacity. 11.3 sq. ft. shelf area. 2 ice trays—42 cubes—one double-depth tray. Dimensions: 56¾" high, 25⅛" wide, 24½" deep. (Shown at left). $129.50

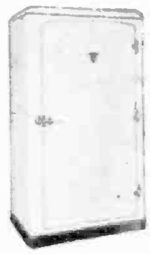
Shelvador Model FA-60

6 cu. ft. NET Capacity. 13.5 sq. ft. shelf area. 3 ice trays—63 cubes—one double-depth tray. Dimensions: 56¼" high, 30¾" wide, 25¾" deep. $149.50

Shelvador Model FA-70

7.08 cu. ft. NET Capacity. 14.9 sq. ft. shelf area. 4 ice trays—84 cubes,—one double-depth tray. Dimensions: 57½" high, 32¾" wide, 25¼" deep. $169.50

3 TRI-SHELVADOR MODELS



Models FA-50, FA-60, FA-70 and all Tri-Shelvador Models also available with porcelain exterior at slight extra cost.

Tri-Shelvador Model F-43

4.3 cu. ft. NET Capacity. 9.15 sq. ft. shelf area. 2 ice trays—42 cubes—one double-depth tray. Dimensions: 56-9/16" high, 23¾" wide, 23½" deep. $139.50

Tri-Shelvador Model F-55

5.51 cu. ft. NET Capacity. 11.6 sq. ft. shelf area. 3 ice trays—63 cubes—one double-depth tray. Dimensions: 57½" high, 29" wide, 24⅞" deep. $164.50

Tri-Shelvador Model F-70

7.08 cu. ft. NET Capacity. 14.9 sq. ft. shelf area. 4 ice trays—84 cubes—one double-depth tray. Dimensions: 58¾" high, 32¾" wide, 25⅛" deep. (Shown at left). $189.50

Crosley Tri-Shelvador Adds 3 Exclusive Features to Famous Shelvador

The Tri-Shelvador has all the features of the Shelvador, with the following added exclusive features:

1—SHELVATRAY. Handy shelf in door that drops to horizontal position. Place articles on Shelvatray and carry them (Shelvatray and all) to table, range, or cabinet. Saves time and steps. (Patent Pending.)

2—SHELVABASKET. A non-refrigerated basket on bottom of door for greens, carrots, cabbages and the like. An exclusive feature. (Patent Pending.)

3—STORABIN. A non-refrigerated bin in bottom part of cabinet for potatoes, onions, and other bulk items. Found only in Tri-Shelvador. (Patent Pending.)

In addition: Self-closing stainless steel door to freezing chamber in all Tri-Shelvador Models.

EXCLUSIVELY IN

CROSLEY

ELECTRIC REFRIGERATORS

This much more in a Shelvador

THIS much more . . . twice as easy to find . . . the all-time high-point in electric refrigerator convenience . . . smartness that excites exclamations everywhere! No wonder sales are going up! *up! UP!* Shelvador—the electric refrigerator showing the greatest sales growth during 1934—will make new sales history during 1935. For SALES are written all over these amazing models that meet every viewpoint, every purse.

When you sell EXCLUSIVE features, you sell something beyond the reach of competition. And the 1935 Crosley line is exclusive, not only in features, but in Streamline Beauty and in foot-saving convenience. Far ahead in value. The prices speak for themselves. Get in touch with your Crosley distributor, so that you may begin now to make 1935 your biggest year. You can't afford NOT to handle Crosley.

THE CROSLEY RADIO CORPORATION

(Pioneer Manufacturers of Radio Receiving Sets)

Home of WLW—the world's most powerful broadcasting station.

POWEL CROSLEY, Jr., *President* CINCINNATI

Western prices slightly higher.

ALL PRICES INCLUDE DELIVERY..INSTALLATION..ONE YEAR FREE SERVICE

UTC

The Answer to Your Modulation Choke Problem
A Universal Choke for Every Purpose

What This Universal Modulation Choke Will Do:

It is tapped so that it can be used as an autotransformer coupler from Class B to Class C stages; various impedance taps are available so that each choke will readily accommodate push pull Class A-Prime or Class B Modulators, single ended Class A Modulator with the DC adding, or single ended Class A Modulator with the DC bucking.

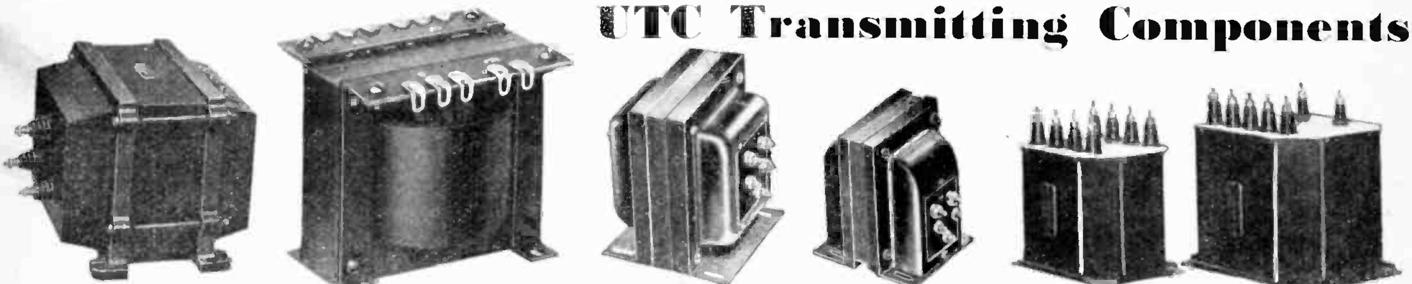
The chokes are huskily constructed and air gaps are arranged to take care of the maximum DC currents.

Broadcast and phone men who want an output audio unit that will match all possible tube impedance combinations to the RF Stage cannot afford to be without the new UTC Universal Modulation Output Chokes.

TYPE		LIST PRICE	NET TO HAMS
HUC-20	Will handle 20 watts audio power. Can be used with class B 46's, 59's, 53, 6A6, 79, etc., or class A 2A3's, class A prime 42's, 45's, etc.	$7.00	$4.20
HUC-50	Will handle 50 watts audio power. Suitable for use with class B 210's, 801's, 830's, 841's, push pull parallel 46's or 59's, push pull parallel 45's A prime, push pull parallel 2A3's.	$12.50	$7.50
HUC-100	Will handle 100 watts audio power. Suitable for use with class B 800's, 211E's, A prime 284's, 845's, etc.	$20.00	$12.00
HUC-200	Will handle 200 watts audio power. Suitable for use with class B 203's, 830B's, HK-354's, single EIMAC 150T, push pull parallel 845's, prime, etc.	$32.50	$19.50
HUC-500	Will handle 500 watts audio power. Suitable for use with class B 204's, HK354's, EIMAC 150T's, A prime 212D's, A prime 849's, etc.	$80.00	$48.00

Complete circuit matching dots furnished with each unit.

UTC Transmitting Components



UTS mtg. OT mtg. DS mtg. VS mtg. PA mtgs.

The transmitting type of UTC plate, filament and filter components have been developed for and are used widely by Commercial Telephone, Telegraph, Communication and Broadcast systems. They are particularly well adapted for use in AMATEUR TRANSMITTER applications. All units are fully enclosed in cases having a professional appearance when grouped in finished equipment. Plate transformers housed in the UTS or PA type shields are fully impregnated and sealed with a special heat dissipating compound. The units are specifically treated to withstand adverse climatic conditions in any part of the Globe.

PLATE TRANSFORMERS, PRIMARY 115 VOLTS A.C. 50/60 CYCLES

		LIST PRICE
VS-10	450 each side of center at 150 MA: 5V-3A: 2½V-10A. VS mtg.	$ 6.50
DS-2	500 each side of center at 200 MA; 2½ V.C.T. 14 A; 5 V.C.T. 3 A; DS mtg.	8.00
DS-3	600 each side of center at 200 MA; 2½V-10A; 7½V-3A 5V-3A. DS mtg.	10.00
DS-4	800 each side of center at 150 MA: DS mtg.	7.50
DS-5	800 each side of center at 250 MA: DS mtg.	11.00
PA-111X	750 or 900 each side of center at 350 MA; PA mtg.	17.00
PA-112X	1250 or 1400 each side of center at 500 MA; PA mtg.	32.00
PA-113X	1600 or 2000 each side of center at 400 MA; PA mtg.	43.50
PA-114X	2500 or 3000 each side of center at 500 MA; UTS mtg.	65.00
PA-116X	1250 or 1400 each side of center at 200 MA; PA mtg.	20.00

SMOOTHING CHOKES

VS-1	12 Henry. 200 MA; D.C. resistance 140 ohms. VS mtg.	$ 5.00
DS-30	12 Henry. 300 MA; D.C. resistance 105 ohms. DS mtg.	7.50
DS-50	12 Henry. 500 MA; D.C. resistance 70 ohms. DS mtg.	13.00

INPUT SWINGING CHOKES

VS-2	5/25 Henry. 200 MA; D.C. resistance 140 ohms. VS mtg.	$ 5.00
DS-40	5/25 Henry. 300 MA; D.C. resistance 105 ohms. DS mtg.	7.50
DS-60	5/25 Henry, 500 MA; D.C. resistance 70 ohms. DS mtg.	13.00

FILAMENT TRANSFORMERS, PRIMARY 115 VOLTS A.C. 50/60 CYCLES

		LIST PRICE
DS-12	2½ V.C.T. 20 A; 5 V.C.T. 3 A; 7½ V.C.T. 6½ A. 2500 V. insulation. DS mtg.	$ 8.50
DS-13	10 V.C.T. 6½ A; 10 V.C.T. 6½ A; 7½ V.C.T. 2½ A; 2½ V.C.T.5 A; 2500 V. insulation. DS mtg.	11.50
DS-14	11 V.C.T. tapped at 12 and 14 volts at 10 A. 5000 V insulation. DS mtg.	8.50
DS-15	2½ V.C.T. 12 A; 5000 V. insulation; 10 V.C.T. 6½ A. DS mtg.	8.00
DS-16	5 V.C.T. 20 A; 7000 V. insulation. DS mtg.	7.50
DS-17	5 V.C.T. 20 A; 10.000 V. insulation. DS mtg.	10.00
VS-12	2½ V.C.T. 12 A; 7000 V. insulation. VS mtg.	4.50
VS-13	7½ V.C.T. 6½ A; 5000 V. insulation. VS mtg.	4.50
VS-14	10 V.C.T. 6½ A; 5000 V. insulation. VS mtg.	5.00
VS-15	5 V.C.T. 3 A; 5 V.C.T. 3 A; 5 V.C.T. 6 A; 5000 V. insulation. VS mtg.	5.00
OT-1	2½ V.C.T. 20 A; 2500 V. insulation. OT mtg.	3.00
OT-2	7½ V.C.T. 6.5 A; 2500 V. insulation. OT mtg.	3.50
OT-3	10 V.C.T. 6½ A; 2500 V. insulation. OT mtg.	4.00
OT-4	6.3 V.C.T. 5 A; 5 V.C.T. 6 A; 2500 V. insulation. OT mtg.	4.00
OT-5	2½ V.C.T. 12 A; 5000 V. insulation. OT mtg.	3.50
OT-6	5 V.C.T. 3 A; 5 V.C.T. 3 A; 5 V.C.T. 6 A; 2500 V. insulation. OT mtg.	4.00
OT-7	Three 7½ V.C.T. 2½ Amp. windings; 2500 V. insulation OT mtg.	4.00

Standard 40% Discount to Amateurs on Above Prices

UNITED TRANSFORMER CORP.

264-266 CANAL STREET — NEW YORK, N. Y.

Export Division, 15 Laight St., New York, N. Y.

Exclusive UTC distributors carrying a complete stock of UTC products.

Goldhamer's, Inc.	610 Huron Road, Cleveland, Ohio
Wholesale Radio Service Co., Inc.	100 Sixth Ave., New York, N. Y.
Wholesale Radio Service Co., Inc.	219 Central Ave., Newark, N. J.
Wholesale Radio Service, Inc.	430 W. Peachtree St. N. W., Atlanta, Ga.
Sun Radio	227 Fulton Street, New York, N. Y.
Gross Radio, Inc.	51 Vesey Street, New York City
Leeds	45 Vesey Street, New York City
William Gram	1444 Sheridan St., Lansing, Mich.
Mohawk Electric Co.	1335 State St., Schenectady, N. Y.
Walter Ashe	1100 Pine St., St. Louis, Mo.
Radio Shack	46 Brattle St., Boston, Mass.
Nutter & Cross	900 Milk St., Boston, Mass.
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Hatry & Young	203 Ann St., Hartford, Conn.
Cameradio Company	603 Grant Street, Pittsburgh, Pa.
W. H. Edwards & Co.	32 Bway, Providence, R. I.
SEATTLE, WASH.—Seattle Radio Supply, Inc.	2319 Second Ave.
Portland Radio Supply Co.	1300 W. Burnside, Portland, Ore.
Spokane Radio Co., Inc.	611 First Ave., Spokane, Wash.
San Francisco Radio Exchange	1284 Market St., San Francisco, Calif.

SOUTHERN CALIFORNIA

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Coast Electric Co.	744 G. St., San Diego
Prest & Dean Radio Co.	400 American Avenue, Long Beach
Radio Television Supply Co.	1701 S. Grand Ave., Los Angeles, Calif.
Radio Specialties Co.	1816 West 8th St., Los Angeles, Calif.