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RADIO

ESTABLISHED 1917

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OHM'S LAW

$E = I \times R$

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

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

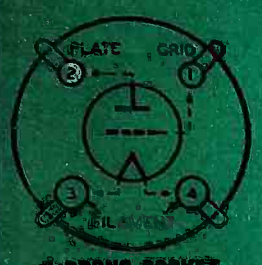
CONDENSERS IN SERIES

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

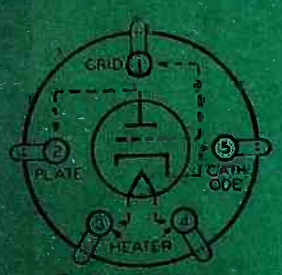
RESISTANCES IN PARALLEL

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

BOTTOM VIEWS OF SOCKETS



4-PRONG SOCKET
00-201-A, 45, 210, 30, 31, ETC.



5-PRONG SOCKET
56-46-47-76-27-37

6-PRONG SOCKET
2A5-41-42-45

6-PRONG SOCKET
57-58-606-606-77-78

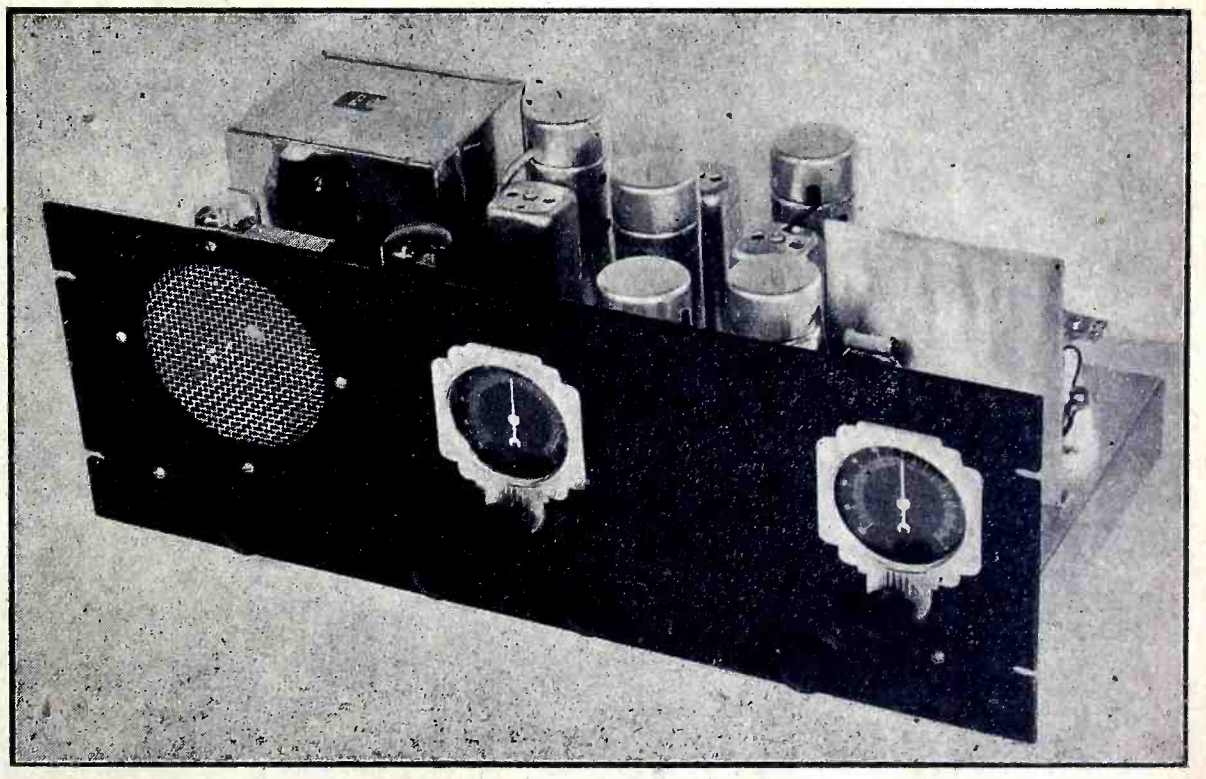
7-PRONG SOCKET 59

7-PRONG SOCKET
2A7-6A7

—IN THIS ISSUE—

★

Frank C. Jones' 5-Meter Superheterodyne —the First Workable Receiver of Its Kind. See Page 8.



FEATURE ARTICLES BY . . .

CLAYTON F. BANE - FRANK C. JONES - COL. C. FOSTER

J. N. A. HAWKINS - - FRANK LESTER - - I. A. MITCHELL

"WE USE 'EM AND LIKE 'EM"

Sylvania GRAPHITE ANODES

Sylvania Type 212-D

RADIO STATION WFBE, INC.
MEMBER STATION -- THE AMERICAN BROADCASTING SYSYEM
STUDIOS AND EXECUTIVE OFFICES
HOTEL SINTON
CINCINNATI, OHIO

24 November, 1934.

PArkway 2760
2761

Hygrade Sylvania Corp'n.,
Electronics Department.
Clifton, N.J.

Att: Mr. C.A. Rice, Sales Mgr.

Dear sir:

Type 212-D We purchased and installed five (5) Sylvania used in the transmitting tubes on 8 April, 1934, one being four being used in our transmitter, the other with two tubes in parallel on each leg of the circuit. modulator stage of our final amplifier push-pull stage,

These were in continuous use for 17 hours daily from that date (8 April, 1934) until the present time, when they were replaced by another set.

This replacement was not absolutely necessary, but merely to guard against any possible interruption, inasmuch as the old set, when tested still proved up to virtually the same standard values (plate current etc.) as prevailed when they were initially placed in use. As a matter of fact they checked almost as good as the new set just installed! The old set is maintained on hand for any possible emergency use, being still in excellent operating condition.

We feel that the Sylvania 212-D tubes are most excellent, and have recommended them to many of our technical friends in other stations, many of whom are now using them also.

We are more than pleased with the service these tubes have rendered at WFBE.

Very truly yours,

Radio W F B E,
Per: H. F. Breckel,
Engineering Div.

NRA CODE

Sylvania Graphite Anode tubes are taking the country by storm. Broadcasters everywhere praise these tubes for their stability and long service life.

The engineers at Hygrade Sylvania Corporation's Clifton plant developed, and were the first to successfully produce GRAPHITE ANODE tubes. There is no doubt in the mind of the keen, up to the minute broadcaster that these tubes are definitely superior to other tubes.

Prove to yourself the economy resulting from the extra long service life of Sylvania Graphite Anode types, by specifying the purchase of Sylvania tubes in your next tube order!

The type 212-D has gone over big! The letter above tells the story. Can we say more?

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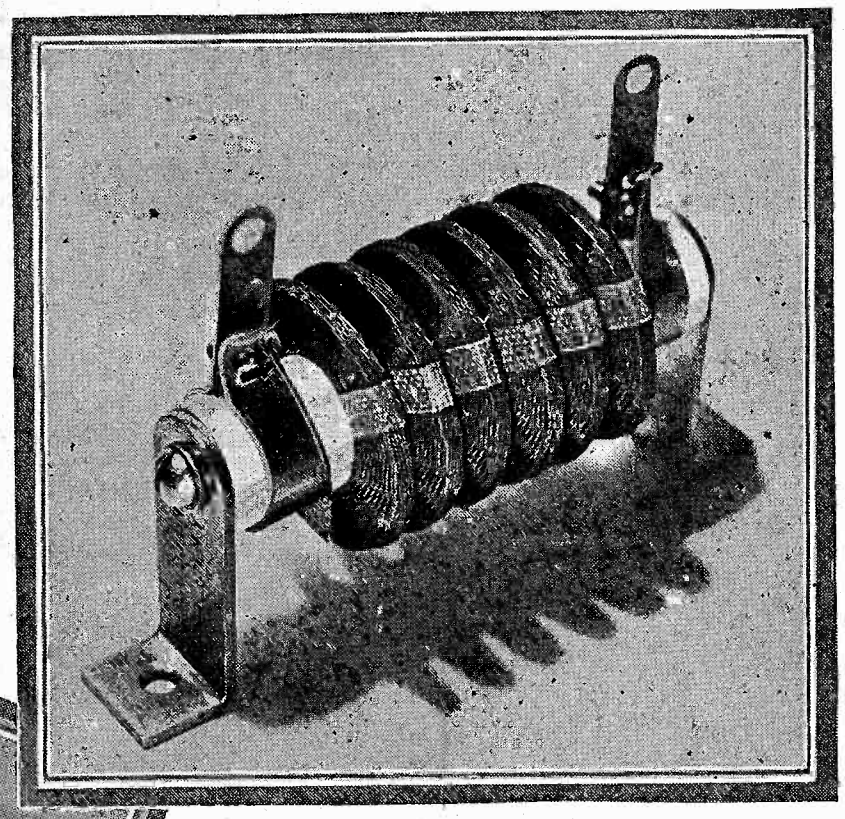
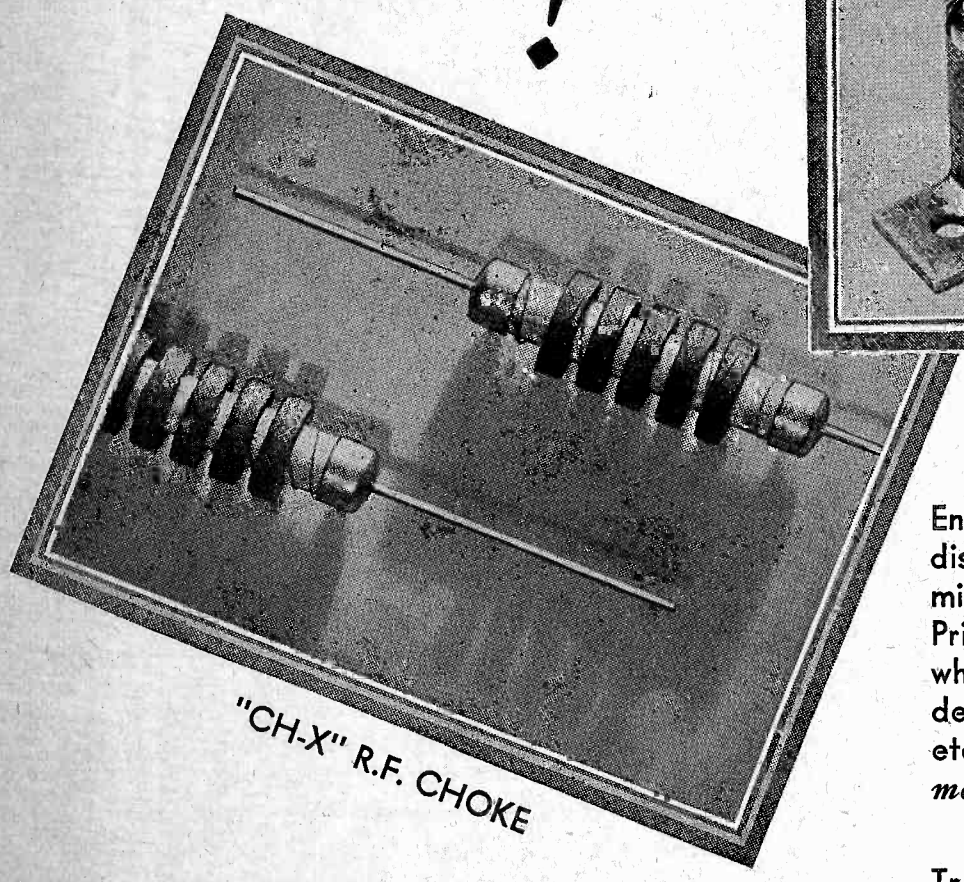


"CH-500" TRANSMITTER CHOKE



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DON'T be misled by similarity of appearance or claims. Know the FACTS! HAMMARLUND Chokes have been *proved* different and better in all essential qualities. As evidence, the Hammarlund "CH-X" is the smallest and lightest R.F. choke made. Its features are *exclusive*. Only ½" x 1½", it is small enough for restricted spaces, and so light that the tinned copper leads are ample support. Leads extend *straight* from the end caps. This makes for neater wiring.

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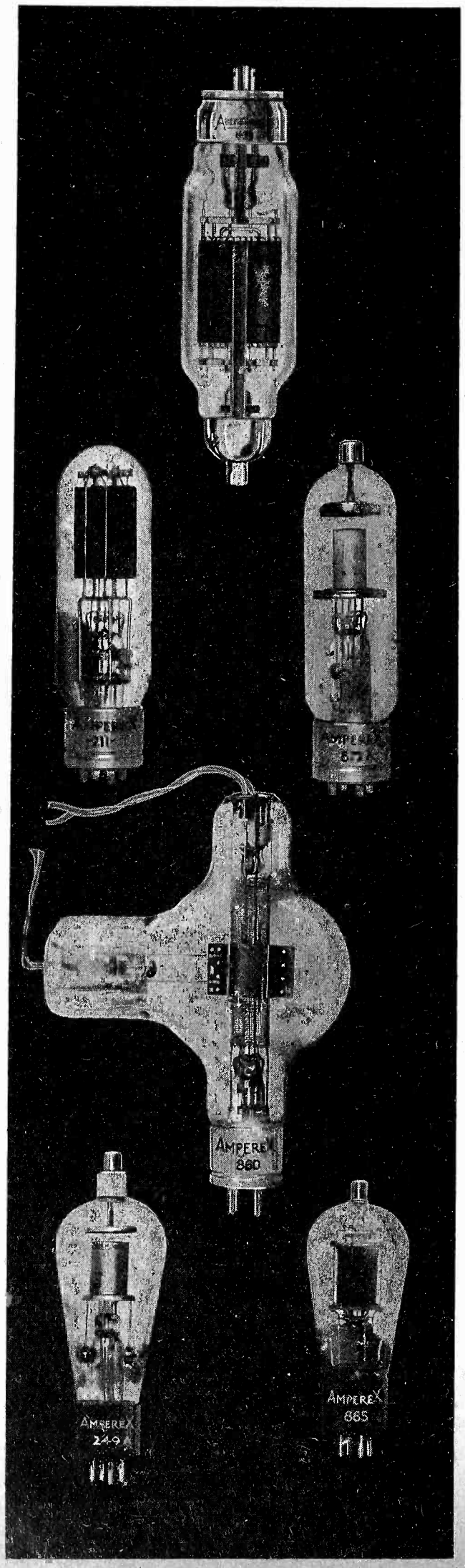

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Vol 17 JANUARY, 1935 No. 1

RADIOTORIAL COMMENT

Worthwhile New "Q" Signals

WHEN an amateur CQs on the high-frequency end of the band it is generally assumed that he covers only that portion of the band when listening; he seldom goes beyond the middle of the dial. Thus those whose transmitters are tuned to the low-frequency end of the band are not often recognized by the high-frequency CQer, simply because he never gets to the other end of the band. Or vice versa.

A dyed-in-the-wool DX hunter covers his choice end of the band with great care, tunes slowly and depends upon his old acquaintances to answer his CQs. But the newcomer and the man who calls CQ for the purpose of raising anybody, anywhere in the band, has a different problem on his hands. Sometimes he starts to tune from the high-frequency end, sometimes from the other end. So that those who hear a CQ will know which end of the band the CQer will cover when he throws his switch to the receiving position, it is suggested by Art Bates of the CALL BOOK that a few new "Q" signals be added to the list. The suggestion is timely, should appeal to all good amateurs. Here are the proposed new signals:

QHM . . . I will begin listening at the high frequency end of this band, tuning towards the middle of the band.

QLM . . . I will begin listening at the low frequency end of this band, tuning towards the middle of the band.

QMH . . . I will begin listening at the middle of this band, tuning towards the high frequency end.

QML . . . I will begin listening at the middle of this band, tuning towards the low frequency end.

Although Mr. Bates has already sent these proposed new "Q" designations to various domestic and foreign radio magazines, it has been suggested by a staff member of "RADIO' that the new signals be reduced to two in number, i.e., one signal to indicate that the operator is tuning from the high frequency end of the band towards the middle, and another signal indicating that he will tune from the low frequency end of the band towards the middle. QLO would indicate, "I start tuning from the low frequency end." QHY would indicate, "I start tuning from the high frequency end."

Thus only two new signals would be added, both self-evident in character, the "LO" portion of the "Q" signal automatically means "LO Frequency" and "HY" means "HIGH Frequency." 'Twould be better to make it QHI instead of QHY, but for the laugh that HI has associated itself with.

An expression from the reader is asked for. Quick action is needed so that the new signals will be widely known and used when the next international tests are with us. Do you favor four new "Q" signals as suggested by Bates, or only two new signals—QLO and QHY—as suggested by "RADIO"?

★ ★

Thank You, Ever So Much!

"THE destiny of amateur radio is in the hands of Congress," you were told by the Political Editor in December "RADIO." And a flood of letters from subscribers—far too many to answer individually, are stacked high in the editor's files. How to approach a Congressman? That's easy. Colonel Foster will present the plan in full in the next issue of this magazine. If you are seriously interested in the future welfare of amateur radio, you will

Uncle Sam to Amateur Radio Spokesman: "If it's more privileges you want, why not come up and see ME sometime?"

heed his timely advice and join the vast army of amateurs who have already pledged themselves to leave no stone unturned to prevent the frequency-grabbers from ultimately putting V-wheels on sacred amateur territory.

Fortunately for the amateur, the President of the United States is a man of vision. Every amateur is ready to back him in the event of national emergency. We are going to ask him to back us, without a penny of cost to our Government or to our people, so that we will still be AMATEURS when the time of need arrives. If you thrive on fact, not fancy, you will find a lot of it in next month's "RADIO." Colonel Foser knows Washington and Washington knows Foster. Thus the constructive program of telling the amateur what to do and how to do it will be presented with full vigor in the months to come.

★ ★

The First Successful 5-Meter Super

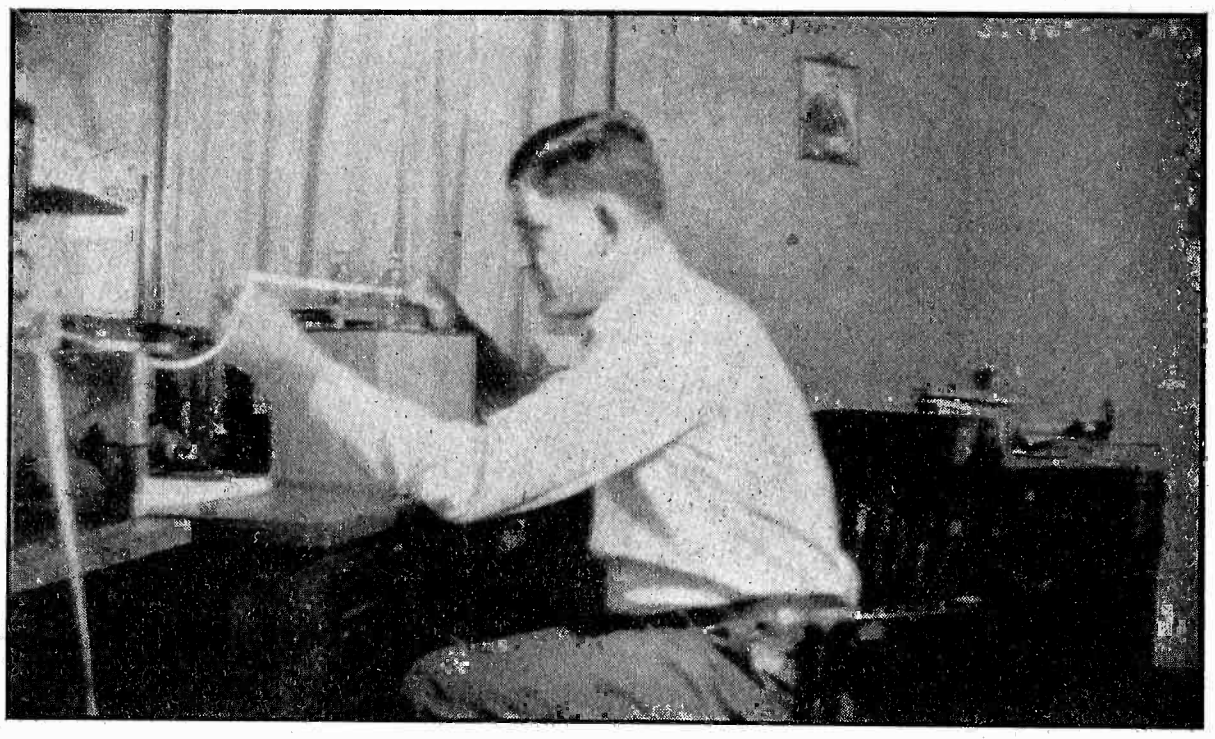
ELSEWHERE in these pages you read what Frank C. Jones has accomplished in the form of 5-meter reception via the super-heterodyne route. Again, necessity was the mother of invention. The 5-meter band is already overcrowded in many of the larger metropolitan areas. The super-regenerative receiver must soon give 'way to inexpensive forms of 5-meter super-hets. Until this time there has not been available a WORKABLE super for the ultra-high frequencies. The latest achievement of Frank C. Jones will be welcomed by experimenters, manufacturers, jobbers and retailers.

May this latest contribution to the art bring you greater pleasure and more thrills from your 5-meter experiments.

TALKING about Frank C. Jones, turn back the pages of "RADIO" to 1925. Nine years ago, Jones was at work in his laboratory, conducting a series of transmitter amplifier tests. The amplifier was coupled to the antenna by means of two wires. Accidentally, Frank Jones moved the feed wires closer together, found that the output was increased. Thereupon he twisted the two wires together and observed a marked increase in antenna current. And so "Link Coupling" was discovered. Unquestionably, this form of coupling has played one of the major roles in modern amateur practice; it seemed reasonable to assume that Link Coupling could also be applied to receiving equipment. Consequently, Frank Jones went to work to find out what would happen when an antenna is link-coupled to a detector circuit. Also in these pages is an article from his pen, telling how to build a marvelous little amateur superheterodyne receiver which uses this new form of antenna coupling. If you like to "roll your own," here is your opportunity to build a receiver that is literally a hair-raiser. Thus "RADIO" starts the new year right, with a pair of editorial scoops that should be welcomed by all. The technical standard of the magazine will be vastly improved during 1935. It will be an exciting year for the radio amateur.

A Deaf Mute Asks for an Amateur License

★ *If this story does not make your heart throb, you are not worthy of the name "amateur". For here is an appeal to every radio amateur in the United States to do his small part in helping Mr. Adolph Czajka of Chicago in his efforts to secure an amateur license. Petitions from radio clubs should be sent directly to the Federal Communications Commission at Washington.—Editor.*



Adolph J. Czajka at the tape recorder. He will send you a piece of the tape on request.

TOTALLY deaf, he hears all over the world. Mute, he understands the language of the far places. In thirty-six countries of the globe his name is known but his voice has never been heard. And now 15,000 persons are asking Washington to abrogate federal regulations in order that he may have a tongue. Introducing: Adolph J. Czajka, deaf mute radio operator of 2428 West 34th Place, Chicago, Ill.

Adolph is one of the world's most remarkable people. Totally unable to hear a sound he is a first-class radio operator. In his humble home where he sits through the long nights, and silent days, he has 900 QSLL cards from "hams" from all over the world. He has never heard a signal from any of their stations. In place of ears that will not function, Adolph uses his eyes—that and a recorder of his own design.

Adolph "sees" radio signals. Incoming continental is logged on a tape and becomes to this man who lives in a world of silence, living speech from the outside world. Thirty—forty words a minute his little chattering recorder plods away and through it Adolph Czajka knows the gossip of the airlanes. He saves his tape and sends it to fellow hams so they may see a picture of their sending—good or bad. And they thank him for it.

It is the great dream of Adolph's life to own a federal amateur license. Regulations provide that he must copy audible signals in order to be licensed as an operator. But a movement has been started by fellow operators to have federal regulations waived in his behalf. The need is imperative. Through radio a new world has been opened to this man who cannot hear and who must depend upon the lightning speed of his fingers for communication with others.

"I cannot be without my radio", he writes on his typewriter, with a world of pent-up feeling behind the words. "I like very much to be radio ham or fan better than to go around bums on the street. My wife says if I stay at home with my short wave receiving station I will be a good man."

And so Adolph stays home and listens to the world talk. There is the itch of brass in his fingers. He wants to talk back. He knows the code. He can handle a key. He knows how to build his transmitter. All he needs now is for Uncle Sam to temper regulations with discretion—and help him get a license, even though he cannot hear. For without ears, he is better than most.

"I made my own first tape-recorder in 1925", he writes. "But it was only fair. It worked only 100 or 125 miles but it picked up 32 amateur radio stations. I changed it again in 1928, and picked up more than 100 amateur and commercial stations. I made it over again in 1931 and this time picked up 800 QSL cards from amateur stations. I have been a student twelve years in radio without a ticket."

Once he went up to get his ticket—his federal license. He was turned down because he could not hear. Now radio amateurs all over the country are signing a giant petition to have the license given to him. There are a number of blind operators working the ham lanes. Adolph believes he is just as good with his perfect eyes, even though he cannot hear or speak. So do his fellow hams and they are going to try to convince the federal communication commission of the fact.

Adolph's list of letters and acknowledgment cards is amazing. Letters from battleships, from commercial stations, from radio men all over the world. He has "heard" their signals by seeing them on his tape. He logs the station, writes it a letter, and enclose a tape record of the message. Hams, thousands of miles away have been astonished to receive from the Chicago deaf mute a photographic picture of their sending. For the first time they have had revealed a "rotten fist" as it showed on a recorder. Invariably they have written back to him sincere thanks.

These return letters—these 900 QSL acknowledgments are the salt of life to this man condemned to sit through the days and nights without the sound of his own children's laughter. For he has children—two of them "and a nice wife", as he himself describes her. Cheated of one of man's birthrights, Adolph years ago turned to radio and found there an electrical voice he could see with his eyes. Therafter a new world was opened to him.

One of Adolph's friends—operator on the U.S.S. Pontchartrain at Norfolk, Va., wrote to him, expressing a hope that the federal body would grant him a license.

"We all think here it would be a dirty shame not to," he wrote. "You could have my ticket if there was any way of giving it to you. I know it would mean a lot."

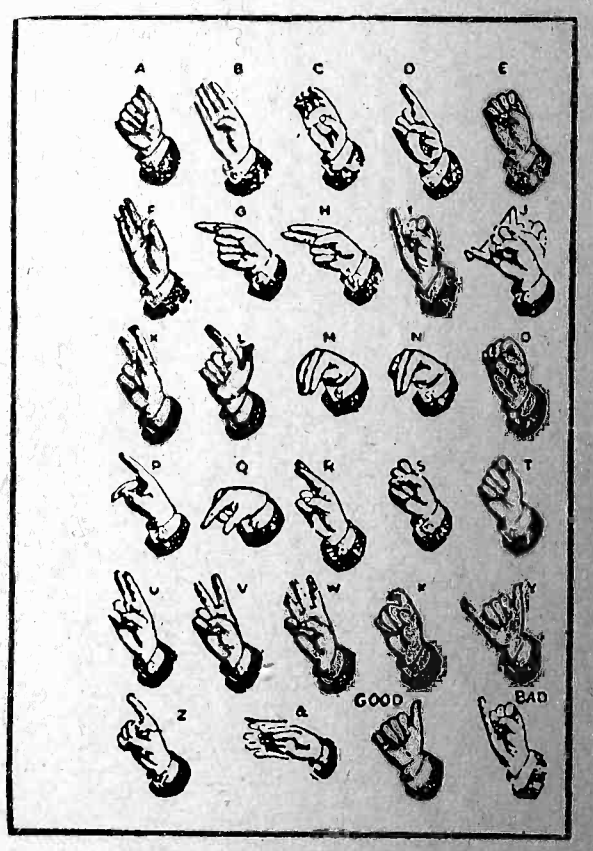
Only Adolph Czajka knows what it would mean to break the radio silence of 12 years—to reach out, touch a key with hungry fingers and through the tiny spots on his recorder tape learn for the first time that his far-flung radio impulses had been received. To talk, in other words, for the first time in his life, through the necromancy of the new science that has linked the countries of the world in a new understanding.

That is the New Year's gift that radio hams of the United States are seeking for this undaunted hero of the air lanes through petition to official sources. How they feel about it is shown by some of the scores of letters in which fans express their thanks to Adolph for the real service he has done ham radio by his soundless check on transmitted signals. One from W8IZE at Clarke Summit, Pa., in point:

"Thank you very much for your tape recording of my signal . . . while examining the tap I notice I have a tendency to hold the last dash in '8' 'w' and 'z'. I am glad to know this and will try to correct that to improve my keying. Sure hope you are successful in obtaining a special license to operate. You ought to work fb with a tape recorder . . 73."

From 9WL at Chicago came this one:

" . . . fb on your building your own recorder. Your good work speaks for the



This—and the radio code are the only languages that Adolph Czajka knows. The illustration above depicts the "sign language" of the deaf mute. It was reproduced from his QSL card.

great interest that radio can stir up in people, surely handicapped as you are. I think it is marvelous. I hope you have good luck . . ."

From W8BCV at Detroit:

" . . . I am writing a letter to the ARRL

(Continued on page 18)

I Voted "NO"

By COL. C. FOSTER, W6HM

AT THE Fresno convention a motion was made to split the Pacific Division in two and make the southern half a new division. It was made by W. W. Matney, W6EQM, the ranking officer of the new little group with the new big name, "Federation of Radio Clubs of the Southwest, ARRL, a California Corporation". Generally speaking, resoluting at ham gatherings is merely a form of pastime and about as futile as praying for rain in Death Valley. The accompanying arguments do, however, give us a chance to blow off steam. Some of us like to "debate", some of us blow tin whistles, some hammer out calls on the steam pipes. Some of us ease the pressure merely by "seconding" motions and casting votes in all directions—long, loud and often. As most pleasures are largely in their anticipation, we hams get ours from the pictures our wishes present in these "resolutions." The fact that their objects are seldom realized and always soon forgot takes none of the pleasure from the making of them.

We older hams who are more or less "sales-proof"—more or less immune to herd emotionalism—vote perfunctorily if we vote at all. We know perfectly well that when a ham assemblage votes to raise the power limit of stations it has just as much effect on the Federal Communications Commission as throwing stones at the moon. There is an intelligent and forthright way of getting more power for amateur stations but men of experience know that firing broadsides at ONE ANOTHER at hamfests will never get it.

But occasionally there appears a resolution that concerns only the machinery of the amateurs' own organization. Such movements do hold the possibility of bearing fruit—sweet or sour, as the case may be. This motion of the "Federation" to secede from the Pacific Division and force Southern California to become a part of a new division was of this nature—an internal ARRL affair. The younger element of the south had been well proselyted in advance, so there were many pairs of lungs under high compression with suppressed "Ayes". When the chairman called for these ayes the hall was filled with them. Surmising that there would be few "Noes" I put plenty of steam back of mine to make it go as far as possible. And I had the proud distinction of voicing the ONLY "no"! Perhaps "Ten thousand Frenchmen can't be wrong", but I'll swear that one hundred hams can—when well narcotized beforehand. I was asked if I would be willing to give my reasons for voting "no." I replied that I would do so in writing. I hereby do.

This plan of the Little ARRL, Incorporated, however sinister, is fairly easy of accomplishment, provided the Warner-Segal-Maxim combine desires it. That combine, the key man of which is Warner, controls a majority of the ARRL directors. It controls likewise the executive committee, all of the acts of which are invariably accepted by the ruling majority of the board as their own acts. Warner encountered no obstacles in throwing the Philippines out of the Pacific Division and actually disfranchising the Philippine members in 1930. This was done not only without the knowledge and consent of the Pacific Division but even without the knowledge of the Philippine members themselves! And the Philippines STAYED out until 1932—until Warner was apprised by the then director of this division that unless the Philippine members were restored to their rightful status he and the directors would be taken into court and FORCED to put them back. Now, if Warner could engineer such a violation of all the canons of courtesy and justice as that he could as easly, with the backing of this resolution of the Little ARRL, Incorporated, remove Southern California and Utah, (or any other state), from the Pacific Division. In the Philippine case Warner made the mistake of keeping the project secret from the division members. I suspect that in the present case he is avoiding his former mistake by permitting the present plan to "originate" in an open meeting of Pacific Division amateurs—even though only 155 of the 536 registrants at this convention claimed membership in the ARRL. In which event he would have an alibi such as he failed to provide for himself in the Philippine case. History has a way of repeating itself and the amateur who is unacquainted with it or ignores its lessons is losing the greatest opportunity for seeing what is going on under the surface today.

The Little ARRL, Incorporated, is a federation only in name. The association of the amateur body with it is loose in the extreme. Its members are such of the southern clubs as have joined it. Its meetings consist of its officers and such "delegates" of the member clubs as put in an appearance. The rank and file of the clubs know little and care less of the inner workings of Little ARRL, Inc. The scheme is to make a small group appear to be speaking for a large body of amateurs—to make the Little ARRL, Inc., appear to be speaking for all the amateurs of Southern California, just as the Big ARRL, Inc., has conveyed the impression that it is composed wholly of amateurs and that it speaks for all the amateurs of the United States, while in fact it is composed largely of commercial radio people and other non-amateurs with only a small proportion of the amateurs of America in it. Its motivation is essentially the aim of a few men to dominate the amateurs of Southern California, regardless of how few may have any interest in either the Little ARRL, Inc., or the Big ARRL, Inc. However wholehearted may be the moving spirits of the Little ARRL, back of it all lies the aspiration to shine as IT.

It is common belief that this group of secessionists is a Warner outfit. There is much evidence to substantiate the belief. The character of correspondence between the group and the ARRL headquarters points to it. And last year when the San Jose Club—long villified by headquarters—sponsored the division convention, no headquarters man was sent to it—while not long afterwards when the newly hatched "federation" worked up a hamfest under its own name Warner sent his right-hand man, Budlong. The only instance of which I have heard of the ARRL's money being spent to send a man clear across the continent to a mere hamfest. At the Fresno convention it was again Budlong. Much of his time was spent in the company of officers of the Little ARRL. And after the convention he was again with them in and around Los Angeles. If Budlong had disapproved of the Federation's plan to disrupt the Pacific Division it is a cinch that Matney would never have offered his resolution. The plan must have had at least Budlong's tacit approval. It would not have had his approval without having Warner's approval. So much is certain; for with Budlong as with everyone else on Warner's staff he plays Warner's game or he loses his job. And fat jobs aren't picked out of the bushes these days.

Officers of the Little ARRL definitely approved Warner's action in failing to report the truth of the Madrid convention. They approved of Warner's actions in Washington against the efforts of amateurs all over the country who were striving to prevent ratification of the new amateur restriction, thus providing the spectacle of a group of amateurs siding with the commercial element that had contrived the new restriction—the spectacle of Pacific Division amateurs approving a new restriction devised for killing the greatest continuous public service ever performed by the amateurs (and performed almost wholly by Pacific Division amateurs) —the trans-Pacific traffic. So when we call this group of secessionists a Warner outfit we do so with deep conviction.

The proponents of the secession plan had only two reasons to advance for it. They had some arguments besides, but when their talk was divested of inconsequentials and irrelevancies the reasons boiled down to just two—(1), That Mr. Culver, director for the division, lives too far from them to come and see them as often as they would like, and, (2), That the ARRL members of the division are so numerous they cannot be properly represented by one director at the yearly meetings of the board.

As for No. 1—There are some wise, grown-up amateurs in Southern California, and in all the years of the Pacific Division's existence none of these men has ever intimated that a director residing in the San Francisco area was too far away. Anyone in any part of the division who wishes to confer personally with the director is welcome to do so. If a man wishes to see the director there is no reason why the director should always be the man to do the traveling. The director attends a number of important gatherings each year in different parts of the division. There is no reason why a director should attend every hamfest, nor does he—even in his own vicinity. If he had no better use for his time than running to hamfests all over the map he would not be exhibiting the common sense needed for a director. Perennial playboys and glad-handers don't make dependable directors. In all the history of the division no intelligent ham ever before kicked because the director resided approximately in the middle of the division. And just remember that Hawaii and the Philippines are also in the Pacific Division.

Claim No. 2 is wholly specious. The truth of the situation is that the secessionists don't like Culver. If they did, it would not have occurred to them that they themselves needed a different director. In their dislike for Culver they are disclosing either that they cannot recognize outstanding ability and character or else that they are taking their cue from someone else who doesn't like him. The ARRL headquarters does not like him; and for the sufficient reason that of all the directors at present on the board he and Director Jabs are the only two who are bent upon cleaning up the mess the ARRL is in. This is the common knowledge of discerning amateurs throughout the United States.

Just presume, for the sake of argument, that the secessionists had got their new division. They would, of course, expect to name a man of their own way of thinking as its director. Now, at the last meeting of the ARRL board, 14 of the 16 directors approved Warner's Madrid conduct just as did the secessionists; so the men of the Little ARRL, Inc., cannot well maintain that they need

(Continued on page 33)

What Goes On Inside a Vacuum Tube

By JAYENAY

● The common triode type of vacuum tube has three elements; a heated cathode, which is the source of the electrons, a control grid, which controls the flow of electrons from the cathodes and a plate, or anode, which receives the electrons which are thrown off the cathode.

It is difficult to directly visualize the action of a triode tube in an electrical circuit without the use of mathematics and equations, but in Fig. 1 an attempt is made to replace the triode vacuum tube with a mechanical analogy which uses electrical and mechanical principles less strange to the layman.

In Fig. 1 there are two separate circuits which have a common ground connection. One circuit terminates in the terminals A and B and includes the solenoid magnet. The other circuit terminates in the terminals X and Y and includes the fixed resistor R2, the variable resistor R1 and the high-voltage battery.

These two circuits are related mechanically through the iron pendulum which is also the movable arm of the variable resistor R1.

When a DC voltage is applied to the terminals A and B, current flows through the circuit energizing the solenoid magnet. The core of this magnet attracts the upper end (that above the fulcrum point) of the pendulum, which therefore swings in the direction indicated by the arrows. When the bottom of the pendulum moves to the right, it moves the point of contact between the pendulum and the resistance R1, thus reducing the total resistance in the right-hand circuit.

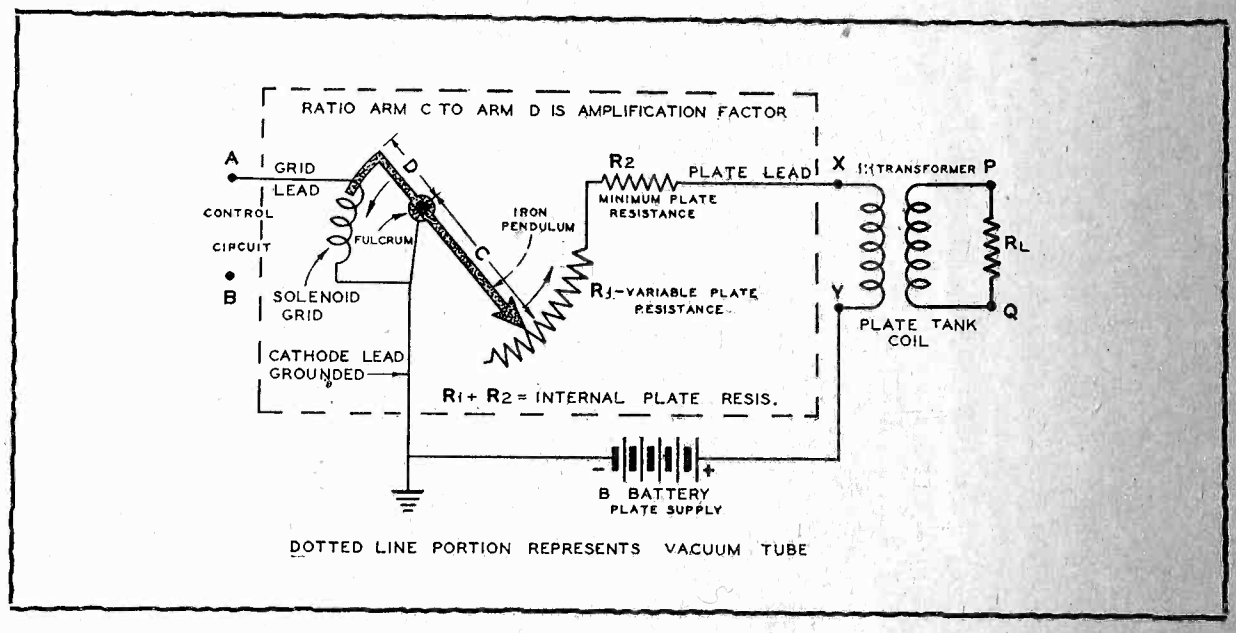
The more voltage applied to terminals AB, the more current will flow through the solenoid magnet, and thus the more the upper end of the iron pendulum will be attracted over to the left. Therefore, the more voltage applied to AB, the lower will be the resistance of R1.

As the lower end of the pendulum is swung up to the right, the more actual power it takes to move it, because the pendulum is becoming more and more horizontal and thus more of its weight is resisting further movement upward to the right.

What has all this to do with a vacuum tube? The solenoid acts as the control grid and R1 and R2 together equal the resistance of the plate-to-cathode electron path; in other words, the plate resistance. The high voltage battery corresponds to the B battery and the output transformer, which corresponds to the load, is connected across the terminals XY. Battery current (DC) flows through the right hand circuit.

As more voltage is applied to the solenoid, the lower the plate resistance (R1) becomes. This lowers the circuit resistance connected across the battery, and consequently more current flows. The more voltage applied to the solenoid, the higher the current goes in the battery, or plate circuit.

Now apply an AC voltage to the solenoid magnet instead of the DC used above. Choose, for the purposes of illustration, a low frequency, 10 cycles per second. Thus as the polarity of the voltage across the solenoid magnet changes, the magnet will alternately attract and repulse the upper end of the pendulum. This causes the resistance of R1 to alternately increase and decrease at 10 cycles per second. This means that the current in the battery, or plate circuit, also alternately increases and decreases at the rate of 10 cycles per second. What effect has this on the output transformer connected across XY? The primary of this transformer has lines of magnetic force set up around it by the presence of the original electric current. When the current is varied by the change in the plate resistance R1, these lines of force change their direction and strength. Thus a varying magnetic field is set up around the primary of the transformer. We know that any coil whose turns are cut by a varying magnetic field has a voltage induced in it. It is not the field that induces the voltage, it is the CHANGE in field. Thus the changes in the magnetic field surrounding the primary of the transformer induce a voltage in the secondary winding, which is wound on the same iron core. Therefore the alternating change in DC current through the primary winding causes an induced AC current to flow through the secondary winding when the secondary circuit is closed by some form of load, such as the voice coil in a loudspeaker.



Briefly, then, a weak alternating voltage applied to the grid (solenoid magnet) circuit causes a large change in plate resistance (R1) which causes a large change in the DC plate current. This large change in DC plate current flows through the primary of the output transformer and induces a large AC voltage in the secondary of the output transformer. Thus the presence of a relatively small AC voltage in the grid (solenoid) circuit controlled the release of a much larger AC voltage in the output transformer.

Consider R2. To what does it correspond in the actual vacuum tube circuit? R2 represents the MINIMUM plate resistance.

This resistance is really a part of R1, but it represents that part of R1 which the pendulum cannot slide across and thus eliminate from the circuit. It is not a constant value of resistance but varies with both the grid excitation and the plate voltage. The higher the grid excitation, the lower this value of minimum resistance, because the higher the grid excitation, the further up R1 the pendulum swings. However, no amount of grid excitation can entirely eliminate the minimum resistance; thus it is shown as a separate resistor. This value of the minimum plate resistance is very important. It should be evident that the higher the value of this minimum resistance, the higher must be the battery voltage (B or plate supply voltage) in order to force the desired amount of current to flow through the plate circuit. The AC current that flows in the secondary of the output transformer is related to the amount of DC that flows through the primary circuit; the more DC that flows from the battery, the more will be the variation in that current which can be caused by the variation in R1.

In transmitting tubes it is found that there is a direct relationship between the minimum plate resistance of the tube and the amount of plate voltage that must be used to obtain a given RF power output, when the tube is used as a class C radio frequency amplifier. For example, the low plate resistance of the new 150-T allows a given amount of power output to be obtained at a materially lower plate voltage than if the type 852 were used, because the 150-T has a considerably lower minimum plate resistance under a given set of conditions.

Because this analogy of vacuum tube performance applies best to class C use of a vacuum tube, it is well to show how high plate efficiency is obtained. Note that there is a load resistance R_L across the secondary of the output transformer. Assume that the amplifier is handling radio frequencies, thus eliminating the iron core from the output transformer. The load resistance can be the resistance of an antenna connected to the secondary. Also assume that the impedance ratio of the output transformer is one-to-one. Thus the AC resistance reflected into the primary circuit is exactly equal to the resistance of the load. The total current that flows through the plate circuit must force its way through R1, R2 and the primary resistance of the output transformer, which in this case is the same as R_L. These resistances are all in series so that the voltage drop, across each resistance, will be proportional to its resistances. It also follows that the POWER dissipated in each resistor will be proportional to its percentage of the total circuit resistance. The power in R1 and R2 is dissipated in the form of radiant heat from the plate of the tube. The power used up by R_L is that power radiated usefully from the antenna. Thus we want to make R_L take as much power as possible and lose as little as possible in R1 and R2.

As the power divides in proportion to the voltages across R1-2 and R_L, it is desirable to make R_L as large as possible and R1-2 as small as possible so that most of the voltage drop will be across R_L. If R_L is nine times as high as R1-2, then the total power dissipated in the circuit will divide 9/10 in R_L and only 1/10 in R1-2. This means that 90 per cent of the power supplied by the bat-

(Continued on page 31)

Practical High Fidelity

By I. A. MITCHELL*

TO THOSE of us who have watched the progress of radio reception from its infancy, the forward movement of the past two years has been of considerable interest. Not only is the engineering fraternity beginning to talk in terms of high fidelity, but high fidelity is actually being sold to the public. The user of broadcast facilities is beginning to realize that in addition to fine studios and artists, program reproduction must have a low distortion level. In keeping with this, broadcast stations are continuously improving fidelity; lines are being equalized

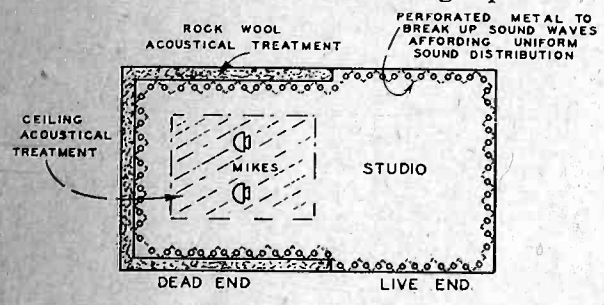


FIG. 1

and better audio equipment is being developed. Unfortunately, not all stations have been able to completely modernize their equipment. Using a real high fidelity radio receiver harmonic distortion and frequency discrimination become quickly apparent and as the dial is twirled to different frequencies, the high fidelity broadcast stations can readily be separtaed from those affording mediocre program fidelity.

Unfortunately, high fidelity as it has been applied to radio receivers during the past year has to an extent been too theoretical. From an engineering viewpoint, it is easy to picture a high fidelity mike placed in an ideal studio—working through a high fidelity transmitter at the broadcast end. It is also easy to picture a flat top tuner—a straight line amplifier—a high fidelity speaker combination at the receiving end. There is but one flaw in this entire picture, namely, acoustic operating conditions. While a microphone or speaker may have a perfect characteristic thirty feet off the ground in an ideal open air test, how will these units operate respectively in the studio or your home?

The importance of acoustics in the broad-

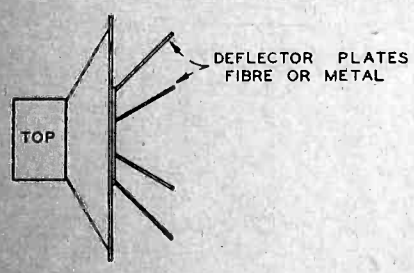


FIG. 2

cast station studio is well attested to by the fact that an entire new studio technique has been developed for high fideliy work. This system is called the "live and dead end" pickup, Fig. 1. From one-half to two-thirds of the studio, depending on its size, is lined with sound absorption material, while the balance of the room is finished off with hard surface walls and ceiling. The microphones are placed in the dead end where every note can be picked up from the program which goes on in the live end. The musicians, at the live end, can gauge their playing with a normal amount of reflection, using this type of studio, while the dead end microphone position eliminates abnormal reflection and standing waves.

Acoustics in the home should be studied just as carefully. When installed, a radio receiver should be placed at least a few inches from the wall or the low frequency response will be affected. It is also desirable to place the set in a number of different positions in the room and so determine where best acoustic conditions exist. Standing waves and objectionable reflections can often be eliminated in this way. The high frequencies reproduced by a high fidelity receiver are highly directional. If a deflector arrangement is not provided with the receiver, it should be added. Fig. 2 illustrates such an arrangement.

In many cases, particularly with modern small apartments, it is difficult to obtain a large baffle area. For true low frequency reproduction, a speaker baffle should be at least six to eight feet square. This is an impossibility in the average home, but equalization of the electrical low frequency end will help compensate for the loss of lows. Another alternative which is being brought to bear in the high fidelity receiver field is the acoustic labyrinth used to simulate a large baffle with a small space requirement. A unit of this type can readily be built by the amateur or experimenter. Put simply, the purpose of a baffle is to eliminate the pressure wave from the front of the speaker diaphragm reaching the rear of the diaphragm. In the acoustical labyrinth this is done on the same principle as a Maxim silencer. Referring to Fig. 3, it is seen that the long acoustic length of the labyrinth is placed between the front and back sides of the speaker diaphragm. To construct a unit of this type, get a wood box about 13 by 13 by 18 inches. The barriers shown consist of a 1-inch thickness of hair felt extending from the top to the bottom of the box supported by chicken-coop wire. A one-inch passage is left at the end of the barrier for the sound pressure wave. At the bottom of the rear of the box an opening 2 inches long is left as an exit for the air. If the unit is operating properly, with normal music coming out of the speaker, practically no sound will be heard at the exit opening of the box.

For ideal audio amplifier fidelity, it is essential that high fidelity transformers be used. Unfortunately, while these are excellent for the broadcast station, laboratory, or high quality sound system, they are too expensive for the average home. Fig. 4 illustrates an amplifier circuit using medium priced components which has excellent fidelity. The amplifier is simple in nature and construction and provision for the tuner filament and plate voltage is provided. The use of two push-pull stages tends to reduce plate and filament hum and eliminates the necessity for parallel feeding the interstage transformer. A special input transformer feeds two 57s connected as triodes which are in turn transformer coupled to two 45s operated A prime self bias. In the circuit shown 10 watts can be obtained from the 45 tubes before 5 per cent distortion is reached. If additional gain is desired, an additional

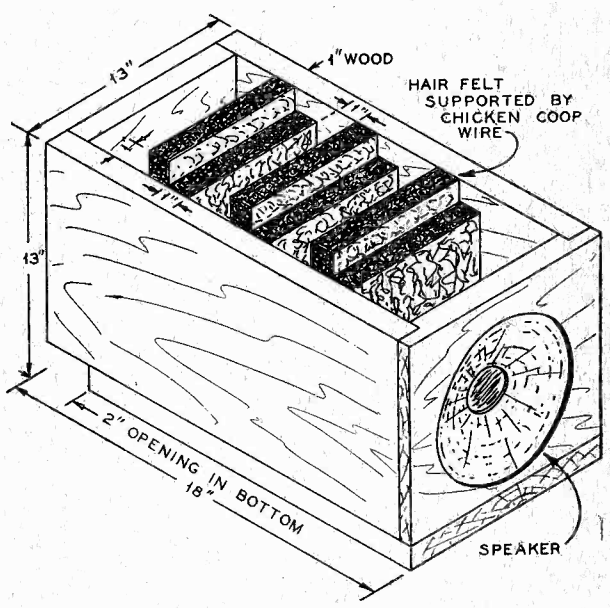


FIG. 3

stage of transformer coupled push-pull 57 triodes is suggested.

The circuit of Fig. 4 shows for the first time a newly developed input transformer having unusual characteristics. The primary of this transformer consists of two wind-

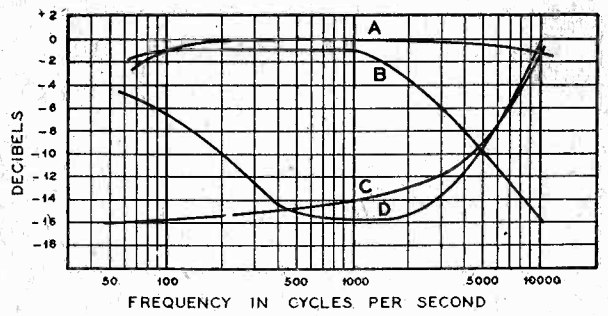


FIG. 5

ings, one is a high impedance winding designed to operate from the plate of an amplifier or detector tube. It is also suitable for use with a high impedance magnetic pickup. The other winding is a center-tapped low impedance winding suitable for

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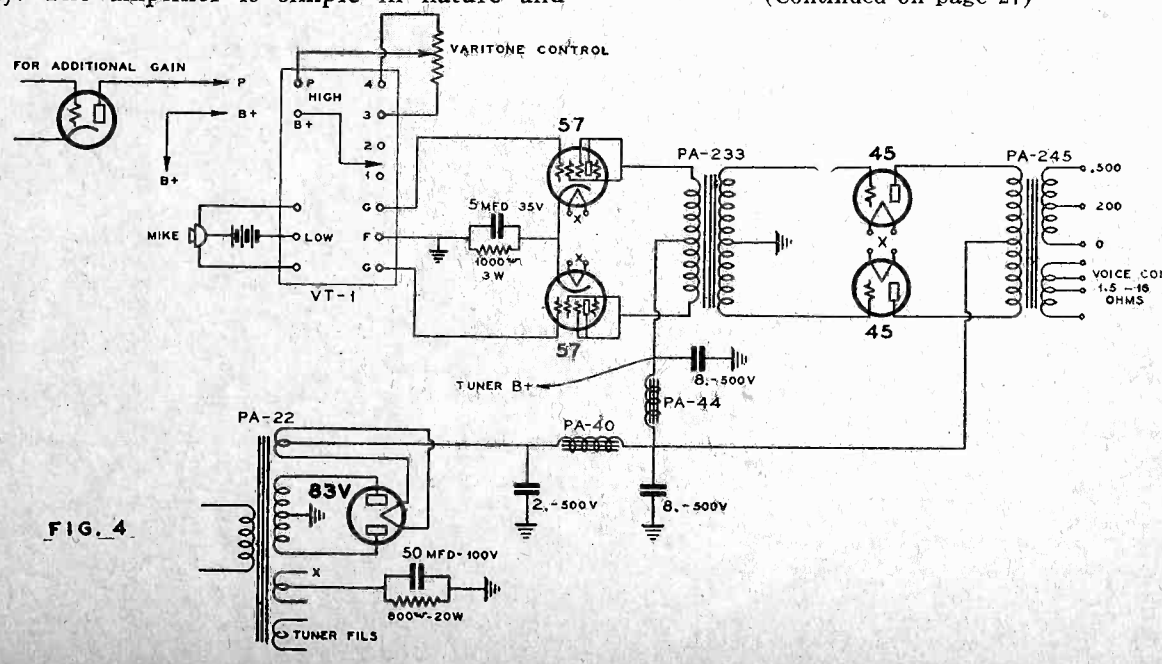


FIG. 4

* Chief Engineer, United Transformer Corp.

The First Practical 5-Meter Super

By FRANK C. JONES
Ultra-Short Wave Editor

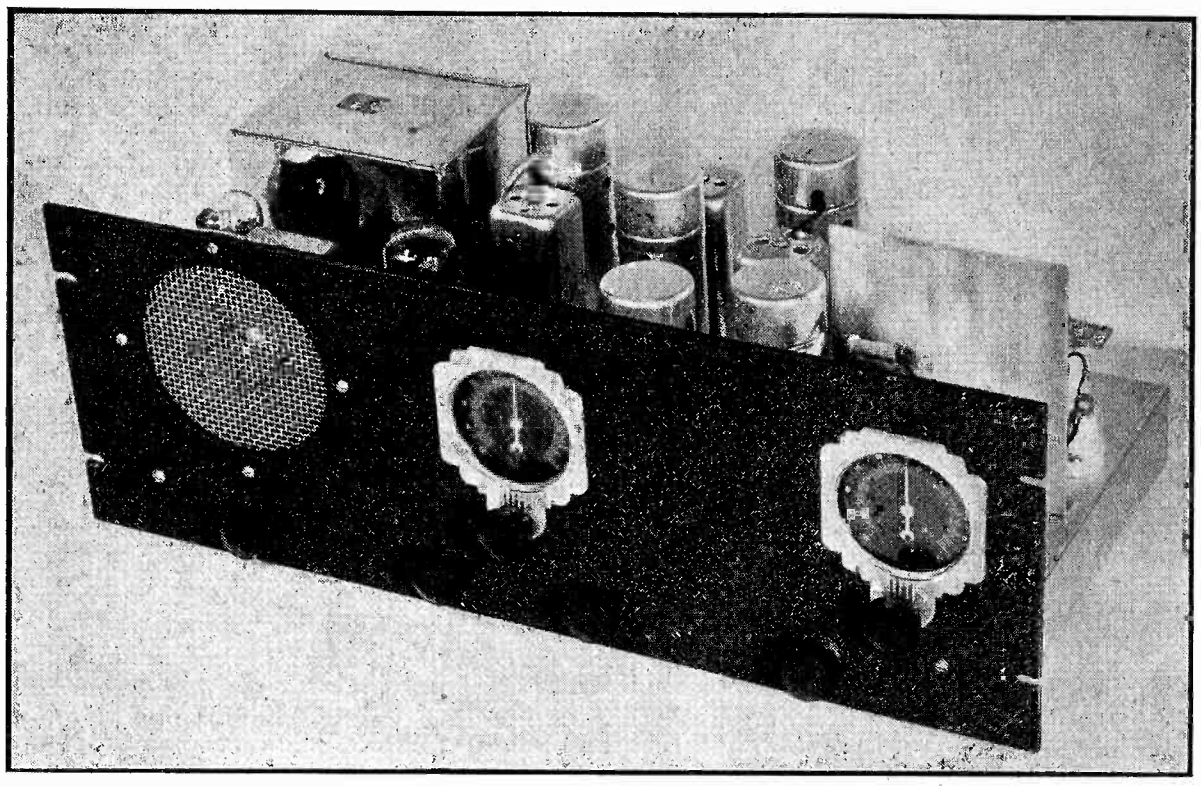
● The writer, in common with other 5-meter experimenters, has always had better luck with super-regenerative receivers than with any other type on the 5-meter band. An analysis of the situation brought out some interesting points, so another superheterodyne receiver was built and the results have been very gratifying. The sensitivity and selectivity of this receiver is better than any super-regenerative receiver that I have ever tested.

For present day purposes, a receiver must tune broadly enough to cover from 50 to 100 KC band width in order to receive the usual modulated oscillator transmitter signals. Very few stations use crystal or MOPA controlled sets and thus a special IF amplifier was built using a short wave about 110 meters for the intermediate frequency. This, with close coil coupling, gave a nice band width and the superheterodyne therefore becomes really practical for present day service.

A superheterodyne receiver for police 8-meter work should also tune broadly, since even with MOPA or crystal control in the car sets, the main station must have a stand-by service without constant retuning. The ordinary first oscillator in the superheterodyne will drift from 20 to 80 KC as its temperature changes and with variations of line voltage. This means that the IF amplifier should be broad enough in its tuning to take care of this oscillator drift. The car transmitters are also liable to drift; therefore the IF amplifier should be broad.

Most 5-meter superhets have lots of noise and very little signal. The trouble usually lies in too much IF gain and not enough RF gain ahead of the mixer tube. A straight RF amplifier will provide some gain, but regeneration is the real answer. Regeneration at the IF frequency does no good, but it can be used in either the RF stage or in the detector grid circuit. Both methods were tried and best results were obtained by using regeneration in the detector circuit, since antenna resonance has no effect of dead spots in the regeneration control. Better weak signal response from a signal generator was obtained by using first detector cathode tap regeneration than when the same method was used for the RF tube.

The RF stage provides a little additional gain where it is really needed, reduces image interference, and removes antenna resonance absorption spots from the regenerative circuit. This combination brings in 5-meter signals that are inaudible on super-regenerative sets using a stage of TRF. The same results were obtained in comparing it with an ordinary transceiver set.



● The front panel presents a symmetrical and pleasing arrangement. The loud-speaker is protected with a metal grille. Illuminated Crowe airplane tuning dials add beauty to the job. The panel is of standard relay rack.

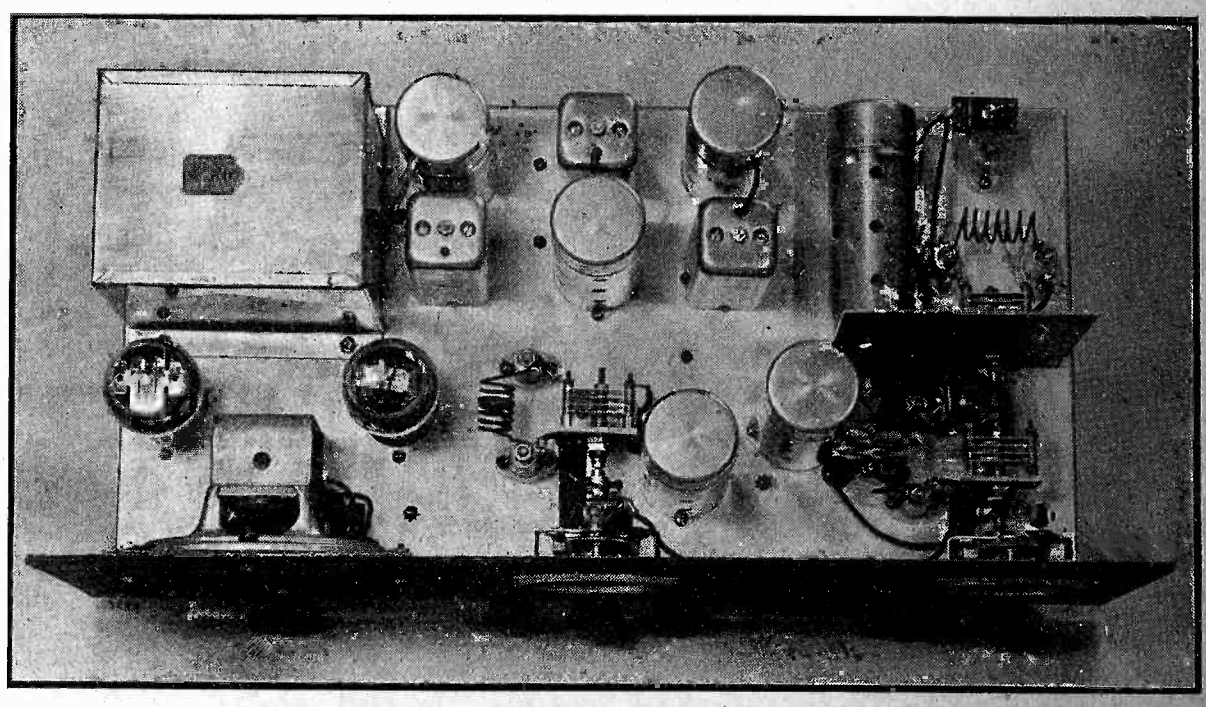
The image interference is minimized because of regeneration and two pre-selection tuned circuits. The IF frequency being about 2.7 megacycles, the image is 5.4 MC away from the desired signal. This means no image interference from other amateur signals in the 5-meter band of from 56 to 60 MC.

AVC was included in this set to prevent overload on strong local signals. To provide maximum sensitivity, delayed AVC was used and this voltage applied to the grids of the two IF stages only. An audio volume control is used to maintain the desired amount of loudspeaker volume. The sensitivity control, a 50,000 ohm IF cathode variable resistor, could have been made 5,000 or 10,000 ohms with a slotted shaft for screwdriver adjustment only, since the usual field strength of 5-meter transmitters is quite low.

Examination of the circuit will show that the RF and detector circuits are quite similar to those used in longer wave sets. These two circuits are tuned by a gang condenser made from a couple of midget condensers. The condensers were originally 100 mmfd type and later were double spaced and only 7 plates left in each condenser. Double spacing helps on 5 meters since the condensers are less microphonic when the loudspeaker is being operated at good room volume. Trimming the detector and RF stage is accomplished by means of the semi-variable coupling condensers from the antenna to grid, and plate to grid of the respective stages. The coils were made of No. 14 wire so the inductances can be varied by slightly altering the turn spacing. No attempt was made to track the oscillator with the other two circuits, although this could probably be accomplished. Regeneration makes the detector tuning about as sharp as that of the oscillator.

The second detector and audio power stage is quite similar to that used in some broadcast receivers. Delayed AVC is obtained by using one of the diode plates biased with respect to the cathode. The signal must be of a certain amplitude before any negative AVC voltage is generated for AVC control. The audio frequency is taken from the other diode plate without any bias, since the latter would cause audio distortion. The high mu triode section of the 75 tube is used as a regular resistance coupled audio stage giving a gain of about 40 to 50. A type 42 pentode increases the signal to loudspeaker volume.

A tone control is provided to reduce automobile ignition interference which is quite serious when using a superheterodyne receiver in most locations. A high half-wave receiving antenna, transposed two wire feeders and an electrostatic shield should reduce



● Looking down into the 5-meter Super. The RF coil is mounted horizontally to permit the use of very short leads. An aluminum shield isolates the RF stage from the detector. The inductances are mounted on porcelain stand-off insulators. The power transformer is at the left rear of the chassis. It is the new UTC Niklshield unit, with 6.3 volt filament winding. The midget dynamic speaker is a 5-inch Magnavox.

this trouble. The antenna coupling condenser should then be connected across the tuning condenser and a Faraday electrostatic shield placed between the tuned grid coil and tuned antenna feeder coil. Most of the auto QRM is picked up in the down leads and is transferred beautifully by even the slightest bit of capacity coupling. The receiver should be mounted in a relay rack with a metal dust cover, or in a metal cabinet if used on a table or desk. Too much emphasis cannot be placed on the need of using an efficient, noise-reducing type of receiving antenna.

Several oscillator circuits were tried and best results were had from a 76 tube instead of the usual electron coupled 6C6 or screen grid tubes. A form of electron coupling is used to the mixer tube because the suppressor grid is used for that purpose. This puts the suppressor grid at a positive potential of about 100 or so, since it ties directly to the oscillator plate. However, this seems to give better conversion gain in a regenerative detector than any other system tried. Invariably, comparisons between capacity coupling or any other form and this method, gave the latter the edge by about two or three times in sensitivity.

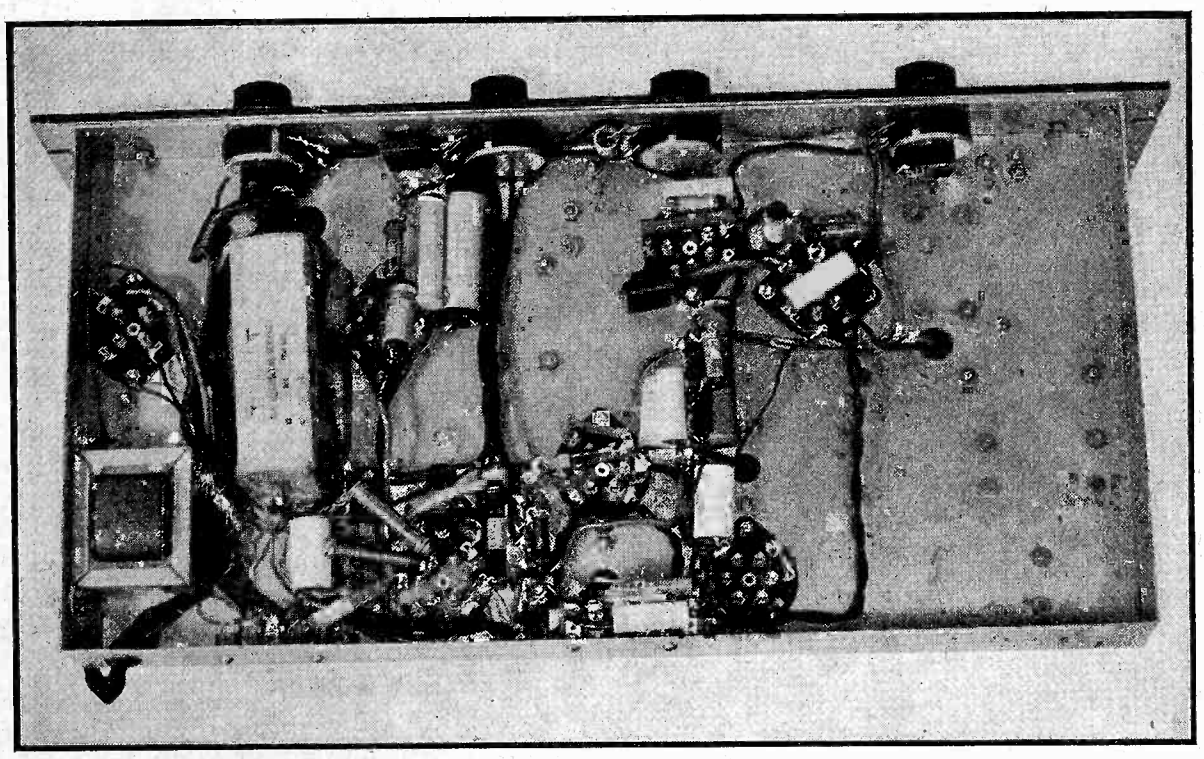
The receiver is mounted on a 7 x 19 x $\frac{3}{16}$-inch aluminum panel for relay rack mounting. The holes for the loudspeaker opening and the two airplane type dials can be cut by means of a flying bar cutter. The chassis was made of No. 14 gauge aluminum because it is easily drilled and does not require plating. The chassis measures 9 x 17½ x 1¾ inches. The pictures of the set give a good idea of the general layout of the parts. The signal comes in at the grid of the horizontally-mounted RF tube, through the first detector, two IF stages, second detector and power audio stage. The power equipment and loudspeaker are mounted at one end and the RF portion at the other. The IF amplifier occupies the rear middle portion and the high frequency oscillator the front middle portion. The oscillator tuning condenser must have an insulating coupling to the dial because this circuit is "hot" at both ends of the LC circuit.

The two radio frequency chokes were made by winding about an inch of winding length of No. 34 DSC on a ⅜-inch diameter bakelite rod. All of the coils were made of No. 14 wire, space wound on a half-inch diameter. These coils are mounted on small stand-off insulators near the tuning condenser terminals and they can be changed in a few minutes, if the receiver is to be used on some other short wave band.

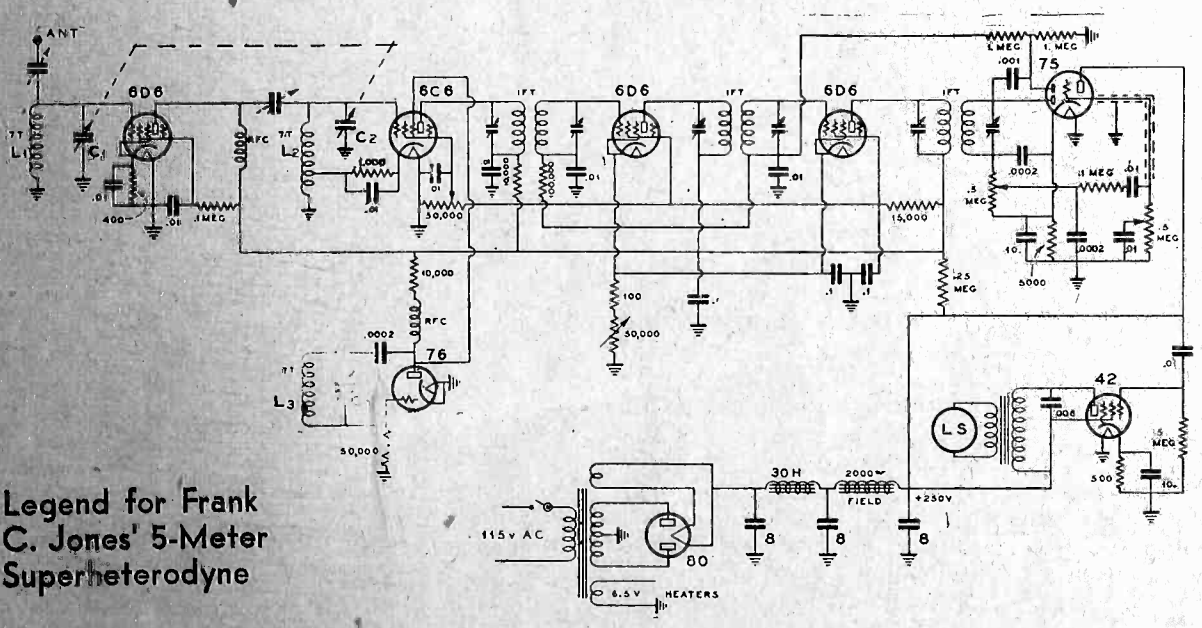
The RF tube was mounted horizontally so as to obtain a short plate lead to the detector grid circuit. All of the RF stage by-pass leads are very short and return to the common ground point on the RF partition shield. By making this point at the tuning condenser rotor connection, interlock between the RF and detector circuits is avoided. Short leads are necessary in 5-meter work because an extra inch of wire adds quite an appreciable value of inductance.

The IF amplifier uses about 2.7 MC as its frequency. The transformers were home-made affairs, using the parts of regular IF transformers. Those used in this set were wound on ⅜-inch diameter tubes. The 450 KC litz coils were removed and two windings each of 120 turns of No. 34 DSC wire put on in jumble fashion to cover a winding length of ⅜-inch. ⅛-inch spacing was used between adjacent coil edges. These windings, tuned with the mica trimmers of the original transformer, cover from approximately 100 to 120 meters. If one lives very close to a 120 meter police station it would be desirable to use about 100 turns and tune the transformers to about 90 or 100 meters. The first transformers tested used litz wire and were made by pulling off 40 feet of wire from each coil and closing up the coupling until adjacent coils were ¼-inch apart. The IF frequency was adjusted to 1550 KC, but the selectivity was a little too great and the image interference was troublesome. The higher frequency of 2700 KC or 2.7 MC proved to be best. So far no trouble has developed due to IF amplifier pick-up from the antenna circuit on 110 meters. This is minimized by the use of the RF preselector stags and shielding.

The IF amplifier should be lined-up by means of a modulated oscillator of the all-wave type. Starting from the second detector circuit, each stage should be aligned by coupling to the oscillator, then a recheck made of the overall amplifier by coupling the oscillator into the first detector grid circuit. The latter should connect temporarily through a 1000 ohm resistor to ground instead of to its LC circuit, while aligning this IF amplifier.



Under-chassis view, showing proper location for filter choke and condensers.



Legend for Frank C. Jones' 5-Meter Superheterodyne

L1 and L2—Each 1½ in. long, 7 turns, No. 14 enameled wire, ½ in. dia. turns. L3—1 in. long, 7 turns, No. 14 enameled wire, ½-in. dia.

C1, C2, C3—100uufd. double-spaced variable condensers, with only 7 of the original plates remaining. Maximum capacity of these re-built condensers to be about 18uufd.

I.F. Transformers tuned to approximately 2,000 KC.

An interesting test was made with a signal generator and a small radiating antenna. A regular receiving antenna was first connected to a good super-regenerative receiver and the signal attenuated in the generator until it was just barely noticeable in the high background noise of this form of receiver. The super-regenerator was then replaced with the superheterodyne receiver and this same signal gave loudspeaker volume without the background noise of the other set. The absence of background hiss is especially pleasant when comparing the two sets for loudspeaker operation. When the auto ignition noise level is low, the 5-meter signals roll in and out without any fuss or change of hiss level, making it difficult to tell an R9 signal from an R6 signal. If the local flashing sign or auto ignition QRM is high, the 5-meter signal strength can be judged by the amount that it overrides the noise level.

What Goes On Inside a Vacuum Tube

By JAYENAY

● The common triode type of vacuum tube has three elements; a heated cathode, which is the source of the electrons, a control grid, which controls the flow of electrons from the cathodes and a plate, or anode, which receives the electrons which are thrown off the cathode.

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In Fig. 1 there are two separate circuits which have a common ground connection. One circuit terminates in the terminals A and B and includes the solenoid magnet. The other circuit terminates in the terminals X and Y and includes the fixed resistor R2, the variable resistor R1 and the high-voltage battery.

These two circuits are related mechanically through the iron pendulum which is also the movable arm of the variable resistor R1.

When a DC voltage is applied to the terminals A and B, current flows through the circuit energizing the solenoid magnet. The core of this magnet attracts the upper end (that above the fulcrum point) of the pendulum, which therefore swings in the direction indicated by the arrows. When the bottom of the pendulum moves to the right, it moves the point of contact between the pendulum and the resistance R1, thus reducing the total resistance in the right-hand circuit.

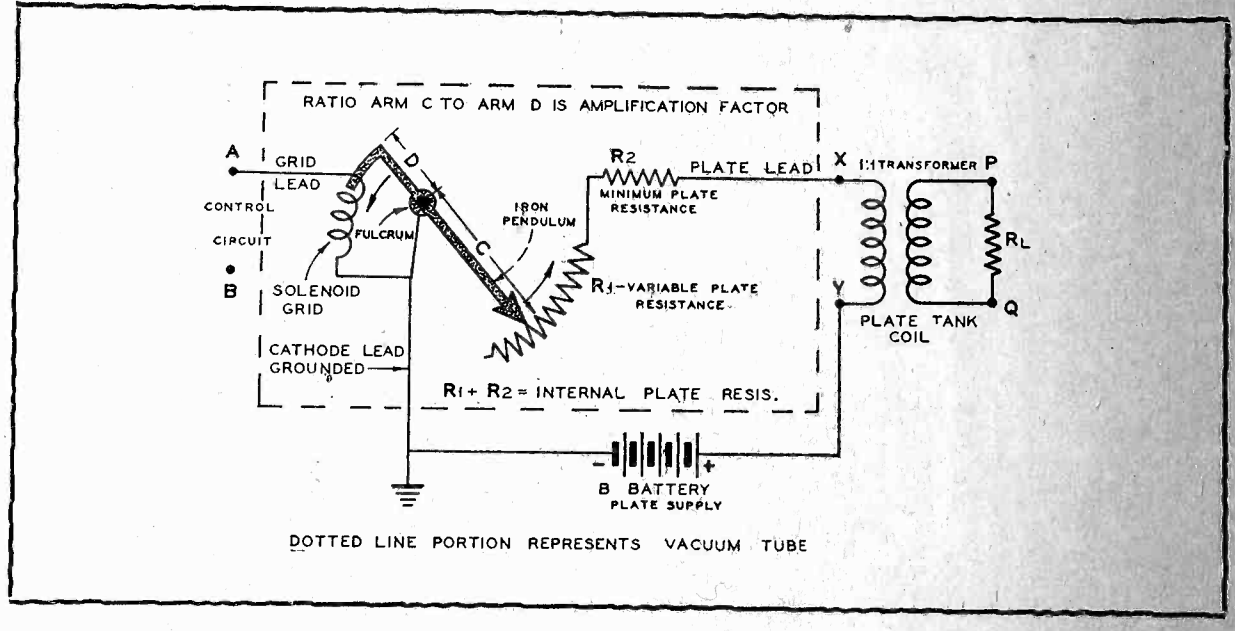
The more voltage applied to terminals AB, the more current will flow through the solenoid magnet, and thus the more the upper end of the iron pendulum will be attracted over to the left. Therefore, the more voltage applied to AB, the lower will be the resistance of R1.

As the lower end of the pendulum is swung up to the right, the more actual power it takes to move it, because the pendulum is becoming more and more horizontal and thus more of its weight is resisting further movement upward to the right.

What has all this to do with a vacuum tube? The solenoid acts as the control grid and R1 and R2 together equal the resistance of the plate-to-cathode electron path; in other words, the plate resistance. The high voltage battery corresponds to the B battery and the output transformer, which corresponds to the load, is connected across the terminals XY. Battery current (DC) flows through the right hand circuit.

As more voltage is applied to the solenoid, the lower the plate resistance (R1) becomes. This lowers the circuit resistance connected across the battery, and consequently more current flows. The more voltage applied to the solenoid, the higher the current goes in the battery, or plate circuit.

Now apply an AC voltage to the solenoid magnet instead of the DC used above. Choose, for the purposes of illustration, a low frequency, 10 cycles per second. Thus as the polarity of the voltage across the solenoid magnet changes, the magnet will alternately attract and repulse the upper end of the pendulum. This causes the resistance of R1 to alternately increase and decrease at 10 cycles per second. This means that the current in the battery, or plate circuit, also alternately increases and decreases at the rate of 10 cycles per second. What effect has this on the output transformer connected across XY? The primary of this transformer has lines of magnetic force set up around it by the presence of the original electric current. When the current is varied by the change in the plate resistance R1, these lines of force change their direction and strength. Thus a varying magnetic field is set up around the primary of the transformer. We know that any coil whose turns are cut by a varying magnetic field has a voltage induced in it. It is not the field that induces the voltage, it is the CHANGE in field. Thus the changes in the magnetic field surrounding the primary of the transformer induce a voltage in the secondary winding, which is wound on the same iron core. Therefore the alternating change in DC current through the primary winding causes an induced AC current to flow through the secondary winding when the secondary circuit is closed by some form of load, such as the voice coil in a loudspeaker.



Briefly, then, a weak alternating voltage applied to the grid (solenoid magnet) circuit causes a large change in plate resistance (R1) which causes a large change in the DC plate current. This large change in DC plate current flows through the primary of the output transformer and induces a large AC voltage in the secondary of the output transformer. Thus the presence of a relatively small AC voltage in the grid (solenoid) circuit controlled the release of a much larger AC voltage in the output transformer.

Consider R2. To what does it correspond in the actual vacuum tube circuit? R2 represents the MINIMUM plate resistance.

This resistance is really a part of R1, but it represents that part of R1 which the pendulum cannot slide across and thus eliminate from the circuit. It is not a constant value of resistance but varies with both the grid excitation and the plate voltage. The higher the grid excitation, the lower this value of minimum resistance, because the higher the grid excitation, the further up R1 the pendulum swings. However, no amount of grid excitation can entirely eliminate the minimum resistance; thus it is shown as a separate resistor. This value of the minimum plate resistance is very important. It should be evident that the higher the value of this minimum resistance, the higher must be the battery voltage (B or plate supply voltage) in order to force the desired amount of current to flow through the plate circuit. The AC current that flows in the secondary of the output transformer is related to the amount of DC that flows through the primary circuit; the more DC that flows from the battery, the more will be the variation in that current which can be caused by the variation in R1.

In transmitting tubes it is found that there is a direct relationship between the minimum plate resistance of the tube and the amount of plate voltage that must be used to obtain a given RF power output, when the tube is used as a class C radio frequency amplifier. For example, the low plate resistance of the new 150-T allows a given amount of power output to be obtained at a materially lower plate voltage than if the type 852 were used, because the 150-T has a considerably lower minimum plate resistance under a given set of conditions.

Because this analogy of vacuum tube performance applies best to class C use of a vacuum tube, it is well to show how high plate efficiency is obtained. Note that there is a load resistance R_L across the secondary of the output transformer. Assume that the amplifier is handling radio frequencies, thus eliminating the iron core from the output transformer. The load resistance can be the resistance of an antenna connected to the secondary. Also assume that the impedance ratio of the output transformer is one-to-one. Thus the AC resistance reflected into the primary circuit is exactly equal to the resistance of the load. The total current that flows through the plate circuit must force its way through R1, R2 and the primary resistance of the output transformer, which in this case is the same as R_L. These resistances are all in series so that the voltage drop, across each resistance, will be proportional to its resistances. It also follows that the POWER dissipated in each resistor will be proportional to its percentage of the total circuit resistance. The power in R1 and R2 is dissipated in the form of radiant heat from the plate of the tube. The power used up by R_L is that power radiated usefully from the antenna. Thus we want to make R_L take as much power as possible and lose as little as possible in R1 and R2.

As the power divides in proportion to the voltages across R1-2 and R_L, it is desirable to make R_L as large as possible and R1-2 as small as possible so that most of the voltage drop will be across R_L. If R_L is nine times as high as R1-2, then the total power dissipated in the circuit will divide 9/10 in R_L and only 1/10 in R1-2. This means that 90 per cent of the power supplied by the bat-

(Continued on page 31)

Practical High Fidelity

By I. A. MITCHELL*

TO THOSE of us who have watched the progress of radio reception from its infancy, the forward movement of the past two years has been of considerable interest. Not only is the engineering fraternity beginning to talk in terms of high fidelity, but high fidelity is actually being sold to the public. The user of broadcast facilities is beginning to realize that in addition to fine studios and artists, program reproduction must have a low distortion level. In keeping with this, broadcast stations are continuously improving fidelity; lines are being equalized

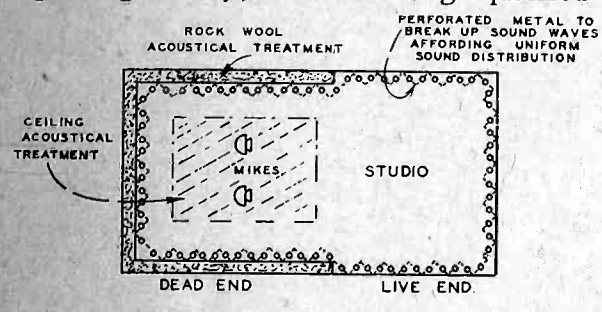


FIG. 1

and better audio equipment is being developed. Unfortunately, not all stations have been able to completely modernize their equipment. Using a real high fidelity radio receiver harmonic distortion and frequency discrimination become quickly apparent and as the dial is twirled to different frequencies, the high fidelity broadcast stations can readily be separtaed from those affording mediocre program fidelity.

Unfortunately, high fidelity as it has been applied to radio receivers during the past year has to an extent been too theoretical. From an engineering viewpoint, it is easy to picture a high fidelity mike placed in an ideal studio—working through a high fidelity transmitter at the broadcast end. It is also easy to picture a flat top tuner—a straight line amplifier—a high fidelity speaker combination at the receiving end. There is but one flaw in this entire picture, namely, acoustic operating conditions. While a microphone or speaker may have a perfect characteristic thirty feet off the ground in an ideal open air test, how will these units operate respectively in the studio or your home?

The importance of acoustics in the broad-

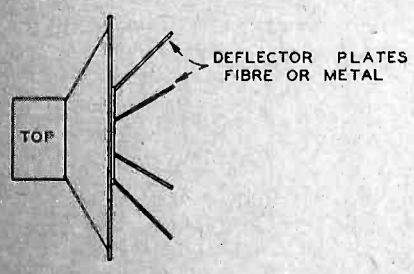


FIG. 2

cast station studio is well attested to by the fact that an entire new studio technique has been developed for high fideliy work. This system is called the "live and dead end" pickup, Fig. 1. From one-half to two-thirds of the studio, depending on its size, is lined with sound absorption material, while the balance of the room is finished off with hard surface walls and ceiling. The microphones are placed in the dead end where every note can be picked up from the program which goes on in the live end. The musicians, at the live end, can gauge their playing with a normal amount of reflection, using this type of studio, while the dead end microphone position eliminates abnormal reflection and standing waves.

Acoustics in the home should be studied just as carefully. When installed, a radio receiver should be placed at least a few inches from the wall or the low frequency response will be affected. It is also desirable to place the set in a number of different positions in the room and so determine where best acoustic conditions exist. Standing waves and objectionable reflections can often be eliminated in this way. The high frequencies reproduced by a high fidelity receiver are highly directional. If a deflector arrangement is not provided with the receiver, it should be added. Fig. 2 illustrates such an arrangement.

In many cases, particularly with modern small apartments, it is difficult to obtain a large baffle area. For true low frequency reproduction, a speaker baffle should be at least six to eight feet square. This is an impossibility in the average home, but equalization of the electrical low frequency end will help compensate for the loss of lows. Another alternative which is being brought to bear in the high fidelity receiver field is the acoustic labyrinth used to simulate a large baffle with a small space requirement. A unit of this type can readily be built by the amateur or experimenter. Put simply, the purpose of a baffle is to eliminate the pressure wave from the front of the speaker diaphragm reaching the rear of the diaphragm. In the acoustical labyrinth this is done on the same principle as a Maxim silencer. Referring to Fig. 3, it is seen that the long acoustic length of the labyrinth is placed between the front and back sides of the speaker diaphragm. To construct a unit of this type, get a wood box about 13 by 13 by 18 inches. The barriers shown consist of a 1-inch thickness of hair felt extending from the top to the bottom of the box supported by chicken-coop wire. A one-inch passage is left at the end of the barrier for the sound pressure wave. At the bottom of the rear of the box an opening 2 inches long is left as an exit for the air. If the unit is operating properly, with normal music coming out of the speaker, practically no sound will be heard at the exit opening of the box.

For ideal audio amplifier fidelity, it is essential that high fidelity transformers be used. Unfortunately, while these are excellent for the broadcast station, laboratory, or high quality sound system, they are too expensive for the average home. Fig. 4 illustrates an amplifier circuit using medium priced components which has excellent fidelity. The amplifier is simple in nature and construction and provision for the tuner filament and plate voltage is provided. The use of two push-pull stages tends to reduce plate and filament hum and eliminates the necessity for parallel feeding the interstage transformer. A special input transformer feeds two 57s connected as triodes which are in turn transformer coupled to two 45s operated A prime self bias. In the circuit shown 10 watts can be obtained from the 45 tubes before 5 per cent distortion is reached. If additional gain is desired, an additional

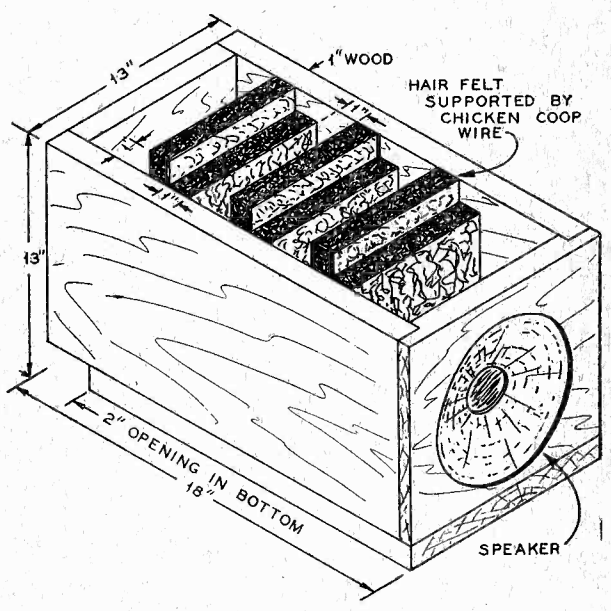


FIG. 3

stage of transformer coupled push-pull 57 triodes is suggested.

The circuit of Fig. 4 shows for the first time a newly developed input transformer having unusual characteristics. The primary of this transformer consists of two wind-

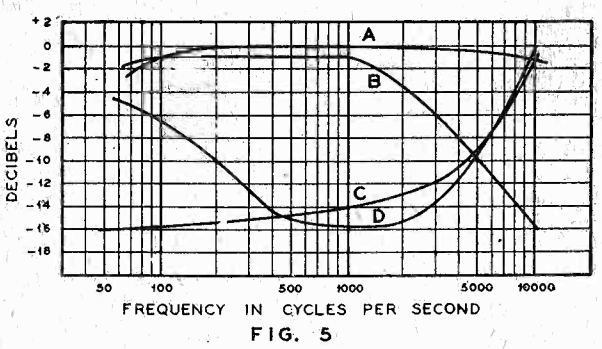


FIG. 5

ings, one is a high impedance winding designed to operate from the plate of an amplifier or detector tube. It is also suitable for use with a high impedance magnetic pickup. The other winding is a center-tapped low impedance winding suitable for

(Continued on page 27)

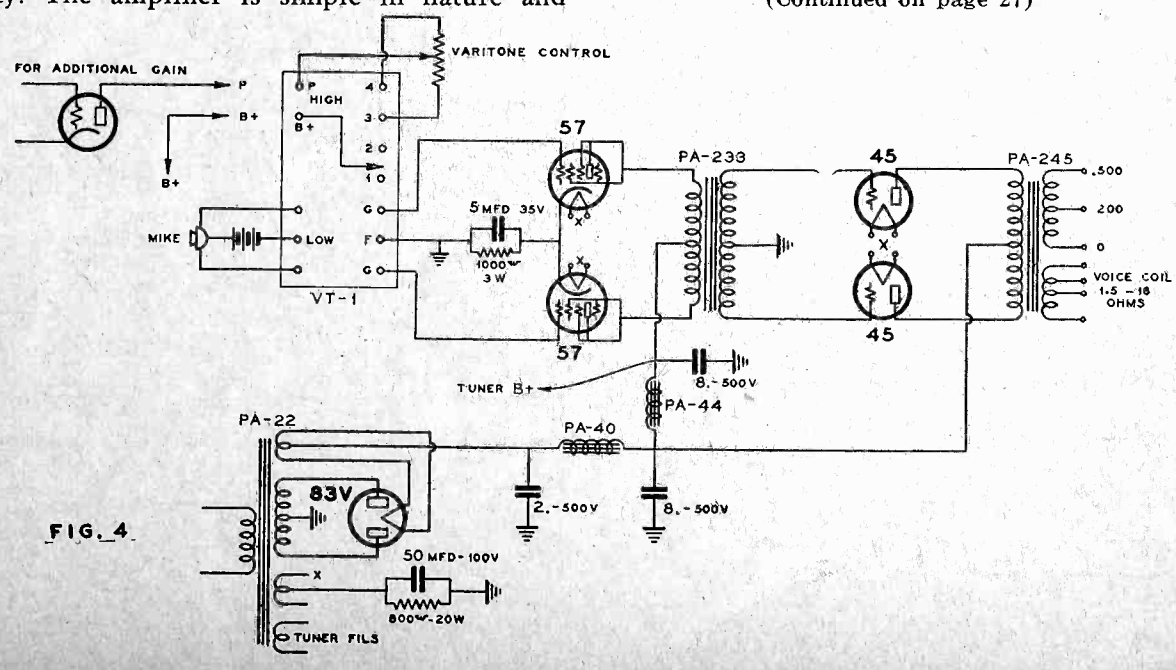


FIG. 4

* Chief Engineer, United Transformer Corp.

New RCA-802 Amplifier Oscillator

● RCA-802 is a pentode transmitting tube of the heater-cathode type for use as an RF amplifier, frequency-multiplier, oscillator, and suppressor- or grid-modulated amplifier. The plate connection is brought out through a separate seal at the top of the bulb to maintain low grid-plate capacitance. Neutralization to prevent feedback and self-oscillation is generally unnecessary. The suppressor and the special internal shield of the 802 are connected to individual base pins.

TENTATIVE CHARACTERISTICS

Heater voltage (AC or DC)	6.3 Volts
Heater current	0.95 Amp.
Grid-plate capacitance (max.)	0.15 uuf
Screen-plate capacitance	0.5 uuf
Input capacitance	12 uuf
Output capacitance	8.5 uuf
Bulb	ST-16
Overall length	$5\frac{15}{32}$"-$5\frac{23}{32}$"
Maximum diameter	$2\frac{1}{16}$"
Cap	small metal
Base	medium 7-pin bayonet

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

As RF Power Amplifier—Class B (Telephony)*
(Carrier Conditions; for use with a Modulation Factor up to 1.0)

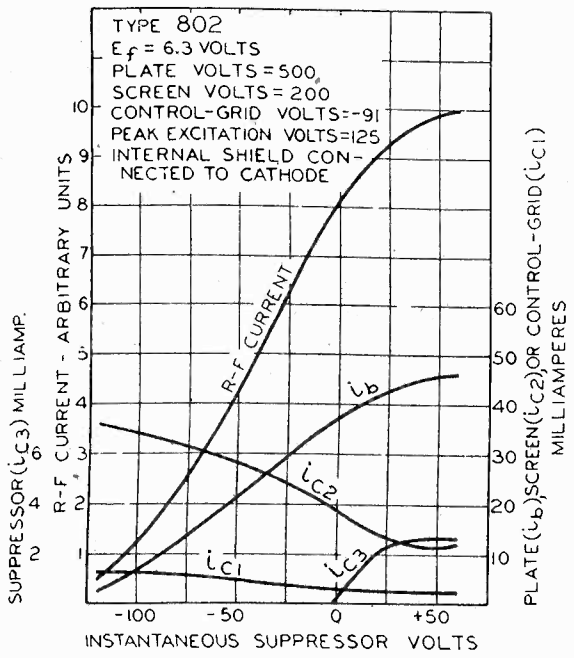
Screen voltage (Grid No. 2)	250 **max.**	Volts
DC plate voltage	500 **max.**	Volts
Suppressor voltage	40 **max.**	Volts
DC plate current	30 **max.**	MA
Plate dissipation	10 **max.**	Watts
Screen dissipation	4 **max.**	Watts

TYPICAL OPERATION:

DC plate voltage	400	500	Volts
Screen voltage (Grid No. 2)	150	200	Volts
Grid voltage, approx. (Grid No. 1)	—22	—28	Volts
Suppressor voltage (Grid No. 3)	0	0	Volts
Peak RF grid voltage	70	63	Volts
DC plate current	25	25	MA
DC screen current	6.5	7.0	MA
Driving power (approx.)	0.5	0.18	Watts
Peak power output (approx.)	11	14	Watts
Carrier power output (approx.)	2.75	3.5	Watts

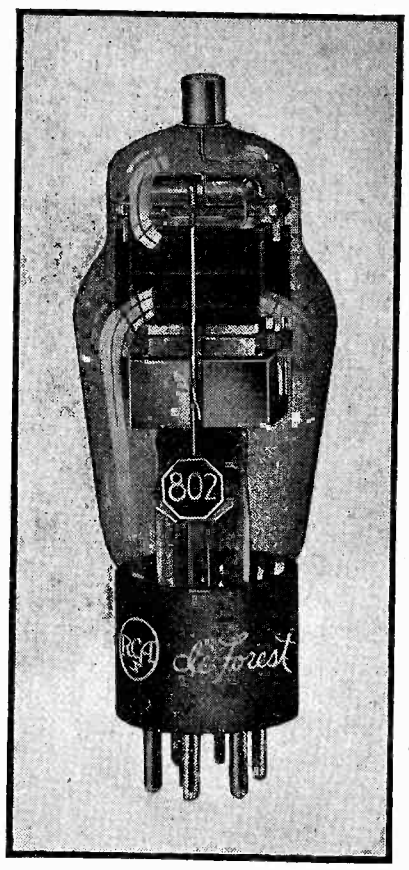
* Grid No. 1 is control grid; grid No. 2 is screen; grid No. 3 tied to cathode; internal shield tied to cathode.

SUPPRESSOR MODULATION CHARACTERISTICS



As RF Amplifier—Class C Telephony (Suppressor Modulation)**
(Carrier Conditions; for use with a Modulation Factor up to 1.0)

DC plate voltage		500 **max.**	Volts
Screen voltage		200 **max.**	Volts
DC plate current		30 **max.**	MA
DC grid current		7.5 **max.**	MA
Plate dissipation		10 **max.**	Watts
Screen dissipation		6 **max.**	Watts
TYPICAL OPERATION:			
DC plate voltage	400	500	500 Volts
Screen voltage	150	200	200 Volts
Grid voltage (approx.)	—85	—90	—90 Volts
Suppressor voltage (approx.)	—40	—53	—45 Volts
Peak AF suppressor voltage	40	53	65 Volts
Peak RF grid voltage	125	125	125 Volts
DC plate current	18	20	22 MA
DC screen current	28	28	28 MA
DC grid current	7.5	5.0	4.5 MA
Driving power (aprox.)	0.9	0.6	0.5 Watts
Peak power output (approx.)	8	12	14 Watts
Carrier power output (appr.)	2	3	3.5 Watts



RCA-802

** Grid No. 1 is control grid; grid No. 2 is screen; grid No. 3 is suppressor; internal shield tied to cathode.

As RF Amplifier—Class C Telephony (Grid Modulation)†
(Carrier Conditions; for use with a Modulation Factor up to 1.0)

DC plate voltage		500 **max.**	Volts
Screen voltage		250 **max.**	Volts
Suppressor voltage		40 **max.**	Volts
DC plate current		30 **max.**	MA
Plate dissipation		10 **max.**	Watts
Screen dissipation		4 **max.**	Watts
TYPICAL OPERATION:			
DC plate voltage	400	500	Volts
Screen voltage	150	200	Volts
Grid voltage (approx.)	—105	—130	Volts
Suppressor voltage	0	0	Volts
DC plate current	25	25	MA
DC screen current	7.5	8	MA
DC grid current	2	1	MA
Pear RF grid voltage	125	145	Volts
Peak AF grid voltage	40	50	Volts
Driving power (approx.)	1	0.8	Watts
Peak power output (approx.)	12	16	Watts
Carrier power output (approx.)	3	4	Watts

† Grid No. 1 is control grid; grid No. 2 is screen; grid No. 3 tied to cathode; internal shield tied to cathode.

As RF Amplifier—Class C Telegraphy§
(Key-down Conditions)

DC plate voltage		500 **max.**	Volts
Screen voltage		250 **max.**	Volts
Suppressor voltage		40 **max.**	Volts
DC plate current		60 **max.**	MA
DC grid current		7.5 **max.**	MA
Plate input		25 **max.**	Watts
Plate dissipation		10 **max.**	Watts
Screen dissipation		6 **max.**	Watts
TYPICAL OPERATION:			
DC plate voltage	400	500	500 Volts
Screen voltage	150	200	250 Volts
Grid voltage (approx.)	—85	—90	—100 Volts
Suppressor voltage	0	0	+40 Volts
DC plate current	45	45	45 MA
DC screen current	20	15	12 MA
DC grid current	5	2	2 MA
Peak RF grid voltage	130	125	135 Volts
Driving power (approx.)	0.6	0.25	0.25 Watts
Power output (approx.)	9	14	16 Watts

§ Grid No. 1 is control grid; grid No. 2 is screen; grid No. 3 tied to cathode; shield tied to cathode.

Installation

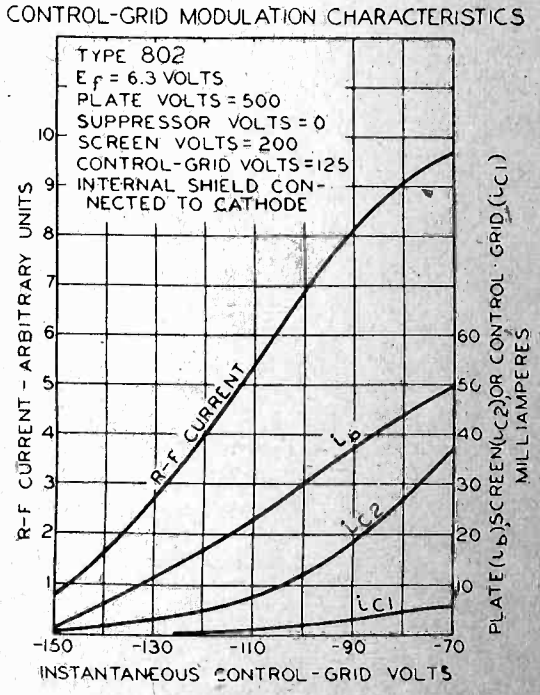
● The base pins of the RCA-802 fit the seven-contact (0.855-inch pin-circle diameter) socket which may be installed to hold the tube in any position. The plate lead of the tube is brought out at the top of the bulb to a metal cap. A flexible lead should be used to make connection to the plate cap so that normal expansion will not place a strain on the glass at the base of the cap. Likewise, the cap should not be made to support coils, condensers, chokes, etc. Under no circumstances should anything be soldered to the cap, as the heat may crack the glass seal.

The bulb of this tube becomes very hot during continuous operation. For this reason it should not come in contact with any metallic body nor be subjected to drops or spray of any liquid. Free circulation of air should be provided.

The heater of the 802 is designed to operate at 6.3 volts.. The heater supply may be either AC or DC. AC is usually employed because of its convenience. The voltage across the heater terminals should be checked periodically. In radio transmitters during "standby" periods, the heater should be maintained at its rated voltage for convenience in promptly resuming transmission.

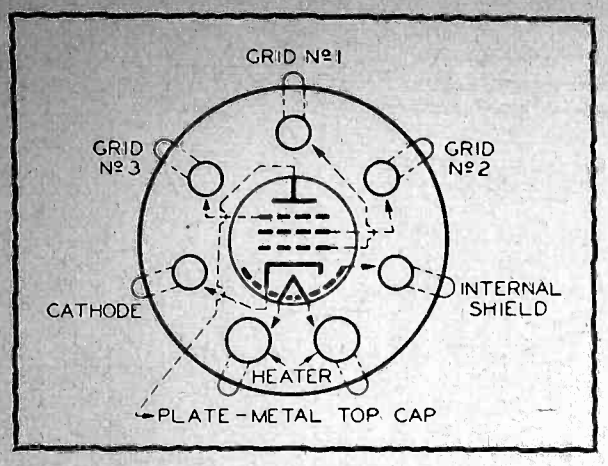
The cathode of the RCA-802, when operated from an AC supply, should preferably be connected directly to the electrical midpoint of the heater circuit. When it is operated from a DC source, the cathode circuit is tied in either directly or through bias resistors to the negative heater supply lead. In circuits where the cathode is not directly connected to the heater, the potential difference between them should be kept as low as possible. If the use of a large resistor is necessary between heater and cathode of the 802 in some circuit designs, it should be bypassed by a suitable filter network to avoid the possibility of hum.

CONTROL-GRID MODULATION CHARACTERISTICS



The plate dissipation of the 802 (the difference between input and output) should never exceed the maximum value given under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS. At these maximum values the plate shows no color when the power switches are opened with the tube operating in the dark.

A DC milliammeter should be used in the plate circuit to provide a ready check of the plate current. Under no condition should



the DC plate current exceed the maximum values given under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS.

Suppressor grid voltage for the RCA-802 may be obtained from any suitable DC supply. In cases where the suppressor draws current, the supply should be a battery or other DC source of good regulation.

The internal shield is brought out of the tube to its own separate base pin. The internal shield should be tied to a terminal operating at zero RF and/or AF potential. In most cases this connection will be made to the cathode or suppressor terminal.

Adequate **shielding** and isolation of the input circuit and the output circuit are necessary if optimum results are to be obtained. If an external shield is employed with the 802, it should be designed to enclose the base end of the tube and extend up to a point level with the bottom of the internal shield. Clearance between the glass bulb and external shield should be at least 1/16 inch. The impedance between the screen and filament must be kept as low as possible by the use of a by-pass condenser.

When a new circuit is tried or when adjustments are made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect. It is advisable to use a protective resistance of about 3000 ohms in series with the common negative high-voltage lead during such adjustments.

The rated plate voltage of this tube is high enough to be exceedingly dangerous to the user. Great care should be taken during the adjustment of circuits, especially those in which the plate tank coil and condenser are at the DC plate potential.

Application

As a **Class B radio-frequency amplifier,** RCA-802 may be used as shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS. Grid No. 1 is the control grid; grid No. 2 is the screen; and grid No. 3 is tied to the cathode and serves as the suppressor. The shield is connected to cathode. In such service, the plate is supplied with unmodulated DC voltage and the grid is excited by RF voltage modulated at audio frequency in one of the preceding stages. The plate dissipation for this class of operation should not exceed 10 watts.

Grid bias for the 802 as a Class B RF amplifier should be obtained from a battery or other DC source of good regulation. It should not be obtained from a high-resistance supply such as a grid-leak, nor from a rectifier, unless the latter has exceptionally good voltage regulation.

As a **grid-modulated Class C RF amplifier,** RCA-802 may be used as shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS. Grid No. 1 is the control grid; grid No. 2 is the screen; and grid No. 3 is the suppressor. The shield is connected to cathode. In such service the plate is supplied by unmodulated DC plate voltage and the grid bias is modulated at audio frequency. Grid bias for this service should be obtained from a battery or other DC source of good regulation. It should not be obtained from a high-resistance supply.

As a **suppressor-modulated Class C RF amplifier,** RCA-802 may be used as shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS. Grid No. 1 is the control grid; grid No. 2 is the screen; and grid No. 3 is the suppressor. The shield is connected to cathode. Grid bias for this service may be obtained in the same manned as for Class C RF telegraph service. Suppressor bias may be obtained from a battery, or a bleeder tap on the high-voltage supply.

As a **Class C RF amplifier for telegraph service,** RCA-802 may be operated as shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS. Grid No. 1 is the control grid; grid No. 2 is the screen; and grid No. 3 is the suppressor. The shield is connected to suppressor.

Grid bias for Class C telegraph service may be obtained from: a grid leak of 20,000 to 50,000 ohms, depending upon amount of grid excitation; from a battery; from a rectifier; or from a cathode-bias resistor (preferably variable) by-passed with a suitable condenser. The cathode-bias method is especially desirable due to the fact that the grid bias is automatically regulated and that there is little chance of the plate current becoming dangerously high either with or without RF grid excitation. When the grid-leak method of obtaining grid bias is used, bias is on the tube only when RF excitation is applied. Since grid-bias values are not particularly critical, correct circuit adjustment may be obtained with widely different values.

The **DC grid current** will vary with individual tubes. Under any condition of operation the maximum values should not exceed 7.5 milliamperes.

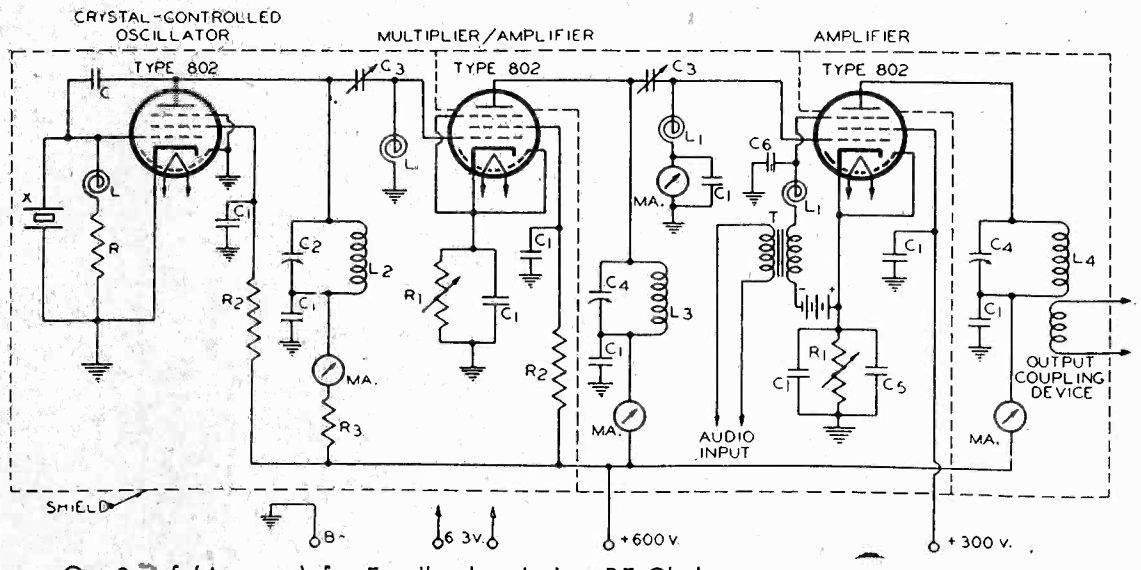
If more power output is required than can be obtained from a single 802, two or more of these tubes may be used either in parallel or in push-pull. The parallel connection provides approximately twice the power output of a single tube without an increase in exciting voltage, while the push-pull connection gives twice the output but requires twic the RF excitation voltage necessary to drive a single tube; with either connection, the grid bias is the same as for a single tube. The push-pull arrangement has the advantage of balancing out the even-order harmonics.

When two or more RCA-802s are operated in parallel, a non-inductive resistance of 10 to 100 ohms should be placed in series with the grid lead of each tube, close to the socket terminal, to prevent parasitic oscillations.

As a **pentode oscillator (crystal or self-excited),** the 802 should have its screen, suppressor, and shield connected the same as in amplifier service. Because the general internal shielding is unusually effective, it is generally necessary, in this service, to introduce external feedback. This may be done by the use of a small condenser of 2 to 3 uuf connected between grid and plate.

RCA-802 is not recommended for use as a Class A triode amplifier, Class B AF triode amplifier, or Class C plate-modulated tetrode amplifier, because it is inadvisable to operate this tube with any of the grids at the maximum rated plate voltage.

TRANSMITTING CIRCUIT DIAGRAM
SHOWING USES OF TYPE 802 R-F POWER PENTODE



C =3 uuf (Approx.) for Feedback
C_1=.01 uf
C_2=10.0 uuf (Max.)
C_3=30 uuf (Max.)
C_4=50 uuf (Max.)
C_5=10 uf (low voltage)
C_6=.0001 uf

L, L_1=RF Chokes
L_2, L_3, L_4=Value dependent on frequency
R =40000 Ohms, 2 watts
R_1=2000 Ohms (Max.) 10 watts
R_2=20000 Ohms, 10 watts
R_3=4000 Ohms, 10 watts
T=Modulation Transformer
X=Crystal

Note—Ground Connections Made to Shield.

UNSOLVED

"A problem well stated is half solved"
—Steinmetz.

● **In this column will be briefly outlined some of the problems of general interest in the radio field which remain unsolved. You are invited to submit your statements regarding unsolved radio problems. A one-year subscription to "RADIO" will be given each month to the person who sends in the best worded statement of a timely problem.**

WANTED—A new high voltage variable condenser. Should be compact, insulated for at least 15,000 volts, and free from losses. A small condenser about the size of the midgets used in receivers, sealed inside of an evacuated glass tube, may represent the answer to this problem. Its capacity can be varied by attaching a heavy weight to the rotor in such a manner that the rotor remains fixed, while the stator is moved in relation to the rotor, by rotating the glass envelope. Connections to the rotor and stator can be brought out of the envelope through tungsten seals, as in vacuum tube manufacture. One-eighth-inch plate spacing in a good vacuum will easily withstand 20,000 volts.

The "222 Communications Receiver"

An Efficient, Simple and Inexpensive Superheterodyne
The Antenna Is Link-Coupled To the Detector
The Receiver Employs Regeneration, Tone and Volume Control, One Stage of I. F. and Other Useful Features

By FRANK C. JONES

● This receiver was designed for the amateur who likes to build his own sets and who is primarily interested in three band operation. The parts are available from most radio supply houses and the cost is not excessive. It is the next logical step from a TRF receiver and costs much less than an elaborate crystal filter superheterodyne. The set will cover the 20 and 40 meter amateur bands without coil changing, which is a convenience when one is interested in two bands, such as 20 and 40 meters. For 80 meter operation a separate set of coils is needed.

The receiver is very sensitive on 20 and 40 meters due to the special first detector circuit employed. Regeneration is used and a variable antenna coupling allows maximum effect from the regeneration. The antenna coupling is a simple unit using a sliding rod, knob controlled, and a sliding coil. Link coupling is used between the antenna coil and the first detector coil and one of these link coils is slid back and forth for variable coupling. This also minimizes capacity coupling to the antenna without using a Faraday electrostatic screen, thus reducing man-made static. The same antenna and link coil assembly are used on all bands, thanks to the link coupling as applied to receivers.

Regeneration is obtained by means of a cathode tap on the detector coil because this gives a more uniform regeneration effect over the wide range of any one set of coils. The conversion gain of this detector is very high, due to regeneration, and to the method of oscillator coupling used. The suppressor grid connects directly to the plate of the electron-coupled oscillator. This practically eliminates oscillator radiation into the antenna because the screen grid is by-passed to ground and electrostatically shields the suppressor grid from the control grid circuit. The positive potential on the suppressor grid works fine in giving a very sensitive regenerative first detector.

The first and second oscillators are orthodox electron-coupled circuits with good frequency stability. The first oscillator is made to oscillate strongly for good conversion gain, while the second one oscillates weakly to minimize harmonics which would cause steady beat note whistles in certain spots in the short wave range. Adjustment of this oscillator strength and twisted wire coupling capacity to the second detector grid also allows maximum signal to BFO noise ratio. The use of a high plate and screen grid resistor limits the harmonic output and simplifies the shielding problem for the BFO. A strong oscillator for the BFO means that it should be double-shielded and usually results in high noise level in the audio output. This trouble has been eliminated in this receiver.

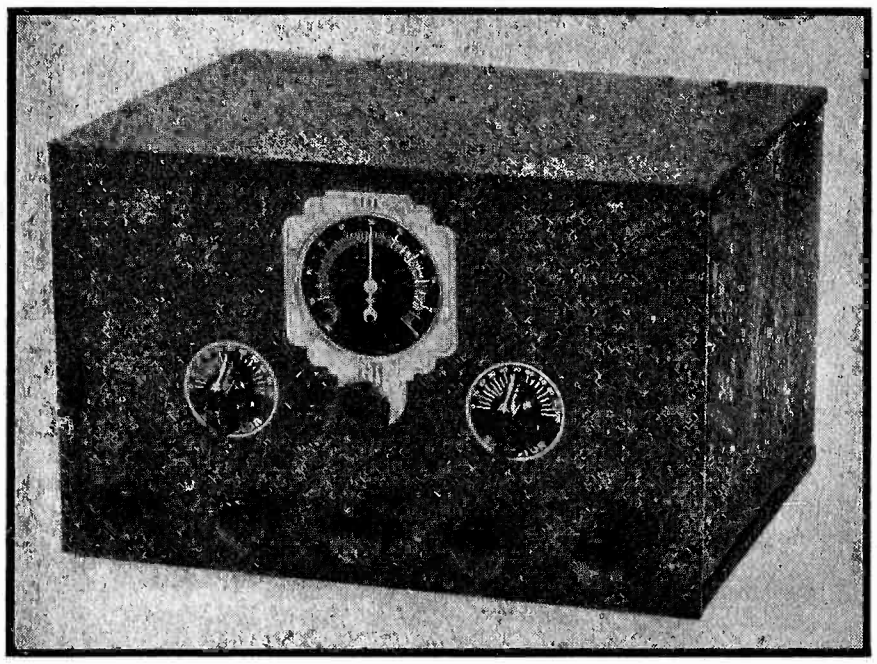
The IF amplifier uses only one stage because two stages complicate the set and provide more noise than signal, unless a crystal filter is to be used. With only one high gain IF stage operating at about 500 KC, no isolating condensers and resistors are needed in plate, screen-grid and cathode circuits. An IF and audio volume control are both provided because often low audio gain and high IF gain will pull a weak signal into readability through the noise level.

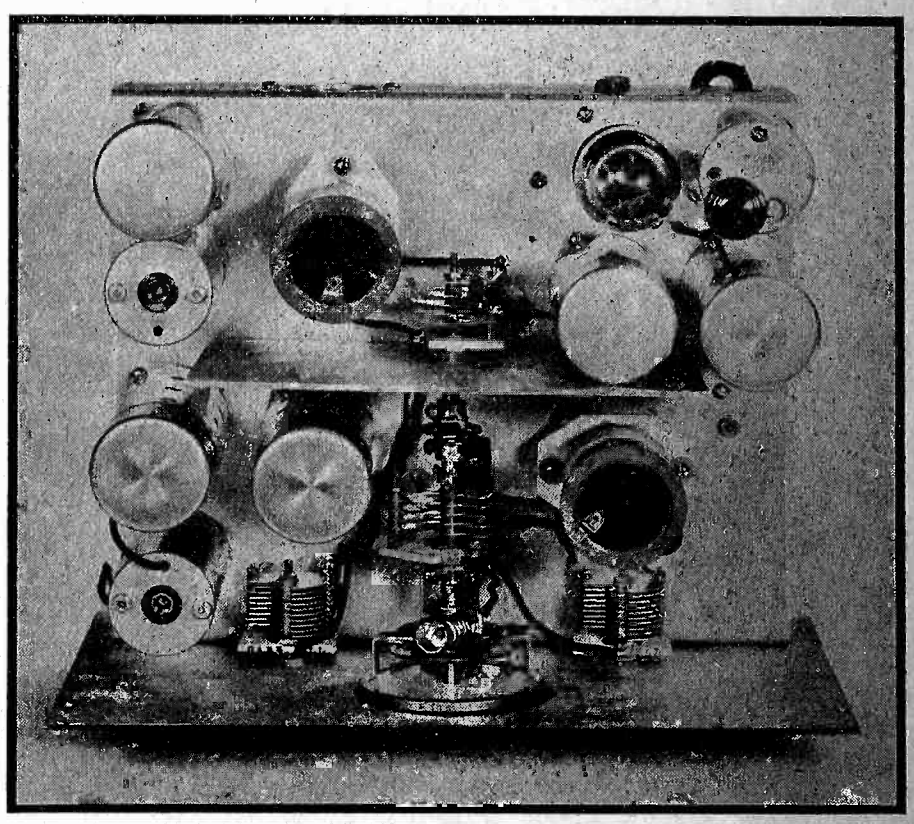
A stage of audio amplification is used to provide a method for audio and tone control and also more gain when necessary. The set is designed for headset operation but has actually enough volume to drive a magnetic speaker to good volume on signals that are well down into the noise level. The type 76 or 56 tubes make good power detectors and audio amplifiers. The audio amplifier uses the headset as a bias resistor for this tube, with the tone control across the phones. This connection allows the telephone jack to be grounded to the aluminum chassis or panel. The grid circuit audio signal is confined to the grid and cathode by means of a 0.1 megohm resistor and a 0.1 mfd by-pass from the audio transformer to cathode. This prevents any audio degeneration and loss of signal—so the output is the same as if a cathode resistor and large by-pass condenser were used and the headset placed in the usual plate circuit.

A separate power pack is used. B batteries and a 6-volt storage battery can be used, providing the on-off switch external to the set cuts both A and B leads in the off position.

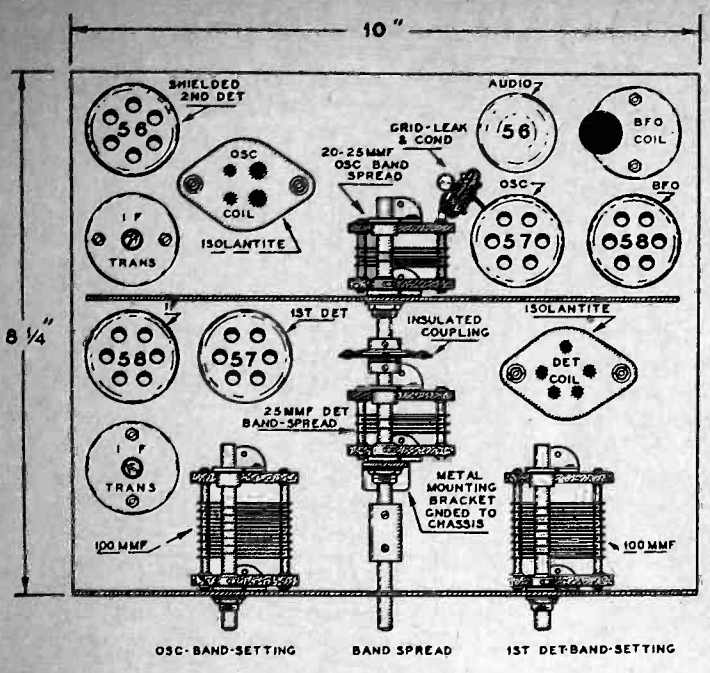
The IF amplifier uses a pair of the new iron-core transformers which have a little better selectivity and gain than the ordinary air core type. They are tuned by means of trimmers, like any other IF transformer. If these transformers are not available the usual air core units can be used with entire satisfaction. In any of these IF units, the coupling has been adjusted at the factory for best broadcast reception gain and band width. This is generally too close for best short-wave practice where greatest selectivity and good gain are desirable. The two coils should be at least an inch apart and 1¼ inches works very well with most small air-core IF transformers. Some makes can be adjusted by warming the supporting tube with a soldering iron tip until the wax softens, then sliding the coils apart. The iron core transformers have a pair of coils mounted at right angles to each other on short molded straight cores. Coupling is adjusted by a screw adjustment on the lower coil which slowly moves it along its axis.

As previously stated, a single stage of IF

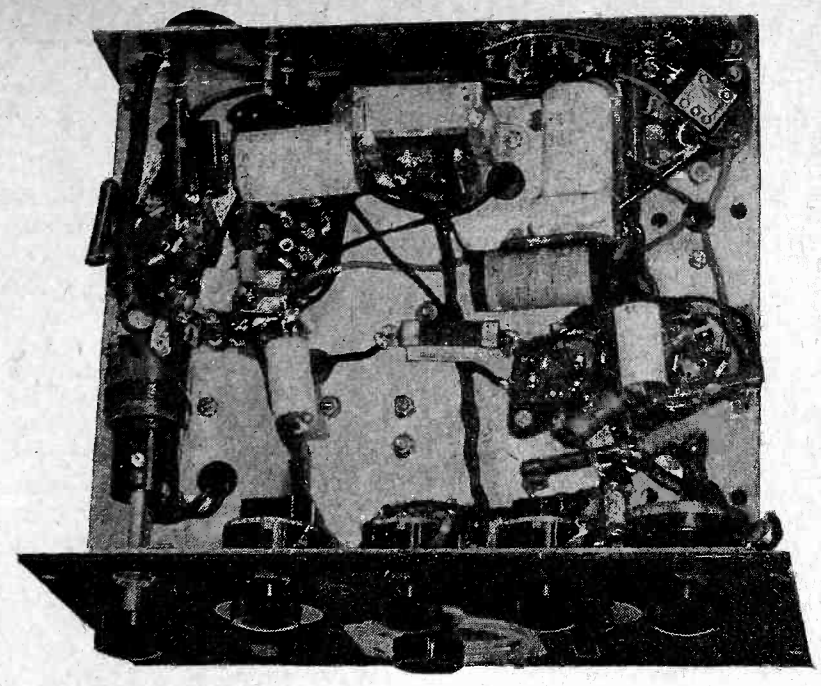




● One set of coils covers both the 20 and 40 meter bands. A separate set of coils is used for 80 meters. The illustrations show the front view and the interior arrangement of parts. The receiver is A.C. operated, but it can also be used with batteries if 6.3 volt tubes are used.



The constructor is advised to use the exact layout of parts, as shown above. All tubes are shielded, other than the type 56 audio tube. Isolantite sockets should be used for the Detector and Oscillator coils.



Under-chassis view. Note the variable link-coupling device. It slides into, and out of the antenna coil by means of a plunger which is fitted into a phone jack. The audio transformer is seen at the center rear.

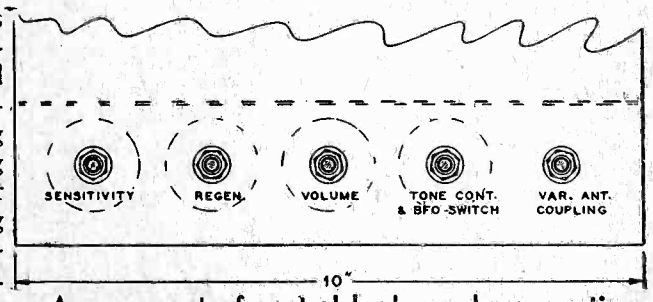
will give ample gain if the front-end of a super is functioning as it should. A stage of RF ahead of the first detector is sometimes desirable, but it does not compare with a super using a regenerative first detector unless regeneration is used in the RF stage. This adds complications and means another ganged circuit, which does not simplify the set. The present set uses a ganged oscillator and detector circuit because both of these circuits have 100 mmfd padder or band-setting condensers controlled from the front panel.

The oscillator tuning condenser is a double spaced midget condenser of eight plates while the detector condenser has nine plates double spaced. These condensers were made from 100 mmfd Cardwell "Trim-Air" normally spaced midget condensers, similar to those used for band setting. By winding the oscillator to cover a greater winding space of 1¼ inches as against 1⅛ inches for the detector coil, the oscillator and detector will track throughout the narrow amateur bands. With the number of plates left in these double spaced condensers, the 20-meter band covers about 15 divisions on the airplane type dial and the 40-meter band about 60. Greater spread can be had by removing plate from each of these condensers. *A flexible coupling should be used to gang the oscillator condenser to the front detector condenser so as to eliminate torsion detuning effects on the beat note of a CW station, which always occurs with any dial and condenser mounting.*

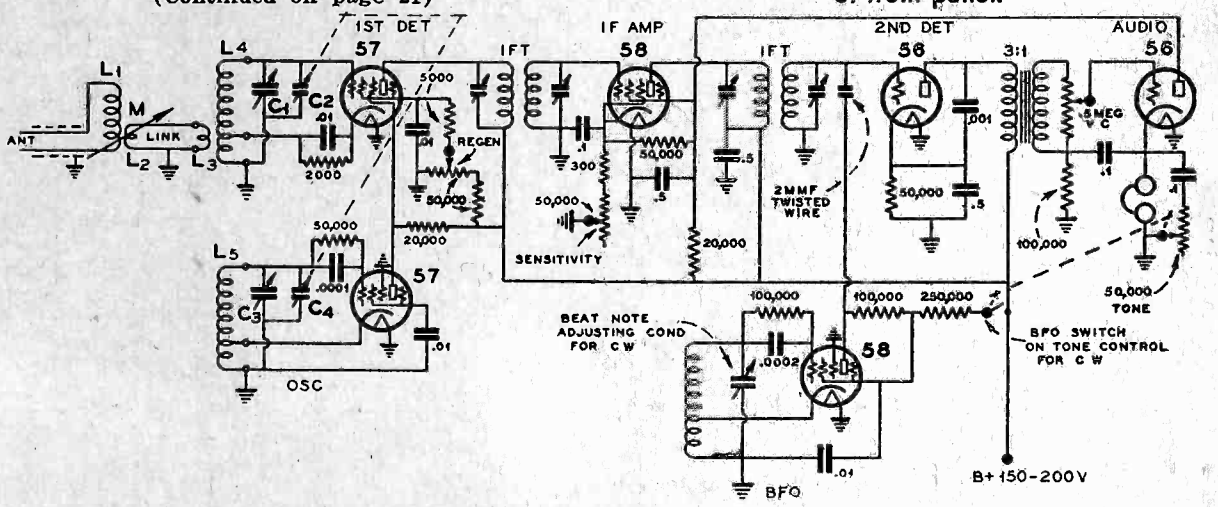
The antenna system uses a shielded lead-in pair which connects directly to the fixed antenna coil underneath the chassis. This eliminates binding posts and unwanted pick-up and presents no complications since the shielded pair can be insulated with tape from the underside of the chassis terminals. The antenna coil consists of 12 close wound turns of No. 24 DSC on a 1¼ inch diameter bakelite tube about 1¼ inches long. The sliding coil is of 4 turns close wound of No. 24 DSC on a 1-inch diameter tube. Flexible leads form the remainder of the link coupling device to the isolantite coil socket above the chassis. Four turns of this same wire were wound on the detector coil about ⅛ inch from the ground end and thus very little capacity coupling exists between the antenna and first detector coil. This 1-inch bakelite tube is controlled from the front panel by means of a plunger action knob over a distance of about an inch. This knob has a ¼-inch diameter brass rod extending through the front panel and fastened to the 1-inch tubing with a couple of machine screws. The bearing and retaining or pressure spring is simplicity itself, being an ordinary short telephone jack. The rear tip connection acts as a pressure spring against the brass rod and it remains in whatever position it is adjusted to with the knob.

This antenna coupling device is well worth

(Continued on page 21)



Arrangement of control knobs on lower portion of front panel.



FRANK C. JONES' 222 COMMUNICATIONS RECEIVER

Coils L1, L2 and L3 are the same for 20, 40 and 80 meter operation. L1—12 turns, No. 24 DSC wire, close wound, on 1¼ in. dia. tubing.

L2—4 turns, No. 24 DSC wire, close wound, on 1-in. dia. tubing. This coil slides into coil L1; the coupling is made variable by sliding L2 into and out of L1.

L3—4 turns, No. 24 DSC wire, wound on 1½-in. dia. tubing, separated ⅛ in. from L4.

For 20 and 40 meters: (same coils used for both bands).

L4—11 turns, No. 18 DCC wire, space-wound on 1½-in. dia. tubing, to cover a winding space of 1⅛ in. long, and tapped at one and one-third turns from bottom.

L5—11 turns, No. 18 DCC wire, space wound on 1½-in. dia. tubing, to cover a winding space of 1¼ inches, and tapped at 2½ turns from bottom.

C1-C3—100uufd. midget variable condenser.

C2—9 plate double-spaced midget condenser to give approx. 25uufd.

C4—7 plate double-spaced midget condenser to give approx. 20 uufd.

(Use 8 plates for C2 and 6 plates for C4 if more band-spread is desired).

Condensers C2 and C4 are standard Cardwell 100uufd. "Trim-Air" midgets, with alternate plates removed so as to double-space the plates.

L1, L2, L3 same as for 20 and 40 meter operation.

L4—30 turns, No. 24 DSC wire, wound to cover a space of 1½ in. on a 1½-in. dia. form, with cathode tap taken at one turn from bottom.

L5—26 turns, No. 24 DSC wire, wound to cover a space of 1⅜ in. on a 1½-in. dia. form, with cathode tap taken at 4¼ turns from bottom.

NOTE—The cathode tap on the oscillator coil must not be too high, otherwise image interference will become serious.

TUBES—Instead of using type 56, 57 and 58 tubes, this receiver will give equal satisfaction if the types 6C6, 6D6 and 76 are used for 6.3 volt operation.

160 METER BAND—This receiver will not operate successfully on the 160-meter band unless large variable condensers are used in place of the small midgets. The receiver was primarily designed for 20, 40 and 80-meter operation.

CONDENSER SETTINGS

Band	Oscillator Band-Setting Condenser	Detector Band-Setting Condenser	Coverage on Main Tuning Dial
20 Meters	8°	10°	12° to 15°
40 Meters	80°	95°	50° to 60°
75 Meter Phone Band	45°	50°	25°
80 Meter C.W. Band	50°	55°	100°

Mercury Vapor Rectifier Tubes

By RICHARD H. SEAMAN*

● The average life of a mercury vapor rectifier tube is approximately 1,000 hours. It is possible that 10,000-hour mercury vapor rectifiers will soon be manufactured.

The failure of a mercury vapor rectifier tube before 5,000 hours, if properly used, is generally due to one of the following reasons:

1. Improper Tube Design:
   - *a. Poor heat dissipation*
   - *b. Low voltage breakdown*
   - *c. Inadequate filament design*
2. Improper Exhaustion:
   - *a. Poor vacuum*
   - *b. Impure mercury*
   - *c. Contaminated elements*
3. Inferior Materials:
   - *a. Oxide coating*
   - *b. Filament base metal*
   - *c. Plate*
   - *d. Glass envelope*
4. Flakeing-off of Oxide Coating:
   - *a. too-wide ribbon*
   - *b. Low wattage filament*
   - *c. Oxide not thoroughly decomposed*

If the above considerations are all taken care of, the life of the tube will be proportional to the amount of oxide coating on the filament.

The first problem is to apply a maximum amount of coating and to provide a means to keep it there. The customary coating process consists of spraying or dipping the filament ribbon in barium and strontium carbonates with pyroxylin binders. This is a very unsatisfactory process for large filaments because the amount of coating which can be uniformly put on and not flake off is limited by the surface tension of the coating. The use of wire mesh instead of ribbon for filament base allows the use of oxide coating without pyroxylin binder and there is no flaking whatsoever. The coating surrounds the individual wires and fills the intervening space. The maximum amount of coating that can be applied with good results is limited by the heat radiating ability of the oxide coating. The heat dissipation of the filament increases with the thickness of the coating and the filament will therefore run cooler, unless it is shortened. If the coating is too thick, the outside surface will run cooler than that next to the filament; he filamen runs too hot, thus causing increased electrolysis of the oxides and evaporation of the filament base metal. With the proper or possible maximum coating applied, the life of the tube will be roughly dependent on the ratio between mean plate current and filament wattage. The more generous the filament wattage, the longer the tube life. (The filament should have over 12 watts per ampere mean DC plate current). The filament voltage should not be over two-and-one-half volts; a higher-voltage filament will tend to emit only from one end of the filament, resulting in a rapid deterioration of oxide and short life. Five-volt tubes should be of the heater type.

The next equally important item for a long life rectifier is an extremely high vacuum, equaling that of large transmitting tubes. A high degree of exhaust must be obtained before any mercury is introduced into the tube. This is necessary because it is impossible to degasify the elements and obtain a high degree of vacuum with any mercury present in the tube. High vacuum is the only insurance against high voltage breakdown, and the spacing of the plate and filament apparently have no effect. It is possible to get a higher degree of vacuum, with the proper pumping equipment, without the use of a "getter". This is very essential because mercury, under these conditions, will adhere to the glass walls and will seriously affect the mercury vapor pressure of the tube. The operating pressure of mercury vapor is a critical factor for long life and high voltage breakdown. The pressure increases with the increase in temperature. If the tube is so designed that no mercury remains adherent to the glass walls and collects only in the coolest part of the tube, the pressure will then be correspondingly lower. As there is no appreciable consumption of mercury during the operation of the tube, the minutest drop of mercury is sufficient. The normal DC drop is from six to fifteen volts and decreases with the rise in temperature. The curve in Fig. 1 shows the relation between pressure and the increase in temperature.

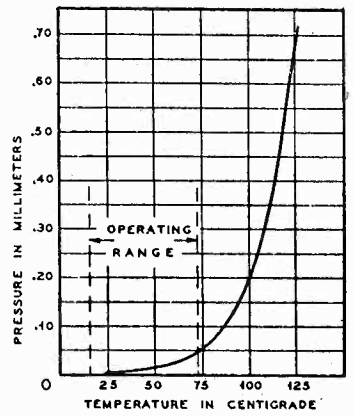


FIG. 1

The decrease in DC voltage drop with the increase in temperature is shown by Fig. 2. Fig. 3 is plotted to show the decrease in inverse peak voltage as the temperature increases. The DC voltage drop will increase with age and deterioration of the oxide coating. When the tube is in operation and working properly, the discharge is either a purple or dark pure-blue color. If the filament fails to give sufficient emission or is overloaded, the discharge is sea green.

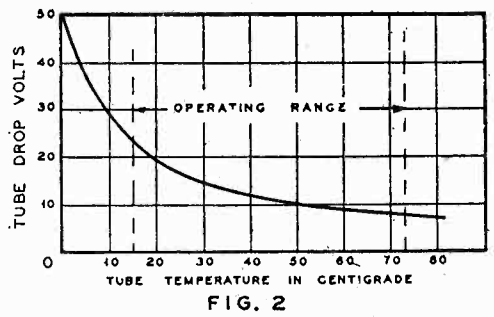


FIG. 2

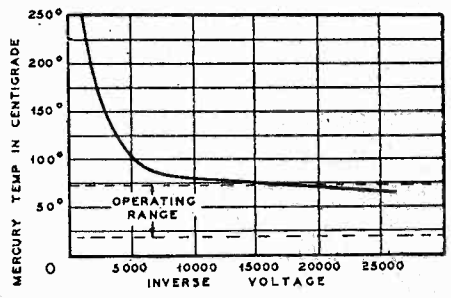


FIG. 3

Because the rectifier is frequently subjected to sudden heavy loads the tube must withstand sudden changes in temperature and this is one of the reasons why the soft glass tubes fail. Sudden changes in temperature will cause the glass to crack or soften and "pull in". Nonex, a hard glass; has a lower coefficient of expansion than soft glass, $3\text{-}^{6}\text{x}10\text{-}^{6}$ for Nonex, compaired with $18\text{x}10\text{-}^{6}$ for soft glass, and has considerably higher heat resistance. Nonex is the ideal glass for any type of transmitting tube. The operating temperature range of a mercury vapor is critical. Care should be taken when building the power supply so as to give the rectifying tube generous or forced ventilation. The tubes should be well spaced from magnetic

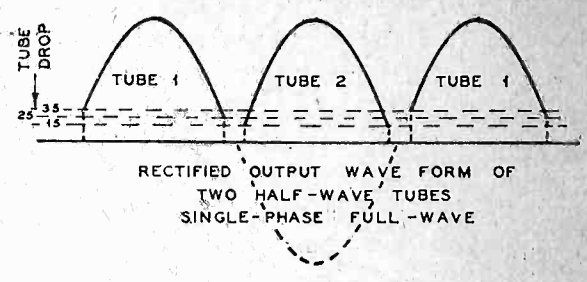


FIG. 4

or radio frequency fields. These fields tend to produce breakdown effects and they are detrimental to tube life and performance. The presence of such currents may sometimes be detected by a glow in the tube with no applied plate voltage. The absence of this glow does not necessarily mean freedom from these harmful currents because they may only occur at the time the tubes are conducting. The rectifier plate leads should be provided with radio frequency chokes and the tubes should be shielded with copper screen. The filament should be kept at rated voltage under operating conditions. Less than the recommended voltage may cause heavy filament bombardment and loss of emission. Greater than rated voltage will cause evaporation of the filament and will shorten the life of the filament.

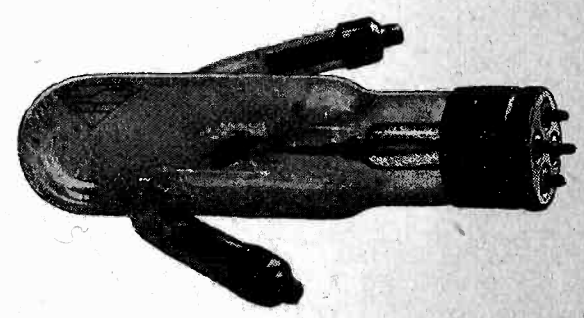


FIG. 5

The fundamental limitations in the operation of a rectifier are the maximum peak plate current and the maximum peak voltage. Maximum peak plate current is the highest peak current that a rectifier tube can safely handle. If a large choke is used in the filter circuit next to the rectifier (Fig. 6, choke input) the peak plate current is not much greater than the load current. If a large condenser is used in the filter next to the rectifier (Fig. 7, condenser input) the peak current may be, and often is as much as four times the load current. Peak current can best be measured with an oscillograph. It is not advisable to use condenser input in a single phase full-wave rectifier system merely to get higher voltages because this method only raises the voltage about 10% and lowers the load current considerably. For instance, with the '66 type rectifier a 1 mfd. condenser, in a condenser input filter, will lower the safe maximum load current to about 150 mills. The remainder of the rated current is used in circulating current and is of no use whatsoever. For best results use

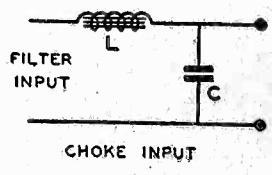


FIG. 6

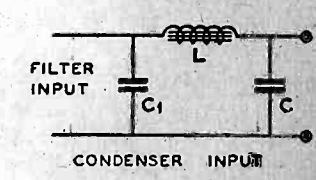


FIG. 7

(Continued on page 29)

* Chief Engineer, Radio Scientific Laboratory.

How Telegraphers Are Made

First of a Series By T. R. McELROY, World's Fastest Telegrapher

PART I

SEATED before a "mill" with a set of phones clamped on my nerve-tingling ears, watching the judges and awaiting the whiz of a Wheatstone with code batting out around 50 or 60 words per minute—hey, it's a cinch—compared with sitting in front of this typewriter right now trying to find words with which to start some kind of an article that will be worth the time of "RADIO" readers wading through. So here goes! Stay with me, ops. I'm no Shakespeare nor Wilde, nor Poe. And no matter how greatly I may admire some of the personal proclivities of those writing gents (?), I couldn't even attempt to emulate their facile pens with my rusted typewriter. But I will try to tell you, truthfully, something about code working. And I pledge you my word that if you'll sweat half as much in reading it as I do in writing it, you'll start yourself on the road toward better operating. Let's go!

Back in '14 following my "graduation" from school (they threw me out for the good of the school), I proceeded with the usual matriculatories attendant full fledged membership in the fraternity of "all day trotters" in the University of Western Union. Those were the happy days when you'd deliver a message to a non-English speaking addressee and painstakingly explain that there was a small charge of one dime! We used to pool the dimes and buy cans of beer. I remember we had an empty pickle tin that held about a gallon. It was really a vitally necessary adjunct to the providing of good service. Tramping through hot, dusty streets was thirst provoking—and when you recall the large numbers of horses in those days you'll readily realize that a messenger boy's throat required the thorough cleaning attendant the sluicing down of gulps of beer.

A few months on the streets taught me the necessity for "higher education", and the greatest heights to which any messenger might ever aspire—was the third floor, where the Morse operators sat in the midst of a clatter greater than any steel mill produces. I can remember as though it were only yesterday, sneaking up the backstairs to watch those fellows sitting there with their legs crossed and "putting ten on a line" with the greatest of ease. This guy that we're singing about these days who plays around with a flying trapeze—why he is a hard worker compared with those old time telegraphers who turned out 50 and 60 messages an hour with Murad-like nonchalance. I can remember one guy, Bucky Kane. He used to work Pittsburgh. And to this day I can see him sitting there copying, chewing tobacco with the priceless sense of security that was his in the knowledge of his own personal spittoon—a paper cup in his shirt pocket!

I started doing little odd jobs. Running errands to deliver personal notes for the operators. Boston was a wicked city in those days. And we had what the evangelists might term "sinks of iniquity".

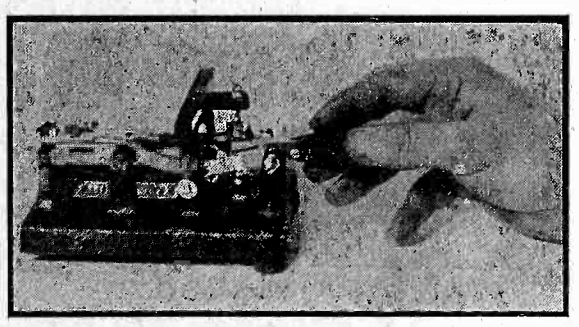
So, anyhow, in return for my efforts, some of the Morse men would give me a little practice on their "shorts"—their 15-minute respites from the grind. And out of a few weeks of this smoking room tuition I emerged what I fondly figured to be a good operator. Well, sir, the first few minutes on a wire when they finally decided to try me out, convinced me that maybe there was another operator or two who might be better. You've all been through it probably. That, anyhow, was my start as an operator.

I went through the various stages of working in the woods, moving up to the ways, and finally to the trunks where a man would work bonus, and have a chance to make a real week's pay, with the aid of a peculiar telegrapher's style of mathematics which skipped ten numbers occasionally. Be that as it may, however, I went through the grades and finally wound up as an operator at Camp Devens where I fought the battle

T. R. McElroy, Holder of World's Record for Fast Telegraphing.

for the outlawing of war—with a telegraph key. All I need now is another good war to sell some of my own telegraph keys! About 1918 or 1919 things were pretty dead at Devens, so I was let out. Coming back to Boston I found no telegraph jobs and thus commences the entry into radio work.

A few weeks loafing in Boston convinced me that eating was a habit so firmly entrenched in my system that I couldn't get over it. A kind of a senseless habit, but there it was and I had to make the best of it. So I managed to borrow a few bucks from some of the Morse men I had worked with, and, on the basis of a rumor that the RCA were hiring Continental code operators at their trans-oceanic station in Chatham, WSO,



The "Bug" that McElroy used when he won the Championship.

I hopped a train for the Cape. Kripes! One way fare and I hardly knew Continental code.

Fortunately for me, and rather unusual, too, there was an American assistant superintendent who hired the operators. A real gentleman for whom it was a pleasure to work, Fred Heiser. It developed that Fred had been a real high grade Morse operator and during my test which brought out a palpable lack of knowledge of radio code, he threw some Morse at me. It was a cinch. A guy would have to be deaf, dumb and blind not to be able to copy the kind of Morse he sent. So on the strength of that he hired me. So began the career of Mac as a radio operator. They were sorry! They could pay me only $140 a month! Whoops! A first class Morse man was drawing only about $125 in Boston at the time.

We used to work POZ, Nauen, Germany, and LCM, Stavanger, Norway. Sometime I'd like to tell you all of some of the experiences on those circuits. We had two and sometimes three landlines to New York, and it was on these circuits that I worked most of the time. Continental code. It was murder for about two weeks but then easy. They had some wonderful operators down in New York, too. All Morse men who had learned Continental as I did in a few days. There was Jack Dorien, and Jim Shea, and a fellow named Henderson, and a flock of other wonderful operators. And I remember especially Joe Chaplin who was probably as fine an operator as there ever was in the business. And Benny Suter and others. I wonder where they are now?

We had some great operators at WSO, too. I remember Joe Lynch who used to send with a straight key almost with Wheatstone perfection. Funny about Joe, too. He was about the only operator I'd ever met who was a real good operator and yet hadn't been a Morse man. I guess it ought to prove that an operator can be a first class man without first being a Morse operator.

I guess it was about 1920 when RCA decided to work the trans-oceanic stuff from New York and a lot of we operators were taken from Chatham down to the big city. That was the beginning of the end. You see I lived in Boston most of my life among American people. And I fondly congratulated myself upon my six or seven generations of Bostonese antecedency. And naturally I liked to talk about it. It didn't enhance my standing with the boys "from home" who ruled RCA. And they ruled it with an iron hand. So that between my propensity for voicing the virtues of our American citizenry, and my espousal of the cause of "collective bargaining", it was only a matter of time before I was out "for the good of the service"—they couldn't take it!

I remember I used to work POZ much the same as I'd work a Morse bonus wire, turning out faultlessly beautiful copy at extremely high speeds. But what did exceptional telegraphic merit amount to when the finer sensibilities of His Majesties' expatriates were offended by uncouth Americanisms! So sometime during 1920 I found myself back in Boston. Still a good American though somewhat befogged as to the consequences thereof. It cost me a job.

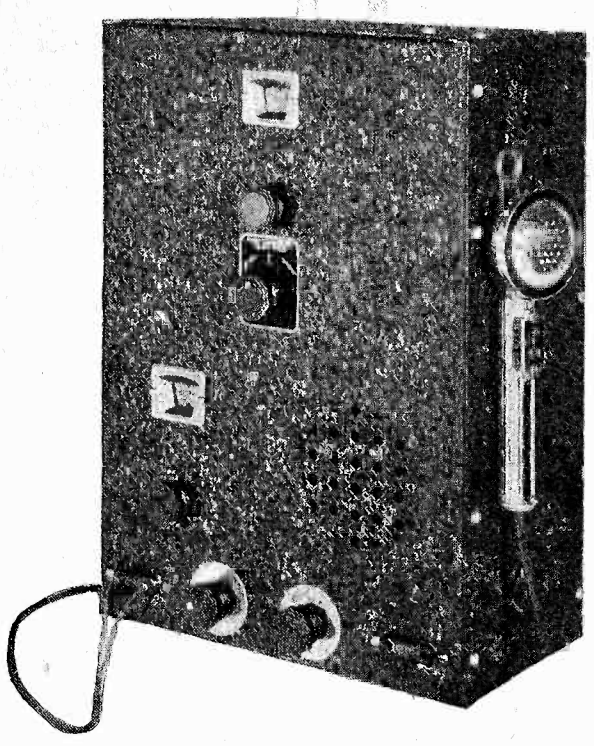
I "boomed" around the country, working here as a broker operator, there as a press operator, and again somewhere else with a packing house, and finally wearied of the road and its belly-reducing vicissitudinousnesses, (what a word to ripple out of a guy's fingers). So I returned to the bosom of good old Uncle Wess at Boston where my original boss and the kindly father to all Boston operators, took me again under his supervision. I'll never forget the debt I owe him: J. B. Rex, the chief operator of the Western Union in Boston.

Sometime late in 1921 or early 1922 there was a radio exposition at Boston wherein were displayed the latest models in salt box wound induction coils and basket wound vario-couplers, to say nothing of those new

(Continued on page 28)

New 5-Meter Developments

Jacobs' Duplex Transmitter-Receiver



Exterior View of Radio Transceiver Laboratories Duplex Transmitter Receiver

THE Radio Transceiver Laboratories Type 53-6A6 Duplex Unit employs a radiophone transmitter similar to that of the Jacobs' 53-6A6 Transceiver. Like the transceiver, it employs twin-triodes, unity coupling and class B modulation; but in addition, the TR unit has a separate four-tube super regenerative receiver and a dynamic speaker. Receiver radiation interference is eliminated and duplex operation is thus made possible. Duplex, or break-in operation is two-way transmission and reception, similar to that of a land telephone circuit. The operator talks and listens without throwing a switch. He can interrupt the conversation at will, or "break-in". A panel switch knob is provided for turning off the transmitter when listening on the transmitting frequency.

Transmitter and receiver are separate units, completely shielded from each other, and each has its own power supply socket. The unit can be installed with individual power supplies for transmitter and receiver, or both may be connected to the same power source. Supply cables should be shielded to prevent receiver radiation. The entire duplex unit is housed in a black crackle finished steel case, 10x14x5-in. and is provided with ventilating holes and two handles. The latter may be used for securing a strap for carrying or for fastenings in mobile use.

The receiver employs a super-regenerative detector of the indirectly heated cathode type. No better type of receiver has been developd for ultra-high frequencies to date. The enormous sensitivity of this type of receiver creates a loud background noise when no signals are received, but this noise is completely eliminated when a strong station carrier is tuned in. A superheterodyne of equal sensitivity would have as great a noise level and an automatic volume control would then be necessary. The super-regenerative receiver has a perfect automatic volume control inherent with the detecting action.

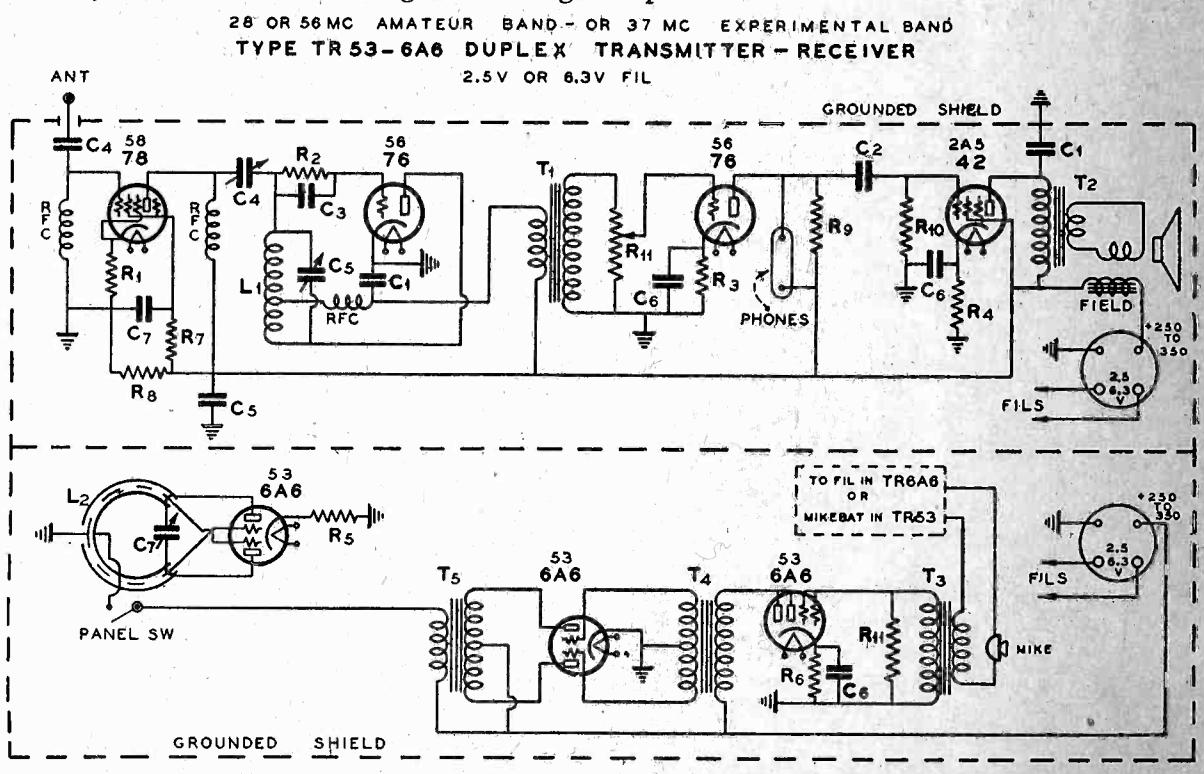
Radiation from the detector and its attendant inerference o other receivers is eliminaed by the use of a screen grid RF stage and careful shielding. The receiving antenna and receiver proper are shielded from detector radiation. If complete shielding is required, supply leads must also be shielded.

The super-regenerative detector is followed by a stage of AF amplification. A volume control is introduced in this circuit, as are tip jacks for headphone insertion. The final or output stage employs a power pentode capable of delivering 3.5 watts to the five-inch dynamic speaker which is mounted behind the front panel grill.

POWER REQUIREMENTS:

250 v.—175 MA (maximum)
2.5 v.—10.75 amps.
or
250 v.—175 MA.
6.3 v.—3.95 amps. (maximum)

Dynamotors running from a six-volt storage battery and delivering 250 v.—175 MA may be used with the TR-53-6A6 for mobile operation.



R1—400 ohms. R2—½ meghom. R3—2700 ohms. R4—500 ohms, 2 watt. R5—500 ohms, 2 watt. R6—1000 ohms. R7—50,000 ohms. R8—40,000 ohms. R9—100,000 ohms. R10—250,000 ohms. R11—500,000 ohms. RFC—50 turns No. 30 DSC on ⅛-in. dowel. C1—.004 ufd. C2—.05 ufd. C3—.00025 ufd. C4—35 uufd. C5—1 ufd, 450 v. C6—5 ufd, 25 v. C7—15 uufd Cardwell. L1—9 turns No. 12, ⅝-in. dia. (60 MC) spaced thickness of wire and tapped at 6 turns. L2—2 turns, ⅜-in. copper tubing, 2-in. dia., with piece of No. 19 Corlac 1300 v. insulated solid wire threaded through for Grid Coil (60MC). T1—3:1 Audio Trans. T2—Pentode Output Trans. T3—Mic. Trans. T4—Class B Input, UTC HB1 or NS29. T5—Class B Output, UTC HBM or NS33.

A Deaf Mute Asks For An Amateur License— (Continued from page 6)

and also to the federal communication commission to help you get an amateur radio station license."

Station W8LDH of South Haven, Mich., wrote to Adolph to say: " . . . Have showed your letter to various local hams and they all think you should have a license and will do anything in their power to help you as I will also . . ."

The stack of mail of this nature is legion. All over the country radio hams are writing to Washington to aid the man who refused to be stumped by a disability that would have been insurmountable to many. From coast to coast the night hawks of the air are waiting for the first spoken word of the man who has never spoken and who hopes soon through government generosity to talk direct to his many friends in the crystal whispers of DX. (Adolph Czajka's QSL card is reproduced here.—Ed.)

FROM ONE SPECIALIST TO ANOTHER
I am the first deaf mute radio fan
I watched ur sigs on my signal recorder white paper tape
at.....M., C. S. T. Hrd on.....19.....

Home Made	Believe It or Not
100% Signal Recorder Tape	U C tt I'm deaf mute fan as ham
Tape-puller Power Amplifier	I hv no head-phone or loud-spkr.
A pair of 45's Push-Pull	Vy 73 es DX. OM.
National's Parts. monitors or	Adolph J. Czajka, Opr.
frequency meter	(Deaf mute fan es ham)

If you want to read the white paper tape of your sigs
Write me on ur QSL crd OM. I wl send it to u.
Wud appreciate ur crd OM

—AMATEUR NEWS—

Largest Amateur Gathering To Be Staged in San Francisco

A TWO-DAY amateur conclave and high-frequency radio show will be staged by the Federation of Radio Clubs of Northern California, a newly-formed association which comprises the more important radio clubs. The purpose of the Federation is to promote better conventions and hamfests and to enable the radio clubs of the entire northern portion of the state to more effectively work together.

New innovations in hamfests are promised when the amateurs of Northern California convene on February 23rd. The affair will close on February 24th. There will be a series of contests to determine the best de-

"The Prize Drawing"
—or "After the Raffle Was Over"

signed and constructed pieces of radio equipment; there will be contests for fixed and mobile 5-meter equipment, receiver and transmitter contests. All amateurs are invited to bring their special pieces of equipment. A large number of prizes will be awarded, the total value of which will exceed one thousand dollars. Many of the more valuable prizes will be awarded to those who win the various equipment construction and design contests.

Another of the innovations is the manner in which the prizes will be obtained. The donors of the prizes will be given a pro-rata refund of 75 per cent of the total net receipts. It is hoped that this refund will be ample to reimburse the donors for the actual cost of the prizes.

The registration fee is $1.50, which includes the banquet ticket. Many of the better prizes will be reserved for those who send in their moneys previous to the opening of the conclave.

There will also be a 5-meter hidden transmitter hunt. Many new pieces of equipment will be demonstrated and all of the new receivers will be in action. Hotel rooms have been reserved for the prominent receiver manufacturers. Provisions have been made to install effective antenna systems so that all equipment can be demonstrated to best advantage.

There will be a "round robin" technical meeting. It will be a clearing house for questions asked by the audience. These questions will be answered by a group of more than ten well known technical men.

PROGRAM

Registration, 9 AM Saturday, February 23rd. 9 to 12 AM, trip to Tropical Beach, Sutro Baths.

1 to 5 PM, Technical Round Robin. Chairman, W6CAL. Speakers (15 minutes each), Charles Perrine, Jr., W6CUH; Al O'Neil, W6GIS; George Becker; Ralph M. Heintz, W6XBB; Clayton F. Bane, W6WB; Frank C. Jones, W6AJF; John L. Stevens, W6PW; W. W. Smith, W6BCX; J. A. McCullough, W6CHE; Charles Watson, W6DW; J. N. A. Hawkins, W6AAR.

7:30 PM, meeting of delegates of Federated Radio Clubs of Northern California. Visitors welcome.

7:45 PM, political meeting.

Sunday, February 24th

9 to 12 AM, Hidden 5-meter transmitter hunt and receiver demonstrations in hotel rooms.

1:30 to 3:30 PM, Two feature speakers.

3:30 to 5:30 PM, Amateur-built equipment contest.

7:00 PM, Banquet, entertainment and prize drawing.

Advance registration fees should be sent to W6JAL, Arthur Holmes, Secretary, 431 Lincoln Way, San Francisco, California. Arrangements have been made to accommodate 900 amateurs. Reduced hotel rates will be in effect. YLs and YFs are cordially invited.

●●●

● From Emil Guidici at Sheepranch, California, comes word that ZS2A, South Africa, will be off the air indenitely due to the passing of his mother. The amateur fraternity extends deep sympathy to ZS2A.

●●●

● W7CFJ H. P. Hoshi, 307 15th Ave., Seattle, Washington, wants the QRA of OA4AI in Peru. He worked this station on February 24, 1934, but can't find the QRA. If any reader knows the whereabouts of OA4AI, he is kindly requested to communicate with W7CFJ.

●●●

● Australian amateurs have a few ten meter (and five) enthusiasts among their number, and a constant watch has been kept on ten for three or four years by one or two. As this time of the year produces the best results on this band, activity has been increasing during the past week-ends.

Sunday, 25/11/34, proved to be exceptional. In Sydney, VK2LZ, 2HZ, 2NO and 2YC were on the air from 9 AM. VK4BB in Maryborough and VK4XN started to romp in and were speedily QSO'd by the VK2 gang. Whilst VK2NO was QSO VK4BB, the latter suddenly broke off and started calling ZL1BA. He hooked the ZL and subsequently told me that the reason was because the ZL's signal swept across the band in the process of tuning at QSA5 R8. VK4BB followed the signal to see who he was and nearly fell off his perch when he found it was a Maorilander. This was exciting because we have been looking for ZL's on ten for a long weary period. Shortly after this, VK6SA in Perth, 2000 miles across Australia, began to come through at good strength and the two VK4's landed him. The chief interest at VK2NO was that just after this, K6EWQ's harmonic was heard at QSA4 R4 calling CQ and subsequently working an LU7. This was at 11 AM our time. It was only when K6EWQ started working the LU that I realized it was a harmonic. Surely this shows that conditions are becoming favorable for trans-Pacific working again on ten VK4BB and 4XN had a great day. They worked several VK2's 3's and 6's. This kind of thing hasn't happened since 1928. In December, January and February, a VK-ZL ten-meter contest is running. Here is an opportunity for your ten-meter exponents on the West Coast to look for us. The contest will be confined to the Sundays, our time, and will run from 8 AM to 8 PM. VK4BB has also heard J2IS on ten, so things are looking up.

All good wishes,

Don B. Knock,
Radio Editor, "The Bulletin" (VK2NO-2NU)

●●●

I. R. F. NEWS

NEW IRF MEMBERS: K7BND, W6ITH, W6CSX, W6RH, W6ICX, W6JWL, W6GVS, VE5EO, and VE5FH. We wish you many IRF QSOs!

●●●

● If you know of any YL operators, whom you think can qualify for IRF, we would like to get them pledged. It may interest the general membership to know the YL members of IRF to date:

W7AHJ—Esther Brunk
VE5KS—May Rose Sparks
W6EK—Flora Card
W6DHV—Mae Amarantes
W5BKV—Sally Walker
W7NH—Nellie Hart
W9LW—Lucia Mida
W6HEG—Harriett Gilbert
W6AET—Florence Jones

●●●

New Division Chief

● W1BZC, William Ellsworth, has been the Division Chief for the East Coast Division in the past, but has changed his QRA from Massachusetts down to Pennsylvania, and is now in the Capitol Division. Dr. John A. Stewart, W1SK, has very kindly accepted to succeed Mr. Ellsworth in the position of Chief for the East Coast Division. We wish him luck, as they have a fine Division of fine men.

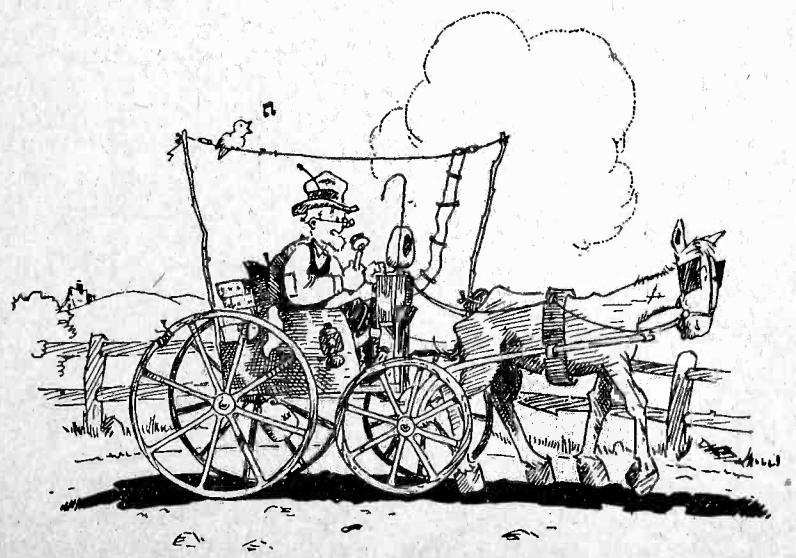
●●●

Eastern News

● W8ELO: "Heartily in favor of east coast gang get-togethers as suggested in last LJ." W2CJP says, "Rehabilitation plan is FB, and it will be the biggest publicity stunt ever pulled for Amateur Radio." His frequency is 3547 KC.

5-Meter QRM Problem Solved!

● Farmer "Jinks" and his good horse, "January", have solved the perplexing problem of automobile ignition QRM on 5 meters. If you are troubled with auto noise, or if the 5-meter band in the big cities is overcrowded, do as the good farmer does. The radio inspector will then have an ell of a time finding your QRA.



The Evolution Of A Vacuum Tube

(With Apologies to W6AAR)*

By W. W. SMITH, W6BCX
Associate Editor, R/9

SALES Manager of Novacex Inc. informs Chief Engineer that what the hams need is an addition to the Novacex line of electronic devices that will fill the gap between the NG-210 and NG-211 transmitting tubes. Chief Engineer stays up all night trying to decide whether to first build the tube and then name it, or to name the tube and then build it. After going into conference with second pint of Old Crow† gets inspiration to call new tube the NG-210½. Office boy remarks that designation is very fitting, but reminds C-E that Feebeltron has a tube called the FB-479½, and confusion might therefore arise because they sound so much alike. Suggests to C-E that they call the tube the NG-73.

For rough draft of proposed tube, design department uses pantograph on drawing of NG-210, and brings plate lead out top of envelope.

Office boy takes home first experimental model of tube and reports after trying it in his TNT that the thing got "pretty red" with 93 watts input and the key held down. Chief had a TNT once, and found efficiency to be 47 per cent, so with 93 watts input the tube must have been dissipating 50 watts, he figures. Office boy discloses that his milliammeter has bad habit of sticking and getting loggy; therefore figure of 93 watts should not be taken too seriously. C-E replies not to worry about that, because he was not sure of the accuracy of the ratings on the carbon lamps he used for dummy load, and only guessed at normal brilliancy anyhow. So maybe a TNT was 69 per cent efficient instead of 47 per cent.

Janitor asks C-E why he doesn't run static test on the tube to determine how much it will dissipate without getting too red, instead of fussing around wih TNTs. C-E shuts him up by giving him second experimental tube to take home with him to play with, and then rushes off to lab to see about the matter of static inputs. Janitor reports next morning that tube gets fairly blue at 1250 volts.

Advertising department releases advance data on new NG-73 along with tentative ratings: Plate dissipation (max.) 50 watts. Plate voltage (max.) 1250. Oversupply of 210 filament stock results in tube having 1¼ amp. filament, 15 volts to give necessary watts emission. Shop foreman's son reports that he had 1500 volts on one for 5 minutes and it didn't blow up or go soft, so rating is changed to read 1500 maximum plate volts.

Charlie Perrine writes in and says that he obtained 231 watts output from an NG-73, with a note that if grid lead were brought out side so a 203-A driver could be used without the NG-73 flashing in the base, and the tube were pumped harder to allow 2800 volts on the plate instead of the 2200 he was using, it would be possible to get 239 watts output without exceeding the dissipation rating. Chief Engineer after reading letter five times announces that he has, after much scientific research, decided to scrap current design and change mechanical construction. He carries the idea one step further and brings not only the grid lead out the side, but also the filament leads out the other side. Notices that pins on base are not connected to anything, so decides to throw base away. Discovers difficulty of mounting tube which has no prongs, so decides to put base back on.

Remembers about remark that tube should be pumped harder. Makes memo to put more "getter" in the tubes and increase the size of the envelope to allow cool spot of glass at bottom of tube for gases to collect on. President sends him memo never to use a preposition to end a sentence with.

Tube now handles 2800 volts without celebrating Fourth of July. Assistant Engineer notes new size of envelope and remarks that it is now large enough that if cooling flanges were put on the plate, the dissipation rating could be raised to 75 watts. "Improved" NG-73 makes its debut, sporting new corrugated-carbonated plate with cooling flanges giving the anode the appearance of a burned drug-store waffle wearing flippers. Data sheet states 300 watts input now permissible in high-efficiency circuits.

Skroo Loos, W5NUT, takes antenna off his Perrine rig to show visitors how he can draw off a 7-inch arc, and blows NG-73 through roof. Writes to factory saying tube sure enough "NG" all right, and asks why bother to put the 'ex" on "Novacex"? Does not think it necessary to mention small matter of plate voltage of 3200 and removal of antenna.

W6AM writes in that tube gets very hot with 300 watts input, which should be permissible according to ratings. Does not notice that he has mixed up coils on trick Don Wallop coil-changing scheme and is using 20 meter coil on 40 (resulting in very high "C"), as he has become far-sighted from trying to point out to visitors the trade mark on "Q" antenna atop his new tower.

W4SOS writes in plate ready to melt at 250 watts input, but neglects to mention that tube was running self-excited on 1½ meters. After mailing letter finds that the tube wasn't on 1½ meters after all, because the tube wasn't even oscillating. Decides to keep discovery to himself and lets letter ride.

W7RAZ forgets to remove shunt from milliammeter, and writes very derogatory letter about tube being over-rated. Visiting ham notices shunt and calls it to his attention, but RAZ remarks that the tube probably isn't any good anyhow, and that even if it were good he wouldn't like it.

Adjustment department gets tired of replacing tubes and answering complaints, so advises engineering department to make the tube huskier so that the hams can run 300 watts input, and not just 300 Perrine watts input.

Plate is made larger to handle more heat, and spacing is increased to raise breakdown and keep interelectrode capacity at approximate rated vlue. Proving laboratory finds tube okay except plate resistance now twice original value, which is corrected by putting in a huskier filament, now drawing 4 amps, instead of 1¼ amps at the same 15 volts.

News leaks in through grapevine that Feebeltron is about to release a tube with a mutual conductance of 9237 as compared to 3879 mmhos. for the NG-73. Chief decides that too much plate is hiding from the filament. Designs phantom grid structure to cut down shadow and raise mutual conductance. Research department brings in tube in which no grid can be seen at all. C-E compliments research department, and then notes they carried things a bit too far by leaving out grid altogether. New Novacex high voltage rectifier for cathode ray equipment announced; appearance is suspiciously similar to the NG-73.

Chief decides to quit playing with ghosts and leave grid structure as originally planned, and to raise mutual conductance by putting in still more filament. New 8 ampere filament radiates so much heat that envelope melts with no palte input. Envelope glass changed to Stonex.

President's son decides to build himself a ham rig using low level modulation with a pair of NG-73s as linear amplifier. Because of comparatively low efficiency, finds that output is limited by plate dissipation long before maximum allowable plate voltage and plate current are reached. Instructs dad to instruct C-E to put flanges on the cooling flanges to increase dissipation rating. New NG-73 is announced, more suited to low-level and grid-modulation as dissipation rating has been raised from 135 to 165 watts, without change in other characteristics.

Letter from Perrine states that at 4600 volts he finds it possible to run 2800 watts input to a single NG-73§ without the plate getting much more than a vivid red if keyed with light enough dots.

Engineering staff compliments itself on new tube, and celebrates occasion by opening case of Old Crow. President opens letter from field man advising him that what the hams need is a tube that will fill the gap between the NG-210 and NG-211. President has idea for new tube. Chief Engineer has delirium tremens.

* See August 1934 QST.

† An old favorite of both receiver and vacuum tube manufacturers.

§ As measured in a dummy antenna.—Editor.

This R-S-T System

THE readibility, audibility and tone system now used is the standard of the world, and has worked out very well. In fact, almost everyone is well satisfied with its meaning, except the A.A.R.S. and N.C.R. stations who have been using a S-1 to S-5 scale. All have learned to give correct reports by the QSA system, so why change to the R-S-T method?

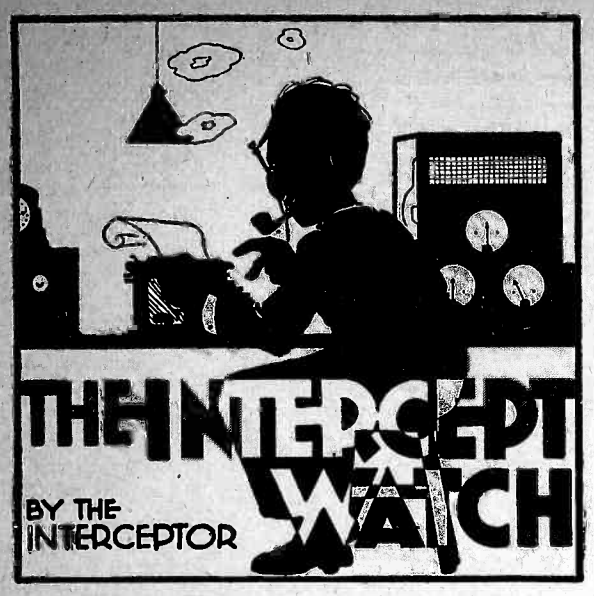
In the October QST, W2BSR outlined a new system, which has been approved by the ARRL and is in use at W1MK.

In a letter received from Mr. Handy, Communication Manager of the League, he says: "THE QSA SYSTEM IS PART OF THE SUPPLEMENTARY REGULATIONS (MADRID CONVENTION) AND WILL ALWAYS BE IN USE INTERNATIONALLY, UNLESS CHANGED AT FORTHCOMING CONVENTIONS (CAIRO). THE R-SYSTEM IS WELL KNOWN, AND HAS EARNED HIGH AMATEUR REGARD."

In this case why does the ARRL try to start something new like this when, in the first place, they are encouraging the ham to break international laws in addition to getting the ham all muddled up with just another regulation?

I suggested that the signal strength portion of the R-S-T system be raised to 9, but Mr. Handy says this would involve very wide confusion at this time. Funny thing that he never thought of a "very wide confusion" when the League adopted the R-S-T system.

(Continued on page 32)



Here is a thriller, if ever there was one. Picture yourself in a lighthouse on the ocean. A storm breaks . . . your entire radio station is destroyed. What would you do to effect radio communication with the mainland? The Interceptor has intercepted a letter from F. L. Black, one of Oregon's SCMs, and attached to the SCM's letter was the thrilling story of how Henry Jenkins, first assistant Lighthouse Keeper of the Tillamook Rock Light off the Oregon coast, succeeded in building an entire amateur transmitter and receiver from salvaged pieces of junk—put the rig into operation and effected communication with nearby amateur stations. The Intercepter considers himself fortunate in receiving this thriller from F. L. Black and he hopes that all amateurs will profit from the reading of it.

● This record begins with the violent storm that swept the north Pacific, causing severe damage to the Light Station on Tillamook Rock on the 21st of October, 1934. At 10 P.M. October 20th, a fresh southeast wind was blowing with light rain. During the night the wind increased to gale force and changed to the southwest. About 3 AM October 21st the seas ran extremely high, swells hitting base of the rock from the southwest and the spray coming over the rock. At 9:30 AM I was awakened with a sudden jar, completely covered with water. All my clothes and bedding were soaked. The seas at this time were washing over the entire tower, pounding against the window shutters of my room. The window catch let go and the entire room was flooded. At this time the wind was blowing at an estimated 100 miles per hour or more, seas covering the Lighthouse, carrying with it large rocks, debris and fish which were smashed through the lantern plate glass, breaking 16 panes and flooding all quarters. In endeavoring to replace glass panes with emergency wooden shutters, Hugo Hanson's right hand was deeply cut. While assisting dressing his wound, I read the barometer which was 28:92 inches. Each time the tons of water would cover the building, coming down with terrific impact on the roof, the barometer would drop immediately to 28:72 inches, returning as soon as the impact was over.

Impacts from tons of water and rocks would occur most every three seconds, lasting from about 10 AM to 12 noon. Prior to that time they were not so frequent. About 10:15 AM a terrific impact occurred and the tower and building were enveloped with giant seas. The large 80-foot derrick and telephone cable had been swept away.

A 6-foot section of the west end of the rock was carried away, hurling rocks weighing as much as 50 pounds through tower and on the roof, smashing shutters which were made of ½-inch wood. The shutters at the base of the building were carried away, flooding all floors, breaking the piping of the heating system and thereby cutting-off the heat which was badly needed at this time. We were all soaked, walking in cold water and extremely tired. The lantern and fog signal were now inoperative. Both of these were greatly needed by mariners. We had no other means of warning them. If we put out a different light, and if they would come up close enough to identify it, the consequences might have been disastrous. Nevertheless, a fixed white light was set up and a crude short-wave transmitter and receiver were built from parts of an old Atwater Kent broadcast receiver on hand at the station. We also had some batteries, scraps of tinfoil, copper and brass.

At 6:50 PM, October 23rd, I made the first call for W7CXK and was picked up by a Portland amateur, Merrill Peoples, W7WR, who was QSO W7CXK and who notified Henry Goetze, W7CXK, that someone was calling him. W7WR could not tell who was calling, because the signals were so weak and chirpy. A message informing the superintendent of the damage incurred was the first traffic handled.

When things around here got half dry, I immediately got two boards approximately 10 by 12 inches. Not having any tube sockets, I drilled holes in each board for sockets and took the two 30 type tubes out of the BC set and soldered leads on the prongs of the tubes.

On the transmitter board I placed a tank inductance which I made from some Bell transformer wire. The wire was wound on the cardboard case of a No. 6 "A" battery. I used 14 turns. The tuning condenser was a 3-gang condenser taken from the BC set, but I only used the middle section. I made the series fixed condensers for the antenna out of tinfoil and wax paper in which a loaf of bread had been wrapped. I used no grid condenser or leak. The plate blocking condenser was "swiped" from the BC set. I made the RF choke from one of the regular BC chokes by removing some turns. This junk, when finally assembled, completed a TNT circuit but used no grid condenser or leak. I took the batteries from the telephone and used them for lighting the filaments. Two No. 6 cells were connected in series. The three "B" batteries from the BC receiver were down to 80 volts. For a key I simply broke the battery connection with my hand. Later I found a piece of spring brass and made a hand key. I sent my first four messages with my fingers breaking the connection on the "B" batteries. But after that I used the home-made hand key. My transmitter antenna consisted of 40 feet of salvaged wire that was left from the BC set.

Not having anything to work with, the receiver was a crude affair. For the coil I found an old regular telephone receiver and I used the shell as the form on which I wound the 80-meter band coil. I used 45 turns of wire which I swiped from BC set. This made the grid coil. There were 20 turns on the plate coil. I had no means of controlling oscillation, so I put enough plate turns on the coil to keep it oscillating at all times. For the antenna series condenser I simply twisted two feet of insulated wire together and the capacity of the separation by the insulation served as the series condenser, between the grid coil and the antenna.

I used tinfoil condenser for the grid condenser, but I used no grid leak. The tuning condenser was made from two brass plates that I removed from the door knob. I fastened one plate on the receiver base and the other was separated by a piece of wax wrapping paper. Tuning was accomplished by shoving one plate over the other with a pencil. The values of these parts were unknown, but due to my past experience I finally found the 80-meter band and the first station I heard was W7RT in Seattle. Then I knew where I was, and I immediately tuned with the aid of a pencil. I found W7CXK working W7WR, so I left the receiver tuned on W7CXK and while he was transmitting I tuned my transmitter to his frequency by listening to him with my transmitter oscillating. At 6:30 PM October 23, I called W7CXK. W7WR informed W7CXK that someone was calling him, so that was the way QSO was made with the mainland and God's country. Shipping was warned through notifying the Superintendent of Lighthouses by sending message to Goetze, W7CXK, who relayed them to the superintendent at Portland via Western Union.

(Editor's Note—Box 215, Seaside, Oregon, is the address of Henry Jenkins, the man who wrote this story.)

The 222 Communications Receiver

(Continued from page 15)

while, since it allows adjustment of the resonant antenna coupling so as to obtain optimum value of first detector regeneration. It can be used with any type of antenna and the latter may be tuned to resonance externally and the optimum coupling easily found. The results were very gratifying. The image interference on 40 meters measured 60 DB units down in level from the desired signal, using a signal generator for these measurements. 60 DB means an image rejectivity of 1000-to-1, which is extremely good for sets using a good stage of RF. The image measured 50 DB down on 20 meters, which is more than most superheterodyne receivers can even approach at that wavelength. The receiver has practically no image whistles of "phantom" commercial signals in the amateur bands, unless the commercial signal is of very high field intensity. The signal generator gave an audible signal in the headset with an input of 130 DB down from 1 volt, which is less than one microvolt input. This is ample sensitivity, with low internal receiver noise level, to reach down into the atmospheric noise level in any locality.

The receiver was built into a metal cabinet measuring 8½ inches deep, 7 inches high, and 11 inches long. The front panel is 7 inches x 11 inches of No. 12 gauge aluminum. The chassis is also of No. 12 ga. aluminum, bent in the form of a U, two inches deep and 8¼ inches wide by 10 inches long. All of the necessary tube socket and dial holes can be punched, or cut out with a circle cutter and drill press. The shield partition between the oscillator and detector is also of No. 12 gauge aluminum, 7 inches long, 4¾ inches high with a ½-inch lip along the bottom for fastening to the chassis with 3 machine screws. In building this set it is a good plan to take all of the larger parts and set them on the chassis so as to get the proper chassis layout before drilling. The pictures of this set and the plan drawings should enable anyone to duplicate it without trouble. The lower knobs on the front panel from left to right are sensitivity, regeneration, audio volume, tone control and BFO switch combination, and antenna coupling. The upper row: oscillator band setting adjustment with knob and small 0-100 metal escutcheon plate, main tuning control, and last, the detector band setting control and 0-100 division plate. The antenna leads, power cable plug and telephone jack are at the rear of the chassis with large holes around them through the metal cabinet. The cabinet has a hinged lid.

The receiver is simple in its circuit and easily built. It can be, and was, in this case, built and put on the air in two day's time. The circuit line-up is simple if a modulated oscillator is available for lining up the IF amplifier. If not, it can be aligned by using the noise level from a large antenna.

A Hum-Free A.C. Operated Pre-Amplifier

By FRANK LESTER*

● The advantages of all AC operation for high-gain pre-amplifiers intended particularly for condenser and ribbon microphones are so obvious that it is hardly necessary to dilate on them.

In a recent article in an engineering publication, a college professor stated that the requirements for a successful AC pre-amplifier were as follows:

1. Type 57 tubes in triode connection; 2. Heater connections in lead cable on underside of copper chassis; 3. All grid connections above chassis and completely isolated from heater connections; 4. Bias resistors shunted by 25 mf. or larger electrolytic condensers to reduce degeneration on low frequencies; 5. Amplifier completely enclosed in copper case; 6. Completely shielded input connecting to completely shielded microphone; 7. Heater and high voltage supply isolated from amplifier (3 ft. or more) and feeding through shielded cable; 8. Completely filtered high voltage supply.

A unit was built with these features: (1) AC operated; (2) hum free; (3) work with a power amplifier of 70 db gain or more; (4) be capable of raising the level of a velocity mike to at least that of a carbon mike; (5) have a frequency response as flat as possible and preferably at least equal to that of the velocity mike itself.

Even if the first four requirements are met, the last is a problem in itself. Accordingly, the simple circuit of Fig. 1 was selected as a starter and carefully constructed of the best available parts. The 57s were used as triodes, as recommended. An audio oscillator was used for input. The output was coupled through a 200-ohm line to a 15-watt amplifier having a gain of 70 db, the output of the latter in turn working into a high quality dynamic speaker.

The residual hum produced by the combination was enough to completely overshadow the oscillator input. The conclusion was drawn that a gross error had been made somewhere in the wiring, but repeated checking revealed nothing amiss. The final cures involved some ideas not previously known.

The possible reasons for the hum were listed as follows: 1. Ripple from high voltage power supply; 2. Hum induced in cathode by heater; 3. Inductive pick-up by leads; 4. Inductive pick-up by input and output transformers; 5. Static hum induced in chassis by power transformer.

To determine the extent of 1 and 2, batteries were substituted for the heater and plate supplies, and surprisingly enough the hum dropped only about half. It was evident, then, that problems 3 and 4 would require much investigation.

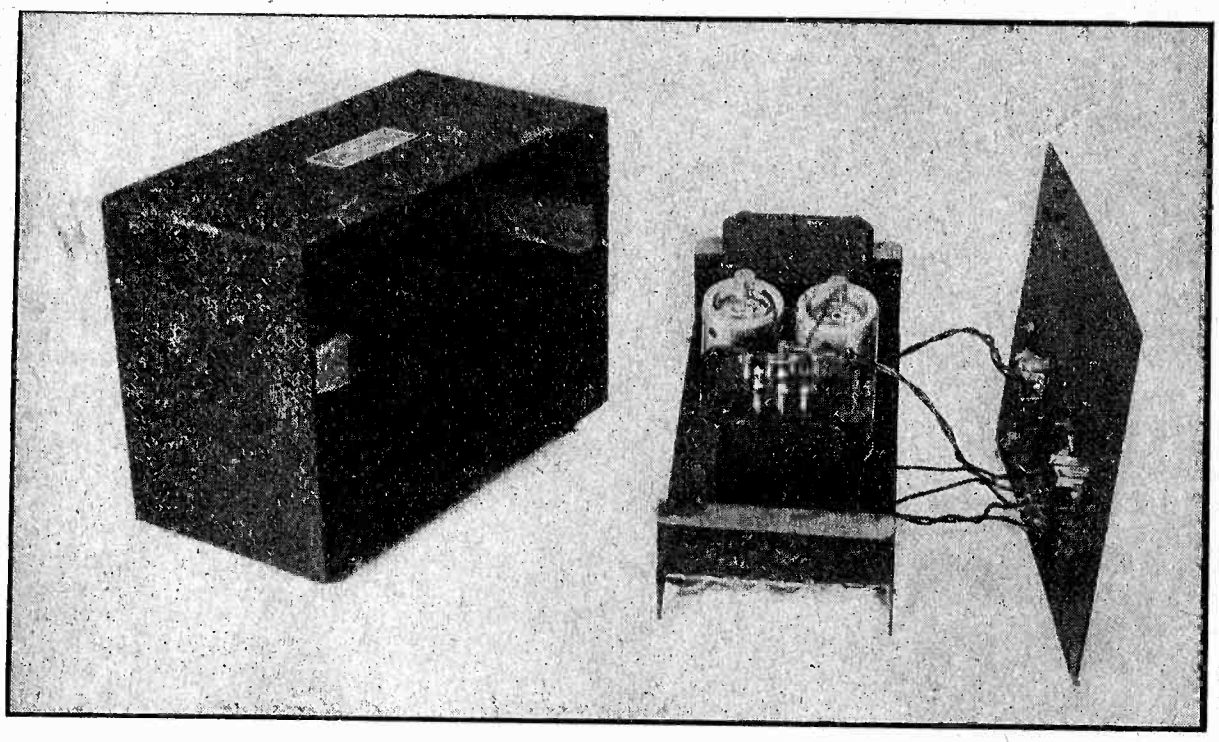
After attempts to isolate the amplifier from all existing wiring by mounting it in a cast, high permeability case ¼ inch thick, and also shielding all input and both grid and plate leads, it was found that the hum was still too high for practical purposes (battery supply still used). Shielding alone obviously was not sufficient.

As a remedy, hum cancelization right in the transformers themselves was suggested, the shielding of the case alone not being adequate with the amplifier working at the high gain expected of it. Much money was spent on experimental designs, and the final transformers were made with symmetrical primaries and secondaries, poled in such a manner that externally induced E.M.F.s cancel-out in the windings while the primaries continue to induce properly in the secondaries because of their correct phase relationships. As an added measure of protection, the cases of these special transformers were made of special iron having five times the permeability of ordinary stamped sheet iron cases.

When these input and output transformers were installed (batteries still used), the hum dropped to a negligible level, proving conclusively that cause 4, formerly so troublesome, was overcome.

When the AC supply was reconnected to the unit, the hum level came up again, but this time to only about half the level of the first test. Was the hum due to high voltage ripple or cathode modulation by the heater? Juggling of power supplies showed that the heater hum, while appreciable, was small compared to the effect of the rectified plate supply, yet any amount of filter up to 100 mmf. and five or six brute chokes did not reduce the hum and was no better than a simpl three-step filter as used in the final amplifier.

It became evident that while the hum was induced by the high voltage supply, it was not due to ripple voltage, and therefore it was static hum of one sort or another. The primary and the high voltage secondary of the power transformer were separated by the usual static shield, so it was reasonable to believe that static E.M.F, from the primary would not be impressed on the secondary independently of the straight phenomenon of electromagnetic induction. It was therefore assumed that any form of static E.M.F. in the **other** windings must come from the high voltage winding, a reasonable assumption because the high voltages developed are high, after all. It might be possible for this winding to induce a static hum in the filament winding, for instance, the hum thus riding into the amplifier by way of the whole filament circuit. There was also a possibility of static E.M.F.s being established in the chassis by this route because of differences of impedances between various grounded points. A similar well-known action takes place in some types of multi-stage RF amplifiers. Even the slightest hum is so aggrevat-



Interior View of Amplifier Case, Showing Soft Rubber Cushion Pads.

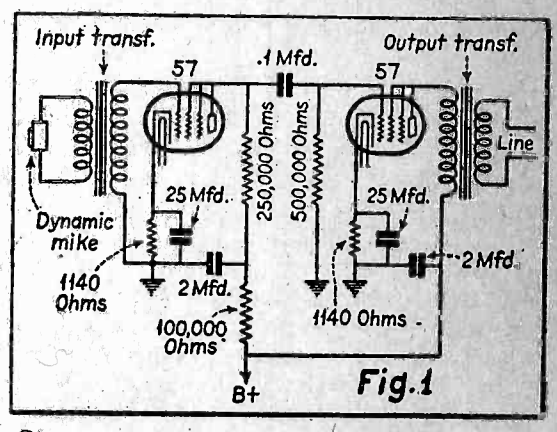


Fig. 1

Circuit of the experimental set-up

* Engineer, Wholesale Radio Service Co., Inc.

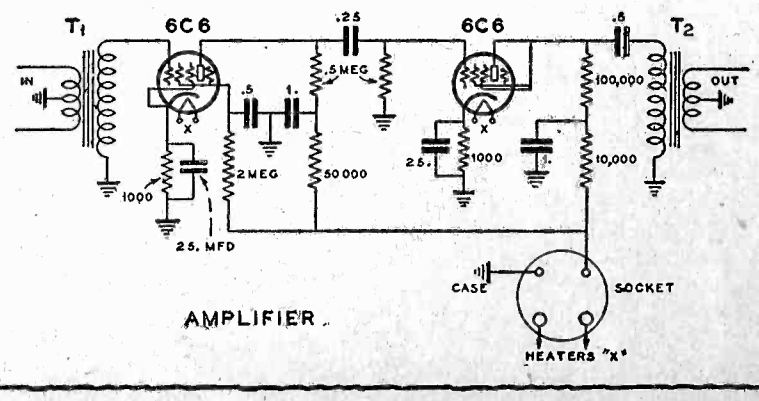
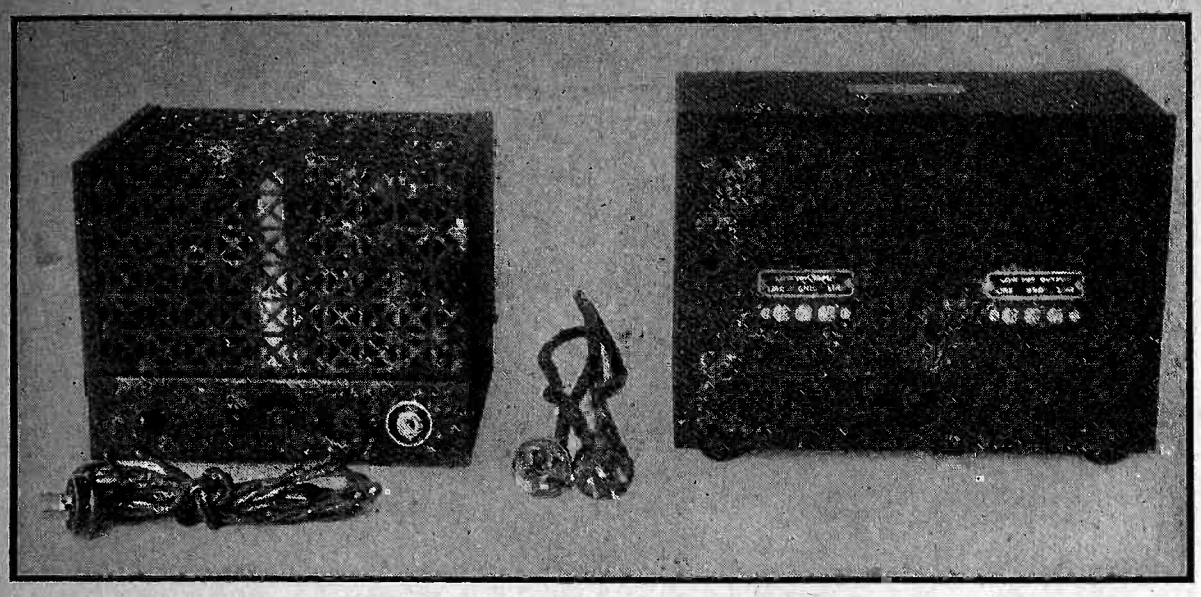


FIG. 2—The Circuit that gave best results. (Courtesy Wholesale Radio Service Co.)



Front and Rear Views of the Amplifier in its Metal Housing.

ing with a high-gain amplifier system that no possibility can be overlooked.

A special transformer was made with all the windings electrostatically shielded from each other. When this transformer was installed, about 90% of the remaining hum disappeared—a most gratifying result.

The remaining hum was definitely cathode-heater hum, and its elimination was merely a matter of tube choice. It was found that 6C6s were by far the quqietest, the 57 being quite noisy.

With the hum brought down to the point where an experimental pre-amplifier feeding a 15-watt power amplifier was just as quiet with the power switch on or off, the next problem was that of gain, which, after all, is what the amplifier was built for in the first place. The gain must be 40 db or more if a 70 db amplifier is to be driven with sufficient reserve. The circuit of Fig. 1 had only about 38 db gain, which was not enough for a velocity mike. An extra stage did not prove successful because of terrific microphone effects. The final circuit chosen for a commercial wide-range high-fidelity pre-amplifier (Lafayette) is shown in Fig. 2. The first 6C6 is operated as a pentode, the second as a triode. The overall gain was found to be 62 db.

The final problem was frequency response. Curve 1, of an amplifier using the two triodes of a 79 in cascade with good transformers, is shown to illustrate how tube choice can affect amplifier performance. The impedance of the input transformer secondary in this case is about 100,000 ohms. Curve 2 shows the same transformer with a pentode and pentode-triode combination. The reflected input capacity of a triode is influenced by the mutual conductance of the tube; with a pentode it is the actual input capacity as determined by the mere physical construction of the tube.

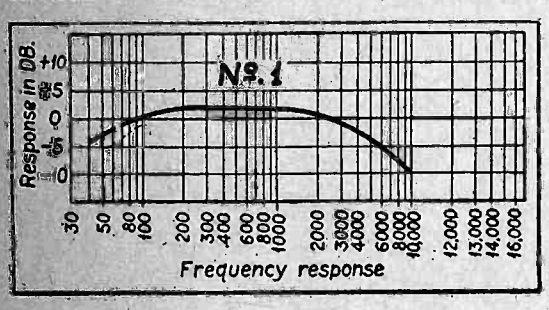
The practicability of using a pentode first-stage amplifier was a bit of luck, from the standpoint of microphonics as well as frequency response. The high gain makes an intermediate stage unnecessary.

The amplifier response represented by Curve 2 was still not ideal for a high fidelity mike. The possible frequency losses in the amplifier were investigated, and the transformers under ideal conditions were found not to possess the discrepencies shown in the curve. It was also found that a response varying only 1 db from 30 to 17,000 cycles was obtained with the input transformer eliminated and the test input fed directly to the grid circuit of the first amplifier. The input transformer was then held responsible, but since it showed no such loss as mentioned under ideal conditions, the blame was placed on the distributed capacity of the tube, its wiring, etc. To lower the distributed capacity of the transformer secondary, and also to reduce the shunting effect of the tube, the secondary impedance was reduced from 100,000 to 40,000 ohms. The final frequency response as shown in Curve 3 is believed to be as good as anything obtained heretofore.

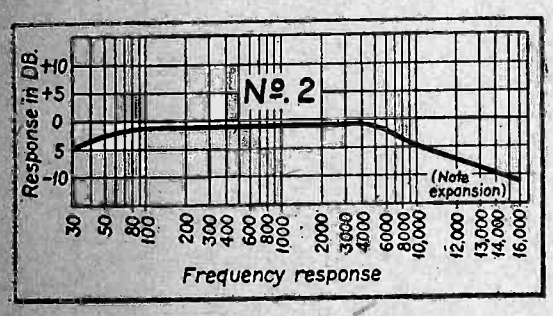
The gain suffers with reduced secondary impedance, but the final amplification of 56 db (instead of 62 as originally measured) proved altogether sufficient.

As the output transformer is worked at low impedance values, no difficulties with frequency discrimination were experienced with it.

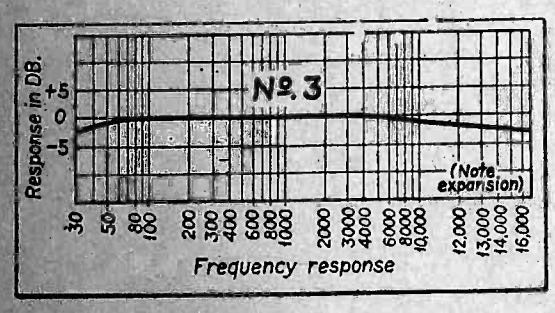
Most of the preceding discussion has been of the electrical features, but the mechanical construction is also of extreme importance. The completed amplifier is shown in the accompanying photographs. Nothing less than ⅛ inch structural steel is used throughout. The pre-amplifier components are mounted on a chassis that slides into sponge rubber guides inside a heavy cabinet measuring 10¼ x 7¼ x 5½ inches. The front panel, containing the input and output connections and power receptacle, is screwed to the corners of the box, not to the chassis. The latter thus floats perfectly free. The whole unit weighs 25 pounds and nothing short of a deliberate kick affects its microphonically.



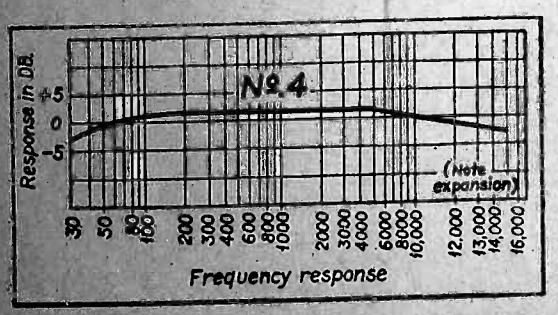
Frequency curve of pre-amplifier with 79 triodes and ordinary transformers.



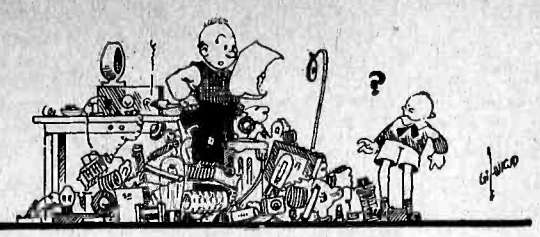
Frequency curve of pre-amplifier with 6C6 pentode and 6C6 triode connection, and ordinary transformers.



Frequency curve of pre-amplifier with special transformers.



Response of entire system illustrated in Fig. 3 and Fig. 4.

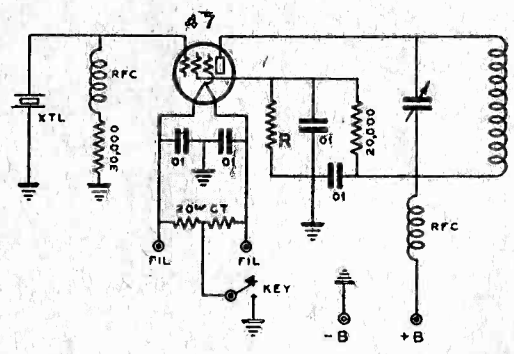


Ham Hints

— By JAYENAY —

Eliminating the Chirps When Keying the Crystal

● In the conventional pentode crystal oscillator circuit the screen voltage is obtained from the plate power supply by means of a series dropping resistor. When an attempt is made to key in the center-tap of this crystal oscillator circuit, a bothersome chirp is usually found in the note. When the key is up the screen voltage rises to the same value as the plate voltage, which is from 350 to 450 volts. With the key open, no space current flows through the tube and because there is no current through the screen dropping resistor, there is no voltage drop across that resistor. The high voltage is thus applied to the screen. When the key



R = 5000 - 10,000 OHMS, (TO GET APPROX 100 VOLTS ON SCREEN)

is pressed, and space current starts to flow in the tube, the screen current causes a voltage drop across the usual series dropping resistor and the screen voltage then drops back to its normal 100 volts. However, it does not drop back instantaneously; during the time the screen voltage is dropping there is often a very noticeable change in the frequency, which causes the chirp. The chirp can be eliminated by keeping the screen voltage approximately constant, whether the key is up or down. This necessitates the use of a voltage divider, instead of a series dropping resistor as a source of screen voltage, as shown in the circuit above. The value of the resistance R should be chosen so that the voltage on the screen, when the key is down, is 100 volts when measured with a high resistance voltmeter.

●●●

McMURDO-SILVER

Receiver Prices . . . *and* Plug-In Coils

Apparently the page of rambling appearing in the December issue of RADIO proved of some interest, to judge from FB cards and comments some of you readers were kind enough to mail in, so here goes for a bit more, mostly on the subject of prices of amateur receivers.

Today there are not one but several good amateur superhets with and without crystal filters available or almost ready below one hundred dollars—in a word at fair prices in terms of design, material and performance. This is as it should be, but the fact that you can now buy a good superhet at a price comparable with good all-wave broadcast receivers—and some of these latter equipped with band spread tuning and beat oscillators are actually better ham receivers than have been available to amateurs as specifically amateur jobs—is largely due to the entry of cost conscious makers into the amateur market.

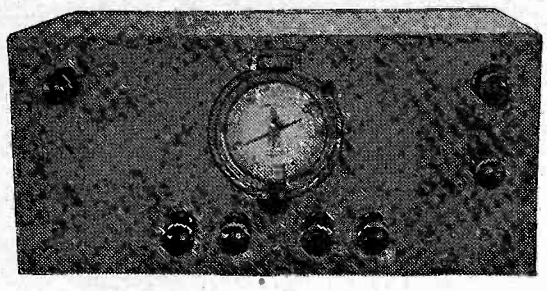
The point is that amateur receiver design technique has been greatly aided by the all-wave broadcast flurry. So much so that the amateur market looks good today to some of the b.c.l. makers, and in consequence amateur radio is finally getting a break on receiver costs—a break made possible by the cost knowledge of makers who have had to meet serious price competition to live.

The plug-in coil situation is a good example——lots of them cost money—much more money than more convenient, and I believe better, permanently installed coils with a good switching system. And usually in cost lies the hope, if not the actuality, of maker's profit. No, none of us are in business for love alone, although we don't make a nickel net on 5C receivers, though we do have a lot of fun. But if you want to spend over one hundred dollars for a receiver, the dual xtal filter MASTERPIECE III-X is the answer to the super fine receiver question.

And speaking of plug-in coils, there finally seems to be a trend away from them in transmitters —to tapped coils such as the commercials have used for years. This seems quite sensible and I've recently done some checking on the subject of losses in tapped coils in transmitters. The answer was as expected. The losses are measurable, but just measurable, and even if they ran up to 5%, which they don't in a good layout, 5% power isn't much in decibels to the receiving operator when compared to convenience and permanence. Our 10F transmitter is a good example of economy and efficiency—10, 20, 40, 80, or 160 meters by shifting clips on permanently mounted coils. Why not try it in your own rig—you'll be surprised, whether you leave your coils open ended (we prefer it so) or short circuit unused turns. Tnx-cul.

McMurdo Silver

The MASTERPIECE III-X . . .
. . Is As Revolutionary As the Single Signal



You know what single signal code selectivity is, and of course the MASTERPIECE III-X has this selectivity, although it and the 5C are the *only* receivers made today that don't sacrifice one iota of sensitivity to get this super-selectivity—you don't lose half an R for its crystal code selectivity. But—it has the new Silver dual crystal circuit that chops out of the air exactly one phone signal at a time, and no more—that eliminates heterodynes within one kc. of the station you want. This is made possible not by the old useless "parallel crystal" scheme that made you wonder what it was ever included in receivers at all for. Not at all! Two crystals 700 cycles apart are used, one alone for code, both in parallel for phone. Thus you get a one kc. wide band, which gets intelligible speech, sans noise, sans heterodynes, sans interference as has never before been possible.

And when you want high quality broadcast, turn the crystal switch and you've got the world's finest broadcast receiver—the receiver that has elicited more enthusiastic praise from experts than all other radios put together have ever received—even good words.

The MASTERPIECE III-X in the opinion of those who have used it in action, is the supreme receiver of all types. For it alone combines without reservation or sacrifice the unequalled and spectacular broadcast performance on all waves of the internationally famous MASTERPIECE III, with the unequalled completeness and flexibility of the 5C, plus the new dual crystal phone selectivity that competitors will begin copying the day they read this ad.

Whatever it is you want, the MASTERPIECE III-X has it. One tuned r.f. stage so good it puts other two-r.f. supers to shame. Three air tuned i.f. stages. Perfect automatic volume control as found in no other receiver in the world—or cut out at the throw of a switch. Separate audio volume and r.f. sensitivity controls. Selectivity anything you want it to be when you want it. Tone quality that out high fidelity's high fidelity. Beauty, ruggedness, ease of operation, band spread anywhere in the range by the originator of "one dial band spread." Briefly, it has every feature found in other sets copied from it by other makers, plus dual crystal filter for real, serious, phone work. Yet it's as low in price as competition that won't even equal the 5C!

THE 5-C IS TAKING AMATEUR RADIO BY STORM

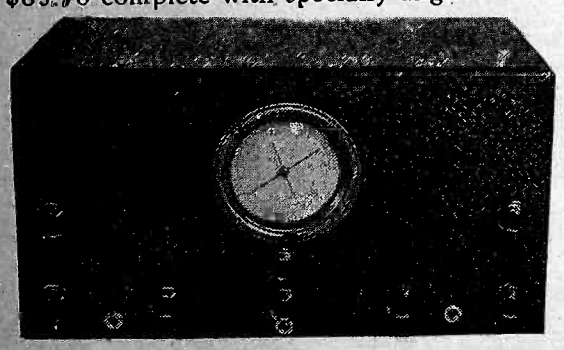
The 5C is going into more amateur stations today than are practically all other receivers put together! But the answer is simply that it has everything. Name almost any feature you desire and the 5C has it. That's why its predecessor caused W9USA to junk the competitive receivers the World's Fair used in 1933 and get Silver's for 1934. And ask anybody that operated W9USA *how* they worked!

The 5C is built by a maker who believes in giving, and knows how to give, amateurs full value for their hard earned dollars. It has every feature of sets selling at twice its price, is easy to handle, and has the exclusive and only crystal filter circuit that gives no loss of signal strength in series operation.

This alone would deservedly make it the most popular of amateur receivers and if you don't think it's popular, just ask the QSO's who give you an R9 report what they're using and you'll probably find it's the 5C.

If you want technical dope, it's yours for a postcard—or a look at a back issue of "RADIO" or R/9. But whatever you ask "has it—," the answer is "yes." Tuned r.f., AVC that IS AVC, super-efficient crystal filter, band spread anywhere in its range of 1500 to 23,000 kc., right on the main accurately calibrated, easy to read airplane dial. But why go on—just ask your QSO's! They'll give you the lowdown.

Despite all this, the 5C is priced down where it and its competition belong. Just $74.70 net with Raytheon tubes and Jensen speaker, or $83.70 complete with specially aligned Xtal filter that is an Xtal filter.



Get it from your jobber, or order direct—you can return it to us within ten days for full refund if you don't think it's a world beater. Oh yes—what other maker dares offer you receivers on such a trial basis?

McMURDO SILVER, Inc.

3362-A NORTH PAULINA STREET CHICAGO, U. S. A.

THE 10-F 100 WATT PROFESSIONAL PHONE C-W TRANSMITTER

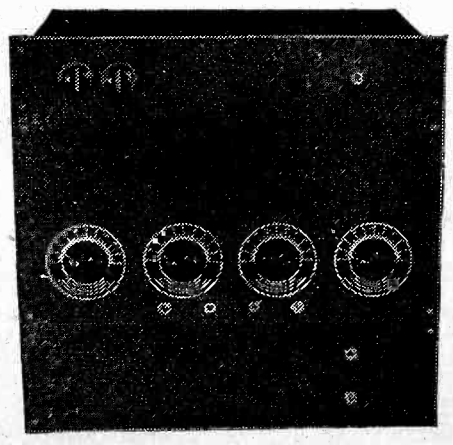
The type 10F transmitter is the improved and "prettied up" model of the now famous 10D. It is the amateur's dream come true. It provides 100 watts of crystal controlled r.f. power on crystal fundamental in any amateur band, and 60 watts on second crystal harmonic. Its phone carrier output is 25 watts modulated 100% with high fidelity broadcast station modulation, all at a cost below what you can build it for!

It employs one RK-20 screen grid r.f. pentode as a crystal controlled Tritet (electron coupled) oscillator. Modulation is affected by suppressor grid voltage variation, which is obtained from a simple two-stage audio modulator.

But read its specifications, look at its price, and get on the air with 25 watts of broadcast station voice quality or 100 watts C.W. cheaper than you can build a 100 watt telegraph transmitter alone! Order it from your dealer or direct and join the P.W.A.C. Club (Phone Worked All Countries)! If you don't believe it, ask anybody working one, W9NKH has obtained R9 phone reports out of every district—W9DDE gets R9-QSA5 phone out of every district on one installed in Waukegan, Illinois.

SPECIFICATIONS

R. F. Output: 100 watts on fundamental crystal frequency. 60 watts on crystal second harmonic. Phone carrier 25 and 15 watts respectively.
Frequency Range: 10, 20, 40, 80 or 160 meter amateur bands. Complete coverage with one set low loss tapped coils included.
Tubes Needed: 1-RK20 Oscillator, 1-RK19 Rectifier, 1-'57 Voltage Amplifier, 1-2A5 Power Amplifier, 1-80 Rectifier.
Modulation: Linear suppressor grid modulation variable from zero to over 100% at will. Harmonic distortion less than 5% at 100% modulation.
Audio Frequency Range: Modulation curve flat to 4 db. from 40 to 8000 cycles. Variable tone control provided for high audio frequency attenuation as desired.
A. C. Modulation Hum: Negligible.
Phone-Telegraph Selection: Two position toggle switch on r.f. unit selects phone or C.W. telegraph position at will.
Antenna Tuning: Impedance matching network with two 365 Cardwell mmf. condensers and tapped coil. Will feed any antenna.
Meters: None provided except on special order (mounted on r.f. unit panel). One 0-200 ma. milliameter and, if desired, one 0-2 antenna thermoameter are all required to check operation.
Controls: Oscillator plate, r.f. plate and two antenna tuning dials. Phone-Telegraph, send-receive, modulator on-off and power on-off switches. Screen and plate current measuring and key jacks.
Size: Total height of all three 19x1/18" black crystaline steel relay rack panels 19¼". Supplied complete on crystaline black table rack frames.
Power Required: 350 watts at 105 to 125 volts, 50 to 60 cycle A.C.
Accessories Needed: One Bliley crystal and holder, one crystal microphone, and tubes as above.
Price Net to Amateurs, $119.70 Five Raytheon tubes, price $25.23 net. Turner crystal microphone and cord. Net price to amateurs $12.60.



Common Causes of Tube Failure

By LINEAR

● A survey discloses the interesting fact that few amateurs get more than 100 hours of life from their tubes, i.e., the time during which some plate current is flowing—although the filament may be lit for a considerably longer period of time.

Broadcast stations usually expect a minimum tube life of 1000 hours. The tube manufacturer is blamed for most tube failures in amateur stations, especially those failures that occur in the first few hours of operation. An amateur will take his new 210 or 230A to a dealer for replacement after the tube has been in use for only a few hours. The dealer finds that the amateur has been running the tube at about 50 per cent higher-than-rated plate current. The amateur protests, because another amateur has the same type and make of tube, has used it for two years with the same amount of plate current, and is still going strong. The manufacturer gets the blame, often unjustly. Few amateurs realize that tubes are most susceptible to failure in the first 15 to 30 hours of operation. Not many of the conventional tubes are "hard" enough to withstand an overload until they have first had an opportunity to harden-up in operation.

Tubes should be "broken in", just like an automobile. For at least 20 hours the tube should be run "lightly" at not much more than about two-thirds of its rated plate current, never at more than the **maximum** rated plate voltage. The passing of current through the tube actually makes it more free from gas; 99 per cent of tube failures are caused by the presence of gas. A "soft" tube and a "flat" tube generally mean the same thing. "Age" your tubes before attempting to draw maximum plate mills.

A tube that does not turn blue through ionization is regarded as "gas-free" by most amateurs. This indication means nothing at all. Long before there is enough gas present to ionize, the thoriated filament can have its emission materially reduced through thorium poisoning. A thoriated filament requires one of the "hardest" vacuums known to science for satisfactory emission and long life. Tubes with tungsten or oxide-coated nickel filaments can operate satisfactorily in partial vacuums, but these filament materials have other important disadvantages, restricting their use to receiving types or in such tubes where it is impossible to get a really gas-free vacuum, such as in a mercury vapor rectifier or a water-cooled tube. A properly made thoriated filament operating in a truly "hard" vacuum is by far the best all-around filament for transmitting tube use.

For long life it is essential that the tube not only be originally gas-free, but that it also remain gas-free throughout its life. This usually means that the plate must not be permitted to show color. In higher-priced tubes, pumped and bombarded during the exhaust period for a relatively long time, it is permissible to operate the tube with some plate color. Even this is dangerous practice because a gas molecule may be released and it will literally go over and bite a big piece out of the filament." The Western Electric tubes with the large molybdenum plates are good examples of a well-pumped tube. Some tubes, of course, are designed for operation with the plate showing color, but these tubes use tantalum as a plate material; the use of nickel is avoided. Usually a hard tube can be identified by the fact that it uses no "getter" to clean-up the tube. The presence of a "getter" is indicated by a splash of silvery coating on a small portion of the inside of the tube.

Effect of Gas in a Tube

● The deleterious effect of gas in a thoriated tube is caused by the fact that the gas molecule sooner or later breaks up into its constituent atoms, which are then ionized by being struck by a flying electron. This speeding electron, which is traveling on its way from the filament to the plate, strikes the atom of gas and drives one or more electrons out of the atom. Because atoms are neutral, electrically, and because electrons consist of negative particles of electricity, taking one or more electrons out of an atom leaves it with a positive charge. This positively charged remnant of the original atom is called a positive ion and the process of driving electrons out of atoms is called ionization.

The positively charged ion is repulsed by the tremendous positive charge on the plate of the tube and is thus forced in toward the filament. The higher the plate voltage, the higher the velocity of the ion. If the ion is allowed to strike the thoriated tungsten filament, it ruptures the monatomic layer of metallic thorium which covers the surface of the tungsten, and which is the active emitter of electrons. Only a few of these ions are needed to sand-blast the entire active coating of thorium off of the filament. The result is a tube with flat, or low filament emission. However, few of the ions produced by these collissions of electrons and atoms are ever permitted to reach the filament, UNDER NORMAL CONNDITIONS. They are foiled in their dire purpose by what was once considered a deadly enemy . . . the space charge. The space charge is the cloud of negative electrons which have been thrown off the filament, but which have not yet accelerated away from the filament. An electron thrown off the filament starts out at a relatively low velocity and gradually accelerates until it is traveling at maximum velocity when it reaches the plate. It requires a finite time for the electron to leave the neighborhood of the filament and because it is traveling much faster just before reaching the plate than just after leaving the filament, a cloud of electrons surrounds the filament while relatively few electrons are in the space near the plate. The number of electrons in this space charge cloud depends upon the plate voltage, (leaving the grid out of the discussion for the moment). The higher the plate voltage, the fewer are the electrons in the space charge, because more of them are attracted by the pull of the positive charge on the plate. The cloud of electrons is thickest when there is no plate voltage, and thus no plate current. At high plate currents the cloud is small because it requires a high instantaneous plate voltage to effect the high flow of plate current.

Getting back to the positive gas ion which is speeding in toward the filament, due to the repulsion of the plate, it is seen that the ion exercises an attraction over any loose electron that comes into its field. As soon as it finds an electron it combines with it and turns into an atom again, and thus looses its velocity. This is the process of de-ionization. The atom then wanders around in the tube until another high velocity electron strikes it and ionizes it again. This process is repeated over and over again. The few ions that normally reach the filament in the average tube which is only slightly gassy, do little damage **as long as a large space charge surrounds the filament and de-ionizes all of the gas ions as fast as they appear.** However, at high values of plate current the protective sheath of the space charge is greatly impaired and more and more ions are allowed to get through into the filament without being deionized. Thus a gassy tube can have a life of 1000 hours if the plate current is kept down to perhaps 50 per cent of the normal rated plate current, but it may last only one hour more if operated at even its normal rating.

If operated materially above the rated plate current, the filament can fail in a few seconds. Thus if a tube is slightly gassy, the plate current must be held within conservative limits; it will then last for a long period of time. It is much better to have a tube that will last 1000 hours or more, even at reduced plate current, than to squeeze the last possible watt out of it and lay the filament open to the first gas ion that comes along by stealing most of the space charge for the use of the plate circuit.

It should now be evident that an increase in filament voltage to slightly more than the rated voltage will sometimes allow a tube to come back to par. Increasing the filament voltage increases the number of electrons which are thrown off the filament and increases the space charge. If the filament has not been permanently damaged, the thorium coating can be replenished by "boiling" more thorium out of the interior of the Tungsten wire which comprises the filament. This "boiling" process is accomplished automatically when the filament voltage is raised.

The average tube engineer designs a tube for a very different purpose than that of amateur operation. He thinks in terms of long life, 24 hour per day operation at perhaps 75 per cent of rated plate current. An examination of the average commercial radio transmitter will show that practically all of the tubes operate at surprisingly low levels, compared with the service that the average amateur demands of the same tube. Thus the tube is designed so that the filament operates at the coolest temperature which permits satisfactory emission. However, such a filament is usually very susceptible to overloads. If the designer were interested in a tube primarily for amateur use at medium and high frequencies, he would first provide an excess of filament and then run it slightly hotter to provide a larger reserve of filament emission in order to increase the effectiveness of the protective space charge sheath previously mentioned.

Thus it is often good practice to increase the filament voltage to about 5 per cent above the rated voltage in order to provide some protection against the occasional overloads to which the average amateur subjects his tubes. This sugestion is aimed particularly at the buyer of new tubes. The precautions should be taken **before** the damage is done. After the tube begins to turn "flat" it is usually too late to save it. Higher-than-normal filament voltage will undoubtedly shorten the ultimate life of the tube, in some cases as much as 20 per cent. But even a 20 per cent reduction in total life is a small price to pay for insurance against life's darkest moment . . . when tubes suddenly begin to run hot and become hard to excite. Ultimately they run too cool. The answer? Use a tube that is known to be really hard. Hold the plate current down! Do as the old-timers do . . .use a transmitter that has sufficient tube capacity so that the filaments are under-loaded rather than overloaded. Another good suggestion is to closely com-

(Continued on page 30).

Practical High Fidelity

(Continued from page 11)

use with a single or double button microphone, a 200 or 500 ohm line, or a low impedance pickup. In line with the universal nature of the primary winding, the center tapped secondary is designed to operate into push-pull grids or a single grid equally well. In addition to this, a newly developed equalizing structure has been incorporated into this unit. As mentioned above, many radio stations and also many phonograph recordings are not as yet up to true high fidelity standards. Through the use of the tone corrector network incorporated in this transformer structure these can be fully equalized to obtain quality reproduction. The Varitone transformer can also be used to compensate for poor acoustic conditions. This network is not a tone control. Fig. 5 illustrates what can be done to the frequency response of this transformer through the use of the Varitone principle. The curves show what occurs when the control is set at the maximum position when either of the primary windings are working. A is the normal curve of the transformer and this response is obtained when the variable potentiometer arm is set at the center. With B+ strapped to terminal 1 and the potentiometer arm at one end the lows are equalized as in B. With the potentiometer arm at the other end the highs are equalized as in C. If the B+ is strapped to terminal 2 equalization at both ends is obtainable, as in D.

While very great equalization is indicated in these curves, this is controllable from zero to maximum through the Varitone control potentiometer.

The importance of a wide range equalizing transformer for high fidelity radio receiver or PA work cannot be overemphasized. Through the use of controllable equalization veritable "new life" can be given to radio and phonograph music. In addition, this unit affords an inexpensive method of converting an average receiver to high fidelity performance.

It is the writer's impression that high fidelity is here to stay. However, adequate measures should be taken in all high fidelity receivers to allow tone correction for defects in the original program or record fidelity and for the wide range of acoustic conditions of modern homes.

How Telegraphers Are Made

(Continued from page 17)

fangled audion bulbs invented by some guy named DeForest. Well, sir, one of the features of that radio show was to be a code speed contest. I thought it might be fun to enter it, and besides it would give me an excuse to geta night off. So "the old man", as the operators affectionately referred to Mr. Rex, said okay for Mac to take the night off. So after working Morse all day and not having heard Continental for about a year, I entered the tournament. Very fortunately for me there were no good operators there, so it was a cinch. I think I copied about 51 words per minute, which as you all know is not fast. But they thought it was in those days and we had a lot of fun.

Sometime later there was another tournament at New York. And again "the old man" secured the good offices of another wonderful friend to telegraphers: a gent named Shute who was one of the real big shots in the Western Union. Mr. Shute arranged to let me have some practice on Continental code and then go over to New York where it was the greatest thrill of my whole life to sit down and thoroughly and unmistakably beat the other entrants. I think the speed was around 55 wpm that time.

Some time later there was still another tournament at Chicago and again those two splendid gentlemen who are typical of what I believe Western Union executives all are—again they sent me to Chicago to participate.

We had a lot of fun out there and I returned to Boston with a beautiful diamond medal which has since proven its worth many times in its ever-ready availability as a pawnable asset. You know how it is? I copied 56½ wpm out there that time for three or five minutes with perfect copy.

And so on and on. Always with the big thrill in proving to the world that we Americans are the finest operators. You and you and you, the American hams who read "RADIO", you are the finest operators in the world. I know. I've met them in tournaments. And the best of them can't compare with the average fair-to-middlin' American operator. So go to it. Develop yourselves into the kind of operators you are capable of becoming.

In another article in "RADIO" for February I am outlining what I believe to be the correct method for use of semi-automatic ("bug" type) keys. And a few pointers which will, I believe, help any operator to become a better operator. And isn't that what we all want? If you are operating for a living, you are anxious to hear anything that will make your job easier, aren't you? And if you are operating as a hobby, you want to get the most out of that hobby. And the more skilled you are as an operator, the greater will be the measure of your enjoyment in the pursuance of your hobby.

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CRYSTALS—Dependable X Cut, 1-in square. Fully finished and unconditionally guaranteed. Specify frequency desired. $2.00. Holders $1.00. W8DEM, Rochester, Michigan.

NEW AND USED Weston, Jewell Meters. Bargain prices. All types. Perfect condition. Individually checked. Low prices on meter repairs. Want burned out meters. Free bulletin. W2EDW, Far Rockaway, New York

TRANSFORMERS—1 K.W., 1,500-2,000 each side, $18.50. 1200 watt 1200-2200-3200 each side, $24.00. Quotations given. Frank Gerben, W9CES, 2012 S. Peoria St., Chicago, Illinois.

COMPLETE file of "RADIO" year 1934, in heavy leatherette ring binder. $3.75, postpaid. "RADIO", Pacific Bldg., San Francisco, California.

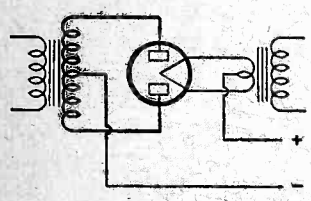
THE FRANK C. JONES 222 Communications Superheterodyne described in this issue, with 20, 40 and 80 meter coils. Made by the author. Will sell as have no further use for same. Cost $39.00 to build. Sell for $35.00, complete with tubes. First money order takes it. Frank C. Jones, 2037 Durant Ave., Berkeley, California.

Mercury Vapor Rectifier Tubes

(Continued from page 16)

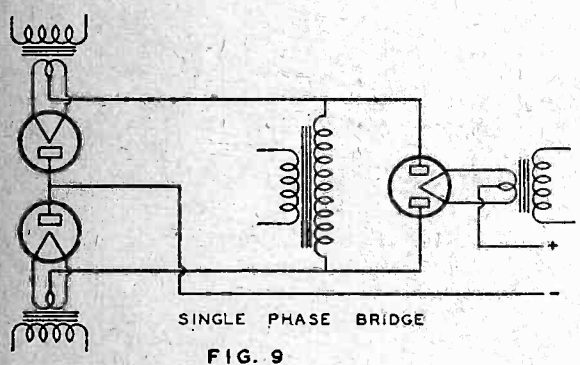
large choke input. A 10% increase in primary voltage of the output transformer is usually permissible when slightly higher voltages are wanted. Maximum inverse peak voltage is the highest peak voltage that a rectifier tube can safely stand in the direction opposite to that in which it is designed to pass current when operating within the specified temperature. In a single-phase circuit, the peak inverse voltage is approximately 1.4 times the R.M.S. value of the voltage applied to the tube.

If frequent breakdowns are experienced in some transmitters, the cause should not be attributed to faulty tubes unless all of the



SINGLE PHASE FULL WAVE

FIG. 8



SINGLE PHASE BRIDGE

FIG. 9

THREE PHASE HALF WAVE

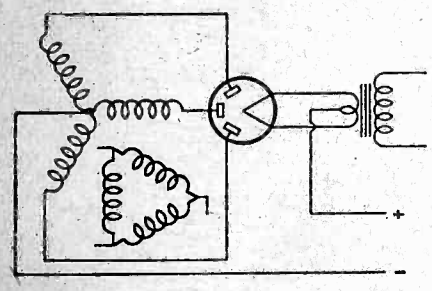


FIG. 10

preceding precautions have been taken.

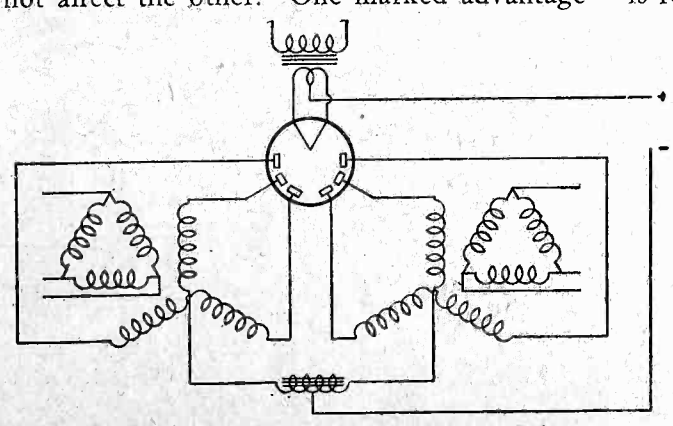
In a full wave rectifier system it is impossible to have two tubes operate identical for several reasons:

a. The quantity of mercury will differ.

b. Vapor pressure will vary and the rise and fall of temperature will be uneven.

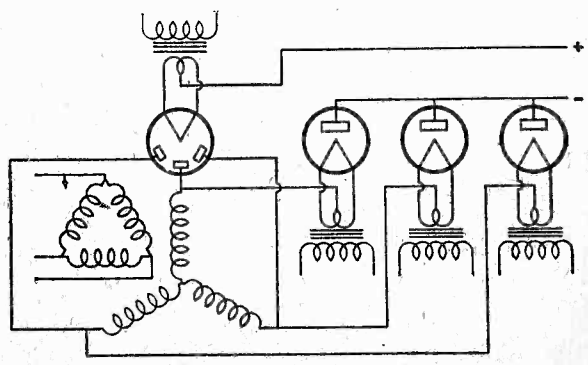
c. Impossibility of having two filaments with equal emission.

These irregularities will cause a difference in each half cycle of the output wave. For instance, tube No. 1 is older than No. 2 and has a lower filament emission; this will cause the DC voltage drop across the tube to be more than 15 volts. If the drop across No. 1 is 25 volts and the starting voltage is 35 volts, tube No. 2 has a starting voltage of 15 volts and a drop of 15 volts; the straight sides of the waves, caused by these voltage drops, will not be uniform and his difference in each half cycle is readily audible as a rough note. Fig. 4 shows the straight sides of the waves with the height of each straight side indicated by the 15, 25, and 35-volt level. This, of course, can be filtered-out by a brute force filter of two microfarads at 30 henrys. A one-half microfarad condenser with a 15 henry choke and one of the new R S L full wave, high voltage rectifiers will give pure DC results. This power supply was first tested in several amateur transmitters and CW reports were crystal pure DC. For phone operation an absolutely silent carrier was secured. This rectifier is so designed that it has two plates equidistant from one filament, so placed that the ionized gas from one plate while conducting will not affect the other. One marked advantage of the full wave hot cathode mercury vapor rectifier is that the filament works all of the time instead of only half of the time, so that only one-half as much filament heating power is required.



THREE PHASE HALF WAVE DOUBLE "Y"

FIG. 11



THREE PHASE FULL WAVE

FIG. 12

Common Causes of Tube Failure

(Continued from page 26)

pare the plate current ratings of the various types of tubes. Compare the watts of power drawn by the filament with the rated plate current. A gas-free tube has a more efficient filament than a tube that is not free from gas. Plate current is usually very closely related to the number of watts used in heating the filament. Few tubes can operate for long periods when the rated class C plate current exceeds about 6 MA per watt of filament heating power. The newer tubes are usually rated at about 4 MA of plate current for each watt of filament heating power. There is no substitute for a generous amount of filament heating power.

Phone operating is infinitely harder on a tube than CW operation. In the first place, the plate current is not keyed; it flows all of the time the transmitter is on the air. Next, the tube used in the plate modulated amplifier has its peak current increased, up to 100 per cent for complete modulation. Phone operation gives the tube's overloaded filament no time to recuperate between dashes and dots. All thoriated filaments tend to recuperate if the overload lasts only for a small fraction of a second. A tube used in a phone transmitter should be operated somewhat below the level used for CW operation.

Rectifier tubes will also last longer when operated within the manufacturer's ratings. One thing that helps mercury vapor rectifier tubes stand high voltage slightly better is to buy a cheap mail order electric fan and use it to cool the tubes. The best mercury vapor tubes are free from discoloration. The discoloration of the glass envelope reduces its ability to radiate heat. A discolored tube runs hotter and its inverse peak voltage will be decreased.

There is no substitute for a generous amount of filament heating power in mercury vapor rectifier tubes. Absence of sufficient filament emission tends to make a tube arc-back easier on high voltage than would otherwise be the case if more filament was used.

Summary:

(a) The tube should be gas-free.
(b) It should have ample filament.
(c) It should use no "getter".
(d) The filament heating power should be high, as compared with rated operating plate current.

What Goes On Inside a Vacuum Tube

(Continued from page 10)

tery will be usefully applied to the output load (an antenna, in this case) and only 10 per cent will be dissipated in the form of radiant heat from the plate of the tube. In other words, the amplifier is 90 per cent efficient.

If R_L was chosen equal to R1-2, then the power would divide equally between the two resistances of the circuit and the amplifier plate efficiency would be only 50 per cent. Now note that in the latter example the TOTAL circuit resistance was only twice the internal tube resistance. In the first example the TOTAL circuit resistance was nine plus one, or ten times the same internal tube resistance. THUS in order to get the same current to flow from the battery or plate supply (in other words, to make the amplifier draw the same plate input in both cases), it is necessary to make the battery voltage $\frac{10}{2}$ or 5 times as great in order to raise the plate efficiency from 50 per cent to 90 per cent. This tends to show why a high plate voltage is necessary in order to obtain high plate efficiency.

The actual values of the resistances involved had nothing to do with the plate efficiency, it is their RATIO that determines how the power in the circuit divides. However, the required battery voltage depends entirely on the actual value of the total resistance, so that a tube of low internal plate resistance allows the use of a similiarly lower value of external load resistance in order to keep the RATIO of their resistances 9-to-1. Thus the tube with the lowest plate resistance allows a high value of plate efficiency to be obtained with a lower battery voltage than when a tube with a somewhat higher plate resistance is used.

There are necessarily many qualifications that must be made before this analogy can be considered strictly accurate. These qualifications were avoided in order to simplify the conception.

This R-S-T System

(Continued from page 20)

This R-S-T system, in the first place, is far from a check on signal strength. For example . . . two stations will be coming into a certain location, one we will say is R7 and the other R9. In keeping with the R-S-T system this means that they would both be given an S5. How many of you are thrilled when you both work the same station right after each other and one of you gets an R better report . . . doesn't that make you feel fine? No one could tell, after making a few changes in his rig, if it is any better than previously if the in-between Rs are taken away.

I would just like to present an idea for your approval. Leave everything "as is," with a change in tone, if any changes are really going to be made. After all, when something as important as this comes up, several ideas should be presented and placed before us so that we can vote on it . . . with the majority winning.

"Q" Readability
QSA 1—Unreadable
QSA 2—Readable now and then
QSA 3—Readable with difficulty.
QSA 4—Readable
QSA 5—Perfectly readable

"T" Tone System
T 1—Rough 60 cycle
T 2—Rough note, fair filter
T 3—Smooth RAC xtal ring
T 4—Good DC
T 5—Purest DC with xtal ring

"R" Audibility System
R 1—Very faint
R 2—Faint
R 3—Weak
R 4—Fair
R 5—Medium
R 6—Good
R 7—Very good
R 8—Very strong
R 9—Exceptionally strong

Please bear in mind that this is only a suggestion, as I am for the present QSA system.

With W2BSR's system, one would almost have to be a musician in order to understand all of the different "no trace of musicality, slightly musical, moderately musical," and other musical designations. After all, we are interested in how loud we are being received at the other end. That is why we must have more Rs in order to give us better checks and comparisons. Of course, we would all like to have the best and purest DC notes with xtal ring, but Mr. Braaten thinks that a very accurate report is only necessary for tone, and that our signal strength can be judged with only 5 variations. After all, we are amateurs and not commercial people who are interested only in readability. If we were all using 50 kw. we would not have to wonder how loud we are coming in because we would just about know without asking. Stations that handle traffic don't care how loud they are coming in, as long as they can get their messages through, and getting a QSA 4 or 5 is all that is necessary. The Rs or Ss don't mean a thing to them.

I am on the air 'most every day and only five stations have used this R-S-T system on me. After telling them that I don't accept R-S-T reports, they all agreed with me except an ARRS 9 who called me a "mossback." Listen, and you will find that only about one out of a thousand use this R-S-T system. Let all of us real hams continue with the QSA-R-T system, the standard of the world.

(Signed) HORACE GREER, W6TT.

I Voted "No"

(Continued from page 7)

still more "representation" of the same kind! No, if a director is competent he can represent on the board 10,000 members just as well as 1,000. On the other hand, if TEN directors are incompetent, or cajoled, or coerced, or mesmerized, the whole lot of them couldn't represent the big toe of one real amateur! In 1932 Warner had a plan for re-divisioning the whole country. He strongly urged the directors to approve it. It actually added one new state to the Pacific Division! That was two years ago—before headquarters knew Culver. Hi.

Before I would consider for one minute the desires of the secessionists I should want the opinions of such old-timers and experienced Southern Californians as Dr. Waters, W6EC, Lee Potter, W6AKW, Bert Sandham, W6VO, Hal Nahmens, W6HT, James Brown, W6VH, Mel Wood, W6AVJ, and many more of these wise heads I could name if space permitted. If any men of this class believed it a wise move to disrupt the division I should listen with close attention. My guess is that they would not countenance such a move. My next guess is that if this matter comes to a fight, all the intelligent hams of the South will line up with the solid North to prevent the despoilment of our Pacific Division, the greatest in the United States.

Grown men know that in any organization that depends for its effectiveness on solidarity of aim any move that tends to destroy that solidarity is suicidal. It is the great weakness today of the amateurs of America that they have done everything they could think of to keep themselves disorganized by disjointing themselves into more and more warring units. The theory of the hams seems to have been that the more "organization", the more "government", the more "control", the more contested elections, the more internal strife, the better would be their chances of combatting the common enemy. Their belief seems to have been that, given "organization" enough, they could get along without brains and experience. So that now amateur radio is staggering under such a tremendous load of so-called organization it has no time for anything except trying the impossible—to make this monstrous machine function for the good of the amateur members of the ARRL alone. The ablest administrators in the world could not devise and operate organic machinery for an organization composed partly of amateurs and partly of commercial people who have no use for the amateurs except to exploit them. The amateurs have indeed come to a sad estate. They have ended by being absolutely without organization and without leadership. They have today—actually—less of real organization and less of real leadership than the Girl Scouts. And this Little ARRL, Inc., now proposes to keep up the ham tradition by making the disorganization still more pronounced!

The Pacific Division is the most prominent division of them all. It is generally so acclaimed throughout the country. It is looked up to by amateurs of other divisions as the leader in the fight for a square deal for ALL amateurs. It has earned this prominence by working and fighting steadily for years towards the goal of a league we can call "amateur" without lying about. And now along comes this Little ARRL, Inc., and cooly proposes to destroy this great division! Either they stupidly conceive themselves as the rulers of a small division all their own, (which I do no believe is the case), or else they are working by the suggestion of people who have good cause to fear that the courage and energy of the Pacific Division

(Continued on page 34)

will upset their private racket. The game looks like the old one: always split the opposition if you can and get them involved in an internal fight of their own. That is good political tactics and it has been employed time and again in the ARRL. If the instigators of this especial occasion think the fight that will result from any attempt to disrupt and despoil the great Pacific Division will leave them unmaimed they are badly mistaken.

Clair Foster, W6HM.

●●●

COL. FOSTER'S IDEA OF A RETROACTION

Some Excerpts From a Letter To W6GTE

Dec. 13/34

W6GTE:

TKS for your very straightforward letter of December 11 regarding my yarn in December "RADIO". I know it takes considerable courage for a youngster to get up and paste a man of my years of experience in a hardboiled world, but I'm such a great admirer of courage—and I see so damn little of it among hams—that I positively LOVE the man who displays some of it, even when I myself am the object of his wrath.

Which being said I am now at liberty to tell you that aside from its frankness and its clarity of expression there is no other quality in your letter that commends it to me. Its animus is obvious—just from your first paragraph in which you refer to my quotation of Schnell's remarks as "the alleged statement of Fred Schnell's". You had read in the December "RADIO" article that I had taken the Schnell statement from the stenographically recorded proceedings of the ARRL board meeting at which it was made. The term "alleged" might well be applied to "minutes" of board meetings such as are printed today but could hardly apply to statements appearing in proceedings recorded verbatim by court stenographer. So your choice of the word "alleged"—carrying the implication that you did not believe me—was gratuitous and indicative of your own state of mind towards me. Personal animosity cannot be concealed, in either talk or writing, from an experienced observer.

Approaching a subject with personal animus is about the surest way of confusing one's logic. For example, I cannot follow your reasoning when you conclude your letter with, "In the interest of fair play, Colonel, I believe that some sort of retraction is in order". I don't question the sincerity of that belief; to me it rings true. But I don't see how you conclude the retraction should come from me; or in fact that there is anything for me to retract. Schnell's remarks quoted from the record are clear and unqualified. If there is any retracting to be done it would seem to be on the part of Schnell himself.

This seems to be what caused you to conclude that a retraction was due from me: You say that on October 30 you asked Schnell whether he had made the statement in 1923 that less than 20 per cent of the ARRL members were licensed amateurs and that, "He flatly denied making such a statement". I am quoting you accurately, including the underscoring. Then, you say, Lansingh told him he was so recorded in the stenographic record of the board meeting of December 8, 1923. Whereupon, you say, "Mr. Schnell then stated that if he did say such a thing he had no recollection of it and in all probability referred to the percentage of ARRL members who were actively engaged in message handling".

(Continued on page 35)

Schnell first denies flatly that he had made any such statement. Then when he is reminded that a copy of the stenographer's record had come to light he forthwith commences to alibi by saying he has no recollection of it and that he probably meant something else. Hi. Well, if he had no recollection of his statement just how, do you conceive, he could have met your first inquiry by flatly denying that he had made any such statement?

And the alibi is not credible. Hebert's statement that first Bidwell and then Schnell challenged was that it had been figured 10,000 of the then 14,000 members were licensed. Not a word had been said about "active" amateurs or message-handling amateurs—either before or after Schnell's remarks. Now, is it believable that Schnell is right in his present recollection that eleven years ago he didn't mean what he had said but was referring to something that wasn't under discussion at all! To a grown man it isn't believable.

The stenographic record of that meeting of December 8, 1923, is quite complete. Even the most insignificent remarks are recorded. It makes a book about an inch thick. "Come up and see me some time" and I'll show it to you. It is full of disclosures that would be intensely interesting to any present-day ham.

One more thing in your letter I'd like to refer to. You say, "I personally am not greatly worried over the number of commercial operators in the ARRL ranks". Well, who is? In the demand of the amateurs that Warner disclose the number of licensed United States amateurs there are in the ARRL, nobody has said anything about "commercial operators". If you are putting in the minds of your hearers and readers the thought that we wish to know how may of the ham members are also commercial operators, then the premise is entirely of your own making. There are many commercial ops who are also licensed hams; and they are just as much hams as any of us. There are also many men engaged in radio for a livelihood who are licensed hams. When we refer to commercials in the membership of this organization that proclaims itself to be "amateur", we refer to the thousands of non-amateurs who are officials or employees of commercial communications corporations—the people who have wellnigh stripped the amateurs of their rights and frequencies, the people whose money is the chief support of the employees at ARRL headquarters. We refer to attorneys for commercial radio people—such as Paul Segal who is employed by commercial radio corporations—the traditional enemies of the amateurs—and who is expected at the same time to be guarding the amateurs against the encroachments of the very people who employ him! We refer to manufacturers, non-amateur dealers, agents, jobbers, distributors, advertising men, salesmen, crooners and all the rag-tag and bob-tail of commercial radio who join this "Non-commercial association of radio amateurs" without even a question as to their class, color or citizenship so long as they cough up $2.50 for a subscription to QST.

Now, if there is any retracting to be done in the matter of my story in December "RADIO" I suggest that Schnell is the man to do it. He was a director on December 8, 1923, and has a copy of the record of that meeting. No doubt he has read it many times. If at this late date he wishes to retract the statement in question he may do so in any form he may devise and we will see that it gets wide publicity. If QST won't print it, "RADIO" and "R/9" will.

While you were going over my December story looking for some statement to rub my nose in, how come that you decided that a

defense of Schnell was necessary rather than a defense of the ARRL officers? It was the ARRL officers that the story showed up; it did not in the least question Schnell's statements or conduct. What the story disclosed was a new all-time high in mendacity by the ARRL headquarters in their writing to an amateur, "All voting in ARRL affairs is now restricted to licensed amateurs". This glaring affront to the truth seems not to have caused you any uneasiness.

Let's look at the probable reasons why you jumped to the defense of Schnell, who needed no defense at all, while you failed to defend Warner who needs a hell of a lot more than you or anyone else will ever be able to provide. You have started to take me apart, OM, and you ought to know by this time that I can be depended upon to finish anything the other feller starts.

You are the secretary of the group that calls itself, "Federation of Radio Clubs of the Southwest, ARRL, a California Corporation". Which sounds big, at any rate. A group that is widely known to be backers of K. B. Warner. Your group publicly supported Warner in his failure to report the truth of the Madrid convention's new restriction on amateur stations. It approved this restriction that aimed to kill the greatest public service the amateurs of the Pacific Division provide—the trans-Pacific traffic. Your group was AGAINST the efforts of those amateurs who were working to prevent the ratification of that restriction.

It is your group that has been working up interest in getting the southern half of the Pacific Division to secede and form a separate division. It was Matney, W6EQM, the ranking officer of your association who proposed this disruption of our division at the Fresno convention in November. It is common knowledge that your group has sided with the ARRL officers against all the amateurs of the United States who are endeavoring to clear the ARRL of certain abhorrent and destructive practices and that the officers welcome your assistance. It is well known that while the ARRL officers failed to send a headquarters man to the last Pacific Division convention—sponsored by the San Jose Club—they did send one, Warner's right-hand man, to a hamfest arranged by your group since then. The first instance of a headquarters man being sent clear across the continent to a mere hamfest. It is well known that this same man, Budlong, spent much of his time with the officers of your group on a more recent trip to this coast. Perhaps you will tell us that all of these significant circumstances have nothing to do with your reason for ignoring the chief theme of my December story—this latest audacity of the ARRL headquarters.

I am glad you wrote me when and as you did. I was just writing my story for January "RADIO". Your letter provides some additional ideas. You will recall that when I voted "NO" on the Matney proposal I was asked if I would be willing to give my reasons and that I replied I would do so in writing. I prefer to do my talking in writing or print rather than orally. That's what constitutes my story for "RADIO"—if the publisher sees fit to use it. I like to say my say with black and white; then if I pull a boner the gang can nail me to the mast. Incidentally it guards against misquotations, although being misquoted does not worry me. We are all misquoted at times. There are only two kinds of men who escape it—those who never open their mouths and those who never say anything worth listening to.

Thanks again for a letter that while it stirs my risibilities I am bound to concede, nevertheless, is temperate and courteous.

73,

CF W6HM

SCRATCHI

Osockme, Japan, November 23rd, 1935.
Etseemished Editor of RADIO,
Dear Sire:

Happy New Year are soon come again, and with it come more ballyhoos and resolutions which are make to become broken into pieces and bits. Scratchi have resolved to make resolution which cannot be broken, by making no resolution at all.

So instead I are ready to make announcement of public services which I are to perform in 1935 for benefits of easy going radio amateurs. I are organizing The Scratchi Foundation. It are built on solid rocks, and it are for the purpose of replacing the now defunct Society For The Protection of Cruelty To Radio Amateurs. From such Foundation great goods will come forth and fifth, etc.

Scratchi wish first to make it become known that he have great secret. When he are told great secret he never make divulge of such secret except to two partis, Republican and Democratic parties.

Secret of Scratchi Foundation are for make protection of all sacred amateur rights. Scratchi are having difficulty in finding right man to become President of Foundation. He must be man with credentials which he can show at Cairo Conference. Good credentials for such man to have would be, methink, two large bulky fists. When he are asked by Conference to show his credentials, he can pound them heavily on table.

One applicant make apply for President's job of Scratchi Foundation. I ask him what are he qualified for and what do he do to make protection for amateur rights? He snort back at Scratchi and say—"Humph, Amateur Rights! You make mistake, Hon. Scratchi. There are no such thing as amateur rights. They are now known as Amateur Lefts! They used to be rights . . . but now they are what is left of them, and amateur always take what are left, so why call them rights when they are Lefts?"

So Scratchi scratch his head and see lights through it. The man was right. The hams got left. There are no ham rights. We took what they left us. So what we got now is Lefts, not Rights! Thereupon Scratchi organize new Left Flank Brigade to march to Cairo to bring back Amateur Rights.

All good amateurs with big hearts and soles are become requested by Scratchi to send contributions to my home in Osockme, Japan, so that great Camel caravan can be purchased for march to Cairo. Such desert race horses will carry large amateur delegation to Conference and will make imposing spectacle on amateur frequency grabbers who will also pop up at Conference with evil thoughts in mind.

Such are purpose of the new Schatchi Foundation, conseeved, inspired, devised and made into great functioning institootion by Hashafisti Scratchi himself. All in favor say Aye. Others please remain silent.

Well, Hon. Editor, by time you receive this letter, it will seem like Christmas are over and completed. I have prepare my Christmas list. My wife ask me what kind new quartz crystals I would like best from her for Christmas gifts. There are such many new kinds of cuts now available for crystals that choice seem to lie between nineteen different kinds. There are A-T Cut, Cross-Cut, and Old-English Curve Cut. One type which appeal to me expecially over and above all rest are famous 40%-Cut which my gyp friend in New York radio store advertise in Japanese newspapers last week.

I have already receive much holiday mail, which all smell of true spirits of Christmas. Each have statement or bill attached. I find one letter from you, Hon. Editor, amongst all such mail and I open it with gleeful smile. I think it are check from you for many fine letters which I have writ for you in year just pass but I find you write exactly same kinds of letters as other news gyppers. In your letter you say that you have receive all my contributions and that if I send you $3.00 cash by return fast mail I will have privilege of reading my own letters in your magazine for another full year.

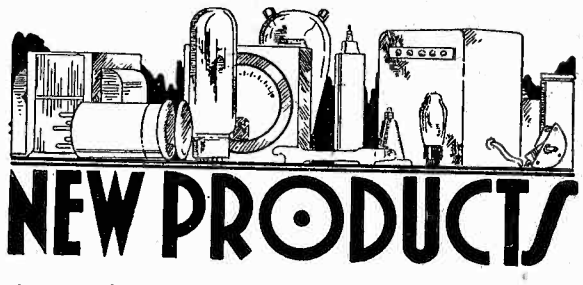
I wish for you Hon. Ed. to extend best 1935 wishes from Scratchi to all my followers in great United Shakes of America. To make especially sure that you get greeting card from H. Q. I are sending one for you to Hon Postmaster of Hartford, with request that he make forward to you. Hoping you remain unchanged in 1935, and not shortchanged, I remain

Your devoured servant,
HASHAFISTI SCRATCHI.

Radio Dealers and Jobbers who desire to advertise in these columns are invited to write for rates.

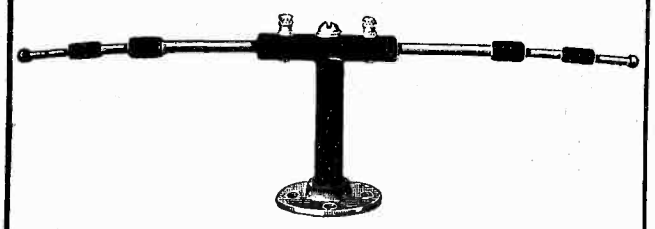
RADIO BUYERS' GUIDE

A Monthly Listing of Reliable Radio Dealers and Jobbers who solicit the patronage of our readers. Buy from your nearest Dealer or Distributor. He is dependable and reliable.



2½ and Five-Meter Doublet Antenna

The new American Radio Hardware Co. 2½ and 5-meter Doublet Antenna is a good solution to the antenna problems encountered in ultra-high frequency transmission and reception. It has always been the desire of the amateur to obtain the maximum efficiency from each piece of equipment used. Tests conducted within the last few months prove that successful high frequency transmission depends to a great extent on the type of antenna system employed. In most cases, 5 meter antennas were made by the cut and try method and it took hours to "tailor" the antenna for the particular transmitter or receiver. With this new antenna with its special force type locking devices, it is a simple matter to obtain the proper length and this is important — maintain these adjustments for long periods of time.



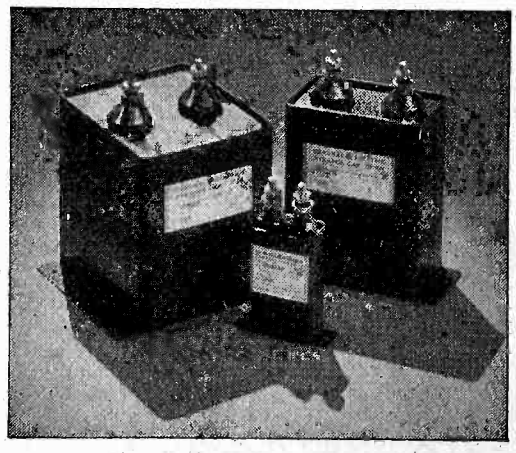
●●●

The New G.E. Pyranol Transmitting Condensers

Inadvertently, the new G.E. Transmitting Condenser cuts were used in this column of the December issue of "RADIO" to describe a group of transmitting condensers manufactured by The Aerovox Corporation. The publishers hasten to correct this error. Here is a description of the new G.E. product, illustrated in the cut below:

General Electric D-C, Transmitter Capacitors are filled and treated with Pyranol, a nonflammable, non explosive dielectric developed and patented by General Electric. Pyranol has extraordinary insulating and dielectric qualities, and its use makes possible an unusually small and compact unit for all transmitter capacitor ratings. Compare the size with a capacitor of conventional design.

The lacquer-finished cases are hermetically sealed, assuring permanence of the characteristics of the capacitors, as contamination from air and moisture is impossible. Long life and ability to withstand temperatures as high as 75 deg. C. make these capacitors outstanding in their field. Porcelain bushings and mounting feet are included as standard equipment, and the units can be mounted in any position. They are suitable for continuous operation at voltages up to 10 per cent above the rated values.



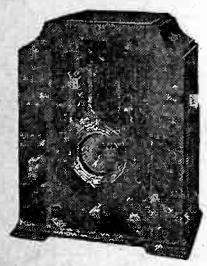
The New General Electric Pyranol Transmitting Condensers

. . . and what **SALES VALUE** there is in these **QUALITY-AT-LOWEST-PRICE** Radio Receivers *that represent the LAST WORD in Round-the-World reception!*

A model in this group for every purse—American-Foreign and All Wave Radio Receivers

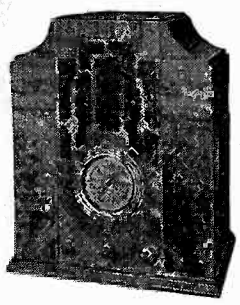
The public is now enthusiastic about radio receivers that will bring in foreign reception. This idea of having world-wide reception is going far to open wide the radio market. For no matter how fine a last year's radio may be—if it does not bring in the foreign stations, the owner is perhaps this moment considering a new radio that will. Certainly he has good reason for listening when you talk to him about a second set for the home!

The market is there . . . growing every day. Crosley has given you the models to fit every need and every purse. Crosley has given you the program, the goods, and the price. You are losing money if you delay getting in touch with your Crosley distributor.



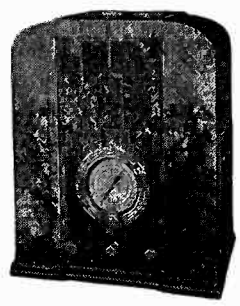
Sixty-One A. F.
Eight-tube effectiveness, airplane type dial, automatic volume control, 3-gang tuning condenser, distinctive cabinet.
$39.95

614EH 3-Band All Wave
Two double purpose tubes provide 8-tube effectiveness. Many distinctive features. Outstanding quality of tone and performance. Low in price.
$49.95



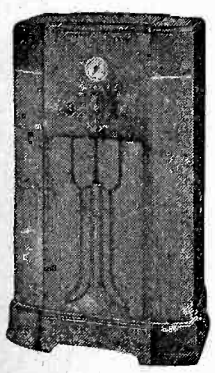
Seventy-TwoA.F.
Airplane type dial, automatic volume control, continuous tone control, 10-tube effectiveness.
$59.95

714GA 3-Band All Wave
Same cabinet as to left. 3-Band receiver for American-Foreign, police, amateur, aviation reception.
$65.00



814FA All Wave
Illuminated airplane type dial, dual ratio tuning control, automatic volume control, push-pull output, continuous tone control. Gorgeous cabinet.
$79.50

Sixty-Four MD (Lowboy)
Uses same chassis as Sixty-One A.F. Covers standard broadcasts from 550 to 1700 Kc. and Foreign broadcasts 5,800 to 15,300 Kc. Many distinctive features.
$54.50



614PG 3-Band All Wave (Lowboy)
Uses same chassis as 614 EH. Covers standard broadcasts from 540 to 1650 Kc., police, amateur, aviation 1650 to 5000 Kc., Foreign 5800 to 15,300 Kc.
$65.00

Seventy-TwoA.F. (Lowboy)
A 7-tube American-Foreign receiver. Uses same chassis as Seventy-Two A.F. Covers standard broadcasts from 540 to 1700 Kc. and Foreign broadcasts 5800 to 15,300 Kc. Exquisite cabinet.
$79.50

714NA 3-Band All Wave (Lowboy)
An all wave, seven tube, 3-band receiver in the cabinet shown at right. Uses same chassis as 714 GA.
$85.00

814QB All Wave (Lowboy)
An all wave receiver, 530 to 24,000 Kc. Houses same chassis as 814FA. A superbly beautiful cabinet. The ultimate in all wave reception. Attractive in price.
$99.50

All prices subject to change without notice. *Montana, Wyoming, Colorado, New Mexico and west, prices slightly higher.*

THE CROSLEY RADIO CORPORATION

Home of "*the Nation's Station*"—WLW—500,000 watts—most powerful in the world—70 on your dial.

POWEL CROSLEY, Jr., *President* **CINCINNATI**

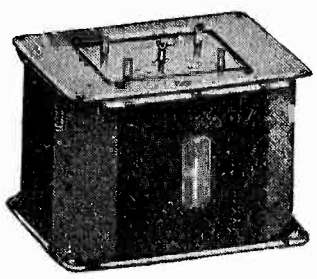
WHATEVER HAPPENS . . . YOU'RE *THERE* WITH A CROSLEY

CROSLEY RADIO

AND NOW THE NEWEST 1935 DEVELOPMENT FROM THE UTC ENGINEERING LABORATORIES . . . .

THE VARITONE* AUDIO TRANSFORMER

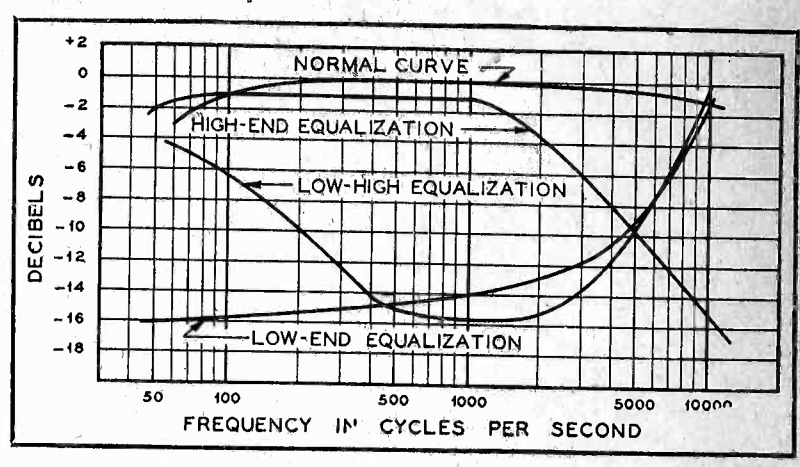
A universal audio input transformer giving continuously variable low end, high end, or low and high end equalization.



VT-1—Designed to work from a single plate or low impedance broadcast microphone line to one or two grids.

List price $8.50—net to dealers $5.20

Affords 15 DB controllable correction of low frequency response, high frequency response, or simultaneous correction of low and high frequency response.



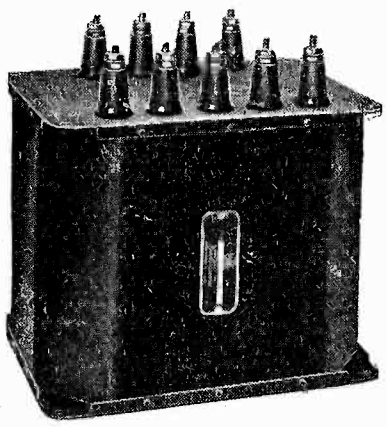
The VARITONE is an essential component for high fidelity theatre and PA amplifiers. Manufacturers of such equipment are invited to write us regarding the application of the VARITONE to their equipment.

*PATENT APPLIED FOR

Typical Components for Use in a Popular Priced High Fidelity Receiver Amplifier Using the VARITONE as an Input Source.

		List Price	Net Price
PA-233	From two triode plates to 45 A prime grids	$ 6.00	$ 3.60
PA-245	From two A prime 45 plates to Broadcast and Voice coil lines	7.00	4.20
PA- 22	45 A prime plate and filament supply transformer	10.00	6.00
PA- 40	A prime input choke	4.50	2.70
PA- 44	Output smoothing choke	4.50	2.70
		$32.00	$19.20

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.

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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.
SEATTLLE, 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.

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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.