BY SUBSCRIPTION

RADIO

ESTABLISHED 1917

SHORT-WAVE AND EXPERIMENTAL

$E = I \times R$

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

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

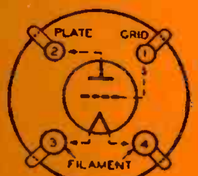
CONDENSERS IN SERIES

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

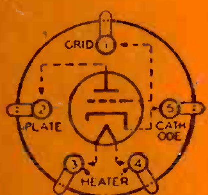
RESISTANCES IN PARALLEL

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

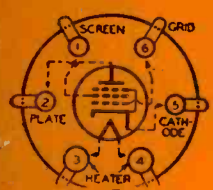
BOTTOM VIEWS OF SOCKETS



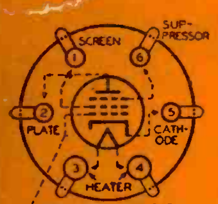
4-PRONG SOCKET
0-201-A, 45, 210, 30, 31, ETC.



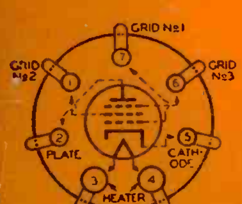
5-PRONG SOCKET
56-46-47-76-27-37



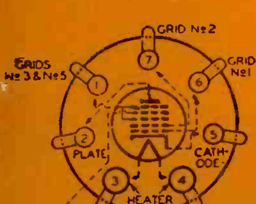
6-PRONG SOCKET
2A5-47-42-43



GRID-METAL TOP CAP
6-PRONG SOCKET
57-58-6C6-6D6-77-78



7-PRONG SOCKET 59



GRID №4-METAL TOP CAP
7-PRONG SOCKET
2A7-6A7

—IN THIS ISSUE—

A New Plan for Protecting Amateur Privileges

Push-Pull vs. Parallel Operation, Part II

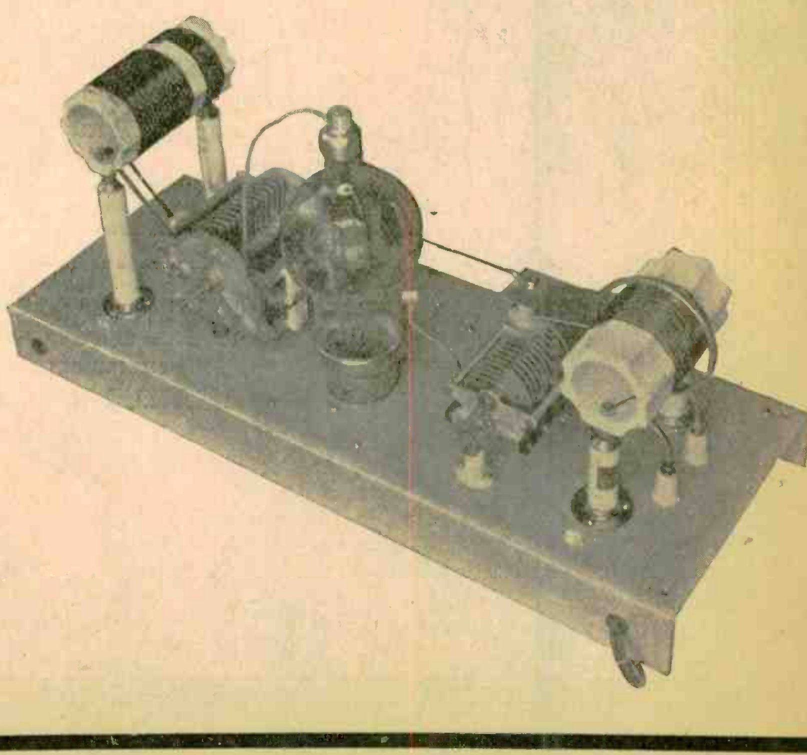
Auto Interference Elimination for 5-Meters

Efficiency versus Power Modulation

Review of the New R C A-A C R Receiver

New Data On The 2B6 Les-Tet Exciter

Design Factors For Class A-Prime Systems



★ 400 Watt Link-Coupled Amplifier Using the New 150-T.

FEATURE ARTICLES BY . . .

CLAYTON F. BANE - FRANK C. JONES - JOHN L. REINARTZ
NORRIS HAWKINS - - FRANK LESTER - - I. A. MITCHELL

$500 REWARD!

Sylvania

— — · —   · · ·   · — · ·

STARTS
DEC. 4, 1934

CONTEST!

ENDS
FEB. 4, 1935

PRIZES

1st	1-204A tube
2nd	2-860 tubes
3rd	2-852 tubes
4th, 5th, 6th	2-203A tubes each
7th, 8th, 9th	2-830B tubes each
10th, 11th, 12th, 13th	2-830 tubes each
14th, 15th, 16th, 17th, 18th, 19th, 20th, 21st, 22nd	2-210 tubes each

OBJECT—To gather the greatest possible number of QSL cards from other amateurs who are users of SYLVANIA GRAPHITE ANODE transmitting tubes.

THOSE ELIGIBLE—All licensed amateurs in the United States except Hygrade Sylvania employees. *It is not necessary that you have SYLVANIA transmitting tubes in your own transmitter in order to participate for prizes.*

REQUIREMENTS—The following information must be written on all QSL cards received from SYLVANIA tube users by the Gatherer in order to have them count in the contest.

1. Types of Sylvania tubes used.
2. In what stages used.
3. From whom purchased.
4. When purchased.
5. Time and date of QSO.

TIME LIMITS—Contest starts December 4th at midnight and ends February 4th at midnight. All QSLs must bear postmarks within these limits. Gatherers must send in their bundles of cards so that they will be received at our Clifton Plant on or before February 15th. Packages should be securely wrapped and carefully addressed to Hygrade Sylvania Corporation, Amateur Radio Division, Clifton, N. J.

REGISTRATION—To enter this contest all you have to do is to mail *one of your own* QSL cards direct to our Amateur Radio Division in Clifton, merely stating thereon "I desire to enter the QSL contest." For further details see or write to your nearest Specializing SYLVANIA Distributor.

In case of a tie for any prize—the persons tying will each receive a prize.

HYGRADE SYLVANIA CORPORATION

ELECTRONICS DEPARTMENT

AMATEUR RADIO DIVISION

NRA CODE

CLIFTON NEW JERSEY

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253 W. 128th St.
Boston,
J. H. Condon,
6 Marlboro St.
Chicago,
C. W. Nelson,
185 No. Wabash Ave.
Los Angeles, Calif.
1455 Glenville Drive.

RADIO

ESTABLISHED 1917 Reg. U. S. Pat. Off.

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Vol. 16 JANUARY, 1934 No. 1

RADIOTORIAL COMMENT

Chinese Puzzle No. 1

"THE banquet was good. Enthusiasm running high for non-radification of the Madrid Treaty. Almost 300 in attendance, including a radio inspector, who was 'put on the spot', literally. We asked him . . . 'How come—the hams are forbidden to solicit general message traffic at State Fairs, other public gatherings, etc., where portable amateur rigs are placed in operation?' Also, 'How come, the A. T. & T. Co. was permitted to give free telephone service as part of their 'demonstration' at the Chicago World's Fair'? If THEY can do THAT, why can't we amateurs give free message service, or is this free-for-nothing something handed out to commercials only?"

Thus reads a letter from an enraged amateur radio club.

There isn't much difference between a free telephone message and a free message sent via amateur radio. The same people would probably have sent it, and the same people would have received it. It's things like this that make amateurs wonder just where they stand. There's nothing romantic nor mysterious to a dx telephone call, especially after one receives the bill for the tolls. But there is something decidedly human and educational when an amateur, with a few small tubes and a portable antenna, gets out into the open spaces with a message that may be heard anywhere.

Perhaps the term "AMATEUR" is what is holding down this good old game. Some more suitable name, as suggested previously in this and in other magazines, might cure a lot of our present ills. But what shall we call ourselves? Surely, they can't call a fellow an "amateur" after he invests a few thousand dollars in the most modern type of transmitting and receiving equipment, learns to copy 40 w.p.m., and works all continents. There must be a better name . . . something that would make the outside world look UP at us, instead of down upon us. The Nobel prize could well go to the person who suggests the proper name to replace that old nickname "HAM".

Just to start your thinking, how about "WAIF"? It typifies our present situation and gives some significance to the "W" in our signature. This is a good old English name for stolen goods thrown away by a thief in his flight. It strangely defines the channels which have been allocated for amateur use. Or why not get chesty and dub ourselves "experts", which originally meant those who had learned by trying? "Adept" connotes much the same idea as one who has penetrated the secrets of his art. There is no lack of good words in the dictionary, and if those fail to give just the right shade of meaning, new ones can be coined as easily as greenbacks can be printed.

Chinese Puzzle No. 2

OUR dear friend in Washington, the F. R. C., continues to make this amateur game more interesting than ever. When you use a portable set you are required to sign first the regular call letters duly assigned to your "home" station and then to add "BT—number of district in which you are operating." For instance: you live in the 9th district. Your call is W9XYZ. You get the portable urge, the wanderlust. You go into the 8th district with your portable. But before you get there you must have permission to use it in the 8th district. So you make application for that privilege. Granted, and you are on your way. Your strength finally gives out, after lugging that bag of iron cores and batteries over the hill, and you sit down to thrill in the glories of portable radio. You call CQ. And here is how you sign . . . de W9XYZ BT 8. Which means that W9XYZ, a licensed amateur from the 9th district, has now entered the region of 8's, the "BT", or — . . . — that separates your "home" call from the 8 simply designates the conventional "break".

Why is it necessary to put that "BT" into the call? It has confused many an old-timer. It takes long enough to sign W9XYZ, not alone to add to this con-

(Continued on page 29)

COL. FOSTER'S COMMENT

TREATIES . . . . and How They Are Made

JUST tell an amateur, "The treaty forbids you to do that", and you strike him dumb. To him an international treaty is sacrosanct. He conceives it as the written record of the combined wisdom and deliberations of the best radio minds of all nations. He has been instructed by men old enough to know better that a radio treaty is sacred because it is evolved by months of the hardest kind of unselfish work of 78 nations. Yes, it is hard work, no doubt. It is always hard work for warring commercial interests to try to compose their differences so that each will get all it wants of the people's air and the people's money. It is hard work to break into a bank, too, but plenty of men seem to find the results worth the labor.

These commercial treaties are called treaties only for lack of a true definition. They are not like real treaties. In the making of real treaties statesmen of course have an eye on their special interests; but their special interests are their nation's interests. While in the case of commercial treaties the special interests are largely the special interests of individuals, groups and commercial corporations. The deliberations are enveloped in an aura of righteousness—"the public interest", "the development of the art", "progress"—but this is largely camouflage.

When a convention draws up a commercial treaty each special interest tries to arrange the wording so that it may be interpreted to suit itself. And after the treaty is ratified each interest does just that—interprets it to suit itself. Proof of this is provided by the manner in which each interest involved in the 1927 radiotelegraph treaty has operated its stations. Even the table of allocation of bands for services was only a "guide", and each interest stood by the old saw, "Let your conscience be your guide". Consciences are elastic; those of commercial corporations notoriously so. When the English amateurs were refused a place in some of the bands assigned to amateur stations by the 1927 treaty they were curtly informed that the allocation tables were "only a guide". Get it? Canada, on the contrary, takes rather a casual view of this treaty so far as amateurs are concerned. She regards her amateur stations as a national asset and treats their owners far more liberally than does the United States. Canadian amateurs may do many things that United States amateurs are not permitted to do. Canada, like most other countries, takes the sane and rational attitude that whatever she arranges with her own amateurs is her own business so long as their signals do not interfere with the communications of another country.

The 1927 treaty bars superfluous signals. And yet many high-powered commercial stations immediately started and have continued ever since to clutter the air with V wheels. It is claimed that this is necessary to indicate that a circuit is open for business. It is not at all necessary. The Globe Wireless is operating by far the best radio service on and across the Pacific Ocean, and that company has never put superfluous signals on the air. The United States V-wheel commercials started spilling superfluous signals the moment they secured their channels from the Federal Radio Commission, and when there was little or no business for these noisy circuits to handle. The real purpose was to set up "prior use" of the channels and to make it impossible for foreign stations to use them.

No sooner was the 1927 treaty made than over 25 commercial interests throughout the world filed with the Berne Bureau on channels in bands allocated by the treaty to amateur stations. Japan filed on 9 channels in the amateur 40 meter band alone. And, what's more, put high-powered stations on them and destroyed amateur communications with superfluous signals. To this day hundreds of commercial stations in various parts of the world are operating in the bands assigned by the treaty for amateur stations.

There is no way of stopping one commercial station's usurpation of another's channel except moral suasion or an appeal to self-interest. People who control commercial stations haven't advanced far enough ethically for the moral aspect of the issue to have much effect; but when two interfering commercials try to operate in the same channel, self-interest dictates that one or the other has to give in or get out. In such a dilemma, representatives of the two confer directly and settle their differences—somehow. They HAVE to, or neither station would do any business. But when a commercial station invades an amateur band the amateurs interfered with have neither this recourse nor the protection of the treaty itself. The commercial cooly tells the amateur to go jump in the sea. The amateur may protest to his own government to call upon the government of the marauding commercial to abide by the treaty and remove himself from amateur territory. He MAY, but he seldom does, because he knows that such a procedure is all but futile. That is why the provision of the Madrid convention that says "special arrangements" may be made between nations for the exchange of amateur third-party messages is just so much blah. No such special arrangements would ever be made. The commercial people who devised this joker to take the curse off their flat prohibition against international message-handling by amateur stations knew the provision would be inoperative.

The formulation of a commercial treaty IS hard work. Warring commercial interests must needs stop cutting one anothers' throats for the time being and try to do a little team-work. Well, you know how hard it is to get any team-work out of a group of individuals who have been fighting one another all their lives, and who know that each will double-cross the other the moment their backs are turned! Add to this condition the circumstance that each representative at an international convention must say in his own language what he wants, and must make his "say" mean the same thing in a French translation capable of being re-translated into all the other foreign languages represented in the convention. Add that, in French as well as in all other languages, there are no words for conveying certain meanings and shades of meanings. Add again that radio is new and radio communication a new art with a whole new vocabulary. The net result, therefore, of an international commercial radiotelegraph convention is a huge volume in many tongues capable of many interpretations, and each nation doing its own interpretating in the interest of its own commercials.

The convention of Washington in 1927 especially was dominated by commercial corporations. That is where the amateurs lost all but their tail-feathers. Before that time they had been plucked of most of their body covering. Up to that time the United States amateurs had held all of the short waves from 1500 kilocycles upwards. Their representatives, at various conferences of no legal status, had of their own accord relinquished all but a few narrow bands. When the international convention of Washington came along the amateurs had already established their reputation as push-overs, so it was a foregone conclusion that without competent representation they would lose territory. They WERE without such representation and they DID lose three-fourths of what they had not already given away. They were not only deprived of most of their territory but their rights were invaded by incorporation in the treaty of provisions designed to limit amateur communication with other countries. The attempt was made to specify the nature and content of amateur messages. There were two reasons why the attempt failed on this occasion. First, it was a violation of the primary assumption on which all commercial treaties are founded; namely, that each nation has the inalienable right to govern its own affairs in its own way. Second, the formulators of the treaty were so hampered by this primary postulate that they made a mess of their language while trying to dodge it.

Now, the whole necessity for international radiotelegraph conventions revolves about the problem of interference. Where there is no interference of signals there is no need for international conferences. Commercial people, however, have used the mechanism of international conventions for purposes quite outside the problems of interference. The attempt to so use them is what causes the greater part of the muddled meddling with the affairs of individual nations that encumbers the treaties. It has long irked certain American commercial interests that the 1927 treaty could not be used to stop all international exchange of third-party messages by amateur stations. So, long before the Madrid convention of 1932, plans were afoot among these commercials to put an absolute ban at Madrid on such traffic. When the United States was preparing for the Hague conference of 1929 these commercials were instrumental in getting into the proposals to the other nations this one:

"It is recommended that amateur stations be permitted to transmit, on behalf of third parties, communications which are of the same class as the amateur is permitted, by the regulations of his administration, to handle on his own behalf".

This was, and was known to be, a wholly improper subject to propose at the Hague; for the conferences at the Hague, and, subsequently, Copenhagen, were engineering conferences limited solely to the discussion of technical problems. But the recommendation of these amateur restrictions, by reason of their submission in writing to all other nations, did in fact put those nations on notice of the attitude the United States delegation would take at the following Madrid convention which would not be limited to technical subjects. The subject of course was not discussed at the Hague. It was never intended that it should be. But its distribution among the other nations did serve its designed purpose at Madrid. This is an instance of making use of the mechanism of an international convention in a matter that is the sole concern of individual nations.

The question of the source, destination and content of messages—either amateur or commercial—has no proper place in the deliberations of an international convention. Madrid did not presume, you will notice, to interfere with the primary assumption laid down in the convention itself—that each nation is free to conduct its own affairs in its own way—by specifying the character of the messages of commercial companies! If our Senate were to ratify the Madrid ban, ("Made in USA"), on the free international handling of third-party messages by amateur stations then our government would be meddling in the private affairs of every other country that is disposed to permit the free exchange of amateur communications.

We amateurs will, of course, conform with even the worst of treaties when, if, as, and for so long as they shall be or become the law of our land; but now that we know who makes them, and the kind of stuff they are made of, we need not stand in respectful awe of them and raise a crop of goose-pimples every time mention is made of "the international treaty".

—Clair Foster, W6HM.

Forecast For Next Issue

W6CUH, Chas. Perring, Jr., has a bang-up article on High-Efficiency—one of the most comprehensive and worth-while articles of its kind yet presented. Cathode-Ray Television articles will be resumed next month. Also be prepared for a real surprise on the Banehawk Receiver.

THE NEW DEAL and the Radio Amateur

ROUNDING up the crooks of big business and high finance is only a small part of the New Deal. Cleaning up the mess they made of our country is the big job. No department of our moral and economic life has been more thoroughly messed by hoggishness and incompetence than that of communications. In America this applies more especially to radio communications. In times of peace, wires and cables carry the great bulk of our rapid communications. In the matter of safety of life at sea, radio is a dominant essential at all times; but in times of national emergency radio communication is an absolute necessity.

The wireless situation in the United States, for all the glamour and clamor and extravagant claims, has always been horribly mismanaged. From the emergency point of view the present state of affairs is anything but reassurring. While it is true that in emergency the government can always take over all communications systems, nevertheless what interests our people most is the CONDITION of the systems when we shall be obliged to take them over. The government's own radio systems are in good shape and excellently managed. The non-commercial, or "amateur" stations are well organized under the direction of the Army and Navy. But taking over a bad mess of commercial communications systems in time of national emergency is not a nice prospect to contemplate.

President Roosevelt has long known this situation. He has a committee of his own studying the plight of our people, brought about by the muddled and impoverished condition of some of our commercial communications companies that are now unable to help themselves out of the holes into which they have maneuvered themselves. The President's committee is headed by his Secretary of Commerce and has the cooperation of certain committees of Congress and of the Federal Trades Commission that have already made exhaustive investigations of our communications systems.

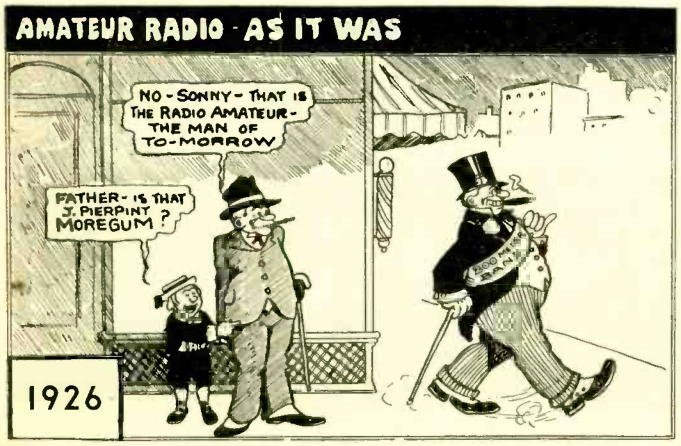
The President is well aware of the truism that when you go at the task of cleaning up a bad mess you NEVER take advice from men who were responsible for making the mess. You get information from them, but never advice. So this augurs well for the suggestions the President will make to Congress for relieving the people of a burden that was imposed by the stock-peddling control of our largest radio systems.

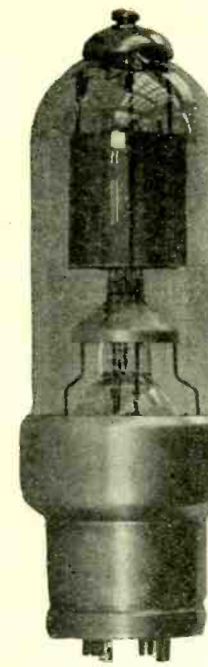
Some of these systems are headed straight for the rocks. High salaries of executives, big fees to lawyers for showing them "the safest way to do it", enormous expenditures for ill-advised propaganda and lobbying, the high cost of being investigated by legislative and regulatory bodies, the huge penalties of inefficient and top-heavy organizations, the abnormal cost of corporate contrivances for banker control, big commissions to bankers and securities-peddlers, elaborate and overpowered radio stations for which there never was and never will be business to justify their existence—these and many more undisclosed extravagances have brought some of the communications companies to a sad estate.

And all at the expense of the public. So the President, to protect the public from further exploitation and to provide for national security, is going to do something about it. Just what form this "something" will take is of course not yet known, but it is certain that drastic reforms are on the way. It is certain that a rigid government control will be imposed and exercised to end this appalling waste and muddling of our communications. It seems certain that many of the unnecessary stations will be taken off the air and the wasteful fighting for public business stopped. The suggestion of a mere "ham" is that the government prescribe the field of operations of the three largest radiocommunications companies—the RCA, Mackay and Globe Wireless, leaving the trans-Atlantic field to RCA, the ship-to-shore on the Atlantic Coast to Mackay, and the shipping and trans-Pacific work to Globe Wireless.

Globe Wireless, though the youngest in point of years, is by far the most efficiently managed system on the Pacific. It was built in the first instance primarily for the service of the Dollar Steamship Co. All the money that was invested was spent with an eye solely to creating a complete, up-to-the-minute system without spending one nickel for non-essentials. It was built and has been operated by practical men who know radio and know the communications needs second to none. It is under no banker control and not one dollar's worth of stock was sold to the public. It has never been burdened by a single one of the extravagances listed with respect to other companies. From what I

(Continued on page 31)

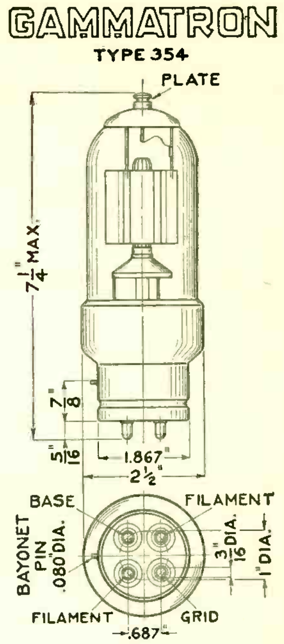




A new tube *for the Amateur!*

The Heintz & Kaufman 354 Gammatron

• • •



BOTTOM VIEW OF BASE

THE man who took the tuned-grid-tuned-plate circuit and put it into practical form for the amateurs, at the same time that some of the authorities in the east were still ensnarled in the Hartley, once again makes a contribution to amateur radio. This time it's a tube—the 354 Gammatron.

This tube differed from its predecessors from the very time of its inception. Imagine, if you can, a tube designed exclusively for amateur use—a tube having all the advantages of the already existant tubes, practically none of their limitations and—a few separate, distinct and unique features exclusively its own! Believers in the old adage that "Big things necessarily come in big packages" are going to be disappointed in the small size of this new tube. Based on present standards, the small size of the envelope would seem to lend no credence to the fact that the tube has a rated plate dissipation of 100 watts. Don't be deluded, as we were. This smaller-than-usual envelope is desirable for reasons of mechanical strength, and also because more complete elimination of occluded gases can be effected. The glass used for the envelope is a very hard one (Nonex), and this feature, combined with the fact that no "Getter" or "Keeper" is used to form on the walls of the tube and impede the radiation of heat, make this small envelope entirely practical.

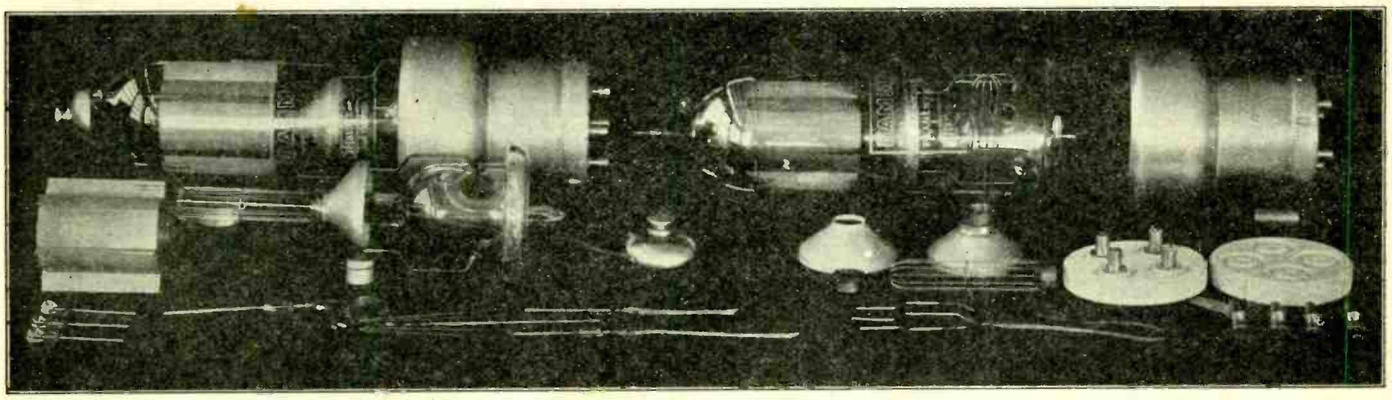
The 354 depends upon no multiple grids or circuit tricks for its fine performance. It has the conventional three elements and is designed to operate in the conventional circuits. I personally like to compare it to the '52, but it differs from that tube somewhat, in its ability to give real output with voltages common to the fifty-watt type tubes; this, in addition to its ability to withstand the high plate voltages used on the '52 in high efficiency operation. The plate has no collar on the stem to break down and is, in fact, entirely supported from the dome of the tube; the plate connection coming out to a new type cap from the top.

From the standpoint of simplicity of construction, the tube is really remarkable. Clever design has completely eliminated the various supports and insulators common to most tubes. There is nothing in this tube but metal and glass. This fact becomes significant when one considers that each piece of insulating material in a vacuum tube, no matter how small, is a potential source of gas when heated. Carrying this gas elimination a step further, both the grid and plate elements are made of Tantalum, a metal that will give up practically all of its gas after running at a temperature of 800° C., for a few minutes. Thereafter, the rate of gassing steadily and rapidly decreases even at higher temperatures. The color of the tube elements during the exhaust process would simply make you gasp. You can actually see them bulge! The total absence of gas in the finished product, coupled with the fact that the very high exhausting temperature would have to be exceeded to produce more (almost an impossibility in practice), mean simply that this tube can be run with its plate showing color without impairing its performance. Tantalum, as a matter of fact, has the unique property of being able to absorb small amounts of gas when running at a dull red temperature! All this is not an invitation to take one of these tubes and melt the plate, but means that if, in tuning, the plate should show color, the owner can feel safe in knowing his tube has not turned gassy.

The filament of this tube is of a special, double inverted V type and is extremely rugged. It is recommended that the filament voltage be kept strictly within the limits of 4.9 and 5.2 volts, if satisfactory operation and long life are to be considered. The somewhat higher than usual amperage drawn by the filament, make it extremely important that heavy leads be used to avoid excessive drop. It is suggested that the filament voltage be measured by an accurate voltmeter directly at the terminals of the socket. The filament is of the Thoriated Tungsten type that has proven up so well and the same that is used in many similar transmitting tubes. The extremely high vacuum in the 354 has, as one of its advantages, the fact that the filament is not subjected to the degree of ionic bombardment it receives in other tubes of lower vacuum when very high plate voltages are used. This near-to-an-X-Ray tube vacuum makes the possibility of the tube turning blue highly improbable.

The grid differs from the usual spiral grid quite radically. The grid wires run vertically from around the smaller opening of a funnel-shaped piece, whose larger rim is fastened to the stem by three small arms.

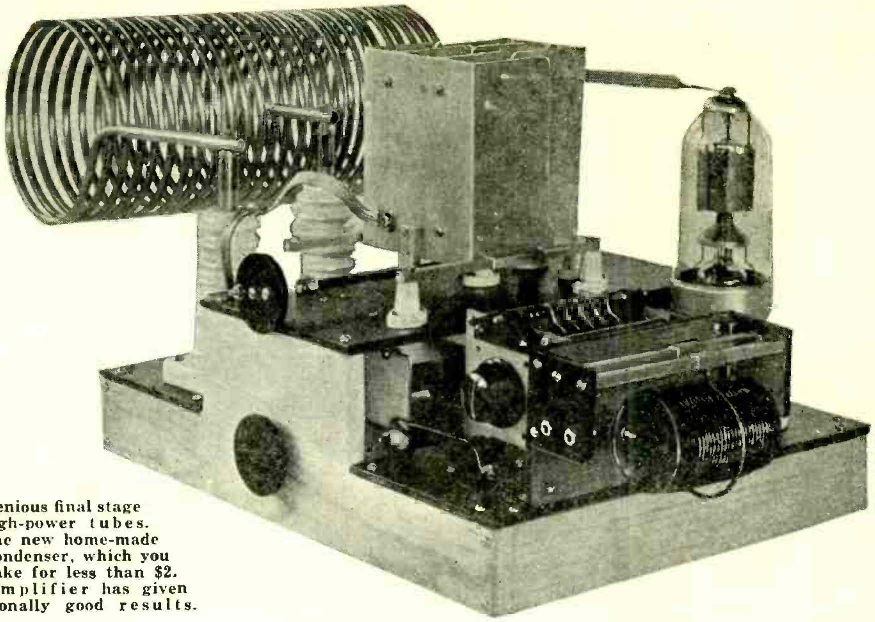
(Continued on page 8)



SUCCESSIVE STAGES IN CONSTRUCTION OF THE NEW H-K 354 GAMMATRON

—and a new *Final Amplifier* *for the* Gammatron

—— By CLAYTON F. BANE ——



An ingenious final stage for high-power tubes. Note the new home-made tank condenser, which you can make for less than $2. This amplifier has given exceptionally good results.

THE numerous comments that we have received from the high power design article published in August "RADIO" have largely dictated the design of the present stage. It must be said by way of justification, that the entire story as set forth in that article holds as good today as at the time it was written. Apparently, the only disadvantage was the fact that the apparatus used, though selected with an eye to economy, was still prohibitive in price. The tank condenser is perhaps the greatest stumbling block, so that in the design of this unit it was definitely decided to build our own and eliminate this consideration entirely. The neutralizing condenser, of course, is comparatively simple to build.

This amplifier stage, including the final tank condenser and the large tuning inductance, can be built for well under ten dollars. How much under this amount is, of course, largely dependent upon the number of the necessary parts that are already available. I hesitate to say anything about the junk box, having been a victim of that snare myself. Too many articles say that things can be built almost entirely from the junk box, when in reality, to duplicate the layout shown, the so-called "Junk Box" would have to take on all the proportions of a well stocked radio store. The other extreme is the showing of apparatus that would necessitate the poor reader being an expert machinist with all the tools of the trade at hand. This particular layout was built entirely in the author's basement workshop, using only those tools that the average radio man will undoubtedly possess.

It is felt that the various photos and drawings will serve to illustrate most of the salient points, as the individual will undoubtedly wish to make certain changes and alterations to fit his particular needs. It is recommended however, that the layout be followed, as the placement of leads and parts as shown has been found to be very effective.

Since the appearance of this unit differs somewhat from the conventional ones, a word or two in explanation may be in order. The double-deck arrangement is not merely a flight of fancy, but was used in order to provide space underneath for the neutralizing condenser. Previous experiments have shown the absolute necessity for short direct leads from this condenser to the tank, on one hand, and the grid on the other. Mounting the condenser in the manner shown solves this problem very nicely. It was found that upon assembly, the leads to the tank coil from the tuning condenser were even shorter than originally contemplated. This is apparent when we consider that the supporting insulators for the tank coil are about six inches off the base-board, and would increase the length of the leads down to the condenser if it were not for the fact that this condenser is also mounted on a level with their tops. These large inexpensive insulators are a distinct contribution to the set builder. Old timers will remember the time when such an insulator was regarded as an unattainable luxury, due to the exorbitant price. The coil plugs used on the tank coil are made to mount on these insulators and are a very efficient, low cost plug. A quick glance at Fig. 2 will show the details of the brass sleeves used to fasten the tank coil ends to the plugs. These sleeves allow a much longer lead from the coil to the supporting plug (necessary to keep the coil field isolated) and at the same time provide a degree of rigidity that would not have been possible if the leads themselves were used. In this latter case, the ends of the tubing would have had to be flattened and then drilled to take the plugs. The ends, when flattened, would hardly be strong enough to support the bulky coil. Incidentally, these brass

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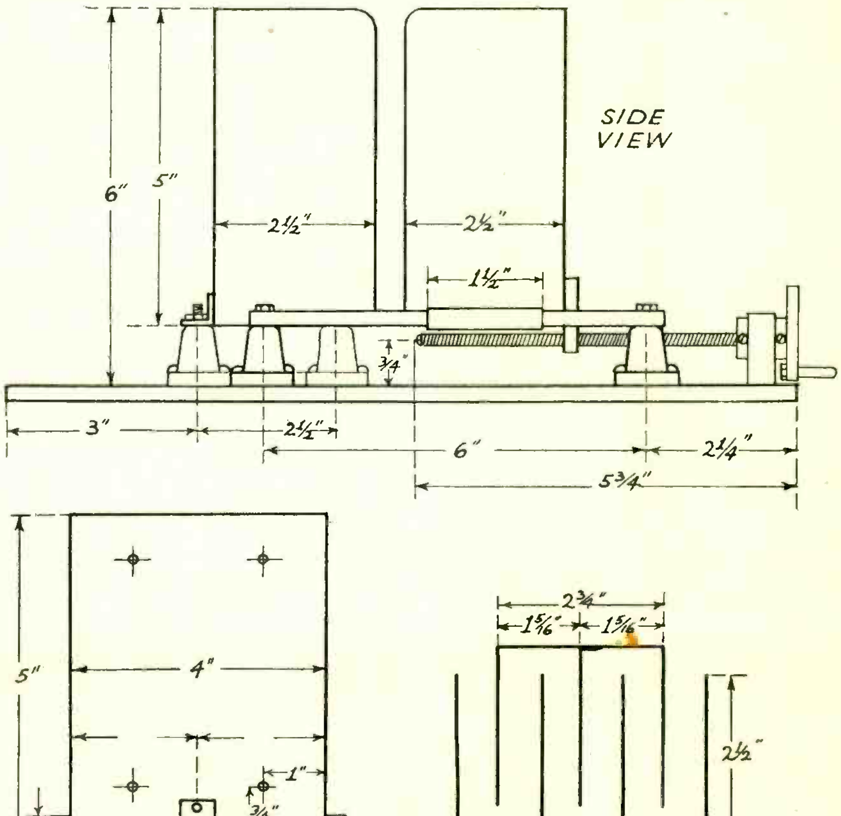


CONSTRUCTIONAL DETAILS FOR BUILDING THE HIGH-POWER VERNIER TRANSMITTING CONDENSER

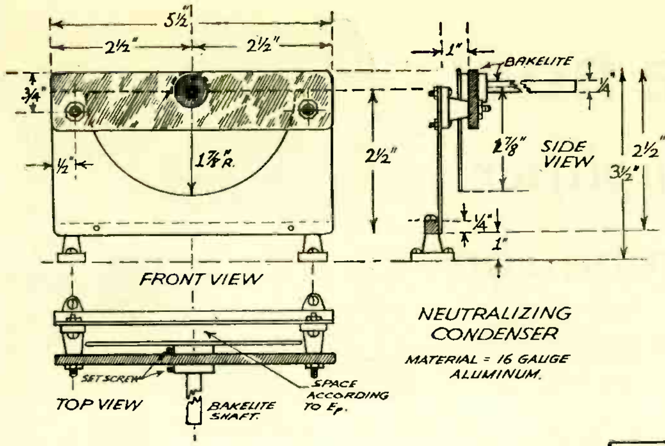
sleeves are not machined, but are standard, stock brass tubing, one-quarter inch inside diameter and three-eights outside. A twelve-inch piece can be purchased for about twenty cents, and its use is most heartily recommended. The navy-type RF chokes, the grid and plate bi-pass condensers and the center tap resistor are all mounted beneath the chassis. All power leads come out to binding posts mounted on a bakelite strip which is, in turn, mounted on the back piece. A slot was cut in the wood for the leads to come through in anticipation of possible leakage from the high voltage.

Since the photo shown in Fig. 1 was taken, some last minute changes have been made. The tank coil has been "clipped" down to 22 turns and a bakelite extension added to the grid tuning condenser. This extension shaft was added because the lead from the neutralizing condenser is too close to the fingers for any peace of mind when tuning.

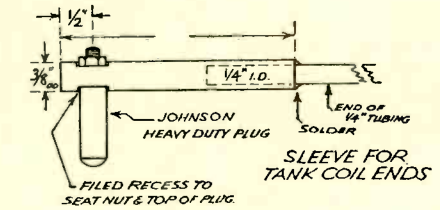
While this stage was primarily designed to work with the new 354 Gammatron, it is really quite flexible as to the type of tubes that can be used. A change in the type of socket is all that is necessary for a '52. The 354 and the '52 are so close in characteristics that no change in circuit constants is necessary. For an 'O3A or a 211, the plate lead can be shifted down to the socket connection with no increase in its length. It may be found, however, that the neutralizing condenser capacity may have to be made larger in order to properly neutralize. Three plates instead of two should be ample.

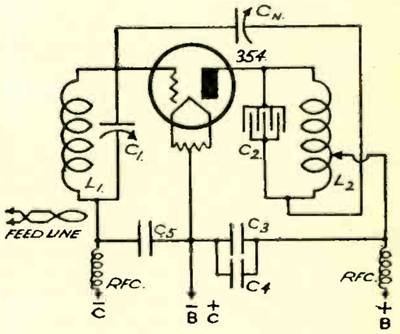
There are some few additional features that are perhaps worthy of consideration. It should be mentioned that the insulation and spacing on the final tank condenser is such as to be capable of holding up under voltages up to and including 3,500 volts. Calculations show that this condenser should have a maximum capacity of about 30 mmf. The minimum capacity is extremely low, as it is possible to adjust the plates so that the fixed and movable plate edges are separated by a full inch! The insulation, as can be seen by reference to Fig. 3, is furnished by the seven, one-inch Johnson stand-off insulators which further serve to support both fixed and movable plates. It is well to remember that in making one of these condensers, the utmost care must be taken to see that all edges are rounded and polished. Along the same line, be sure that the quarter-inch machine screws that hold the inside plates in place have their heads inside. To put the irregular end with its nut right in the condenser field would result in a source of sparking and corona. Avoid sharp, projecting edges on any of the plates or the screws. No reliance should be placed on the side rods for contact from the moving plate. Use a good-size flexible copper braid instead, and fasten it directly to the moving plates. The bakelite lead screw is merely a piece of quarter-inch rod threaded with a quarter-twenty thread. This threads into a piece of aluminum fastened to the moving plates. It is really surprising to see what a splendid vernier this arrangement makes. If the tuning condenser is to be used out at the minimum capacity position, it might be well to extend the shaft of the lead screw out a couple of inches to avoid hand capacity. An extension shaft might not be a bad idea on the neutralizing condenser also.

At this point, someone is certain to be thinking, "Say, this fellow harps on economy, but how about those bakelite panels the stuff is mounted on?" Nay, nay! Those panels are made of a species of fibre-board called, I think, "Prestwood". It is hard enough to be drilled clean, and has the additional advantage of having one side that is glassy-smooth, will take lacquer in great fashion. That's how the illusion of nice glossy bakelite is accomplished—at a total cost of about two bits!



Detailed drawings, showing how to make the neutralizing condenser. This condenser is mounted "below-deck", beneath the tank condenser. See photo on page 7.





In the Circuit Diagram, C3, C4 and C5 are Sangamo .002, 5000 volt fixed condensers. L1 is the grid coil, C1 the grid condenser.

Having learned a good lesson from previous articles, I hope herewith to anticipate a question that will inevitably come up—that big tank. Now, in the first place, the coil is separated from the tank condenser by well over its diameter! The same holds true of its proximity to any other metal in the set. Tests by the author and many others have shown, beyond the shadow of a doubt, that the use of real low C and a coil of ample proportions have a decided effect on the output. Anything that can be done to an amplifier that will give more output for the same amount of input has decided merit. I, for one, am perfectly willing to overlook the fact that such a coil takes on proportions of an overgrown still, if I can get more output with a limited amount of input. Excitation costs money, but in these days copper is cheap. The use of a great number of turns is entirely possible because of the very low minimum capacity of the tank condenser used. Incidentally, the condenser plates are entirely disengaged to tune this particular coil to 7075 KC.

The performance of this unit is all anyone could reasonably expect. Neutralization is complete, and achieved without any trouble. One point that is worth mentioning is that there is a correct place for the neutralizing tap and an incorrect one. Both apparently neutralize, but one position shows a higher grid mill reading than the other. This latter is the correct one, the other in some manner seems to cancel part of the excitation. (Possibly a degenerative effect.) Using the 354, results on both 7 and 14 MC have been very gratifying; there being very little, if any, loss in output on the higher frequency. Inputs to this stage were in the neighborhood of 600 watts, though the input was limited by the available plate voltage and excitation.

In conclusion, the author and "RADIO" sincerely hope that the man who is forced to roll his own may find some helpful pointers in our homespun final stage.

The HK-354 Gammatron

(Continued from page 6)

These vertical grid wires come together at a point just above the filament, completely screening that element from the plate. The bottom of the filament is also effectively shielded from the plate by the supporting cone of the grid. This shielding results in an exceptionally low plate-to-filament capacity, making this tube very suitable for "Grounded Grid" operation. The grid current curves of these tubes are very regular, with a total absence of the erratic nature due to secondary grid emission. (See data sheet elsewhere in this issue.)

The tube has a standard fifty-watt-size base, which differs from the conventional one in that it continues up into a flare into which the base of the glass rests. This shell adds greater strength of support to the envelope in addition to acting in the capacity of an electrostatic shield. The base pin that is usually used for the plate is connected to this shell and can be grounded. If it is desired to reduce the grid filament capacity, the ground connection can be left off.

"RADIO" does not subscribe to the presenting of new ideas and developments to its readers only from the standpoint of theory. It is our contention that anything can be made to work on paper. In line with our long-established policy we present in the following paragraphs the results of actual tests carried on by ourselves with the Gammatron 354.

This tube was so obviously superior to the fifty-watt types that it was deemed inadvisable to carry on any tests to show exact comparison between the two. Since the characteristics of the '52 were very close to the 354, comparisons of these two seemed more in order.

On 7MC, using the amplifier stage described on the following page and a neutralized 'ten' as an exciter, an input of 525 watts was realized without any difficulty (3000

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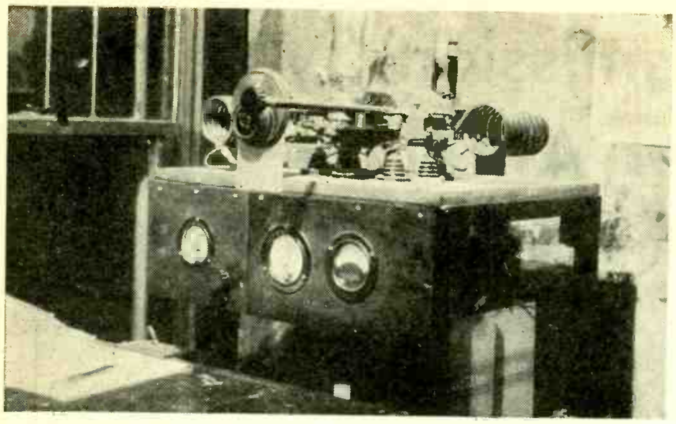

W7TX, who stood by during the crisis in case W7AIE should fail to hear K7AAC. This is the transmitter with which W7TX for several years handled hundreds of important Alaska messages.

K7AAC at Boca de Quadra, the point for which the fishermen were bound when disaster overtook them.

That Old Devil, SEA . . .

By Louis R. Huber*

WHEN Anna Christie's father, aboard his barge off Cape Cod, clenched his fist and shook it at the white shroud of fog, muttering imprecations which don't go well in print, he was giving expression to a contempt and a fear which every seafaring man from the Phoenicians forward has felt. Gentle or savage, kind or cruel: the "mother sea" of the romancers is not so romantic to those who live with her. A fair wind and a fair tide and good fortune—or numb death beneath her waves: they are the same to her, "that old Devil, Sea!"

And yet it is doubtful if Sverre and Olie, as they came down the ladder at the Ketchikan dock where their dory was tied, thought much about the whims and caprices of their old Mistress. They had come around the Island the day before from Boca de Quadra, a small village a ways down the Inside Passage, to get supplies and mail, a few magazines and a package of snuff. After an evening with friends, and the ensuing morning's purchases, they were now ready to embark on their return. Six, seven hours . . . they would be home again that night.

The purring little outboard motor nosed the dory out past the varied fishing boats—halibut fishermen with black triangles of auxiliary sail, purse seiners, salmon trawlers tied up for the winter—into Tongass Narrows. Olie having taken charge of the motor, Sverre sat amidships and watched Ketchikan recede into the distance.

It was late autumn, with characteristic Southeastern Alaska weather. Fine rain drifted in skeins across the spruce-covered mountain sides above the town, obscuring the snow peaks higher up. It was partly dark, the nightfall descending early at this time of the year, and a few windows were lighted already in the houses that climbed a little way up the hill. Just above the level of the water, the lights of an occasional automobile along the waterfront road gleamed in reflection across the rain-splashed water. Farther up the channel beyond the town, the red lights on the towers of WXH, the Signal Corps radio station, glowed warmly behind the rain. And while he watched over the squat figure of his companion beside the droning motor, this whole picture—the mountains rising above the town, the lighted windows, the lights reflected in the water, and the tall towers of WXH—faded gradually behind the curtains of rain, grew smaller and finally disappeared from view. A marker buoy slid past, and they were alone.

Their course led straight down the steamer lane to Seattle, as far as the end of the Island, where they turned—or rather where they would have turned—and made their way up on the other side of the Island to Boca de Quadra. It was growing from dusk into night when they picked up the light which was to have shown them their way at this turn around the foot of the Island, when the purring motor stopped . . . dead.

Now, an outboard motor in a fresh-water lake may be a joy and consolation to its owner, but hang one of them over the stern of a dory and use it in salt water and you have a fish of different scales. Olie and Sverre took turns cranking and cussing . . . and cussing and cranking, until both of them had blistered hands from pulling the flywheel-rope. And not so much as a sputter from the motor.

They tried tinkering the motor, feeling in the dark clumsily, but they had neither the proper tools nor a flashlight. At last they both took to the oars, rowing for the now fast-disappearing light. The tide at this hour was flowing out, and with it a freshening shore breeze.

Doggedly they rowed, silent. Each one knew what was in store. Soon they would feel the swell of the open ocean, soon leave the steamer lane and then only the chance—and what a slim chance!—of a halibut schooner appearing at Dixon Entrance would save them from going to sea in an open dory. The light at the foot of the Island grew fainter . . . finally winked its last as the curvature of earth intervened. Everything was dark, save for an intermittent glow of phosphorescence at the eddy from the oars. The wind picked up a little more, bringing with it a nasty little chop that rocked and tipped the dory awkwardly about. They began taking

(Continued on page 32)

* W9SU, also K7AHK.

Ketchikan—on one of those rare days when it didn't rain. The southern metropolis of Alaska, with fishing the main industry, Ketchikan is not so thoroughly overrun by sled dogs, Eskimos, igloos, icebergs, reindeer and Santa Clauses as is the rest of Alaska!

The near-victims of disaster. Sverre Hustad and Olie Olson, the two fishermen rescued from death in the Pacific by the Coast Guard Cutter *Alert*, after their plight had been flashed to headquarters by amateur radio.

Contrary to the popular impression fostered by schoolbooks and adventure stories, Alaska is not an ice box. This is one of the hundreds of delightful bays along its 2,500 miles of forest-covered coast line.

High-Efficiency Transmission System For the Doublet Antenna

By E. F. JOHNSON[1] and RALPH P. GLOVER[2]

One-half of the radio-frequency power available from the output stage is never radiated in a great many amateur transmitting stations. In fact, it is entirely deprived of access to the antenna system.

THIS unfortunate state of affairs exists whenever a half-wave doublet is fed through a conventional open-wire transmission line, and is brought about simply by the inequality of antenna and line impedances. The elimination of this loss would double the radiation, or would produce the same radiation with half the available transmitter power—both highly inviting possibilities which can be realized with small effort and insignificant expense by any transmitting amateur. Naturally the impedance matching must be accomplished with high-efficiency or the overall performance will still fall far short of the optimum. This article describes a simple yet highly efficient transmission system for the doublet antenna which has been developed by the E. F. Johnson Company.

Shortcomings of Conventional Systems

BEFORE describing the constructional details of the new system, a brief consideration of the shortcomings of conventional doublet feeder systems is in order. No attempt will be made to argue the case for the doublet against other types of radiators, although in the writer's opinion, the current-fed Hertzian doublet, properly operated, repsents a close approach to the ideal system for the amateur transmitter.

A half-wave doublet antenna has an impedance of about 75 ohms, composed mainly of radiation resistance if the ohmic and loss resistances are reasonably low. This impedance (really resistance) is practically independent of frequency; that is, all half-wave doublets, whether 20 or 80 meter affairs, for instance, appear to be 75-ohm resistances when viewed from the antenna terminals at the center of the span. The value is sensibly the same for both the horizontal and vertical types.

The transmission line which feeds the antenna at the center is usually of non-transposed open-wire construction. A feeder which is typical of hundreds or possibly thousands of present-day amateur layouts consists of a pair of No. 14 to No. 10 conductors spaced 6 inches apart with straight feeder spreaders similar to that shown in Fig. 1(A). The characteristic impedance, which is most simply described as the impedance to which the apparatus at the ends should be matched for optimum efficiency, can be computed from the formula—

$$Z_0 = 277 \log_{10} \frac{2S}{D}$$

where S is the separation of wire centers and D is the conductor diameter, both dimensions being expressed in the same units, that is inches or millimeters. The results of our computations are listed above in Table 1:

TABLE I

CHARACTERISTIC IMPEDANCE OF PARALLEL CONDUCTOR LINES

(Six-inch conductor separation)

Wire Size, B&S Gauge	Characteristic Impedance, Ohms
No. 14	629
No. 12	602
No. 10	573

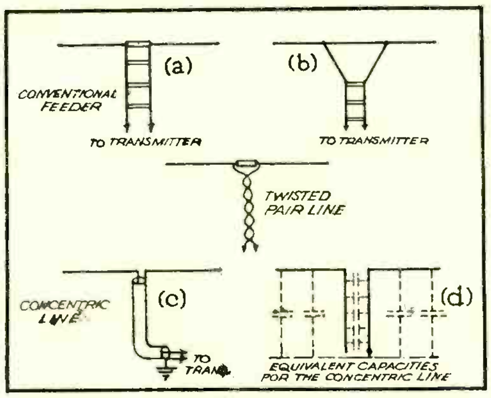

FIG. 1

Thus, even if No. 10 wire has been used, the line impedance is 573 ohms, or more than seven times the antenna impedance which we desire to match. Under these conditions, the antenna is only taking 41% of the power which it would absorb if impedances were matched. This represents a reflection loss of 3.9db, which, if eliminated, would result in a gain of 3.9db, in signal-to-noise ratio *without any changes whatsoever in the transmitter!* An improvement of this order means definitely louder signals and better DX.

Of course, the line impedance can be lowered by bringing the conductors closer together, but even in the limiting case where the wires are barely separated by a minute air film, the characteristic impedance would be 83 ohms and, needless to say, it would be quite out of the question to insulate such a line.

Fanning-out the line so that it taps across a central section of the antenna is somewhat better than direct connection of the close-spaced line to the center of the flat top. This scheme is shown in Fig. 1(B), and is based on the principle that the impedance of the antenna varies from point to point due to the presence of standing waves, and it is possible to find points where impedance is the same as that of the top branch of the feeder. The line impedance at the upper end is much higher than the impedance for the portion which is uniformly spaced, due to the increased separation of the conductors. Accurate matching is an experimental procedure characterized by a great deal of hoisting, lowering and adjustment of the feeder-antenna junction points. The most serious objection, however, is the fact that we no longer have orthodox doublet, but something resembling two "T" antennas joined together! This not only requires a great deal of free space for construction, but the sides of the "Y" radiate nearly as much as the top portion. The primary purpose of any good feeder system should be the efficient transfer of power from the transmitter to a particular type of radiating system, and the feeder should neither radiate appreciably nor distort the radiation characteristics of the antenna itself. The "Y"-fed doublet hardly meets these specifications.

Still another possibility is the concentric line using a single conductor in the center of a tube with insulating beads at intervals. The tube acts as the return path and is usually grounded as shown in Fig. 1(C). The concentric line has two advantages, namely that the characteristic impedance is approximately the same as the antenna impedance and no matching is required at the antenna junction; secondly, the system does not radiate because the tube acts as a shield. To offset these advantages, we have the difficulty of assembling the line and maintaining the insulation, an especially troublesome problem for high-power systems. Moisture is likely to collect inside the tube, where it remains for long periods of time, and this by no means improves the line insulation and may actually lead to breakdown. Repairs are difficult at best, always involving complete dismantling and reconstruction of the line.

The concentric line is an unbalanced system, as can be seen from the disposition of equivalent capacities in Fig. 1(D), and this may lead to departure from the anticipated directional properties of the antenna. The capacity unbalance tends to make the currents in the two halves of the antenna unequal, leading to a lop-sided radiation pattern.

Twisted pair feeders have likewise been used in the attempt to build a line which would approach the impedance of the antenna directly and thus dispense with the necessity for matching devices. The low impedance of such lines is due to the close proximity of the conductors and the use of solid insulation. This results in a high capacity and low inductance per unit length of line, both of which factors tend to lower the line impedance. However, regardless of the convenience of this simple feeder system it is poor economy, for the net gain in efficiency due to impedance matching can easily be cancelled out by losses in a low-grade line.

The Quarter-Wave System

THE whole problem would be simply solved if it were possible to build a lightweight, non-radiating 100% efficient high frequency transformer. All we need is something to match our line of about 500 ohms characteristic impedance to the 75-ohm an-

[1]—*E. F. Johnson Company, Waseca, Minn.*
[2]—*Consulting Engineer, Chicago, Ill.*
[3]—*E. J. Sterba, Proc. I.R.E., p. 1184; July 1931.*

tenna load, with good efficiency, of course. A pair of coupled inductors would theoretically serve the purpose, but practical difficulties in the construction and suspension of such a unit, capable of handling considerable power, rule out this method. Tuned circuits, hung in the air, are still less convenient and of dubious efficiency.

Some time ago it was pointed out that a quarter-wave line functions as an impedance-matching transformer.[3] Lines of this type, with copper bar conductors supported horizontally on poles, have been used by the Bell Telephone Laboratories for matching antenna arrays to a main transmission line, but obviously this type of construction would be out of the question for the average amateur installation. Still, it was apparent that the quarter-wave line offered the advantages of extremely high efficiency and simplicity, and would constitute a close approach to an ideal matching system, provided the electrical and mechanical problems could be solved. Fig. 2 shows an antenna insulator suspension assembly, supporting a pair of aluminum quarter-wave tubes at the center of the doublet—a practical and inexpensive answer to these problems.

Large conductors, closely spaced are essential in a quarter-wave system to match the usual types of transmission line to a 75-ohm doublet. The characteristic impedance required for the quarter-wave section is—

$$\frac{Z\lambda}{4} = 8.66\sqrt{Z_L}$$

where Z_L is the characteristic impedance of the main transmission line which is to be matched to the antenna. In the case of a 600 ohm line, for instance, (2-No. 12 conductors spaced 6 inches) the required q.w. line impedance is thus 212 ohms, a value far below that obtainable with ordinary sizes of wire, air-insulated with reasonable separation. Large conductors provide the necessary low characteristic impedance with practical conductor spacings. Naturally solid conductors would answer the purpose, but weight is an important consideration since the system is to be suspended at the center of the antenna span. Aluminum tubing, one-half inch in diameter has been selected by the writers for this purpose. Copper tubing is satisfactory, although it is 3.32 times as heavy as aluminum of the same dimensions.

Since the main line impedance is likely to lie between extreme values of 440 to 630 ohms, depending on the size of wire and conductor spacing chosen, it is necessary to adjust the impedance of the quarter-wave line to the correct value for any particular main transmission line. This is done by altering the spacing of the tubes according with data in Table 2. The glazed porcelain spacing bars (See Fig. 2) are slotted to provide for this adjustment and should be installed not more than 3 feet apart along the line to insure accurate spacing.

Fig. 3 shows how a transposed main transmission line is connected to the lower end of the quarter-wave section. The transposed line is not essential to the proper working of the q.w. section but it provides an economical, balanced feeder and is to be preferred over the straight non-transposed line using ordinary feeder spreaders, although the latter is quite satisfactory. The main transmission line is practically unlimited in length and has no appreciable losses up to several thousand feet.

Practical Details

ALTHOUGH the antenna insulator assembly shown in Fig. 2 is a commercial product, it may be duplicated by any mechanically-minded amateur. It consists of two 7-inch glazed porcelain bars, spaced one-half inch apart, and assembled with bolts through the holes. A cable eye is slipped over each V bolt to relieve the bend in the antenna wire. Lead washers are used next to the porcelain to prevent breakage.

The 7-inch insulator provides adequate insulation for the voltage is quite low at the center of the antenna, being less than 300 volts when radiating 1,000 watts. The voltage at the ends of the antenna is considerably higher and 12-inch insulators are recommended for powers up to 250 watts, and 20-inch insulators for 250 to 1,000 watts.

The quarter-wave tubes are supported by circular 18 gauge hard brass straps which

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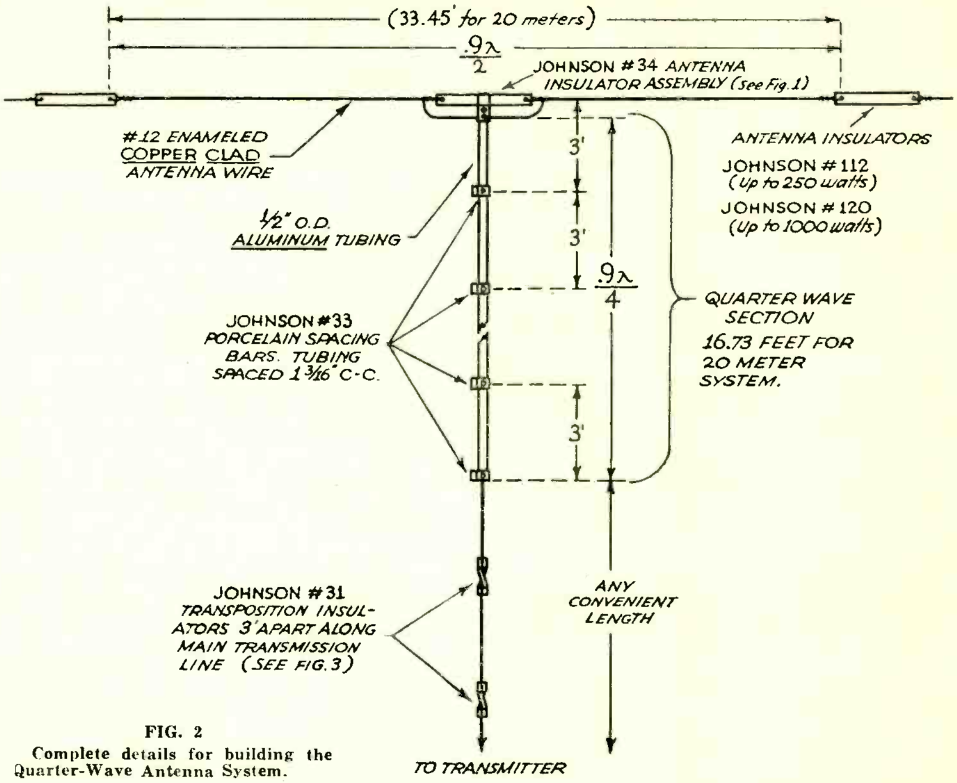

FIG. 2
Complete details for building the Quarter-Wave Antenna System.

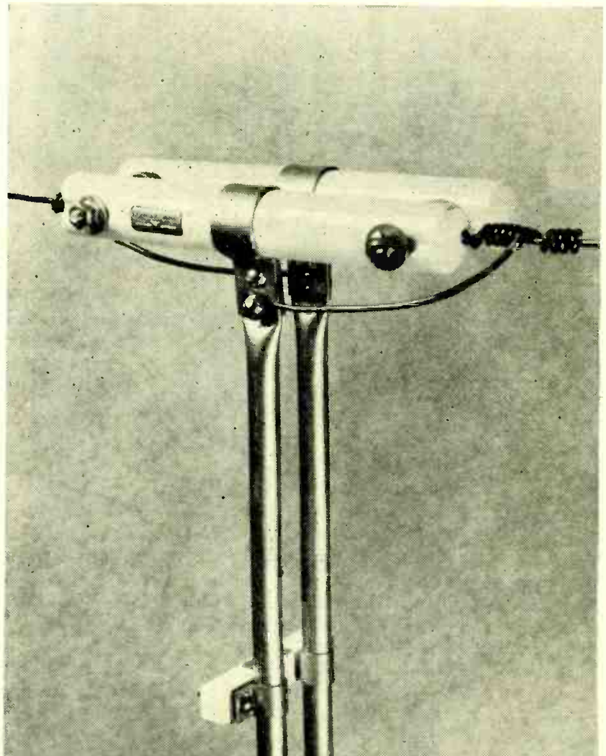

FIG. 4
Quarter - Wave Tubing Section secured to the Doublet.

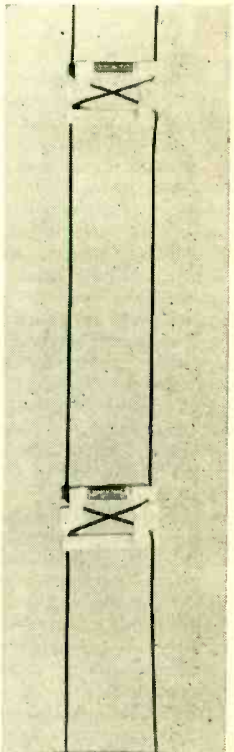

FIG. 3
The Transposed Lead-in can be as long as 1000 feet.

The Banehawk Receiver

—Something New and Better in 1934 Amateur Super-heterodynes

By the Technical Staff of "RADIO"

CHAPTER I.

The Antenna Circuit

THIS is the first presentation of a series of constructional engineering and design features for amateur and short-wave superheterodynes which conform to the 1934 trend. The purpose of the series is to enable the constructor to build superheterodyne receivers in which are incorporated mechanical and electrical features not generally found in present-day receivers.

Speaking of mechanical construction, we wonder very often at the lack of imagination shown by a good many of the manufacturers. The sets we have today, are very largely a duplication of the ones we had several years ago. All this notwithstanding the fact that the tubes, and conditions under which they work, have changed radically. One particular method of making a receiver with a stage of tuned radio frequency comes in for a great deal of criticism. Tuned radio frequency stages are, at best, not particularly helpful from the standpoint of gain. Something should be done when the lead from the plate circuit which carries the signal is made to travel over about three-quarters of the other wiring in the set, and then comes into too-close proximity with the shielding. Obviously, a great deal of the signal is lost in this "wandering around", looking for a place to stop. Very few of the commercial receivers set any kind of a precedent to the amateur set builder. Western Elctric is among the notable exceptions.

Simply because it has been customary to design a receiver with its parts mounted in the conventional manner is no reason why some better means cannot be found for accomplishing the same objective, but with a marked improvement in performance. From a standpoint of radical mechanical design, we feel that the receiver which we will present next month has many noteworthy and commendable features.

Refinement of detail, rather than radical circuit changes, is the keynote of the series, for these many refinements when multiplied often result, literally, in transforming "QRM" to "WAC". Many of them have been overlooked by the average constructor, because they have not been given sufficient stress, nor has the set builder had at his disposal the necessary information and laboratory equipment to enable him to tell if certain changes are desirable. Such a minor detail as a poor RF ground will often result in a tremendous loss in selectivity, combined with an equally tremendous increase in noise. Noise is the enemy of short-wave reception. Noise can be divided into two kinds . . . that which comes into the receiver from the antenna, and that which is produced in the receiver proper. The "signal-to-noise-ratio" (which means, in plain language. that the signal must be louder than the noise by at least one point of the "R" scale in order to make the signal readable) is very high in receivers which will be described in this series.

No matter how much gain or sensitivity the set may have, it will NOT bring in the desired signal if the signal is lost in the noise which is present in the "front end" stages of the receiver. Improper shielding also is responsible for a share of noise-introduction and loss of selectivity. Stray feed-back reduces the gain ahead of the first detector, so that the noise inherent in the detector and the high-frequency oscillator is higher than necessary.

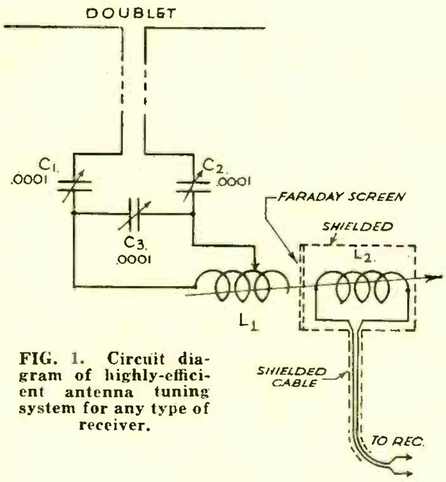

FIG. 1. Circuit diagram of highly-efficient antenna tuning system for any type of receiver.

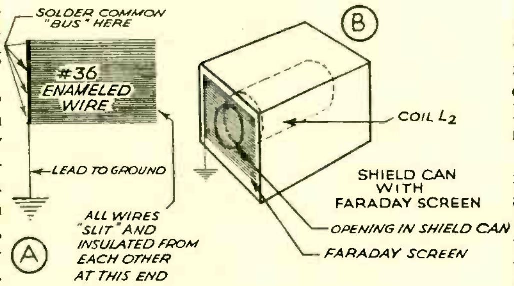

FIG. 2. Showing how to make the Faraday Screen and how to mount it on the shield can.

Another bothersome source of noise is introduced when there is lack of mechanical isolation between the "front door", so to speak, and the intermediate frequency and audio amplifiers, not to mention the power supply. For the amateur constructor who has no extensive laboratory facilities at his disposal it is generally agreed that it is best to keep all power-supply apparatus at least two feet away from the first detector and its associated circuits so as to prevent hum pick-up and unwanted noise which may leak in through the 110-volt line.

It has also been found advantageous to isolate the intermediate-frequency amplifier from other stages of the receiver, and thereby avoid heterodyne whistles and unwanted regeneration. Speaking of shielding, it is well to state here that there is no justification for "crowding" a lot of equipment inside of microscopic shield cans merely for the purpose of obtaining compactness and inaccessibility. While it is true that shielding, in general, prevents feed-back, it does so by reason of by-passing, which always introduces a loss. Keep these losses down to a minimum by wide mechanical separation between stages. This is especially true when a shield surrounds a coil, because not only is the usual by-passing loss introduced, but the presence of the shield itself introduces serious eddy-current losses, due to its being in the magnetic field around the coil. Consequently no shield for use around a coil should be smaller than twice the diameter of the coil. Flimsy shields are worse than no shields at all, because they do not retain their proper contact along the seams, thus introducing noise and undesired feed-back.

For a long time aluminum has been considered the ideal shielding material for high-frequency work. However, experiments have proved that cadmium — or copper-plated-steel is just as effective at high-frequencies and is infinitely better for eliminating 60-cycle hum and other low-frequency noise, because of its magnetic properties. In these times we are also interested in the fact that steel, even when plated in small lots, costs only about one-fourth as much as aluminum and is easier to drill, bend, and solder.

The Fundamental Problem of Reception

IT IS a fundamental principle that you cannot amplify something which you do not detect. Consequently, the first and most important step is to see that the signal reaches the grid of the first detector with as little loss as possible, and accompanied by the minimum of noise.

This brings us to the consideration of taking the signal which is intercepted by the antenna to the grid of the first tube in the receiver by means of some form of "water-tight and noise-proof tunnel". We all know the advantages inherent in the usual form of transposed doublets. However, there have recently been some marked improvements made in this form of antenna coupling. For example, the article in this issue of "RADIO" on the Johnson-Glover antenna system is indicative of the progress which has just been made with respect to transferring the signal from the antenna to the feeders.

Let us give a little thought to the problem of getting the signal out of the feeders and into the receiver, under the best possible conditions. There are numerous opportunities for loss at the junction between the feeders and the first tuned circuit in the receiver. Improper coupling gives either too great or too small a signal input; both of these conditions being undesirable. Too great a signal will cause overloading and cross-modulation in either the RF or first detector tube, which makes the receiver particularly susceptible to key-clicks and cross-talk. Too small a signal, obviously, reduces the signal-to-noise ratio.

The solution lies in the use of a tuned-coupling system, in combination with resonant feeders, which, incidentally, aid the overall selectivity and reduce image interference; a condition which has caused so much grief in the majority of amateur and short-wave supers in the past.

Probably the most important contribution in this field has been made by Ralph M. Heintz, W6XBB. The strict requirements of commercial service brought about the development of a system for use primarily with break-in, and its value has been proved over a period of years in everyday ship-to-shore communication.

Fig. 1 shows a complete system applicable to any ham receiver, whether super-heterodyne or autodyne. This system is a fundamental requirement for the successful operation of the 1934 Banehawk Superheterodyne receivers which will be described in later issues.

Briefly, the system operates as follows: The signal is intercepted in the usual manner by the two halves of a doublet antenna. It is then brought down the transposed feeder line which is resonated to the desired frequency by means of the two series condensers C1, C2. The purpose of C3 is to resonate the tapped-coil L1 which acts as the primary of the coupling transformer whose untuned secondary is L2. So far, we have shown nothing particularly new and startling. However, it will be seen that the coils L1 and L2 are electrostatically shielded from each other. This is for the purpose of limiting the coupling between L1 and L2, so that pure inductive coupling results. It has been found that most of the noise which we desire to eliminate reaches the receiver principally by means of capacitive coupling from the antenna, because the peculiar wave-form of noise is not transferred by inductive coupling.

As the diagram shows, L2 is shielded, but the shielding has some special features which are shown in Fig. 2. The shielding is complete except for a hole, twice the diameter of the coil, which is covered by a Faraday Screen. This Faraday Screen is an electrostatic shield which introduces no losses in the electromagnetic coupling between L1 and L2. This is because of its unusual construction. The Screen is made by winding #36 enameled copper wire around a stiff piece of cardboard or thin bakelite. This "form" should be large enough to cover the hole in the shield can in which L2 is housed.

The turns of the wrie should be close-wound. After the screen has been wound, it should be coated with clear Duco, in order to hold the turns in position. After the Duco has dried, take a razor blade or sharp knife and slit all of the turns at one end of the card. Then scrape the insulation along the other end and solder a common lead (a thin strip of copper or a piece of wire) to this end, as shown in Fig 2(a). This lead, of course, is grounded. Mount this Faraday Screen over the hole, as shown in Fig. 2 (b). Small escutcheon pins or brads can be used as "rivets", if a professional job is desired.

The coupling between L1 and L2 should, for best results, be variable. L1 may be tapped, if it is desired to work on more than one band and yet keep the number of coils in the receiver at a minimum. L1 is wound with 16 turns of #22 DSC wire, close wound. A tube base can be used for this coil. L2 is wound so that its inductance matches that of the antenna coil, to which it is coupled (inside of the receiver). Experiments conducted by W6PW produced good results when L2 was made by winding 3 turns of #22 DSC wire on a tube base.

The leads from L2 to the receiver must be carried through shield cable in order to prevent noise pick-up, which we so carefully avoided up to this point. It is also very important that the first stage in the receiver be thoroughly shielded, if best results from this method of coupling are wanted; this holds true whether the receiver is a superhet or a lowly two-tuber.

The next chapter will deal with the actual construction of the Banehawk Receiver, which has been pronounced the acme of perfection for amateur and short-wave reception.

High Efficiency Transmission System for the Doublet Antenna

(Continued from page 11)

clamp around the center of the insulators. The end of the tubing is flattened and bolted securely between the straight portions of the strap. The antenna wire is passed around the cable eye, allowing about one foot of slack, and is brought back and twisted for strain relief.

The free end is sweated into a solder lug which is bolted firmly to the tubing supporting strap. As shown in Fig. 2, one lead is longer than 90% of a quarter-wave overall, this exact dimension applying between the points where the antenna and main transmission line terminals actually connect to the tube.

If No. 12 wire on 2-inch transposition insulators is used for the main transmission line, the tubing spacing should be 1 3/16-inch center to center. For other wire sizes and spacing, use the separation indicated in Table 2.

TABLE 2

CENTER LINE SEPARATION OF 1/2-INCH QUARTER-WAVE TUBES TO MATCH VARIOUS LINES

Wire Size	Main line spaced by 2-inch Transposition Insulator	Main line spaced by 6-inch Feeder Spreader
No. 10	1 1/8-inch	1 3/8-inch
No. 12	1 3/16-inch	1 7/16-inch
No. 14	1 1/4-inch	1 1/2-inch

connected to each tube. The aluminum tubing may be lacquered or given a coat of clear duco to prevent surface oxidation, if desired.

Fig. 4 shows a broadside view of a doublet with a quarter-wave tubing section matching the antenna to a transposed transmission line. As explained previously a non-transposed line may be used if desired. No. 12 gauge enameled copper-clad wire is recommended for both antenna and main transmission line, for it will not elongate appreciably and the enamel prevents corrosion with attendant increase in high-frequency resistance. The overall antenna length should be 90% of a half wavelength as indicated, with the suspension insulator assembly located in the exact center of the span. The quarter-wave tubes are slightly

A 20-Meter Quarter-Wave System

COMPLETE specifications on a 20-meter doublet and quarter-wave system will be of interest as a typical example.

Frequency—14 M.C.
Length of Antenna—33.45 feet.
Length of Quarter-wave Sec.—16.73 feet.
Weight of Quarter-wave Sec.—1.85 pounds.
Spacing of Quarter-wave Section—1 3/16-in.
Feeder—No. 12 copper-clad enameled wire on 2-inch transposition insulators.
Approximate net cost, antenna and quarter-wave section, including insulators but exclusive of main transmission line, $6.42 net.

December 8, 1933.

The Editor,
"RADIO".
Dear Sir:

Since the preparation of this manuscript the writer's attention has been called to the following passage in the text book "Radio Engineering" by F. E. Terman, First Edition, Second Impression, published by McGraw-Hill, 1932, page 539.

"When the load impedance which the antenna offers **differs by only a moderate amount from the characteristic impedance** of the line it is possible to transform the load impedance offered by the antenna to the characteristic impedance of the line by connecting the two with a quarter wave-length non-resonant transmission line having a characteristic impedance of $\sqrt{ZrZo}$, where Zr is the load impedance offered by the antenna, and Zo is the characteristic impedance of the transmission line which goes to the transmitter. This method of coupling an antenna to a non-resonant transmission line is shown at Fig. 305d." (Bold face mine).

This reference is especially interesting in view of the inconsistency of the bold face portion quoted with the schematic circuit used to illustrate the point. The Fig. 305d mentioned shows a horizontal antenna feed in the center and coupled to the non-resonant line through a quarter-wave coupling line. I infer that this antenna would be operated as a half-wave doublet although this is not specifically mentioned. To repeat, Dr. Terman says, "When the load impedance which the antenna offers **differs by only a moderate amount from the characteristic impedance of the line it is possible to transform the load impedance . . .**", but it is a matter of common experience that the antenna load, when center fed as a half-wave radiator, differs widely, not "moderately" from the characteristic impedance of any practical open-wire line. The antenna load under these conditions is very closely 75 ohms, while the line impedance for a pair of numher 14 conductors six inches apart is 629 ohms. The impedance ratio here is approximately 1 to 8.4, or a difference **of nearly a whole order of magnitude!** This, of course, accounts for the enormous reflection power loss when no impedance matching is attempted. Even if the conductor

(Continued on page 31)

Ham Hints

—— By JAYENAY ——

How To Identify An Image Response

MANY Ham supers "enjoy" image interference, which is due to the heterodyning of signals twice the IF away from the desired signal. Most image interference can be recognized as code sending, from 60 to 500 words a minute, either dots, V's, or ABC. Occasionally, of course, someone sends a message via these stations and actual intelligence is sometimes transmitted. However, we often find foreign commercials operating right in our bands. Some method of distinguishing between an image and a true signal is necessary. If your super has the "single signal" effect, either with a crystal or sharp IF transformers, you can identify an image by the "strong" audio response which appears on the opposite side of zero beat from the "strong" response to signals at the frequency to which your first detector is tuned. As you tune across various signals in the 7000 KC band, for example, you find that the "strong" audio response always appears on the same side of zero beat. This may be either the high- or the low-frequency side, depending on which side your beat-frequency-oscillator is located. Whatever side you use, you will find that image signals have the "strong" response on the other side of zero beat. Incidentally, if you find that a certain commercial signal in our bands is NOT an image, and interferes with a station you are working, log it with all details as to time, frequency, station interfered with, and with what station the commercial is working. Send the report to "RADIO".

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Keying the Crystal

FIG. 1 shows a simple and effective means of keying the crystal oscillator for break-in operation. The grid leak may be slightly larger than usual in order to make the crystal start quickly. Otherwise, the circuit is conventional. The 2500 ohm cathode bias resistor effectively stops oscillation when the key is up.

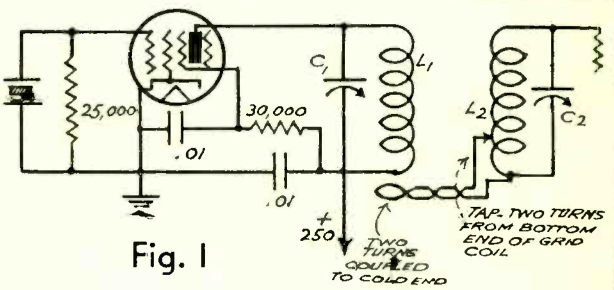
Incidentally, this is a fine circuit for phone break-in, but pure grid-leak bias in a high-power stage may have to be added by some other form of bias, or fireworks will result when the excitation is removed.

Keying the Crystal

The coupling link is No. 18 insulated wire, twisted like lamp-cord. L1 and L2 are both identical in size and each has the same number of turns (No. 14 wire on 2" dia. form, close wound).

L1 and L2 for 160 meters —80 turns; for 80 meters, 28 turns; for 40 meters, 11 turns.

C1 and C2 each 100 mmf. (.0001) maximum.



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"By the Beautiful Sea"

DR. HEISING (of modulation fame) of the Bell Laboratories has determined that very definite advantages are realized when receiving trans-oceanic high frequency signals when the receiver is located as close to the water's edge as possible. It has been known for some time that radio signals suffer less attenuation over water than over land, but it is rather surprising to realize the extent of which a signal is reduced when it leaves the water and travels over even a short land path. The first mile inland from the beach does most of the damage; for greater distances inland the attenuation per mile is greatly reduced. It takes from six to sixteen times the transmitter power to put the same signal into a receiver located one mile inland as compared with a receiver located directly on the beach. Whether this same rule applies to transmitters located near a seashore depends on the angle of radiation, frequency, etc. W6CUH, W2AWR and others with similar locations are much to be envied.

●●●

Modulating Grounded Grid RF Amplifiers

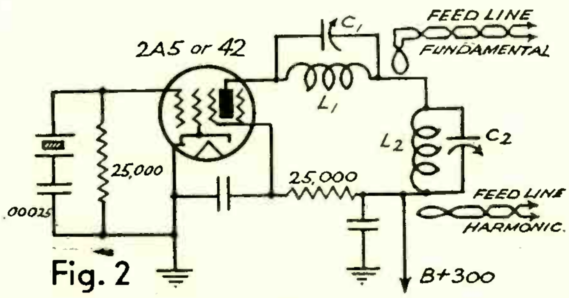
THE "Grounded Grid" amplifier is characterized by the fact that the filament is above ground to RF and has the excitation fed to the filament rather than the grid. Of course, the exciation reaches the grid CIRCUIT just as it did before, but the "hot" lead goes to the filament while the grid is grounded.

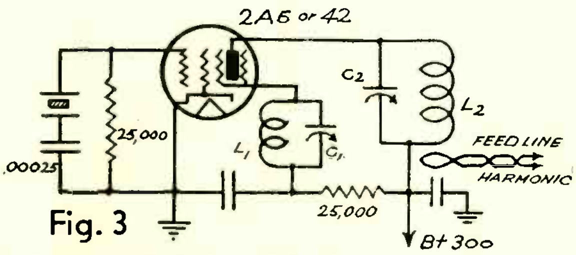
If it is desired to modulate this type of amplifier (and it makes a FB modulated amplifier), it should be noted that the modulation must be applied between plate and filament and not necessarily between plate and ground. In some bias arrangements for this amplifier, we get a combination of grid and plate modulation when the audio modulation is applied between plate and ground. The resulting hash of the voice quality far exceeds even loop modulation for unintelligibility.

●●●

Doubling In the Oscillator

HEREWITH are shown two crystal oscillator circuits which allow an appreciable amount of second or third harmonic to be delivered to the next stage. In Fig. 2 is shown a circuit which most nearly resembles the tuned-plate version of the electron-coupled oscillator with the crystal replacing the grid coil. This circuit performs well, but is rather hard on tubes because the screen current is higher than normal for this type of tube. The other circuit, shown in Fig. 3 more nearly resembles the conventional pentode oscillator circuit, except that the grid leak is larger than usual in order to increase the harmonic output. The harmonic is then picked from the tank L2-C2 which is tuned to twice the crystal frequency. The LC ratios of the two tanks are somewhat critical. If they are very low C tanks, the circuit refuses to oscillate. If the C is too high, the power output drops off until again the circuit refuses to oscillate. For best results the LC medium ratios of the two tanks should be approximately equal. In both circuits the cathode is grounded. Filament type tubes, such as the 47 and 865, add no complication to the circuit.





L1, C1 resonate at stated frequency.
L1—20 turns on 2" dia.
C1—250 mmf.
L2, C2 resonate at harmonic frequency.
L2—12 turns on 2" dia.
C2—150 mmf.

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Killing Superheterodyne Image When Used As Fremeter

WHEN trying to adjust a self-excited transmitter it often becomes quite a problem to get its frequency in the band you want to work in, because your super (which you are using as an approximate frequency meter) responds just about as well at the image frequency as it does to the frequency to which the detector is tuned. Thus it is easily possible to have your transmitter as much as 1000 KC outside of the band. (Twice the intermediate frequency). In the case of the FB7 using the band spread coils or the Comet Pro, the image can be reduced to a very small value by removing the detector coil (marked WL in the Pro) from its socket. The desired frequency will still come through R9, but the image is a low R3, and thus will not be mistaken for the desired response. Why this undesired response should disappear when the detector coil is removed, is a great puzzle to your correspondent, whose attention was called to it by W6FFP.

Fuses

A BAD fire and a near death from suffocation by a three-year-old girl leads me to again call attention to the danger of haywire connections. A filament transformer was left in operation and set fire to a wooden frame on which it was mounted. The walls of the room soon caught fire and luck alone saved the life of the little girl who wandered into the radio room. Perhaps the transformer shorted, but the 30-ampere fuses in the basement were too big to blow out. In any event, it pays to be careful about the 110-volt leads to the transmitter. Fuse boxes are cheap, so is No. 8 wire. Use plenty of loom and place a main line switch where you can turn EVERYTHING off whenever you leave. Children like to experiment, so make sure that they can't turn the rig on while you are away. IT ONLY HAS TO HAPPEN ONCE.

Ten Meters

MUCH activity is being reported on ten meters from all over the world, and it is interesting to note that most of the activity is in Europe. Sunday seems to be the day, so how about winding up some coils for the receiver and taking a listen down there? If you want to put your transmitter on 10, but don't want to go to the bother of another doubler, etc., I might point out that all you need is a new tank coil for the final amplifier. Then over-neutralize, and you have a Simpson oscillator. The other tubes in the rig are turned off, of course and you won't have a crystal note, but this is an advantage on ten meters with 2,000 lonely kilocycles to get lost in.

●●●

Power Sensitivity

WHAT is meant by "Power Sensitivity"? This term describes the relation between grid excitation and power output of an amplifier tube. It is usually used in reference to audio power amplifiers but it has a great deal of significance in radio frequency amplifiers. It is generally admitted that pentodes have the greatest "power sensitivity" due to the small amount of excitation necessary to obtain a large output, whether at audio frequencies or radio frequencies. Pentodes have certain disadvantages when used at audio frequencies because of the comparatively large amount of distortion produced. However, at radio frequencies this distortion is no handicap, and sometimes, as in doubler circuits, is a highly desirable feature.

Several tube laboratories have been working on the problem of a satisfactory power pentode with a plate dissipation in the neighborhood of 100 watts. The greatest problem seems to be in obtaining sufficient insulation and freedom from occluded gases in the necessarily complicated element structure. However, we can expect some progress in this direction before the end of 1934, if all goes well.

Co-planer grid tubes, while still in the development stage, have many of the advantages of conventional pentodes, plus a simpler grid structure which will avoid many of the drawbacks of both pentodes and triodes. Co-planer grid tubes also have less shunt capacity (from grid to ground and plate to ground) than pentodes, and make nearly ideal frequency doublers.

Reflex

WHO remembers that budding young scientist who decided that reflexed operation of tubes was the only answer to the depression? He used a 210 crystal oscillator on eighty, reflexed back and doubled to forty, reflexed back and doubled to twenty, then reflexed back again as a straight neutralized amplifier on twenty. However, he went crazy because every time he neutralized it, it stopped oscillating . . . Such is life.

Grid Leak Bias

THE grid acts as a half-wave rectifier and the rectified AC appears as bias, due to the voltage drop across the grid leak resistor. This form of bias automatically regulates itself to the excitation and is FB for class C amplifiers. It is unsuitable for class A or class B amplifiers because it has the disadvantage that if the excitation is cut off, the bias disappears and the resulting fireworks may damage the tube.

Automatic Or Cathode Bias

THIS form of bias is most common in receivers. The grid return is brought to the negative end of a resistor in series with the B minus lead. Thus the drop across this resistor depends on the plate current and this method is ideal for any amplifier whose average plate current remains constant. If used to bias a plate modulated class C amplifier, a large audio by-pass across the resistor becomes necessary. This source of bias is unsuitable for class B amplifiers (AF or RF) and is to be avoided in class A Prime circuits because of plate current variations. It is quite satisfactory, however, for true class A circuits.

Battery Bias

BATTERY bias may be used with any type of amplifier, but it is expensive and somewhat inflexible because most high voltage batteries are tapped in steps of 22½ volts. If the amplifier draws an appreciable amount of grid current (such as a class B or class C amplifier) the batteries often increase their voltage output and internal resistance, due to the charging effect of the DC grid current. This causes noise and instability which can only be avoided by use of a LOW RESISTANCE rectifier of good voltage regulation characteristics. All series resistance must be avoided in this rectifier circuit because they lower the voltage regulation. Thus adjustment of the voltage output is difficult unless some form of tapped autotransformer is used (such as the GENERAL RADIO VARIAC) to control the AC input to the rectifier.

Audio Feedback and Its Effect On Fidelity

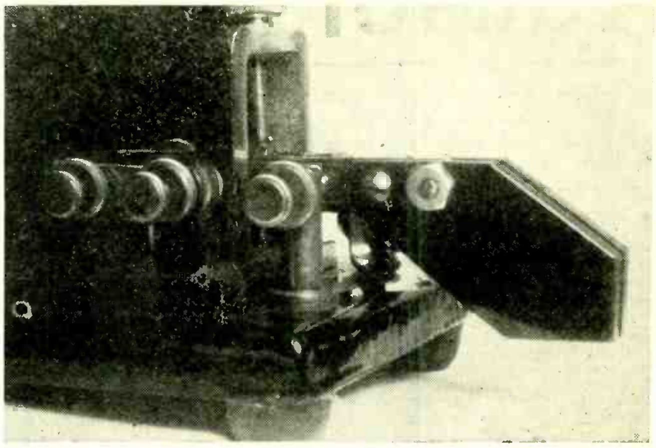
WE ALL can recognize audio feedback when it manifests itself in motorboating or singing. However, an audio amplifier can be quite regenerative without actually breaking into audible oscillation. This regeneration can emphasize any peaks in the fidelity curve (gain-frequency characteristic), and greatly impairs the quality of the amplifier. The best way to remove this tendency is to shunt from 50,000 to 300,000 ohms across the secondaries of all the audio transformers in the amplifier. Besides reducing regeneration, this will flatten-out any peaks in the response curve, and thus will improve even a non-regenerative amplifier. The small amount of gain that is sacrificed by this equalization is unimportant compared with its benefits. Isolation chokes, or resistors, and plenty of by-passing helps to minimize most regenerative tendencies in audio amplifiers.

High C and Low C Tank Circuits

HIGH C is to be heartily recommended for the frequency determining tanks in self-excited oscillators. However, in most amplifier circuits, the lower the C the greater the output and efficiency. If you want to get the most out of your doublers it is well to avoid all "C", except the distributed capacity of the coil and circuit connections. The coil can be tuned to resonance by varying the spacing between the turns. Western Electric uses a threaded insulating rod which is connected to one end of the coil. By screwing this rod in and out of the mounting, one can stretch or compress the coil, which varies its inductance and distributed capacity and thereby its resonant frequency.

Commercial communication companies often use fairly high C in the final amplifier tanks of their high frequency transmitters. They sacrifice efficiency thereby, but gain increased harmonic suppression. High C amplifier tanks also have another advantage for the commercials. An amplifier working into a low load impedance is easier to excite than if a high impedance tank were used. The loss in efficiency is unimportant because the commercials are limited to OUTPUT not INPUT, as we amateurs are. Tube cost is also a much smaller item with them, so plate efficiencies of 30 to 50% usually are satisfactory from their standpoint.

Key Knob for an Underslung Bug



PERSNICKITTY operators who think Mr. Martin didn't construct his product just right can build new handles like the one shown above. Two pieces of ¼-inch bakelite are sawed to the proper shape and their edges beveled. Bolted on where the "knob and flipper" used to be, they make a handle that is "underslung" and well adapted to 40-per work. The handle shown in the illustration was constructed by K7AHK.

High Resistance B Eliminator As Bias Supply

MANY Hams are using an old B eliminator as a bias supply. This is usually satisfactory, provided the shortcomings of this bias source are recognized. Due to the high resistance voltage dividers and series resistors used to vary the voltage output, the regulation leaves much to be desired. This means that the bias will vary as the grid current varies, which prevents one from using this bias source on class B amplifiers. However, it is FB for class A and class C amplifiers (except grid modulated class C amplifiers), because it acts like a combination of battery bias plus a high resistance grid leak. If more than one class C stage is biased from the same voltage divider, there will be interaction whenever the excitation to any stage changes, either through keying or adjustment.

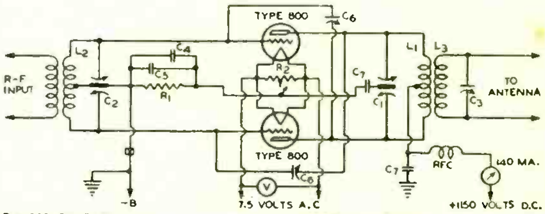
Resistance Or Transformer Coupling, Which?

RESISTANCE coupling between audio stages has long been recognized as a cheap way to obtain high quality. However, in the last few years some remarkable improvements in audio transformers have been made. Vastly improved core materials and other design refinements now permit exceptional quality at low cost. Transformers have always had the advantage of superior gain over resistors as a coupling medium, and now that fidelity is available at low cost, we find transformers in most of the newer sound applications in place of resistance-capacity coupling. Some of the higher-priced broadcast receivers are going back to transformer coupling and transformer prices may be reduced even lower because of quantity production.

Class A Prime

THIS type of audio amplification is attracting much attention and I have had many inquiries as to what tubes are most suitable, etc. The first requisite for a good class A Prime tube is a low plate impedance. A low plate impedance is usually associated with a low amplification factor as in the 71A,45,50 2A3,845,WE284A and the HK255. A low plate impedance is essential because the plate load resistance must be about five times the tube's plate resistance. The design of output transformers becomes something of a problem at high values of load impedance and therefore the low impedance tubes are most common in this service. High plate voltage, high bias and large grid swings are essential, although the grids are not driven positive as in class B. Class A Prime is only applicable to push-pull circuit; otherwise harmonic distortion becomes excessive. The normal, undistorted class A output of any low-mu tube can be increased about two and a half times in the class A-prime system. Thus a push-pull stage gives about five times the rated class A output of one tube. Class A prime requires an external bias supply for maximum output and cathode resistor bias is unsatisfactory due to the variations in plate current which occur in this type of amplifier. Plate efficiencies in the neighborhood of 50 per cent are not unusual in well built class A Prime amplifiers, as contrasted with efficiencies of about 20 per cent in ordinary class A amplifiers. The saving in power supplied to the plate circuit is offset by the added cost of a separate bias supply, but the real point is that we can get much more power output for a given plate dissipation, and the plate dissipation dictates the cost of the amplifier tubes.

TYPICAL PUSH-PULL R-F AMPLIFIER CIRCUIT
CLASS C



R_1 = 1000 OHMS. 50 WATT
R_2 = 30 OHMS. CENTER TAPPED
C_1 = SPLIT-STATOR HIGH-VOLTAGE TRANSMITTING CONDENSER (SEE TABLE)
C_2 = SPLIT-STATOR LOW-VOLTAGE CONDENSER, 0.0005 μf. PER SECTION
C_4 = 25 μf. (500 VOLT ELECTROLYTIC FOR MODULATED SERVICE ONLY)
C_5 = 0.01 μf. (500 VOLT)
C_6 = 2.5 μμf. (APPROX.) HIGH-VOLTAGE CONDENSER
C_7 = 0.002 μf. (3000 VOLT)
L_3, C_3 } DEPENDENT ON ANTENNA & FEEDER DESIGN
L_1 = SEE TABLE
L_2 = SEE NOTE
RFC = R-F CHOKE, EFFECTIVE AT FREQUENCY USED
⊠ = POWER LINE CIRCUIT BREAKER (NON-RECLOSING TYPE, SET TO OPEN AT 210 MA.)

TYPICAL DESIGN DATA FOR L_1

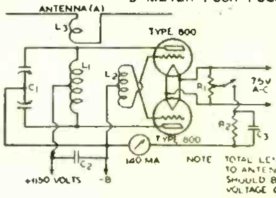
FREQUENCY KILOCYCLES	TURNS *	INSIDE DIA. INCHES	TURN ** SPACING	C_1 MAX. μf. PER SECTION
28000	4	1 1/2	5/8"	0.0002
14000	8	2 1/2	1/2"	0.0002
7000	14	3	1/4"	0.0002
3500	24	4	1/8"	0.0002
1750	20	6	1/8"	0.0005

* ALL COILS OF 1/4" COPPER TUBING
** SPACING IS BETWEEN TURNS (NOT CENTERS)

NOTE: L_2 SAME AS L_1 BUT WOUND WITH №14 SOLID COPPER WIRE, SPACED THE DIAMETER OF THE WIRE. CONDENSER RATINGS ARE D-C WORKING VOLTAGE.

FIG. 1

5-METER PUSH-PULL OSCILLATOR CIRCUIT



A = №14 SOLID WIRE, 80" LONG EACH HALF
L_1 = 4 TURNS 1/4" COPPER TUBING SPACED 1/2" 2" INSIDE DIAMETER
L_2 = UNITY COUPLED GRID COIL, THREADED THROUGH L_1; №14 WIRE, EXTRA HEAVY RUBBER INSULATED
L_3 = 1 TURN №14 SOLID WIRE, 2" DIA. SEE NOTE
C_1 = SPLIT STATOR TRANSMITTING CONDENSER, 80 μμf PER SECTION
C_2 = 0.001 μμf, 3000 VOLTS (D-C WORKING VOLTAGE)
C_3 = 0.001 μμf, 250 VOLT
R_1 = 30 OHMS, CENTER TAPPED
R_2 = 1000 OHMS, 50 WATT

NOTE: TOTAL LENGTH OF WIRE IN L_3 IS 16" (INCLUDING CONNECTIONS TO ANTENNA) L_3 IS PLACED IN EXACT CENTER OF L_1. IT SHOULD BE INSULATED SO THAT THE HIGH D-C PLATE VOLTAGE ON L_1 CAN NOT BE ACCIDENTLY APPLIED TO ANTENNA.

FIG. 2

Official RCA Circuit Diagrams for the New "800"

Radiotelephony

By LINEAR

Editor's Note—You asked for it. Here it is . . . a new monthly department for the phone men.

The Simplest Phone—The "Junkbox Special"

MANY inquiries have been received, asking for the ultimate in simplicity in a 160-meter phone. I hesitate in describing such a transmitter because its quality and modulation leave something to be desired, and the 160-meter band is already too full of haywire phones. However, I show herewith such a transmitter, but feel obliged to say that it is far from perfect and is only recommended as a step to something better. I suggest that this transmitter be avoided if you intend to use it in a metropolitan area which already has a QRM problem. With the rig shown in Fig. 1 it is possible to work fifty miles or so, if an efficient antenna system is used. Each month I will describe a radio telephone of some kind in these columns. So I will begin at the beginning.

The "Junkbox Special" consists of a 2A5 (or 42) crystal oscillator, modulated by another 2A5 by means of choke coupling in the familiar Heising system. After the plate tuning condenser is tuned to resonance, the antenna should be resonated by means of C2, at which time the amount of coupling between L1 and L2 should be varied until the oscillator draws exactly 20 milliamperes, no more and no less. This will represent an input of 6 watts at 300 volts, which can be nicely modulated by the 3 watt audio output of the 2A5 modulator. It also represents a 15,000 ohm load which provides a 7,500 ohm load at the choke tap for the modulator to work into. If you have progressed this far, all you have to do is talk. Don't expect to work the world and don't be surprised if you are chided by other operators on 160 meters for not emulating WLW in quality. However, it is a start toward something better. It is a simple matter to make this rig MOPA, and next month I will show the logical development of this transmitter.

However, a word to the wise. Don't accept any modifications from the "expert" in the next block, who says that a crystal is a needless luxury and that any old filter choke will do in place of the choke shown. Every part shown is necessary or it wouldn't be there, so don't make all sorts of modifications and then tell me it won't work.

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The Three Major Problems of Telephony

FIRST: The generation of a stable RF carrier, free from unwanted noise and hum. **Second:** Developing a large amount of undistorted audio power from the small mike output. **Third:** Coupling the audio power to the RF portion of the transmitter in such a manner that the RF output is modulated in exact accordance with the sounds impressed on the microphone. This last problem is perhaps the hardest of the three to solve.

The answer to the general problem of building a good phone is to lick the bugs one at a time. Don't try to build a whole transmitter from a circuit diagram and expect it to work well the first time you turn it on. It pays to build up the RF portion first, and lick all the bugs before proceeding with the audio channel. The audio channel should be built up, a stage at a time, until all the hum and feedback is removed. A good way to test your audio channel, as you build it, is to apply the output of a broadcast receiver to the input of the amplifier (after reducing the volume to a low level), then a speaker is attached to the amplifier output. Changes in bias, etc., can be tested as you go along. A speech amplifier should not be considered satisfactory until it sounds as good as a BCL midget receiver. This is the worst quality that you should be satisfied with. After the bugs are all out of the audio channel you can consider methods of coupling the AF output to the RF carrier. This matter of coupling is very productive of distortion, but if all the bugs have previously been removed from the audio channel, you can quickly isolate the trouble and cure it. If you will follow this suggestion you will avoid much of the grief often associated with the construction of a high quality phone station.

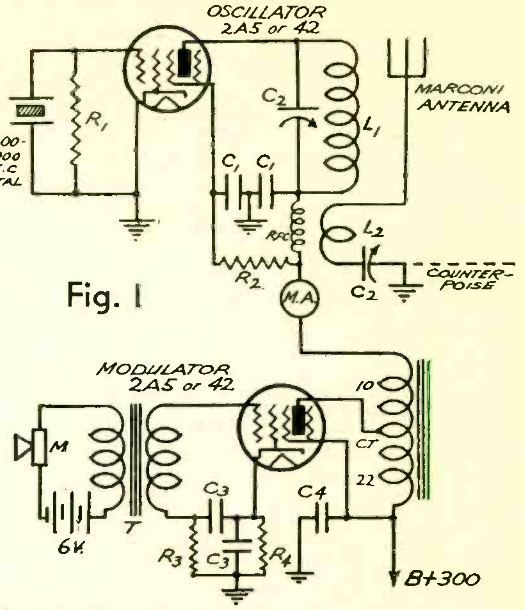

Fig. 1

The "Junkbox Special" Circuit Diagram and List of Parts

R1—50,000 ohms.
R2—30,000 ohms.
R3—100,000 ohms.
R4—400 ohms.
C1—.01 mfd.
C2—.00035 mfd., variable.
C3—.5 mfd.
C4—4 mfd. or more.
T—Mike-to-grid transformer.
CH—Center-tapped choke 60 MA and all the henries you can get. Don't put two chokes in series.
L1—45 turns No. 14 wire space wound on 2½" form.
L2—22 turns No. 14 wire, space-wound on 2½" form.
M—Single button carbon microphone.
Milliammeter—0-500 MA.

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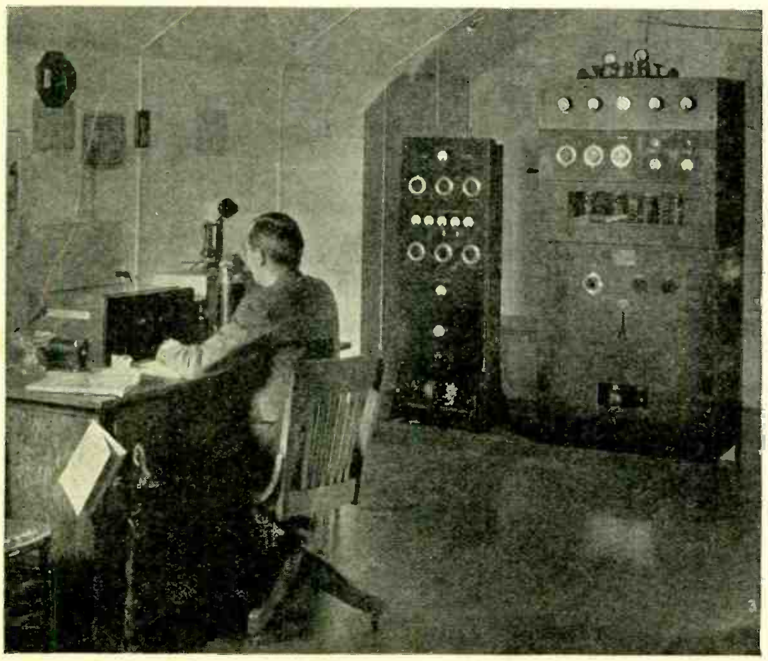

A RECENT COLLINS INSTALLATION . . .

The first installation of a 20B Collins 'Phone was made at W9BHT, the station of Mr. W. P. Ingersoll at Canton, Illinois. Mr. Ingersoll is an old-time amateur. Before installing the 20B, he had built several record making transmitters which had won him a WAC certificate and a host of friends throughout the country. Mr. Ingersoll's desire to have a station which would be the "last word" in appearance and performance led to the creation of the 20B. W9BHT now operates on 3905 kc and 14224 kc and "Bill's" voice has become familiar to amateurs and short wave listeners all over the globe. He has received an R8 report from J5CC.

Distortion

IN GENERAL, there are three types of audio distortion not found in GOOD amplifiers. A brief outline of their characteristics may prove helpful.

FREQUENCY DISTORTION—This is often termed "FIDELITY". An amplifier suffers from frequency distortion if all of the various audio frequencies are not amplified equally well. The human ear responds to audio frequencies between 20 and 16,000 cycles per second. If an amplifier only amplifies the frequencies between 200 and 2800 cycles per second, it distorts all frequencies outside of this range. (This particular range is that of an especially good telephone line). The low frequencies add naturalness to the voice, but most of the articulation (intelligibility) is supplied by the higher frequencies. An audio channel which is flat from 80 to 4000 cycles will receive "Broadcast Quality" reports, but, personally, I like to have a voice channel flat from 40 to at least 8000 cycles per second. The difference is appreciated when the signal is down to R3, as only high fidelity then makes it readable.

AMPLITUDE DISTORTION—This type of distortion is also called HARMONIC DISTORTION. Amplitude, or harmonic distortion occurs when a given increase in the volume of sound applied to the microphone does not cause a proportionate increase in the amplifier output. While all the frequencies applied to the input may be amplified equally well, the amplitude of the output should always be that of the input, times the gain of the amplifier. This type of distortion is usually caused by either an overloaded tube (grid driven positive) or a mismatch of impedance which causes a vacuum tube to work into an improper value of load resistance. Harmonic distortion is characterized by a harsh, fuzzy sound which makes the speech hard to understand. Turn the gain wide open on almost any BCL set and you will have a fine demonstration. (In some well known sets it is hardly necessary to turn up the gain to hear plenty of harmonic distortion).

PHASE DISTORTION—This type of distortion is relatively unimportant, for two reasons. In the first place, the ear can stand a lot of phase shift in the various audio frequencies, without perceptible impairment of quality, and second, this distortion rarely exceeds small amounts in audio amplifiers. The only place that this distortion causes trouble is in long wire lines, where some audio frequencies travel much faster than others, and consequently reach their destination ahead of their "brothers", who started at the same time.

My Side of the Discussion On "Overmodulation"

I HEARTILY agree that there is something wrong with the modulation of about 90% of the phones in the 4000 KC band. I also agree that this maladjustment causes all of these phones to take up more than their proper share of the band. However, I do not think it is due to overmodulation, but to CARRIER SHIFT. Carrier shift, or change in the AVERAGE amplitude of the emitted wave, occurs when the positive and negative peaks of modulation are not equal. In all good broadcast transmitters the average amplitude of the carrier remains constant, whether modulated or not. The peak amplitude may rise to twice its unmodulated value (under 100% modulation) but immediately afterward it falls to zero amplitude, so that the average value, as reflected in the plate current of a linear (plate or diode) detector, remains constant. Carrier shift may be reflected in EITHER an increase or decrease in linear detector plate current, depending on whether the positive or negative peaks predominate, but OVERMODULATION ALWAYS results in a decrease in plate current. When a carrier is overmodulated, it is being cut off entirely during part of the audio frequency cycle. Thus the average amplitude becomes less than the unmodulated value. Overmodulation can usually be recognized by the terrific harshness of the quality and a tremendous loss in intelligibility, whereas carrier shift has only a minor effect on the quality. However, both conditions cause unnecessary interference and take up more room in the band than is desirable.

The causes of carrier shift are many. Impedance mismatch between the modulators and the modulated amplifier; regeneration in the RF portion of the transmitter; insufficient excitation to the modulated amplifier; poor voltage regulation when class B modulation is used; cathode bias on the modulated stage that is insufficiently by-passed; improper bias on the modulators or modulated amplifier; improper screen voltage or lack of screen modulation, if a tetrode is used in the modulated amplifier, and detuning of the plate or antenna tank. Any or all of these troubles may be present, so check them one by one.

The best test for a modulated amplifier is to rig up a power supply which can supply TWICE the plate voltage normally used when transmitting. The voltage output of this power supply must be variable from zero all the way up. Then take a piece of graph paper and plot antenna current against plate voltage, at about ten or fifteen points in the range of zero to twice normal plate voltage. When these points are joined by a line, the result should be a straight line. If this line curves upward at its upper limit, your troubles are largely due to regeneration; if downward, insufficient excitation is probably the cause. This test of linearity increases the plate input, in watts, to four times the normal unmodulated value, when testing with the higher voltages, so make your readings in a hurry before the tube heats up. A key comes in handy at this point. One dot to read the plate voltage, and a dash to read the antenna current. If your tubes run overloaded normally, this test is dangerous and may cost you a tube. The only other answer is to buy, steal or borrow an oscilliscope and audio oscillator.

The next best test, as detailed by our contemporary, is to see that there is NO VARIATION IN ANY PLATE OR GRID MILLIAMMETER, class B audio stages excepted. (In case you are using a linear amplifier, the grid current will vary with modulation, but the plate current must be constant).

Another good test for carrier shift is to borrow a SW receiver with undelayed AVC and a tuning meter. Watch the tuning meter while you, (or someone else) talk, and if it wiggles you can be sure that all is not as it should be. Tune in on a BC station and see how little shift they have. A simple, non-regenerative detector, with cathode bias and a milliammeter in its plate circuit, will show the same thing.

Don't worry too much about overmodulation, as nine ham phones out of ten have not enough audio power to modulate 90%, let alone 200%. By the way, overmodulation cannot be expressed in percentage, as the degree of overmodulation is neither a linear function of the audio power, nor an expression of the relationship between sideband and carrier amplitudes.

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Class B Driving Class B

IT HAS been asked whether satisfactory quality can be obtained when a high-power class B audio stage is driven by a low-power class B stage. The answer, generally, is "no". The resistance reflected by the grids of a class B stage back into the plate circuit of the driver stage varies quite widely with the amplitude of the signal. The load resistance of a class B stage is quite critical for best quality, and thus this variation in load would seriously distort the quality. A class A amplifier, using low impedance tubes such as the 45, 2A3, 50 or 845, is not particularly critical as to load impedance. Consequently, if there is enough step DOWN to the class B input transformer, little distortion will result.

Reduce the WWW Ratio

WHAT, you don't know what the WWW ratio is? Well, it's the ratio of "WASTED WATTS TO WORDS". What is your rating in wasted watts per word? Why don't you clip the coupon and be popular? Are you a wallflower? Do your CQ's go unanswered? The answer? . . .sh, it's a secret . . . BREAK-IN . . . Never mind emulating Rube Goldberg with 7 tubes and 69 trick delay relays. All you need is some form of push-button control on your carrier. A door bell will do in a pinch. Augment grid-leak bias and then cut your crystal center-tap to receive. There are fifty ways to start and stop quickly. Avoid snap switches, they take too long to throw. How about it, gang? Let's widen the phone bands by not working those stations who switch over once every half hour. They will soon get the idea and find that a real two-way QSO is much more enjoyable than a monologue.

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Modulated Output From a Given Tube

THERE seems to be a rather general assumption that any given tube has the same carrier output, when plate modulated, as it has when used for CW communication. This is not true, because the DC plate input to the modulated amplifier is augmented by whatever audio power is supplied by the modulators. In the case of 100% modulation, the total input to the modulated amplifier is increased 50% over the unmodulated DC input. Thus we must provide a reserve capacity in the tubes used in the modulated amplifier, or else take a chance on failure through overload. Here is the story. The plate dissipation and DC input rating of the tubes used in the modulated amplifier must be 50% greater than necessary to justify the same unmodulated input to a CW amplifier, whose plate runs cold with the key held down. In other words, the carrier output is one-third less than is possible on CW, given the same tube and coupling efficiency. Thus the same tube capacity is required of a 100-watt input phone as is required of a 150-watt input CW transmitter, given identical efficiencies.

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Shielding

STRAY RF feedback can cause a great deal of trouble in a phone station, while the same feedback will not adversely affect a CW transmitter at all. In a CW transmitter the feedback is fairly constant, and only tends to slightly roughen the note. However, in a phone this feedback is not constant, but often is modulated, and this modulation is therefore impressed on the grid of one or more amplifier stages whose output should be kept absolutely constant. This can cause audio distortion, background noise, carrier shift, sideband splatter and sometimes peculiar echoes. This stray RF feedback usually is caused by electrostatic fields around the final amplifier and the feeders. Thus it follows that electrostatic shielding, such as metal partitions, should be used. Next to a grounded metal partition, mechanical separation is the best bet.

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Class B Modulation

MANY operators of ham phones have tried class B modulation only to abandon it, due to the excessive harmonic distortion which often characterizes this type of audio amplifier. However, RCA is using class B modulation almost exclusively in the newer, low-powered broadcast transmitters. Collins (W9CXX) also has had highly satisfactory results with class B, and thus it is our own fault if we can't make it work. The two main troubles with class B, as practiced by amateurs, are poor transformers and insufficient driving power. Most of the distortion in a class B audio stage is produced in the plate circuit of the driver tube or tubes. Use plenty of driver power, good transformers and MATCH IMPEDANCES. This problem of matching the class B tubes to the modulated amplifier is not especially complicated. Every type of class B tube has a recommended load resistance into which it works best. This load resistance may, or may not, be equal to the resistance of the modulated amplifier, to which it delivers power. (The load resistance of the modulated amplifier is obtained by means of Ohm's law.) The class C amplifier plate current, in amperes, is divided into the plate voltage and the result equals the load in Ohms. We use an output transformer, with class B, for two reasons. First, we must change the push-pull circuit somehow, so that we can ground one side of the output, as the filaments of the modulated amplifier are presumably grounded. Second, the use of this output transformer allows us, by means of step-up or step-down, to match our modulators to the load. For example, let us assume that we have four 210's in push-pull parallel as modulators, and a 203A as a modulated amplifier. Without going into actual volts and amperes, let us assume that we are operating the 203A at such values of voltage and current that, through Ohm's law, we obtain 6250 ohms as the load represented by the class C amplifier. Let us also assume that the four 210s work best when working into a 4000 ohm load. How, then, can we turn the 6250 ohm load into 4000 ohms for our modulators?

This is done by means of our output transformer. If we choose a transformer whose impedance ratio from primary to secondary is equal to 4 to 6.25, then the 6250 ohm load on the secondary appears as a 4000 ohm load across the primary terminals. This transformation of impedances (AC resistance) is represented by the impedance ratio of the transformer. The impedance ratio is, for all practical purposes, equal to the square of the turns ratio. Thus a turns step-up of two-to-one would give an impedance step-up of four-to-one. Then, it follows that the turns ratio of any transformer equals the square root of the impedance ratio. In our example above, we have an impedance ratio of 4 to 6.25. The square root of these two elements gives a turn ratio of 2-to-2.5 or 1-to-1.25. I think it is evident that any given transformer of the usual type works best into one fixed value of load impedance, depending on the type of modulator tube and its plate voltage. Because amateurs are always experimenting with various different combinations of voltage and current on the modulated amplifier, it seems strange that only one transformer manufacturer has provided us with a universal class B transformer that has a tapped secondary. While it is true that several manufacturers make class B transformers with two secondaries for high powered modulators, such as 203A's, nevertheless even this step toward flexibility is denied the man who uses the lower-powered tubes, such as the 46, 59, 210 or 841.

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Room Echo

IF YOUR shack has tendencies toward reverberation (echo, to us) the use of Monk's Cloth will absorb the troublesome sounds. Monk's Cloth is cheap, but ask for acoustic cloth, because the ordinary kind is much less effective. This simple remedy will sometimes work wonders with your intelligibility at the other end of the QSO.

A "General Call" . . . But the General Doesn't Answer

QUARTZ CRYSTALS AND THEIR APPLICATIONS

Rationalizing Radiating Rocks and a Novel Scheme for Dodging QRM

By W. W. SMITH, W6BCX

MOST amateurs underestimate the value of the straight crystal oscillator as an 80 or 160-meter transmitter. A surprisingly large number of hams have the idea that crystal control entails a multi-stage layout. Some even have such pet theories as "the crystal irons out the keying." This idea must have started 'way back when a crystal was expected only to oscillate, and not to deliver power—back in the good old days when 210's cost $9 and the crystal needed a jar or two to get it going.

It is possible to put over 15 watts in the antenna on 80 or 160 meters with nothing but a 47 crystal oscillator It is not necessary to use a "high C" tank, extremely loose coupling to the antenna, nor scads of filter to get a good DC note. While not having the characteristic "ping" of the multi-stage outfit, the note will be as steady as a rock, and the keying very clean. Unless one has at least an 800 or a pair of 10's with 100 watts or so to feed them as a final, he had best tie the antenna right on the crystal oscillator and forget the idea of using MOPA until he can afford a real power amplifier. Regardless of what anyone may try to tell you, 15 watts in the antenna sounds to the ear just like 50 watts in the same antenna. It is necessary to increase power several fold to make a difference of "one R" at the other end. If you are skeptical, try it yourself; don't tell the fellow at the other end when you change the power. And also remember that it sometimes takes only a few seconds to fade several "R's" when a selective fade is on. Yet, amateurs worry, fret, and stew over how to get the last fraction of an amp. in the antenna, instead of paying more attention to the radiating properties of the antenna. A 47 oscillator with a good antenna will make a 50 watter in a poor location sound like a "pip-squeak".

The power input to a properly loaded and tuned 47 crystal oscillator is limited only by the "hardness" and interelectrode spacing of the particular tube used. A particularly "hard" 47 that had good spacing between the suppressor grid and plate was used at the writer's station for two evenings with 720 volts (actual measured voltage with key down) at 55 mils, with apparently no bad effects to the 47. But when the key was left down for more than a few seconds, the 47 would begin to act up. It was then necessary to let the 47 cool off for a minute or so before it would act normally again. When keyed, the 47 did not reach this critical point, and was very stable. However, it is not good practice to try to put over 600 volts on most 47's, and the plate current should not be allowed to run much over 50 mils. Even with 600 volts it is a good idea to first load the oscillator and tune it up with reduced plate voltage, as the crystal current will run quite high at 600 volts when the oscillator is unloaded or detuned from minimum plate mils. It is advisable to use fairly tight coupling to the antenna, and to use a potentiometer arrangement to obtain screen voltage instead of using a straight dropping resistor. The screen voltage is not critical—anything between 125 and 200 volts being satisfactory. Ordinary "center-tap" keying is simple and effective.

There will be a "plop-plop-plop" in some receivers when they are tuned past the frequency of the crystal oscillator if there is much coupling between the two antennas, or if the oscillator is in close proximity to the receiver. This can be eliminated by placing a small anti-capacity SPST switch across the crystal and closing it when listening.

The use of a good, space-wound, "low C" tank coil will increase the output, and at the same time discourage the crystal from oscillating at two frequencies in case it should have any such tendencies. There is absolutely no reason nor excuse for using a "high C" circuit in a crystal oscillator. Experiments have shown that the frequency stability is not improved one bit by large tank capacities.

While on the subject of twin-peaks, let it be said that X cut crystals CAN have double response frequencies. They are sometimes ground with trick contours to boost the output. If the process is carried too far, the crystal will have a tendency—while not as pronounced as with some Y cuts—to oscillate at two frequencies. An X cut crystal that has been ground with both sides absolutely flat and parallel will oscillate at only one frequency, but the edges must be free from nicks, the crystal must be finished very accurately, and the top plate of the holder must not press too heavily against the crystal, if good output is expected. By giving the crystal a special contour it is possible to get good output without finishing the crystal so accurately, and the output of a crystal ground in such a manner is not appreciably reduced by heavy pressure on the holder electrodes. But, as said before, the crystal will have two peaks if the process is carried very far. If you are using a holder with heavy pressure on the top electrode, it would be a good idea to try lighter pressure to see if the output is increased. Your X cut crystal may be of the "flat ground" type and not designed for the particular holder in which you are using it.

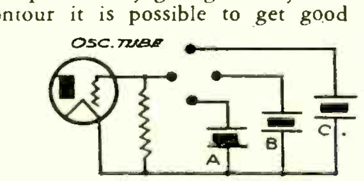


FIG. 1

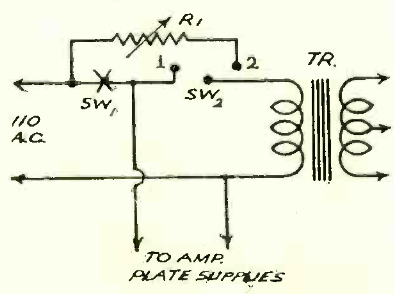


FIG. 2

TR—Oscillator Plate Transformer.
SW_1—Main switch turning on all plate supplies.
SW_2—Two-way toggle switch.
R1—20,000 ohm heavy duty variable or tapped resistor.

Many hams do not fully appreciate the large effect of the crystal holder on frequency. The frequency of an 80-meter crystal may vary as much as 3 kilocycles with different holders. This is due to the fact that the electrodes of some of the manufactured holders are far from being flat. The warped electrodes touch the crystal only in two or three spots, forming, in effect, a sort of air-gap holder.

The amateur who gives his crystal a scrubbing once a week, or makes a practice of rubbing the top electrode around on the crystal to dislodge any dust that may have worked in between them, may find after a year or so that his frequency has increased a couple of kilocycles. This is especially true of unpolished crystals. However, if the crystal is covered or put in a dust-proof holder, it should not be necessary to touch it for months at a time.

Figs. 1 and 2 show a QRM-dodging system that really has merit. It can be used with equal simplicity with either a simple crystal oscillator rig or multi-stage layout. For QSY when QRM becomes too hot on one channel, most amateurs use a plug-in arrangement with two or more crystals, making it necessary to change crystals, retune the amplifier stages, and then take a chance that there is no QRM on the new frequency. With the system to be described, all that is necessary is to flip a switch to change frequency, and, when the skip is not too bad, it is possible to tell just when one has a clear channel without depending upon a report from another station.

In Fig. 1, A, B, and C are crystals with frequencies about 3 kilocycles apart. If the amplifier stages are tuned to crystal B, the outfit will work with about 99.99% efficiency with crystals A and C without retuning the amplifier tanks. Changing frequency then becomes a simple matter of turning the selector switch. The selector switch should be of low capacity and be mounted close to the oscillator tube, and all leads to the crystals made as short as possible. Any number of crystals in the different bands can be used with such a switch, making it unnecessary to plug crystals in and out to change frequency. The above system of using three adjacent crystals allows instantaneous QSY.

The scheme in Fig. 2 allows one to spot the oscillator in the receiver and see exactly where he is in the band, and just who is hetrodyning him. Sw2 is a toggle switch

(Continued on page 34)

RADIO's Practical Data Sheets

Heintz & Kaufman GAMMATRON

DATA SHEET NO. 15

A New High-Power Tube for Amateurs and Experimenters

The Heintz & Kaufman Gammatron Type 354 is a new general purpose tube for use in amateur transmitters. Here are its general characteristics:

Number of Elements	3
Filament Voltage	5 Volts
Filament Current	7.75 Amps.
Filament Type	Thoriated Tungsten
Type of Plate	Cylindrical, Tantalum
Type of Grid	Vertical Bar

Average characteristics at:
Ep = 2000 Eg = 0 Ef = 5

Plate Current	.5A.
Amplification Factor	13.5
Plate Resistance	2000 Ohms
Mutual Conductance	6900 umhos.

Approx. Interelectrode Capacities:

Grid to Plate	3.7 uufd.
Grid to Filament	9 uufd.
Plate to Filament	Less than 0.4 mmf.

Max. Overall Dimensions:

Length	7¼ Inches
Diameter	2½ Inches
Type of Cooling	Air

Class "B" Operation

Normal Operating Plate Voltage	2000 Volts
Max. D.C. Plate Current (Unmodulated)	65 M.A.
Max. Plate Dissipation	100 Watts
Max. R.F. Grid Current	7.5 Amps.

Typical operation at:
Ep = 2000V. Eg = —200V. Ef = 5 Amps.

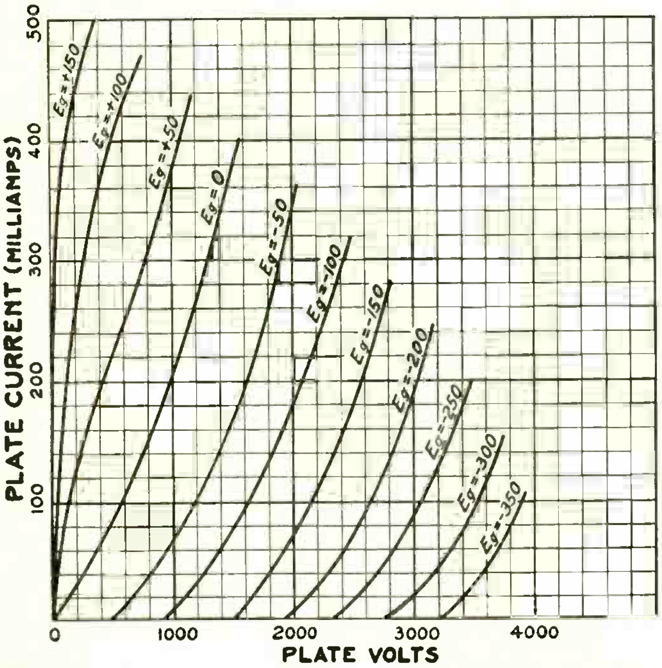
Peak Power Output	160 Watts
Carrier Output (Mod. factor 1)	40 Watts

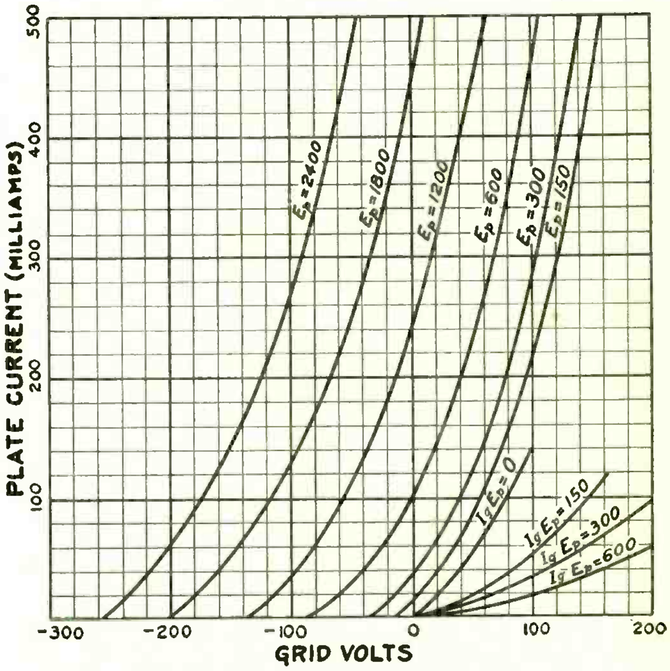
Class "C" Operation

Normal Operating Plate Voltage	2000 Volts
Modulated D.C.	2000 Volts
Unmodulated D.C.	2000 Volts
A.C. (R.M.S.)	2000 Volts
Normal D.C. Plate Current	150 M.A.
Max. Plate Dissipation	100 Watts
Max. R.F. Grid Current	7.5 Amps.
Max. D.C. Grid Current	50 M.A.

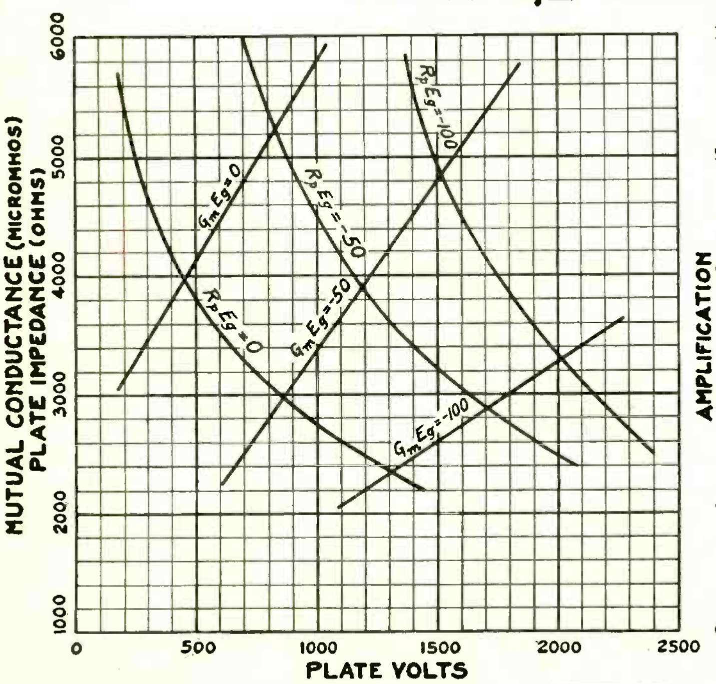
Typical operation at:
Ep = 2000 Eg = —375 V. Ef = 5 Amps.

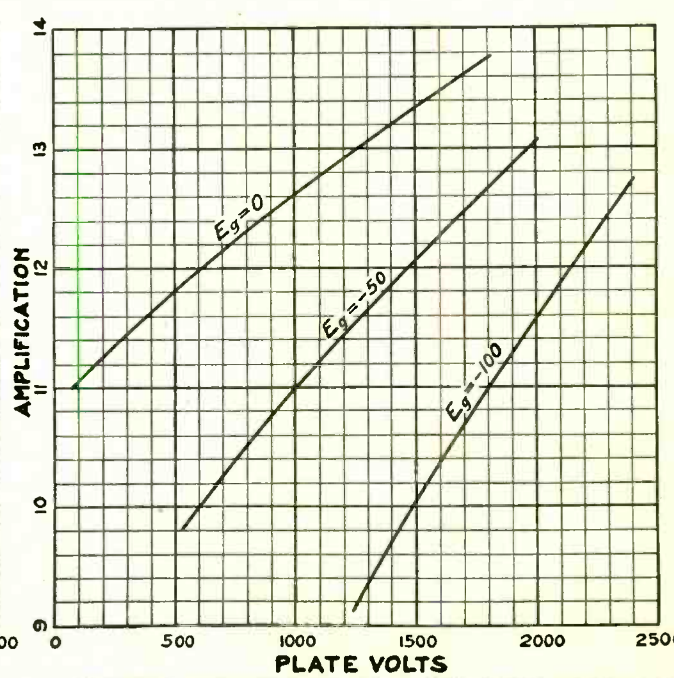
Peak Power Output	200 Watts
DC Plate Current	150 M.A.





AVERAGE CHARACTERISTICS





RADIO's Practical Data Sheets

DATA SHEET NO. 16 Design of Small-Size Electrolytic Condensers

Reprinted from the "Aerovox Research Worker"*

DURING the past year a number of developments have taken place in electrolytic condenser design to permit the manufacture of more compact units. Not only have the ordinary single section electrolytic condensers been made in smaller sizes but through changes in methods of winding and assembling it is now possible to house multi-section electrolytic condensers in relatively small size containers.

Compact multi-section electrolytic condensers are produced by what is known as "concentric" winding, a method of winding known for years and used to some extent in the manufacture of wax paper condensers but only applied within about the last year to electrolytic condensers. It is our purpose here to discuss, briefly, certain characteristics of concentrically wound electrolytic condensers and their bearing on radio receiver design.

First, what is a concentrically wound electrolytic condenser? Formerly, when two or more electrolytic condensers were to be placed in a single can it was customary to wind two individual units, then place the units in a can, connecting all the negatives to the can and the positives to individual terminals on the cover.

This is illustrated in Fig. 1, taking as an example a three section condenser of which a common type is the 8-8-8 mfd., 450 volt unit housed in a can 3-in. in diameter by 4⅛-in. high—Aerovox type E 5-8-8-8 mfd.

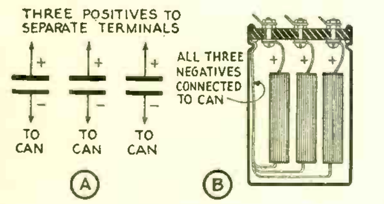


FIG. 1

Now if the diagram Fig. 1-A is studied it will be noted that while the three positives are separate all three negatives are connected together. This unit can very readily be wound concentrically. The method is illustrated by Fig. 2-A. We start as though an ordinary single section was to be wound. However, when the end of the first positive is reached the negative foil and separator are not cut but instead the second positive is introduced and the winding continued. When the end of the second positive is reached, the third positive is added and there is produced finally a single roll consisting of one long negative foil and three positive foils, all separated from each other, and because the three positives are wound into a single roll a very compact unit is obtained. Such a unit is called a "concentric" common negative condenser" and it functions and is used exactly the same as though it were made of three individual sections as shown in Fig. 1. This is the simplest type of concentrically wound condenser. It would ordinarily be used in a double section filter circuit requiring three filter condensers. Fig. 2-A shows how the condenser is actually wound and Fig. 2-B shows how such a unit is indicated diagrammatically.

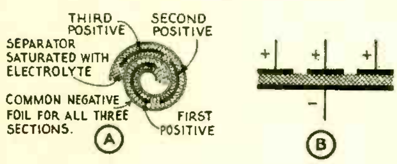


FIG. 2

In the above example we have assumed that all three sections are identical, i.e., each section is rated, for example, 8 mfd.—450 volt working. However, it is not necessary that all sections be identical and in fact each section can have a different rated working voltage and different capacity, and this fact adds considerably to the usefulness of this type of condenser. For example, we can combine in one unit two high voltage sections for the filter circuit and the third section can be a low voltage by-pass unit. The only limitation is the fact that all the negatives must be common.

To illustrate such a use Fig. 3 is shown. Here we have a triple section concentrically wound common negative condenser consisting of two sections rated at 450 volts working and a third section rated at 50 volts. The first two units are used in the filter circuit and the third unit acts as a by-pass across a C bias resistor connected in the cathode circuit of the power tube.

The preceding two examples indicate that concentrically wound common negative (sometimes termed common cathode) condensers may consist of any number of individual sections, each section having any desired capacity and any desired working voltage.

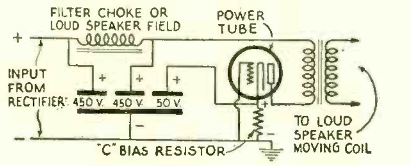


FIG. 3

Another type of concentric unit uses a COMMON POSITIVE foil and is known as a "concentric common positive condenser." Such a condenser consists of a single POSITIVE foil and several individual negative foils and is wound as shown in Fig. 4A and illustrated diagrammatically as shown in Fig. 4-B.

Such a condenser finds most frequent use in filter circuits where the filter choke is placed in the negative lead; Fig. 5 illustrates such a case. Apparently such a condenser is no more complex than the common negative type but in practice we find that certain factors must be considered to make the circuit function properly with a concentric common positive unit.

In Fig. 5 we have indicated certain voltages which might be taken as typical of those encountered in such a circuit. At the output of the rectifier is shown a voltage of 450 volts. Assuming that the loud speaker field is used for the filter choke, approximately 100 volts may be required to give proper energizing and hence there will be a 100 volt DC drop across the choke and the output voltage will be 350 volts. The polarity of the voltage drop across the choke (that is, the loud speaker field) is such that the side of the choke connected to the rectifier is negative and the side connected to the output of the filter is positive. These polarities are shown on the drawing. The effect of this voltage is extremely important.

As we know, all ordinary types of electrolytic condensers are polarized which means that the positive terminal of the condenser must always be connected to the positive side of the circuit. When properly connected the leakage current through the condenser is very low. However, when we connect the negative side of the condenser to the positive side of the circuit the leakage current becomes very high and the unit acts more as a resistance rather than as a condenser.

When an electrolytic condenser is connected properly in a circuit the leakage current is low due to the effect of the film formed during manufacture on the positive foil. When the positive foil is connected to the positive side of a circuit it is this film which limits the current to a very low value. The negative foil, however, has no such film formed on its surface and hence if the unformed negative foil is connected to a positive potential a large current flows since there is no film to limit the current.

Now if Fig. 5 is examined it will be noted that the effect of the 100 volt drop across the choke is to make the first negative marked A 100 volts positive with respect to the second negative marked B. If there is no film on the negative foil a current will flow from the foil A to the foil B through the electrolyte with which the separator is saturated.

This flow of current from the positive side of the choke to negative A, thence through the electrolyte to negative B and back to the other side of the choke has exactly the same effect as though a resistor were to be connected across the choke coil. The effect of this current flow is therefore to lower the effectiveness of the choke and increase the hum voltage in the output of the receiver.

Some numerical examples will serve to indicate the importance of this point. First let us list the impedances of various size choke coils at 120 cycles, the hum frequency from a full wave rectifier. The impedance of a choke is equal to 6.28 times the frequency times the inductance in henries. So calculating the impedance of several inductances we obtain the figures given in Table No. 1.

TABLE NO. 1

Inductance of Choke in Henries	Impedance in ohms at 120 cycles
10	7,560
15	11,340
20	15,120
30	22,680

Now assuming 100 volts impressed between the two negatives, let us calculate the resistance of this path for various currents. This is done simply by assuming various values of current and dividing these values into 100, the voltage. The quotient is the resistance in ohms. Table No. 2 gives the results thus obtained.

TABLE NO. 2

Resistances corresponding to various currents for an applied voltage of 100 volts.

Current in milliamperes	Resistance in ohms
0.5	200,000
1	100,000
2	50,000
5	20,000
10	10,000
20	5,000
50	2,000
100	1,000

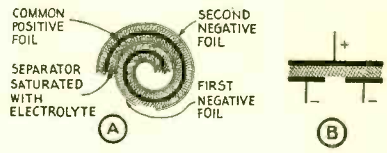


FIG. 4

As a safe rule we might say that the resistance connected across the choke should not be permitted to drop to less than four times the impedance of the choke. Assuming 15 henries as the choke coil inductance then the choke coil impedance is 11,340 ohms and the resistance across it should not be less than 45,360 ohms or in round numbers 50,000 ohms. From Table No. 2 it will be noted that this value of resistance will be obtained if the current is limited to 2 milliampere or less.

If we use two ordinary unformed foils for the negatives of the condenser shown in Fig. 5 the current between them will be much greater than 2 milliampere and hence the receiver will hum but if, for the negative A we used a FORMED foil then the film on this foil will limit the current usually to values much less than 2 milliampere and consequently no trouble will be experienced in the use of such a condenser. The voltage to which the film on the negative foil is formed must be equal to and preferably somewhat greater than the voltage impressed between the two negatives in order to bring about this result.

While, in a concentric common positive condenser each section may have any desired capacity, but all sections will have the same rated working voltage since a single anode or positive foil is common to all sections.

In connection with the problem of servicing it is desirable that replacement units be of the same type originally used in the receiver. For example: In replacing old three section condensers, either wet or dry, it is desirable to use for the replacement unit a dry condenser using three individual sections rather than one of the concentric units described above. This will generally result in a more satisfactory performance. To be more specific, in replacing a triple section wet condenser, the best type to use is E 5-8-8-8, which is in a 3-in. can and consists of three separate sections as shown in Fig. 1 rather than a three section concentric unit of the type shown in Fig. 2.

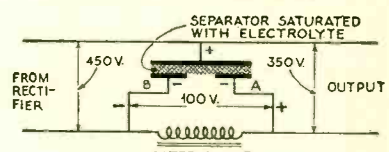


FIG. 5

The above discussion will, we hope, serve to indicate to some extent the advantages of concentrically wound condensers. If all the operating conditions are known it is possible to design such condensers to meet almost any circuit conditions.

* By the Engineering Dept., Aerovox Corp.

RADIO's Practical Data Sheets

Methods of Volume Control

Circuit Diagrams Courtesy of Electrad, Inc.

DATA SHEET NO. 17

1. This circuit shows a potentiometer connected between the aerial and ground, the variable tap being taken to the primary of the aerial coupler. The resistance used for the volume control ranges from about 1000 to 25000 ohms. This system gives fairly satisfactory volume control for a set of moderate sensitivity. A non-uniform, or "tapered" resistor is best to use.

2. Here the plate circuit of one of the RF stages is shunted by a variable resistor, the resistance providing a by-pass to the plate return. The resistor used varies from about 2000 to 25000 ohms. A tapered resistance control is best for this service.

3. This is practically the same as the method in Fig. 1. The results obtained are quite similar. It gives fairly satisfactory results. Resistance ranges are as given in Fig. 1.

4. Here the grid circuit of the first RF tube connects to the variable connection on the volume control. This is quite critical, and may introduce some detuning effects. The resistor used is usually of a total value of from 2500 to 10000 ohms, and the tapered type generally works best.

5. This is a system where the signal received is varied by the by-pass to ground provided by the volume control. This system works fairly well, but is unsuited to very sensitive sets, as are all of the antenna resistor control methods. Resistance values (total) range from about 1000 to 5000 ohms. The tapered resistor usually works best.

6. This system is somewhat similar to that shown in Fig. 2, and the constants given there are satisfactory.

7. This system actually performs a dual function. As the signal input is raised, the bias on the RF tube is changed to compensate for the increase in signal strength. It gives satisfactory operation. Resistor values of about 5000 to 15000 ohms, tapered, give the best general performance.

8. A series resistance in the cathode return of the RF tube. The volume control is obtained by the fact that the higher the resistance of the cathode return, to ground, the higher the grid bias, and hence the stronger the signal necessary. This usually gives very satisfactory performance. The resistor values used in this circuit range from as low as 200 ohms total, to 25000 ohms, depending on the circuit arrangement. Tapered resistors are most widely used.

9. In this system, the resistor in the plate circuit actually limits the plate current, the result being that the signal from the loudspeaker is varied in accordance with the plate energy received through the controlling volume control resistor. This is a satisfactory arrangement, but is not suited to sensitive sets, or to fine gradations of control. The resistor units usually total about 15000 to 100000 ohms, the tapered types giving somewhat smoother control than the uniform types.

10. The potential of the grid, with respect to the received signal, is varied directly in this system. It is not particularly satisfactory, and has a tendency to broaden the tuning. The total values of the resistor usually range from 100000 to 500000 ohms. Tapered resistors should be used.

11. This is practically the same system as that shown in Fig. 10. Because the grid is connected directly to the moving arm of the volume control, care must be taken that extraneous pick-up is not introduced, which may cause noise, and detuning. Tapered resistors of 100000 to 500000 ohms are generally used.

12. This is a standard and very satisfactory method of controlling the operation of an audio-frequency amplifier. The volume control is obtained by the "voltage divider" resistor connected across the secondary, the slider permitting the selection of any desired voltage, and the resulting signal strength is easily controlled. This circuit will, in some cases, reduce the high frequencies, especially if low values of shunting resistance are used. However, with properly designed transformers, and with resistors of the proper value, very satisfactory results will be obtained. The use of properly tapered resistor units is essential, the total resistance value ranging from 100000 to 500000 ohms.

13. This is a similar method, whereby the transformer secondary potential is varied. It has the advantage that there is no need for a long, troublesome variable grid connection. The performance and circuit conditions are about the same as for Fig. 12.

14. This method gives very rough, erratic and unsatisfactory control, generally, although some special conditions justify its use. It is cheap, simple, and very easy to arrange. The resistance values used depend on the tubes, varying from 10 ohms to 30 ohms maximum, the uniform type resistor being used.

15. In this system the voltage applied to the screen (grid) of a tube is adjusted to give various values. This is a satisfactory method for use in some types of regenerative (oscillatory) receivers, especially those used for short-wave work. The resistor values range from 10000 to 50000 ohms, the uniform resistance type being most satisfactory.

16. Here we have a combined arrangement. In some types of circuits it is impossible to obtain enough variation by the use of a single control unit. By placing one in the antenna, and one on the cathode return, the two being mounted on a common shaft, two simultaneous variations are made at one time, and satisfactory results are obtained. Because the values vary with different types of sets, it is not practical to give the resistor ranges. Some systems use tapered, and some uniform resistors, depending on the detailed arrangements.

17. Here we again have dual control, the same remarks holding as for paragraph 16.

18. This shows a "tone control" for a pair of push-pull tubes. The so-called tone control actually being a by-pass for the high frequencies. The small fixed condenser allows a large percentage of the high frequencies to pass through it, the series resistance varying the actual attenuation introduced, the final result being to give an apparent increase in bass or low frequency response by the elimination of the high frequencies.

19. Where the receiver is used in the vicinity of powerful local stations, it is sometimes advantageous to use the simple shunt arrangement shown here. This is usually a 25 to 100 ohm resistor, and may be either tapered or uniform.

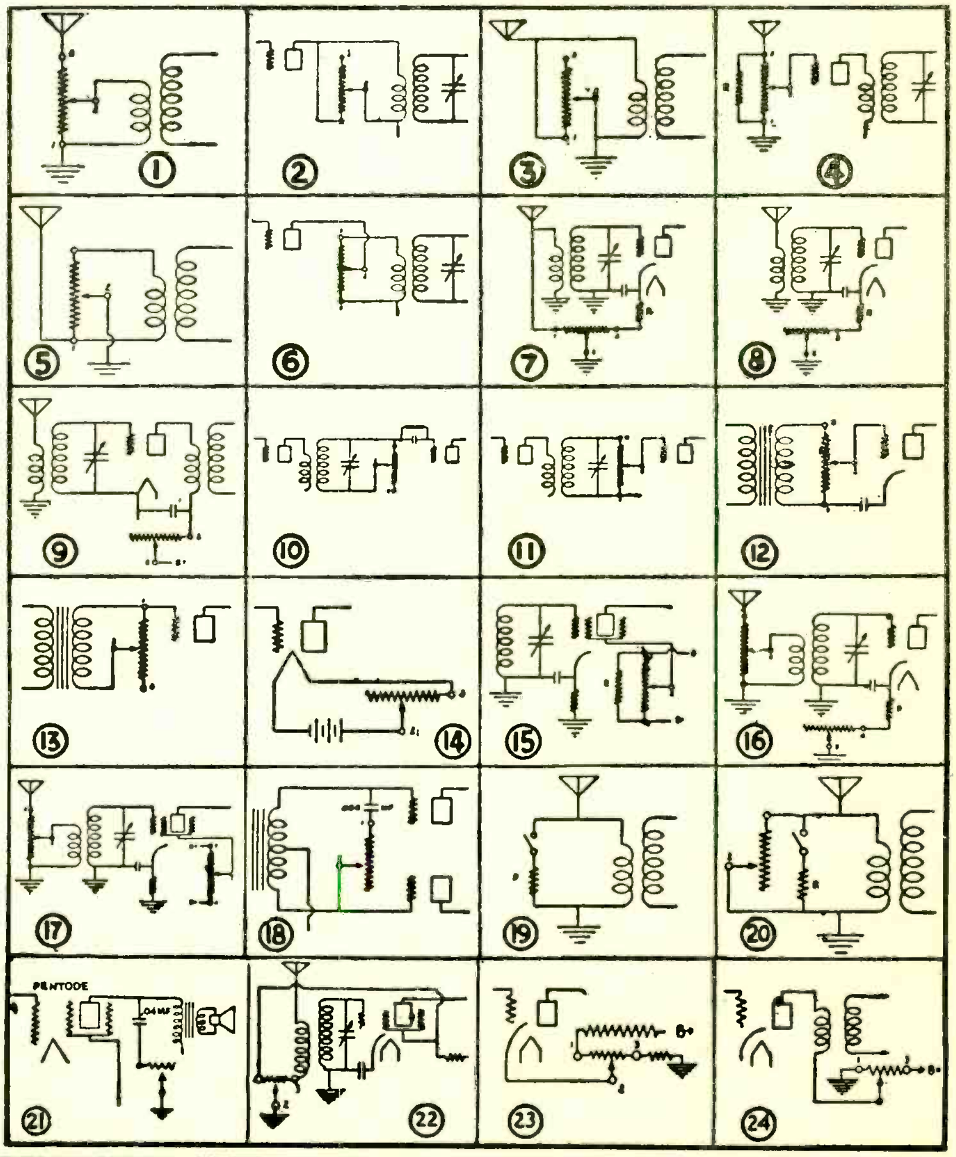
20. An antenna shunt system, with a "distance-local" switch provided. In the "local" position a resistor is placed directly across the antenna. Values of from 25 to 250 ohms are best for the distance-local unit, and the uniform type of resistors are generally used.

21. A "tone control", consisting of a shunting condenser and a series resistor, are shown here. The condenser is about 0.01 mfd., and the series resistor is about 25000 ohms.

22. Sensitivity and resultant signal output is controlled by a variation of two functions . . . the ground from the antenna, and the ground return from the screen. This is applicable to special circuits designed for such an arrangement. The resistor values range from about 5000 to 15000 ohms, of the uniform type.

23. This arrangement permits very satisfactory control. The cathode potential to ground and the resultant grid-bias provide the needed control feature. The resistor values range from about 200 ohms to about 15000 ohms, maximum, depending on the circuit used. Tapered resistance units should be used.

24. This system provides for actual variation of plate potential with a potentiometer in the plate supply. This method is sometimes quite satisfactory in some types of short-wave regenerative receivers. The resistance values, usually of the uniform type, range from about 2500 to 50000 ohms.



Modulation and Coupling Methods

By NORRIS HAWKINS, W6AAR

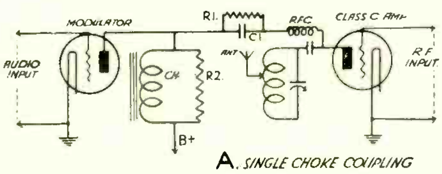
ONE of the most prolific sources of grief in a phone transmitter is the coupling medium used to apply the audio frequency modulation to the radio frequency carrier. I am going to assume, for the moment, that we have a satisfactory radio frequency amplifier, suitably excited by the buffer stages. I am also going to assume that we have a high quality audio channel, which is free from distortion, regeneration and RF pickup, and which has a power output sufficient to completely modulate the DC input to the modulated RF amplifier. At this point I might remind you that, for 100% modulation, the power output of the audio power amplifier must be equal, in watts, to one-half of the DC input to the modulated RF amplifier, also expressed in watts.

How are we going to apply this AC audio power to the DC flowing from the power supply to our class C amplifier? We are going to do it by the Heising system, which superimposes the AC on the DC so that both currents flow through the plate circuit of our modulated amplifier. At any given instant, the plate voltage applied to our modulated amplifier is the ALGEBRAIC sum of the DC voltage and the AC voltage. As we know, an alternating voltage is positive for one-half of the cycle and negative during the other half cycle. Thus if we measure the instantaneous plate voltage on our modulated amplifier when the AC voltage is on the positive half of the cycle, we must add the DC and AC voltages together. If, however, we choose an instant when the AC voltage is on the negative half of its cycle, we must SUBTRACT the AC voltage from the DC voltage. This is due to the fact that the NEGATIVE AC voltage NEUTRALIZES the POSITIVE DC voltage, so the EFFECTIVE peak voltage is the difference between the DC and the AC voltages. This all leads to the conclusion that, during 100% modulation, the EFFECTIVE peak plate voltage applied to the modulated amplifier varies from zero volts (when the negative AC voltage equals the positive DC voltage), to twice the unmodulated DC voltage (when the two voltages are both positive).

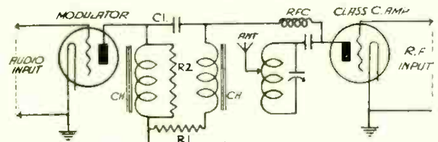
If we were dealing only with voltage, the problem of modulation would be simple indeed, but we must not lose sight of the fact that CURRENT is flowing in the plate circuit of the modulated amplifier, while all this variation in plate voltage is going on. Circuits which have current flowing in them insist in abiding by Ohm's law (or one of its AC cousins). Therefore, when we add our AC component to our DC voltage, and thus double the plate voltage periodically, we also cause the current flow to double. Thus our source of AC must supply enough power to satisfy this increase in current flow. This increase, averaged over one audio frequency cycle, amounts to 50% of the DC input power at 100% modulation. (It varies with the percentage of modulation).

In terms of wire and solder, just how are we going to go about getting the AC into the DC circuit leading from the power supply? This depends primarily on our audio power amplifier (Modulator, to you). If our modulator is a single tube, we can use either choke or transformer coupling. The simplest method is the single choke system shown in Circuit A. The plates of the modulator and RF amplifier are in parallel, and the choke keeps the AC from short circuiting through the power supply and filter. Because no known class A audio amplifier has an AC plate swing equal to its plate voltage, we must drop the voltage to the class C modulated amplifier through resistor R1, so that we can obtain 100% modulation. However, we don't want to drop the AC voltage, at the same time, so we bypass the AC around that resistor by means of the condenser C1, which may be anything from 2 microfarads up. The resistance R2, which you will see in some form in all of the coupling circuits shown, is used for the purpose of improving the fidelity of the coupling inductance and also to stabilize the load on the modulator, which tends to minimize "Carrier shift".

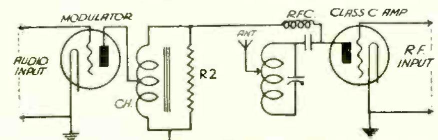
The double choke system shown in circuit B has only one advantage over circuit A, namely, the plate current to the two tubes is divided so that the total inductance is greater and two cheap chokes replace one expensive one. This circuit was probably developed



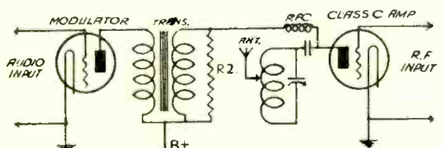
A. SINGLE CHOKE COUPLING



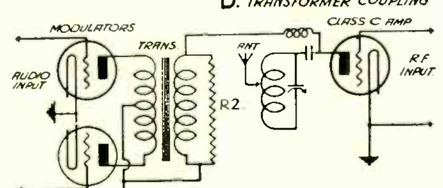
B+ B. DOUBLE CHOKE COUPLING



B+ C. AUTOTRANSFORMER COUPLING



D. TRANSFORMER COUPLING



E. PUSH-PULL TRANSFORMER COUPLING

by some ham who had two small chokes but no large one, and thus he devised circuit B to avoid having to buy a special choke to carry the total current of both tubes.

In both circuits (A and B) we must adjust the plate voltage to the modulated amplifier (by means of the dropping resistor R1) and the plate current (by means of variable antenna coupling) to such values as will represent exactly the proper load impedance for the modulator. Every audio amplifier transfers audio power most effectively to one definite value of load resistance. If this value of load resistance is not matched to our modulator, the transfer of energy suffers and we also are troubled with harmonic distortion. This adjustment of load resistance is not hard to make, but it sometimes happens that in order to get a good impedance match we must operate our modulated amplifier inefficiently. What to do? Observe circuit C. The plate of the modulator is tapped down the choke. We have now done two things. By autotransformer action we can transform a high impedance load into a low impedance load for the modulator. At the same time we obtain a step-up in the AC voltage which eliminates the dropping resistor and its troublesome bypass condenser.

In circuit D we have the same thing, but we call it transformer coupling, because the two windings are not in series, but in parallel. Otherwise the autotransformer system is identical. One advantage of circuit D is that we can run the DC through the two windings in opposite directions, so that the magnetic lines of force neutralize, to a certain extent, in order to avoid core saturation. This allows cheaper construction of the transformer with the same fidelity of reproduction.

In all of the preceding circuits we used class A modulation with a single ended audio amplifier. What if we desire to use push-pull modulators? See circuit E. This is a logical development of circuit D, and is used for all push-pull modulators, whether class A, class A Prime or class B. Our old friend R2 is still with us to flatten out the fidelity curve of the output transmitter and to stabilize things generally. Otherwise the circuit probably looks very familiar.

In matching impedances by means of the transformer or autotransformer we must remember that the impedance transformation ratio is equal to the square of the turns ratio. Therefore, a transformer with a turns ratio step-up of one-to-two reflects and transforms impedances in the ratio of one-to-four. Thus 5000 ohms across the primary matches 20,000 ohms across the secondary (or 4000 ohms matches 16,000 ohms, etc.). Note that if the primary is center-tapped, the impedance each side of center is ONE-FOURTH of the total primary impedance, not one-half. In the case of the autotransformer, suppose we want to tap down so that the load on the modulator is just one-half the reflected load of the modulated amplifier. This is an impedance ratio of two-to-one. Therefore, we take the square root of two, or approximately 1.4. Thus the turns ratio would be one-to-one-point four, and the tap would be located ten-twenty-fourths of the total turns, counting down from the top of the autotransformer.

If a radio-frequency amplifier is biased to two or more times "cut-off" and then excited hard by the buffer, the AMPLITUDE of its RF output varies in exact accordance with any variations in its plate voltage, provided it is non-regenerative. Thus the variations in plate voltage which we have caused by the modulators, varies the RF output so that the modulation "envelope" is a faithful reproduction of the speech frequencies impressed on the microphone.

A radio-frequency amplifier that is modulated has its plate input increased 50% during complete modulation, so that the maximum allowable DC plate input can be only two-thirds of that possible in an equally efficient CW transmitter.

The 5-Meter "Transceiver"

By Franklin Hansen, Jr.*

THE RCA-Victor "Transceiver", a recent development of that company, is being employed in the film studios of Hollywood with excellent success. Few portable communication systems have proved so effective in the saving of time and money.

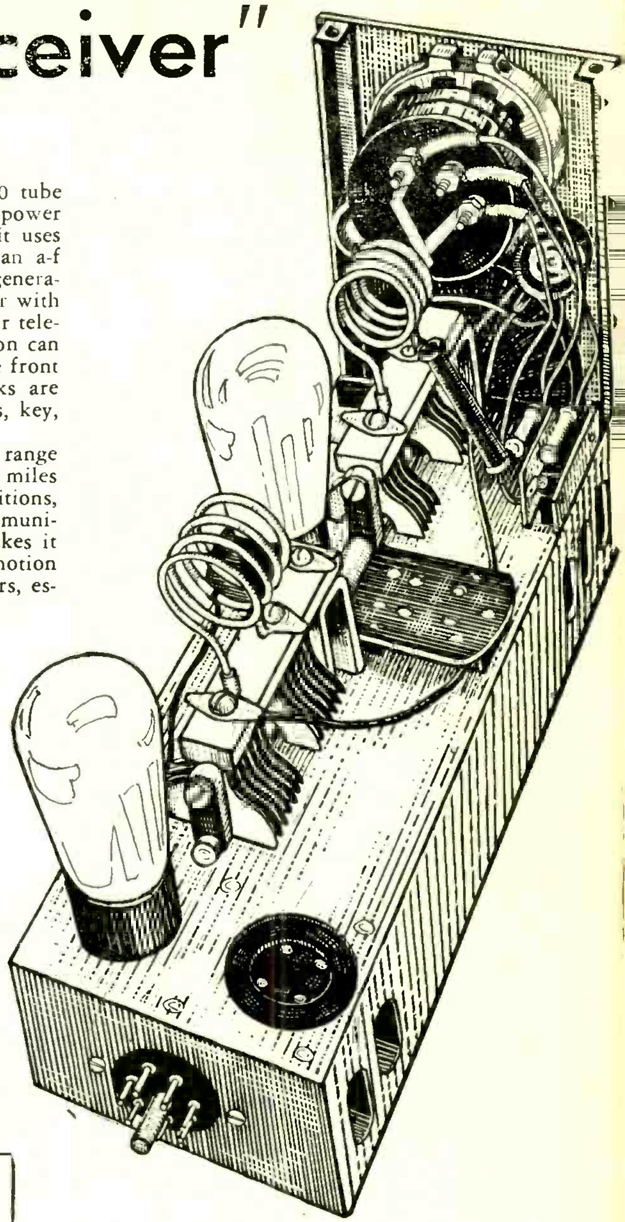
The Transceiver is a small unit, comprising a complete receiver and transmitter in a single metal carrying case. This case contains the entire apparatus, except the batteries, headphones, microphone and key, and, of course, the short wires used for aerial and counterpoise. The battery box holds the necessary dry batteries for the entire power supply, which provides from 8 to 10 hours service. The entire outfit, batteries included, weighs about 25 pounds, and can be strapped to a man's back.

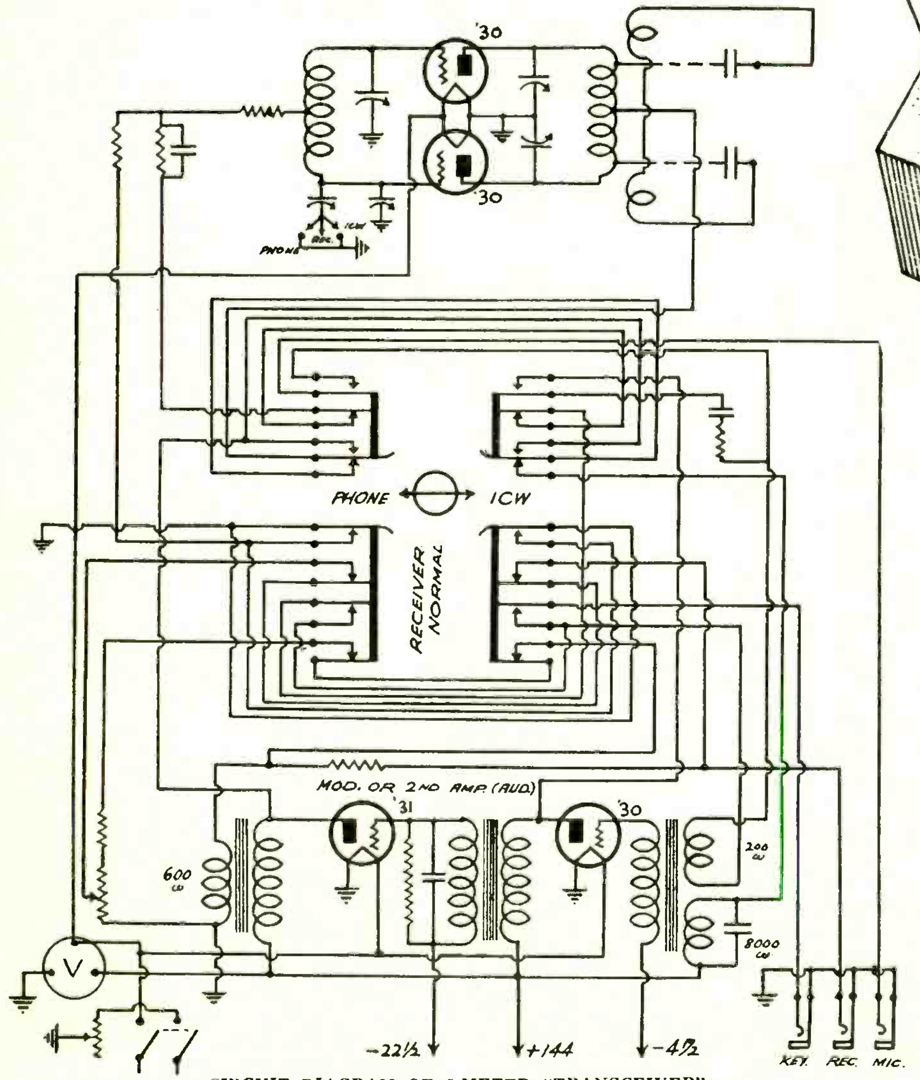
Designed to operate over a range of from 27 to 36 megacycles, the Transceiver employs two pieces of copper tubing, just a few feet longf, for aerial and counterpoise. The former extends upwards and the other downwards, for best results. This radiation system may be tuned by varying the length of the copper tubes; that is, by sliding smaller tubes in or out of the ends.

There are two separate units in the metal box. The transmitter uses a single 230 tube as a self-excited oscillator, with a 231 power tube as a modulator. The receiver unit uses a 230 detector, with another 230 as an a-f amplifier. The very sensitive "super-regenerative" circuit is employed in the receiver with excellent results. For transmission either telephone or C.W. telegraph communication can be used. A telephone key switch on the front panel allows instant change-over. Jacks are provided to accommodate head phones, key, and microphone.

This equipment is designed for short range communication, of course. A range of 10 miles is easily obtained under average conditions, while good conditions will permit communication over a 15 mile range. This makes it ideal for communication between the motion picture director and his crew and actors, especially when employed on a large outdoor set. It has been in use in the Paramount Studio for some time, operating under the special portable call of WIOXE.

There are times when the camera is set up at a considerable distance from the scene of action, in order to get all that is going on.





CIRCUIT DIAGRAM OF 5-METER "TRANSCEIVER"

Scenes of aircraft in flight is one instance of this. Sometimes a public address system will serve the purpose. Sometimes it will not. By the use of the Transceiver the director may communicate with the actors, or the members of the technical staff, simply by speaking into his microphone. This eliminates all the old methods of communication, such as semaphore flags, wig-wag, and flashing lamps. And it allows the director to explain himself more thoroughly.

The Transceiver was used with great success during the filming of the recent Paramount picture, "The Eagle and the Hawk," starring Frederic Marsh. Many of the difficult air scenes were directed via this radio equipment, where direction would otherwise have been impossible. Maurice Chevalier has also used the Transceiver with gratifying results.

Several of these units may be operated on the same lot at the same time, if desired, without interference, because they are tuned very sharply. Thus a headquarters station may keep in touch with several field stations, or two or three directors may be working with their own casts on the same lot without bothering each other.

* Chief Engineer, Sound Department, Paramount Publix Studio, Hollywood, Calif.

I-TAPPA-KEE News

THE AMATEUR'S LEGION OF HONOR

Happy New Year, Brothers!

As 1934 rolls around it also chronicles the first birthday of the reorganized ITK Radio fraternity, the "Amateurs Legion of Honor", and a very successful year at that, for ITK faces the new year with a most promising future. It was conceived and organized in 1926 by its present executive officers, J. Meloan, W6CGM, ex9BPX, and K. Isbell, W6BOQ, ex9AQA. The Amateur Division ITK had little opportunity to progress because shortly thereafter its leaders and many charter members engaged in commercial radio for a livelihood. 1933 brought the long-desired opportunity to reorganize ITK for action. Fifteen charter members were carefully chosen, men who reflected ITK's ideals. These Charter Members are: W6CGM, W6BOQ, W6GEG, W6DVD, W6DZN, W6EDW, W7AVL, W7AAT, W6BSV, W6AAN, W6PQ-WLV, W6AKW, W7DDJ, W6ETM, and W6CWU. With this nucleus of active, outstanding amateurs, ITK forged ahead with its original plan, choosing each new man carefully. Thus it became known that to be pledged and invited to become a candidate to the order of ITK is a distinct honor.

A year has passed and the spirit of ITK has met with instant and wide recognition of amateur leaders and lay operators everywhere. Today, our fraternity has several hundred members, every man a crack operator and a regular fellow. It is a national fraternity covering the United States and its possessions, and Canada. It is an organization far more interested in quality of membership rather than quantity, yet expanding as rapidly as its careful choosing will permit as more eligible men are found, pledged and accepted into the order. Aggressive plans are in readiness for the coming year, and before this is published they will be well under way. Much of this information is "Confidential to ITK only", and will be conveyed to fraternity men via the ITK Official Bulletin, ITK broadcasting stations and other official communication channels.

DIVISIONS

DIVISIONS of ITK for the United States and its possessions are as follows:

ATLANTIC DIVISION: New York, New Jersey and Rhode Island.

EAST COAST DIVISION: Conn., Mass., Vermont, N. H., and Maine.

CAPITOL DIVISION: Penn., W. Va., Virginia and Dist. of Col.

EVERGLADES DIVISION: Florida, Ga., N. Carolina, S. Carolina and Cuba.

SOUTHERN DIVISION: Ark., Miss., Ala., Tenn., Ky., and Louisiana.

GREAT LAKES DIVISION: Ill., Minn., Wis., Mich., Ind., and Ohio.

CENTRAL DIVISION: Kansas, Neb., N. D., S. D., Missouri and Iowa.

BORDER DIVISION: New Mexico, Texas and Oklahoma.

CONTINENTAL DIVISION: Mont., Wyo., Utah, Colo., and Idaho.

OLYMPIA DIVISION: Oregon, Washington and Alaska.

WEST COAST DIVISION: Calif., Ariz., Nev., Hawaii and P. I. Canadian Divisions are: Ontario, Quebec, Alberta, British Columbia, Manitoba and Saskatchewan.

Lyle White, ex9EAI 9JC, an original 1926 ITK Charter Member, is new Chief of the Border Division. At this writing Lyle is waiting for a newly-assigned "5" call, meanwhile operating 5FC at Dallas, Texas. W7AAT is new Chief of the Continental Division, while Chiefs of other divisions are being selected on probationary trial appointments. Each state has its ITK Chief, chosen by a similar method.

Official ITK QST Dispatches are broadcasted on schedule from the following stations:

W6JYN, San Francisco, on either 7290 or 3815 KC.

W9SU, Tipton, Iowa, on both 3580 and 7250 KC.

W6BSV, Redding, Cal., 3507 KC.

W2BPY, Perth Amboy, N. J., on 3588 KC.

W8OQ, Shelby, Ohio, on 7292 and 14300 KC.

These QST's contain special ITK news. Portions of these broadcasts labeled "Confidential to ITK Only" are sent in secret cipher.

The ITK Traffic Network is now functioning in skeleton form and already offers a fast communication service to any part of the world. Additional trunk lines are being formed with definite schedules and working frequencies so that any ITK station can tie into this established network for clearing traffic.

New ITK fraternity pins are attractive and classy and distinguish between the various degrees.

All member-stations identify themselves as fraternity men by signing "ITK" after their call letters at the end of each transmission. This is used instead of the conventional "K" go-ahead signal.

Most of the original Charter Members of 1926 have been found to be still active and have automatically been reinstated as regular members.

Typical of letters received at ITK headquarters from amateur leaders is this one from Capt. Black, head of the Army Amateur Radio System:

WAR DEPARTMENT
OFFICE OF THE CHIEF SIGNAL OFFICER
WASHINGTON

OCSigO-080-A.A.R.S.

November 15, 1933.

Mr. J. Rihcard Meloan,
1302 "M" Street,
Bakersfield, California.

Dear Mr. Meloan:

Your recent letter pertaining to the "I Tappa Kee Radio Fraternity" was most welcome.

While I had some general knowledge of your organization I was glad to get the detailed information as set set forth in your letter and the accompanying literature. It is believed that the A. A. R. S. as a whole is not fully acquainted with this set-up and therefore I am taking the liberty of circulating your correspondence among our radio aides. Also will bring the I. T. K. to the attention of all through the medium of "PDC".

It is to be hoped that your membership committee will find additional membership material among the operators of the A. A. R. S. that meet with your qualifications.

Again thanking you for your interest and very good letter, I remain,

Very truly yours,
(Signed) Garland C. Black,
Captain, Signal Corps,
Liaison Officer, A. A. R. S.

Incidentally since this letter was received, Captain Black has been pledged and accepted by the fraternity. The fraternity now numbers among its brothers many prominent army amateurs as well as USNR members, Ensigns and Lieutenants. Qualifications for Degrees, as detailed in the secret constitution, recognize achievements in both the AARS and USNR as well as other accepted amateur radio organizations.

To Ronnie Martin, W6ARD-6ZF, genial manager-engineer of KUP, the San Francisco "Examiner's" powerful short-wave commercial radio station, will go ITK's first Honor Degree award. To be eligible for this highest ITK Degree, an ITK fraternity man must first possess the highest ITK Degree attainable through individual merit, that of "lightning Jerker" and in addition must perform some unusual service to radio and humanity. This award to Ronnie of 6ARD-6ZF-6XG-KUP is in recognition of his prompt and efficient action in the saving of a million-dollar ship and the lives of its crew from an approaching typhoon. This service, ITK believes, further reflects honor upon the operating profession and upholds its noblest traditions. The Honor Degree is awarded Martin principally because of the following account, and secondly, because of his many similar actions of which ITK is justly proud:

"Back in 1928-29 Martin at KUP held daily schedules with WSBS, the yacht 'Carnegie', the pride of the Carnegie Institute at Washington. This was no ordinary ship, being especially designed for magnetic research. She was built entirely of wood with absolutely no iron in her construction; even her engines were made of bronze and non-magnetic metals—the last word in a true 'magnetic ship', and she cost a million dollars to build! Her job was charting the ocean floors all over the world and making scientific magnetic observations. For eighteen months KUP held special press, weather, and traffic schedules with the "Carnegie's" wireless, WSBS. This continued until the time of her ill-fated end. The yacht exploded at Apia Harbor, resulting in the untimely death of Capt. Ault and one cabin boy. Further death and disaster was foiled by a young man sitting at a key.

It was midsummer in 1929 when the yacht "Carnegie", WSBS, sailed on placid seas between the Philippines and Guam, busily engaged in running circles and charting "bottoms" unaware of approaching danger. NPO flashed a typhoon warning to the Orient and way points. WSBS was in its direct path—the operator hadn't heard NPO, a quirk of fate, almost fatal. Martin at KUP was reading a mass of customary data usually received nightly from NPG for the use of WSBS, when this typhoon storm warning and the "Carnegie's" position both flashed through his mind. Then things began to happen.

Martin went into action, and the signals from KUP were soon tearing up the ether, frantically trying to get the attention of the WSBS radio operator. The typhoon advanced swiftly, crushing all in its path, leaving disaster in its wake and as it paused to pounce upon the helpless little ship and its crew, KUP's signals of mercy reached the ears of the "Carnegie's" operator. Contact once established, Martin quickly apprised the ship's captain of the approaching typhoon, its direction and velocity. At once Captain Ault changed his course, was just caught in the very tail end of the typhoon as it roared past, weathered the storm, and all were saved . . . the crew, the million-dollar magnetic ship, its delicate scientific instruments and its invaluable records. Martin held hourly schedules with WSBS until danger had passed. He received the heart-felt thanks of Captain Ault and his crew. Later the Carnegie Institute expressed gratitude to Martin and KUP, while newspapers chronicled the event.

For this service, I Tappa Kee awards its first Honor Degree to Lightning Jerker Ronnie Martin, 6ARD-6ZF-6XG-KUP, ITK Brother No. 39.

I.T.K. Station Activities

W9AFN, Chicago, uses a '61A tube in his final with up to 1 KW input, has a WAC, worked 62 countries, uses both CW and fone, was qso England on fone and is a fast code man, placing in the World's Amateur Code Championship contests.

W8CRA, Lucas, of Pa., is having some difficulties at this writing but we hope he comes out OK—you can't keep a good man down.

W6CGM is using a new Tritet to excite his final amplifier with excellent results. Can qsy any freq instantly and change bands in a few minutes with a good note and E. C. stability. Fits in well with his operation as AARS Minute Man.

W6BOQ on 7 mgc mostly and maintaining skeds with fraternity men in Chicago. Kenny is well known as 9AQA back in that section and meets many old friends via the airways.

Capt. Black, Liaison Officer. AARS, WLM-W3CXL operated a ham station back in 1910-1913 when licenses were unheard of and nobody cared. Happy memories for a lot of the old timers.

W6GEG was recently elected Chief Operator of the Bakersfield, Cal., Amateurs Short-Wave Club and supervises the operation of their fine new station W6HPZ.

W6FTV is new vice-president of the San Bernardino Amateurs Club.

W6FEW, Bill McNatt, organized the Southern California ITK Chapter.

W6FFP, Andy, at Fresno, Cal., boasts of a new FBXA for a receiver.

W2ADQ, Long Island, is a key man in a large So. Amer. traffic net, also will aid on NY end of Byrd Antarctic Expedition traffic.

W6ETJ, of 6USA fame, reports 189 traffic total for the month. Don's in the radio service business and couldn't get on the air much.

W6DTJ, Russ Bennett, announces and operates at KWG, Stockton, Cal.

W8OQ acting as Chief of the Great Lakes Division. Congrats, Bert!

W6COJ is President of the Modesto Amateur Radio Club, no small position.

INFORMATION

Amateur radio operators who are not otherwise pledged, but who desire to enter ITK, may secure information from ITK headquarters as to the membership requirements and as to whether or not they know any fraternity men who will pledge them. If not, the applicant will be thoroughly investigated, and if found eligible will be pledged for membership. In either case the candidate is subject to the investigation and vote of the Membership Committee and if found worthy is honored with ITK brotherhood. The fraternity does not solicit members but is glad to welcome every amateur *who can meet ITK standards* and who believes in the spirit of I Tappa Kee.

ITK Radio Fraternity Headquarters: Secretary-Treasurer, Kenneth Isbell, Radio W6BOQ-6AMR-KFI, 5143 So. 6th Ave., Los Angeles, Calif. Hi-Kilowatt, Joe Meloan, W6CGM-6ZZGM-KERN, 1911 Forest St., Bakersfield, Calif.

The Reflector Antenna

By R. N. HARMON,
Radio Division, Westinghouse Electric & Manufacturing Company,
Chicopee Falls, Mass.

KYW, the Westinghouse station of Chicago, is located about twenty miles from its studios in the Strauss building in metropolitan Chicago. This station with a power of approximately 10,000 watts, had, until recently, an even distribution of signal in all directions from the station. This distribution was obtained from a capacity type of antenna called a "diamond antenna". This diamond antenna consisted of four 100-foot wooden poles spaced on the ground in the shape of a diamond and with the antenna wires stretched between and across these four poles. The lead to this antenna system was carried down along the side of one of these poles and connected to the tuning equipment leading to the radio station. This type of antenna has a relatively low effective height.

Late in December 1932, KYW began regular operation from a new type of antenna consisting of a tuned vertical copper tube, 204 feet high, and excited directly from the KYW transmitter. This antenna, in conjunction with a reflector, gave a remarkable increase in the signal strength of KYW in the direction of Chicago, and yet allowed sufficient signal in other directions to accommodate the service area of the station.

The main antenna, which has been designated the "exciter", is a vertical conductor 204 feet high mounted on a 200-foot spliced wood pole with large porcelain standoff insulators. The reflector antenna is also a vertical conductor but is only 150 feet high. It is a vertical conductor mounted on one of the original 100-foot antenna poles with a 50-foot duralumin tower mounted on top of the pole. The reflector is spaced ¼ wave length (approximately 250 feet) behind the exciter unit. Both the reflector and the exciter are loaded with inductance at the ground end and grounded so as to operate at ¼ wave length.

Radio frequency power from the transmitter is fed to the exciter antenna by means of a two-wire transmission line, extending between the transmitter and the tuning house where it is terminated in a parallel resonant circuit with the center lap of the condenser grounded. The resonant circuit is used to suppress harmonics. A secondary is wound on the inductance of this circuit, one end being grounded, the other end connected to a single wire transmission line which is connected to the exciter unit of the antenna at a point about 50 feet above ground.

The reflector antenna is not directly excited from the transmitter but picks up its radio frequency energy by absorption from the field of the exciter antenna. Theoretically, the best spacing between exciter and reflector antennas for the largest ratio of front to back signal is .32 wavelength. This is for a reflector which is not directly excited from the transmitter. For a reflector directly excited the best spacing is .25 wavelength. The spacing of .25 wavelength was chosen for KYW because the reflector was somewhat lower in height than the exciter antenna and there was some doubt as to whether or not it would have to be directly excited from the transmitter.

For a directly excited reflector, as stated before, the spacing of .25 wavelength or 90 electrical degrees in phase is correct. Likewise, the spacing of .32 wavelength is correct for the indirectly excited reflector because for this spacing the resultant field from the exciter antenna at the reflector antenna is lagging in phase with respect to the radiation field of the exciter antenna at the reflector antenna. The resultant field at the reflector antenna induces in the reflector antenna a current which leads the resultant field of the exciter antenna. The field set up by the current in the reflector antenna retards in phase as it travels toward the exciter antenna. On arriving at the exciter antenna it is exactly

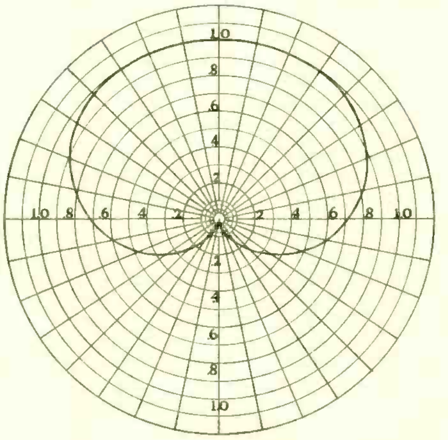


FIG. 1. Theoretical Pattern with Reflector directly excited.

in phase with the field of the exciter antenna, and, therefore, adds to the field strength of the exciter.

Thus, in a direction directly ahead of the exciter antenna the fields of the reflector and exciter will be completely in phase and thus give the strongest field. In a direction directly behind the reflector antenna the fields of the exciter antenna and the reflector antenna will be out of phase and therefore tend to cancel each other. The field directly behind the reflector antenna will be weakest and be strongest directly in front of the exciter antenna.

Complete cancellation of the signal in a direction directly behind the reflector antenna will occur only when the radiation fields of the exciter antenna and reflector antenna are exactly equal in strength and 180 degrees out of phase with each other. This can be accomplished only by having no losses in the reflector, or by having it excited directly from the transmitter. Fig. 1 shows a field strength pattern of the theoretical system and Fig. 2 shows how the system may be adjusted so that some signal will remain in a direction directly behind the reflector antenna.

In the actual operation of such an antenna system, the phase of the two fields can be changed by either the spacing of the two antennas or the tuning of either one with respect to the other. Once the antennas have been erected the only economical method remaining is to change the tuning of the reflector. This changes the phase angle of the current in reflector and thus will change the phase angle of its radiation field with respect to that of the exciter. To obtain the largest ratio of front to back signal with a .25 wavelength spacing the reflector antenna will have to be tuned to a frequency slightly lower than the frequency of the exciter. For a .32 wavelength spacing the reflector antenna must be tuned to the same frequency as the exciter for the largest ratio. For spacing slightly greater than .32 wavelength the reflector must be tuned to a frequency slightly higher than the exciter.

The further away the reflector antenna is located from the exciter, the weaker the field will be which it receives from the exciter. That is, the reflector antenna is excited less strongly the further away it is from the exciter. Thus, even if the phase angle of the fields between the two antennas were cor-

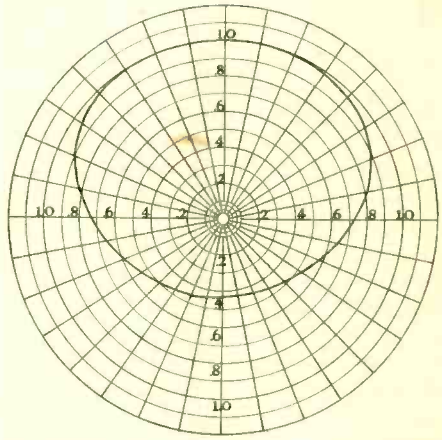


FIG. 2. KYW Antenna Field Strength Pattern.

rect, the amplitude of the two would not be the same and the signals would not cancel directly behind the reflector. Fig. 3 shows the amount of signal increase for the reflector in tune with the exciter, but spaced at different distances from the exciter. From this curve, it will be noted a gain in field of 42%

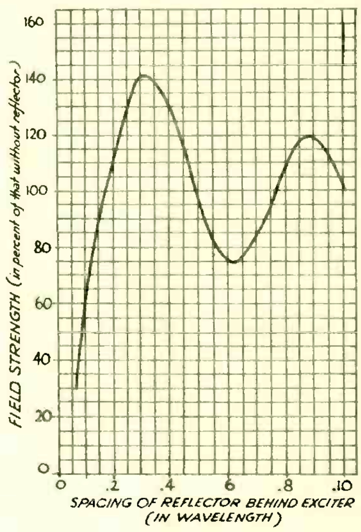


FIG. 3.

is possible. This is equivalent to doubling the power in the transmitter.

The actual tests at KYW of this antenna system indicated that (in a direction forward of the exciter unit) the signal was almost twice as strong as that produced by the original diamond antenna. That is, if the same field were to be produced by the old antenna

(Continued on page 35)

Globe Girdlers

Conducted by CLAYTON F. BANE, W6WB

W8CCW—Edwin J. Ruth, Washington, Pennsylvania

THIS month we go east to Washington—no, not D. C., but Washington, Penn. Two miles south of the town with the nickname of our Capitol, situated on the top of a rather high hill, is the station of our Globe Girdler for this month, W8CCW. This is the station of Edwin J. Ruth.

The station call was originally W9CFY; the present call being obtained in 1927. The first transmitter used a '10 in a Colpitts circuit and had 300 volts of B Batteries as the plate power. Like his friend and rival DX'er W8CRA, all continents were worked on 7MC during 1927. Came 1928 and the urge to investigate the 20-meter band. At this time, there was no AC in the district and the station worked under the handicap of very low power. In a vain attempt to overcome this handicap, a Delco plant and a 600 volt dynamotor was purchased and duly installed. Crystal control was immediately forthcoming. It was found though, that the plant was incapable of supplying the necessary power for all of the stages, and W8CCW went back to self-excited.

The "Hello CQ" bug got in its evil work and the melodious voice of CCW was heard on 80-meter phone for nearly a year. Then came the installation of AC and the power situation was solved. From that time, '10's, '03A's, 04A's and '52's have followed in rapid succession as final amplifiers in the various crystal rigs.

The present transmitter consists of a 3.5MC crystal with a 47 as an oscillator; its screen tuned to 3.5MC and its plate circuit tuned to 7MC. A '10 working as a regenerative doubler, doubles to 14 MC and its output is fed into a neutralized '10 as a buffer which, in turn, feeds the '52 final amplifier. Input to this stage runs around 600 watts at a plate voltage of 3500 volts. The photograph shows the details of this very sweet looking job.

W8CCW says that he is also using link coupling between the buffer and the final amplifier.

The antenna system in use is a Fuchs type antenna (end fed Hertz), 136.5 feet in length. This antenna is 85 feet high on the far end and 50 feet high at the station end. Do you remember what we said about the station also being on the top of a high hill? Huh?

The receiver is a conventional one using a 58 TRF stage, a 58 as a detector and a 58 audio amplifier. If only the pole was 58 feet high, and the operator 58 years old—what a story for Ripley! Hi! Incidentally,

Here's the old boy himself --- W8CCW

the transmitting antenna is also used for receiving. Can he hear 'em? Listen to this. . . The writer and W8CRA were having a large argument over whether or not W6WB was hearing a certain African that CRA couldn't hear. We got nowhere as both claimed the other was wrong. Finally, CRA said, "I'll call W8CCW and ask him if he hears the bird you say you are hearing. If he says no—well, boy, that DX just ain't on the air". Coming from that old micro-eared DX'er, I consider it as a grand tribute to CCW's ability.

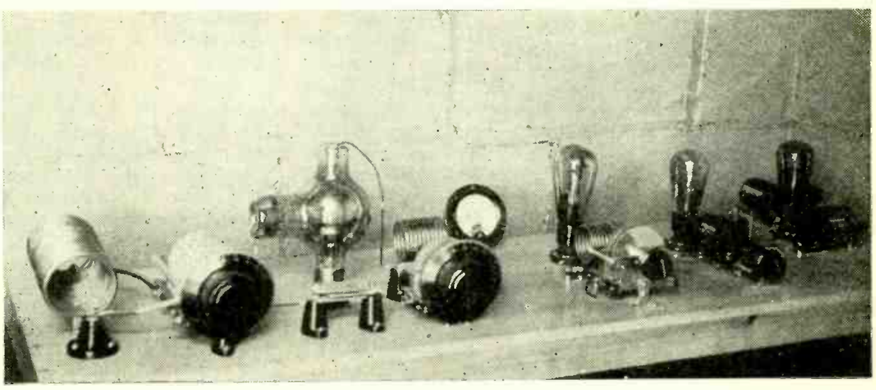
The station is housed in a shack, 8 by 8 feet in the basement. Take a look at Ed at the receiver in the photo.

W8CCW won the International DX contest for the Western Pennsylvania section of the Atlantic Division in 1930, 1931 and 1933. Suspecting that there was more to the story, we find that he also placed third in the entire country during the '33 tests, working 40 countries. He is unable to supply a complete list of the countries worked as that would necessitate going back over his old logs, but here is some of the better DX:

AU, F8, CP, CT1-2-3, CX, FQ, EAR, EI, EU, F3, FM4, FM8, CN8, G, GI, HAF, HB, HC, HH, HI, HK, HR, I, J, K4-5-6-7, KA, LA, LU, NN, NY, OA, OH, OK, ON, OZ, OM, PA, PT, RX, LY, SM, SP, SU, TI, UO, VK, VO, V1, VP-2-4-5-9, VQ4, VS6, VU, X, YI, YS, YV, ZE, ZL, ZS, ZT, ZU, TG.

Attesting the fact that some messages do get delivered, we received the following additions to this list by amateur radio, two separate stations delivering the message. Chile, Canary Islands, Virgin Islands, Cuba, Greenland, Canada, U. S. A., Trinidad, British Guiana, Scotland, Cape Verde Islands and Belgium Congo. This incomplete list adds up to around 81 countries! Of course, WAC on both 7 and 14 MC.

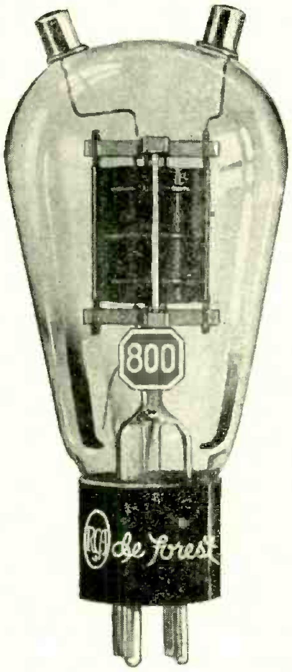
And so ends the story of another of the "Big Eights". What? You say you just heard F8PZ? Mmmm—well, I gotta go now. Solong!



The accessible arrangement of all transmitter parts at W8CCW is shown in the above photo.

RCA de Forest AMATEUR TYPES

RCA de Forest amateur types are sold through authorized distributors of the RCA de Forest Amateur Radio Division. ¶If your amateur distributor is unable to supply you, please write to us, giving his name and address, and we will advise you where RCA de Forest tubes may be obtained.



RCA-800

List Price, $10.00

Now available through authorized distributors of RCA de Forest Amateur Radio Division

AMATEUR TRANSMITTING TYPES

Type	Description	Electrodes	Max. Plate Dissipation Watts	Cathode Type	Cathode Volts
203-A–503-A	Oscillator, R-F Power Amplifier, Class B Modulator	3	100	Filament	10.0
211–511	Oscillator, R-F Power Amplifier, Modulator	3	100	Filament	10.0
800	Oscillator, R-F Power Amplifier, Class B Modulator	3	35	Filament	7.5
841	Voltage Amplifier, R-F Power Amplifier, Oscillator	3	15	Filament	7.5
842	A-F Power Amplifier, Modulator	3	15	Filament	7.5
843	Oscillator, A-F and R-F Power Amplifier	3	15	Heater	2.5
844	A-F and R-F Power Amplifier, Oscillator	4	15	Heater	2.5
845–545	Modulator, A-F Power Amplifier	3	100	Filament	10.0
850	R-F Power Amplifier, Oscillator	4	100	Filament	10.0
852–552	Oscillator, R-F Power Amplifier	3	100	Filament	10.0
860–560	R-F Power Amplifier, Oscillator	4	100	Filament	10.0
865–565	R-F Power Amplifier, Oscillator	4	15	Filament	7.5

Type	RECTIFIERS	Electrodes	Max. Peak Inverse Volts	Cathode Type	Cathode Volts
866-A	Half-Wave Mercury Vapor	2	10,000	Filament	2.5
872–572	Half-Wave Mercury Vapor Heavy Duty	2	7,500	Filament	5.0
872-A–572-A	Half-Wave Mercury Vapor Heavy Duty	2	10,000	Filament	5.0
878	Vacuum Type for Cathode-Ray Tubes	2	20,000	Heater	2.5
885	Gaseous-type triode for cathode-ray sweep-circuit control	3	300	Heater	2.5

Type	CATHODE RAY TUBES	Electrodes	Max. Anode No. 2 Volts	Cathode Type	Cathode Volts
904	5 in., Electro-static-magnetic deflection, high-vacuum, hot-cathode	5	4,600	Heater	2.5
905	5 in., Electro-static deflection, high-vacuum, hot-cathode	4	2,000	Heater	2.5
906	3 in., Electro-static deflection, high-vacuum, hot-cathode	4	1,000	Heater	2.5

Type	HIGH-POWER TYPES	Electrodes	Max. Plate Dissipation Watts	Cathode Type	Cathode Volts
204-A–504-A	Oscillator, R-F Power Amplifier	3	250	Filament	11.0
831	Oscillator, R-F Power Amplifier	3	400	Filament	11.0
849–549	A-F and R-F Power Amplifier, Oscillator	3	400	Filament	11.0
851–551	A-F and R-F Power Amplifier, Oscillator	3	750	Filament	11.0
861–561	R-F Power Amplifier, Oscillator	4	400	Filament	11.0

Fill out and mail this coupon if you wish the following: ☐ RCA de Forest Price List; ☐ technical data on RCA de Forest types, or write Dept. O.

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RCA de Forest AMATEUR RADIO DIVISION

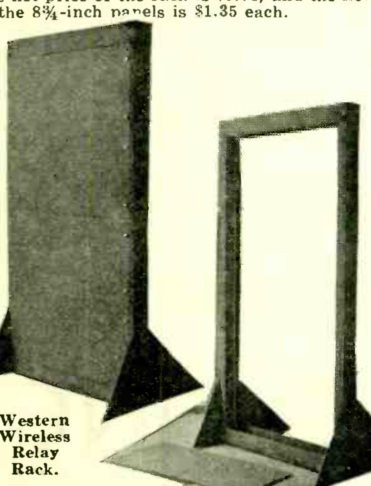
RCA RADIOTRON CO., INC.

CAMDEN * * * * * * * * * * NEW JERSEY

New Relay Rack

WESTERN WIRELESS, LTD., 95 Minna St., San Francisco, offers the amateur and experimenter a new table-type relay rack for all types of transmitting and receiving equipment, as well as portable sound systems. This relay rack provides sufficient room for mounting thirty-five inches of standard panels, and comes drilled for four 8¾ inch panels. The rack is thirty-nine inches high, twenty inches wide and sixteen inches deep. It is made of sheet steel, finished in crystal black. One of the unusual features of this rack is the method used in assembling. Four bolts and nuts in each corner permit the rack to be knocked down for shipment.

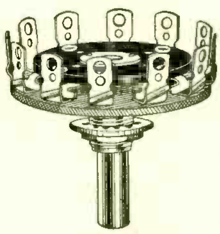
Blank panels, finished in black crystal lacquer and flat black on the back and having a width of 8¾ inches, can be furnished from stock. Other standard widths may be obtained on special order. The net price of the rack is $9.75, and the net price of the 8¾-inch panels is $1.35 each.



Western Wireless Relay Rack.

NEW PRODUCTS

New Wave-Band Switch



Side View

H. H. Eby Mfg. Co., 21st St., at Huntington Park Ave., Philadelphia, Penna., announce this new Wave-Band Switch, for which the following features are given: Compact Design; definite indexing; sturdy construction; low capacity; single hole mounting; silver-plated contacts; low contact resistance; special solder lug features; will stand all rigid life tests; floating contacts, grounded or ungrounded. These switches are furnished in all combinations, from single-pole single throw, to 4-pole double throw.

Birnbach Standoff Insulators

THESE new Birnbach Insulators are ideally suited for mounting on metal panels as they require only one hole for mounting to make possible connections on the bottom of the sub-panel, thereby eliminating unsecured wiring.

The body is made from a good grade of porcelain and is thoroughly glazed with the smooth finish so necessary for high frequency work.

They are supplied in several sizes ranging from ⅝-inch to 1¼-inches high, and come complete with nickel plated brass hardware. The ⅞-inch and 1¼-inch sizes are supplied with jacks, making these insulators desirable for plug-in coils, chokes, and all types of high voltage apparatus. Prices range from 13c to 30c.

Burgess No. 1040 "A" Pack For Use With 2-Volt Tube Battery Operated Sets

Burgess Battery Company, Freeport, Illinois, announce the No. 1040 "A" battery especially designed for 2-volt tube radio receivers.

This new "A" pack embodies a "close pack" construction which makes it light, portable, and economical.

Will give 400 hours service at a cost of less than 1 cent per hour.
Weight—15 pounds.
Size—12 7/16" x 4½" x 6 13/16".
Easy to handle, attractive in appearance.
No servicing with water or chemicals.
100% DRY; Hermetically sealed.
List Price $3.20—Slightly higher west of the Rocky Mountains.

RADIOTORIAL COMMENT

(Continued from page 3)

glomoration. One amateur has suggested that the "BT" be dropped from the portable "sign". He writes: "Why not make it read this way — CQ, CQ, CQ, de W9XYZ8 . . . leave out that needless 'BT' Any listener would know that when W9XYZ tacks an 8 to his call, he is operating in the 8th district." Not a bad suggestion. What do you think of it?

The F. R. C. has simplified the station and operator's license form to vest-pocket size. It has fooled those who sell and buy answers to amateur license examination questions for two-bits and less. And now it wants to make life harder at the end of the trail when we set-down the old portable and put a few flea-power watts into a haywire antenna. What next?

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Chinese Puzzle No. 3

WHEN your lawyer makes a mistake, you finish second-best. When your barber makes a mistake, he patches it with stickum-tape. When your doctor makes a mistake, he buries it. But when you go to the R. I.'s office for an amateur license examination and you make too many mistakes, he tells you to come back in 90 days.

To avoid that 90-day sentence, it is suggested that you thoroughly familiarize yourself with all the laws and regulations relating to operation of amateur stations. Make sure that you can draw a good diagram of a transmitter and receiver, and know for what each part is used, and why. Understand tuning the transmitter so that it will not create interference. Know what to do when you hear a distress call. All in all, you are required to have only a practical knowledge of what you are to do after a license is issued.

An applicant for license recently memorized the answers to all of the questions as asked in the old examination. When he was handed the "new-deal" question-sheet, he did not do so much as read the questions. He simply wrote down the answers, from memory, believing that the continuity was the same as that which he had memorized. By sheer coincidence, he actually happened to "land on the home plate" three times out of fifteen . . . putting down the proper answers to three respective questions which just so happened to fall into the continuity of the answers he gave.

Yes, he flunked. He dropped in to tell us how it happened. We saw the drab humor of it. (He didn't). Neither did he know that the question-sheets had been changed. Now he's studying amateur radio, and in 90 days it will be almost safe to predict that he will know a lot about it.

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This One Puzzled An Old-Timer

THE parson was standing on the railroad platform, waiting for the five-fifteen, which was late, as usual. An angry telegraph operator was beside him, cussing merrily away because the train was late. The parson admonished the operator for the language he used. Said the parson: "My man, why do you use such language? The Good Lord wouldn't like to hear you talk like that." "Who did you say?" queried the operator. "The Good Lord", replied the parson, "don't you know who he is?" To which the operator replied . . . "Never heard of him, what's his call?"

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Automobile Receivers

SATISFACTORY and quiet performance from an automobile radio is about 2 parts set and about 8 parts installation. There is no substitute for experience and no two cars are alike. Two identical cars of the same make will have entirely different sources of RF noise, which must be found and suppressed. Moral: let a specialist do it.

The Commercial Brasspounder

Recognition for the American Radio "Op"

By JEROME GOLDBY

THE American radio operator aboard ship is one of the eight wonders of the world. He is neither one of the officers, nor part of the crew. This, of course, is not the case on passenger vessels where, because he still carries an aura of mystery about him and his "radio shack" is respectfully peeped into by the passengers, he is ranked with, but below the lowest officer aboard. But on freighters and tankers, where brawn and not brain is the outstanding quality, the radio operator is only recognized during those moments when he is required for getting compass bearings, transmitting messages, the copying of press, etc. . . Because he does not go about shouting orders, and always appears shaved, it is believed that his work does not command the importance he attaches to it. Or rather, one gains the impression that he does not work at all yet, although the average man aboard is finished for the day after eight hours of work or watches and has his day of rest on Sunday, the operator must stand a continuous watch for a period of time sometimes aggregating a total of 84 hours per week. During these past years of economic stress, some shipping companies have cut their operator strength from four to two operators on passenger-carrying vessels, seemingly not interested in the dangerous position they put the lives of those passengers aboard by undermanning this important department.

Since the year 1898 when the first paid radiogram was transmitted from the Isle of Wight (Needles) station by Marconi, wireless operators as they were then known, have been fighting for the recognition which is due them for their continual efforts in the guarding of lives at sea and for their experimental work in cooperation with engineers, making it possible to pass the written word and news item from one part of the world to the other. By the martyrs who have gone down with their ships, have the international conferences of Safety of Life at Sea been taught the hazards to overcome and the means of minimizing them. One of the many laws enacted because of the martyrdom of a hapless operator was that each vessel must carry an auxiliary radio transmitter and receiver in addition to the regular outfit aboard. This law is most stringently carried out in foreign countries.

If the radio operator were only necessary for that moment of extreme necessity one can rest assured he would have been displaced long ago by an apparatus known as the automatic SOS signaling device which is supposed to work on the distress frequency and transmit from a perforated tape. But it was found that he was necessary to the conduct of the vessel, the command of most clerical matters, transmission of routine traffic, coastal compass bearings for the enlightenment of the Captain, upon which he depends more than he does on his sextant. The guiding natural brain must be there to guide, correct and repair these mechanical contrivances made by man.

It does look very simple to the average layman to watch a radioman copying a message on his typewriter, but he does not realize with what profound intensity the operator is concentrating on that one signal which may be coming through his headphones at the same time with about six other signals. This ability has taken years of hard study and application. Sometimes when static is terrific, an operator bends double over his receiver trying vainly to copy a signal which is coming faintly through the far off atmospherics. Many operators have gone raving mad in exasperation after trying for hours to decipher broken signals. This strain on their nerves has made nervous wrecks of many of them and statistics show that the majority of cases of nervous disorders in all marine hospitals are radio operators.

A comparison between American and foreign operators shows that, figured on the dollar basis, the average foreign operator's wage is on a par or about $77.00 per month, but as the purchasing value in foreign countries is much higher than that of this country, the foreign operators receive a more liveable wage than the American operators. Although the United States government grants regular subsidies to American shipping companies, not only for the mails which these ships may carry, but also for the purpose of keeping the American standards of living conditions high, these shipping companies utilize such money for matters more in keeping with their own personal selfish plans. Dividends must be large and, therefore, economies are made at the expense of labor and materials. Because the laws of the country make it imperative that a licensed commercial operator be aboard to take a ship out of port, they comply with this regulation by employing a youngster who has just graduated from one of the numerous schools and who has had no experience in practical work aboard ship. In some cases it is known that a company has signed an operator on as a deck hand, paying him a few dollars more for his license. They do not consider the fact that they are jeopardizing the lives of those aboard the ship, but only think of the money which this economy will save them. Recently a letter of fervent thanks was written by the captain of a foundered vessel to his radio operator which said in part, "I thank God that you were aboard and handled the situation so well, and not one of those inexperienced new graduates who would have been frozen with fear." These inexperienced youngsters usually take trips as sightseeing jaunts and not for the money paid as wages. Due to this fact, the morale is very low and at the present time a bill is before Congress which in part states, " . . . although the man has a license, he must have had one full year of experience operating on board a vessel under the guidance of a First Class licensed operator before he be permitted to take a ship out of port in charge of the Radio Department of that vessel."

Is it conceivable to believe that the average seagoing passenger would entrust his life to an inexperienced operator? The man who sends his family off to foreign travel aboard one of these inexperienced-operator-manned ships would not be able to rest peaceably until he had received word from their port of debarkation that they were safe, if he knew the amount of practical operating experience one of the above type of operators have had. He would not entrust his family to their care any more than to a pilot who had just received his license to pilot a plane. It is not very difficult to pass the government examinations after the questions are put into book form by the radio schools, but it takes actual years of practical experience before one of these operators are capable of withstanding the strain put upon him during a time of extreme stress. There would be an immediate change in the standards on most vessels if all passengers and crews made inquiry as to the proper complement of any vessel which they are taking. Because of the few accidents met with by passenger steamers during the past ten years, there is a feeling of complete safety by those aboard, but accidents still occur and they are not given too much headline space in the newspapers because of the unimportance of those aboard. Only recently an American freighter rammed and sunk a steamer in the Baltic sea during a heavy fog and only one newspaper carried the item somewhere on a back page. Another example of gross neglect and economic inefficiency was the recent sinking of a tanker which did not have an auxiliary radio aboard her. An explosion in the fore part of the vessel tore away the radio shack. Fortunately for those aboard, the vessel was in the shipping lanes and a few hours later a passing freighter rescued those aboard the stricken vessel.

At a recent hearing held before the Advisory Board of the NRA on wages for radio operators promulgated by the shipping companies, Mr. E. H. Rietske of the Capitol Radio Engineering School, quoted an article with special reference to the necessary education and experience which a radio man must have before he can become classed as an efficient and experienced operator. Due to the new apparatus continually being developed, it is imperative that the operator become acquainted with each new development and he can accomplish this only through continual study. From the old time spark transmitters and crystal receivers to the present tube transmitters and receivers, it has required laborious study and practical application before the operator can understand their intricacies to be able to give them the care necessitated by their being so complicated. It is easily understood that the more complicated the apparatus, the more care it requires, and here, also, is the necessity for capable operators self-evident.

The American radio operators, realizing the necessity for organization, have banded together under the banner of the American Radio Telegraphists Association which is very similar to the I. F. R., for foreign operators who have successfully fought for their rights. Today they are classed with the second officer of a vessel in position and salary, and it is not unusual when they are receiving the second highest salary aboard ship. Furthermore, when the foreign ship reaches port, the operator is not immediately discharged but is carried on the salary list of the company until he has another assignment. He is treated with due regard to the work he does and is given a regular vacation each year with pay. The writer believes that it is not because the foreign organization is so strong, but because foreign shipping companies understand and appreciate the importance of the work the operator is performing. The principles of the I. F. R. has built up the morale of the entire profession by refusing to permit any member to take a vessel out of port unless he is fully acquainted with the type of apparatus aboard that ship. Examinations are held regularly and each operator is classified according to his ability. In this manner a second class operator cannot take the position of a first class man. They also take into consideration the amount of experience or the number of years an operator has had in the profession, and their morale is so high that shipping companies have very little trouble with these officers over their actions in foreign ports. The old saying "as ye think of me, so shall I be" holds very true in these cases and it is, therefore, hoped and believed that with the new order of things and the strong cooperation of the American Radio Telegraphists Association, conditions will be bettered for the American operators who, because of the past economic conditions, have had to bow before the great and inhumane strength of interests more concerned with yearly profits than with fair play to their employees.

10-Meter Antennas

IT IS hard to beat a 16-foot vertical copper tube with single wire feed at 30 MC. Low angle radiation is very important, and unless you use a beam, avoid horizontal antennas. RF ammeters on each side of the single-fire feeder, in series with the antenna, will both read the same when everything is properly adjusted. Locate the feeder 27 inches from the center.

The New Deal—and the Radio Amateur

(Continued from page 5)

myself hear on the air it is my opinion that Globe Wireless transmits more messages across the Pacific than both RCA and Mackay combined. The whole Globe system is operated at a cost of about $12,000 a month—about what it costs to operate only one of the unnecessarily higher-powered stations of the other systems. Every dollar that has gone into Globe Wireless is working at the legitimate job of radiocommunication.

What is all this to the amateurs? This magazine told the amateurs five months ago that there was an opportunity coming for them to recover some of the frequencies that were taken away from them to make room for the useless commercial stations. In certain small quarters our prophesy was hooted. The standpatters of amateur radio who handed over our channels to these corporations fought our suggestion as a matter of course, citing the "impossibility because of the international radiotelegraph treaty". Well, America, which is notably respectful of international obligations, will continue to have due regard for the fundamental need for international radio treaties—the problems of interference and safety of life at sea—but in other respects America can run her own affairs without intervention of conniving commercials and squabbling foreigners. Our statement that much short-wave territory was idle and available for use of the scandalously overcrowded amateur stations is now more positive than ever before. Amateur stations are in fact a national asset and a public benefit; and it is through the medium of these non-commercial stations that serve the public nationally and internationally that idle frequencies can best be made to serve the "public interest, convenience or necessity".

—Clair Foster, W6HM.

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Letter from Ralph P. Glover On New Antenna System

(Continued from page 13)

size is increased to number 10 and the spacing reduced to two inches, the line impedance, still 440 ohms or an impedance ratio of 1 to 5.86.

A large portion of a text book must necessarily consist of mere reports of the work of others in the field for no one person or small group can possibly undertake exhaustive experimental and research work on all phases of the radio art. The only previously available literature on the use of the quarter-wave line for impedance matching has dealt with applications where the antenna impedance has been of the same order of magnitude as the line impedance, and in commercial installations where the expense of such a quarter-wave line, supported on a structure resembling a power substation, was an unimportant consideration. (See Sterba and Feldman, Proc. I.R.E., July, 1932, p. 1181, for example).

An entirely new set of problems arise in applying the principle of quarter-wave impedance matching to the horizontal half-wave doublet, for the desirable feature of suspending the matching structure from the antenna itself, requiring light weight construction, is complicated by the necessity for a very low characteristic impedance, which usually implies a physically heavy line—two points which are apparently incompatible. However, the eminently satisfactory electrical and mechanical features of the Johnson Type Q Antenna System indicate an entirely practical, convenient and economical solution of these problems.

Very truly yours,
(Signed) RALPH P. GLOVER.

THAT OLD DEVIL, SEA . . .

(Continued from page 9)

turns rowing, only trying to keep the dory's head into the wind and sea.

"Well", said Sverre at length, above the continual wash and lapping of the angry chop of the waves, "well",—and he turned his head for Olie to hear—"I guess we gonna go for ride."

"Yah", answered Olie. There was nothing more to say . . . nothing . . . except. Olie turned toward Sverre in the darkness. "Sa-ay—that wireless feller dere: he knowed we comin' back tonight, didn't he?"

He did.

Furthermore, knowing the condition of the weather and the frailty of outboard motors, K7AAC at Boca de Quadra didn't let too many raindrops slither down his lead-in before he started to do something about it. When Sverre and Olie had not showed up by noon the next day, he decided that even the joys of Ketchikan could not have detained two Scandinavians that long.

He sat down before his receiver and tuned over the 40-meter band.

"Nobody likely to be on in Ketchikan at this time. Probably skipping right over even if they were," he thought. "I think I'll just send out a 'CQ URGENT'."

He was answered by W7AIE, the Moran School on Bainbridge Island, near Seattle, Washington.

"Say, old man," he said to the operator in Puget Sound, "a couple of fishermen are overdue about 14 hours here from Ketchikan. Would you mind calling up the Coast Guard in Seattle and telling them about it?"

"Not at all," said W7AIE, "stand by a couple of minutes, will you?"

When he had talked to the Coast Guard headquarters in Seattle, W7AIE returned to his key. "They say they're ordering the Alert out from Ketchikan at once to search for those men," he reported.

"Fine business," returned K7AAC. "Say, I'd like to keep an hourly schedule with you until they're found."

"Okay," came the answer from W7AIE. "I'll be seeing you at three o'clock next, then."

It happened that this whole procedure had been overhead by W7TX in Seattle, who had been accustomed to keeping schedules with several Alaskan radio amateurs for several years, and who (being an Alaskan himself) realized the significance of distress anywhere in the Territory. So W7TX "horned in" to tell W7AIE that he could call on him for any help necessary. W7AIE arranged, then, to keep contact with K7AAC through the night if necessary; W7TX to take over the next day.

Early the next morning W7TX called. "Well, what news?"

"Everything Okay now", said W7AIE. "The two men were found off Dixon Entrance by the Alert last night. Been drifting 24 hours. Not suffering badly from exposure . . . Some ride, eh?"

Leotone Radio Co. Offers Wide Variety of Speaker Cones for Replacement

LEOTONE RADIO CO., 63 Dey Street, New York City, is specializing in the manufacture of speaker cones and field coils for any speaker known to radio. It is obvious that a dealer or jobber can ill-afford to stock the hundreds of types and sizes of cones and field coils which need replacement. Service men have often been stumped as to a source of supply for special cones or coils. The problem is solved by Leotone, who offer immediate delivery on any conceivable type of cone or field coil. Readers of "RADIO" are invited to write direct to the manufacturer for further information.

NEW BOOKS
AND REVIEWS of CATALOGS

Kruse's Radiophone Guide, by R. S. Kruse, E.E., with contributions by F. S. Dellenbaugh, Jr., Boyd Phelps, E. E. Griffin, Ralph R. Batcher, Raymond Morehouse, R. F. Shea and McMurdo Silver. A book that every radiophone experimenter needs, because it deals with the more modern systems of grid modulation and other phases of radiophone work. Contains data on Universal Audio Amplifiers and Modulators, Leak Bias for the Modulated Tube, Modulator Mistakes, New Frequency Measuring Service, Economical Tuning Condensers, Microphone and Amplifier Levels, Feeders, Class A Prime Modulators, Simple but Good Converter, Modulating Tetrodes, Design of RAC Power Supplies, Single Signal Receiver, Commercial Phone Circuits and Sectional Transmitters.

Well illustrated; 7 x 10, paper bound; 35 cents per copy. Procurable from most radio dealers or direct from R. S. Kruse, North Guilford, Conn.

✣ ✣ ✣

Volume Control Guide. A handy little pocket booklet showing replacement volume controls for any factory-made receiver has been issued by Electrad, Inc., 175 Varick Street, New York City. A copy can be secured from your local Electrad jobber or by writing direct to the manufacturer. Twenty-four circuit diagrams are shown, covering all of the many applications of volume controls. More than forty additional pages are devoted to the correct type of Electrad volume control to use for replacement.

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New Final Amplifier For the HK-354 Gammatron

(Continued from page 8)

volts at .175 mills.). At this input, the plate showed a very faint trace of color when the key was held down, but not enough to even bother about. This is really remarkable, considering the somewhat limited excitation which was not over 50 watts out of the ten. With the same bias (double cutoff), plate voltage, and excitation, the 354 gave about 10% more output than the '52. A drop in plate voltage to 1500 volts showed a slight gain in output over the '52 with the same input. It is felt that this gain in output is due in part to the fact that the 354 is somewhat easier to excite than a '52. The similarity in characteristics of these two tubes is well illustrated by the fact that with the same operating conditions, both tubes showed practically identical grid current readings (35 mills).

On 14 MC, the same input was maintained but with slightly greater plate dissipation. On this band, the two tubes had about the same output but the 354 seemed to have less tendency to show color. This may be due to the very low plate-filament capacity which allowed the use of more turns in the inductance and consequent greater efficiency. This tube is ideally suited to high plate voltage and high efficiency operation but it must be remembered that high bias and excitation are a requisite. We have seen one of these tubes running with a full 1-KW input, working as though it had a mere 100 watts instead. The high-power ability of the tube can be taken for granted. It is with the idea of presenting the facts on what this tube will do, with the generally available input and excitation, that we have selected these values for our tests. The Gammatron is in the socket at W6WB at the present time and is likely to stay there.

This presentation would hardly be complete without a compliment by the staff of "RADIO" to Mr. Eitel (W6UF) and his associate, Mr. McCullough (W6CHE), who, in conjunction with Mr. Ralph Heintz, have been responsible for the development of this new transmitting tube of such unusual merit.

Rationalizing Radiating Rocks

(Continued from page 18)

which is normally left in position "1". All tube filaments, including rectifiers, are left running constantly and are controlled by another switch. Closing Sw1 turns on all plate supplies simultaneously. With Sw1 open, Sw2 is flipped to position "2". R1 is then adjusted until the plate voltage on the oscillator is quite low, or until it produces an R6 or R7 signal in the receiver. We can then see who is hetrodyning us and on which side. We can then throw our selector switch one way or the other, depending upon which side the QRM is on, and be in the clear (maybe!) . . . all a matter of a few seconds. If the oscillator happens to be tuned too close to the "edge" it may not oscillate with reduced plate voltage, and should then be operated "backed-off" a bit from the unstable region. The toggle switch is then turned back to position "1" and the set turned on in the regular manner with Sw1. This will change the frequency of the oscillator a few cycles, but for all practical purposes the frequency as heard in the receiver may be considered as the actual operating frequency. Obviously this system is unsuited to 14 mc and night work on 7 mc, because a station 100 miles away may be causing a terrific hetrodyne with you in the receiver of someone in Australia, and yet be inaudible in your own receiver. But if you once try it on 80 or 160, you won't ever be without it. And the selector switch is a time-saver on any frequency.

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High Vacuum Rectifiers With Grids

THE 84 is a high vacuum rectifier designed for use with automobile sets and in order to reduce the space charge and voltage drop from plate to cathode a grid is located between those elements and is kept positive due to the fact that it is internally connected to the plate. This positive grid accelerates the electron stream and reduces the tube's internal impedance. What will they think of next?

The Reflector Antenna

(Continued from page 25)

approximately four times as much power would have to be supplied from the transmitter. The tests also indicated that the signal directly behind the reflector could not be completely cancelled unless the reflector was directly excited. However, it was felt that the signal in the direction directly behind the reflector should not be less than from one-half to one-third of that in the direction in front of the exciter. This signal ratio, front to back, was obtained without exciting the reflector directly from the transmitter, and since it permitted such a simple setup of feeder lines to the exciter antenna only, it was left that way for permanent service.

This antenna is a good example of the increased efficiency of higher vertical antennas. While the increase of signal finally obtained at KYW partly came through the use of a reflector, the new vertical exciter unit, when used alone, indicated that its signal was equal to approximately twice the power in the old diamond antenna. There seems to be little doubt that the efficiency of most of the antennas as used now in broadcasting could be appreciably increased with only a moderate expenditure of money.

SCRATCHI

Osockme, Japan.
October 23, 1933.

To EDITOR "RADIO" (which dispel misinformation by the month to all bugs and bugesses who have forwarded free coupon with proper sum):

Honorable Sir:—

Since hearing from me before several little things have passed me by which I desire to place in front of you for illumination. Scratchi have formed radio club in Japan which consist of fancy liars who say such things as "Last night I work Constantinople and he come in so loud I can hear him one foot away from fones with A and B batteries shunted in serious." Such chin-chat continue until referee count ten o'clock and meeting come to adjournment. After meeting, Scratchi and all other two members adjourn to Rusty Spoon coffee shop and commence discussion which kind best receiving apparatus to buy. We first dissect latest copy "RADIO" and pursue carefully special offerings in aft section of magazine, and have arrived at far end of wits to make buying decision. We enjoy clever words of advertising exaggerationists who make special offer this month of EZ2C receiver with rubber-tired ticklers and finished in shining walnuts. On next page we see modest announcement from fellow who say, "You can fool all the people quickly if you sling the Durham slickly", and he beg us make purchase modest radiophone equipment which cost only 2 or 3 hundred dollars, exclusing tubes, batteries and everything.

Why pay so much prices for equipment, think Scratchi, when can easily and quickly make duplicake of same for few cents? All you must purchase for such are some vary condensers, rheostacks, curls and sockits. We climb into Scratchi's tintype jumpabout which Mister Ford issue wholesale and make tour of radio dealer shopping districkt. We make converse with very superior clerical gent who are safe behind glassy counter and he jot down what we desire.

He add up all parts which we desire to have and it show twelve dollars. We then require how much cost it would become to put same in small box, six-inch in all directions. He rapidly jot down 13 additional dollars, which he explain are for labor, time, roomrent, income tax and loss from bootleg revenue from annex of radio store which once keep wolf away from radio counter. We pay for radio parts but tell slick clerk we come back for 13 dollar box some other time, which never come. Such robbery make Scratchi want to join Q Cluck Canners and distribute tarfeather overcoats to highbounding radio dealer magnates. With flowery oriental language we tell him what we think, when we get six blocks away from store.

We arrive home and commence assembly of famous receiver with impudence coupling and which use special large size grid-leak drip pan into which can flow tremendous unneeded amount strong signals from such efficiency creating receiver. Long and laborious hours of work find receiver totally completed and when loud speaker become hooked on we get nothing but strong draft from tin horn. Only kind of music which emanate from receiver is various octaves of squeak from turning rusty condenser shaft. Further experimenting show lack sufficient high voltage for make receiver operate, so Scratchi connect "B" terminal to high-tension outside power pole so can get more voltages. First make two-finger test across binding posts to see if power sufficiently strong, which result in leaving Scratchi only eight fingers where once had ten.

When finally turn on full current, my brother radio club member friend say, "Scratchi, I smell something like burning rubber." And I say to him, "I should inform jap-eyed universe that you always do. Mightbe heated bath would assist you."

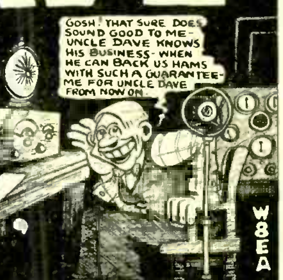
I respectfully ask you, Hon. Editor, to send more details for make my receiver work because I are ruining my indigestion and distemper. If I continue along such lines and success do not soon come, there are going to be social function at our place by Hon. Coroner, and the guest of honor will be you.

Yours superstitiously,
Scratchi.

UNCLE DAVE

356 BROADWAY ALBANY, NEW YORK.

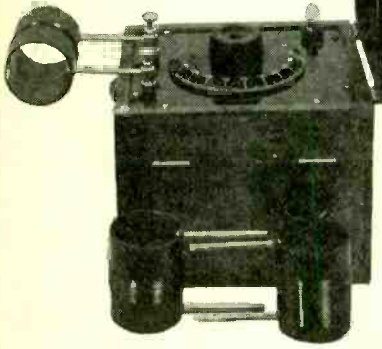
LONG DISTANCE PHONE 4-5746



PEERLESS

PRECISION Wavemeter

. . . an invaluable aid in tuning the transmitter and finding foreign broadcast stations; 20, 40 and 80 meter bandspread coils, individually calibrated, neat walnut cabinet, indicator lamp, hinged lid, curve included, VERY POPULAR AMONG THE AMATEURS, special $6.25



Peerless Radiophone Transmitter

At last . . . a complete phone transmitter that is within the reach of every ham. 8 to 10 watts output, 100% modulation, excellent quality, guaranteed. May also be used for CW operation. A carefully designed MOPA transmitter using a 45 oscillator and 46 modulated amplifier, constructed for operation in the 160 meter phone band. For minimum reaction between components, the RF, modulator, and power supply are in separate sections.

The RF portion uses a 45 oscillator and 46 modulator amplifier. The modulator uses a 56 speech amplifier coupled to a 250 modulator which completely modulates the 46. A Gavitt star single button microphone which lists at $10 is included. The power supply uses a husky transformer which furnishes all voltages. An 83 rectifier tube in conjunction with heavy filter chokes makes for excellent regulation. The whole transmitter is designed to operate at the highest efficiency. Wiring diagram and detailed instructions on operation are included. Complete with microphone, tubes, milliameter, ready to plug into 110 volt 60 cycle AC supply.

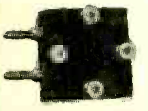
SPECIAL $36.50

The parts alone cannot be purchased at this price!

LOOK AT THIS!

The above transmitter, crystal controlled, with crystal ground to your frequency in the 160 meter band; exactly the same as above except with 47 crystal oscillator, SPECIAL $41.25

Peerless Adjustable Crystal Holder



. . . a molded bakelite, dust-proof, adjustable crystal holder. With this holder you get the exact tension you desire on the crystal. An invaluable holder for the portable transmitter, SPECIAL........$0.74

SAME as above, but plug-in, each........ 1.05

Peerless Precision Crystals

Made of best grade Brazilian quartz obtainable, ground to your specified frequency in 1715 or 3500 KC band to a guaranteed accuracy of 0.1%. Molded bakelite, adjustable, dust-proof crystal holder FREE with purchase of this crystal at only........$2.75

Peerless crystal complete with commercial type plug-in precision holder 3.60

7000 KC crystals........ 7.50

Finished oscillating blanks, guaranteed, each 1.60

Unfinished blanks, guaranteed, ea........ 1.00

Precision grinding—your present crystal ground to and higher freq. 1.50

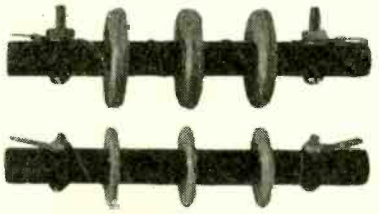
ALL CRYSTAL WORK IS GUARANTEED!

Peerless Precision Plug-in Holder

. . . for the Ham that wants the best. Plates accurately lapped flat. G.R. plugs, knurled nuts to facilitate removal of crystal. Really a precision job.

SPECIAL $1.29

JACK MOUNT for precision plug-in holder .... .30



PEERLESS Lattice-Wound RF Chokes

. . . for use in plate or grid circuit of transmitter. Pie wound on bakelite rod. A beautiful job with low distributed capacity. A very efficient choke for use on all ham bands.
400 ma. ....$0.85   1 amp. $1.25

PEERLESS 1-TUBE BAND SPREADER RECEIVER

. . . a neat compact receiver with general coverage 15 to 230 meters. Bandspread over any part of this band. Uses a type 30 tube. Neatly enclosed in metal cabinet, finished in black with all coils and 21 foot battery cable.

SPECIAL $5.85

Broadcast band coil, each........ .75

METERS

EXTRA SPECIAL! Weston Model 301 meters, sl. used, 0-5, 10, 25, 50, 100, 150, 200, 250, 300, 500 Milliameters, each $3.69

High voltage DC voltmeters, slightly used Weston meters, calibration checked against accurate standards:

0- 500 volts ....$ 9.75	0-3000 volts $30.00
0-1000 volts 15.00	0-4000 volts 45.00
0-1500 volts 20.00	0-5000 volts 60.00
0-2000 volts 25.00	

Weston slightly used AC voltmeters:

0-10, 50, 100, special, each........$4.25

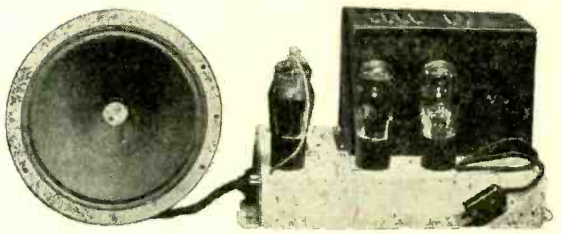
0-150, 250, each 5.55

0-300, each........ 6.75

0-300, 600, each 11.00

Jewell Pattern 88 0-200 microamperes, slightly used 8.50

Rawson and Sensitive Research Microammeters, 0-15 micro-amps, semi-portable lab. type, extra special, ea. 18.00



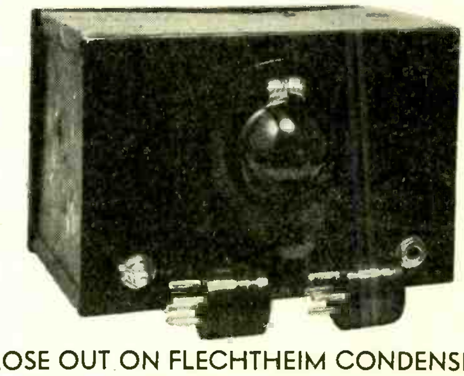
UNCLE DAVE'S RE-DESIGNED AND IMPROVED LOFTIN-WHITE AMPLIFIER

. . . a wired and tested, licensed Loftin-White built by Sprague for their Home Talkie outfit. '24A followed by '45; 280 rectifier; excellent audio characteristic; high gain—small bulk; splendid mike and speech amp. for ham or PA service; AND THE PRICE $6.95

PEERLESS 2-TUBE LOUDSPEAKER RECEIVER

. . . a very popular distance-getting receiver which on actual tests has received all of the major European short wave broadcasting stations. This receiver will pull in practically all the short wave stations in almost any location. Embodies latest type tubes in the most efficient circuit it is possible to design . . . only two major controls make for easier tuning of distant stations. Persons with no previous experience with short waves have tuned in foreigners the very first day they operated the set. Hundreds of enthusiastic letters from satisfied customers prove the ability of this receiver to reach out and drag them in. Designed by an engineer having years of experience in the short wave field. This receiver embodies 32 and 33 tubes and operates from 2 dry cells and 2-45 volt B batteries. A real distance-getter! Complete with coils from 15 to 200 meters, Special........$10.85

Broadcast coil, each .... .75



CLOSE OUT ON FLECHTHEIM CONDENSERS!

2 mfd. 1500 volt, each....$2.95	2 mfd. 650 volt, each....$1.65
1 mfd. 1500 volt, each.... 1.85	2 mfd. 3000 volt, each.... 11.25
4 mfd. 1500 volt, each.... 5.25	1 mfd. 2000 volt, each.... 3.20

READRITE MILLIAMETERS 0-15 to 400 mills, each $0.59

ONLY A FEW LEFT Brand new Beede Milliameters, 0-10, 15, 25, 100, 150, 200, 250, 300, 500, 3¼-in. diameter, long scale, D'Arsonval jewelled movement, dead beat, zero adjustment, flange mounting, black enamel case, each........$2.95

EVERY DOLLAR THAT YOU INVEST IN RADIO HAM STUFF IS BACKED BY THE FAMOUS

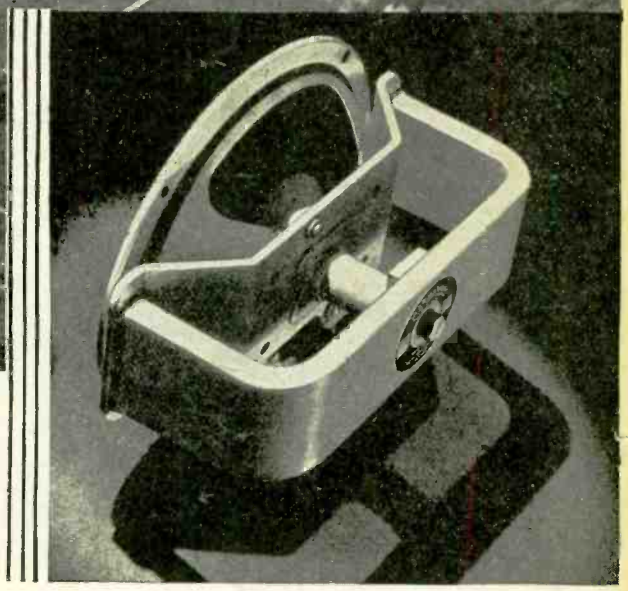
UNCLE DAVE'S UNCONDITIONAL GUARANTEE

REAL RED HOT RADIO BARGAINS — **ORDER NOW!** — 24 HOUR SERVICE SHIP ANYWHERE

WRITE FOR SPECIAL HAM SHEETS

SPECIAL ATTENTION GIVEN TO EVERY ORDER....

IN THIS GREAT MARKET FOR BATTERY RADIO



This Magnavox Permanent Magnet Speaker makes possible the development of the great farm market because it provides dynamic performance for battery operated radio sets.

USE

MAGNAVOX P. M. SPEAKERS

for Dynamic Performance

ONE vast undeveloped market for radio lies ahead . . . *the Farm Market.* Hundreds of thousands of American families living in isolated homes not connected with electric service *need* the best modern radio for business, culture and entertainment. Rising prices have increased their income. *At last they have the money to buy!* And they can now enjoy radio as rich, true and delightful as the A. C. set provides in the city home.

The Magnavox Permanent Magnet Speaker *gives genuine dynamic performance to battery operated radio sets*—with complete frequency range and entire freedom from distortion. Write for P. M. Speaker Bulletin. Our engineers are at your service.

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