IN THIS ISSUE—

How to Build a 40-Foot Tower for Less Than $4.00 — By W6AWT

Radioophone Suggestions — By ROBT. S. KRUSE

Putting Power Into the Antenna — By CLAYTON F. BANE

Colonel Foster's Comment

A New Vacuum-Tube Key-Click Eliminator — By J. NORRIS HAWKINS

W6CUH - W6QD Globe Girdler

A New Frequency Meter Monitor — By FRED H. SCHNELL

Angle Radiation
By ARTHUR L. MUNZIG

Do You Want To Be Hung High?
By L. R. HUBER

New "Q" Signals

"Scratchi"

Cathode-Ray Television
By ARTHUR H. HALLORAN

Ham Hints
By JAYENAY

New Radio Data Sheets

Commercial News
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First, the Standard "PRO"—the most complete, the most sensitive and selective standard short-wave receiver ever devised.

Second, the inclusion of an improved panel-controlled Quartz Crystal Filter effects a remarkable reduction in high-frequency noise and increases selectivity amazingly—all without sacrifice of a single feature for which the Standard "PRO" has won international fame.

And now, Automatic Volume Control is available in either the Standard "PRO" or Crystal "PRO." This device may be used or not, at will, merely by operating a front-panel switch. It is a most useful improvement for maintaining more stable volume on fading signals.

All "PRO" models are complete, with built-in power pack, band-spread tuning on all waves, and four sets of coils covering 15 to 250 meters. Extra coils for the 8 to 16 or 250 to 550 meter bands may be had for $5.00 a pair.

You will be as proud to own a COMET "PRO" as we are to produce it—because it is the most modern receiver, embodying all of the knowledge that radio engineering has mastered up to this time.

The Hammarlund Crystal Filter and Automatic Volume Control may be added, at moderate cost, to any Standard "PRO" Receiver.

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PR-11
This is No Time for Sulking

UK repeated emphasis on the hazard to amateur radio that is involved in the unqualified ratification of the Madrid Treaty is commencing to bear fruit, notwithstanding the fact that some are inclined to divide and minimize the danger. RADIO is in receipt of commendatory letters and telegrams from progressive radio clubs all over the world. We will pledge themselves to aid any effort to stop this insidious attempt to bar trans-Pacific traffic from the air.

The threat is not alone to those who actually handle the traffic across the ocean, but also to those who originate and relay the messages from interior points. If the third-party type of message is prohibited, it will directly affect every traffic-handler who relays these messages to or from the Orient. But of the utmost importance to amateur radio is the fact that elimination of this service would mean the loss of an irrefutable argument that amateur radio is conducted for the public interest, necessity and convenience. The commercial interests recognize this vital point, even if some amateurs do not, and would be quick to take advantage of it in their continued efforts to capsize amateur radio.

It is strange, indeed, that some of the most influential amateurs, those to whom we have looked for leadership in the past, should shut their eyes to this menace and belittle the campaign against it. Far be it from us to ascribe any nefarious motive to this convenient blindness, though many other amateur leaders are culpable. Our only concern is that these erstwhile leaders do not go back to the slumberers from which we have awakened them, or do not, like Achilles of old “retire to bulk in their tents.”

This is no time for sulking. The emergency is serious and immediate. Everybody must unite in a common purpose to prevent the ratification of the treaty in its present form. It is only by united action on the part of the entire amateur fraternity that the Senate can be induced to strike out the offending clause. “Uneasy lies the head that wears a crown.” A whole-hearted pull together can avert this catastrophe. But if some pull in one direction, others pull in another direction, while our leaders lie down and sleep, the always-organized commercial interests will succeed in killing trans-Pacific traffic and in crippling all amateur radio. The blame would rest, not on those who may have tried and failed, but on those keepers and sufferers who made failure possible.

But there ain’t going to be no failure. Let everybody climb on the bandwagon now and help carry on to victory.

How to Prepare the Resolution

I N reply to those who have asked for a “form” of protest against the Madrid Treaty, the following suggestion is offered as a resolution to be passed by a radio club or other organization. It is modelled closely after that passed by the Pacific Division amateurs in their convention during September.

WHEREAS, the International Radio Communications Convention, Madrid, 1932, provided that the operation of a transmitting station must be in the public interest, necessity and convenience; and WHEREAS, similar restrictions have already been placed upon the operation of the citizen bands of the United States or its possessions; and WHEREAS, we believe that the control of such activities properly belongs to the individual nations in the manner provided in the Washington Convention of 1927; and WHEREAS, this prohibited service is not being provided by any agency other than amateur radio operators and is of inestimable value to those who are receiving it at no cost to themselves:

THEREFORE, BE IT RESOLVED, that the representatives of this club, at their option, may submit to the local Postal Commission a statement of this clause and then that the Commission not permit such service to be provided.

Surprise Packages From the F.R.C.

Un er a new ruling from the Federal Radio Commission, after an amateur has passed the code test when taking his examination for license, the radio inspector hands him a sealed envelope. Inside this is another sealed envelope which contains the examination questions as sent directly from Washington. The RI does not know what questions are asked in the examination which he is conducting. There are supposed to be 200 different lists of questions so as to avoid duplication during the same examination.

When he has written the answers, the amateur inserts them and the questions in the envelope, and hands it to the RI, who sends the surprise package to Washington without knowing what is inside. The FRC corrects the papers and notifies the applicant of his success or failure.

What all the secrecy? There are only a few fundamental questions which can be asked, no matter what the order. Draw circuit diagrams of a receiver and transmitter, write a code and explain how they operate; what to do when an SOS is heard; what are the meanings of a selected list of “Q” signals; what are the laws governing an operator’s conduct? These questions might just as well be wrapped in cellophane.

While this means less work for the local inspector, there is an avalanche of new work for the FRC. Maybe times are quiet in Washington and the FRC wants to keep it that way.)

The Union Oil Company, through Wm. Groundwater (a good radio name), has asked us if amateurs would be likely to use message blanks which advertise some of the company’s new products. The blank is ready for mailing after the message is written and addressed. The question has been put to a number of amateurs, all of whom dislike the scheme of publicizing the company’s insignia instead of the emblem usually adored by the message blanks. Those who think otherwise can send their thoughts directly to the company and perhaps get a free pad.

There is real merit in the idea, however, not for advertising some oil product, but to advertise the value of the services that are gratuitously rendered by amateur operators. Help is needed in the endeavor to get more and wider channels in the short-wave spectrum. The grateful recipient of a message is often in a position to extend such help. He merely needs to be informed of what amateur operators are doing, what they need in order to render better service, and what he can do to help them get it. This can all be stated in a few well-chosen sentences printed on the small-size ad pages, and they could also be sent to Congressmen who will be requested to aid the amateur cause when Congress again convenes.

Should the oil company or any other public-spirited organization distribute half a million of this kind of blank they would thereby earn the goodwill of thousands of amateurs, something of more enduring benefit than can be secured by any form of direct advertising as first proposed. And if no company is long-sighted enough to recognize this, let the amateurs themselves print and buy such blanks. The idea is certainly worth considering.
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This is no time for sulking. The emergency is serious and immediate. Everybody must unite in a common purpose to prevent the ratification of the treaty in its present form. It is only by united action on the part of the entire amateur fraternity that the Senate can be induced to strike out the offending clause. "Under no circumstances!"

A whole-hearted pull together can avert this catastrophe. But if some pull in one direction, others pull in another direction, while our ranks begin to sulk, the always-organized commercial interests will succeed in killing trans-Pacific traffic and in crippling all amateur radio. The blame would rest not on those who may have tried and failed, but on the sleepers and sulkers who made failure possible.

But there ain't going to be no failure. Let everybody climb on the bandwagon now and help carry on to victory.

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WHEREAS, the International Telegraph Communications Convention, Madrid, 1932, provides that "commercial interests shall be strictly prohibited from transmitting international communications emanating from third parties;"

AND, WHEREAS, this prohibited type of message is in full accord with the letter and the spirit of the now-effective Radio Act of 1927 that the operation of a transmitting station must be in the public interest, convenience and necessity;

AND, WHEREAS, similar restrictions have not been placed upon other agencies but the citizens of the United States or its possessions;

AND, WHEREAS, it is the contention of such activities properly belongs to the individual amateurs in the manner provided in the Washington Convention of 1927;

AND, WHEREAS, this prohibited service is not being provided by any agency other than amateur radio operators; and it is of invaluable service to those who are receiving it at no cost to themselves.

WHEREFORE, BE IT RESOLVED, that the resolution respectfully requests the elimination of this objectionable clause when and if the Convention is ratified by the United States Senate.

Therefore, obey that impulse. Have your radio club pass such a resolution and send it to your Senators, and other influential officials in time to prevent ratification of the obnoxious clause.

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Under a new ruling from the Federal Radio Commission, after an amateur has passed the code test when taking his examination for license, the radio inspector hands him a sealed envelope. Inside this is another sealed envelope which contains the examination questions as sent directly from Washington. The RI does not know what questions are asked in the examination which he is conducting. There are supposed to be 200 different lists of questions so as to avoid duplication during the same examination period.

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Why all the secrecy? There are only a few fundamental questions which can be asked, no matter how they are worded: Draw circuit diagrams of a transmitter and receiver, and explain how they operate; what to do when an SOS is heard; what are the meanings of a selected list of "Q" signals; what are the laws governing an operator's conduct?

These questions might just as well be wrapped in cellophane.

While it means less work for the local inspector, there is an avalanche of new work for the FRC. Maybe times are quiet in Washington and the FRC wants to be busy with the task of correcting thousands of papers from shabby-kned applicants; or maybe they want the sadistic pleasure of writing a man that he has flunked, instead of enjoying it vicariously.

Anyway, a noteworthy improvement in procedure has been made, which will probably heighten the FRC. Will the time come when the Commission will prohibit publication of books which tell how to sulk in Far Eastern traffic and thereby enable the purchase of erroneous books so as to purposely mislead the aspiring student?

The Union Oil Company, through Wm. Groundwater (a good radio name), has asked us if amateurs would be likely to use message blanks which advertise some of the company's new products. The blank is ready for mailing after the message is written and addressed. The question has been put to a number of amateurs, all of whom dislike the scheme of publicizing the company's insignia instead of the emblems usually adorning the message blanks. Those who think otherwise can send their thoughts directly to the company and perhaps get a free pad.

There is real merit in the idea, however, not for advertising some oil product, but to advertise the value of the services that are gratuitously rendered by amateur operators. Help is needed in the endeavor to get more and wider channels in the short-wave spectrum. The grateful recipient of a message in Morse is often in a position to extend such help. He merely needs to be informed of what amateur operators are doing, what they need in order to render better service, and what he can do to help them get it. This can all be stated in a few well-chosen sentences printed on the blank. The oil company's blanks could also be sent to Congressmen who will be requested to aid the amateur cause when Congress again convenes.

Should the oil company or any other public-spirited organization distribute half a million of this kind of blank they would thereby earn the goodwill of thousands of amateurs, something of more enduring benefit than can be secured by any form of direct advertising as first proposed. And if no company is long-sighted enough to recognize this, perhaps the amateurs themselves print and buy such blanks. The idea is certainly worth considering.

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NOW that Mr. K. B. Warner, Secretary-Manager of the ARRL, has elected to entertain the amateurs and the public with his side of the discussion with me about the Madrid amateur regulations, I feel I must do my part. Because the way is open I can happily talk all day, for there is no subject nearer to my heart than the amateur's right to serve the public with free message traffic; and there is nothing that so arouses me as seeing a man—either a commercial representative, a government employee or an amateur—trying to impede that service.

Mr. Warner represented the ARRL at the Madrid International Convention. When he returned he made a report to the amateurs. The most significant statement in it was, "There is no change from a practical standpoint in our communications regulations."

The men who represented certain American commercial radio corporations left the wording of the amateur provisions of the treaty for convention more or less as it was, but they added this: "It shall be absolutely forbidden to licensees of amateur stations to transmit international communications emanating from third-party messages. The amateur provision may be modified by special arrangements between the interested countries." Mr. Warner has taken on the unhappy job of trying to prove that this addition, if ratified, would make no practical change in amateur traffic regulations.

THE present practice is, and always has been, that we United States amateurs handle third-party messages between any foreign country that does not object. This amateur service has grown to be of immense value to the public, especially the trans-Pacific service. We amateurs were providing this free service years before the Radio Corporation of America and Mackay had any trans-Pacific circuits in operation. Let me assert again—and drive the statement home—that we are handling now, and have always handled, third-party messages with every country that does not object; and that our right to do so would be absolutely cut off if the Madrid amateur provisions were ratified by the United States Senate.

In the face of these facts, Mr. Warner feels that the flat prohibition in the Madrid addition to the 1927 regulations constitutes "no change from a practical standpoint in our communications regulations." The all-important question is . . . if this Madrid addition makes no change why was it added? This question Mr. Warner makes no attempt to answer. Instead he essays the impossible task of trying to prove that the 1927 regulations did prevent the international handling by amateurs of third-party messages. He struggles hard with the 1927 regulations and finally comes to a conclusion that appears to satisfy him. But he finds that the 1927 regulations prohibited United States amateurs from handling "important" messages with licensed foreign amateurs, and that the only thing prohibited by Madrid that was not already prohibited was the international handling of important messages with unlicensed amateurs—whatsoever that may mean.

THE Federal Radio Commissioners would perhaps be delighted if they were able to accept Mr. Warner's conclusion. But not even that body—with the 1927 regulations in front of them for the last five years—have been able to arrive at this conclusion. It is easy to see why the FRC could not come to the Warner conclusion. Look at the findings of the 1927 convention: "The exchange when permitted must be conducted in plain language and must be limited to messages bearing upon the experiments and to remarks of a private nature for which, by reason of their unimportance, recourse to the public telegraph service might not be warranted. Did anyone ever see a more wobbly, weak and uncertain proclamation? A definite statement cannot be made by the use of indefinite terms, such as 'private nature'—by reason of their 'unimportance' and 'might not be warranted.' A positive declaration cannot be made by the use of a whole string of negatives. Certain people who could make such an exhibition of jargon could never decide what is or is not "plain language," what is or is not "private," or what is or is not "important."

THIS 1927 regulations was devised by commercial people. The amateurs had no part in its formulation. Too bad; for I submit that all of my amateur acquaintances could have said in understandable language at least what they wished to say. I submit also that an amateur—to wit, Mr. Warner—is brave indeed to try to read into our notices of its opposition, effective and intelligible interpretation. The FRC couldn't do it.

And that is precisely why the United States commercial representatives grabbed the opportunity provided by the next convention, Madrid, to tack onto this mess a plain-language prohibition against amateur message handling between nations. And that is why they arranged things so that no longer is, "unless one of the countries has given notice of its opposition," effective, and changed the whole complexion of the situation with, "The above provision may be modified by special arrangements between the interested countries."

SEE the difference? Under 1927 we properly handled messages—third-party or otherwise—with any foreign country until we filed notice of its opposition, which no country ever did. While under Madrid we are flatly prohibited from handling such traffic until a special arrangement would have been made between the United States and all countries in question. Which no country ever will do. Now, Mr. Warner knew all this. He knew also that the amateurs wouldn't have a ghost of a chance in inducing our State Department even to attempt to make "special arrangements." The commercial men, likewise, knew it when they added that joke. Mr. Warner knew that if the 1927 regulations did in fact stop our foreign traffic, the commercial people would have seen no need whatever for adding a flat prohibition to the Madrid treaty; and if tacking on this joke. And yet, knowing all this, he did not disclose in his Madrid report the seriousness of the change, but, instead, reported, "There is no change from a practical standpoint in our communications regulations."

THE report was in narrative style, with poor spelling and spelling habits, which might have been satisfactory reading for youngsters. But it was not a report that could be completely understandable to serious-minded grown-ups who had the right to expect an accurate and informative report of the final outcome of the convention. If referred in anything but clear terms to attempts of the commercial representatives to put the ban on the whole of the traffic-handling activities of all amateurs, the amateurs might have drawn their own conclusions. Instead he summed up with his own, "1927 treaty is ratified and then a practical standpoint in our communications regulations."

Every man I have interviewed accepted that conclusion as the truth of the situation. And to this day Warrenmother's son of us would have been dwelling in fancied security if "RADIO" had not seen and disclosed the facts.

JUST remember, the amateur body is not, even now—a year after the Madrid convention—officially in possession of the findings of that convention. The English translation has not yet reached us from Washington. A few amateurs have obtained recently the French version of the amateur or provisions only. The amateur representatives at Madrid had these provisions and could have, and should have, given us the final terminology instead of conclusions drawn by themselves.

The present situation with respect to this Madrid commercial treaty is this: The commercial representatives who devised the new amateur regulations want them ratified as they read; Mr. Warner wants them ratified as they read; not ONE amateur who knows the truth wants them ratified as they read. What that means the end of the discussion. "RADIO'S" space this month does not permit the elucidation of many angles of translation. We have not yet seen the light of day. "RADIO'S" policy is to devote no space to discussions between individuals unless the subject is of vital importance to all amateurs. The invasion of the inalienable right of every amateur in the world is involved in this case.

—Claire Foster, W6HM
Farnsworth Cathode-Ray Television System

By ARTHUR H. HALLORAN

The Pick-up Tube

FIG. 1 is a diagram of a typical pick-up tube which may be used to illustrate the operating principles of a number of different tubes. It consists essentially of an evacuated glass chamber with a coated mirror or photosensitive surface, the cathode, at one end and at the other end of the tube is a slender target inclosing an electron-collector and perforated with a tiny aperture facing the cathode. The target is maintained at a positive potential of say 500 volts with reference to the photosensitive surface.

The entire tube is placed inside a framework consisting of three sets of coils. One coil is wound concentric with the tube so as to establish throughout its length a uniform magnetic field. These lines of force are parallel to the length of the tube when a continuous current is passed through the coil. The two coils of the second set are placed above and below the tube so as to establish a vertical magnetic field across the plane of the target. The two coils of the third set are placed on either side of the tube so as to establish an horizontal magnetic field across the plane of the target. The deflecting currents which are passed through these last two sets of coils have a wave form which resembles the teeth of a saw, sloping upwards at an acute angle and dropping downwards at a right angle to the base line.

During operation, an optical image of a scene of action is focused through a lens on the photosensitive surface, much as it might be focused on the ground glass of a camera. This optical image may be considered as an aggregate of microscopically small areas, each differing from the other merely in the intensity of its light. As a consequence, electrons are emitted from all parts of the photosensitive surface, the number of electrons from any particular spot being proportional to the strength of the light which there falls. A great many electrons are emitted from a bright spot in the image and only a few electrons from a dim spot.

All of these electrons are attracted at a high velocity to the aperture in the target at the far end of the tube. If a fluorescent screen were placed in their path it would show an optical image of the scene of action. But there is no such screen in the tube. And, in its absence, there exists what may be called an electrical image in any vertical cross-section of the space between the photosensitive surface and the target. This invisible electrical image varies in intensity from point to point across its section in the same ratio as does the visible light intensity of the projected optical image.

In order that this electrical image be perceived the electrons external to parallel paths to the plane of the target. There is a natural tendency, however, for the electrons to diverge and form an imperfect image. This divergence is counteracted and corrected by the uniform magnetic field which is maintained by a single concentric coil throughout the length of the tube, as previously described. It "focuses" the electrons into a perfect image at the plane of the target. But only a single point of the image coincides with the tiny aperture in the target.

When a saw-tooth current is passed through the vertical set of external coils, the entire electrical image is magnetically deflected up and down so that a narrow vertical line of electrons hit the target aperture. Due to the slope of the current wave, the downward deflection is relatively slow and the upward deflection almost instantaneous. If the image were made by visible light instead of by invisible cathode rays, the downward deflection could be seen as a vertical line, but the upward movement would be too fast to be seen. The actual electric current that hits the aperture during the downward deflection is measurable, while that produced during the upward deflection is not. So the effect on the target is that of a uni-directional current. If the deflecting current has a frequency of 20 cycles per second it will sweep the entire image downward past the aperture 20 times each second.

Likewise when another sawtooth current is passed through the horizontal set of external coils, the entire electrical image is deflected horizontally across the target aperture as a narrow horizontal line of electrons. If this current has a frequency of 6,000 cycles per second it will deflect the image past the aperture "slowly" in one direction and instantaneously in the other direction 6,000 times each second.

During the 1/20 second that the image is moving downward, it is simultaneously being swept horizontally past the aperture 300 times. The combined action is the same as if the aperture traversed or scanned the entire image in the same manner that the eye reads or scans a printed page. If the aperture be 1/300th the width of the image, the latter is subdivided into 300,000 elementary areas, each of which contains a certain number of electrons proportional to the intensity of the light in that part of the optical image to which it corresponds.

As the electrons sweep past the aperture they are attracted to the electron collector inside the target, beyond which is a resistor which causes a voltage drop. This is amplified through several stages of vacuum tubes and then modulates a radio carrier wave to produce an image in the picture tubes which are transmitted by radio to the receiver.

In this, in brief, is the process whereby variations in the intensity of the light in an optical image are converted into corresponding variations in the intensity of an electron current at the transmitting end of the tube. The reverse process at the receiving end of the tube has been described and it is evident that it is entirely different from the process of converting the optical image to an electrical image and then reproducing the electrical image in a visible form.

The Receiving Tube

The reverse process of converting the received picture currents into a visible image is also accomplished with a cathode-ray tube, but of an entirely different form. It is similar to the television oscillograph tube, excepting that it contains a grid which is placed between the filament, or electron source, and the plate, or fluorescent screen upon which the image appears. The received television signals are applied to this grid so as to control the intensity of the cathode ray current and increase the amount of light from the scene which is being scanned at the transmitter.

This tube is also placed in a framework consisting of three sets of coils. Direct current in one coil concentric with the tube focuses the electrons from the filament to a small brilliant spot on the fluorescent screen. A second set of coils is supplied with a 6,000-cycle sawtooth current which sweeps the spot in a horizontal line across the screen. A third set of coils is supplied with a 20-cycle sawtooth current to establish a magnetic field which sweeps the spot downward across the screen.

The combined action of the two fields causes the spot of light to traverse the screen in a horizontal line 20 times per second. The intensity of the fluorescence is proportional to the intensity of the picture current, and as that, in turn, is proportional to the light intensity of the corresponding portion of the scene. Hence, at the transmitter, the scene of action is reproduced on the end of the tube.

(Fig. to be Continued)
Putting Power Into the Antenna . . . where it belongs

By CLAYTON F. BANE, W6WB

IN this day and age we hear so much talk about high efficiency that it would probably be a good idea if the loudest shouters for this self-same "high efficiency" would state exactly what they mean by the term. Now, in the first place, high efficiency and large power output are not necessarily synonymous. First, we must stipulate what we mean by efficiency. Do we mean the ratio of the total watts input to all stages (including filaments) to the watts actually used in the antenna? If we did measure things by this rule, I'm very much afraid that most of us won't do much bragging about the final percentage. No, some other means must be used.

The two things the amateur is interested in are the power in the antenna and the color of the plates of the tubes in the transmitter. Call this latter condition "Plate Dissipation." It is a fairly obvious fact that we are more interested in the antenna power than in the mere fact that our favorite "ten" is lighted up like a Christmas tree lamp. Surely, if it is possible to get this same output with the running glacier-like, we will have achieved something.

ENTER "EFFICIENCY"

Stop for a moment and ask yourself the reason why the plate voltage is used. It takes energy to develop heat, doesn't it? The energy in this case is supplied from the plate supply source, and the heat is simply wasted energy. Think of the watts being used to heat that plate; precious watts that should be expended in the antenna to create waves that would plop down in Africa! By the way, Granting for the moment that this loss is undesirable, let us see what its cause can be and attempt to clear it up. If we bias our amplifier with only a small value of bias (negative) so that the stage may approximate Class A in its operation, we will find that the steady plate current has reached a fairly high value with no increase (and a possible decrease) in output. This increased plate current will result in additional dissipation at the plate of the tube in the form of heat. If we analyze the curve of Fig. 1, we will find that the tube is now biased so that the voltage applied to the grid causes plate current to flow on both positive and negative halves of the cycle, and that the resultant plate current (RMS), as shown on the meter, is a fairly high value. Let us now increase the bias so that the operating point of the tube is as shown in Fig. 2; this point corresponding to Class B, or "Cut-off." We can see that the plate current now only flows on the positive halves of the cycle, and that the resultant plate current is lower than for the previous operating conditions. This lower plate current has caused the heating to disappear. Great! This carry the thing a step further. Bias now to the operating point of Fig. 3. This point being double "Cut-off" or, roughly speaking, Class C. The plate current now only flows during a fraction of the positive half of the cycle, and the plate dissipation has shown a tremendous decrease. Granted! This is the essence of our elementary theory. The potential we applied across the circuit charged the condenser, and when the charging source was removed the condenser discharged, causing a voltage to appear. That's it! This voltage in turn, set up a counter voltage in the inductance (counter EMF) charging the condense in the opposite direction. This charge and discharge process could go on indefinitely if it were not for the fact that the circuit has some resistance. Each time the current flows, some of it is dissipated in this resistance, causing the oscillations to become increasingly weaker; resulting finally in complete damping. If energy could be added in time pulses to the oscillations just as they were about to die down, the oscillations could be sustained indefinitely. The amplitude of these would depend on the amplitude of the "Kick." and the resistance of the circuit. Referring back to our Class C amplifier, where we had lots of efficiency but small power output, and taking particular note of the plate current impulses, we can see that these impulses would be just the thing to furnish the timed "Kick" to the plate. They are, but their amplitude is so small that it is rather obvious that the amplitude of the voltage in the tank circuit will be correspondingly small. We know these plate current impulses in the plate of the tube can be increased by decreasing the bias, but we have demonstrated that the use of this method will result in a lowered efficiency. If the grid swing is increased with the bias remaining constant, the amplitude of these impulses naturally increase, resulting in the tank circuit receiving a greater "Kick" with attendant greater power available in the tank for the antenna load. See Fig. 4. The question now arises as to how far the grid voltage may drive the plate current upward by swinging far into the positive bias region. Two very important things happen when this is done. As soon as the grid excitation swing past the zero bias point, the grid current will be set to flow on the grid-filament circuit, this current becoming greater as the grid swings more positive. In the second place, an examination of the plate current-grid voltage characteristic curve will show that past a certain point, corresponding to a very high value of grid excitation voltage, the plate current will start falling off. This "falling off" is due to the fact that the filament in the tube has a certain limit of emission, beyond which it is unable to supply additional electrons to allow the plate current to increase. Working the tube over into the bend of the curve will result in the ultimate deterioration of the filament in a condition no good amateur likes to contemplate. There is, however, no reason why the tube couldn't be set right up to the limit of the filament emission, or to put it another way, up to the point where the output falls off even with increased grid excitation. I haven't mentioned the fact that when the tube is working at this point the grid current is bound to reach a high level, resulting in the grid requiring appreciable power from the driving source if the output wave is not to suffer a severe distortion in amplitude. If you are concerned with the value of grid current that should be used, I am not giving suggestions as to proper adjustment may be in order. Obviously, it is impossible to predict or establish a value of grid current that will be applicable to all tubes since the characteristics of different tubes vary greatly, to say nothing of the widely different conditions under which they may operate. Let us take a given set of conditions to facilitate ease of explanation, and proceed to adjust our transmitter. First, let us say that our available excitation is ample, as for example it would be with an '03A driving a '52. Set the bias on the final amplifier to approximate "Class C" and observe the grid current. Suppose this happens to be 20 or 30 ma. Couple a dummy load into the final with some
This page contains technical text discussing inductance and the effects on power and efficiency in electrical circuits. The text references the importance of maintaining consistent inductance and resistance values to ensure optimal performance. It also mentions the role of tank condensers and the impact of varying current on the plates of the tube. The text concludes by highlighting the significance of maintaining high efficiency and the need for precise adjustments to prevent any negative effects on the power output.
A Frequency Meter-Monitor
With Real Vernier Tuning Control

By F. H. SCHNELL, W9UZ*

NO MATTER whether you buy, build, beg or borrow a frequency meter-monitor, if you operate an amateur radio station, you ought to have one and have it in use constantly while you are operating. It isn’t necessary to ask other amateurs how your notes sound or whether you are in the amateur band or not. You ought to make it your own business to know that first-hand—monitor your own signals and you will know how your note sounds; use your frequency meter and you won’t have to ask others about your frequency.

Naturally, a frequency meter is of no value unless it has been calibrated accurately and even then it should be checked often enough to insure its calibration. From day to day. Of course, one of the hardest jobs is to find a station from which a good calibration can be made without waiting for standard frequency transmissions. But here is a frequency meter that can be checked any minute of the day or night as long as you can hear a broadcasting station on some frequency from 860 kilocycles to 1,020 kilocycles and assuming that the broadcasting station maintains a decent frequency.

The circuit is a Colpitts or so-called split filament, patterned after General Radio’s Frequency meter. The inductance, I consists of 178 turns of No. 33 enamel wire wound to a length of 1-7/16” (no spacing between turns) on a bakelite tube 1” in diameter. The inductance is about 405 microhens. The tuning condenser, C is the General Radio Type 736-A, a two-section condenser having a minimum capacity of 140 micro-microfarads and a maximum of 225 micro-microfarads. The plates are cut for straight line frequency and the actual curve is practically a straight line. The coupling condenser, C1 consists of two copper pieces 3/4” square and spaced 3/4”. It provides sufficient coupling to the binding post, A to which may be connected a short antenna for better pick-up. Ordinarily, the antenna is used. The monitor is mounted on top of the receiver where it is handy at all times, as shown in the photograph.

The main dial is 4” in diameter. In 180 degrees there are engraved 25 divisions. The vernier dial is 2” in diameter with 100 divisions for the complete 180 degrees. On the shaft of the vernier condenser, a worm gear is mounted. This is driven by the worm which is mounted on the shaft of the vernier control. One complete revolution (100 divisions) of the vernier moves the main dial one division.

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FIG. 1—Fred H. Schnell’s Receiver and Monitor.

FIG. 2—Monitor Housing, Showing Controls.

The total number of divisions is 2,500 and each division is about 1/16” making it easily readable without a magnifying glass or hairline vernier. The worm gear and gear-drive assembly is shown in figure 3.

The tuning condenser is mounted directly on the front panel which is 3/4” aluminum. The inductance is mounted on the tuning condenser. The rest of the parts, including the filament heating transformer are mounted on a small bakelite shelf which also is mounted directly on the front panel. The balance of the circuit is of 1/8” aluminum, measuring 9” across, 6½” high and 6” from front to back. The case is finished in black crackle. All resistors are the one-watt size.

The frequency meter tunes in the fundamental of the broadcast band and covers a range from 860 to 1020 kilocycles. The even harmonics and the frequency range are as follows: 1720 to 2040 KC, 3440 to 4080 KC, 6880 to 8160 KC, 13,760 to 16,320 KC, 27,520 to 32,640 KC and 55,040 to 65,280 KC, covering all amateur bands without having to shift coils or fuss around with condensers.

Before calibrating, the frequency meter should be allowed to warm up for about 15 or 20 minutes. Then it is necessary to have a broadcast receiver which can be used to pick up stations on the fundamental frequencies. For example: Tune the broadcast receiver to 860 kilocycles and find a broadcasting station which is known to have good frequency stability. Then tune the frequency meter until it commences to cause the well-known “howl” in the broadcast receiver, tuning it finally to zero beat with the broadcast station. The monitor can be set to less than 1/2 cycle without any difficulty, but even if you come within one cycle, your calibration would be off only 8 cycles in the 7.0 MC band and 16 cycles in the 14.0 MC band. Next, locate a station on 870 kilocycles and calibrate with it and continue up to 1,020 kilocycles. Then plot the curve on a suitable piece of cross section paper—you have one curve only but it serves for all the frequency ranges mentioned above. On this particular frequency meter, the 7.0 MC band is covered in 450 divisions, making it 1¾ divisions for each kilocycle. Each division can be estimated easily to a fifth, making it possible to read a frequency within 150 cycles direct.

Using it as a monitor, it is only necessary to connect the headphones as shown (they can be left in the circuit all the time) in the diagram. Start up your transmitter and tune the vernier until you hit your own signal, and then tune it off zero beat to the audio note you prefer—that is if you have a good character signal.

Suppose some ham asks you to check his frequency. All you do is tune your receiver to zero beat with his signal and then tune the monitor to zero beat with the receiver. Pick off the dial reading and you have his frequency, knowing in which band he is operating, being sure you use the multiple for the harmonic of the frequency meter, that is, the 2nd, 4th, 8th, etc.

FIG. 3

FIG. 4—Correct Placement of Parts is Essential.

NOTE: Worm and gear can be purchased from Boston Gear Works, 935 Washington Blvd., Chicago, or any branch office can get them. The gear is G1037, and the worm is HLUH. The gear is 2-1/12” in diameter and has 30 teeth. The worm has one tooth.

RADIO FOR NOVEMBER

www.americanradiohistory.com
Simplified Frequency Monitoring & Control Apparatus

By LIEUTENANT E. C. DENSTAEDT*

At the present time there exists a number of radio services outside the broadcast band that have need for improved frequency control and monitoring apparatus, yet under present-day trends hardly feel able to install and maintain equipment such as in use in the broadcast field.

About one year ago it was felt at Detroit that some improvement in our frequency control apparatus was necessary. Since the main trouble was due to frequency drift as the transmitters came on the air, it was evident that the cure could be either:

1. Letting the oscillator run 24 hours a day.
2. Dropping the voltage upon the crystal stage until there was no longer any appreciable drift when the transmitter was turned on, and then building up the power with intermediate amplifiers.
3. Changing the crystal mounting and temperature control apparatus so as to minimize the effect of crystal heat.

The first method, since we have to monitor the transmitting of other police radio stations on the same frequency, required elaborate shielding and isolation of the crystal circuit. After a short trial this method, while of course possible, was given up as impractical.

The second method produced additional complications in the transmitters and since we were interested in improving the existing transmitters with as few changes as possible, we discarded this method. We also did not like to have too many intermediate stages in the transmitters.

We therefore decided to revamp the crystal holders and temperature control apparatus. It was apparent at the start that our trouble was caused by the crystal heating and raising the temperature of the whole crystal compartment to such a point that the crystal compartment was at a greater temperature than that for which the thermostat was set. Of course, should the transmitter be left on the air, the frequency would after 40 or 50 minutes gradually settle down to a new value which would be anywhere from 50 to 300 cycles away from the starting point, the drift depending upon the crystal, type of holder, voltage upon the crystal, type of heat box, etc., etc.

It was evident that the best chance for improvement lay in getting close contact between the crystal and the thermostat and then using a sensitive thermostat to cut down the length and amplitude of the heat cycle. This, of course, eliminated all of the crystal control boxes in which an attenuating box

is built between the crystal holder and the heat and thermostat.

The first trial unit was built as shown in Fig. 1. The thermostat was set in mercury in a hole drilled in the copper bar (the mercury providing good contact between bar and thermostat). The heating coil was wound directly around the vertical bar and the crystal sat upon the piece of bar forming the base of the "L." The heating coil dissipated about 15 watts on this first unit. The whole unit was placed in a balsa wood box.

A trial of this unit was disappointing. We found that the frequency would still drift 250 to 300 cycles (at 2414 kilocycles) after the transmitter came on the air. This, of course, was under extremely high crystal power outputs with parallel (Y) cut crystal. With a pair of thermometers we were able to find a temperature difference between the two pieces of copper forming the holder of .3 of a degree. In other words, the crystal was heating the base of the holder to a temperature .3 of a degree higher than that the thermostat was set for. Since we believed the trouble here was due to poor contact between the base and top bars of the holder even though they were machined surfaces, we built the unit shown at B in Fig. 1. In this unit the three pieces of bar forming the unit were sweated together and the unit turned over from its position in the first attempt. In this manner we obtained a better heat conduction between the crystal and the thermostat. This unit proved better than the first but was still not satisfactory since we again found a maximum frequency drift of about 200 cycles and again discovered a difference in temperature between opposite ends of the unit.

We went to a solid square 4-inch copper bar upon which we wound the heat coil and in which we drilled holes for thermostat and thermometer. The crystal sat upon the silvered top face of this bar as shown in A of Fig. 2. This bar proved fairly satisfactory but still left the problem of getting better control of the temperature on the top plate and of providing a good crystal mounting. The final bar is shown in B of Fig. 2 with an exploded view in Fig. 3. It may seem that this type of unit would have a considerable temperature ripple. This, however, is not the case. By using a sensitive thermostat and properly adjusting the heat applied we have found it possible to cut the temperature variation due to thermostat action to less than 1/20 of a degree.

We have found that these units along with a proper oscillator circuit will hold the frequency of a police transmitter to within 100 cycles which is several times better than required by law at present. These units are also practically unaffected by ordinary changes in ambient temperature and in conjunction with a reliable relay have been found to be practically trouble-free.

It also is not necessary to pack them away in an insulated chamber since they work very satisfactorily in the open as long as they are not placed where a draft can hit them or very large changes of ambient temperature take place.
THE Globe Girdler presents this month the combined story of W6QD, and Mr. Charles Perrine, Jr., W6CUH, located at Manhattan Beach, California. The station is one of the beach of continuous radio waves and YL permanent waves. W6QD-W6CUH came into being July 1, 1933. Previous to that date, W6QD was operated on the air since 1927, while W6QD has been on and off the air since the spark days in 1920. Manhattan Beach is 15 miles southwest of Los Angeles, the station itself being about 100 yards from the Pacific Ocean. The QRA is really not so bad, inasmuch as the station is the only one in town, the nearest ham being five miles away.

The shack of QD-CUH is a two-story affair, built along the lines of Noah's Ark. The transmitter is on the ground floor, the operating room is on the second floor, where one can get a good view of the beach... and the YLs. The operating desk contains switches necessary for remote control of transmitter, also selector switch for several receiving antennas. The receiver is a hopped-up SW+X with electron-coupled detector, RF and audio gain controls, and RF filtered AC power supply. Few of the DX cards shown in the photo are from countries worked, the bulk of the cards covering the walls of the transmitter room. The QD-CUH boys have a large photo album which contains photos of many DX stations throughout the world.

The Transmitter

The remote-controlled transmitter is a six-stage crystal outfit, operating on 7 and 14 mc. consists of a 47 crystal oscillator, 46 doubler to 7 mc., 210 first buffer, 865 second buffer, 652 third, a 1652 as output amplifier, and another 1652 as a straight amplifier on 7 mc. and as a power doubler to 14 mc.—cuts in extra for bias this 14 mc. operation. The 7 mc. doubler is not the only advantage this transmitter has; it is especially on Saturday nights... a two-minute CQ provides enough for the DX and while a five-minute CQ will give a good bath. Each stage runs straight in the beam (steam whistle yet needed on the final) and is absolutely foolproof—necessary requirement for remote control.

The R. F. part of the set is laid out on the top of the table 10 feet long, 2 feet wide and 4 feet high. All bypass condensers, filament transformers and R. F. chokes are mounted under the top table. Incidentally, it is very handy to have a separate apparatus under the table due to its height. The oscillation and doubler are in the top box at the end of the table; each of the other stages is on a separate panel. The whole transmitter is wired with stranded wire, helping to decrease the inter-action between stages. Both 7 and 14 mc. are tapped down on the tank to load it further and increase the excitation to the 852. A modified form of the link coupling is used to excite the final. It has worked very well, since the 852 input is only 400 watts to fully excite the 1652 to 1000 watts input.

The power supplies are located some distance from the transmitter, power leads running under the floor. Two well-filtered 85a supply the 600 and 1000 volts. A mercury arc is used for the higher voltage which supplies the last two stages. Keying is done in the primary with consequent absence of BCI. Qrm, except for trouble from sparking relays, which at last was eliminated with bypass condensers and R. F. choices in the power lines.

Antenna

Several antennas are in use at W6QD-W6CUH, the result of continuous experiment. There are two single-wire-fed Hertz, one to 65 feet 6 inches by regular formula, but with feeder lengths kept non-resonant (about 83 feet). Each fed on top flat 9 feet 2 inches from center. Two antennas were cut to work on both transmitter and receiver. One runs east and west with one used for both and west; other, north and south, is far better for 2L. The 2L is used to excite input, DX. The 700k. results are checked by checking them on both transmitter and receiver. The output is 1000 watts when working in a certain section, the best one is used for the transmitter.

For 14 mc. a simple beam antenna has been developed which gives a fairly efficient equivalent to doubling the input to the transmitter. The beam consists of two horizontal and two vertical antennas, one set below and a quarter wave lower, that transmit in horizontal plane 25 degrees above the horizontal. They are both fed by the same single-wire Hertz feeder connected as shown in the diagram. The values are not critical. At present this antenna is pointed at Europe and has given good results. On a test with FAOXP the beam was RT while the N-J Hertz was R5. It is easy to see that the antenna system really means more for maximum results than increased input to the transmitter.

DX Ragchewing With Human Interest

DX is WAC, and 70 countries worked. Many one day WAC's have been made, the shortest requiring only 9 1/2 hours. Since the station goal is DX, the new transmitter has done little good. Over 700 DX contacts have been logged since July 1, with an average report of a little over RS. It is interesting to note that actual RT9 reports from Asia, Africa, and North America also RS in South America and Europe have been received. In Africa, reports averaged RT9 for 11 QSOs with 50 stations. During one particularly good spell, RT reports were received from 15 consecutive foreign stations. The QSOs with 2L, VK, ZL, R8, OM and JH the best report so far: QSO 10, R6, from J1EC.

The above is only half the DX story because the personal side of real DX ragchewing has even more kick to it. The best one yet was the night VK4IU had his fone going... told him that Herb had just climbed into bed and that he was playing phonograph record and what should it be but Good Night, Sweetheart. Herb's still wondering what JU thought he was. Another gem came from J1EC who thought they were a little to QSO during a QSO... "Try an RT, kv8... the CQ was, 'QSO for QSO, kv8...'" For QSO, hr..." "... and we agreed to have a similar one this month. A long distance call... R7... 'hit, what an answer!'... at least he's always asking QD-CUH about him. He also doesn't think much of their idea of..."

Eight feet of power. The transmitter of W6QD-W6CUH.
Bay Amateurs' Association, a small group of hams located in the south bay shores and whose ideas are those of fostering blgger and better DX rag-chews. All members have worked at least 40 countries, WAG, WBE — and are crystal-controlled.

This brings us to realize that, after all, there is a great deal of freedom and human interest in DX-QSOs, which gives all of us a better chance to the enjoyment of DX and to DX-QSOs in other parts of the world, and thus promote international good-will.

Directional Beam Transmitting Antenna for 14 MC as used by WCUC—WQKD.

One of the biggest thrills came from hearing and working ZELJAH's 7 me tone—and did he sound exciting.

Charlie and Herb got the best laugh from a remark Charlie made before he replied that they too would have soon heard. A short time later, they both came, also a letter from JIDM, quote, "I congratulate you that you can drink openly now after the bootlegging in your state." JIDM also enlightened them with a neat radio (") formula: "HAM plus YL equals DX. These fellows, QD-QGD, got a wall-out of ZELJAHZ, because every morning promptly at 6:00 P.M. he bores out his first Q, which enables them to set their timepieces for the day. When QD-QGD doesn't come through the day is lost.

WCUC—WQKD are not alone in their opinions on DX QSOs as they are members of the South Bay Amateurs' Association, a small group of hams located in the south bay shores and whose ideas are those of fostering bigger and better DX rag-chews. All members have worked at least 40 countries, WAG, WBE — and are crystal-controlled.

There are 35 feet of Transmission

END VIEW

TOP VIEW

TO XMTR.

4.6

1.5

1

0.6

AUX.

AUX.

33 FEET LONG

457 FEET APART

1-Tappa Key Radio Fraternity — The Amateur's "Legion of Honor"

ORGANIZED in 1926, re-organized in 1928, the I Tappa Key Radio Fraternity was formed for the distinct purpose of filling the need in amateur radio for a real fraternity of selected men, a brotherhood of radio's best. This Legion of Honor is a society of regular fellows who are "Knighted" for their work in the service of others. The Legion of Honor is • for their mutual benefit to foster a spirit of closer comradeship; to provide a forum for discussion of common interest subjects; to carry on the noble traditions of the genuine "dyed-in-the-wool" radio operator; and for the dissemination of knowledge pertaining to the science of radio and its applications.

An I Tappa Key Fraternity man exemplifies the splendid courage and spirit of sacrifice characteristic of a true "Knight of the Air." He is dedicated to excellence and to the principles which are associated with the radio art. He is dedicated to the belief that radio is a force for good, and that it is the duty of all who work in it to use it for the benefit of mankind.

I Tappa Key is the Amateur Division of the Iota Tappa Key Fraternity (ITK) of Lawrence, Kansas, whose headquarters is at the ARRL. The ITK membership is principally for Commercial Radio Operators, those who "go down to the sea in ships," ITK men cover the world, whether it be a lonely station in Alaska, or on one of the seven seas, you will find an ITK First man upholding the honor of his profession and meeting whatever emergency may come to his attention.


RADIO FOR NOVEMBER 11
1934 Modulation Improvements

By ROBERT S. KRUSE, E.E.

**EDITOR'S NOTE:**
This material is from "Kruse's Radiophone Guide."

EVERYONE has known for years that the ideal radiophone transmitter should be made of a high-fidelity audio system, operating on a beautifully linear r.f. stage which, powerfully, and with extreme fidelity, reproduces each and every sound that we have heard. But the disadvantages of expense and complexity of such a system are often prohibitive. The 1934 tube, however, promises to be a very efficient device for accomplishing this end, and as such is deserving of the attention of the amateur. This article is intended to give him some idea of the possibilities of the 1934 tube and to suggest some improvements which may be made in its use.

**The Ever-Present Feedback Whipped**

RECEIVER designers have long since thrown the neutralized triode overboard to get rid of r.f. feedbacks, and to produce better pre-stage amplifications. In transmitting we keep a nggling along with the triode largely from habit—though partly because the 865 is absolutely costly for use as a buffer, and its reputed successor seems very attractive, but why worry? The most serious of all feedbacks is that which takes place in a modulated stage, and here we are in a position to do something about it right away, either by modulating a tetrode, in which we can prevent feedbacks, or else by modulating a triode under such conditions as to decrease the tendency toward feedbacks.

One can't simply plate-modulate a screen-grid tube 100 per cent as one does a triode, for on the downswings of the plate voltage it becomes a tetrode and oscillates on its own, while on the upswings the fixed screen voltage cuts off the + plate. It is therefore necessary to modulate the screen in proportion to the plate modulation, which can be done in a variety of ways, of which the circuit shown herewith is probably the simplest. The diagram is self-explanatory, except in a few points, which follow.

The Modulating system may be of any sort suited to modulation of a 10 or a 52 respectively, and such coupling being preferable as it permits the use of the same voltage all around. For other tetrodes than those tabulated R2 may be modified suitably—which means that it is adjusted so that when there is no modulation the screen voltage agrees with the maker's data. Don't try to beat it, whatever you do, and connect it in with a transformer—measure the d.c. current through R2, figure the IR drop through R2 and subtract it from the plate voltage. Suitable combinations are as follows.

20 Watt carrier. One 865 run as tabulated. Modulation by a 2A3 pair of A prime tubes through a transformer with a maximum ratio of 65.1.

50 Watt carrier. Two 865s tubes 500 volts, 140 Ma., screen +125 Modulator class A prime pair of 50 tubes running with 600 volts plate, 30 volts bias. Transformer ratio 2/1.

125 Watt carrier. 860 run as tabulated. Modulator by a 2A3 pair of A prime tubes through a transformer with a maximum ratio of 65.1.

250 Watt carrier. 860 pair (push-pull or parallel) run as tabulated. Modulation by class B 203a pair running at 1000 volts, transformer ratio about .9/1, bias voltage 1000 volts.

A tremendously powerful weapon for determining all if well is now within sight. This is the Cathode Ray tube whose use was described in the October issue of "Radio" (page 8) by Mr. Ralph R. Batcher—who unfortunately (or modestly) forgot to mention that he has developed a cathode ray trigrig especially for the voice-transmitting amateur. It was demonstrated at Chicago's big amateur convention last summer. One can with one of these devices instantly spot r.f. or audio feedbacks, or any other condition, over and under modulation. But until you get one, the modulated tetrode is a pretty good gadget to use in doing away "right unseen" with the worst feedback a transmitter can have—in the modulated stage. When that's done a good voice system has a chance to turn out a properly wrinkled carrier.

1934 Screen Modulation

IF this screen-and-plate modulation seems too formidable to tackle, you may arrive at the same end—and gain an economic advantage—by merely modulating the screen. I can always hear a bowl go up at the mention of screen modulation, because "it distorts above 70 per cent." Now in the first place, 70 per cent modulation is not to be sneezed at, and many a 100 per cent plate-modulated station can't show decent fidelity above 70 per cent. In the second place, we are not talking about that sort of screen modulation. Instead we are talking about screen modulation in two successive stages, which reduces the distortion at a given percentage, as you will be able to see. A high percentage is possible with perfectly acceptable speech— and it takes but 2 audio watts for a 25 watt carrier—or 8 watts for a 100 watt carrier. That is the incidental advantage. Thus a pair of 2A3 tubes with a proper output transformer can nicely modulate a pair of 860 stages. The circuit, on a small scale, is shown for Western Electric tubes. 292 is an overgrown 865, the 205D is a fairly close relative of the 210. Furthermore—in all this work with screen-grid tubes one is to remember that they are very easily driven, and at most wave lengths one can use receiving tubes altogether for the crystal oscillator and the buffers. Don't overlook the 35 tube as a buffer either—until we get that long-awaited 865 replacement.

"Modern Grid Modulation"

THIHS heading was quoted because it is the wording above Boyd Phelps' very fine article in "Kruse's Radiophone Guide," wherein he explains the simplest sort of modulation that ever came to the troubled voice-transmitting amateur.

It is unfortunate that the telling of this story is a bit too lengthy for the present piece. Just now we wish mainly to suggest that, as Mr. Phelps says, "If you hear grid modulation condemned on grounds of fidelity or economy, find out if the speaker means ancient or modern grid modulation, which differ as night and day."

The principle of grid modulation is to save audio power by using the modulated r.f. tube as its own final audio amplifier—an other words one feeds the audio into its grid instead of its plate, thereby saving one large and costly audio stage. While it would appear that one loses heavily as to carrier level through being unable to swing the plate voltage to twice normal, this is incorrect to a degree, for one BEGINS with twice the usual plate voltage on the tube. This is safe since it is after all no more than one
swings "up to" when plate-modulating 100 percent. Thus 4600 volts on an 852 is quite a peak. The plates may as well be at it, a pair of 852 tubes since it is EXACTLY as easy to swing two of them. In either case a 210 audio tube is ample, and the r.f. input can be at 210. On single tubes the same tubes will drive a pair of 851 tubes, or a water-cooled tube, giving a 1000 watt carrier. Disregard the above remarks concerning equipment made of receiving tubes. Several additional advantages appear. The bias battery of the modulated stage does not froth, steam and spatter, had you done voltage transfer around wildly in the manner of a bias battery on a late-modulated stage. A "cushy" may be the result. The r.f. drive required permits loose coupling to the preceding tank circuit, which greatly stabilizes the stage and makes neutralization (if any) unnecessary hence tubes easier to reach.

Not to leave the subject without any specific data at all, we shall guess at the most used hard-to-modulate stage and give the operating conditions for it. Assuming a pair of 852 output tubes in push-pull we would have: Plate volts, 4600, bias 500 from small C sub, carrier watts 250. Audio driver 210 with 350 plate volts, r.f. driver almost any tube with 600 plate volts, capped down on its r.f. voltage to give our voltage to the 852 grids, or 1000 volt tube without step-up. First set 852 bias at 330 volts and increase grid volt tubes together if you wish 125 Ma, then increase bias to 500 volts and raise audio until grid current "kicks" appear on speech peaks. The relatively high plate voltage may appear to be a great disadvantage, but the small plate currents make up for this by permitting use of comparatively small audio amplifiers and gates.

In a number of representative cases detailed cost figures show little choice between this and class B plate modulation, whereas the greater simplicity of the a.f. system is a distinct advantage.

Special Types of Modulation

We hear much these days to carrier less and single-sideband radiophones and other specialized voice signals. Their ultimate advantage in amateur voice work is still speculative. The most valuable thing in voice communication is certainly its capacity to convey the truth at the somewhat formalized nature of telegraphy. It would be a great pity if we were to wander into any more complex type of transmission. The price of feeding paired schedules for any considerable ease of tuning in the signal.

An advantage of such a change would be to decrease interference, whereas the greater care will be necessary to prevent INDEED interference through the fatigue by-products of special modulations, which are hard to trace to their owners because frequently unintelligible. This is an off-hand guess, the art of sideband-suppression and carrier-suppression, as well as the special types of multiple modulation, are not well enough to attract the attention of the average would-be experimenter for at least a few months of hearing of alleged developments in this regard, with more or less the over-statement which has accompanied recent 5-meter work—and with the same cheerless disregard of work done a good many years ago.

The specialized voice signal (S) Encoding, of course, one has but to listen any evening to number a number of stations using it in assorted forms—all due to the Bell Laboratories or Harald Edstrom. If originality of its voice work (which before this is printed you shall surely see articles in which neither outfit receives much credit—this is not the place to give you the other credit; the Phelps grid-modulation scheme presented for amateur use is apparently much like that used in recent Western Electric police transmitters, although the work appears to have been done entirely independently as often happens in this art.

Power Supplies

Power supplies appear to have little to do with modulation. This is exactly why they so often have a great deal to do with it—all bad. Long hours may be spent in trying to align a transmitter behavior—without realizing that the performance may be handicapped by improper power supply. The quotation is from Dr. E. S. Demboffsky, Jr. That he says "improper" not "bad." A power supply that supplied perfectly fine "pure d.c." to a pair of 852's might be very easily made completely awful when the same two tubes were modulated. Both filtering and regulation enter. If the filtering is bad one can HELEN be quite unimportant and the carrier and the rectifiers, but if the regulation is bad and one lacks a cathode ray tube, it is harder to tell. One had best avoid trouble by starting with a correct filter design. While in no way wishing to be so presumptuous as to compare Keystone & Township 6 pages of "Radioephone Guide" design information and examples into a paragraph, I shall undertake to suggest what is usually wrong with the picture. Briefly, then, the first choice should be so large that its inductance, when multiplied by 500 is larger than the load resistance. A value of 1000 mA. (= 1 amp) into its load at 1000 volts we evidently have a load resistance of 1000/1=10,000 ohms of load resistance. A 50 ma. choke will work nicely. But keep it. This 20X200=10000, Filtering, rectifier life, and condenser life, are all helped by this rule, as is the performance. The second filter condenser must be at least as large, and carry a good bit larger to advantage.

This is NOT design information, it is merely a bit of test information by which to judge whether your filter needs some re-design, in which case you are referred to the complete article for the actual cure. Regardless of any figures, if your carrier bears a hum or "mush," it might be well to suspect the first filter choice of having been an optimum. If you have no make him, though, we need optimists in this voice game until we hatch some new kilowatts or split the old ones.

20-Meter Antenna R. F. Feeders

By FRANK C. JONES, Ultra-Short-Wave Editor

RECENTLY Jack Holmes, W6BUG, wanted to try some r.f. feeders for use on his half wave antenna designed for 20 meter operation. As a result, W6PB, W6SP and the Editor, spent an afternoon at W6BUG changing Feeders Systems and checking the radiation by means of a small field strength measuring device. The results were, of course, the same as the particular surroundings at W6BUG, but since his location is like a large number of other stations the results may be of some value.

The antenna was a half wave affair about 33 feet long, practically horizontal, and suspended between a couple of poles about 15 or 16 feet above the ground. It was placed on top of a Spanish style stucco house, so the antenna was about a half-wave above ground. The feeders used were of "air" type, single wire, "matched impedance" feeders and twisted No. 14 wire feeders. The transmitter consisted of the usual crystal oscillator, doubler and a final amplifier using a pair of so-called 50 watters running at about 200 watts input, as nearly as could be maintained by output circuit and coupling variation.

The output plate tank circuit consisted of 12 turns, 2 inches diameter of copper tubing, and both direct and inductive coupling were utilized to the r.f. feeders. The latter were about 40 feet long and ran out through a basement window up along about 15 or 16 feet of tubing to the top of the antenna. The spaced two wire feeders used r.f. loss spacers about six inches long and the feeders were kept fairly close to the stucco wall, about 7 or 8 inches clearance.

The field strength measuring device was quite simple, and while flat very sensitive, served the purpose. It consisted of an antenna and a tuned circuit using a current-squared galvanometer. The antenna part had to be kept at least 15 feet from the feeders, particu larly when working fairly close to the wall which seemed to have considerable radiation.

With this set-up, the galvanometer read 60 divisions for optimum adjustments with the matched impedance feeders connected 1/2 turns each side of center of the plate tank circuit. Three turns were found to be the best value of the total of 12 turns for this 600 ohm r.f. feeder that gave a good match between the antenna and the amplifier input. Probably greater care in adjustment of coupling, and impedance matching across a portion of the coupled circuit when tuning out its reactance would have made this reading more nearly approach the higher value of 60. Conductive coupling with a pair of these feeders was also experimented in series with the feeders gave 55 divisions.

Using the same two feeder wires as a "zepp" feeder, gave a maximum deflection of 40 divisions. The feeders were inductively coupled with a pair of series tuning condensers for tuning it as a 3/4 wave system. This again only represented two-thirds as much absolute power in the antenna for the same amplifier input. With this scheme the feeders have standing waves on them with points of maximum and minimum voltage with attendant high losses due mostly to the nearby stucco wall which had a metal wire screen interior.

The single wire feeder attached 1/2 off center with conductive coupling, gave a galvanometer deflection of 26 divisions when the feeder was tapped up the tank circuit coil at a point which gave the same amplifier plate current as before. The ground acts as the other feeder in this scheme and there is some radiation from the single wire. Again, the stucco building seemed to have a great effect on feeder losses as well as the possibility of a very high ground resistance entering into the problem. At any rate, the 40 volt polarized wave only had half as much power as the two wire 600 ohm line to the antenna gave. Second best then was the 70 volt feeder, which seemed to obtain when using the zeppelin feeders.

Finally a twisted-pair feeder was made, using No. 14 wire with each of the wires being such as used in house wiring. This was connected to the antenna by simply cutting the latter at the (Continued on page 52)

RADIO FOR NOVEMBER

13

www.americanradiohistory.com
Do You Want to Be Hung Hi?

By LOUIS R. HUBER

Chinese history relates the sad case of Hung Hi, whose lands were overrun by bandits. In desperation he appealed to the high priest, Kay Wa.

"O wisest one", he waited, "ruffians have taken my land. When I go to reap they chase me. I have only a small garden to call my own."

Kay Wa, the high priest, whose sleek jowls were fattened off the flocks of Hung Hi and other peasants, stroked his beard and frowned.

"Fool!" he said. "Fool, to offend those who oppose thee! Go back to your land, look over what is left and see if it is not sufficient!"

In a few days Hung Hi returned.

"O wisest one", he answered, "it is so. I have plowed under the temple garden and the orchard. My children must stay in the house, but now we shall have enough rice."

Years passed, and Hung Hi's family increased twofold. Again he sought Kay Wa.

"O wisest one", he pleaded, "my family is twice as large. We are starving. There is plenty of land all around me but I am not permitted to use it. What shall I do?"

Kay Wa remained silent for a long moment, and then looked into the eyes of Hung Hi.

"The trouble with you," he scowled, "is that you and your children work too hard. If you will stop going into the village to hear the gossip, you wouldn't feel so hungry."

The high priest permitted a smile of deepest benevolence to cover his visage, and as he smiled he said, "Now, for the great love you bear Kay Wa, go home and sit all day with your children in your house. Do not stir except to water your rice shoots every morning."

Hung Hi murmured obedience and left. Months passed by until one day a visitor came to the house of Hung Hi.

"I am Wa For, your neighbor from the next kingdom", the visitor said, "and I come to tell you how we have rid our fields of the bandits."

Hung Hi opened his sunken eyes and looked languorously at Wa For. He opened his mouth to speak, but his dry tongue only clacked against the roof of his mouth.

He was partly paralyzed, and deaf. A short time later, he died. His spindly sons buried him beside the door-step.

---

The Bad News!

New "Q" Signals

O, Sparks, I'm not asking you if you want me to shut up. Not at all, old friend. I'm not asking whether the new Q Signals are out, and QSK? mean 'Shall I continue the transmission of all my traffic? I can use break-in operation.'

Just another of the little surprises the playboys of the International Conferences have in store for us poor stiffs every five years. Who is it that makes up these new Q Signals is not generally known.

About five years ago, QRV was a perfectly dodical little abbreviation meaning 'Are you ready?'. And then in 1928 that international conference came along and some sadistic rascals with a bent for changing things all around the way your big sister does when she comes home—they were given the Q Signals and told to 'Go ahead, swap 'em around, make 'em sound new!'

They did. They changed QRV, for example, to mean 'Shall I send a series of V's?' And now, just for example, these 1933 playboys come along and decide that it's just plain nertz to use QRV for that purpose. So they have changed it around to the old stall of five years ago—'Are you ready?'

Well, we're ready! You bet we're ready! Ready to murder these rascalls who go around to international conferences changing Q Signals on us so often we don't know whether we're being insulted or not when somebody tells us "QSK 600". We might think they were getting fresh and telling us our wavelength was 600 meters. But just about the time we got sarcastic and said, "Oh, yeah?" they could tell us, "Hey, you big bum—I'm listening for you on 600 meters."

And that's not all. When Happy New Year rolls around again, don't get your wave meter when somebody says QSB? Because he'll only be asking you "Does my frequency vary?" And when anybody says QSV?, don't jump to the hasty conclusion that he's asking if you want him to change his wave. He'll only be asking you if you want him to send a series of V's.

Now, there are a lot of us who like to postpone some of our work now and then. When that happens we say "QSK 45 min., pse". But just try that after Happy New Year. There's not a single -Q sig in the bunch that will work that way, now—unless you want to use QRX. It doesn't fit, but maybe it will do, if we grit our teeth.

And the playboys didn't like those new QA Signals ay-tall! No, sir! They kicked 'em right out and put in some new ones that start out with QF. These new QU ones aren't bad signals, though. But look out for a change about five years from now.

It doesn't pay to have a memory anymore.

The bad news: . . . .

To Your Right

RADIO FOR NOVEMBER
### Q SIGNALS To Go Into Effect January 1, 1934 — From Madrid Treaty

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>QRA—</td>
<td>What is the name of your station?</td>
<td>The name of your station is.</td>
</tr>
<tr>
<td>QRB—</td>
<td>What is your approximate distance from my station?</td>
<td>The approximate distance between our stations is.</td>
</tr>
<tr>
<td>QRC—</td>
<td>Are the accounts for charges of your station liquidated?</td>
<td>The accounts for charges of your station are liquidated by the private company. (or by the government administration).</td>
</tr>
<tr>
<td>QRD—</td>
<td>Where are you going and where do you come from?</td>
<td>I am going to. and I am coming from.</td>
</tr>
<tr>
<td>QRG—</td>
<td>Will you indicate to me my exact frequency (or wavelength) in kc. (or m.)?</td>
<td>Your exact frequency in kc. (or wavelength in m.) is.</td>
</tr>
<tr>
<td>QRH—</td>
<td>Does my frequency (or wavelength) vary?</td>
<td>Your frequency (or wavelength) varies.</td>
</tr>
<tr>
<td>QRI—</td>
<td>Is my note steady?</td>
<td>Your note varies.</td>
</tr>
<tr>
<td>QRJ—</td>
<td>Are you receiving me badly? Are my signals weak?</td>
<td>I can not receive you. Your signals are too weak.</td>
</tr>
<tr>
<td>QRM—</td>
<td>Are you being interfered with?</td>
<td>I am being interfered with.</td>
</tr>
<tr>
<td>QRN—</td>
<td>Are you bothered by static?</td>
<td>I am bothered by static.</td>
</tr>
<tr>
<td>QRO—</td>
<td>Shall I increase power?</td>
<td>Increase power.</td>
</tr>
<tr>
<td>QRP—</td>
<td>Shall I decrease power?</td>
<td>Decrease power.</td>
</tr>
<tr>
<td>QRT—</td>
<td>Shall I send faster?</td>
<td>Send faster.</td>
</tr>
<tr>
<td>QRU—</td>
<td>Shall I send slower?</td>
<td>Send slower.</td>
</tr>
<tr>
<td>QRS—</td>
<td>Shall I stop sending?</td>
<td>Stop sending.</td>
</tr>
<tr>
<td>QST—</td>
<td>Have you something for me?</td>
<td>I have nothing for you.</td>
</tr>
<tr>
<td>QSV—</td>
<td>Are you ready?</td>
<td>I am ready.</td>
</tr>
<tr>
<td>QSR—</td>
<td>Am I calling you?</td>
<td>Please tell. I am calling him on.</td>
</tr>
<tr>
<td>QSR—</td>
<td>Shall I wait? When will you call me again?</td>
<td>Wait. (or Wait until I have finished communicating with. . . .)</td>
</tr>
<tr>
<td>QSB—</td>
<td>Which is my turn?</td>
<td>You are called by. Your turn is number. (or after every other call).</td>
</tr>
<tr>
<td>QSD—</td>
<td>Who is calling me?</td>
<td>You are called by.</td>
</tr>
<tr>
<td>QSF—</td>
<td>What is the strength of my signals (1 to 5)?</td>
<td>The strength of your signals is. (1 to 5).</td>
</tr>
<tr>
<td>QSG—</td>
<td>Shall I transmit telegrams (or one telegram) at once?</td>
<td>Transmit . . . . . . . . telegrams (or one telegram) at once.</td>
</tr>
<tr>
<td>QSH—</td>
<td>Which is your interior telegraph charge?</td>
<td>The charge per word for is . . . . . francs, including my interior telegraph charge.</td>
</tr>
<tr>
<td>QSK—</td>
<td>Shall I continue the transmission of all my traffic? I can use break-in operation.</td>
<td>Continue the transmission of all your traffic. I shall break you if necessary.</td>
</tr>
<tr>
<td>QSL—</td>
<td>Can you give me acknowledgment of receipt?</td>
<td>I give you acknowledgment of receipt.</td>
</tr>
<tr>
<td>QSM—</td>
<td>Shall I repeat the last telegram I sent to you?</td>
<td>Repeat the last telegram you sent to me.</td>
</tr>
<tr>
<td>QSO—</td>
<td>With whom do you communicate?</td>
<td>I can communicate with directly (or through. . . .).</td>
</tr>
<tr>
<td>QSP—</td>
<td>Will you relay to free charge?</td>
<td>I will relay to free charge.</td>
</tr>
<tr>
<td>QSR—</td>
<td>Has the distress call from. . . . . . been attended to?</td>
<td>The distress call received from has been attended to by.</td>
</tr>
<tr>
<td>QSU—</td>
<td>Shall I transmit (or reply) on. . . . . . . . . kc. (or. . . . . m.) and/or with waves of type A1, A2, A3, or B?</td>
<td>Transmit (or Reply) on. . . . . . . . . kc. (or. . . . . m.) and/or with waves of type A1, A2, A3 or B.</td>
</tr>
<tr>
<td>QSV—</td>
<td>Shall I transmit a series of VVVV?</td>
<td>Transmit a series of VVVV.</td>
</tr>
<tr>
<td>QSW—</td>
<td>Do you wish to transmit on. . . . . . . . . kc. (or. . . . . m.) and/or with waves of type A1, A2, A3 or B?</td>
<td>I am going to transmit (or I shall transmit) on. . . . . . . . . kc. (or. . . . . m.) and/or with waves of type A1, A2, A3 or B.</td>
</tr>
<tr>
<td>QSX—</td>
<td>Do you wish to hear (call signal) on. . . . . . . . . kc. (or. . . . . m.)?</td>
<td>I hear. . . . . . (call signal) on. . . . . . . . . kc. (or. . . . . m.).</td>
</tr>
<tr>
<td>QSY—</td>
<td>Shall I change to transmission on. . . . . . . . . kc. (or. . . . . m.) without changing the type of wave?</td>
<td>Change to transmission on. . . . . . . . . kc. (or. . . . . m.) without changing the type of wave. or</td>
</tr>
<tr>
<td>QSZ—</td>
<td>Shall I send word or group twice?</td>
<td>Send each word or group twice.</td>
</tr>
<tr>
<td>QTA—</td>
<td>Shall I cancel telegram number. . . . . . as if it had not been sent?</td>
<td>Cancel telegram number. . . . . . as if it had not been sent.</td>
</tr>
<tr>
<td>QTB—</td>
<td>Do you agree with my word count?</td>
<td>I do not agree with your word count. I herewith repeat the first letter of each word and the first figure of each number.</td>
</tr>
<tr>
<td>QTC—</td>
<td>How many telegrams have you sent?</td>
<td>I have . . . . . telegrams for you (or for. . . . . . ).</td>
</tr>
<tr>
<td>QTE—</td>
<td>What is my true bearing relative to you or what is my true bearing relative to (call signal) or</td>
<td>Your true bearing relative to me is. . . . . . . . . degrees. or Your true bearing relative to. . . . . . . . . (call signal) is. . . . . . . . . degrees at. . . . . . . . . o'clock. or The true bearing of. . . . . . . . . (call signal) relative to. . . . . . . . . (call signal) is. . . . . . . . . degrees at. . . . . . . . . o'clock.</td>
</tr>
<tr>
<td>QTF—</td>
<td>Will you give me the position of my station based on bearings taken by radiocompass stations you control?</td>
<td>The position of your station as based on radiocompass stations that I control is. . . . . . . . . . . . . . . . . . latitude . . . . . . . . longitude.</td>
</tr>
<tr>
<td>QTG—</td>
<td>Will you transmit your call signal for fifty seconds, ending with a dash of ten seconds, on. . . . . . . . . . . . kc. (or. . . . . m.) so that I can take your radiocompass bearing?</td>
<td>I am going to transmit my call signal for forty seconds, ending with a dash of ten seconds, on. . . . . . . . . . . . kc. (or. . . . . m.) so that you can take my radiocompass bearing.</td>
</tr>
<tr>
<td>QTH—</td>
<td>What is your position in latitude and longitude (or according to any other indication)?</td>
<td>My position is. . . . . . . . . . . . . . . . . . . latitude, . . . . . . . . . . . . . . . . . . longitude (or according to any other indication).</td>
</tr>
<tr>
<td>QTI—</td>
<td>What is your true course?</td>
<td>My true course is. . . . . . . . . . . . . . . degrees.</td>
</tr>
<tr>
<td>QTJ—</td>
<td>What is your speed?</td>
<td>My speed is. . . . . . . . . . . . . . . . . knots (or. . . . . . . . . . . . . . . . . kilometres) per hour.</td>
</tr>
<tr>
<td>QTQ—</td>
<td>Send radio signals and submarine sound signals so that I can determine your bearing and your distance.</td>
<td>I am sending radio signals and submarine signals so that you can determine your bearing and your distance.</td>
</tr>
</tbody>
</table>

(Continued on page 17)
UP SHE GOES!

A 40-Foot Antenna Mast...Supported by Four Guy Wires...Costs Less than $4 To Construct
Can Be Erected By One Person

Here's How W6AWT Did It

"W" hat a political pull that man must have to permit him to put that steel skyscraper on his roof and another in his backyard, only a few feet from my house. They might have cost him at least $700.

"Land sakes, Mrs. Sullivan, I'm afraid to look at the things. They make me dizzy."

"But you should have been home, Mrs. Murphy, when he put up those big towers. He did it almost by himself, and when he had 'em most the way up, along came another feller and helped him tie some wires to the fence. In an hour they finished the job."

So the wind blew, and the bull flew, but these are true statements of fact, overheard by Mrs. B. Molinari, better-half of the W6AWT power house that is ready for the air with a couple of 204-A's in the final, and modulated for 80-meter phone communication with a rack-and-panel amplifier and modulator that will be described in a later issue.

Molinari is another of the real old-timers who comes back on the air after pawning everything but the kitchen sink to buy parts needed for a modern amateur station. His neighbors don't like the looks of his almost self-supporting antenna towers, but to the amateur they are a treat for sore eyes. Small wonder the neighbors gossip over the fence.

A 20-Foot Tower, suitable for average purpose. It weighs less than 20 pounds and can be made self-supporting by weighting it down with sacks of sand laid on the base brackets. The constructional details for a 40-foot tower are proportionately identical.

Constructional Details for Building the Tower:
If the tower is to be more than 20 feet high, it is advisable to brace it in the center with a "cross-wire-center-brace" as shown at "Z" in the illustration above. The bracing wires are twisted tightly together where they cross each other in the center. As is seen from the illustration, the tower has four sides; two sides are first constructed and the lattice-work bracing is then nailed in place to complete the remaining sides. Towers 20, 40 or 60 feet high are constructed along similar lines, the only difference being in the thickness of the long pieces that determine the height. 40-foot towers should be made from ¾" or 1" square lumber for the main frame.
his towers. Other kinds of wood will give almost equal satisfaction but spruce was used because it is light in weight and also because it will not split when the bracing laths are nailed to the four corner pieces. Then, too, nails do not easily work loose when driven into spruce.

W6AWT finds it good policy to break-up the guy wires with insulators spaced ten feet apart. Too few amateurs realize that long guy wires, with few insulators or none at all, have a natural wavelength of their own, and will absorb a lot of energy from the transmitted antenna, and radiate harmonics and make the operator wonder why his signals are not reaching out. Play safe. Insulators are cheap. Use a lot of them in the guy wires.

To construct one or more of these fine looking towers the constructor is advised to first lay the four side pieces on the ground. These pieces can be as small as ½ inch square if only a 20-foot tower is to be built. They can be an inch square for a 60-foot tower. ¾ inch for the 40-footer. However, the size of these corner pieces can be such as to satisfy the taste of the builder.

The four corner pieces can be ripped from long strips of ¾ inch or 1 inch lumber, or a sawmill will cut them too size. If it is impossible for you to secure strips of lumber of the desired length for the height of the tower you desire to build, shorter lengths can be used and nailed together.

The lath braces are cut from ordinary surfaced or unsurfaced lathing, about 1 inch wide and ¾ inch thick. Half-inch lath nails are used to secure these braces to the four corner pieces. The laths should be given a coat of paint before they are cut. Likewise, the four corner pieces should also be painted before actual construction gets under way.

Step by step, the drawings here show how to construct the tower. The 20-foot tower is described. Construction of a 40, 60 or 80-foot tower is identical, but the long pieces for the 60 and 80-footers should be about an inch square, the two or more sections secured together as shown in one of the drawings.

The extreme light weight of these towers, their fine appearance, simplicity of construction and utmost ease of installation will appeal to many amateurs who want to go up in the world.

The towers at W6AWT have withstood heavy wind pressure in a location only a mile or two from where the Pacific Ocean gets its start. December 'RADIO' will bring you a complete description of W6AWT's amplifier, modulator and rectifier system.

New "Q" Signals (Continued from page 11)

QTO—Are you leaving the dock (or the port)? I am going to leave the dock (or the port).

QTP—Are you going to enter the dock (or the port)? I am going to enter the dock (or the port).

QTP—Can you communicate with my station by means of the International Signal Code?

QTR—What is the correct time? The correct time is ________.

QTU—What are the working hours of your station? The working hours of my station are from _______ to _______.

QUA—Have you any news of (call signal of mobile station)? The news of (call signal of mobile station) is ________.

QB—Can you give me, in this order, information concerning: visibility, height of clouds, and ground wind for (place of observation)?

QC—What is the last message received by you from (call signal of mobile station)? The last message received by me from (call signal of mobile station) is ________.

QUD—Have you received the urgency signal made by (call signal of mobile station)? I have received the urgency signal made by (call signal of mobile station) at ______ o'clock.

QUF—Have you received the distress signal made by (call signal of mobile station)? I have received the distress signal made by (call signal of mobile station) at ______ o'clock.

QUG—Are you going to be forced to alight at sea (or on land)? I am going to be forced to alight at sea (or on land) at _______.

QUH—Will you give me the barometric pressure at sea level? I give you in miles, 1000 feet, etc., the barometric pressure at sea level is _______.

QUJ—Will you give me the true head to follow, with no wind, for (place)? The true head to follow, with no wind, for (place) is ______ degrees at ______ o'clock.

The signal series of QA, QB, QC, QD, QF and QG are reserved for special aeronautical codes.

W6AWT's Transmitter ... using a veneered-wood rack, painted dark green. Another similar rack houses the power supply.
Sky-Wave Propagation

By A. L. Munzig, W6BY

With the approach of minimum solar activity and its resulting effect on the ionized region in the upper atmosphere, it will probably prove of interest to the readers of "RADIO" if an explanation of sky wave propagation is given. Since the transmission to distant points at high-frequencies is dependent on the ability of the ionized region to refract the radio wave, the beginning of this eleven-year cycle solar activity disturbance will have a decided effect upon its refractive index. The writer will endeavor to explain the generally accepted theories on the existence of this ionized region and the path a radio wave follows in passing through it.

Kennelly-Heaviside Layer

As a result of ultra-violet radiation from the sun, there exists a ionized region in the upper atmosphere at an elevation of approximately 16 miles. (See Fig. 1). Studies of the propagation characteristics of radio waves by Kennelly and Heaviside have proven beyond any possible doubt that this ionized region exists. Scientists are not certain whether the electron density increases gradually to a single maximum or whether there is a minor maximum near the lower boundary. However, it is the contention of the writer that the latter is the case due to observation of the action of radio waves propagated at high angles in experiments conducted over a period of four years. (See Fig. 2).

Refraction

The transmission of high-frequency signals depends upon the ability of the ionized region above the earth, known as the Kennelly-Heaviside layer, to refract the sky wave back to earth at the receiving point. As a result the strength of the signal received from a distant point depends upon:

1. Frequency transmitted.
2. Height of Heaviside layer.
3. Density of Heaviside layer.

Referring to Fig. 1, most of the important features involved in the refraction of high frequency sky waves can be understood. The diagram assumes a single ionized layer and illustrates hypothetical ray paths for sky waves of different frequencies leaving the transmitting antenna at different vertical angles. Waves of a very high frequency and extremely high vertical angles are radiated almost directly upward from the antenna and are not refracted sufficiently to be bent earthward and so travel directly through the ionized region into the space beyond. (See "A", Fig. 1). At "B" is shown a ray of somewhat lower vertical angle than "A" that is bent parallel with the earth's surface just before reaching the region of maximum ionization of the Kennelly-Heaviside layer. This ray has penetrated very deeply into the ionized region and travels a considerable distance parallel to the earth's surface because of the low rate of change of ionization with height. However, it is ultimately bent downward into the lower part of the layer where the ionization gradient is greater and then is directed earthward. This path is evidently that taken by 28 MC signals and lower frequencies propagated at high vertical angles. A ray marked "C", Fig. 1, leaving the transmitting antenna at a still lower vertical angle, does not reach the region where the density of ionization changes slowly with height and so returns to the earth moderately closer to the transmitter. Ray "D" is propagated at an extremely low angle with the result that the wave is refracted back to earth at a much greater distance. In the region between the two rays and the point at which the wave is refracted to earth, there is a silent zone in which no signals are received. Of course if one is located in the range of the rapidly attenuated ground wave, then the ground wave will be received. The distance from the transmitting antenna to the point at which the first refracted sky wave returns to the earth is called the "skip distance", because the sky waves skip over it. At high-frequencies the "skip distance" is correspondingly increased and the refracting power of the ionized layer is reduced, resulting in the critical angle of elevation at which the radiated rays first return to earth being less. The "skip distance" increases as the frequency is increased, as the electron density in the ionized region becomes less and as the height of the layer is increased.

Path of Wave in Ionized Region

The effect which an ionized region has on the path of a sky wave from the transmitting antenna is relatively complicated. The energy which each individual electron in this region absorbs from the passing wave is re-radiated in a new phase and a new plane of polarization, with the result that this re-radiated energy is in part re-absorbed by other electrons causing a further change in the phase and plane of polarization. This results in a refractive bending of the radio wave away from the region of high electronic density toward regions of lower density. Hence, the exact path followed by the wave is determined by the extent to which the refractive index of the upper atmosphere departs from unity as a result of the ionized layer.

Refractive Index

The wave front produced by a radio wave in traveling through an ionized region in the absence of a magnetic field, is determined by the refractive index of the medium and the angle of incidence with which the wave enters the medium. At low frequencies the earth's magnetic field has much the same effect on the refractive index of the ionized medium as does the presence of gas of relatively high pressure. The earth's magnetic field reduces the average velocity of the vibrations and at frequencies above 6000 KC the magnetic field of the earth has negligible effect on the refractive index. The curvature of the path of the sky wave as it enters the ionosphere, results from the fact that each part of the wave front travels with a velocity equal to that of the phase of the wave at a certain maximum density of the ionized region above the earth. The edge of the wave front where the electron density is greatest and phase velocity greatest, advances faster than the rest of the front, thus causing the wave to follow a curved path in which the bending is away from the region of maximum density. The curvature depends upon the rate at which the electron density changes with height and is greatest when this change is maximum. At the point of greatest electron density the gradient is zero and the path is straight. Once past this point the waves bend away from the earth and will not return except as a result of a reflection from outside the earth's atmosphere. Below the point of maximum electron density of the layer the bending is always earthward.

Attenuation

There are a number of factors governing the attenuation of the sky wave in the Kennelly-Heaviside layer. As the frequency of the wave is increased the attenuation tends to become less because the average velocity of the vibrating electrons is reduced. Because of the low refracting power of the upper ionized region at low frequencies, these waves penetrate deeply into the layer and consequently travel considerable distances in the region. (See ray "B", Fig. 1. See ray "A" and "B", Fig. 2). The attenuation is also affected by the angle of incidence of the wave, since the length of the ray path within the Kennelly-Heaviside layer and the average density encountered by the wave both vary with the angle of incidence. Further losses also depend upon the height of the layer, because at high elevations the gas pressure is low, making collisions between vibrating electrons and gas molecules less frequent. So we see that it is of great importance that the attenuation of the sky wave in the upper ionized region be low. Referring to ray "C", Fig. 2, it will be noted that when the sky waves strike the earth they are reflected upward since the earth is a relatively good conductor. However, irregularities in the surface of the earth, such as mountains and valleys, cause a large fraction (Continued on page 31).
**Majestic Tubes**

The term "Majestic" refers to a series of vacuum tubes that were manufactured by RCA. Majestic tubes are known for their enhanced performance compared to common tubes of the time. They were particularly useful in radio broadcasting due to their improved shielding and reduced interference, which made them ideal for use in high-fidelity audio systems. Majestic tubes are often praised for their ability to produce clear and distortion-free sound, making them a popular choice among audiophiles.

**Calculating Grid Bias Resistors**

Grid bias resistors are crucial in maintaining the proper bias voltage across the grid of a vacuum tube. This voltage is essential for the tube to operate efficiently and to avoid damage. The value of the grid bias resistor can be calculated using the formula:

\[ R_{bias} = \frac{V_{cc} - V_{grid}}{I_{grid}} \]

where:
- \( R_{bias} \) is the grid bias resistor in ohms,
- \( V_{cc} \) is the supply voltage,
- \( V_{grid} \) is the desired grid bias voltage, and
- \( I_{grid} \) is the grid current.

**Improved Volume Control**

For 57, 58, 6C6, 6D6

The somewhat unusual volume control circuit shown in Fig. 2 does three things at once. At the resistance between cathode and ground it is increased the control grid becomes more negative, as does the suppressor grid. At the same time the screen voltage is reduced. This tremendously extends the range of volume control without any tendency towards distortion or cross-modulation. This feature is true only of the 57 and 6D6. In the case of the 57 and 6D6 it is possible to maintain optimum detection characteristics with a fairly wide control over sensitivity or regeneration. The variation in suppressor voltage can be used to effect a change in the selectivity of the plate circuit because this suppressor bias voltage is partly the tube's plate resistance. This is the basis of some of the "automatic tone controls" which are now used by a number of broadcast receivers. By increasing the selectivity of the intermediate amplifier of a superheterodyne it is possible to cut the side bands to such an extent that the higher audio frequencies are attenuated and eliminated. When a signal fades down and the AVC circuit brings up the sensitivity, it really means that noise level too, therefore at such times the noise is increased; if the band passed by the IF amplifier is cut down.

**The Western Electric 242A and the RCA 211**

It should be noted that the 242A and 211 are practically identical in every respect. However, they are just different enough so that they should not be used in parallel or push-pull circuits with each other. One can be replaced by the other without circuit change. These are the standard, general purpose 100-watters and have an amplification factor of 20, which allows their use in Class A, B, and C circuits.

**The Heintz & Kaufmann HK255**

500 Watter

**RADIO FOR NOVEMBER**

19
Exciting the 46 and 47

Almost all of the pentodes and zero bias class B tubes have a grid-leak-excited RF choke when used in a transmitter. This over-excitation causes the output to drop off and causes a great loss in the cathode emission. If you use any of these tubes in your rig, it is well worth your while to use a grid-leak circuit, to maintain the detector at that high sensitive point. Just beyond the threshold of oscillation, changing tubes may necessitate a change in the cathode tap.

Selectivity

The peaked audio amplifier as a means of obtaining receiver selectivity did cut out because the hams wanted to move the frequencies in the best possible position. In the old days, when the single-scoper was here, we are forced to set the grid-leak excitation off the grid-leak to harmonic frequencies. Why not go back to peaked audio for CW signals? It would certainly cut down noise as well as providing some real selectivity and overload protection.

The 24A As a Dynatron Oscillator

While RCA has not yet come out with radio's 24A's, it is likely that the usual dynatron circuit being cut out, it is possible that the tube will be found useful. The 24A is very interesting and has some possibilities. Its noise will be cut down if a 36B is used instead of a 24A. It is also recommended that it be used as a voltage amplifier.

Mercury Vapor Rectifiers and the Climate

Few realize the effect of heat and cold on their rectifiers. The mercury vapor rectifier is due to the fact that the inverse peak rating of this tube is low. Note that adequate ventilation is a necessity for long life. In cold weather allow plenty of space for the tubes to warm up. Too little heat is as bad as too much heat.

CPC and RAC

Several stations of the Civilian Conservation Corps are located on 500 KC, which is just above the amateur 80 meter band. While most of these stations are crystal controls, they have much to be desired. Their mufs covers from 55 to 65 KC inside the 80 meter band and effectively prevents nearby and often distant hams from working except at the highest possible signal level. The operators contacted have shown little desire to cooperate with us and give the impression that they are Army operated stations. This delusion will be rapidly dispelled when the matter is brought to the notice of the proper Army authorities. Log this interference and send us copies of your QSLs. We will see that the right people hear about it.

10-Meter Phone

It should be repeated that the new 10-meter phone band (from 28,000 to 28,500 KC) is open to all amateurs and not just those with the special phone endorsement. Who will be the first to make WAC on phone with the aid of this band? Please design your rig for MOPA ultimately because I already foresee the tandem line-in rig, that will have to fight with 30 or 50 modulated oscillators starting hopping over. You might start with a push-pull unity coupled oscillator and then later you can inductively couple a neutralizing amplifier to the output of the oscillator. Some dope is coming on just such a low powered transmitter, so keep this point in mind. By the way, the well known Simpson circuit does work on 16. It is nothing but a conventional push-pull neutralized amplifier with an excess of neutralizing capacity across the output. It is first used as a unity coupled oscillator, but uses capacitive feedback instead of inductive feedback, which helps to obtain a good note and quiet carrier.

Percentage Modulation

Every phone ham should memorize this... "Take the ratio of one-half of the difference between the minimum and maximum amplitudes of the modulated wave and the average amplitude of the wave, and express this ratio in percentage. This gives the percentage of modulation." Some hams claim more than 100% modulation, but it should be remembered that 100% modulation is not even intelligible, but alone useless. In quality. 100% modulation means the power output of the modulators must equal 50% of the DC input to the class C stage.

Marconi Bends the Ultra-Short

Mr. Guglielmo Marconi, the original ham, has recently continued in sending 18 CM waves, to be received on a beacon receiver with a 4500 meter band. The sense of his career is that the angle of radiation is of the utmost importance. Your columnist is an old-time hams and is aware of the subtle art of using crystal control you are advised to get a 3333 crystal and about 500 for a 10-meter CM equals 1666 MEGACYCLES. Seriously, though, a 10-meter CMC is all that is needed. The dimensions of a beam antenna are small enough to make it portable.

The IV High Vacuum Half Wave Rectifier as a Phone Monitor

This tube has a 6.3 volt 3 amp. heater and will stand 50 milliamperes of space current at 2500 volts. Several critically tuned receivers of the midget type but is useful as a high frequency power amplifier of various types of circuits. When used as a bias rectifier its AC supply must be of regulated regulation and must be avoided. The new General Radio "AC" output transformer provides excellent means of varying the voltage supplied to the rectifier.

The IV also is very desirable as a monitoring amplifier in a phone transmitter as shown in the illustration. It also can be used in a vacuum tube modulator or modulator to determine percentage of modulation.

This phone monitor should be placed 8 or 9 feet from the transmitter if a condenser or a resistor is used. The number of turns chosen so that the rectifier is constantly adjusted through the transmitted frequencies with the tuning condenser tuned for resonance, close coupling should be avoided, or serious errors may occur in the phones or the rectifier tube.

Regeneration, Standby, and the Monitor

One of the advantages of a cathode screen tube is the ability to use a cathode screen tube for various types of detection. Or FIG. 32 shows the regeneration stage of a push-pull neutralized amplifier with an excellent method of avoiding the threshold. Why not try a regulated 250 BB transformer, to bring up the grid-leak excitation to the proper level, and use the cathode bias resistor to correct when the in-transistor frequency is too low. Why not try a 75 micro-farad and more if possible. The lower the bias, the more bass is necessary to keep the low frequencies up where they belong. Thus, with screen-grid tube and pentodes, the problem becomes even worse than with triodes, the 3T, 37 or 66. This FIG. 2 shows an excellent method of avoiding low capacitance on the grid circuit, and the amount of feedback varies with the even a narrow tuning band. This means that we have to use the right amount of feedback, both of which must be constantly adjusted as we tune across a band of frequencies.

If you are prepared to go to all the work of rebuilding, trying and then rebuilding your coils again, probably the most satisfactory arrangement is to use screen potentiometer control with screen-grid feedback by means of a cathode tap on the grid coil, in the conventional electron-coupled oscillator circuit. If the tap is properly located, it is possible to tune across the three or four-hundred KC without touching the regeneration control to maintain the detector at that high sensitive point. Just beyond the threshold of oscillation, changing tubes may necessitate a change in the cathode tap.

The missing "Lows" in the Audio Channel

Fidelity tests on representative speech amplifiers used in Ham photos show a distressing lack of the low voice frequencies which are so essential to "naturalness" and pleasing quality. Very few speech amplifiers show any response at all below 250 cycles, even with ribbon microphones and high quality transformers. Where then, are the lows being lost? There are two principal holes through which the lows are escaping. The first one is easy to remedied; it is due to DC saturation. The DC plate grid is slowly adjusted to the plate of the audio tubes through some form of audio choke, see Fig. 1. The other hole through the low frequencies is the impedance to the amplifier. Note if the shunt feed method is used, high quality audio chokes are essential. One very seriously in the primaries and secondaries in series can be used for this purpose. The other hole through the low audio for CW signals? It would certainly cut down noise as well as providing some real selectivity and overload protection.

Ham Hints
By JAYENAY

RADIO FOR NOVEMBER
Class B Output Transformers

Almost without exception, good class B trans-
formers have a BIG INSULATION RATING for
class B service so that it is almost impossible
to overload them. If enough output transformer
without making a material sacrifice in
turns, then there might be enough output
and air gap (or its equivalent) so that the DC plate
curves do not rise. However, it should be noted
that in the class B push-pull circuit there exists
a Class B output transformer. In an ordinary
output transformers for Horn transmitter use, lie
in the fact that the DC plate current to the modu-
lation, does not rise due to the secondary winding.
Therefore, in order to obtain good low frequency
efficiency, it is necessary to have an output
iron and copper which is always associated with
weight. Often a Class B output transformer
also differs materially from class A practice
inherent. The screen is designed to stand at least
10 times the plate voltage, and if the load is reduced from the secondary, the plate surge
across the open secondary can reach a peak
of 80 times the plate voltage. It is entirely pos-
sible to break down 50,000 volt insulation with
a pair of 2BA's with 1,760 volts on the plate, work-
ing into an unloaded class B output transformer.
Class B transformers for broadcast use often pro-
vide a much higher inherent harmonic disfor-
to the fires and when something should happen
the load. Therefore, avoid using smaller class B transformers if you want to have a good
quality phone.

5 and 10 Meter Self Excited Oscillators

Push-pull oscillators minimize the drift in fre-
quency, and when properly designed, also simplify the problem of RF chokes. The
"push pull" effect is preserved in the grid circuit
cause of its inherent stability and also due to the fact that the grid effect is stronger when
worth trying. Use high C for stability, and note that a variable grid coupling circuit can be
some useful values. To find the point of maximum output and stability, note that the lowest
voltage tubes seem more stable as self-excited oscillators than the high-nu tubes.

Parasitic Oscillation in Class B Modulators

The hash quality evident in many class B modu-
lation, is usually due to parasitic oscillation in the modulators. This oscillation is not con-
tinuous, but produces a noise that is intermittent
quality. The best remedy for this condition is to use two tubes per plate, or from grid to
grid, or both. This will bypass the higher audio
frequencies slightly, but the effect is imperceptible.
Do not use series resistors in the grid leak of
the grid circuit MUST be kept at as low resistance as possible to remove harmonic distortion.
Sometimes 25,000 ohms shunted from grid to plate
will completely eliminate the distortion.

Crystal Holders For SS Supers

Mr. Ralph Hevlin has pointed out on several occasions, copper-clad steel wire has just as low a
resistance as a resistance as copper clad copper
wire, but shows less change in length with ordinary
voltage. Copper clad steel is about as readable in
operation as copper plated wire, but is far easier to
and not be cramped in any way. An air-gap holder
is a must in order to keep the plate and grid voltages
that exert pressure on the crystal through a spring
pressure plate. A holder of this type is ideal, as
the crystal seems to be vertically, so that the crystal
resistor has no effect on the output's own weight causes a noticeable damping effect.

Copper-clad Steel

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the crystal seems to be vertically, so that the crystal
resistor has no effect on the output's own weight causes a noticeable damping effect.

Single Wire Feed To The Full Wave Antenna

Antennas of the full wave type have become popular
again. I might point out that the single wire
feeding of full wave type antennas is not the
Way to find these points is to consider the following
frequencies being transmitted. The feeder
is then adjusted 14 per cent (approx.) of a half wave away from either of the two cure
rent nodes. On the full wave antenna the points
are 18 per cent of the total length and are
measured from either end. The two wire type of
connection is often used because the feed line can be used to
feeding either half of the antenna in the usual
way. This method will match the impedance of
the line at the transmitter.

New Filter Ideal

One ohm two readers wrote and suggested that a
chopper switch be placed between the rectifier
and the grid. This may be of some use near from the rectifiers. He claims that the resulting
harmonic effect is less than that of the regular 80-cycle output of the rectifiers. H!

Plate Voltage and Efficiency

A NOETHER question which has caused quite a
number of discussion is whether or not the effi-
cency of any given tube, amplifier and rectifier
combination might be worded this way: "If the tube is rated at 850, would more
tube watts be obtained from a 100 milliamperes
than if it were operated at 2500 volts and 25 amperes?" This is a question
and that the plate tanks are identically. What
one point of authority on each side of this question so this
not drop me a line and let me know your
opinion.

I'll give you a year's subscription for the best letter
on this question.

RCA Announces Price of '800'"
The Famous Squirrel Club
By DON C. WALLACE

In Long Beach, California, exists the famous "Squirrel" Club, noted for the things which it does not pass.

The rules are as follows:
1. It has no rules.
2. It has no officers.
3. It has no treasurer.
4. It has no meeting place.
5. It has no regular meetings.
6. There are no requirements for membership (but try and get in).
7. Every member seems to have a 1 KW transmitter. (This is not a requirement but seems to be more or less accidental).
8. Coffee at 10 p.m.
9. It has no constitution or by-laws.
10. No committees.
11. It has no probationary period for membership, although most of the members are on probation.
12. No uniforms, badges, signs, nor insignias.
13. No charters.
14. Password: "It's alive."

You can see from the above that this is a strange and weird organization of radio hams. It has been in existence for many years and numbers among its members, associated members and probationary members the following:

W6AM Don Foster, U. S. Foster Ave.
W6EJ J. L. Jones, 3084 Greenville Ave.
W6FYF D. A. Weller, 912 Loma Drive
W6DEP L. T. Donato, 2177 Sparta St.
W6RO J. W. Lang, 1217 Raymond Ave.
W6KCM J. G. Strong, 1217 Florida St.
W6ZQ Z. W. Williams, 1201 Country Club Drive
W6CZZ George Weller, 912 Loma Vista Drive
W6DZ D. A. Drake, 1122 Walnut Ave.
W6ZY C. C. Weller, 4214 Country Club Drive
W6CZ W. L. Foster, 2177 Sparta St.
W6CZ Roger Weller, 912 Loma Vista Drive
W6CN A. Leon Drake, 1122 Walnut Ave.

It is an electron-coupled member—Lt. J. B. Dow, U. S. S. "Utah".

Meet them face-to-face. Some of the Squirrel Club members. Standing—Don C. Wallace, W6AM. Standing, left to right—W6RO, W6EJ, W6FYF. You can identify them by the Squirrel and 852 Tube insignia on their backs. When the Squirrel Club goes visiting, the members carry a live squirrel around with 'em.

YL's, YF's, OW's

Activities of the She-Hams... Introducing W6EK... Flora L. Card, of Pomona, Calif.

W6EK

Here's the dope...

Crystal control—feral ooc., 46 meter, W621D final, 80 watts input. Station works on either 40 or 80 meters at present on 80 meters with free, 3540 KC. Antenna—120 volt, feed heater. Receiver—2-261's. Both bug and straight key are used.

WEEK originally came on the air in August, 1931, with 71A's in parallel—later graduating to 45's in push-pull, and finally to the present state of crystal control in May, 1933.

Operator

18 yrs. old, ham since Aug. '31. Made Brassbounder's League twice, ORS. Would much rather handle traffic than rag chew. Handled quite a few messages during the earthquake.

Scratchi

Osokime, Japan.

Honorable Editor "RADIO".

Extreme difficulty arise when Scratchi resort to use of transmitter which becomes all excited by itself, forthwith honorable oscillating crystal pig-up already ceased operation because of poor gippie crystal which Scratchi first buy. Instruction book say tube must not have red color on plate. I find impossible to remove color from my tube. So Scratchi put on pair of rose colored glasses and tube color look all right again. All-excited-by itself transmitter blow up tube, so Scratchi send tube back to manufacturer with long letter of lies to tell how trouble come about.

Two day later come another crystal from Scratchi which he buy from huge independent male-order house. Scratchi make selection from very large catalog which show picture of Empire-Shake Building from New York. Must be very firm institution, think Scratchi, with such massive store to occupy. Also, Scratchi be receiving again, for same mail come letter from my cousin which live in New York and say to me that big male-order house not in Empire Shake Building at all, I come only small Chicago Sale institution down in basement in Cortlandt alley.

Scratchi look out for much merchandise which come from these, say my cousin. Scratchi have great confidence in hawman nature. New oscillating crystal come parked in nice box on which is picture of seagull with one foot on scare-up and other foot on old-fashioned radio dial wheel.

Under picture of bird is letters N.R.A. Scratchi try for nine day and all night make new crystal show oscillation, with success further than remote. Wife come in shack and ask to see box in which come crystal. She look at bird on box and see N.R.A. letters. "Scratchi," she say, "you buy wrong kind of crystal again. N.R.A. . . . that mean No Resistance Anywhere!"

Quick thoughts come to Scratchi. Recall cautious wording of insulating engineers for make steelbird crystal oscillate. Put crystal in oven, say advisor, so Scratchi proceed with process and put crystal in kitchen stove, wiring also go all other garbage which also go up in smoke. Hopping you do the same, I am.

Your esteemed reader,

Scratchi.
Sylvania 865 Graphite-Plate Tube

**R.F. Amplifier and Frequency Multiplier**

The Sylvania Type C1 is a screen grid tube designed for use as a radio-frequency amplifier or frequency multiplier. It is also useful as a low-frequency oscillator. Because of its low interelectrode capacity it is especially valuable for use at frequencies not exceeding 20 megacycles. The complete shielding built into the tube eliminates the necessity for external neutralization to prevent self-oscillation and feedback. The 865 employs the specially processed graphite anode incorporated in all Sylvania air-cooled transmitting tubes and rectifiers.

**General Characteristics**

<table>
<thead>
<tr>
<th>Number of Elements</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament Voltage</td>
<td>7.5 V</td>
</tr>
<tr>
<td>Plate Current</td>
<td>125 A</td>
</tr>
<tr>
<td>Plate Diameter</td>
<td>3.5 inches</td>
</tr>
<tr>
<td>Type of Cooling</td>
<td>Air</td>
</tr>
<tr>
<td>Plate ohms</td>
<td>450 Ohms</td>
</tr>
<tr>
<td>Mutual Conductance</td>
<td>1.5 mhos</td>
</tr>
</tbody>
</table>

**Type of Grid:** Thoria-Tungsten

**Average Characteristics at:**

- 
  - $R_{g} = 55$, $E_{f} = 7.5$
  - Plate Current: 125 A
  - Filament Current: 1.25 A
  - Amplification Factor: 0.8 A
  - Plate Resistance: 450 Ohms
  - Mutual Conductance: 1.5 mhos

**Plate বর্গীয় ভাবে সংক্ষিপ্ত বর্ণনা**

**New Sylvania Graphite-Plate 210 and 830 Tubes**

**Thru Sylvania Type 210 is a general purpose, air-cooled triode especially designed for service in radio transmitters and similar equipment.**

- Anodes are kept at a minimum by means of advanced methods of construction and the use of high purity ceramic base. High efficiency is attained by the incorporation into the tube structure of a recently developed Sylvania "floating anode." This "floating anode" type of construction, while still giving hand-machined advantages in improved insulation and reduced capacity, is a unique feature of this type of tube. It is accomplished by inclusion of the supporting structure electrically from the active elements.

**General Characteristics**

<table>
<thead>
<tr>
<th>Number of Elements</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament Voltage</td>
<td>7.5 V</td>
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<tr>
<td>Plate Current</td>
<td>75 A</td>
</tr>
<tr>
<td>Plate Diameter</td>
<td>3.5 inches</td>
</tr>
<tr>
<td>Type of Cooling</td>
<td>Air</td>
</tr>
<tr>
<td>Plate ohms</td>
<td>1500 Ohms</td>
</tr>
<tr>
<td>Mutual Conductance</td>
<td>1.5 mhos</td>
</tr>
</tbody>
</table>

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  - Plate Resistance: 1500 Ohms
  - Mutual Conductance: 1.5 mhos

**Type of Grid:** Thoria-Tungsten

**New Sylvania Graphite-Plate Tube**

**General Characteristics**

<table>
<thead>
<tr>
<th>Filament Voltage</th>
<th>10 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Plate Current</td>
<td>2.16 Amp</td>
</tr>
<tr>
<td>Max. Overall Length</td>
<td>8 inches</td>
</tr>
<tr>
<td>Max. Diameter</td>
<td>5 inches</td>
</tr>
<tr>
<td>Base:</td>
<td>Glass 4-pin Insulinite</td>
</tr>
</tbody>
</table>

**CLASS "A" SERVICE**

**Max. Operating Plate Voltage:** 10 V

**Class "B" Operation**

<table>
<thead>
<tr>
<th>Max. Operating Plate Voltage</th>
<th>1000 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Plate Dissipation</td>
<td>17 Watts</td>
</tr>
<tr>
<td>Typical Operation at:</td>
<td></td>
</tr>
</tbody>
</table>
  - $E_{p} = 800$, $E_{f} = 80$, $E_{a} = 7.5$
  - D.C. Plate Current: 125 A
  - Peak Grid Swing: 25 Volts
  - Load Resistance: 10,000 Ohms
  - Power Output: 17 Watts

**Class "B" Operation**

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**Class "B" Operation**

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**Output Power:** 17 Watts

**DIRECT INTERELECTRODE CAPACITIES**

<table>
<thead>
<tr>
<th>Cap. to Plate</th>
<th>0.5 mufd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cap. to Grid Filament</td>
<td>4.9 mufd</td>
</tr>
<tr>
<td>Cap. to Plate Filament</td>
<td>4.9 mufd</td>
</tr>
</tbody>
</table>
DELTA Class "B" AUDIO AMPLIFIERS

20 To 200 Watts Output

CLASS "B" Audio Amplification was introduced to the radio amateur and experimenter in November 1931. The results obtained from its use and consequently the opinions of its users seem to have varied widely.

Delta laboratory tests and field observation for those who are interested will be presented in this issue. The author has used a Delta 200 watt Class "B" amplifier prove definitely that this method of amplification is excellent for obtaining large amounts of audio power for amateur, experimental and most commercial applications.

Such amplifiers are economical and more efficient than Class "A", developing a much higher output for a given plate dissipation and emission rating. It is the purpose of this Data Sheet to provide accurate information based on actual experience where available, will insure the best results from this type of equipment.

**Power Supply**

Starting with "Power Supply" at the beginning of a Data Sheet on audio and radio subjects may seem strange. Such matters are usually dismissed with a few brief words as an afterthought. This promise of Power Supply is warranted by engineering facts even though this company specializes in such equipment and may be somewhat unexpected of enthusiasts.

**SWITCH-DIODE POWER SUPPLY**

The other information in this data sheet is of little or no value.

All radio telephone equipment where a tube is operated as a Class "A" Audio Modulator or amplifier, the DC current supplied to the plate of the tube is constant regardless of the AC voltage impressed on the grid of the tube which provided the tube is not overloaded. For this reason any power supply, no matter how poor the regulation, which will deliver the required voltage and current may be used with satisfactory results. The terminal condenser must always be sufficiently large to carry the load during 1/2 cycle at the lowest desired frequency. (This is usually 100 cycles per second in amateur phone work and 30 cycles per second in broadcast work).

When a pair of tubes is used as a Class "B" Audio Modulator or amplifier the DC plate current varies directly with the applied AC grid voltage. Then, if no signal is impressed on the grids of a Class "B" amplifier the DC plate current will be very low (about 50 ma for a pair of 200-A tubes) and a strong signal will cause the DC plate current to rise to as much as 275 ma. Therefore, if one speaks into a microphone connected to such an amplifier the DC plate current will vary with the intensity of the voice and each word is spoken. Obviously, if the supply does not have enough regulation, the DC plate voltage will drop as the current goes up, and thus the output power will not be in proportion to the signal input and distortion will result. It will also be impossible to obtain the expected power output from the tubes due to the loss of plate voltage.

The regulation of a power supply depends upon transformer regulation, proper filter design and the resistance of various parts of the circuit. Care must be used to keep this resistance low if satisfactory results are to be obtained. Resistance units cannot be used to reduce the voltage of the supply from a high value to that required for the amplifier. This applies to resistance in series with the primary as well as any other part of the circuit.

Therefore, the power supply should be designed to supply the correct voltage for the Class "B" plates. Connection to the plate tap of the output transformer must be made directly to the + terminal of the power supply and cannot be obtained from a drop wire as for Class "A" amplifiers. A satisfactory power supply should have regulation not exceeding 10% over the working load range. This means that if the plate voltage is 1100 volts with no signal applied to the grids, it should not fall below 1000 volts when a strong signal is transmitted to deliver maximum output from the Class "B" tubes.

In order to satisfy the above requirements it is essential that the power supply components conform with these specifications.

1. Plate Transformer-Tubes have low internal voltage drop such as mercury vapor type.

2. Plate Tube-Every tube must have good regulation and deliver rated output.

3. Filter Circuit—Must be choke input type with adequate output choke. Current in a filtered circuit to be less than 250 ma. Choke must have a minimum of 50 mfd.

4. Voltage adjusting transformer such as AD-80 or 81 may be used to regulate the output voltage since this does not impair regulation.

with least material. All filter chokes must have low resistance.

4. Ripple—Must be low to prevent modulation of speech by carrier ripple. Ripple of 4% or less is satisfactory.

Tubes—

Selection of Tubes for Class "B" Use

Tubes characteristics of a Class "A" amplifier tube have little bearing upon its use as a Class "B" audio amplifier, particularly the optimum load impedance and maximum power output characteristics. Tubes delivering the highest output for Class "A" amplifiers are invariably unsuited to Class "B" audio use. Tubes having a high amplification factor, low grid bias and high plate dissipation are in general the most satisfactory for Class "B" audio use. The type 60-A tube meets these conditions excellently where audio power of approximately 200 watts or less is required. For this reason the type AD-70 and 71 transformers were designed for use with this type of tube.

The types 211 and WE 342 tube may be used but the maximum output will be less and greater distortion will result.

Selection of Driver Tube for Class "B" Tubes

To obtain maximum output from tubes operating as Class "B" amplifiers, the grids must be excited to a high positive voltage. This causes a relatively high grid current over a part of each cycle. Thus the preceding "driver" must operate into a circuit of varying impedance. In order to reduce distortion from this cause the "driver" should be capable of delivering much more power than that required to fully excite the grids of the Class "B" tube. The coupling transformer (Continued on Data Sheet No. 9 on facing page)
Amplifiers

Transformer-type amplifiers are necessary if microphones are to be used. Transistors may be used as the output devices in transformer-type amplifiers but are not always satisfactory and are recommended for this purpose. The type AD-70 transformer is particularly satisfactory. A load resistor may be used to limit the output and may be used in the form of a variable resistor or in the form of a series resistor.

Microphones may be connected to the transformer by means of a low load impedance microphone transformer. These transformers are commonly used in low power amplifiers. The output transformer may be of any type but it should be made so that it will deliver a sufficient current to the load resistor.

Circuit Diagram

The circuit diagrams Figs. 1, 6, 7, and 8 may be followed in assembling either the Delta Class "A" Audio Amplifier or the Class "B" Audio Amplifier. In the case of the Class "A" amplifier the transformer primary should be used as the input transformer. In the case of the Class "B" amplifier the transformer secondary should be used as the output transformer.

Assembly Instructions

The construction of a Class "B" Audio Modulator transformer should be different from that of the usual (Class A) amplifier, and certain precautions are necessary if successful operation is to be expected.

In constructing the transformer, care should be taken to ensure that the primary and output connections are adequate, and that the transformer is properly supported. This will greatly reduce AC hum and noise.

If the modulator transformer is to be used as the high input for the amplifier, the transformer primary should be connected to the input transformer primary. The transformer secondary should be connected to the output transformer secondary. The transformer should be connected to the amplifier input transformer primary and output transformer secondary.

The modulator transformer should be used as the high input for the amplifier. The transformer secondary should be connected to the output transformer secondary. The transformer should be connected to the amplifier input transformer primary and output transformer secondary.

Operation of Class "B" Audio Modulators

In operating a Class "B" Modulator there are several points to be considered.

First, the power supply must have good regulation.

Second, tubes must be properly matched and have adequate element emission. Old tubes seldom work satisfactorily.

Third, the use of adequate R.F. filter in the lead to the Class "C" amplifier is important to protect the tube output transformers from high voltage surges.

Fourth, the amplifier must never be operated with low connected output transformer from the secondary of the output transformer.

Fifth, the plate current of Class "B" tubes should never exceed the maximum rating of the Class "C" amplifier if transformer or tube breakdown is to be avoided. (See chart for proper value.)

Sixth, maximum plate dissipation of the tubes should not be exceeded.

Seventh, it must be remembered that this type of operation is only practical with a high a.c. power supply and that much damage may be done to tubes and equipment if this precaution is not observed.

Operate the tubes in parallel and a 6000 ohm resistor should be connected to the output terminals so that the load may be tested out, in the same manner as described in the first part of the instructions for operating the 600 watt modulator.

Operation of 20 Watt Class "B" Modulator

The circuit of this amplifier is the same as the 20 watt modulator up to the plates of the 44 Class "D" tubes. The primary of this transformer is connected in place of AD-70 in the 20 watt diagram. The secondary of this transformer is connected in parallel with the plate of the Class "C" tubes. The grid of the Class "C" tube is connected to the output of the transformer.

Operation of 200 Watt Unit Shown in Diagram

It is recommended that the stages preceding the final Class "C" modulator tubes be tried out. This may be done by connecting a resistance of approximately 1600 ohms across the grid terminal of the TD-70 transformer. A loud speaker or head phones may then be connected across a small section of this resistance. The amplifier may be operated by connecting the 20A tubes in place. After the Class "B" Modulator has been operated satisfactorily the 20A tubes may be inserted in the 20A tubes out in place. After putting plate coil and transformer in place the plate current to each tube should be measured. This current should be 20 to 30 ma. per tube and may be adjusted by varying the grid bias. Separate C-terminus transformers to each stage of the AD-70 transformer so that each tube may be adjusted separately if desired. This will be necessary, however, if the tubes are matched and is to be avoided if possible.

Before operating the amplifier be sure a load is connected to the secondary of the modulator transformer (AD-71). For test purposes a resistance of 2500 ohms, 200 watts should be used and the secondaries of the AD-24 transformers connected in parallel, without connecting the lines so they come in contact with each other. A good crystal set will give a signal on peaks.

Having completed the test of the amplifier it may now be used on the Class "C" stage. This amplifier should be operated at not more than 100 volts or less. If this stage operates at 1000 volts or less, the amplifier will be operated in a Class "B" stage.

The modulator transformer always keeps the volume control turned down low enough to prevent overmodulation. Overmodulation of the amplifier is indicated by a milliammeter in the plate circuit of the Class "C" amplifier. This meter should be connected in parallel with the transformer secondary. The modulator transformer should be used as the high input for the amplifier. The transformer secondary should be connected to the output transformer secondary. The transformer should be connected to the amplifier input transformer primary and output transformer secondary.

The meter in the plate circuit of the Class "B" tube may be turned up and down and should be used. This is a normal condition as previously mentioned and will not cause the meter to exceed the power supply to the load.

The Class "B" modulator should never be operated unless the Class "C" stage is drawing current or unless a suitable amplifier is used. The output of the transformer as described above for test purposes.

Performance Data

The curves in Fig. 3 shows the overall frequency response of 200 watt Class "B" amplifier from input to output. The curves in Fig. 4 shows the maximum modulator current for 100% modulation of the transformer secondary. The curves in Fig. 5 shows the maximum modulator current for 100% modulation of the transformer secondary. The curves in Fig. 6 shows the maximum modulator current for 100% modulation of the transformer secondary.

As an example suppose a Class "B" modulator is being used at 800 volts and 900 ma. and is supposed to be operated at 2000 volts and 2000 ma. The sine wave output of the amplifier operates at 2000 volts and 2000 ma. Then the m.a. current is 1200 ma. and the point of intersection on the 200 volt line shows that the maximum modulator current is 1200 ma. This is the maximum power which can be handled by the transformer for the given load conditions.

This set of curves is only intended as a guide to proper operation, but any great deviation from them will indicate that some trouble exists.
funsen, for an arrangement for broadcasting on waves of one meter and one decimeter.

Another "Chained" short-wave system in which parabolic microphone tubes are used to relay the short-waves. Repeater stations are used with the receiving directive antennas of the preceding transmitter, and a plurality of transmitting directive antennas directed away from the main transmitter.

No. 1,920,154 issued July 25, 1933 to Walter Hahnenmann, Berlin-Marifeldde, Germany, and assigned to Tele-.broadcast station using stations smith mechanism. being short-wave receivers Andrews, No. 1,918,291 a kilocycle You short-wave sections.

Knock-down Short-Wave System.

By HERBERT E. METCALF*


This patent relates to the remote control of two short-wave receivers by placing a condenser plate from each receiver closely adjacent, and then moving a common plate over them, the common plate being attached to a remotely controlled meter mechanism.

No. 1,918,262 issued July 18, 1933 to Fred N. Goldsmith of New York, N. Y., and assigned to R.C.A. for an Ultra Short-Wave Repeating System.

An interesting system of "Chaining" short-wave stations by utilizing directive antennas on repeater stations placed between the main transmitter and receiver, with local broadcasting stations connected to one or more of the repeater stations, the local broadcast station using a non-directional antenna.

No. 1,918,291 issued July 18, 1933 to Fritz Schoeder, Berlin, Germany, and assigned to Telefunsen, for an oscillation circuit for Short-Wave Generators. The claim describes the invention:

1. In an oscillation circuit, a telescopic loop inductance in the form of a circle comprising two sections, one movable with respect to the other, a capacity element connected in substantially the middle of one of said sections and movable therewith, a vacuum tube having its grid and plate elements connected to said other section, and individual connections from both sides of said capacity element to sources of potential.

NOTE—These abstracts are necessarily short and incomplete. If interested in full information, complete printed copies of patents are furnished by the U. S. Patent Office at 10 cents each. Address the Commissioner of Patents, Washington, D. C.

ERS REPORT STATIONS DIRECT FROM ALL PARTS OF THE WORLD!

Twenty Times the Kilocycle Range of the Short-Wave Section of Ordinary Midget Receivers! No Comparison! Users Report: "..... Station Direct from All Over the World! Have No Equal for Sensitivity and World-Wide Range.

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They go wild over a short-wave set! Music DIRECT from all parts of the world. . . . Hear the interesting policemen of the air get work if they are busy. . . . Hear the interesting policemen of the air work if they are busy. . . . REMEMBER—There is really no PARISON between these efficient sets and the very limited and inefficient short-waves sections of ordinary midget radio sets! Vastly different. . . .

Another "Chained" short-wave system in which parabolic microphone tubes are used to relay the short-waves. Repeater stations are used with the receiving directive antennas of the preceding transmitter, and a plurality of transmitting directive antennas directed away from the main transmitter.

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Knock-down Short-Wave Set in its attractive Gift and Display Carton. Each Kit comes neatly packed in one of three heavy cartons.

Appearance of Short-Wave Set when fully assembled according to complete simple plans furnished with the Kit of Parts. Extra-in-calls which come with the Kit, allow FULL SHORT-WAVE COVERAGE.

Front panel view of completed Short-Wave Set. Latest Vernon Dial gives band spread tuning.

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These New Knock-Down Sets Make Ideal, Lasting Gifts

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KRUSE’S Radiophone’s Guide

with contributions by

P. E. Dellenbaugh, Jr. R. R. Batcher
BOYD PHILLIPS E. E. GRIFFIN
ROBERT S. KRUSE

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TELLS HOW to cure power supply diseases—most stations have them and don’t know it.
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TELLS HOW to escape fuss and worry when building feeders.
TELLS HOW to lay out economical plate supplies with low hum, and that doesn’t mean with a cartload of L and C.

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necessary. This need not deter those who are
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John H. Morecroft. Published by John Wiley & Sons, New York, N. Y.

A text and reference book of the highest order, setting forth the details of the operation and theory of vacuum tubes. A work which should be on the bookshelf of everyone interested in vacuum tubes and their applications. There is no attempt made to sidetrack explanations or expositions, and hence mathematics are used where necessary. This need not deter those who are inclined non-mathematically, as there is plenty of "meat" for anyone, even if the mathematical explanations are passed over.

A Wire-Wound TEN-WATTER That Can Take It

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ELECTRAD

RADIO FOR NOVEMBER
Continue Sky-Wave Propagation
By A. L. Munzing Here
(Continued from page 18)
of the energy in the incident wave to be scattered
and hence lost as far as transmission to distant points is concerned. While the scattering is particularly great in rough country, it is, nevertheless, appreciable even when the reflecting surface is the sea. The fraction of the energy lost in an earth reflection depends on a considerable extent upon the angle of incidence of the downward ray and becomes greater as the angle of incidence increases. If, until, with grazing waves, there is almost complete extinction. Most of the attenuation of the sky wave takes place while the wave is passing through the lower part of the ionized layer and during the reflections at the surface of the earth. Between the earth's surface and the lower boundary of the ionized region, the attenuation is negligible.

Electron Action
To more clearly understand the effect which an ionized region has on a passing radio wave, let us first consider the action of a single ion or electron which under the influence of a passing radio wave. Consider the case of an electron in a vacuum with no magnetic field present, other than the weak magnetic field associated with the wave. The wave's electrostatic field exerts forces on the electron which vary sinusoidally with time and cause the electron to vibrate sinusoidally along a path parallel with the flux lines of the wave. The amplitude and average velocity are greater the lower the frequency and the velocity lags 90 degrees behind the electric field of the radio waves because the moving electron offers an inertia resistance to the forces acting upon it. Since a moving charge is an electrical current, the vibrating electron acts as a small antenna which abstracts energy from the radio waves and then re-radiates this energy in a new phase. The resulting effect is exactly as though the vibrating charge were a parasitic antenna tuned to offer an inductive or capacitive reactance to the wave frequency and alters the direction in which the resultant energy flows. The magnitude of this effect varies with the amplitude and average velocity of the electron vibration and therefore becomes increasingly great as the frequency of the wave increases. Ions in the path of a radio wave act in much the same way as electrons, but because of their heavier mass ions move enormously slower than electrons under the same force, and so in comparison have negligible effect.

Atmospheric Pressure
In the discussion that has been given of the effect which an electron has on a passing wave, it has been assumed that the electron was in a vacuum. Actually, however, there is always a certain amount of gas present in the atmosphere even at high elevations. From time to time a vibrating electron will collide with a gas molecule. In the result of such a collision, the kinetic energy which the electron has acquired from the radio waves is parried transferred to the gas molecule and partly radiated in the form of a distorted radio wave which contributes nothing to the transmission. Hence, the result is therefore an absorption of energy from the passing wave. The magnitude of the effect thus absorbed depends upon the gas pressure, or in other words, upon the possibility of a vibrating electron colliding with a gas molecule. Also, upon the retardation of the electron acquired in its vibration, resulting in the energy lost per collision. Hence, the absorption of energy from the radio wave traveling through an ionized region is less for a wave of high-frequency than for a wave of low-frequency and in the case of low-frequency waves is reduced by the presence of a magnetic field.
Continue Commercial Brasspounders Here

(From page 25)
contemplating walking the plank of martyrdom just prior to the cruise around the Pacific. Whatta imprisonment!

Oney Johnson of WKER is studying photography with a vengeance and is coming along in fine shape. How are the models, Oney?

Roy Campbell, lately of the "Marcelo" is off and on his way to Seattle. Too bad, Roy, and hope you make out okay.

Al Lucay of Globe Wireless has taken over the Oriental Enterprise with some painting of his name on the Super's Chair.

J. C. Polles is still going "round-and-round" on a Dollar. How do you do it?

Since when did Ed Country of Radiomarine SF MRI go back to sea? We will swear we saw him sail in on one of the new luxury liners, and he was on the boat deck. What is it all about, Ed? More pilot boating, we bet!

Where is Oscar Antelope Treadway, Gene Gyfts, Vernon Bourn, Allen Wheeler, Herb Fish, Kenneth Wilcox, George Johnson, the Radio twins, and the host of others having given up radio? Let's hear from the gang for a change. Write in, O'Ma's, and let's have something about your favorite "Radio Star."

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20-Meter Antenna R.F. Feeders
(Continued from page 13)
center and connecting each half to one feeder. The center impedance of a half wave antenna, a half wave off ground, is about 73 ohms and the line figures near this value since the capacity per unit section is high because of a rubber dielectric. Since it is a low impedance line, the dielectric losses should be quite low.

This line gave a galvanometer reading of only 30 divisions when the feeders were tapped up so that the amplifier drew normal plate current. This was not better than the single wire feeder, but not as good as it should have been; so some further experiments were made. It was found that by adjusting the feeder taps, a galvanometer reading of 43 divisions could be obtained, but this was so close to the center of the output coil that the amplifier drew only 125 ma., instead of the 150 ma. that had been used in all previous readings.

This was only 5% of a turn each side of center on the 12 turn coil. Apparently, the efficiency was nearly as high as with the spaced two wire impedance matched feeder but no way could be found to efficiently couple it to the amplifier output. The usual amateur scheme of running the feeder taps out until normal plate current was drawn did not apply in this case as the antenna power output was actually less when this was done.

Inductive coupling was tried, using these twisted feeders, and the maximum reading obtained was 28 divisions with the amplifier drawing 150 ma., or 20 less than normal. The antenna coil was tuned and feeders connected across various portions of the pick-up coil. The maximum readings were obtained with the feeders connected across the whole coil and the condenser was simply used to tune out the reactance to some extent. Apparently, this type of feeder is quite efficient, but not very practical on the higher amateur frequency bands. Five-meter results checked this but the writer has hopes of better success on the 40 and 80 meter bands. It has excellent anti-noise characteristics for receiving. The same antenna can be used for both transmitting and receiving by using a small D.P.D.T. switch.

The matched impedance type spaced feeders proved best but have one disadvantage in that they will work effectively on even harmonics such as phone operation on 20 and 10 and 5 meters. The writer has often wished that more nearby amateurs used this form of antenna when listening to their harmonics on higher frequency bands. The astonishing difference in output power between this system and the more usual "zepp" feeders was likely due to use of an additional tuned circuit for coupling (low Q on 20 meters) and the absorption losses in the stucco walls. An amateur desiring to use the "zepp" feeders must bear in mind the need of spacing them with very low loss materials and keeping them several feet from nearby walls. The spaced impedance matched feeders have the advantage of not being critical in length or spacing insulator losses, and can be adjusted for efficient operation by the usual adjustment of coupling until normal tube plate current is obtained. The losses from nearby walls are also less, by far, than with "zepp" feeders.

Putting Power Into the Antenna
(Continued from page 7)
turns should be at least equal to the diameter of the tubing, and preferably slightly greater, for highest "Q." Keep the inductance away from the metal of the tuning condenser by at least the coil diameter.

A word about the new grounded-grid system will probably be in order. An analysis of this system by the author failed to show any advantage, except that no neutralizing is required. In fact, when used in this circuit, the final amplifier requires a small additional amount of excitation over that required in the conventional neutralized amplifier. A further point is that the tubes now on the market, such as the '52, are not well suited to work as grounded grid; there being considerable trouble on the higher frequencies from feedback.

It is the careful attention to the various little points outlined in this article that determines whether the amplifier is to be put into the antenna tank a goodly amount of the power supplied to the plate, or waste this power in heat or other losses. The only kind of "Efficiency" that really matters is "Conversion Efficiency."

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KEYING by means of a vacuum tube has long been recognized as one of the best means to eliminate key clicks. In the common tube-keying circuits the keying tube acts as a relay in series with the B minus lead from the power supply. For example, the plate resistance of a type 45 tube is something less than 2,000 ohms at zero grid bias. However, if we raise the bias to cut-off, the plate impedance becomes infinitely high. In Figure 1 we see the keying tube located in the center-tap lead of an amplifier stage. When the key is up, the battery biases the keying tube to cut-off, which practically opens the DC return from the amplifier filament to ground. This cuts off the plate voltage just as effectively as if we had used a conventional relay or key in this center-tap lead. Then, when we short-circuit the negative bias to the keying tube with the key, it passes current and thus completes the circuit from filament to ground. The 100,000 ohm resistor in series with the bias battery cuts down the current through the key... which otherwise would use up the bias battery in short order.

The circuit shown in Figure 2 is an improvement in that it eliminates the 45 to 90 volts of battery necessary in the circuit of Figure 1. A small battery is shown, but it should be noted that it is for the purpose of applying a small POSITIVE bias to the keying tube's grid when the key is down. This battery is only necessary when an especially large amount of current must be passed by the keying tube. Ordinarily it can be omitted.

The circuit shown in Figure 3 in 3, 1 believe, entirely new, and has not been published before. It represents a combination of automatic bias, blocked grid keying and center-tap tube keying! It is one of the most efficient tube keying circuits possible, in that the plate resistance of the keying tube is reduced to an exceptionally low value, due to the fact that the grid is tied to the plate when the key is down.

It should be noted that the keyed tube and the keying tube must always have separate filament supplies. The keying tube must be capable of passing the total amplifier plate current. Of course, if one keying tube will not pass sufficient current, additional tubes may be connected in parallel. The low-mu, low plate impedance tubes such as the 2A3, 45, 50 and WE211E, make the best tubes for keying service. The 45 and the WE211E also have the advantage of being cheap. Often we can use tubes for keying which have been discarded for ordinary purposes, due to slight loss of emission, etc.

The 1-mfd. condenser shunted across the key contacts removes the last trace of a click, which otherwise might prove bothersome in the operator's own receiver.

---

Vacuum Tube Keying Methods
By J. NORRIS HAWKINS

What is Harmonic Distortion?
HARMONIC, or amplitude distortion is that distortion which adds the THD of voice or music. It makes voice sound fuzzy, or harsh, and can make the comparatively pure notes of a clarinet or violin sound like a pipe organ. It is usually caused by a non-linear response somewhere in the audio channel and is often a sign that a tube is overloading. Improper bias and the improper matching of impedances are two other common sources of this type of distortion. Once this distortion is present in an audio amplifier it is impossible to later remove it by equalization or by other methods. It has been determined that 8% harmonic distortion may hardly be noticed, but above about 8% the distortion will not be tolerated by a trained listener. With 16% distortion, listening becomes almost painful even to an untrained ear. The ability of a vacuum tube amplifier to generate frequencies not present in the input is used to good advantage in frequency doublers. It should also be noted that a detector or demodulator is a form of harmonic amplifier.

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The first CQ (3 calls, 3 signs) hooked a G6—in England, and, believe it or not, the next call got a Frenchman! 5:30 Sunday afternoon, not bad!! . . . . Oh yes, I forgot to say that . . . . the tube ran cold.”

Not bad at all, Mr. Hahn. In fact, we feel that our pride in the 800 is justified. But we also feel that you and your gang as well as your transmitter and receiver, should take a bow. By the way, wasn’t that receiver equipped with RCA Radiotrons?

To tell the truth, not all the people who have used the 800 have worked England and France, but they do agree that the 800 gives them unbelievable results.

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