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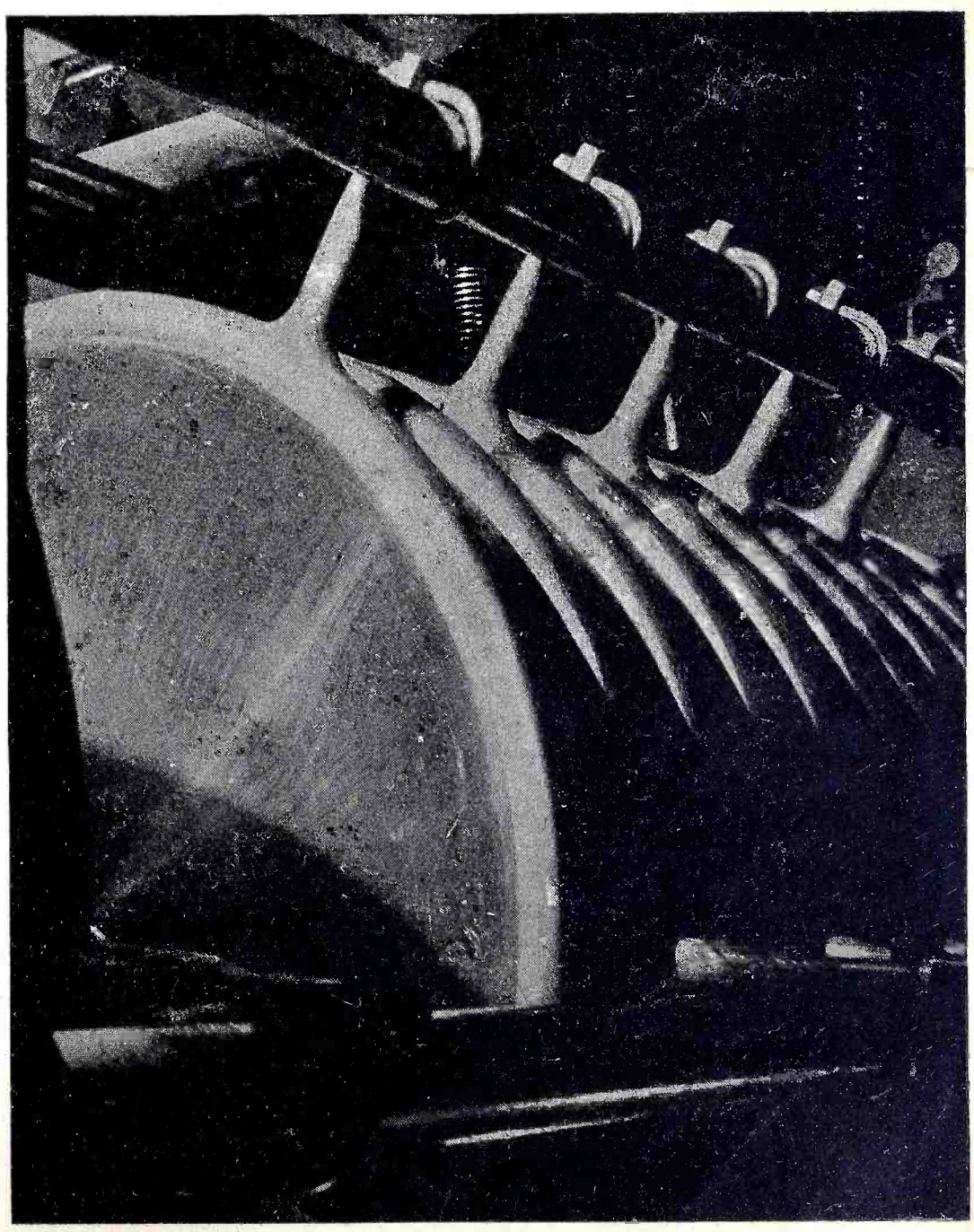

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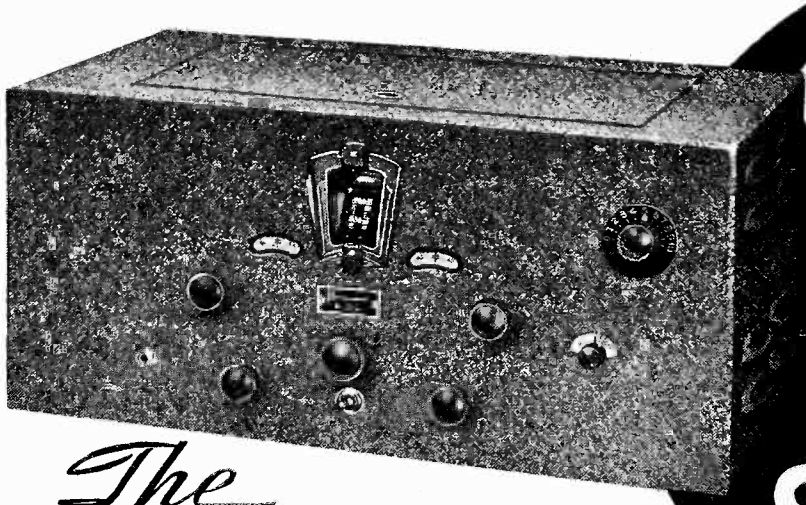

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RADIOTORIAL COMMENT

An SOS From Amateur Radio

"WHAT'S the matter with amateur radio?" Apparently—nothing is the matter. The number of amateurs has more than doubled during the last four years, while the numbers engaged in other occupations has been cut in two. There are now forty thousand amateurs in the United States, and the number is rapidly increasing. Each one is buying as much new equipment as he can possibly afford, and the manufacturers are making money from its sale. There is a veritable boom in amateur radio, due partly, it is true, to the lack of employment in gainful occupations. For an amateur neither receives nor wants money for his services to thousands of people who benefit from what he so freely gives, especially when other means of communication are lacking or are crippled. Amateur radio is certainly a very popular pastime.

Yet in this very popularity is found what ails amateur radio. It is too popular, just as Japan, for instance, is too populous. The amateur bands are more crowded than the dance-floor at a free picnic given by the breweries. The general situation is very much like that discussed by a famous political economist, Malthus by name, over a hundred years ago. He maintained that when a population tends to multiply faster than its means of subsistence can be increased, then the weaker classes must suffer from lack of food. He argued that poverty is inevitable unless the increase in population is checked. And he concluded that increase in population is checked by poverty.

So one way to improve amateur radio is to starve out about half the amateurs. If enough restrictions can be put on their activities, most of them will stop transmitting and thus make room for the others to continue to transmit without being hampered by the present intolerable interference. This is the argument of the modern Malthusian and the trend of the present system. Another way would be to teach birth control or race suicide.

Such extreme measures, however, are neither necessary nor worthy of adoption. There is actually no good reason for trying to check the increase in the amateur radio population. The more humane remedy is to give them room in which to grow.

Analysis of the radio spectrum shows that there are plenty of vacant lands to which the excess amateur population can be transferred. Nor in this connection should it be forgotten that the amateurs once roamed at will throughout the wavelengths now devoted to broadcasting, to make room for which the amateurs were banished to the then useless wavelengths below two hundred meters. When they discovered and developed the rich possibilities of the bad-lands they were again dispossessed of most of their holdings and confined in narrow reservations on 160, 80, 40, and 20 meters, or consigned to the limbo of 10 and 5 meters. The wild rush for the wavelengths from which they were driven was like the stampedes that occurred when the Indian lands were opened to white settlers. All of which is now ancient history.

But the amateurs are a hardy race. They seem to flourish under adversity. Their narrow reservations are so crowded that there is no longer any room, and the amateurs are looking with longing eyes on adjacent territory that is held, but not adequately used, by those to whom it was freely given. In their distress they are appealing to the Great Father at Washington, to Congress and to the Federal Radio Commission. They have tried every known technical means of relief and are now forced to transmit an SOS in hopes for relief.

Their call for help is not unreasonable. They ask for more and wider channels. They want informed representation on the Federal Radio Commission. They urge that the Madrid treaty not be ratified until the clause which prohibits international transmission of free messages for a third party is eliminated. Nor are the means whereby these requests might be granted difficult of fulfillment.

For instance, they propose that congestion in the 80-meter band be lessened by assigning some other wavelength to be used for the drills which the Army and Navy conduct in training amateur operators for possible service in time of war. Ample precedent for such action is furnished by the recent granting of the privilege to use the Navy's 2000-4525 KC band when the Westinghouse Elec. & Mfg. Co. is testing new equipment intended for Navy use. The same privilege might well be accorded to experienced amateurs who may thus be prepared to meet national emergencies in communication. And certainly there is room in this band for the Navy to conduct its drills without infringing on the amateur's 80-meter band.

Study of the wide open spaces, some of which are now occupied by "dog-in-the-manger" holders, would be greatly facilitated by amateur representation on the Federal Radio Commission. It is hardly to be expected that the incumbents, with their manifold duties in connection with the regulation of commercial broadcasting and point-to-point communication, would have an understanding of amateur needs. Consequently, the amateurs suggest that two more commissioners be appointed from the ranks of competent amateurs, and that their salaries be paid from receipts from an annual notorial charge for licenses. The reason for two additional commissioners, instead of one, is to maintain an odd number of commissioners without having to replace any of the five incumbents. A 50-cent notary fee for each license, paid to the radio supervisors each year, would provide sufficient funds for additional salaries, without putting another burden on the general taxpayer.

The faults of the Madrid treaty were pointed out in August "RADIO". As there stated, it "is so infested with 'bugs' as to threaten the very life of amateur radio."

These suggestions for improving the present chaotic condition in the amateur bands were the subjects of strongly-worded resolutions which were unanimously passed at the recent Pacific Division Amateur Radio Convention with its registration of nearly 500 representatives from California, Oregon and Arizona. Other amateur radio organizations throughout the country are expected to pass similar resolutions. Copies are being sent to Congressmen and public-spirited citizens. Strong support is anticipated from those who realize that amateur activities should be encouraged by relieving them of the present hampering restrictions.

The amateurs have missed a lot of good things simply because they did not know exactly what they wanted. Too often, also, they have appeared as mere supplicants rather than as men who can make full return for every favor that is granted to them. Theirs is a proud record of achievement in spite of discouragement. Now that they have formulated their requests you who read this page will recognize the reasonableness of what they ask. If you are a radio amateur or a friend of radio amateurs, see to it that others are converted to the same point of view. And if you have influence at Washington, do your part in helping to secure the remedy which will cure amateur radio of that which is stunting its healthy growth.

—Arthur H. Halloran.

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Col. Foster's Comment

— W6HM —

"He Also Serves"

WE AMATEURS are prone to boast of our considerate conduct. To tell the truth, we are rather a decent lot. But this is the story of one occasion of which most certainly the amateurs have no cause to be proud.

The story starts away back in 1912. On the night of Sunday, April 14, to be exact. That was the night the Titanic sank. This great new White Star liner was on her maiden voyage from Southampton to New York. She was 883 feet long, the biggest ship ever launched. She was said to be unsinkable because of her double bottom; although how anything heavier than water could be unsinkable is not apparent. At any rate she was widely advertised to the traveling public as unsinkable. She carried on this occasion 1348 passengers and a crew of 860.

At 11:45 that night, off the Newfoundland Banks, she hit an iceberg and within two and one-half hours had gone to the bottom. Of the passengers 533 were saved and of the crew 172. The Cunarder, Carpathia, outward bound from New York, that made the rescue, turned about and conveyed the survivors to New York.

This was when much in the form of Radio was Marconi. When the Carpathia proceeded from the scene of the wreck at 8:30 the morning after the disaster message blanks were handed to the survivors and they were told they could "wireless" free of charge. So nearly all availed themselves of the privilege that the operators were ordered to disregard all calls to the ship except such as had to do with instructions to the operators and the captain. The range of the Carpathia's spark transmitter was only about 100 miles in daylight. Coming along the American coast as one shore station found it increasingly hard to receive, the next station down the coast took up the burden of copying the avalanche of shoreward messages. The work on the ship was so heavy that Cottam, worn out with continuous duty, fell asleep at the key on Tuesday night. It was then that Bride, the operator rescued out of the water after the Titanic went down, had recovered enough from his injuries to help Cottam.

The Carpathia's set was a Fessenden. At that time Fessenden's main factory was in Pittsburgh. He had a small plant in one of the huge manufacturing buildings of the Bush Terminal at South Brooklyn—advantageous to him because near the Brooklyn Navy Yard where he was equipping some of the ships of the Navy. I was interested in what was going on at the Brooklyn plant. As an operating vice-president of the Bush Terminal Co. I had been able to accommodate the Fessenden Co. in various small ways. Among other favors they had been permitted to use without charge the roof of the 600 foot building in which their plant was established. At each end of the roof they had erected steel towers for their antenna. And I had built a fireproof shack for them in the middle of the roof. So, while visitors generally were barred, I had the run of the premises.

The Fessenden Co. wished to copy as much of the Carpathia's traffic as possible; by request, I understood, of authorities in Washington where the Carpathia coud not be heard. In the emergency I hustled about and helped the Fessenden men to get the new shack in commission. The operator invited me to sit in with him; and, alone, we listened hour after hour to the Carpathia. The only break in the vigil was while the ship was heading in from the ocean. A severe thunderstorm broke. I wasn't aware that lightning was especially dangerous until, at a heavy clap, the operator jerked the fones from his own head and snatched the other pair from mine. "I don't like to miss any of this," he said, "but I have a wife and family. Let's go down in the street and hit that night-lunch place until this blows over." A half hour later we were back.

I hope never again to see such a stack of heartrending messages. An amateur occasionally handles one that gives the sympathies a wrench, but those from the Carpathia—reading both the text and between lines—were just a stream of shocks. "Mother is with us but James and Father are gone." "Mary and I saved. We know nothing of the rest". "Have Father meet me at the dock. I am all that is left but do not tell him." And so, on and on, broken now and then by messages about the movements of the ship. Occasionally a short station would send a brief instruction—such as the Marconi chief's order that the operators say no word to anyone upon landing but to hurry straight to the Marconi office. An order necessitated by the circumstance that the newspapers were clamoring wildly for information. And there were hundreds of reporters among the crowds at the pier ready to pounce upon all for eyewitness accounts. The survivors were in no mood to tell stories to newspapers and the ship's people had their orders not to talk. The newspapers complained bitterly the next day that the orders had infringed that sacred myth, "the freedom of the press that is guaranteed by the Constitution." Their freedom of expression is—when they have anything to express; but not their freedom to exploit a suffering people for the newspapers' own profit. On this occasion the press was not without its freedom. It felt free to, and did, manufacture out of whole cloth the lyingest messes of slush that ever disgraced the profession of newsgathering.

All ship and shore stations had strict orders to keep off and leave the air free for the Carpathia's messages. Only once did we hear a commercial station disregard the order. A heavy spark banged in, as if from a strong station nearby. It was a ship, leaving New York, and calling the Carpathia. She must have had a dumb operator, for the Carpathia's set was working at the time. Immediately another strong signal crashed in with, "You keep out or you draw your pay when you get to port." It was the Marconi chief, in New York, and it surely set that lad back on his heels.

Here is where the conduct of the amateurs comes in for uncompromising criticism. The air was clear of commercial stations. All amateurs were in position to know that it was of vital importance that they keep off the air. But, no doubt, in those days, too, the amateur ranks had their full complement of dumb specimens. There never was a time when the air wasn't full of ham signals, blathering away about the Titanic and the Carpathia, or just chewing the rag about nothing at all. It was only the distinctiveness of the Carpathia's 500 cycle whine that made copying at all possible.

Many of the messages were broken or garbled because of ham QRM. This accounted no doubt for the non-delivery of many urgent survivor messages. Lawrence Beesley had wirelessed his family in England from the Carpathia that he was among the rescued. That one I know was never delivered. His people had given him up for lost because his name had appeared on no published list of survivors. Possibly his message was not copied in New York; possibly the Marconi Co. deemed that the gratuitous handling of survivor messages did not extend to relaying them to England. At any rate when Mr. Beesley learned upon landing that his name was not among the saved he sent to his family the first word they had had of his rescue. He had only two shillings in his pocket, his funds having been deposited in the purser's safe on the Titanic. The White Star Line paid for his message.

It was this inexcusable misconduct of the New England hams—largely those in the New York area—that had the most to do with driving the whole amateur fraternity down to 200 meters. They would have been moved from the ships' wave in any event for they didn't belong there; but they would have stood much higher in public esteem if the amateur organization had taken the initiative and moved out voluntarily instead of waiting to be kicked out. Or, to put it in accord with the facts of the case, the amateurs could have moved down enough to keep off the ships' wave instead of waiting to be kicked wholly off the air. For this was the deliberate intention of the commercials and their adherents in Washington who believed then that 200 meters was useless for communication.

Now that we have had a look at the conduct of the amateurs on the grave occasion of the sinking of the Titanic let us have a look at the commercial people whose conduct was responsible for the disaster. The Titanic had 2208 people aboard. To take care of all these people only 16 lifeboats were carried, together with 2 collapsibles and a few rafts. All of the life-saving apparatus was capable of saving only 950 people! That 705 were saved was merely by the fortunate circumstance that the sea was as calm as a mill-pond. If it had been at all rough the overcrowded boats would have swamped and put their occupants into water so icy that none could have lived for half an hour.

Now, there was just one motive in selling more passenger tickets than the ship's safety appliances could care for—money. The ship was built to carry 3400 people. That she carried only 2208 on this voyage was only because the Line could sell no more tickets. If she had carried her capacity load the greatest number of people that could possibly have been saved by her lifeboats was one in three!

Testimony before the Senate Committee and the members of the British Board of Trade who conducted the investigation in New York disclosed that the ship was traveling at a high rate of speed, and had continued so after having received a message from another ship announcing icebergs. The message was received at 5 p.m. on the evening the Titanic struck. It was handed by the captain to Mr. Ismay, Managing Director of the Line who was among the rescued. It was retained by Ismay until 7 p.m. when the captain asked for its return so that he could post it for the information of other officers.

Nevertheless when darkness fell the ship did not reduce speed. Testimony showed that speed was maintained right up to the time the ship struck. She had left Queenstown, Ireland, on Thursday. At noon, Friday, the day's run was 386 miles; from then

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until Saturday noon, 519 miles; from Saturday noon to Sunday noon, (12 hours before she struck the berg), the run was 546 miles. She was due in New York Tuesday evening, and it meant money to the Line to arrive on time. There was only one purpose in continuing to drive the ship so hard in the darkness and in a known region of icebergs—**money.** There was only one reason for giving up safety-appliance space to increase passenger and freight-carrying space—**money.** The great Titanic, carrying 2208 lives, sailed on her first and last voyage with only two radio operators, Phillips and Bride. That meant either that each must work 12 hours out of every 24 or that part of the time these lives, (and those on other ships within range), must be left without the protection of radio communication. Again, **money.**

The Carpathia, a passenger liner, had only one operator, Cottam. The great Cunard Line had assumed that the safety of all the Carpathia's passengers and crew warranted the expense of only one radio man. It was only by the merest chance that Cottam heard the distress call of the Titanic at 12:30 a.m. Monday, three-quarters of an hour after the Titanic struck. He was off watch and about to turn in for the night—the time of greatest danger for all ships—when he had a hunch to put on the fones again and have a listen. Instead of going to bed for a much-needed rest after long hours of continuous work he remained on duty until Tuesday night when he fell asleep at his key while transmitting messages for the Titanic survivors.

The Californian had only one operator. When Monday morning broke over the spot where the Titanic had sunk the Californian was lying hove-to, with her engines still, only 19 miles away. She had been much nearer when the distress call went out from the Titanic but her lone operator had gone to bed. This ship could have saved all of the Titanic's passengers and crew if the corporation that owned her hadn't been so keen to save a few dollars.

You may say that this all happened when radio was young and when little was known of the necessities and requirements of radio at sea. Oh, no; ships even then were virtually all provided with radio apparatus. In all, eight ships heard the Titanic's distress call. Bride testified that the first to reply was the German, Frankfurt. From the strength of the signals he and Phillips believed she was the nearest of all the ships they heard, but it developed later that she was 140 miles away. The Carpathia was 58. The Olympic, sister ship of the Titanic, was 560 miles away. The Parisian, 150, the Virginian, 150, the Baltic, 300. Phillips and Bride were in communication also with the Birma, only 50 miles away but separated from the Titanic by the field of icebergs. So, you see, the question was not one of lack of radio equipment but lack of operators to man it.

Again you may say, "Oh, that was long ago. The tragedy of the Titanic changed all that." Well, listen to this one: In June, 1919, I was on a Japanese liner that was loaded down below the load-line with passengers and steel rails; and with a considerable list, at that. On two different nights I went up to see how things were going in the radio shack. I found the room locked and all parts of the radio apparatus enshrouded in their varied forms of canvas covers—and no operator on watch at all! Those were the only two nights I looked. Presumably similar conditions obtained on other nights; for one morning, up along the Aleutians, we learned from another ship that she was headed for a vessel afire that we ourselves had passed unheeded during the night. We were told that we were now too far from the burning ship to be of assistance, and we kept on our course. This was at a time when there was a great scarcity of bottoms and the big trans-Pacific ships were cleaning up something like a million dollars a round trip. But the corporations owning them couldn't waste money on radio operators.

And still you may say, "Oh, that was away back in 1919; there is no such neglect of safety now. Tell us something about modern conditions." Alright; I can do that, too. I know of one of the biggest liners afloat today that no earlier than last year cut her radio force from three operators to two, forcing each to work 12 hours a day. On one occasion one of the two fell ill, and for days the other had to work 24 hours a day! When the ship docked he was a physical wreck.

Want another? I know a liner that recently went out with only two operators. One became ill and the doctor put him in the sick bay. The captain ordered that if the sick operator could work at all he must return to the radio room. The doctor conveyed the message. Asked if he could work, this game operator replied that he supposed he could—somehow, but that he surely felt rotten. Having answered that he "could" he was given the captain's order. Thereafter he stood his watches lying on a mattress on the floor. And after the ship docked he spent four months in the hospital. These steamship companies will spend hundreds of thousands of dollars on advertising ballyhoo to get people onto their ships but they won't spend a few dollars to help ensure the safety of the people influenced by such advertising.

And so, you see, my amateur friends, while we hams at times may be thoughtless and inconsiderate we have not wholly reached the point of disregard for life, health and the rights of others that is exhibited by commercial people. Amateur radio is more and more becoming an universal public service. The amateur of today puts his own station, his own talents and his own time at the free service of his country and the public. When the machinations and wire-pulling of special interests fail of effect—as they surely will—the amateur public servant will come into his own. In peace or in war the country can not do without him. So, you amateurs, stay with it and fight for your rights. Fight for your rights and never stop fighting for them. But with all, have patience. It took us hams 20 years of neglecting our rights to arrive in our present predicament of no place on the air for our service, so we cannot recover from the effects of that neglect in five minutes. While fighting preserve the conviction that, "He also serves who only stands and waits."

MADRID

YE SCRIBE has been taken severely to task for conclusions in, "Amateur Trans-Pacific Traffic Threatened", in the August issue of this magazine; drawn, my critic says, from an incorrect translation of the Madrid amateur provisions.

There are several translations from the original French floating around but the official translation has not yet been distributed. In one respect I feel sure my critic is right. He says I used the word "convened" when it should have been "concerned". And that the conclusion, "One of the countries convened at Madrid might object to amateur message-handling and thus cause the prohibition to be general in all countries", would be absurd. It would; and that is why I said in the criticized article, "No country—no matter how much it is against amateur message-handling—will stand for dictation from one of the countries convened".

The mistake is mine. I hasten to admit it and to apologize to my fellow amateurs for having needlessly thrown a scare into them in the matter of our local traffic. That I got hold of a bad translation is no excuse and I am not offering it as such.

This mistake, however, affects not in the least the amateurs' chief objection to the Madrid provisions—the objection that was the title and the prime theme of the article in this magazine; namely, the provision that will stop the amateurs from serving the public with our trans-Pacific traffic if our Senate should ratify that provision.

My critic quotes this as the correct translation of that provision:

"It shall be absolutely forbidden to licensees of amateur stations to transmit international communications emanating from third parties. The above provision may be modified by special arrangements between the interested countries."

No doubt he is correct in this wording. He was at Madrid. Moreover, he must have noted the change from the 1927 provisions and must have been aware of its significance. We United States amateurs may handle under the 1927 wording third-party messages with any foreign country that does not object, while under this Madrid wording we are absolutely forbidden to do so until the United States has made a special arrangement with the foreign country or countries. We handle traffic now with many foreign countries that do not object. It would take us amateurs one hundred years to induce our Department of State to consider negotiating a "special arrangement" with, for example, China. This fact was well known to the commercial representatives at Madrid who devised the changed wording. It was equally well known to my critic.

The precise purpose of the change was to kill the amateur trans-Pacific traffic, the most valuable to the public of all the services the amateurs perform at their own expense. My critic knows this; and yet he wants the treaty ratified as it reads. My critic knows this; and yet, (instead of protesting against it at Madrid and describing the effect of the change), he stated in his published report to the amateurs:

"There is no change from a practical standpoint in our communications regulations".

My critic uses three pages of single-spaced typing to show me the error of my ways. I know that copies of his letter were distributed widely, therefore I know that I am abusing no confidence when I disclose the nature of it. After three pages of hair-splitting arguments it sums up as follows:

"The net change at Madrid therefore boils itself down to the following: We are now forbidden to handle **unimportant** third-party messages with **unlicensed** foreign stations".

This, to me, (in the face of the clear wording of the provision in question), is a conclusion wholly incredible on any rational ground. However, I am quoting accurately, underscoring and all. I have the letter before me.

And I feel free to quote also the succeeding sentence which is the end of my critic's letter:

"I think you will agree with me that this constitutes no 'threat' to or important change in the communications of our amateurs".

!!!! The exclamation points are mine.

I'll agree that this summing-up is no threat, for I never heard of any amateur's wanting—or even having the opportunity—to handle unimportant third-party messages with unlicensed foreign stations. But I do NOT agree either that Madrid made no important change or that the Madrid changes boil down to the conclusion, "We are now forbidden to handle **unimportant** third-party messages with **unlicensed** foreign stations".

And I still do not agree that there is any compatibility between the new Madrid wording:

"It shall be absolutely forbidden to licensees

(Continued on Page 36)

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...about the "800"

By CLAYTON F. BANE

AT LAST the amateurs get a break! No, not wider bands . . . yet . . . but a break in getting some real medium power tubes. Notable among these is the new RCA-800. We have been so "numbered" to death recently that the mere announcement of a new type number on a tube is not likely to cause the amateur to rush out with the wife's laundry money and splurge himself to a new tube. Instead, he will, upon coming face to face with a new tube, ask "What will this new jug do that my old one won't?" The writer proposes to give the answer to that question; having conducted extensive experiments to determine the adaptability of this new tube to the usual amateur requirements.

A close examination of the new "800" reveals a striking similarity to the 852, the only obvious differences being in the size and shape of the envelope and the mounting of the grid and plate elements. Very similar, too, are the characteristics of the two tubes; so much so, in fact, that an "800" was interchanged with an 852 (the plate voltage being first reduced). Very little change was required in the grid and plate capacities to tune the stage to resonance.

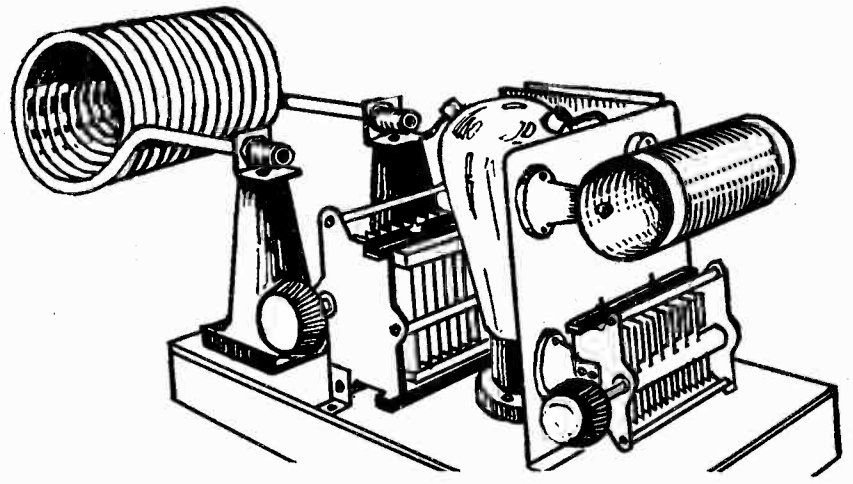
A comparison of this new tube with the popular 210 may be of interest, even though the power ratings of these two tubes are not at all similar. The "800" has an amplification factor of 15, as against 8 for the "ten". A grid-plate capacity of 2.5 uuf. against 8 uuf. for the 10, and a plate-filament capacity of 1 uuf. as compared with 5 uuf. of our old friend.

"Boy", you may say, "this is just the tube to replace my old 'ten'." That's what the writer at first believed, before overlooking some very important factors. The first problem was the difficulty of obtaining anything like complete neutralization when the new tube was placed in a 210 stage. Why? Everything was the same as it had been for the 210. But was everything the same? Evidentally not, as was shown later. The grid and plate leads from the 210 came out from the socket, which was mounted on the metal sub-panel, to provide the shortest leads to the respective tanks. The "800" has its grid and plate leads coming from the top of the tube, necessitating the bringing-down of leads several inches long to make the necessary connections.

It became apparent that these long leads were causing the neutralizing trouble; a contention that was borne out when the leads were shortened and the tube was then neutralized without further difficulty.

The neutralizing problem solved, the plate voltage (700) was applied to the plate and the stage was tuned on the nose. Boy! did she make the 210 look sick? No, indeed! The output was practically the same. Remember, this "800" is very similar to the 852, and did you ever try an 852 on low voltage, around 1000 volts? I have, and the output is miserable. Remembering this, the plate voltage was raised to about 1200 on the "800" with an increase in output of approximately 75%. This, mind you, with no increase in grid excitation.

At this plate voltage and low excitation the tube showed signs of heating, though to no serious extent. However, it must be remembered that the buffer tube will be running continuously if it is not keyed with the final, and, consequently, will obviously have a lower plate dissipation than if it were only working intermittently. All this, by way of saying that you cannot substitute this new tube for a 210 unless you increase the plate voltage and the excitation. (Possibly also the bias).



Constructional design for high-power stage using the new "800" tube

It is the opinion of the writer that the ordinary doubler stage, such as a 46, 47 or 210, will not sufficiently excite this tube to the point where its substitution for a 210 is worthwhile. A neutralized 210 with about 700 volts on its plate, and driven by a doubler, will do a real job as a driver.

A few words regarding the "800" as a doubler are in order. The "800" was substituted for the 210 in the doubling stage, with the same plate voltage (550), and being driven directly by a 47 crystal stage, using a 40 meter crystal. Again, as in the case of the amplifier, the "800" gave identical results with the 210. An increase in plate voltage to 800 volts gave slightly higher output, but hardly justified the use of this higher-priced tube over the 210 or 46 as a doubler. Unquestionably, this would not be the case if the grid were excited by a neutralized 210 stage. In fact, under these conditions, an "800" would probably work quite efficiently and deliver good output, when used as the final stage in a 56 or 28 MC transmitter and doubling to these frequencies as a doubler-amplifier.

These tubes work at relatively high voltages and low currents, and demand a fair amount of excitation and bias to give real performance.

An "800" was substituted for the 852 in the stage described in August "RADIO", with results that were, to say the least, rather startling. Since this stage was designed for the 852, the smaller tube with its similar characteristics was perfectly adaptable under the most favorable conditions to its operation.

The 210 used as a driver for the 852 furnished ample excitation, and neutralization was accomplished without difficulty. The adjustment of the plate tank condenser was nearly the same as when the 852 was used, with only a slight readjustment of the neutralizing condenser from its original setting.

1200 volts was applied to the plate of the "800" for the first test, and then the tube really started to prove its worth. Absolutely no color. More plate voltage! Still no color! Now, I'm not going to tell you what voltage was used when the tube finally started to show color, but believe you me, brother hams, it was plenty! Let it suffice to say that this tube can be used with voltages that are common practice when 50 watters are used.

The ability of the "800" to deliver efficiently at frequencies prohibitive to the 50 watter is one reason why it is certain to be a favorite among the amateurs. It's really interesting to contemplate what a pair of these honeys would do on 56, 28 or 14 MC. The "800" used in the experiments by the author performed equally well on 7 and 14 MC. Tests with W8CRA on 14 MC with this tube in the final showed only a one point drop from reports received when the 852 with 450 watts input was used. (R8 to R7).

The filament of the new tube is a spiral one, practically identical with that of the 852, and draws the same current, 3.25 amps. It should be capable of withstanding a little more input than the manufacturer's rating. The same considerations are also applicable to its big brother, namely, an efficient High "Q" tank, relatively high plate voltage and proper excitation and bias must be observed if real efficiency is to be obtained.

It has been the writer's purpose to point out the path one must follow if he is to realize the full possibilities of this new amateur tube. It is not to be thought, for a moment, that the above remarks are final. Undoubtedly, as time goes on, and this tube comes into general use, further data will be obtained from which a more complete treatise can be written.

Simultaneously with the release of the new "800", one manufacturer of high-voltage transformers announces that he is in production with transformers built to specifications required for proper operation of the tube. The manufacturer is the Inca Manufacturing Co. Elsewhere in this issue is an announcement of his new transformers. One of "RADIO'S" 100 new data sheets, also in this issue, gives complete characteristics for the "800", released to us by RCA just as this issue goes to press.

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Tomorrow's Television Equipment

By ARTHUR H. HALLORAN

TELEVISION is "on ice" today in the laboratory. Engineers have overcome all of the major difficulties in the transmission and reception of satisfactory visual images by radio. They have perfected simple means for sending and receiving motion pictures, either from film or by direct pick-up at the scene of action, provided that the scene is not much greater than ten feet square in area. All the apparatus has been designed and assembled in the laboratory and has proved satisfactory after a long series of tests. It can be put on the market whenever general business conditions warrant.

By a satisfactory visual image is meant not a coarse-grained picture containing less than 5,000 elements as made with a mechanical scanning disk, but a fine-grained picture containing 90,000 elements repeated at the rate of twenty-four complete pictures per second by means of a cathode-ray tube. Disk equipment has been on the market for several years as an interesting scientific toy, but its pictures do not contain sufficient detail to entertain the average person in the home. Pictures created with the cathode-ray tube overcome this objection.

These pictures, with their accompanying sound effects, are broadcast on wide channels in the 3 to 7 meter band of wavelengths. The same channel serves as a common carrier for both pictures and sound. These ultra-short wavelengths behave more like visible light than do the longer wavelengths ordinarily used for broadcasting. They travel in straight lines, cast shadows from buildings and other obstacles, and can be reflected and refracted. They are seldom received beyond the horizon of the transmitting aerial, their service area depending upon the height of the aerial and upon how the waves may be reflected and refracted.

Ultra-short waves have several advantages for local picture transmission: They furnish channels which are wide enough for the great side-band of frequencies necessary to reproduce a picture containing an acceptable amount of detail, whereas such wide channels are no longer available in other parts of the radio spectrum. They eliminate trouble due to fading and multiple images caused by reception over two paths, the so-called "ground" and "sky" waves, since the latter is reflected and refracted into outer space beyond the confines of the earth. Any number of stations can be simultaneously operated without interference on the same wavelength if their aerial horizons do not overlap.

Radio engineers have had little trouble in adapting standard short-wave equipment for the transmission and reception of ultra-short waves. The field is new but the general principles are well known. The greatest difficulty has been to amplify uniformly all frequencies in a side-band whose width approximates 900 kilocycles as compared with the 5 kilocycle width which suffices for the reproduction of sound. This has been satisfactorily solved with resistance-coupled amplifiers. To include here the details of its accomplishment would take us too far afield from our main purpose of learning how the cathode-ray tube has been applied to television.

Perhaps the best approach to an understanding of the how and why of tomorrow's television equipment is through a consideration of the various problems that originally confronted the experimenters. The fundamental task was to imitate the action of the human eye, which constitutes a complete television system in miniature. The lens of the eye focuses an optical image of a scene on the retina. The retina consists essentially of millions of very small cells which are exceedingly sensitive to change in the color or intensity of light. Each cell is connected to the brain by a nerve fiber, millions of which are bundled together in the cable of the optic nerve.

The cells subdivide the image into a great number of separate, closely-adjacent areas, each area being of the same small size as a cell. The eye thus dissects a continuously smooth image into a discontinuous, fine-grained mosaic of separate parts. As each cell receives light from its corresponding part of the scene, it converts the light energy into electrical energy by a process somewhat akin to that which occurs in a photographic plate. The fluctuations in the electrical current thus produced are proportional to the variations in light which cause them. The nerve fibers transmit the electrical currents to the brain, which interprets them in terms of the light variations in the scene.

Any artificial means for imitating the action of the eye should provide light-sensitive cells and connecting wires in sufficient number to produce a fine-grained image. Since no practical means has been devised for accomplishing this purpose directly, advantage is taken of the eye's persistence of vision to accomplish it indirectly. The eye retains an impression of an image for about a tenth of a second after the image disappears. This characteristic has long been used in creating the illusion of a motion picture by projecting a rapid succession of still pictures on a screen. The rapid repetition of discontinuous pictures gives the impression of a continuously moving image.

Imagine, for example, that a photograph be cut into 300 narrow strips and that each strip be cut into 300 sections. Assume that the photograph is 10 inches square so that each narrow strip has a width of 1/30 in. and each section has a length of 1/30 in. or an area of 1/900 sq. in., there being 90,000 such sections. Then imagine that these 90,000 sections are assembled in proper order and position, as in a jig-saw puzzle. Let the entire picture be pasted on the wall of a room so dark that the picture is invisible. Then assume that a brilliant light be focused into a narrow beam having a cross-section of 1/30 by 1/30 in. and that by some ingenious means the beam be caused to traverse the picture in a series of 300 horizontal sweeps, all within the brief interval of 1/10 second. Then the eye would receive and retain much the same impression as if the entire picture were illuminated by a broad beam of light for 1/10 second. There would be a certain amount of flicker which could be lessened by having the beam traverse the picture in 1/24 second. If a positive photographic film were used instead of the picture, the exploring beam would project an image on a screen placed behind the film. This imagined example crudely illustrates the process of scanning, whereby an image is dissected in a pick-up tube or assembled in the receiver tube of a television system. The process is comparable to the action of the eye in reading a printed page consisting of 300 lines, each of which contains 300 letters and spaces.

The Cathode-Ray Tube

The eye of tomorrow's television set, whether a transmitter or receiver, is a modified form of cathode-ray tube, which, in some respects, is quite similar to the vacuum tube used in radio. An understanding of its construction and operation is based upon an understanding of the general subjects of cathode rays, fluorescence and the photoelectric effect.

A cathode ray is a high-velocity stream of electrons. It differs from the stream of electrons between the filament and plate of a radio tube in that the electrons in the cathode ray have a much higher velocity which is imparted to them by a much greater difference of potential between the electron source and the positive plate to which they are attracted. Its constituent electrons are repelled from any negatively charged surface and attracted to any positively charged surface. Consequently, the entire stream can be deflected by passing it between the plates of a charged condenser or through the field of a magnet. The ray itself is invisible, but its presence becomes manifest when it impinges upon a fluorescent surface.

Fluorescence may be defined as the visible radiation which is emitted by certain substances, such as zinc silicate or calcium tungstate, when they are irradiated with invisible energy. Thus, when an invisible cathode ray strikes a screen which has been coated with zinc silicate, the emitted radiations are in the band of visible wavelengths.

The photoelectric effect is similar to the thermionic effect which is utilized in the filament of a radio tube, excepting that visible light instead of heat is employed to liberate the electrons from the substance in which they are confined. Certain substances, such as the hydrides of potassium or sodium or the oxide of caesium, emit low-velocity electrons when exposed to light. The number of emitted electrons is instantaneously proportional to the intensity of the light, many electrons being emitted under the influence of a strong light and few electrons as a result of a weak light. This effect is applied in the photoelectric cell. By imparting a high velocity to the emitted electrons by maintaining a high potential between the emitting surface and a positive plate to which they are attracted, the stream of electrons becomes a cathode ray.

In a television transmitter or pick-up tube, variations in the light intensity of an optical image which is projected on a photo-sensitive surface are used to produce a cathode ray of variable intensity, and thus a varying electric current, whose variations are proportional to those in the image. In the receiving tube, variations in the intensity of the received current are used to modulate or vary a steady cathode ray which comes from a heated filament and is projected on a fluorescent screen so as to create variations in light which are proportional to the variations in the received current. With these general ideas clearly in mind, let us consider the action of the tubes in more detail.

(Part II, "The Pick-Up Tube," will be described in the next issue.)

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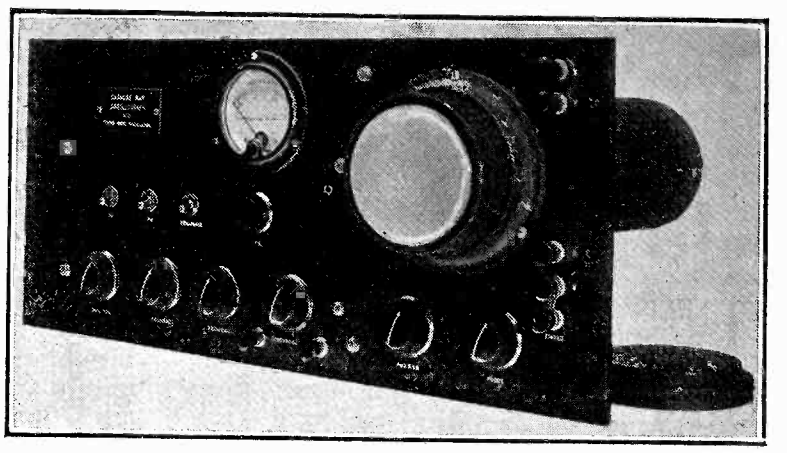
MODULATION DEFECTS AS SEEN BY THE OSCILLOSCOPE

By RALPH R. BATCHER



THE most mysterious problems of radiofones have a habit of blushing violently and dodging out of sight when a cathode ray oscilloscope is turned upon them—for this magic tube instantly exposes secrets it refuses to give up after many days of attack with ordinary meters.

It is a great pity that we do not all have such oscilloscopes, but the next best thing is to show pictures of the effects which have been observed in various ailing radiofones.

In all 15 of the accompanying views you are looking at the cathode ray screen. While it is not in the least important that the technique of the tube be understood the connections will first be described briefly.

In Fig. 1 the tube is running without connection to the radiofone and we have only a bright round spot at the center of the screen.

In Fig. 2 we have applied to two of the deflection plates of the cathode ray tube an r.f. voltage taken from the tuned plate circuit of the tube which is being modulated—the so-called "Class C r.f. amplifier." The spot is now wandering up and down at a radio frequency, hence appears as a bright line.

In Fig. 3 the other (horizontal) pair of deflection plates has been connected to an a.c. source with a frequency somewhere in the audio range—in this particular experiment 1000 cycles. If this were applied alone the spot would become a horizontal line, but since it is at the same time being waved up and down very fast the result is that it paints a glowing rectangle on the screen as shown.

Fig. 3 therefore represents an unmodulated carrier.

Now if we start to modulate the tube by varying its plate voltage at 1000 cycles, and in time with our 1000 cycle "timing" wave, we will alternately increase and decrease the r.f. swings as to size in the usual manner and since the 1000 cycle modulation voltage is in step with the 1000 cycle timing wave we will get the form shown in Fig. 4.

Fig. 4 accordingly shows partial modulation, the narrower left end of the figure being the negative plate-voltage swing, the positive swing (increased plate voltage) giving the broadened right end of the figure.

In Fig. 5 the modulation has been increased to 100 per cent, giving a figure with double width at one end and zero width at the other end. This is the desired operating condition.

If modulation be still further increased we have the shape of Fig. 6. The straight narrow "tail" at the left shows no r.f., therefore there is no r.f. output and the negative audio swings are having their peaks clipped off. The "quality" (fidelity) is not as bad as one would think, even for the 120 per cent modulation shown. If the system were handling speech instead of a steady tone this overmodulation would be taking place on only the loudest sounds and these would have a tendency to "mush," while most of the speech would be o.k.

So far all the figures have shown proper linear modulation, that is the class C tube is working with proper bias and r.f. input, and is non-regenerative. This is the usual operating condition in commercial transmitters and is much less common in home-made ones. By the way—the presence of proper linear modulation is shown by the fact that the sides of the figure are STRAIGHT.

Should the modulated tube be regenerative because of deficient neutralization, shielding or de-coupling in the power supplies it cannot be modulated in a linear manner. As the plate voltage is raised the r.f. output rises FASTER than the plate voltage and we approach an oscillating condition.

Fig. 7 shows a regenerative class C stage. This sounds strictly terrible and is commonly blamed onto the audio system without justice. It can be exposed by making a "static" test with meters, and finding out whether the tuned-circuit r.f. current rises in proportion to plate voltage—by plotting. The cathode ray tube makes the plot in a split second.

If one has BOTH regeneration and overmodulation the result is a figure like No. 7 but with a tail like that of Fig. 6.

Fig. 8 shows a case in which the class C tube is not receiving enough r.f. grid input. It does what it can with the limited r.f. available, but above that the r.f. swings no longer grow and the positive audio peaks are clipped off. Such modulation is muffled in sound and the consonants are dull. This is probably why amateurs are inclined to feed too much r.f. to the grid, even though the efficiency and tube life are damaged.

Fig. 9 seems to be almost the same thing, but is actually a wholly different affair. This is from a transmitter having a class B audio system (modulator) whose plate supply also feeds the plate circuit of the r.f. tube AHEAD of the class B tube—i.e. the driver tube or final buffer. On high audio swings the class B system makes a heavy demand on the plate-power system, its voltage drops and the input AND output of the driver stage go below what is necessary to maintain the class C input r.f. In turn the output of THIS stage drops. The remedy is to improve the regulation of the driver-stage plate supply, preferably by using a separate one. Incidentally, it looks as if this set could stand a better plate supply for its class B audio system too.

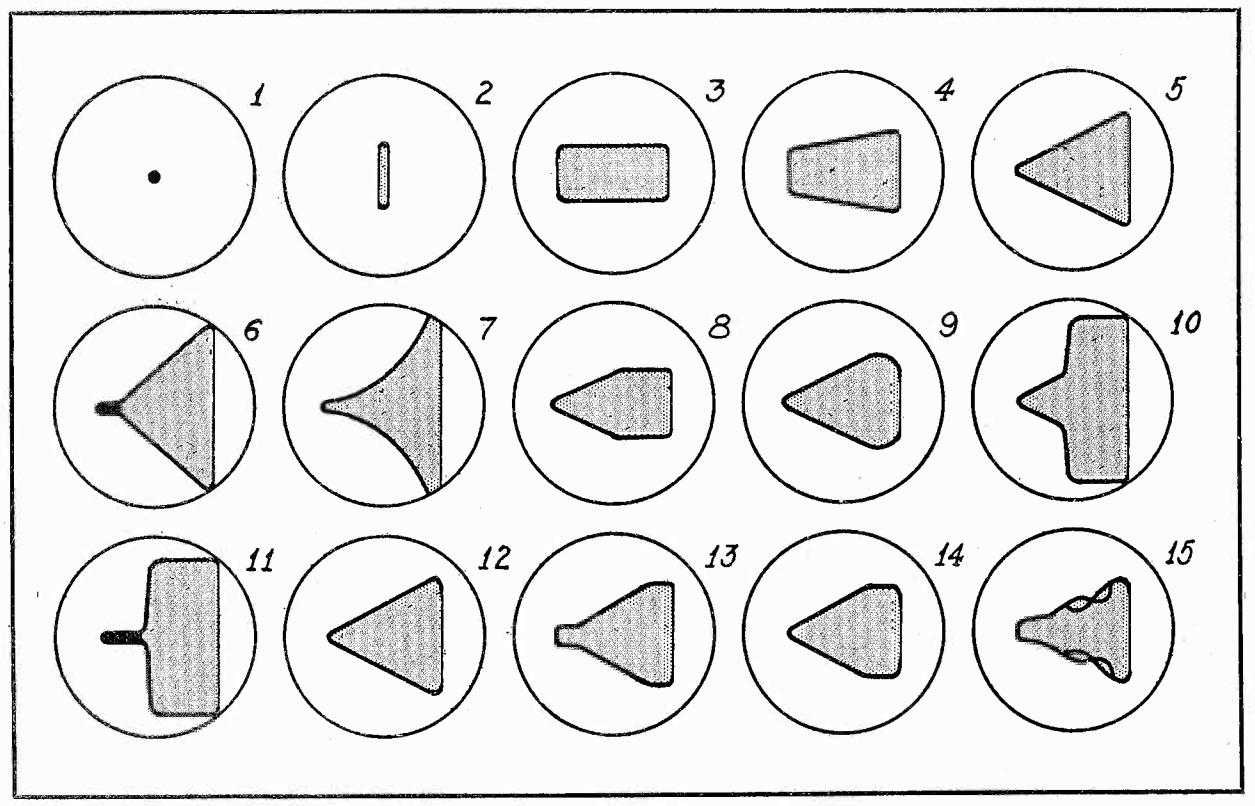
The weird mess of Fig. 10 is due to a highly regenerative class C stage whose normal tendency to "slide" into oscillation as in Fig. 7 has been suppressed by rather close coupling to an antenna load which isn't quite in tune. Modulation is linear for about 25 per cent of the cycle; then the tube abruptly breaks away from the load and pops into full oscillation. The resulting output is a mushy background full of dull mumbles at a low level.

Fig. 11 shows the same thing aggravated by over-modulation which cuts the negative peaks off. This is one of the most puzzling effects the operator can meet—the meters swing up properly, yet almost no sound can be heard with a receiver.

Some of the preceding difficulties can be avoided by making the class C stage out of a screen-grid tube instead of a neutralized triode—of course the combination may be push-pull in either case. If the plate is modulated and the screen is also modulated IN PROPORTION we have Fig. 12, in every way like Fig. 5 for the neutralized triode.

Fig. 13 shows what happens if the screen is not modulated. On the negative swing r.f. output fails to go to zero because the high fixed screen voltage yanks the electrons from the emitter so enthusiastically that some continue to arrive at the plate, even when it is without voltage. On the positive swings (right end) the upswing is not as large as it should be because the fixed screen fails to rise with the plate. A little thought as to

(Continued on Page 36)



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Application of the Class-A-Prime Audio System to Modulation

By McMURDO SILVER

NO matter how complex it may be, the modulator for any radiophone system today is essentially an audio frequency power amplifier, and as such dividbale into three classifications, if its output stage is push-pull. Its output stage may be

(a) Class A (tubes biased to approximate center of negative straight portion of Eg-Ip curve, and grid signal excursions confined to this negative straight curve portion).

(b) Class B (tubes biased to cut off only one tube operating at a time, but grid signal excursions occurring on full negative and positive straight portion of Eg-Ip curve).

(c) Class A Prime (regular Class A, except that tubes are slightly over-biased, and power is supplied by preceding stage to permit utilization of full positive and negative straight portion of Eg-Ip curve).

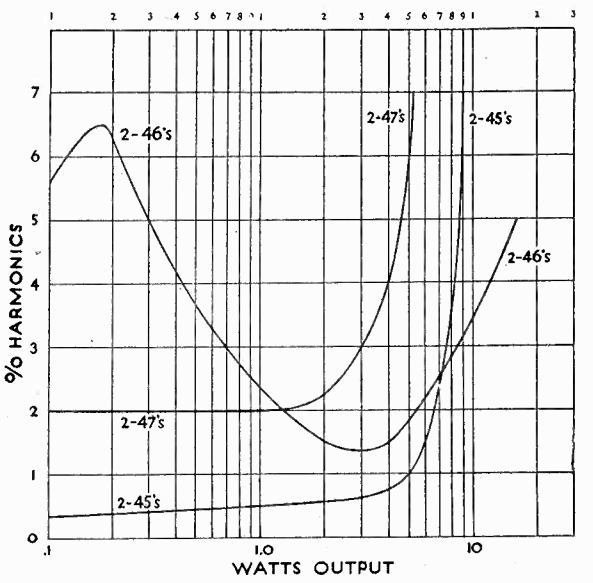
Class B amplification has recently received much publicity because of its high efficiency and the ability to obtain large audio output powers from low cost power tubes and power sources, but all is not gold that glitters, as is indicated by Fig. 1, which compares the harmonic distortion of three typical amplifier set-ups.

It is apparent that the pair of '45's operated Class A Prime (300 volts plate, 68 volts grid bias, 22 MA plate current, and with suitable coupling transformers) have a beautiful harmonic distortion curve. The Class B '46's are very bad indeed, except at intermediate to high power outputs. The '47's are of no interest in terms of radiophone modulators.

This brings up the question of what harmonic distortion is tolerable. For merely intelligable speech, the '46's and other Class B set-ups are OK, though despite their use in some commercial broadcast receivers, they are not capable of good quality in terms of high class receivers or broadcast station equipment.

With the Class A Prime system, however, nearly as much power per dollar can be had as with Class B systems, and with far better quality, hence it is a much to be preferred system.

At this point arises the popular amateur custom of trying to modulate the final r.f. amplifier, which, with carrier powers is in excess of fifty watts or so, becomes quite expensive. It is much simpler to modulate two r.f. stages away from the master oscillator, and much more economical as well. The power of the modulated r.f. stage can then be increased as far as desired with additional r.f. stages—how much simpler to use a 15 watt modulator to modulate a 30



watt intermediate r.f. amplifier input, and then build the carrier up to 200 to 500 watts, than to try to modulate the 200 to 500 watt final r.f. stage direct!

For this reason, while in the following paragraphs data will be given on Class A Prime modulators of up to 400 watts audio output, the writer favors the modulator shown on Page 15 of September "RADIO"—a pair of 2A3 tubes turning out 15 watts to modulate a 30 watt r.f. input 100%, as built for W9USA. Incidentally, the 2A3 tubes appear to have been introduced at the request of a set manufacturer who did not wish to use a competitive maker's Class A Prime development, yet desired an equally good system—but not Class B at any price!

In the accompanying chart are given constants and tube types for Class A Prime modulators (or amplifiers) of 10, 35, 135 and 400 watts output approximately, with their driver specifications as well. In each case a voltage amplifier will be required ahead of them. This can most conveniently consist of two stages using two '56's, with good microphone and coupling transformers, although the two '56's can quite nicely be resistance coupled to each other.

In examining this chart, it will be apparent that the recommended plate voltage is in excess of that specified by the tube makers. But it is also apparent that the grid bias is quite high, so that the actual plate dissipation is actually below the rated maximum for the tubes. Hence it is perfectly safe to so operate them, and no shortening of tube life will result from such operation.

Since in each case the output stage will draw power from the driver, it is essential that the input transformers have low resistance secondaries, and this usually results in a primary to one-half secondary step-down ratio. This is quite OK as the driver tube specifications take this into account. In each case the driver stage is operated straight Class A, and its tubes draw no grid current, though they supply power to the output stage grids.

Suitable coupling transformers can be had from makers of special transformers at reasonable costs, although the data here given is sufficient to enable any competent transformer designer to build them.

Power Watts	Output Harmonics — Pct.	Driver Stage Tubes	Output Stage				
			Tubes	Ep	Eg	Ip	Load Impedance Plate to Plate
10	5%	2-'56 PP or 1-'45	2-'45	300	67	22MA	8,000 Ohms
37	7%	1-'45 or 1-'50	2-'50	600	130	40MA	15,000 Ohms
137	7%	2-'50	2-845	1500	250	50MA	30,000 Ohms
400	7%	2-'50	2-849	3500	165	85MA	80,000 Ohms

The Eleven Year Cycle

By A. L. MUNZIG, W6BY

THE approach of the eleven-year cycle with a change in atmospheric conditions, seemingly dependent upon solar activity, should be of great interest to the high-frequency transmitting amateur. This sun-spot cycle is believed to have a duration of approximately eleven years—to be exact, 11.1 years. The last minimum solar activity began in 1923. The next minimum activity will begin in 1934. What will be the effect on high-frequencies?

Unfortunately, short-wave radio isn't eleven years old as yet, hence, we cannot compare the approaching minimum activity in 1934 with that of 1923. However, we have gone through a period of maximum activity which occured in 1928 and can draw some conclusions from observations made then. We all know how well the 7 MC and 14 MC bands performed in 1928. Practically all our extreme DX was accomplished in these bands.

The conclusion drawn from this is that maximum sun-spot activity is conducive to better performance on the high-frequencies than the low-frequency bands. Since the solar activity has an effect on the ionized region surrounding the earth, known as the Kennelly-Heaviside layer, the effect which this minimum activity will have on the refractive index will be interesting.

With the approach of minimum activity the 7000 KC band should give very nearly the performance that the 14 MC band did in 1928, and the 3500 KC band the performance of the 7000 KC band. Evidence that this is true has already manifested itself, especially in the 3500 KC band. Many amateurs are contacting VK's and ZL's with low power unheard of before and the fone-men are reporting excellent performance on this band.

Cognizant of this approaching change of conditions, serious consideration should be given to angle radiation by the short-wave man. Propagation at the correct angle of incidence can produce some very interesting results in DX transmission! Suppose we find that the angle of propagation is too low during this minimum solar activity. How can we increase the height of the angle? Well, it can be done and the trick is in the antenna! Let's all tackle this problem of angle radiation and pioneer the way again, as we have done in the past!

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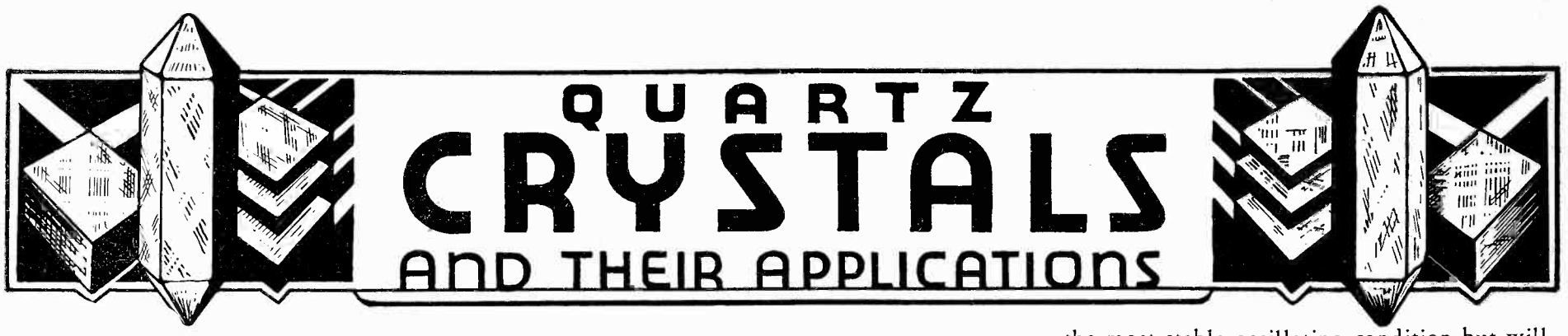

Trouble-Shooting the Crystal Oscillator

By A. F. HOEFLICH

CHAPTER IV

WHILE the crystal oscillator is probably one of the easiest circuits to adjust, beginners and even experienced operators sometimes encounter difficulties with this frequency-controlling portion of the transmitter. With this thought in mind, the writer will endeavor to list some of the difficulties, or so-called "bugs", that are likely to creep into the oscillating circuit. To these will be added some means for making tests which will simplify the finding of the trouble.

We will first assume that the crystal has been secured from one of the reputable makers so that no difficulty need be encountered from frequency jumping, side-tones or inactivity with regard to strength of oscillation.

The most common difficulty, and one that is sometimes trying to the beginner, is the refusal of the circuit to oscillate. In spite of the obvious nature of the difficulty and the possible cures for the condition, several of these instances have presented themselves in the last year in which the writer was called upon to check the circuits. It is indeed strange that a beginner usually assumes that the crystal is at fault, yet does not give consideration to other and more obvious remedies of circuit adjustment.

Provided that the tank circuit is known to be resonant to the frequency of the crystal, i.e., the coil turns and size of tuning condenser are known to be correct, and that the connections have been checked and found correct, the difficulty of non-oscillation can usually be found in the grid-leak resistance.

Some time ago, one of the national radio publications released a circuit of a crystal oscillator in which the grid-leak resistance was specified to be 5,000 ohms. This has caused an endless amount of confusion and trouble among beginners. The correct value of grid-leak resistance in an oscillator circuit depends on the applied plate voltage and, to a certain extent, upon the plate load and the amount of power drawn from the circuit. Thus, 5,000 ohms may sometimes be altogether too small when only 200 volts is used on the plate. On the other hand, this value may be entirely satisfactory if 500 volts is used. It therefore seems obvious that a beginner should have a small supply of grid-leak resistors of different values on hand in order to determine which is best suited for use in his oscillator. The cheap carbon resistors sometimes used for grid-leaks in oscillators are often considerably inaccurate in their ratings. The indicated value of some of these resistors has been found to vary as much as 30%. Therefore, a resistor marked "5,000 ohms" may, in reality, have a resistance of only 3,800 ohms, and the crystal oscillator may not function when this low value of resistance is used.

If it is believed that the grid-leak is the cause of non-oscillation, the leak should be removed entirely and another substituted in its place. The grid-leak mounting itself will sometimes act as a high-resistance leak of 20 megohms or more, and the oscillator should go into oscillation with a very decided dip in the reading on plate current meter. The leak resistance can then be gradually reduced until the most stable operation is secured. In any event, the value of plate current, for the sake of stability, should not be more than half the non-oscillating value of the plate current drawn by the tube. This condition applies to a "loaded" oscillator, feeding the buffer or doubler, and driving the same.

A complete reversal of this condition is found when the grid-leak value is too high. Under this condition the circuit has a tendency to oscillate at the fundamental of the crystal, and also to oscillate at some lower frequency. This lower frequency has a tendency to modulate the higher frequency so that a series of side-bands appears. Thus, the transmitted signal appears in a number of places in the band, but is stronger on the frequency that corresponds to the natural period of the crystal. If the frequencies are measured the separation will be found to correspond with a constant value for a given setting of the oscillator. The separation is evidently equal to the low modulation frequency which appears to be determined by the value of the grid-leak resistance and the capacity of the grid-leak mounting. It is similar to the effect noticed when a self-excited oscillator is oscillating too strongly, and also to the similar effect sometimes observed in the super-regenerative receiver.

Evidently, the cure for this trouble is in the reduction of the grid-leak resistance value. If battery bias is used for the crystal oscillator instead of a grid-leak, the non-oscillating value of the plate current should be at least as large as the oscillating value because oscillators are not self-starting if the grid bias is near cut-off.

Sometimes a crystal oscillator is found in which the available power output is small, and further attempts to draw more power from the circuit, by closer coupling, result in non-oscillation. In such cases, losses were always found to be present which caused a constant load on the circuit, thus lowering the efficiency and reducing the available amount of power output. Plate coils placed too close to shielding, shunt-feed circuits using inferior chokes, and not sufficient grid-leak resistance were found to be the causes of this trouble. By making a change to series-feed, thus obviating the need of a plate choke, improving the plate tank coil and placing it away from the shielding, and by increasing grid-leak resistance, greatly increased efficiency was secured and considerably more power could be drawn from the circuit.

The question of L/C ratio in the crystal tank circuit sometimes enters into the discussion of the crystal oscillator. Tests made by the writer prove that a high inductance tank, tuned by a small capacity, which, however, is detuned from peak, will give not only the most stable oscillating condition but will also reduce the strength of the unwanted harmonics. Thus, frequency multiplication is confined to the doubler stages, without interference from out-of-phase double-frequency components produced by the oscillator.

The use of a high ratio of capacity to inductance will, on the contrary, give lower oscillator efficiency, resulting in loss of available excitation and, in the case of a poorly grounded aerial, cause a bad condition of frequency jumping.

With th use of some of the low-priced crystals now being sold, in which a frequency change is noticeable as a sudden jump, this difficulty may be reduced or even eliminated entirely by using the very highest possible L/C ratio. In other words, the tank coil should be made large enough so that the circuit tunes to resonance when the capacity of the plate tuning condenser is at near-minimum.

A condition that gives rise to much trouble even in the best of oscillators is the sudden cessation of oscillation. In the words of the operator, "the crystal suddenly stops oscillating." A check of the crystal usually shows nothing wrong. Evidently, the trouble lies in the circuit. In the several cases of this trouble that were checked, it was found that the tube was being driven too hard. Considerable power was being obtained from the oscillators at more than normal voltage. The remedy was found in reducing the coupling to the buffer stage, or by a reduction in screen voltage. In the case of a '47, the oscillator tube was over-heated. The fault was remedied in still another case by merely cleaning the crystal plates which had become soiled from contact and rubbing against aluminum holder plates. Still in another case, where '27 tubes were used in an oscillator and 320 volts supplied to the plates, a reduction in plate voltage resulted in stabilized operation.

Crystal plates can be damaged by abnormally large r.f. current passing through the crystal. The values of crystal currents given in July "RADIO" should be adhered to. If the oscillator tube is to be operated at higher than recommended plate voltage given in the tables, the crystal current may be kept at a low value by keeping the oscillator loaded at all times when the plate voltage is on. The buffer stage, which is usually connected across the plate tank, should be adjusted so that its grid circuit draws no power, thus holding down the r.f. voltage across the crystal at all times while plate voltage is supplied to the crystal stage.

A crystal will not oscillate freely if it is exposed to dust or dirt. A simple remedy for this condition is the use of a dust-proof crystal holder. Evidence of dust or other foreign particles on the crystal plates can be detected by applying a slight pressure to the top plate of the mounting. If the plate current decreases, or if the output increases, thus denoting increase in strength of oscillation, the holder should be taken apart and given a thorough cleaning.

The crystal plates should always make good contact with the holder electrodes. Electrodes and crystal should both be free from dust or grease, at all times. Nothing has been found better for cleaning crystals than soap and warm water.

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HAM HINTS By JAYENAY

160 Meters Is Coming Into Its Own

Some great things are being done on 160 meters, both CW and phone. Many East Coast QSO's on phone are being reported by both sixes and sevens and Europe has been worked from Ohio on 160-meter phone. W6FFP reports a four-band QSO with ZL1AR on CW and is trying to raise him on ten meters to get that fifth band. Sixth district stations on 160 are being reported as heard in Manila and Shanghai. Someone is going to get three or four legs on his 160-meter WAC certificate soon. The old timers who stick to 40 meters to the exclusion of the other bands are missing a lot of DX on the lower frequencies.

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Suggestion to Those on 10 Meters

Keep your transmitters above 28,800 K.C. and your signal will not be mistaken for a 14-megacycle harmonic. All kinds of harmonics are being heard and it is hard to tell a real 10-meter signal when it does come through. Of course, this does not apply to the phones, because they must stay below 28,500 K.C. in order to be in the phone band.

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HC2RL On Phone

If you phone men want to work some real DX, listen for HC2RL, whose QRA is Guayaquil, Ecuador. He has a Collins 150B on 1888 KC, 3965 KC, 7089 KC and 14,178 KC. His 7089 KC phone signal is R7 in Northern California and he evidently can hear plenty of W stations for he is always calling them. He is very close to XIQ's phone signal and is usually just as loud.

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Single Sideband and Suppressed Carrier Phones

Several groups are experimenting with single-sideband, carrier-suppressed phones, and we should expect some progress in this field soon. This type of transmission will double the effective size of our present phone bands and therefore represents an encouraging development. We would like to hear from those engaged in this problem.

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Hum On Carrier

Excessive hum is one of the toughest problems of the phone operator when building or rebuilding his transmitter. This hum comes from a wide variety of sources, but principally from inductive coupling between the audio transformers in the speech amplifier and a power or filament transformer located nearby. The microphone transformer is the worst offender. The best solution is to locate the speech amplifier at least three feet from any power transformers. If this is not possible then use long leads to connect to the mike transformer and cut circular slots in the baseboard or chassis, so that the transformer can be rotated until the various magnetic fields neutralize. A tremendous improvement in the amount of hum present in the output of the speech amplifier can be effected by this means. It also pays to use separate ground connections for the audio-frequency and the radio-frequency portions of the transmitter. A good ground on the frame of the mike is very essential, especially in the case of a condenser mike. A 2A5 crystal oscillator in place of a 47 has been known to cause a tremendous reduction in the amount of hum on the carrier. Last, but not least, don't forget to use enough filter in your various power supply circuits.

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Class B Developments

Class B audio amplification has suffered from poor quality. The new 53 represents a real step forward in that harmonic distortion can be reduced to a very low value by its use. The main difference between the 53 and the older types designed for use in Class B circuits (Such as 46 and 59) is that the plate current with no signal on the grid is higher in proportion to the peak value of plate current. This is a step toward Class A Prime, which has proved highly successful, even though the 53 uses zero grid bias.

In the higher-powered field, victory has crowned the efforts of those fighters in the war against harmonic distortion. It is now possible to get 60 watts of audio power from a pair of 210's without materially shortening their life.

Only a few short months ago 210's were considered good for about 35 watts maximum, but by using higher voltages (750) the efficiency has been increased to surprisingly high limits.

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Carrier Vs. Sidebands

One hundred per cent modulation is still rare among ham phones and this situation is causing much unnecessary QRM which can be eliminated. Many phone operators are constantly seeking ways to increase their carrier power without paying much attention to their sadly overworked modulators. They should always remember that the carrier never reaches the other man's phones. It stops at his detector and is bypassed to ground where it is lost forever. The only thing that reaches the other operator's ear are the SIDEBANDS, which depend for their existence on the MODULATORS. The effect of a carrier that is too large for the side bands is to ruin the received quality by overloading the detector in the other fellow's receiver. Why use a 5-ton truck to deliver a telegram? Rebuild your modulators so that they will completely modulate your carrier, and then you are getting somewhere. The proper way to describe any given phone station in terms of the amount of signal it can put in a distant receiver is to state the amount of SIDEBAND POWER in watts which carries the transmitted intelligence. Instead of saying that a given station uses a 210 with perhaps 70 watts input, we should say that that station uses 35 watts of sideband power, which a 70-watt input would justify, if completely modulated.

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YV2AM On Phone

Another of our southern neighbors in this hemisphere is YV2AM of Maracaibo, Venezuela, who puts a good signal into the United States on 7 and 14 megacycles. His phone has broadcast quality and uses a single 203A in the final, modulated by two 203A's in Class B. He is often heard in the early evening calling CQ US on 7 MC and listens for the W stations to answer on 3.9-4 MC. Few 75-meter phones take the trouble to look for foreign phones down on 40 meters but they are in there if you hunt for them. It is also a good idea to listen between 3500 and 3600 KC late at night for the ZLs. They come through R5 to 7 when conditions are good. Their phones are almost uniformly of broadcast quality, but of low power, showing that it takes quality, not quantity, to push through from Australia and New Zealand. W9BHT has both and is QSO J5CC R8 to 9. Hi....

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Colpitts Or Hartley

Most regenerative oscillators can be classified under the above heading. Circuit details vary widely but in the final analysis we come back to the two fundamental types. If most of the feedback is inductive, it is a Hartley. If capacitive, then it's a Colpitts. It should be noted that practically all oscillators have some capacitive feedback through the tube elements. The AMOUNT of feedback for best operation depends largely on the amplification factor and the grid losses; these two factors vary widely with tubes and frequencies, therefore some circuits are better than others, depending on conditions. Usually, it is desirable to have the amount of feedback adjustable, in order to get the cleanest note so those circuits which provide this feature, such as the "Tuned-Grid-Tuned-Plate" or the "Simpson," are commonly found. The Hartley also provides variable feedback by means of the filament tap but this adjustment is not as simple as the capacitive adjustment on the Simpson, for example. Practically all of the common circuits will give good results if properly constructed and adjusted, but remember that for maximum efficiency the feedback should be adjustable.

●●●

Neutralize That Modulated Amplifier

Few phone operators realize how much distortion results from an imperfectly neutralized Class C amplifier. It may be neutralized fairly well, at least it doesn't oscillate at the normal plate voltage, but it should be remembered that the plate voltage is doubled under complete modulation and feedback which cannot be found with a neon bulb as the normal plate voltage can entirely destroy the desired linearity on the voice peaks. So check your neutralization often with a sensitive indicator and improve your quality. Better yet, use screen grid tubes in the modulated amplifier and entirely avoid regenerative distortion.

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Zepp Feeder Separators

They may have been high-grade separators when you put up your antenna, but after a winter in the open air they are just a bunch of dirty sticks. Use a good grade of porcelain, Bakelite or light-weight Isolantite, and your sigs won't get lost in every heavy fog. Or you might look into this business of single wire feed lines to a Hertz antenna. Simple, but very effective. A large number of hams and commercials are using it, so it must be good.

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Economy

One manufacturer offers a broadcast quality, 100 per cent modulated 25-watt phone transmitter, complete with speech amplifier but less tubes, crystal and microphone for around $125. Want his name?

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An Improved Model of the Heterodyne Receiver

A Sensitive Peaked-Audio Receiver For Amateur Code Reception

By FRANK C. JONES

THERE have been quite a number of requests for more details on the short-wave receiver first described in Modern Radio. Experiments after the publication of this article has led to some suggestions for improvements, which will be outlined here.

The original receiver was designed to allow reception of eastern amateur stations on the west coast through early evening interference. Some sensitivity was sacrificed in order to use certain circuits for minimizing detector tube blocking caused by local stations and key-clicks. The circuit consisted of a 56-tube oscillator, a separate 57 bias-detector, and a high-gain, selective audio-amplifier to compensate for lower detector sensitivity. The separate oscillator and bias-detector practically eliminated locking in as found in the usual detector heterodyne note when strong signals or key clicks are received.

The high-gain audio system has certain disadvantages such as hum pickup and audio feedback. The selectivity, with two sets of 800-cycle tuned circuits around the 58 audio amplifier, is excellent for the 7-MC. band, but a little too good for 14 MC. work. Some amateurs object to a "hollow" signal, such as this system gives. Experiments were conducted with a view to increasing the sensitivity for foreign reception, reducing the required high audio amplification.

A radio-frequency amplifier stage was added. This enabled good foreign reception but increased the local interference. Key-clicks and local stations were amplified to such an extent that the signals, through a relatively broad tuned R.F. stage overloaded the bias-detector. By using a volume-control on the R.F. stage, the signal strength can be maintained below the overloading point.

A volume-control on an R.F. stage tends to detune the heterodyne oscillator and detector circuit slightly, but this can be minimized by using "Hi-C" circuits and good R.F.

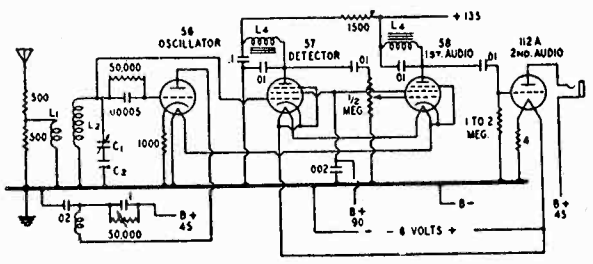


Fig. 1. The Special Heterodyne Circuit.
L_1, L_2, L_3—Windings of plug-in coil, see Fig. 3.
L_4—Iron core coil tuned to 800 cycles.
C_1—50 uufd. band-spreading condenser.
C_2—100 uufd. tuning condenser.
(The band-spreading feature may be omitted or obtained in any of the usual ways.)

This Circuit Diagram shows the Original Receiver as described in "Modern Radio" for November, 1932, whereas the latest version of this popular receiver is shown in the circuit diagram below.

stage isolation. Double shielding, such as separate coil shields is important.

The decreased sensitivity hum in the bias-detector was next considered. It was overcome to a great extent by adding regeneration through a separate tickler-winding or through the R.F. plate-coil, if the winding is connected in the proper direction. The detector grid-circuit is tuned by the same circuit that is used by the heterodyne oscillator, hence the detector screen-grid can be connected back through a condenser to the tickler winding. The regeneration-control requires an R.F. choke in the lead to the screen-grid.

The use of an R.F. stage, and detector regeneration, requires less audio amplification. A 2A5 pentode tube operating at moderate plate voltage can be used. The gain of this tube is higher than that of a 56. It has the advantages of high gain and separate heater and cathode. Heater type tubes help to reduce hum.

A tuned audio-coupling device is shown; it is tuned to 800 cycles. Any form of coupling can be used between the detector and audio tube. One scheme tried consisted of two tuned circuits, one for the plate of the detector and the other in the grid of the audio tube. They are coupled together with a .0005 mfd. condenser giving a band-pass coupler, tuned to about 800 cycles. An ordinary audio transformer will usually peak near 1000 cycles when used in the output of a 57 screen-grid detector. High-frequency noise can be reduced by shunting a condenser of .02 or so across the phones.

An electron-coupled oscillator is suggested in the circuit diagram since it is less subject to frequency changes than that originally used. An AC power-pack produces changes in plate voltage so this oscillator is desirable.

The detector bias-resistor should be such that the bias voltage is always a couple of volts higher than the heterodyne-oscillator R.F. voltage across this tube, to allow large inputs without cross-talk. A value of 5,000 or 10,000 ohms will be satisfactory.

HETERODYNE RECEIVER COIL DATA

Band	L_1	L_2	L_3	L_4	
1,750 KC	10	55	30	55	tapped at 8th turn
3,500	6	28	20	28	tapped at 4th turn
7,000	5	11	9	11	tapped at 2nd turn
14,000	3	5	5	5	tapped at 1st turn

Condensers C_1 and C_3 each 25 to 35 mmfd. (preferably ganged).

Condensers C_2 and C_4 each 100 mmfd. midget type and for band-spreading and "Hi-C".

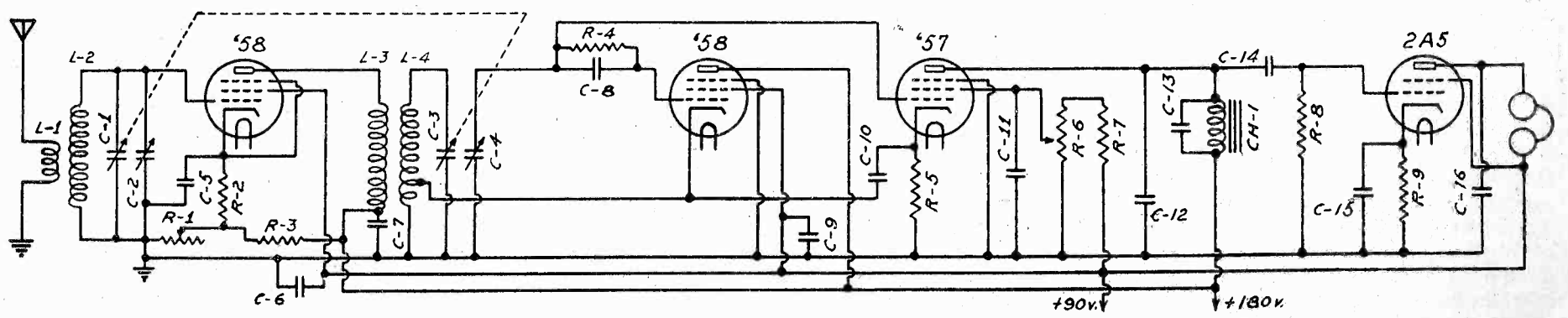
Coils — Primaries of No. 36 DSC wire wound between secondary turns.

1,750 KC. Sec.—No. 28 DCC close-wound.

3,500 KC.—No. 20 DCC.

7,000, 14,000—No. 18, spaced to occupy 1¼ inches.

Coils wound on 1½ in. diameter forms.



FRANK JONES HETERODYNE RECEIVER

C1-C2-C3, See Text; L1-L2-L3-L4, See Text; C5-C6-C7, 0.1 mfd.; C8, .0001 mfd.; C9-C10-C11, 0.1 mfd.; C12, .001 mfd.; C13, .01 mfd.; C14, .01 mfd.; C15, 1 mfd.; C16, .03 mfd.; CH1, 8 henries; R1, 10,000 ohms, tapered; R2, 250 ohms; R3-R4, 50,000 ohms; R5, 5,000 ohms; R6-R7, 50,000 ohms; R8, 1 megohm; R9, 500 ohms.

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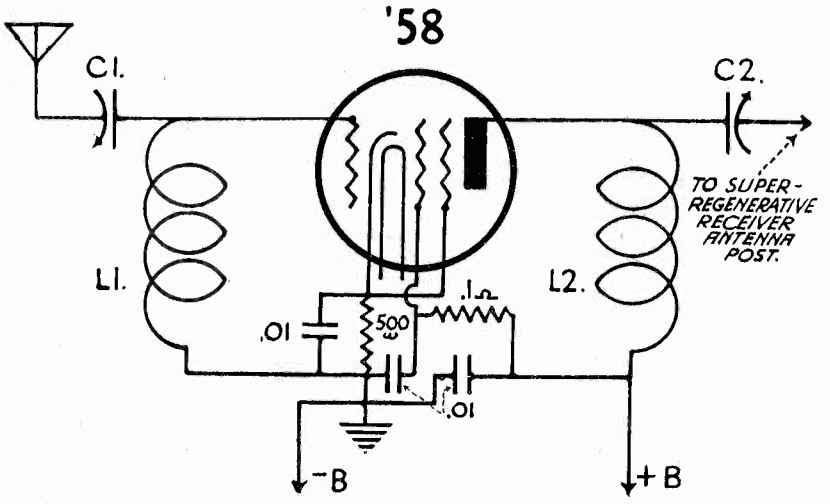
Super-Regenerative Q. R. M.

By FRANK C. JONES
Ultra-Short-Wave Editor



C1 & C2—Semi-variable 25 mmfd. max. (trimmer type condensers)
L1 & L2—8 turns, ½-in. dia., about 1 inch long, self-supporting coils.

MOST amateurs who have made use of the five-meter band have noticed super-regenerative QRM if other five-meter enthusiasts live in the vicinity. Super-regenerative receivers send out a mushy QRM, which has a few whistles also when heard on another similar receiver. Interference of this nature may cause trouble at distances ranging from one to ten miles.

Some measurements here indicate that the antenna current from an average super-regenerative receiver may run as high as 25 milliamperes at the center of a tuned or half-wave receiving antenna. This represents about 50 milliwatts of power in the form of mushy QRM. Some receivers run less, particularly if the detector plate voltage is kept down to as low as 45 volts, but, even so, they will cause QRM nearby. The blocking grid-leak type of super-regenerator in which no external interruption-frequency circuit is used, is a very bad actor in this respect. This naturally follows from the fact that such a circuit is usually oscillating harder, being operated with from 100 to 180 volts on the plate of the detector. Such a circuit will not usually function with less than 90 volts B supply and apparently drops in sensitivity with voltages lower than 135 volts.

One method of eliminating this form of interference is by the use of superheterodyne circuits. Quite a bit of experimenting has been done here with various oscillator-mixer circuits with 1500 or 1600 k.c. intermediate amplifiers. The latter frequency, when two or three stages are used, will normally pass a wide enough band of frequencies to permit reception of modulated five-meter oscillator transmitters. The surprising thing about superheterodyne receivers on 5 meters is their poor sensitivity performance in comparison to a good super-regenerative receiver. This is all right for reception of a television signal, where the transmitter power is high and the field strength good, but for reception of extremely weak, low-powered amateur stations, the super-regenerator seems to be the more practical. The superheterodyne is also subject to image interference and the intermediate frequency has to be quite high (about 10 megacycles) to minimize this effect.

The next step was to provide a method of reducing the super-regenerator QRM. A resistance network in the antenna lead, similar to those used by Europeans, nearly eliminates the radiation but it also makes the antenna aperiodic. It reduces the sensitivity to weak signals, since a tuned antenna will give several times as strong a signal as one which is untuned. This system is all right for use when signals of good field strength are available.

A screen-grid tube r.f. amplifier was next tried. Experiments, at various times, with the usual forms of circuits were not very encouraging as regards sensitivity, but the radiation was practically eliminated when the receiver was properly shielded. The plate circuit of the r.f. amplifier always loaded the detector circuit too much, or the load impedance was too low to get any amplification.

Finally, the idea of using a separate tuned circuit for the r.f. tube plate was tried, with greatly improved results. Very weak capacity coupling could then be used between this tuned plate circuit and the super-regenerative detector circuit. The load impedance could then be made high and the loading effect nearly eliminated.

This meant the elimination of receiver radiation when proper shielding was used as well as an increase of sensitivity. The only disadvantage was the necessity of using two more 5-meter tuned circuits. The r.f. tuning seemed to be quite broad, so the idea of using self-resonated coils (such as the grid coil in a TNT oscillator) was tried. The results seemed to be quite favorable, especially if the receiving antenna resonated near one end of the amateur band, and the untuned r.f. amplifier near the other end. The circuit details are given in the diagram.

In the arrangement used at W6AJF, the type '58 tube and shield are mounted so that the grid coil and coupling condenser are near the top grid clip. The plate coil and coupling condenser solder to the tube socket plate terminal with a short return circuit through a mica condenser to ground and tube shield. The grid and plate circuits must be shielded from each other, and the super-regenerator circuit must also be shielded or at least kept several inches from any nearby antenna leads. An antenna lead 2 inches away from a super-regenerator will pick-up enough energy to radiate QRM over a mile. Here, the antenna tunes near 56 mc. and the amplifier plate circuit tends to peak near 59 or 60 mc. The result is good sensitivity over the whole 5-meter band because of antenna resonance and r.f. amplification.

The r.f. coils consist of eight turns of No. 18 "bell wire" with slight spacing between turns on a ½-in. diameter. The coils were pulled out like a spring, until the right amount of inductance was obtained to resonate with the tube and wiring and coupling condenser capacities. The coupling condensers have a tuning effect, since the ratio of L to C is quite high in these circuits. A high ratio, of course, means more r.f. gain.

Any type of screen-grid tube may be used with a type 58 or 78 given preference. The r.f. unit may be built up as a small separate unit to be used with any existing super-regenerative set, provided there is at least 135 volts B supply available and, of course, an A supply for the r.f. tube heater or filament. The by-pass condensers should preferably be mica for these ultra-high frequencies and all leads should be very short.

The fact that a super-regenerative receiver may cause interference to other stations may have been overlooked by some operators. It has been the purpose of this article to show that this condition not only exists, but to suggest some easy means for its cure.

Improving T. R. F. Performance

By NORRIS HAWKINS

A GREAT MANY of the older TRF receivers have been modernized by installing 58's or 6D6's in place of the older 22's, 24's and 35's. Although a good improvement in sensitivity is realized by this change, a greater gain will result if the tuning coils are rebuilt. The primaries of the older Pilot, Silver-Marshall and National coils are too small to effectively transfer energy from the plate circuit of a 58 or 6D6. The plate turns should be increased until there are at least two-thirds as many plate turns as grid turns. It is usually found that the increased gain calls for a reduction in the size of the tickler coil. A surprising number of receivers use ticklers that are twice as large as they should be. When a tickler is too large the screen voltage must be reduced to a low value to reach the threshold of regeneration, and this low screen voltage materially reduces the sensitivity of the tube. Generally speaking, the higher the screen voltage the better, up to 40 per cent of the plate voltage. There is little to be gained by raising the screen voltage beyond the 40 per cent point, except when the plate voltage is especially low (less than 135 volts). When you rebuild, use the detector screen to provide the feedback. This increases detector stability and often allows one setting of the regeneration control to provide optimum regeneration over the entire band. With plate feedback, either put the regular tickler beconstantly readjusted, when one tunes across the band, to maintain the detector close to the threshold of regeneration. To get screen fedback, either put the regular tickler between the screen grid and its usual bypass condenser, or, better still, use a cathode tap on the grid coil, as in the usual electron-coupled oscillator circuit. This latter connection allows one to add the tickler winding to the primary of the coil and thus increase the primary impedance without rewinding the primary. However, check the number of turns and remember that the efficiency will suffer slightly, due to the fact that few tickler windings are space wound.

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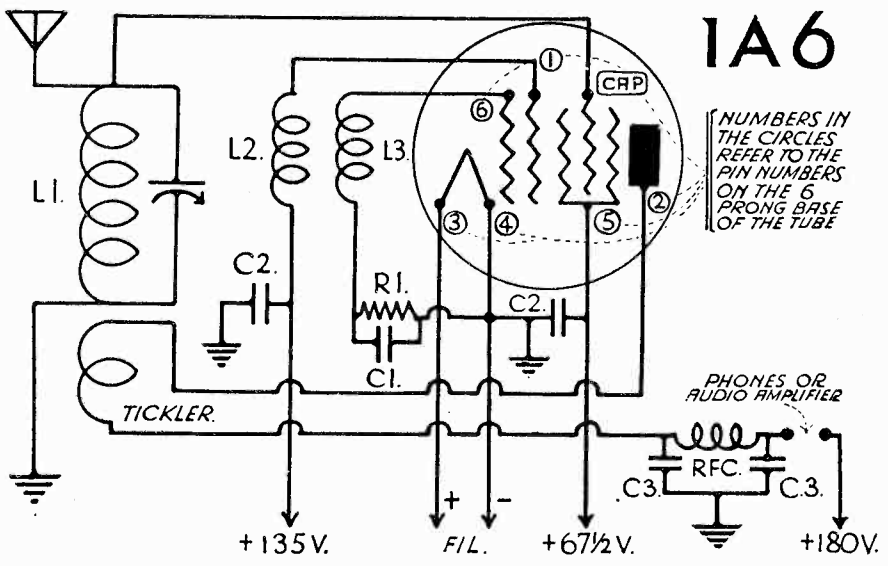
By JAYENAY

The 1A6 As a Super-Regenerative Detector For "5 & 10"



The diagram shows the application of the new 1A6 2-volt Pentagrid Converter in a super-regenerative circuit. The numbers in the circle correspond to the pin numbers on the 6-prong base of the tube. L1 is the 5-meter tuning coil. L2 and L3 are the plate and grid coils for 50,000 cycle oscillation to produce super-regeneration. C1 and R1 are the grid leak and condenser for 50 KC oscillation. C2 is a 50 KC by-pass condenser. C3 is a 60 MC by-pass.

At Last, Efficiency on 30 and 60 Megacycles with New Tube

RCA announces a new transmitting tube whose designation is RCA-800. This tube is especially suitable for frequencies above 10,000 K.C. because inter-electrode capacities are kept at a minimum. It is a triode with a 7½-volt filament. The tube insulation allows the use of 1000 volts on the plate. The elements are cylindrical and both the grid and plate leads are brought out of the top of the tube. This allows us to use real short leads from the grid and plate tanks, eliminating the stray inductance and capacity which costs so much efficiency with conventional tube types at the ultra-high frequencies.

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60 Watts of Audio Power From Two 210's In Class B

If the plate voltage is raised to 750 volts it is possible to get 60 watts of audio power from two 210's in a properly designed push-pull circuit. This audio power is sufficient to modulate up to 120 watts of DC input to the Class C modulated amplifier. This is more power than can be obtained from two 845's in Class A with 1000 volts on the plates. Either 2A3's in push-pull or 250's in push-pull may be used as drivers, and the output transformer should properly match the plate and load impedences. When used on voice the 210's show no adverse effects, but if used on music their life might be materially shortened.

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The 6F7 Either As First Or Second Detector In a Super

The new 6F7, which consists of a triode and a pentode in the same envelope, is primarily designed as a first detector and oscillator. However, there is no internal coupling between the two portions of the tube (as in the pentagrid). As a first detector the pentode portion acts as a mixer, while the triode portion acts as the oscillator. When used as a second detector the triode portion acts either as a grid-leak or power detector, while the pentode portion acts as an audio amplifier, or it can also act as an intermediate frequency amplifier. While this tube eliminates some of the troubles of the pentagrid it also limits some of the advantages of electron coupling. Until we have further data on its operation there does not seem to be much choice between the two. Of course, for high frequency work it is still hard to beat a '57 or 6C6 as first detector, with a separate electron coupled oscillator.

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2B7 and 6B7 Have Critical Screen Voltage

Many set builders and experimenters have complained that the duo-diode pentodes for use as second detectors in superheterodynes will not amplify at the recommended plate and screen voltages. Others have complained that the quality leaves much to be desired when used with suggested constants. Both these criticisms are founded on fact, and it is well to emphasize the fact that these tubes are very sensitive to improper screen voltage. Your columnist has found that about 22 volts on the screen gives best results. This can be obtained by placing a one-megohm series resistor between the screen and the plus 100-volt point on the voltage divider which supplies the screens of the r.f. pentodes, such as the 58's, 78's or 6D6's. The screen current is so small that the drop caused by even a 1000-ohm-per-volt meter prevents one from accurately determining the voltage actually applied to the screen.

●●●

20 Watts of Audio Power with a Cheap, 300 Volt Power Supply

If two 53's are used in Class B, 20 watts of audio power can be obtained in Class B (modified), and the regulation of the 300-volt power supply need not be much better than average. The grids and plates of each 53 are connected in parallel and one tube is used for each side of the conventional push-pull circuit. No bias is necessary, so the cathodes and grids are grounded. The grid current remains below 10 milliamperes, even at maximum output, and but little power is drawn from the driver tube. A 46 or 59 does the job easily; even push-pull 56's will supply enough power but the quality will suffer. If more power is wanted, raise the plate voltage to 400 or higher and use push-pull 45's or 2A3's to drive the grids of the two 53's. Under these conditions it is possible to obtain almost 30 watts of audio power.

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External Bias For Receiving Tubes.

Self-bias from cathode resistors is common these days, but it has some disadvantages that should be kept in mind when building a receiver designed for the absolute maximum of performance. The bias is obtained from the voltage drop across a resistor caused by the plate current of the tube. As the plate current rises so does the voltage drop, and consequently the bias rises, which tends to reduce the plate current. In other words, any change in plate current is resisted by the cathode bias resistor. Howeves, we want a signal to vary the plate current as much as possible, because that is how a tube amplifies. Therefore, if we use external bias, from either batteries or a separate voltage divider, the bias remains constant no matter what the plate current may do, and thus we can realize more gain. This has been proven experimentally and is especially true of the first detector in a superheterodyne. Try it.

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Class B Distortion

Most of the distortion in a Class B audio amplifier originates in the driver stage and not the Class B stage itself. It occurs when the grid current of the Class B stage reflects an improper load impedance into the plate circuit of the driver. Thus, if we desire to improve the quality of Class B amplifiers, we should use low-mu, low plate impedance tubes as drivers, and also use as great a step-down ratio in the input transformer as possible. Turns ratios of 6-to-1 are not uncommon. It should be noted that a turns ratio of 6-to-1 means an impedance ratio of 36-to-1, because the impedance ratio of any transformer is roughly equal to the square of the turns ratio. Using a step-down transformer to drive the Class B grids costs a lot of voltage amplification which must be supplied somewhere else in the circuit, but there is no other way in which to minimize harmonic distortion in the driver stage.

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Replacing An 80 With a 5Z3

IF A 5Z3 is used to replace an 80 in a receiver we can expect a slight increase in plate voltages throughout the set. Most power transformers will stand the extra load imposed by the three-ampere filament of the 5Z3, and the sensitivity of the set should be greater. Add condenser input to the filter, if it is not there already. No additional RF interference will be caused.

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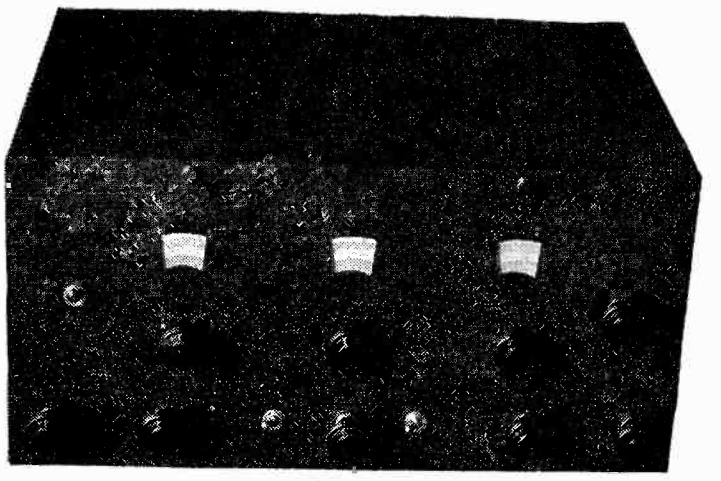
Single-Signal Receiver for Byrd Expedition



By McMURDO SILVER

PROBABLY the first use of the quartz crystal resonator for extreme selectivity in radio receiver design that came to popular knowledge was Dr. Robinson Stenode's Radiostat circuit. Unfortunately, this system contributed greatly to "apparent" selectivity (difficulty of tuning), but very little to "actual" selectivity (elimination of interference), except in almost direct proportion to loss of fidelity. Time seems to have proven that a crystal resonator has no place in a high quality broadcast receiver.

But for C.W. code reception, it has a very definite place, particularly for the amateur bands, the width of which a good crystal resonator receiver (single signal) will effectively double. But a crystal resonator cannot be added to any superheterodyne in a haphazard, hit-or-miss manner. There are plenty of tricks in getting it into a receiver design and making it work as it really will if the design be properly engineered.

The receiver here described and illustrated was selected by Dr. McCaleb of Harvard, acting as Admiral Byrd's radio advisor as the communication receiver for the Admiral's 1933-1934 Antarctic expedition. It and all other short-wave and broadcast receivers for this expedition were designed and built by the writer. It is strictly a custom-built, single-signal superheterodyne, employing a properly designed quartz crystal resonator which effectively eliminates one audio image (one side of heterodyne signal) from every C.W. code signal, actually cutting in less than half the space in the frequency spectrum occupied by any C.W. code signal. It is also an excellent and advanced superheterodyne, which with the crystal switched out, is ideal for short wave broadcast or phone reception.

It covers a range of 200 to 10.1 meters (1500 to 25,000 kc.), can be used with regular or doublet antennas, has a C.W. beat oscillator, is entirely self-contained with no plug-in coils, A.C. operated, and has band spread tuning functioning anywhere in its range—on amateur, commercial or broadcast bands. 17½-in. long, 10½-in. deep and 8¾-in. high, it is self-contained in its own easily removable shielding case, and will fit a standard 19-in. relay rack if desired.

Its sensitivity is better than ½ microvolt absolute, its selectivity with crystal cut-out absolute 10 kc. or one channel (22 kc. wide 10,000 times down) or absolute single-signal with crystal in series circuit, its fidelity flat to 4 db. from 40 to 4000 cycles with crystal out, and its undistorted power output three watts (5% harmonic distortion).

The circuit employs a '58 tuned r.f. stage (V1) on all four bands, and a 2A7 first detector and electron coupled oscillator (V2). The r.f. and first detector circuits are tuned by the left hand six-to-one vernier dial, and the oscillator by the similar right hand dial. The center dial is the oscillator vernier, or band spread tuning—the only control used in tuning over any short wave band.

The new 2A7 tube is the first combination tube which actually does a better job than will separate tubes to perform the same functions. It is a remote cut-off (no cross talk) screen grid first detector, and an electron coupled signal frequency oscillator. Its conversion gain and frequency stability are superior to separate tubes used to perform its two functions.

The tuned r.f. stage preceding it eliminates the image frequency or repeat point found on all short-wave receivers starting with only a first detector tube, and also constitutes amplification which tends to minimize oscillator hiss found in sensitive superheterodynes not so equipped.

Separate coils for all of these circuits, in separate aluminum shields, are selected by a positive, long-lived, five-gang, four-position band selector or wave-change switch at the lower center of the panel.

The tuning dials are six to one reduction ratio, and employ an automatic take-up gear drive, free of backlash or play.

The first detector is followed by two stages of 465 kc. i.f. amplification (V3, V4). The i.f. transformers utilize Litz coils of excellent "Q", tuned by a new type of mica and isolantite compression trimmer, providing better selectivity by virtue of a more favorable LC ratio.

The crystal (XL) is placed in the i.f. amplifier input circuit, and is controlled by a switch having off (for broadcast) parallel (for intelligible phone) and series (for single signal code) positions. The selectivity it provides is variable, being controlled by the lower right knob (C5-C6) which actuates the air tuning condenser of the crystal input circuits. A 465 kc. Bliley crystal and plug-in air-gap holder are used.

The second detector is a '56 triode (V5) to the plate circuit of which is coupled the '58 electron coupled beat oscillator (V7) for C.W. code reception or location of weak phone or broadcast stations. This oscillator is turned on or off by the upper left toggle switch (S7) and its audio beat note is controlled by the vernier condenser actuated by the lower left knob (C8).

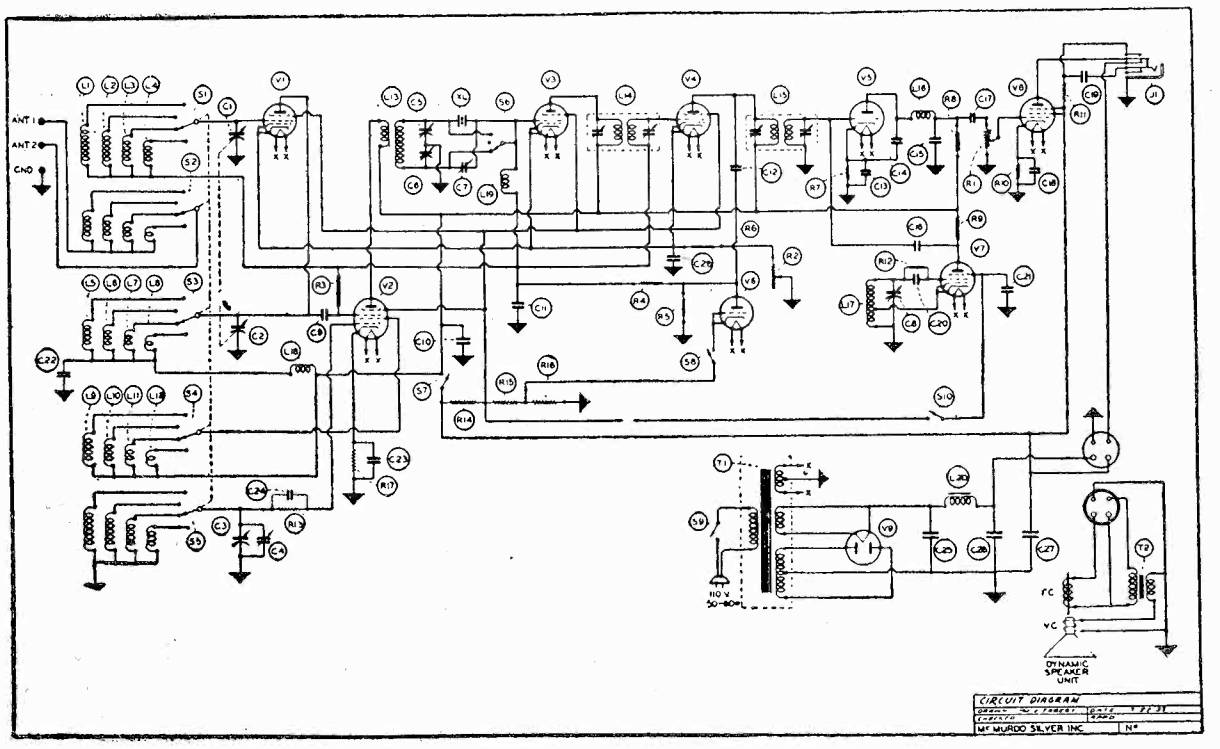
Tube V6 is a '56 diode A.V.C. tube, giving the full benefits of automatic volume control for phone or broadcast reception. It can be cut out when desired for code reception by the lower right toggle switch (S8). The lower left center knob is the audio volume level control (R1) and an off switch (S9), while the lower right center knob is the sensitivity, or manual volume control (R2). The lower left toggle switch (S7) cuts off B supply to prevent blocking when the receiver is used close to a powerful transmitter.

The audio amplifier consists of a single '59, 3-watt pentode (V8), resistance coupled to the second or audio detector, and having an output jack on the rear of the receiver chassis for head phones or magnetic speaker, and a four-pin plug for the eight-inch Jensen speaker furnished. Use of head phones cuts out the dynamic speaker.

The power supply is conventional, using an '80 rectifier (V9) in a condenser input filter system employing two filter chokes—one in the chassis and the second, the five watt speaker field. Semi-self-healing dry-electrolytic filter condensers are used.

Throughout the design of the receiver, electrical symmetry has been rigidly held to in the placement of all parts, so that each circuit progresses through the shortest possible leads on into the next circuit. The result is absolute stability and the entire absence of regeneration, resulting in a most favorable signal to noise ratio.

As for results, foreign amateurs and broadcast stations at excessive loud speaker volume are "duck soup" to the 5A single signal receiver, while selectivity can be made anything from 50 cycles and less to 10,000 cycle band width by means of the crystal switch and selectivity control.



Circuit diagram of the new McMurdo Silver 5-A Single-Signal Super

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Ramblings

A Little o' This—and a Little o' That . . . Taken from the Editor's Mail Bag. Readers are invited to contribute to this Open Forum.

If You Want To Get Rich Quick, Buy A Sound Truck

FORTUNES have been lost by ambitious radio men and promoters who were bitten bv the "sound bug". A few are making money. Those of the more fortunate include the owners of elaborate sound trucks, costing upwards of several thousand dollars. There are also a few who have secured exclusive sales franchises from large manufacturers of sound equipment who, because of their knowledge and experience in the manufacture of sound equipment and because of certain patent rights, have long held a proverbial corner on the market.

County Fairs and race tracks have proved a somewhat fertile field of profit for those who have installed and operated sound equipment. Often the equipment is installed on a lease-contract basis and the contractor is paid sums as high as $50.00 daily for the use and operation of it.

On the other hand, "sound on wheels" has not proved universally profitable for the thousands who have rushed into this overcrowded field. Some sound trucks use pitifully inadequate B-battery installations, a few overworked automobile-type tubes, and the eqiupment is operated by men who had no previous experience in advertising or showmanship. Showmanship is essential for profits. Barnum proved it years ago. A sound truck, in reality, is a miniature show on wheels. An ex-vaudeville performer, comedian or patter-artist, if he can be obtained, is the best insurance for profits. The announcer must have wit, be a fast thinker and understand human nature, if the sound truck business is to be made profitable for its owner.

When a sound truck moves along a busy street it is imperative that "flash" announcements reach the ears of the crowd, that the advertising message has punch and appeal. In many cities it is unlawful for the operator of a sound truck to make announcements unless the truck is in motion. Also, a permit must first be secured from the city "fathers", and a respectable fee in cash paid for the permit. (Which helps buy food for the "fathers").

Care should be exercised when driving a sound truck through the streets of cities or towns other than those in which the truck normally operates. Some towns have ordinances which are rigidly enforced by the "long arm of the law". Others forbid sound truck operations entirely. It is always wise to first drive to police headquarters, with the sound equipment, and determine whether or not it is permissible to use it. A friendly call on the "city's finest" may often save much embarrassment.

The financial return from the average sound truck is not large enough to excite the frenzy of a bloated bondholder. Sound trucks were a distinct novelty when first introduced but, like most things, the novelty soon wears off. To attract attention in these times it almost becomes necessary to set fire to the truck before passerby will stop and take notice.

How about the financial return? You don't see the sound truck operator strolling the avenue after working hours, cane in hand and silk-topper for a skypiece. Why? The answer is obvious. The poor fellow usually works day and night to pay his operating expenses.

It must be remembered that advertising business for a sound truck is transient. The owner of the truck must have a wide acquaintance among business men in his community. For an average day's work the truck operator receives from $15.00 to $30.00, the latter figure being the exception, rather than the rule. Statistics show that the average sound truck "works" from five to ten days per month. However, an aggressive sound truck operator can find enough work to make the venture do more than break even if he is alert and keeps in close touch with all local doings, such as theatre performances, election campaigns, public meetings and other events that draw crowds and flies.—C.M.B.

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Two Wrongs Do Not Make a Right

SEVERAL enterprising men have solicited the services of engineers in the construction of portable ultra-short-wave transmitters to disseminate illegal information. In California it is unlawful to gamble on greyhound racing events, and a subterfuge, the "option" system was adopted. Operators of greyhound race tracks do everything within their power to prevent the results of races from reaching the public not in actual attendance at the track, so that outside gambling and bookmaking can be discouraged and a larger attendance assured at the track, bringing greater revenue into the pockets of the promoters.

Bookmakers rely upon immediate returns of races for the successful conduct of "business". The tracks make it their business to see that the bookmaker does not get these returns until they are published in the morning papers.

Radio amateurs have been approached by bookmakers with somewhat flattering offers for the receipt of race returns, direct from the track by radio. $40.00 per night was the offer of one bookmaker. It is definitely known that radio amateurs are playing no part in the transmission of unlawful information and that such returns which nightly reach the bookmakers, in spite of all attempts of the track promoters to "plug the leak", are coming from other sources, such as dot-and-dash signals from a pocket flashlight, operated by a "plant" on the track, and intercepted by someone on the outside who, in turn, telephones the information to the bookmakers. For this service the flashlight operator and his associates receive, in all, $25.00 per night.

For several nights a rigid investigation was made to determine if results were being transmitted from the track by a concealed portable radio transmitter. Sleuths were busily engaged in tuning over the entire short-wave spectrum, but no signals were heard. Still the returns continue to reach the bookmakers nightly, as the races are run, and the amateur is blamed once more for something that he knows nothing about. Why is it that the amateur should always be made the goat?

—A.R.G.

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Scratchi Got Trouble

Osockme, Japan,
Aug. 2, 1933.

Honorable Editor, RADIO,
Honorable Sire:

For 10 years you no hear from Scratchi. I read much from your pages from varigrated insulting radio enginners who say Ax cut crystal much better than Y cut. If Ax cut crystal better than Y cut, then why cut, and if so should I cut some more? Please do not misunderstand. Ax cut crystal drift less than Y cut, able writer say. But drift problem no problem here in Japan because wind do not blow so strong. More confusion arise instantly. Your magazine say buy Piezo crystal. I no find such word in Hon. Webster's book. Closest I find from Piezo is Pea Soup. I send male-order to gippie house ask for total shield ax cut pea soup crystal. When male-order gippe get my letter in which ask for total shield all around pea soup crystal he send me large tin can from which come quote from label on can: "Campbell's Pea Soup". My wife she see package and gleefully exclaim "We Eat". Scratchi furious. I say, "**WE SHOOT!**"

Now cannot use crystal exsmither. Must continue delight in listen in. Connect up receiving set and hear only crack, crash, bang! Tune some more. Unsuccessful success. Hear only same thing. I write my brother who is atmospheric inspector in Siberia and ask him what mean all this crack, crash, bang! He write back and say "That is something which come free with every radio set, whether make yourself or buy. That is static". In great disgust I think I go crazy, and hope you are the same.

Your esteemed reader,
SCRATCHI.

(Editor's Note: Scratchi has promised to write us a letter every month. Look for it in each issue).

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THE National Association of Broadcasters presented to the Recovery Administration a code for the control of themselves and all the rest of the broadcasters. The NAB controls 253 of the 600 odd broadcast stations in the United States. It provided that no station give any "free time" but adhere rigidly to a certain rate card specifying conditions under which all stations must sell time. It provided a 40 hour week for technical staffs. It set wages at $20 a week for operators, control men, announcers and program production employees. All others would receive a minimum of $15 a week in cities of more than 500,000, with graduated reductions down to a minimum of $12 a week in towns of lesser population.

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The A B C of Modulation

Part I of this Series was published in the August issue. . .

By MAURICE J. FLYNN

PART II

PLATE MODULATION

PLATE modulation, more commonly known as Heising Constant-Current Modulation, but better described as Variable-Voltage Modulation, uses the output voltage of an audio-frequency power amplifier to modulate the d.c. plate input voltage of a radio-frequency amplifier whose power output varies in proportion to its plate power input. If the modulated amplifier stage is operated as a Class C amplifier (described in last issue), the power output of this r.f. amplifier, and hence the antenna current, varies as the square of the input plate voltage. If this input plate voltage is then modulated by applying the audio frequency output voltages of a power amplifier to it, the power output and antenna current of the r.f. amplifier can be varied by means of audio frequency variations.

Now let us see how this can be accomplished in practice. Let us suppose, as in Figure A, we have a microphone feeding into a volume control followed by a speech amplifier that is designed to work into a loud speaker of 8000 ohms impedance. This is, in fact, a small public address system. If the loud speakers are connected and in their place an 8000 ohm resistance is used, we still have the same electrical circuit. Instead of dissipating the energy developed by the speech amplifier by means of loud speakers, we are using this energy in heating a resistance unit, as in Fig. 3. Instead of wasting this energy in heating a resistance, it can be made to serve a useful purpose, such as generating a modulating voltage. Suppose that instead of connecting the output of the speech amplifier to a resistance it is connected to the plate circuit of a Class C amplifier of 8000 ohms load impedance, as in Fig. C. The electrical constants of the output circuit of the speech amplifier have remained the same when it is furnishing power to a loudspeaker, to a resistor, or as a modulator, to the plate circuit of a Class C radio frequency amplifier.

The important point to observe is that the output of the speech amplifier and modulator tube must be matched in impedance to its load; in the case of a modulation system the load is the resistance of the plate circuit of the modulated amplifier. The output resistance of the modulator tube can be coupled to the modulated amplifier either by impedance-coupled circuits or by transformer coupling. In impedance-coupling the output resistance of the modulator tube must equal the plate resistance of the modulated amplifier. This is because the coupling inductance is designed to have high impedance to audio frequency, so that it will not place any load on the modulator and thus allow the full power developed by the modulator tube to be transferred without appreciable loss to the modulated amplifier, as shown in Figure D. If, however, the output resistance of the modulator differs from the plate resistance of the Class C amplifier which it is modulating, then it becomes necessary to use transformer coupling that will match the load impedance of the modulator tube to the plate resistance of the modulated amplifier, as shown in Figure E. With the method of matching impedances clearly understood, let us now design our modulation system "on paper."

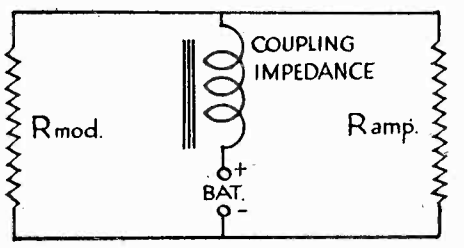


Fig. D. Equivalent Circuit of Heising Modulation.

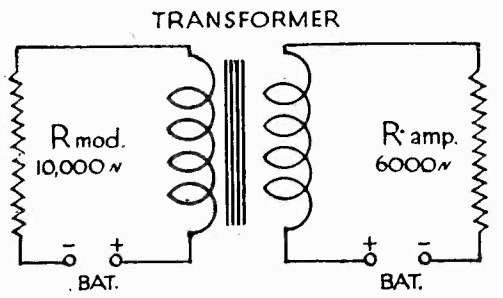
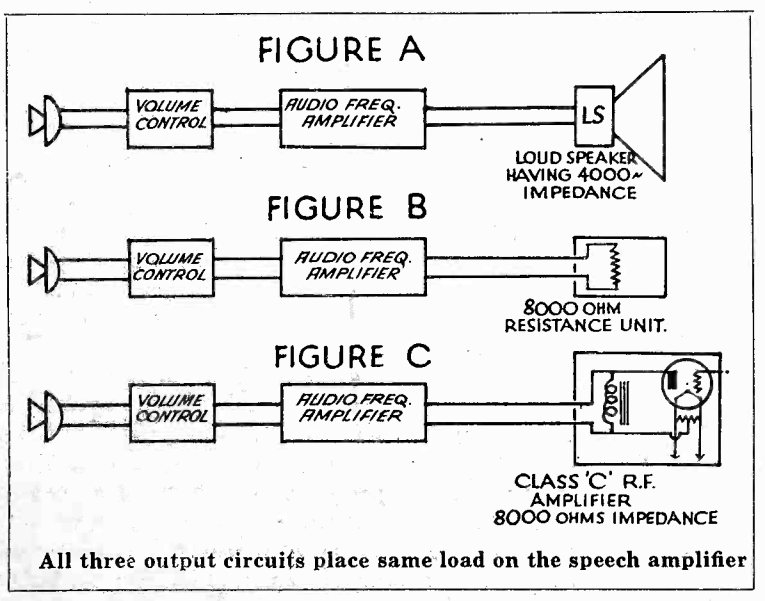


Fig. E. Equivalent Circuit of Variable Voltage Modulation.

Suppose one has a 210 tube that he wants to modulate with a UV-845. The problem that presents itself is to determine the proper load impedance for the modulator tube, UV-845, and then select the proper Class C operating conditions for the 210 tube, as a modulated amplifier, so that the plate resistance of the 210 tube will match the output load impedance required for the UV-845. The proper operating conditions for any type of audio power amplifier tube or modulator tube can be determined by studying the graph of the plate-voltage plate-current chaarcteristics of the tube. The procedure is the same as that for determining the optimum plate load for the greatest undistorted power output of the audio output stage of our B.C.L. set at home.

To explain a phenomenon by means of examples is poor policy. I am afraid we will have to give you that impression. To discuss modulation in terms of theory would only bore you and would help but little, if any, in explaining the methods used in securing high-class modulation. So we will explain by means of an example. Consider the plate-voltage plate-current characteristic curves of the UV-849 modulator tube in Figure F. These curves are made by applying a fixed grid bias to the tube and by varying the plate voltage, taking note of the plate cur-



All three output circuits place same load on the speech amplifier

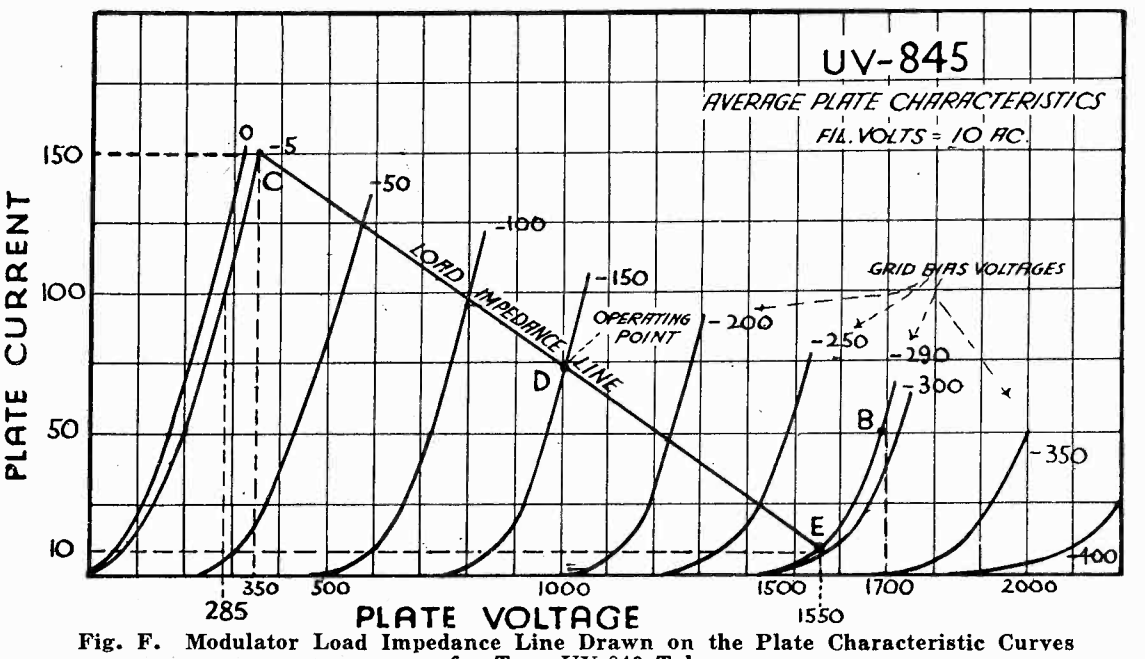


Fig. F. Modulator Load Impedance Line Drawn on the Plate Characteristic Curves of a Type UV-849 Tube.

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rent at each setting of plate voltage. These readings are then plotted on graph paper, giving one characteristic curve. Then this process is repeated by using a different grid bias voltage and another curve is made. For the UV-845 tube, grid biases of 0, —50, —100, —150, —200, —250, —300, —350 and —400 were used. Having secured the characteristic curves for the modulator tube we are to use, we can continue.

Consulting the table of operating characteristics of the UV-845 (Table I) we learn that the recommended plate voltage is 1000 volts, while the maximum plate dissipation is 75 watts. Computing by means of Ohm's Law, $I = E/R$, we have the operating conditions of: plate voltage 1000, and plate current 75 milliamperes. Now locate this point on the graph. It is found that the proper grid bias for these conditions is —150 volts. When a tube is operated with a.c. filament supply (as in most all amateur stations), the exciting voltage impressed on the grid of the tube must have a maximum value less than the bias voltage by one-half of the a.c. filament voltage. Thus, for the UV-845, the excitation voltage on the grid should not exceed 145 volts, hence the grid swing is from —5 volts (—150+145 volts) to —295 volts (—150—145 volts). For distortionless operation, the grid swing must not exceed this value, otherwise the grid of the modulator would be positive with respect to the filament during part of the cycle, and the fidelity would suffer due to the effects of grid rectification. Having determined the limits of the grid swing, we then determine, in the aforementioned manner, the static characteristic plate curves for the limiting grid voltages, —5 and —295 volts. These are also plotted on the previous graph. Let us assume that we are going to operate the modulated radio frequency amplifier with 600 volts on its plate. To completely modulate this amplifier, the modulator tube must vary this 600 volts from zero to twice its normal value, or from 0 to 1200 volts. Therefore, the output voltage of the modulator tube must be 1200 volts for 100 per cent modulation. Returning to our completed graph, and with the aid of a straight-edge, take the operating point (1000 volts, 75 milliamperes) as one point. Select a second point somewhere on the —5 grid bias curve. Placing the straight-edge on both the first and second points, mark a third point so that it is in a straight line with the first two, and lying on the —290 volt grid bias curve. Then, from the second and third points, which we will call **A** and **B** respectively, draw lines perpendicular to the horizontal plate voltage axis. It will be seen that these lines intercept the plate voltage scale at 285 volts and 1700 volts, respectively. This is a difference of 1415 volts, or 215 volts in excess of the 1200 volts required for 100 per cent modulation. We must try two more sets of points on the —5 volt and —295 volt curves, until two points are found that have pendiculars intercepting the plate voltage scale at the required distance of 1200 volts. Points **C** and **E** fulfill these requirements. Having found the determining points, we can draw the straight line through the three points, C, D, and E, and we have what is known as the **load line.** It is this line that determines the output load resistance requirements. It also determines how we shall operate our Class C modulated amplifier and it determines the amount of distortion from the modulator tube. Furthermore, it is the line that also determines the dynamic characteristic of the tube while in operation. Extreme care should, therefore, be given to the location of this line, because the calculations that have yet to come depend entirely on the limits of this **load line.**

To determine the load resistance for the tube to be used, we apply the following formula:

$$R_L = \frac{E_{max.} - E_{min.}}{I_{max.} - I_{min.}}$$

where R_L is the load resistance in ohms.
$E_{max.}$ is the greatest voltage on the load line.
$E_{min.}$ is the lowest voltage on the load line.
$I_{max.}$ is the greatest current on the load line.
and $I_{min.}$ is the lowest current on the load line.

In the case of the UV-845, referring to the table, we have:

$E_{max.}$ is 1550 volts; $E_{min.}$ is 350 volts.

$I_{max.}$ is 150 milliamperes, and $I_{min.}$ is 10 milliamperes.

Substituting in the formula we have:

$$R_L = \frac{1550 - 350}{.15 - .01} = \frac{1200}{.14} = 8{,}575 \text{ ohms.}$$

Thus, in order to match the output impedance of the modulator tube, we must operate the modulated amplifier so that its plate resistance is approximately 8,575 ohms.

Now to complete our calculations. When a modulated amplifier is 100 per cent modulated, the power output of the stage increases by 50 per cent. Likewise, the antenna current will rise to 150 per cent of its normal unmodulated value. This rise is indicated by the current-squared galvanometer used in the antenna feeders to indicate current, when it increases 22.5 per cent above its normal value. Now this increase in power must be coming from somewhere, and since it is caused by modulating the radio frequency amplifier the power must be coming from the modulator tube. So, in order to modulate a radio wave 100 per cent, the modulator must (1) develop across its output load a modulating voltage, whose peak is equal to the plate voltage of the modulated amplifier and (2) it must develop a power output of practically undistorted audio power output equal to 50 per cent of the modulated amplifier's steady d.c. power input. In other words, if the modulator develops 10 watts of undistorted audio power, then the maximum allowable d.c. power input to the plate of the modulated amplifier, if 100 per cent modulation is to be attained, is 20 watts.

To compute the power output of the modulator tube, Kellogg* gives us the formula:

$$P.O. = \frac{(E_{max.} - E_{min.})\ (I_{max.} - I_{min.})}{8}$$

Using the values for the UV-845 tube, we have:

$$P.O. = \frac{(1550 - 350)\ (.15 - .01)}{8} = 21 \text{ watts.}$$

Also from Kellogg we get the formula for determining the percentage of distortion. The allowable distortion is 5 per cent, because the average human ear cannot detect less than 5 per cent distortion. The formula:

$$\text{Distortion} = \frac{\frac{1}{2}(I_{max.} - I_{min.}) - I_{normal}}{(I_{max.} - I_{min.})}$$

$$\text{UV845 Distortion} = \frac{\frac{1}{2}(.150 + .01) - .075}{.14}$$

$$= \frac{.005}{.14} = 3.5\%$$

If the distortion should be above 5 per cent, the load resistance must be increased, and a new dynamic characteristic load line derived which will be within the allowable limit. The allowable plate voltage to the modulated amplifier must be reduced if 100 per cent modulation is still to be attained. In all events the carrier output of the modulated stage will be reduced.

So far we have determined that the modulator tube operates with 1000 volts on the plate and draws 75 milliamperes with a —150 volts grid bias. It requires a 145 volt signal impressed on its grid circuit to operate to capacity, and requires a load resistance of 8,575 ohms to develop 21 watts of audio power having but 3½ per cent distortion. The modulated amplifier must have a d.c. plate resistance of 8,575 ohms to match the required modulator load impedance. If 600 volts is to be used on the plate, then by applying Ohm's Law we find that 600 volts/8,575 ohms gives 70 milliamperes. As a final check we must be sure that the modulator can supply undistorted audio power equal to one-half the d.c. input power to the plate of the modulated amplifier. Six hundred volts times .07 amperes gives 42 watts input to the Class C amplifier. As calculated above, the modulator is capable of delivering 21 watts of audio power, or exactly 50 per cent of 42 watts, which is satisfactory. It is preferable to have the modulator tube deliver more than the 50 per cent required, but it should never deliver less than 50 per cent if the transmitter is to be capable of 100 per cent modulation.

The Class C amplifier tube to use with

TABLE I

Radiotron UV-845

TECHNICAL DATA SHEET

Modulator

Maximum Operating DC Plate Voltage	1250 Volts
Recommended Operating DC Plate Voltage	1000 Volts
Maximum Plate Dissipation	75 Watts
Amplification Factor	5
Plate Resistance (AC)	1800 Ohms
Grid Plate Transconductance	3000 Micromhos

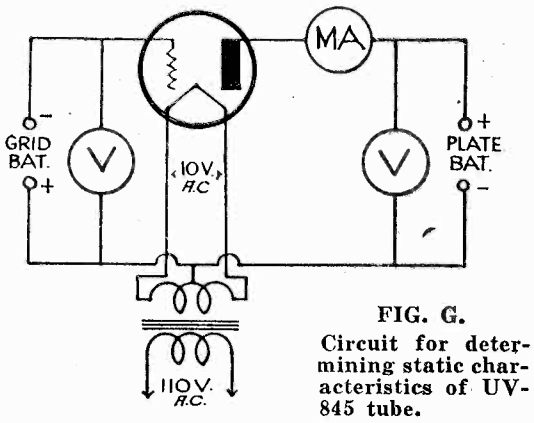

FIG. G.
Circuit for determining static characteristics of UV-845 tube.

(This same circuit can be used with any tube, provided proper filament voltage is used).

* "Design of Non-distorting Power Amplifiers," Jour. A.I.E.E., Vol. 44, pp. 302-315.

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TABLE II

Satisfactory Modulator-Amplifier Combinations

MODULATOR									AMPLIFIER								
Tube Type	Plate Dissipation in Watts	DC Plate Voltage in MA.	DC Plate Current in MA.	Neg. Grid Bias in Volts	Max. Grid Swing	Load Impedance in Ohms	Power Output in Watts	% Harmonic Distortion	Type Tube	Plate Dissipation in Watts	Plate Volts	Plate Current in MA.	Dropping Resistor in Ohms	Neg. Grid Bias	Carrier Output Approx.	% Modulation	Peak Carrier Output (approx.)
UV-845	75	1000	75	—150	145	8,575	21	3.5	03A	42	600	70	5555	—65	29	100	116
									11	42	600	70	5555	—120	29	100	116
									10	42	600	70	5555	—180	29	100	116
									10's * in P-P	42	600	35 per tube	5555	—180	29	100	116
WE-284A	75	1250	60	—228	223	10,000	41.5	5.1	03A	83	900	91	3735	—90	58	100	232
									11	83	900	91	3735	—180	58	100	232
									WE-276A	83	900	91	3735	—170	58	100	232
									WE-242A	83	900	91	3735	—160	58	100	232
WE-284A	85	1000	85	—165	160	16,000	29.5	6.3	10's in P-P	59	600	99 (49.5 per tube)	4040	—180	42	100	168

* Recommended As Best Combination.

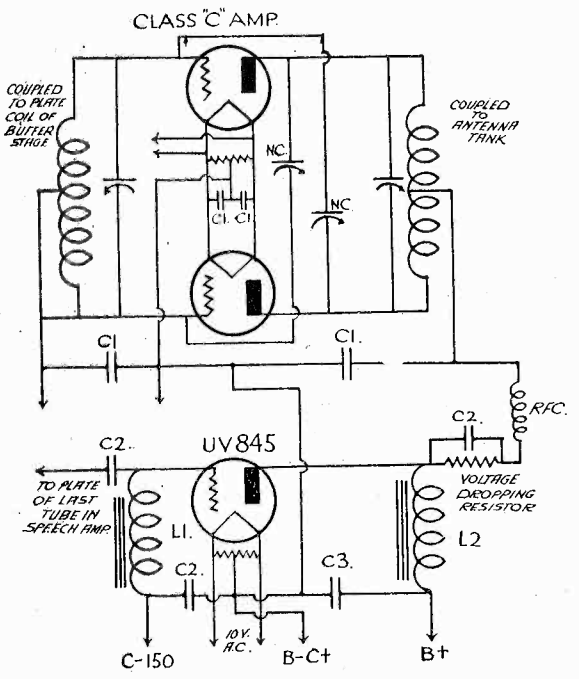

FIG. H.
C1—.002 mfd. Mica Condenser.
C2—2 mfd. 600 volt Condenser.
C3—2 mfd. 1500 volt Condenser.
L1—Grid Coupling Impedance.
L2—Modulation Chokes. Approx. 50 H.

the modulation system just designed is immaterial, except that operating as a Class C amplifier with 600 volts on the plate, it must draw 70 milliamperes steady d.c. input to its plate circuit, no more nor no less. To fulfill

(Continued on Page 20)

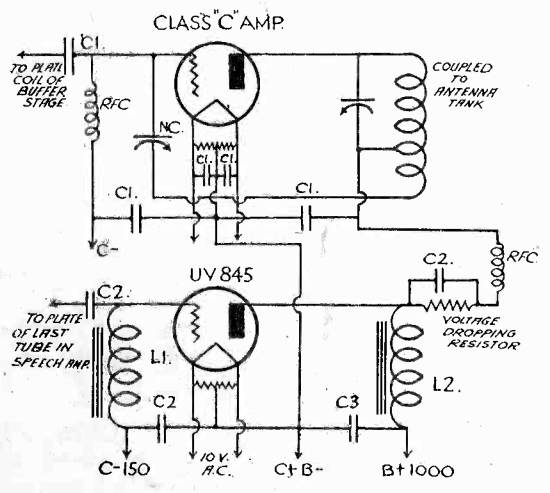

FIG. I.
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C2—2 mfd. 600 volt Condenser.
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Table III—Radiotron RCA-2A3—Technical Data Sheet

TECHNICAL DATA SHEET

General

Filament Voltage (AC or DC)	2.5 Volts
Filament Current	2.5 Amperes
Grid-Plate Capacitance	13 Mmfd.
Grid-Filament Capacitance	9 Mmfd.
Plate-Filament Capacitance	4 Mmfd.
Maximum Overall Length	5⅜ Inches
Maximum Diameter	2-1/16 Inches
Bulb	ST-16
Base	Medium 4-Pin

As a Single-Tube Amplifier (Class A)

Filament Voltage (AC)	2.5 Volts
Plate Voltage	250 max. Volts
Grid Voltage	—45 Volts
Plate Current	60 Milliamperes
Plate Resistance	765 Ohms
Amplification Factor	4.2
Mutual Conductance	5500 Micromhos
Load Resistance	2500 Ohms
Undistorted Power Output	3.5 Watts

As a Push-Pull Amplifier (Class A)—Two Tubes

	Fixed Bias	Self Bias	
Plate Voltage	300 max.	300 max.	Volts
Grid Voltage	—62	—62	Volts
Plate Current (Per Tube)	40	40	Milliamperes
Load Resistance (Plate-to-Plate)	3000	5000	Ohms
Total Percent Harmonic Distortion	2.5	5	
Power Output	15	10	Watts

Table IV—Satisfactory-Push-Pull Modulator-Amplifier Combinations

Modulators				
Tubes	2A3 in P-P Class A		59's in P-P Class B	
Plate Voltage	300		400	
Plate Current (per tube)	40ma.		200 max. ma. 13 min. ma.	
Load Resistance (Plate-to-plate)	3000 ohms		6,000 ohms	
Power Output	15 watts		20 watts	
% Harmonic Distortion	2½%		5.2%	
Grid Bias. Volts	—62 volts		0 bias.	
Class 'C' Amplifiers				
Tubes	46 P-P	Single 210	59 P-P	Single 210
Plate Voltage	400	600	400	600
Plate Current (per tube)	37.5 ma.	50 ma.	50 ma.	67 ma.
Plate Dissipation (per tube)	15 watts	30 watts	20 watts	40 watts
Neg. Grid Bias	—45 volts	—180 volts	—45 volts	—180 volts
Carrier Output approx. watts	21 watts	20 watts	28 watts	28 watts
% Modulation	100 %	100 %	100 %	100 %
Plate Impedance	5,335 ohms	12,000 ohms	4,000 ohms	9,000 ohms

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The ABC of Modulation

(Continued from Page 19)

this requirement a number of circuit arrangements are satisfactory. One may use a 203A or 211 tube, or preferably one should use a pair of 210's in push-pull (especially if this Class C stage is the final stage in the transmitter). A good, well-seasoned 210 may be used by itself, provided extreme care is taken in making the plate circuit tuning of the 210 tube as low-C as possible. In Table II is given the data determined thus far, and a number of workable circuit constants that will perform satisfactorily with the UV-845 modulator tube. Figures H and I are circuit diagrams showing how a single modulator tube, such as the UV-845, is coupled to a single-ended or push-pull Class C amplifier.

A word about the value of voltage dropping resistors. If the modulator tube is working with 1000 volts plate, and it is desired to drop the voltage to 600 with a 70 milliampere drain, we need only apply Ohm's Law: R = E/I = differences in voltage divided by the current = 400 volts/.07 amperes = 5555 ohms. It will be seen from Table II that for one set of Modulator operating conditions all circuit constants are the same, regardless of the tube used in the Class C amplifier, except for the grid bias applied to this latter tube. All other constants, such as modulator plate voltage and plate current, Maximum Grid Swing, dropping resistor value, Class C amplifier plate volts and plate current are the same, no matter what tube is used in the Class C amplifier.

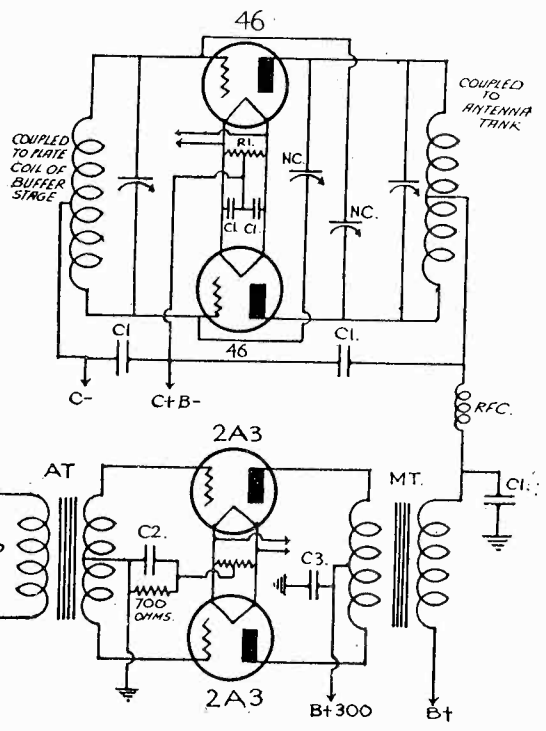


FIG. J.

Circuit for Amateur Phone Transmitter using push-pull 2A3 modulator tubes. C1—.002 mfd. Mica Condenser; C2—2 mfd. 100 volt Condenser; C3—2 mfd. 600 volt Condenser; AT—Audio Coupling Transformer; MT—Modulation Transformer.

With the advent of Class B audio modulation, transformer-coupling has gained prominence. It is more simple to design and construct, does not require the direct matching of impedances, as does the impedance-coupled system, and allows the use of push-pull modulator circuits with the advantage of a lower distortion level, better fidelity characteristics, etc. The author has experimented with a low-power push-pull modulator system that has given surprising results. It uses a pair of the newly-released 2A3 tubes as modulators and utilizes transformer coupling between the modulators and the Class C amplifier.

In using transformer coupling between the modulator and the modulated amplifier we are at liberty, therefore, to use any desired impedances and match them by means of designing the coupling transformer accordingly, as explained in Figure E. First study Table III in which is given the Operating Characteristics of the RCA-2A3 tube. You will see that it is rated to give 15 watts of audio power, with which we can 100 per cent modulate an input of 30 watts to the Class C amplifier. It is also seen that the required impedance for the plate circuits of the modulators is 3000 ohms from plate to plate, which means that the coupling transformer must have a center-tapped primary winding with 1500 ohms impedance on each side of centertap. Now let us consider the secondary circuit. Suppose we wish to modulate a pair of '46 tubes in a push-pull modulated amplifier. The working plate voltage will be 400 volts, which means a plate current for both tubes of 75 milliamperes, or 37.5 milliamperes per tube. Applying Ohm's Law, we have a characteristic plate resistance of 5,335 ohms; therefore the secondary of the coupling transformer should have an output impedance of 5,335 ohms. Thus our modulation is complete. One can readily appreciate the simplicity of design of a transformer coupled modulation system, compared with the many calculations involved in the design of the impedance-coupled system.

If it is desired to modulate a 210 Class C amplifier with the push-pull 2A3 modulator system, the modulated amplifier should operate on 600 volts for good efficiency. We find that for 30 watts input the tube must draw 50 milliamperes. By applying Ohm's Law (R = E/I) the characteristic plate circuit resistance is 12,000 ohms; thus the secondary of the coupling transformer should have an output impedance of 12,000 ohms. In Table IV will be found a group of operating characteristics that have been designed for use with push-pull, Class A, 2A3 modulators. Many other combinations may be designed by using other combinations of modulator tubes and Class C amplifiers. It is merely necessary to follow the above procedure, using the proper constants for the tubes you desire to use.

● NOTE: *In his next article Mr. Flynn will discuss other methods of modulation.—Editor*

●●●

Funny Or Phoney?

By CLAIR FOSTER, W6HM

LAMP this one, Fellows, and see what you make of it.

On the letterhead of a large corporation that has had close business relations with commercial radio I received two weeks ago a communication asking me to transmit a message to the Philippines. The message was purely of a business nature and apparently emanated not from an individual but from the corporation itself. It was such a message as would ordinarily have been sent, (especially by such a large corporation), by commercial means.

The letter contained 5 ten-cent stamps which the writer said were enclosed "to cover the necessary charges." It closed with, "Will you also please give us a confirmation of the transmission of this message?"

If that isn't a trap laid by commercial people to catch a ham breaking the law I'll eat my hat! My conviction may be wrong, but I see in the communication too many confirming circumstances to regard them as mere coincidences.

In the first place, why should a man holding an administrative office in a corporation that undoubtedly does a large business with commercial communications companies ask an amateur to transmit a message? And why should he address me not by name but as "Amateur Radio Station W6HM"? And why should he enclose 5 ten-cent stamps that he knows an amateur would have no use for until exchanged for stamps of the usual denomination; especially as he must have had a drawerful of 3 cent stamps at his elbow? And why should he say, "to cover the necessary charges", when he probably knows that amateurs make no charges? And why should

(Continued on Page 37)

The 1A6 For Amateur Supers

By the Engineering Division, RCA-Radiotron Co.

THE 1A6 may be used as a superheterodyne frequency converter at any frequency at which it can be made to oscillate. The advantages which this tube has at broadcast frequencies are retained at higher frequencies. In particular, the simplicity of the circuits required should appeal to the constructor of an amateur receiver.

The circuit and coil data given below is intended to serve as a guide in the design of such a receiver. Extreme precision is not claimed for the coil data; this is next to impossible in the case of the higher frequency coils unless location of parts, shielding, etc., is specified. However, the coils will have approximately the correct inductance for the bands mentioned, and their construction is such that adjustment should not be difficult. Wind a few extra turns on the coils—it is usually less difficult to remove turns than to add them.

Tracking of the oscillator and R.F. circuits is obtained without the use of a series condenser. The condenser C4 shown in parallel with the oscillator coil provides for the necessary contraction of the oscillator frequency range. The values required are given on the diagram. This condenser may be attached to the coil form in a plug-in coil assembly.

Circuit Design Data For the 1A6 Tube

Voltages: Ef 2.0v. Ec2 100v. Ec3, 5 67.5v. Ec4 —3 to —22v. Eb 180v.

T—I.F. Transformer, 450 KC.

C1, C1—Tuning Condensers. Range 5 to 35 mmfd.

C2, C2—Trimmer Condensers. 3 to 10 mmfd.

C3, C3—40 mmfd.

C, C—By-pass Condensers, .05 mfd.

C5—Grid Condenser. 50 mmfd.

R—Grid Resistor. 50,000 ohms.

L1, L2, L3, L4, C4—See Table below.

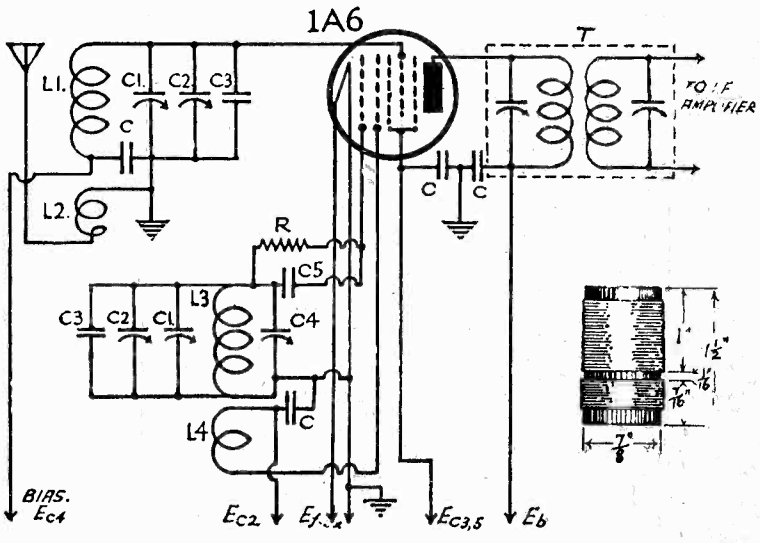
COIL DATA:

Form Diameter 7/8".

Wire, #30 Enameled, wound close. (90 turns per inch).

Spacing between windings, 1/16".

The table gives the number of turns for L1, L2, L3, L4 and the value of C4 in mmfd. for the amateur bands covered. Coils are wound in the same direction and are connected as shown in the circuit diagram.



Band	L1	L2	L3	L4	C4
1.75mc.	74	15	46	20	20
3.5 mc.	28	10	26	15	10
7 mc.	12	5	11	10	6
14 mc.	4.8	3	4.3	6	3

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EDITOR'S NOTE—

● "The Intercept Watch" will be a regular feature of "RADIO". Written by an old timer, it will contain timely commentaries on the art of amateur radio, a bit of criticism now and then, an occasional burst of exultation, perhaps—in short, a many-faceted sidelight on amateur radio today.

"The Interceptor" cut his eye teeth on a Ford spark coil, grew up to the tune of a Marconi rotary, has seen many a month of duty on the high seas, and at present is as devoted a pounder of the brass as ever, on the air almost nightly. We might list the calls he has held—there are a dozen or so—but that would be telling, and "The Interceptor" prefers to remain anonymous.

The Intercept Watch

By The Interceptor

"Sorry That You Are Leaving, and Sorry That You Came"

PROVOKED at what he considers one of the vulgarities of amateur radio, the Interceptor is in a combative mood. The difficulty, it happens, is the recollection of bygone unhappy visits from hams, recalled by a letter which the Interceptor has received from an old friend in a distant seaport town. A part of this letter reads:

What gets me mad around here as much as anything is the way I have to act as official entertainer for every ham who comes through S..... Ninety-eight per cent of them seem to have deeply imbedded in their souls (or what serves in place of a soul) the typical "brotherhood" spirit which gives any ham license to impose on any other ham to any extent whatever. No matter whether one has done any more than hook up a 201A and work across the street: if he has done this much he is a ham and this gives him *carte blanche* to fiddle with your receiver, finger your tools (and I have a pretty good collection of tools and don't relish anyone's monkeying with them), get you out of bed in the morning, and so on and on.

I'm feeling particularly touchy on this now, because for the last three days I've had to put up with a big lunkhead of a ham from T..... who came up on the Ss. S..... as junior operator and is waiting to take the Ss. A..... southbound today. Well, this big boob had seen me at the radio club meetings in T..... and when he ran onto me on the dock here his eye lit up with fraternal exuberance.

"Ah", he beamed in every way except vocally, "my week's stay in S..... will be relieved by all the hammish facilities."

Well, he hung on my neck for three days and I tried to make the best of it and consoled myself with the thought that he would be on his way soon, until the Ss. D..... came in and *she* had a ham on her, too. They both came down before I got up yesterday morning and I stalled them off while I dressed and was starting to get breakfast (the wife being away on a fortnight's vacation). Just as I was stirring the cake batter, they trooped in and this big gawking rube from T..... began to categorize the attractions of the place, telling how he could bother me and that I didn't have anything else to do anyway.

"Go ahead, J.....", he gurgled, "let's see you make some of those good hot cakes."

. . . .

If I hadn't been in this ham game for so long and learned that there is something really fine about it in spite of the riff-raff and tomfoolery over the air, these experiences would sour me in a short time. However, I am held continually enthralled by the magic of communication; when I go on the air and handle a bunch of worth-while messages with *good* operators, and other stations call me, asking me to do this and that for them or for their friends who have no other means of communication, I forget about the disappointments I have known in the past, and those that are in store for me in the future.

The letter from J..... voices a criticism long overdue. Amateur radio may be a fraternity but it is hardly "a great big family", in which one member can impose on the other and run off whooping, with his thumb to his nose.

Furthermore the Interceptor believes that, as a general rule, radio friendships should be restricted to the ether. One will have, of course, a few cronies over the air whom he knows and loves personally—but these are just the exceptions which prove the rule.

Among commercial operators—from whom, many times, amateurs can take valuable precepts—there is an esprit de corps which throttles this indiscriminate visiting. Unless two commercial operators have formed a considerable acquaintance over the air, you may be sure they will not go a-visiting each other. Life is a more serious business than a series of talkfests to them.

The Interceptor knows one ham—a person of considerable renown—who is forced to ignore most "local" calls over the air from around his state, just because answering them would encourage visitors to an extent that no time would be left for the pursuit of his own affairs. And he has, furthermore, a large circle of staunch ham friends whom he has to invite to his home, so conscious are they of his unfortunate position.

About such friends, and the delight they bring to one's hearthside, the Interceptor will have more to say in a future issue.

Bootleg

The Interceptor is in receipt of the following letter from a brother ham, K7AHK:

SO MUCH has been said of licensed amateur radio stations that it seems a word or two might be spoken for that oddity—the bootleg station. The writer has worked and personally met several of this variety of "ham", and, contrary to what might be supposed, has found all of them to be gentlemen of character, and even serving "public interest, convenience and/or necessity".

Probably first among the handful of calls he knows to be bootleg, would be BRJ, a little gas-engine-driven signal emanating in any of three bands from a windjamming cod fisherman—sailing we won't say where. BRJ has the all-season (and a season, for this cod fisherman, amounts to six months during which time the ship never touches shore) job of furnishing the crew of his vessel with news from home—at no cost.

It happened, in the case of BRJ that the skipper's wife, at home, had a near relative who was seriously injured in an industrial accident. His life was despaired of and he was lying in hospital alone in a distant town, out of communication with family and friends.

She, through a local amateur who was in communication daily with BRJ, apprised the skipper of the plight of the injured man. Next day a message was returned by amateur radio authorizing the wife to draw on her husband's pay at the company office to enable her to hasten to the bedside of the injured man. By the last word received, the latter was recovering, thanks to the timely aid through amateur radio.

Your commercial-radio enthusiast would argue that, legally, such practice is iniquitous; that the commercial facilities of the ship should have been used. Such argument is futile, however, since the tolls on messages sent in this case (all of which, the writer knows from personal knowledge, were necessary and pertinent) would have prevented any mere cod-fishing seaman—even be he a skipper—from indulging in what, these days, is the greatest luxury at sea: communication with shore.

As for a definition of "bootleg" operation, one must distinguish between bona-fide bootleg operation, and the stealing of calls. The bootlegger, more often, knows that by no interpretation of regulations can he be regularly licensed as an amateur station and, rather than deceive himself and his fellows, he invents a call of his own which per se advertises to the world that he is an outlaw. BRJ in amateur bands is one of these; likewise VZX4X, R5U, or B4UP. In almost the same category is the chap who "steals" his own call for operation on the high seas. The stealer of other people's calls, however, like the thief who steals the license plates off your car, puts you in jeopardy for any infractions of law he may chance to commit. It would be more accurate, perhaps, to call the bootleg operator "outlaw", and the stealer of calls "law-breaker".

"One never knows", the operator of R5U once told me, "how the other fellow will take his call, and his operation. Some are genuinely delighted, for there is a strange fascination to outlaw operation—the suggestion of adventure, and loneliness, and DX. Often—and this is particularly true of the West Coast—I have been invited to come around and get acquainted when I touch port."

I asked him if he ever divulged his whereabouts.

"Only in a general way," he said. "Such as 'northern Pacific ocean', or 'off the coast of China'. One fellow, when I refused to satisfy his curiosity as to just where I was situated, asked me if I were in jail!"

"As it was, had the operator asking that question known R5U as well as the writer does, he would not have been surprised with 'yes' for an answer. For R5U, in addition to blasting the ether up and down the Alaska coast aboard a government survey ship, once operated for several weeks from the shore of a lonely island in the north Pacific, using a lone 201A and B batteries.

When B4UP was in Seattle, aboard an intercoastal freighter, some of us went down to the harbor to see his layout, which was one of the cleverest arrangements for escaping the notice of inspectors that the writer ever has seen. In the wireless room of the ship there was a seat running athwartships along the after bulkhead, the top of the seat being a lid to a compartment for tools, spare parts and other gear. B4UP had contrived to bring his power, filament and keying leads invisibly into this compartment, where he had a neat little 210 transmitter reposing beneath some magazines. The antenna feed wire led through an insulator in the bulkhead and might have been mistaken for a receiving antenna lead.

It never was the writer's good fortune to meet the operator of VZX4X, a Britisher plying between southern California and the Orient aboard a tanker, but he has worked him and, later, corresponded with him. Like all other "outlaw" hams, VZX4X was confronted with the absolute impossibility of obtaining a license for amateur operation aboard ship. Being a true amateur, and knowing he would violate only the letter, and not the spirit, of the law, he picked him a distinctive call and went ahead. No one (to the writer's best knowledge) ever has found him, or any other bona-fide bootleg station, operating outside the amateur bands.

Probably there will be no alteration of regulations to permit licensing of such stations as BRJ, R5U, B4UP and VZX4X. There is no great demand for sea-going amateur stations; however, the demand now existing, small as it is, justifies some legal recognition of the "public interest, convenience and/or necessity" that might thereby be served.

In the meantime, in the absence of such legal recognition, in the words of one poet—

"Oh, how mad and bad and sad
It was—
But oh! how sweet!"

●●●

Plight of the Traffic-Handler

ABOUT the plight of the serious traffic-handling amateur station the Interceptor has, in the course of several years, developed a considerable concern. This plight—perhaps not visible at first to the casual onlooker—was described in a futile wail of one of the Interceptor's friends who used to handle traffic but gave it up as a thankless task.

"What does it get you" this friend sighed. "There's not a dime in it, and practically no thanks. I've taken scores of messages and relayed them, mailed them, telephoned them, delivered them in person—but nearly always people seem to be dumbfounded, and sometimes a little suspicious of me. And I had to sit there nearly every day, pounding the typewriter and pounding the key."

Such a cross to bear, for the traffic man in amateur radio. Probably it will be always thus, as long as amateur radio continues.

But the Interceptor's friend, quoted above, was missing the greatest point of all in this "thankless task". For the point is that amateur traffic-handling—by its nature one of the oddities of our times, when everybody expects to be charged so much in dollars and cents for every service—is going to be misunderstood by most people.

For this reason, sooner or later, every confirmed brass-pounding "knight of the message hook" comes to the realization that his task is a thankless one indeed, and he lets it go at that. But along with this somewhat painful philosophy is the added realization that his sacrifice is a blessed one; that, in the words of James Russell Lowell,

He gives only the worthless gold
Who gives from a sense of duty;
But he who gives but a slender mite,
And gives to that which is out of sight—

is of a different kind, well repaid by the consciousness of his own service to others.

This spirit was expressed so clearly in a letter the Interceptor received from another friend—an old brass-pounder in Alaska—that he is going to include it in the Watch. This friend said:

I feel that I am a part of the scheme. I feel, I *know* that on me and on my skill depend the happiness or disappointment of people hundreds of miles away. In imagination I can picture them waiting, expecting.

It is a remarkable stimulus and a remarkable task—and generally goes without thanks. For the people I serve are not often gifted with more than rustic courtesy. No doubt they are thankful in their hearts, but it may not occur to them that I have gone to considerable expense to build my station, that I have spent years acquiring the skill to run it, and that I am taking so many hours a day out of my time in order that they may have communication, albeit at my own pleasure and satisfaction.

This pleasure and satisfaction, of course, will not fill the pot with gravy. And I do not like to accept tips for handling messages. I do not, in fact, like to accept messages locally because here there are other means of communication while scores of others in outlying places have absolutely no other way of communicating except by monthly boat.

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The ABC of Modulation

(Continued from Page 19)

this requirement a number of circuit arrangements are satisfactory. One may use a 203A or 211 tube, or preferably one should use a pair of 210's in push-pull (especially if this Class C stage is the final stage in the transmitter). A good, well-seasoned 210 may be used by itself, provided extreme care is taken in making the plate circuit tuning of the 210 tube as low-C as possible. In Table II is given the data determined thus far, and a number of workable circuit constants that will perform satisfactorily with the UV-845 modulator tube. Figures H and I are circuit diagrams showing how a single modulator tube, such as the UV-845, is coupled to a single-ended or push-pull Class C amplifier.

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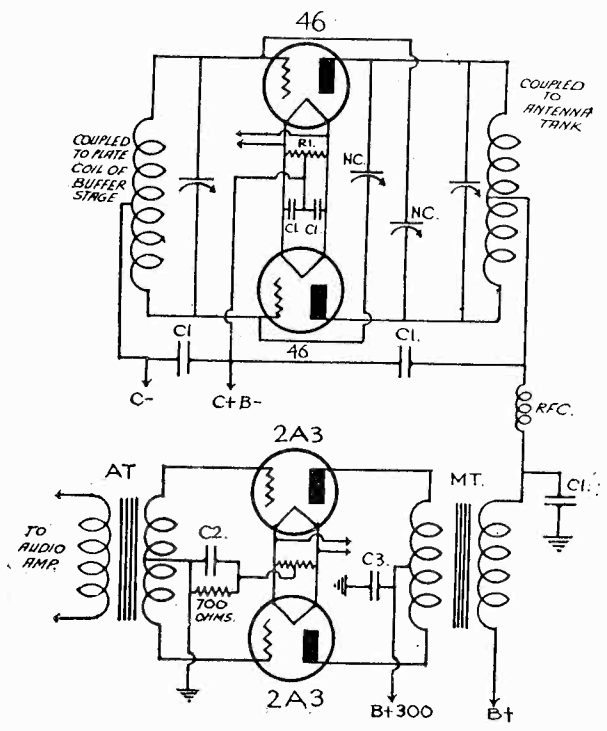

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If it is desired to modulate a 210 Class C amplifier with the push-pull 2A3 modulator system, the modulated amplifier should operate on 600 volts for good efficiency. We find that for 30 watts input the tube must draw 50 milliamperes. By applying Ohm's Law (R = E/I) the characteristic plate circuit resistance is 12,000 ohms; thus the secondary of the coupling transformer should have an output impedance of 12,000 ohms. In Table IV will be found a group of operating characteristics that have been designed for use with push-pull, Class A, 2A3 modulators. Many other combinations may be designed by using other combinations of modulator tubes and Class C amplifiers. It is merely necessary to follow the above procedure, using the proper constants for the tubes you desire to use.

● NOTE: *In his next article Mr. Flynn will discuss other methods of modulation.—Editor*

●●●

Funny Or Phoney?
By CLAIR FOSTER, W6HM

LAMP this one, Fellows, and see what you make of it.

On the letterhead of a large corporation that has had close business relations with commercial radio I received two weeks ago a communication asking me to transmit a message to the Philippines. The message was purely of a business nature and apparently emanated not from an individual but from the corporation itself. It was such a message as would ordinarily have been sent, (especially by such a large corporation), by commercial means.

The letter contained 5 ten-cent stamps which the writer said were enclosed "to cover the necessary charges." It closed with, "Will you also please give us a confirmation of the transmission of this message?"

If that isn't a trap laid by commercial people to catch a ham breaking the law I'll eat my hat! My conviction may be wrong, but I see in the communication too many confirming circumstances to regard them as mere coincidences.

In the first place, why should a man holding an administrative office in a corporation that undoubtedly does a large business with commercial communications companies ask an amateur to transmit a message? And why should he address me not by name but as "Amateur Radio Station W6HM"? And why should he enclose 5 ten-cent stamps that he knows an amateur would have no use for until exchanged for stamps of the usual denomination; especially as he must have had a drawerful of 3 cent stamps at his elbow? And why should he say, "to cover the necessary charges", when he probably knows that amateurs make no charges? And why should

(Continued on Page 37)

The 1A6 For Amateur Supers

By the Engineering Division, RCA-Radiotron Co.

THE 1A6 may be used as a superheterodyne frequency converter at any frequency at which it can be made to oscillate. The advantages which this tube has at broadcast frequencies are retained at higher frequencies. In particular, the simplicity of the circuits required should appeal to the constructor of an amateur receiver.

The circuit and coil data given below is intended to serve as a guide in the design of such a receiver. Extreme precision is not claimed for the coil data; this is next to impossible in the case of the higher frequency coils unless location of parts, shielding, etc., is specified. However, the coils will have approximately the correct inductance for the bands mentioned, and their construction is such that adjustment should not be difficult. Wind a few extra turns on the coils—it is usually less difficult to remove turns than to add them.

Tracking of the oscillator and R.F. circuits is obtained without the use of a series condenser. The condenser C4 shown in parallel with the oscillator coil provides for the necessary contraction of the oscillator frequency range. The values required are given on the diagram. This condenser may be attached to the coil form in a plug-in coil assembly.

Circuit Design Data For the 1A6 Tube

Voltages: Ef 2.0v. Ec2 100v. Ec3, 5 67.5v. Ec4 —3 to —22v. Eb 180v.

T—I.F. Transformer, 450 KC.

C1, C1—Tuning Condensers. Range 5 to 35 mmfd.

C2, C2—Trimmer Condensers. 3 to 10 mmfd.

C3, C3—40 mmfd.

C, C—By-pass Condensers, .05 mfd.

C5—Grid Condenser. 50 mmfd.

R—Grid Resistor. 50,000 ohms.

L1, L2, L3, L4, C4—See Table below.

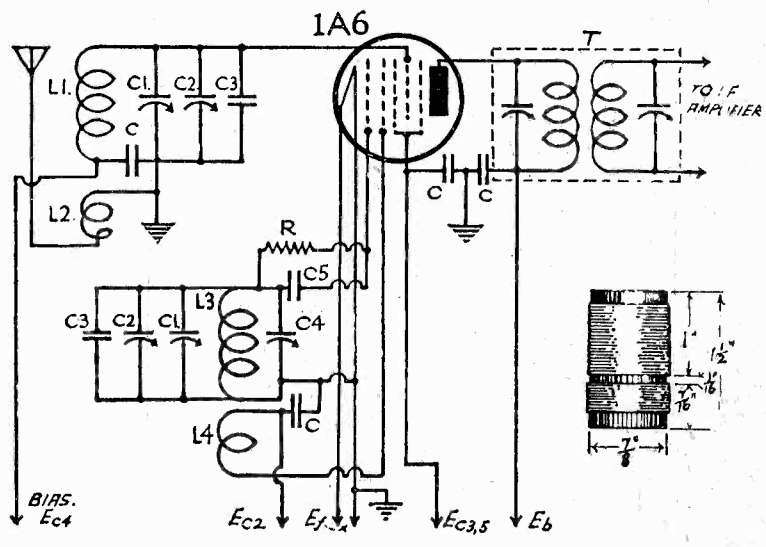
COIL DATA:

Form Diameter 7/8".

Wire, #30 Enameled, wound close. (90 turns per inch).

Spacing between windings, 1/16".

The table gives the number of turns for L1, L2, L3, L4 and the value of C4 in mmfd. for the amateur bands covered. Coils are wound in the same direction and are connected as shown in the circuit diagram.



Band	L1	L2	L3	L4	C4
1.75mc.	74	15	46	20	20
3.5 mc.	28	10	26	15	10
7 mc.	12	5	11	10	6
14 mc.	4.8	3	4.3	6	3

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EDITOR'S NOTE—

● "The Intercept Watch" will be a regular feature of "RADIO". Written by an old timer, it will contain timely commentaries on the art of amateur radio, a bit of criticism now and then, an occasional burst of exultation, perhaps—in short, a many-faceted sidelight on amateur radio today.

"The Interceptor" cut his eye teeth on a Ford spark coil, grew up to the tune of a Marconi rotary, has seen many a month of duty on the high seas, and at present is as devoted a pounder of the brass as ever, on the air almost nightly. We might list the calls he has held—there are a dozen or so—but that would be telling, and "The Interceptor" prefers to remain anonymous.

The Intercept Watch

By The Interceptor

"Sorry That You Are Leaving, and Sorry That You Came"

PROVOKED at what he considers one of the vulgarities of amateur radio, the Interceptor is in a combative mood. The difficulty, it happens, is the recollection of bygone unhappy visits from hams, recalled by a letter which the Interceptor has received from an old friend in a distant seaport town. A part of this letter reads:

What gets me mad around here as much as anything is the way I have to act as official entertainer for every ham who comes through S..... Ninety-eight per cent of them seem to have deeply imbedded in their souls (or what serves in place of a soul) the typical "brotherhood" spirit which gives any ham license to impose on any other ham to any extent whatever. No matter whether one has done any more than hook up a 201A and work across the street: if he has done this much he is a ham and this gives him *carte blanche* to fiddle with your receiver, finger your tools (and I have a pretty good collection of tools and don't relish anyone's monkeying with them), get you out of bed in the morning, and so on and on.

I'm feeling particularly touchy on this now, because for the last three days I've had to put up with a big lunkhead of a ham from T..... who came up on the Ss. S..... as junior operator and is waiting to take the Ss. A..... southbound today. Well, this big boob had seen me at the radio club meetings in T..... and when he ran onto me on the dock here his eye lit up with fraternal exuberance.

"Ah", he beamed in every way except vocally, "my week's stay in S..... will be relieved by all the hammish facilities."

Well, he hung on my neck for three days and I tried to make the best of it and consoled myself with the thought that he would be on his way soon, until the Ss. D..... came in and *she* had a ham on her, too. They both came down before I got up yesterday morning and I stalled them off while I dressed and was starting to get breakfast (the wife being away on a fortnight's vacation). Just as I was stirring the cake batter, they trooped in and this big gawking rube from T..... began to categorize the attractions of the place, telling how he could bother me and that I didn't have anything else to do anyway.

"Go ahead, J.....", he gurgled, "let's see you make some of those good hot cakes."

. . . .

If I hadn't been in this ham game for so long and learned that there is something really fine about it in spite of the riff-raff and tomfoolery over the air, these experiences would sour me in a short time. However, I am held continually enthralled by the magic of communication; when I go on the air and handle a bunch of worth-while messages with *good* operators, and other stations call me, asking me to do this and that for them or for their friends who have no other means of communication, I forget about the disappointments I have known in the past, and those that are in store for me in the future.

The letter from J..... voices a criticism long overdue. Amateur radio may be a fraternity but it is hardly "a great big family", in which one member can impose on the other and run off whooping, with his thumb to his nose.

Furthermore the Interceptor believes that, as a general rule, radio friendships should be restricted to the ether. One will have, of course, a few cronies over the air whom he knows and loves personally—but these are just the exceptions which prove the rule.

Among commercial operators—from whom, many times, amateurs can take valuable precepts—there is an **esprit de corps** which throttles this indiscriminate visiting. Unless two commercial operators have formed a considerable acquaintance over the air, you may be sure they will not go a-visiting each other. Life is a more serious business than a series of talkfests to them.

The Interceptor knows one ham—a person of considerable renown—who is forced to ignore most "local" calls over the air from around his state, just because answering them would encourage visitors to an extent that no time would be left for the pursuit of his own affairs. And he has, furthermore, a large circle of staunch ham friends whom he has to invite to his home, so conscious are they of his unfortunate position.

About such friends, and the delight they bring to one's hearthside, the Interceptor will have more to say in a future issue.

Bootleg

The Interceptor is in receipt of the following letter from a brother ham, K7AHK:

SO MUCH has been said of licensed amateur radio stations that it seems a word or two might be spoken for that oddity—the bootleg station. The writer has worked and personally met several of this variety of "ham", and, contrary to what might be supposed, has found all of them to be gentlemen of character, and even serving "public interest, convenience and/or necessity".

Probably first among the handful of calls he knows to be bootleg, would be BRJ, a little gas-engine-driven signal emanating in any of three bands from a windjamming cod fisherman—sailing we won't say where. BRJ has the all-season (and a season, for this cod fisherman, amounts to six months during which time the ship never touches shore) job of furnishing the crew of his vessel with news from home—at no cost.

It happened, in the case of BRJ that the skipper's wife, at home, had a near relative who was seriously injured in an industrial accident. His life was despaired of and he was lying in hospital alone in a distant town, out of communication with family and friends.

She, through a local amateur who was in communication daily with BRJ, apprised the skipper of the plight of the injured man. Next day a message was returned by amateur radio authorizing the wife to draw on her husband's pay at the company office to enable her to hasten to the bedside of the injured man. By the last word received, the latter was recovering, thanks to the timely aid through amateur radio.

Your commercial-radio enthusiast would argue that, legally, such practice is iniquitous; that the commercial facilities of the ship should have been used. Such argument is futile, however, since the tolls on messages sent in this case (all of which, the writer knows from personal knowledge, were necessary and pertinent) would have prevented any mere cod-fishing seaman—even be he a skipper—from indulging in what, these days, is the greatest luxury at sea: communication with shore.

As for a definition of "bootleg" operation, one must distinguish between bona-fide bootleg operation, and the stealing of calls. The bootlegger, more often, knows that by no interpretation of regulations can he be regularly licensed as an amateur station and, rather than deceive himself and his fellows, he invents a call of his own which per se advertises to the world that he is an outlaw. BRJ in amateur bands is one of these; likewise VZX4X, R5U, or B4UP. In almost the same category is the chap who "steals" his own call for operation on the high seas. The stealer of other people's calls, however, like the thief who steals the license plates off your car, puts you in jeopardy for any infractions of law he may chance to commit. It would be more accurate, perhaps, to call the bootleg operator "outlaw", and the stealer of calls "law-breaker".

"One never knows", the operator of R5U once told me, "how the other fellow will take his call, and his operation. Some are genuinely delighted, for there is a strange fascination to outlaw operation—the suggestion of adventure, and loneliness, and DX. Often—and this is particularly true of the West Coast—I have been invited to come around and get acquainted when I touch port."

I asked him if he ever divulged his whereabouts.

"Only in a general way," he said. "Such as 'northern Pacific ocean', or 'off the coast of China'. One fellow, when I refused to satisfy his curiosity as to just where I was situated, asked me if I were in jail!"

"As it was, had the operator asking that question known R5U as well as the writer does, he would not have been surprised with 'yes' for an answer. For R5U, in addition to blasting the ether up and down the Alaska coast aboard a government survey ship, once operated for several weeks from the shore of a lonely island in the north Pacific, using a lone 201A and B batteries.

When B4UP was in Seattle, aboard an intercoastal freighter, some of us went down to the harbor to see his layout, which was one of the cleverest arrangements for escaping the notice of inspectors that the writer ever has seen. In the wireless room of the ship there was a seat running athwartships along the after bulkhead, the top of the seat being a lid to a compartment for tools, spare parts and other gear. B4UP had contrived to bring his power, filament and keying leads invisibly into this compartment, where he had a neat little 210 transmitter reposing beneath some magazines. The antenna feed wire led through an insulator in the bulkhead and might have been mistaken for a receiving antenna lead.

It never was the writer's good fortune to meet the operator of VZX4X, a Britisher plying between southern California and the Orient aboard a tanker, but he has worked him and, later, corresponded with him. Like all other "outlaw" hams, VZX4X was confronted with the absolute impossibility of obtaining a license for amateur operation aboard ship. Being a true amateur, and knowing he would violate only the letter, and not the spirit, of the law, he picked him a distinctive call and went ahead. No one (to the writer's best knowledge) ever has found him, or any other bona-fide bootleg station, operating outside the amateur bands.

Probably there will be no alteration of regulations to permit licensing of such stations as BRJ, R5U, B4UP and VZX4X. There is no great demand for sea-going amateur stations; however, the demand now existing, small as it is, justifies some legal recognition of the "public interest, convenience and/or necessity" that might thereby be served.

In the meantime, in the absence of such legal recognition, in the words of one poet—

"Oh, how mad and bad and sad
It was—
But oh! how sweet!"

●●●

Plight of the Traffic-Handler

ABOUT the plight of the serious traffic-handling amateur station the Interceptor has, in the course of several years, developed a considerable concern. This plight—perhaps not visible at first to the casual onlooker—was described in a futile wail of one of the Interceptor's friends who used to handle traffic but gave it up as a thankless task.

"What does it get you" this friend sighed. "There's not a dime in it, and practically no thanks. I've taken scores of messages and relayed them, mailed them, telephoned them, delivered them in person—but nearly always people seem to be dumbfounded, and sometimes a little suspicious of me. And I had to sit there nearly every day, pounding the typewriter and pounding the key."

Such a cross to bear, for the traffic man in amateur radio. Probably it will be always thus, as long as amateur radio continues.

But the Interceptor's friend, quoted above, was missing the greatest point of all in this "thankless task". For the point is that amateur traffic-handling—by its nature one of the oddities of our times, when everybody expects to be charged so much in dollars and cents for every service—is going to be misunderstood by most people.

For this reason, sooner or later, every confirmed brass-pounding "knight of the message hook" comes to the realization that his task is a thankless one indeed, and he lets it go at that. But along with this somewhat painful philosophy is the added realization that his sacrifice is a blessed one; that, in the words of James Russell Lowell,

He gives only the worthless gold
Who gives from a sense of duty;
But he who gives but a slender mite,
And gives to that which is out of sight—

is of a different kind, well repaid by the consciousness of his own service to others.

This spirit was expressed so clearly in a letter the Interceptor received from another friend—an old brass-pounder in Alaska—that he is going to include it in the Watch. This friend said:

I feel that I am a part of the scheme. I feel, I *know* that on me and on my skill depend the happiness or disappointment of people hundreds of miles away. In imagination I can picture them waiting, expecting.

It is a remarkable stimulus and a remarkable task—and generally goes without thanks. For the people I serve are not often gifted with more than rustic courtesy. No doubt they are thankful in their hearts, but it may not occur to them that I have gone to considerable expense to build my station, that I have spent years acquiring the skill to run it, and that I am taking so many hours a day out of my time in order that they may have communication, albeit at my own pleasure and satisfaction.

This pleasure and satisfaction, of course, will not fill the pot with gravy. And I do not like to accept tips for handling messages. I do not, in fact, like to accept messages locally because here there are other means of communication while scores of others in outlying places have absolutely no other way of communicating except by monthly boat.

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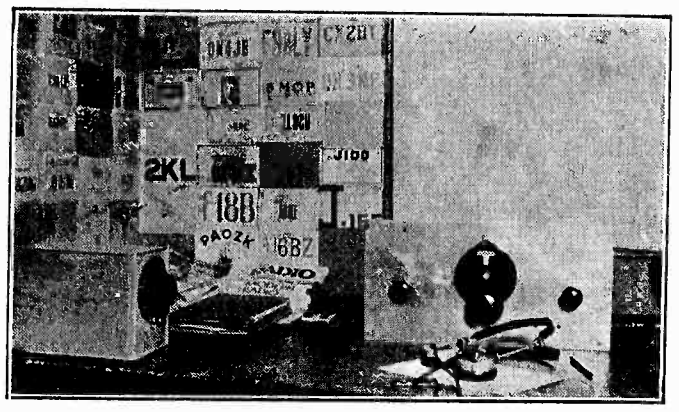
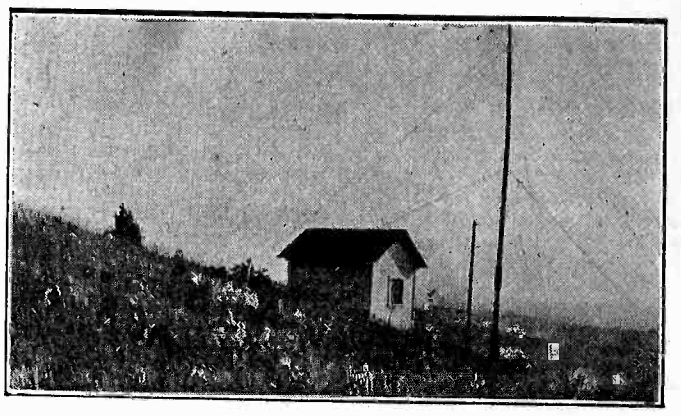
Globe Girdlers

Conducted by CLAYTON F. BANE, W6WB



W8CRA uses a two tube receiver—and it brings in plenty of DX. The secret is his location.



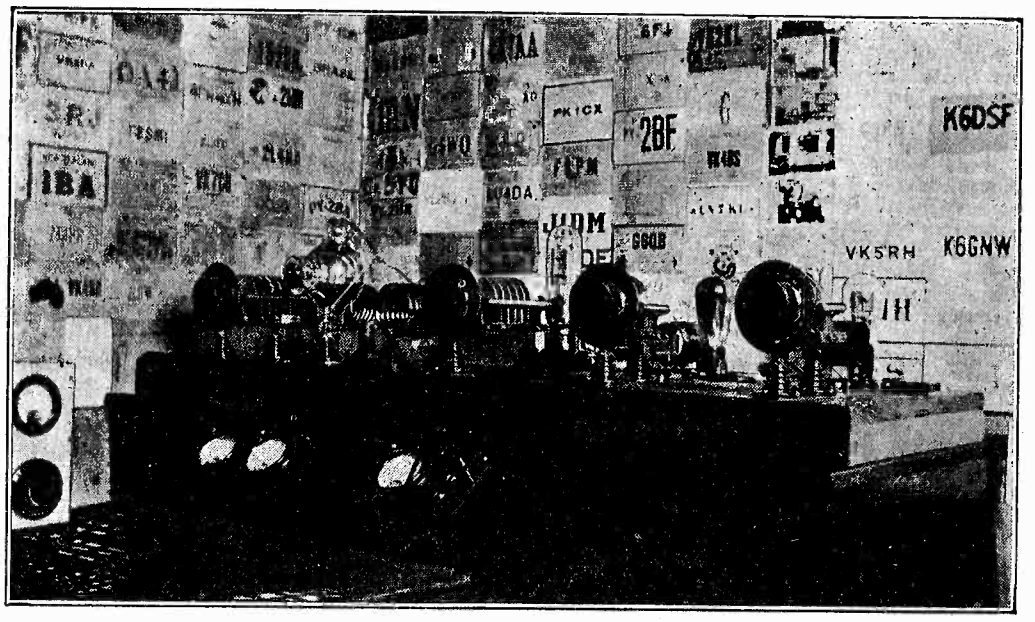
The Shack at W8CRA. It's lined with Celotex.

WITH this issue we introduce a new department, "Globe Girdlers". It is our desire to present each month, super-dx stations of the world with a station description and other points of interest to our readers. The station of Mr. F. Lucas, W8CRA, located at Cannonsburg, Penn., is our first selection because it is one of the representative stations of the East in the DX field.

W8CRA came on the air in June 1927, with a 171A on 40 meters and stayed on this band until by persistent effort, he succeeded in working an OZ, (now ZL), and then migrated to the 20 meter band, where he has spent a great deal of his time. For the first three years he was decidedly handicapped by the absence of an AC power line, but where others would have given up in disgust, Ted stayed with the ship. The net result being an enviable amount of DX, including all continents. When the power company was finally induced to install power in his locality, he discarded the "B" batts that had been his stand-by for so long and installed a higher power rig. He says, though, that the power is not the important factor in working DX. It is his contention that a properly designed antenna system, both for receiving and transmitting, is far more important than the power.

During the past several years, W8CRA has experimented with dozens of antennas in the hope of finding one that would be practically-uni-directional. Vertical, horizontal, with and without feeders, were tried in profusion but all failed to raise the far distant Asian stations that were heard. At this point a significant fact was noted. Certain of the DX stations came in on all antennas regardless of their directional characteristics, while most of the other stations showed a decided gain when the antennas were placed to favor their particular direction. F8PZ came rolling through regardless of the type of antenna or the direction, so the conclusion was drawn that this phenomena was due to some inherent characteristic of the transmitting antenna at F8PZ, rather than the receiving antenna at W8CRA. Forthwith, F8PZ was called and asked what type of antenna he was using. He answered laconically, "Fuchs type." (Editor—this antenna is quite extensively used on the continent and in South Africa). None other than our old friend, the "End-fed" Hertz, and the one at W8CRA is 40 feet high and 137 feet long. The end of the antenna is directly attached to a 10-turn inductance, (tuned by a variable condenser) which is inductively coupled to the final tank. It should be mentioned that the antenna is cut to the exact frequency of the crystal in use. Exact, in this particular case, being a very apt word because Ted tells us that the antenna length was determined by pruning off an inch at a time until the antenna was resonant to the exact frequency. Real patience. This antenna system has worked out extremely well, as anyone can attest who has heard W8CRA working the stations in Asia which are real DX from his locality.

The transmitter in use at the present time uses a '47 oscillator, (7MC crystal), 841 doubler, 203A buffer and 852 final. This combination has worked out very well, but



The "WAC" High-Power Transmitter of W8CRA.

Ted plans to install inductive coupling in the near future; hoping to increase his present input of 400 watts.

The receiver uses two tubes; a 234 as a detector and a 230 as an audio amplifier. Not a very imposing receiver, eh? But—the receiving antenna is only 425 feet long! This simple receiver is possible because the station is rather isolated and hasn't the interference to contend with that the amateurs in congested areas experience. No trouble is had in hearing J's, VK's, ZL's, XU, AC, VU and other difficult DX in these directions. An idea of the isolation of the station can be had by referring to the photograph of the shack. This shack, incidentally, is eight by ten feet and its walls are covered with Cellotex inside, making a cozy, comfortable shack. It might be mentioned that all four walls and the ceiling are covered with DX cards. Ted tells us that he has more foreign DX cards than W and VE cards combined. Not bad! You must come up some time!

All continents have been worked with each of the many transmitters built at W8CRA. WAC also, on both 7 and 14 MC bands and the following countries:

China, Siberia, Chile, Canada, Cuba, Morocco, Bolivia, Portugal, Azores, Maderia, Uruguay, Germany, Spain, Irish Free State, Esthonia, U. S. S. R., Martinique, France, Tunis, Algeria, England, Scotland, Northern Ireland, Hungary, Switzerland, Ecuador, Haiti, Dominican Republic, Colombia, Honduras, Italy, Japan, U. S. A., Porto Rico, Virgin Islands, Canal Zone, Hawaii, Alaska, Philippines, Norway, Argentina, Nicaragua, Peru, Trinidad, Finland, Szecho-Slovakia, Belgium, Denmark, Netherlands, Curacao, Java, Sumatra, Brazil, Persia, Panama, Sweden, Poland, Egypt, Sudan, Costa Rica, Yugo-Slavia, Austria, New Foundland, Bahamas, Barbados, Jamaica, British Guiana, British Honduras, Bermuda, Kenya Colony, Malay Peninsula, Hong Kong, British India, Mexico, Iraq, Latvia, El Salvador, Venezuela, New Zealand, Paraguay, South Africa, Malta Islands, Ascencion Island, Chatham Island, Greenland, Labrador, Fanning Islands.

Eighty-eight? Count 'em! Ted says that there have been times when, for some reason or other, the transmitter has been off the air, he has heard Samoa, Saar Basin, Lithuania, Rhodesia, Tanganyika, Ceylon, Palestine, British Samoa, Danzig, Southern Rhodesia and Borneo.

On 28MC he has had some eighteen QSO's with the U. S. A. and has heard South Africa, England, Denmark and Porto Rico.

Taking everything into consideration, we think that W8CRA is one of the Grand Daddy "Globe Girdlers".

NEXT MONTH'S GLOBE GIRDLER . . . W6CUH—W6QD. Complete description of this new amateur "power house" will be in November "RADIO." DON'T MISS IT!

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RADIO'S Practical Data Sheets

A Compact, Sensitive 2-Tube Short-Wave Receiver

The Find-All "Globe-Trotter" Using Standard Parts

DATA SHEET NO. 1

By H. G. CISIN, M.E.

THE "Globe-Trotter" will bring in foreign stations on the loud speaker. It uses Alden plug-in short-wave coils and covers the short-wave band from 15 to 200 meters. It brings in all desirable classes of short-wave signals, including police calls, airplane messages, amateur calls, ship and other code signals, etc.

A simple regenerative circuit is used consisting of a regenerative detector and a resistance coupled audio stage. A '32 type 2-volt tube is used as the detector, while the output tube is a '33 type 2-volt pentode. Loud speaker operation is obtained on most stations. Regeneration is controlled by means of an Electrad potentiometer in the screen grid circuit of the detector. The set uses comparatively few parts and these are of standard make. As a result it may be constructed at very low cost. Furthermore, its simplicity makes it easy to assemble and wire.

The various parts are mounted on a compact little metal chassis. The magnetic speaker is fastened on this same chassis. Provision is made for earphone reception through the use of a closed circuit jack.

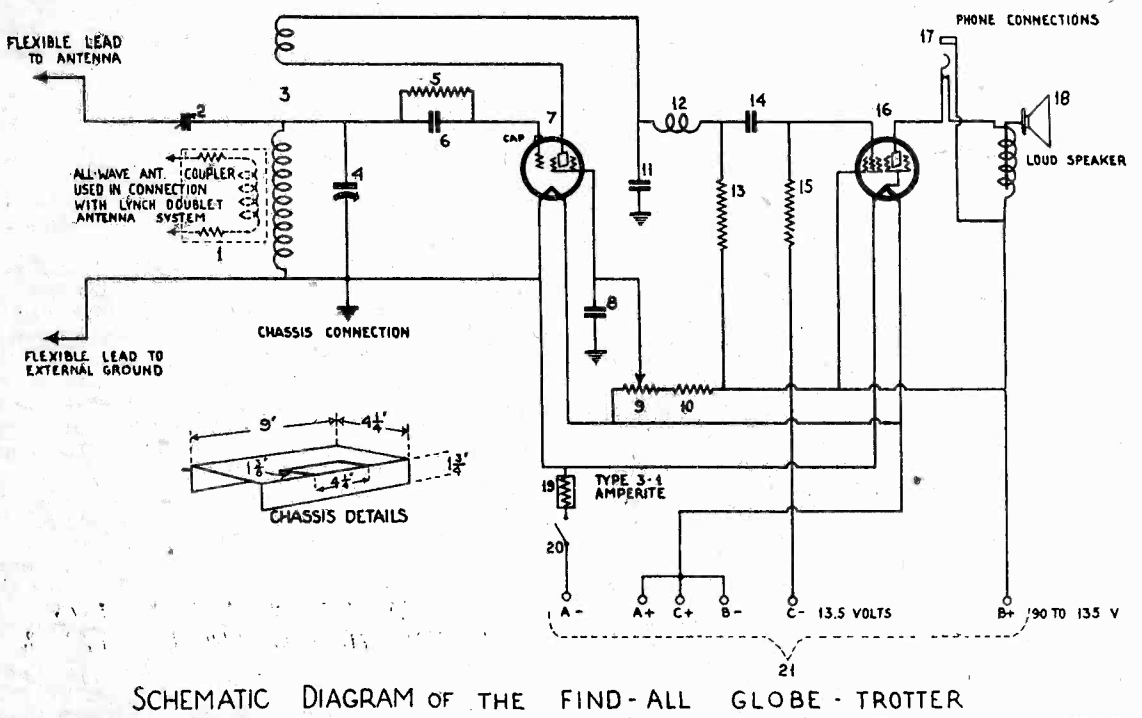
THE maximum "B" voltage is 135 volts. Excellent operation, however, is obtainable with only 90 volts on the plates. The diagram shows the set arranged for dry cell operation. Two No. 6, 1½-volt dry cells supply the "A" current for the filaments. Voltage is reduced to exactly the correct value for these tubes by means of an Amperite of the 3-1 type. This useful device also serves to keep the filament voltage constant as the batteries start to wear out. The air-cell type of battery may be used with the Globe-Trotter or even a 6-volt storage battery. In the latter case, a 630 amperite is employed in the filament circuit of the '32 tube and a 633 amperite in the filament line of the '33 tube. It is necessary to use a "C" battery in the grid circuit of the '33 pentode output tube. The normal grid bias required is 13½ volts. Two 7½ volt "C" batteries may be used in series, although it is just as satisfactory to take the closest tap to 13½ volts which can be obtained on a standard 22½ volt "B" or "C" battery.

Those who wish to obtain maximum results from the "Globe Trotter", both as regards noise elimination and distance reception, can use the Lynch short-wave antenna system.

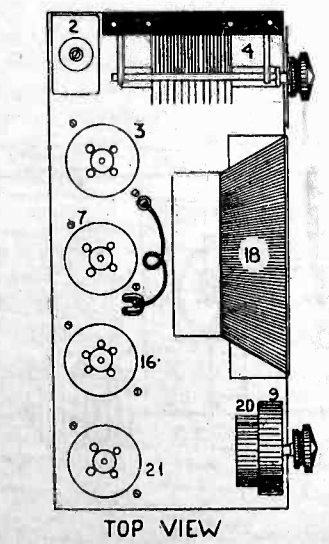
A METAL chassis is available with holes drilled for the sockets and also for the speaker cone. The first step is to mount the four sockets. The chassis is then turned upside down and the amperite (19) and the r.f. choke (12) are fastened to the under side. The metal case Aerovox condenser (8) and the jack (17) are secured to the rear chassis wall. The other parts which mount beneath the chassis are soldered in place during the process of wiring.

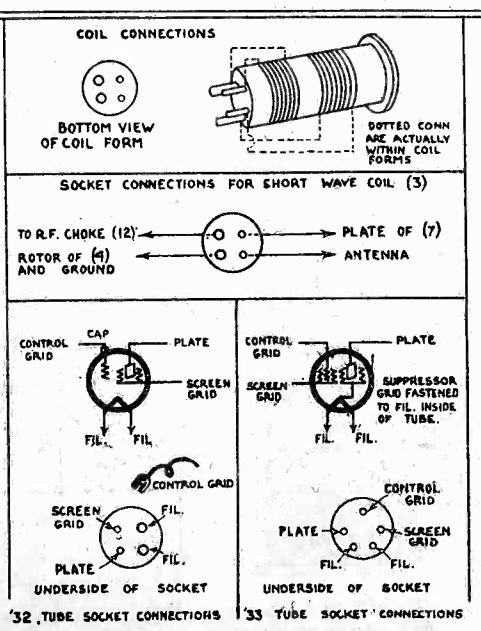
The method of wiring a short-wave receiver and also the type of wiring used, are of greater importance than in the case of the ordinary broadcast set, since magnetic interaction which might not be noticeable in an ordinary radio set, keeps the short-wave receiver from functioning efficiently and bringing in the desired distant stations. After wiring the filament circuits, the grids should be wired, then the plates and the bypass condensers, finally wiring in the antenna portion of the circuit. Follow the diagrams carefully in wiring the socket terminals. Note, however, that there is an error in the sketch showing the socket connections of the short-wave coil (3). The thin terminal hole, marked "plate of (7)" should have been marked "To R.F. Choke." The thick terminal marked "To R.F. Choke" should have been marked "Plate of (7). In the sketch showing the coil connections, the top of the tickler should be connected to the thin prong and the bottom of the tickler winding should have been shown connected to the thicker prong, instead of visa versa. Ground the chassis to the negative filament line, but do not depend upon the chassis as a return circuit but run wires instead to all points, especially those in the high frequency circuits.

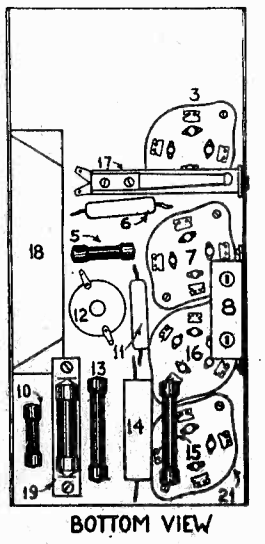
IN TESTING the set, try it out first, using the green (80-200 meter) coil. If the set does not oscillate, it is usually a sign that the tickler has been incorrectly connected and this will necessitate reversing the tickler connections at socket (3). The first adjustment is that of the antenna condenser (2). This is adjusted by experimentation for the antenna it is to be used with, and thereafter is no longer touched. Then the regeneration control (9) is advanced until the tube goes into oscillation. If oscillation is attained too quickly condenser (2) must be adjusted further. In certain cases, it may be necessary to reduce the size of the grid leak (5) for greater smoothness of regeneration control. Turning the tuning dial slowly, the regeneration control is advanced towards the right until the set goes into oscillation. Meanwhile, the tuning condenser is turned until a station is heard. If speech is tuned in, it will probably be indistinct. The signal may be cleared up by turning the regeneration control (9) back very gradually. For best results, the filament voltage must be correct and the antenna condenser must be adjusted properly. After testing the set on the green coil, test it out on the other three coils. It may be necessary to readjust condenser (2). In using the Lynch All-Wave Coupler, this is connected to the lead-in by means of the flexible twisted pair and inserted within the coil (3). The ground remains connected to the flexible ground terminal of the set, not to the lead-in.



SCHEMATIC DIAGRAM OF THE FIND-ALL GLOBE-TROTTER







Complete List of Parts Required For the Find-All "Globe-Trotter"

1— Cardwell Midway "Featherweight" Variable Condenser, .00015 mfd. capacity, type 405-B (4)
1— Set of Alden Short-Wave Coils, Plug-in Type—covering following bands: Green—80 to 200 meters, Yellow—40 to 80 meters, Red—20 to 40 meters, Blue—15 to 20 meters. (3)
1—*Acratest Trimmer Condenser, 5 to 50 mmfd., type No. 2882 (2)
1— Electrad 75,000 ohm Potentiometer, type RI-202-P (9), with Switch (20)
1— Aerovox Mica Condenser, .0001 mfd., type 1460 (6)
1— Aerovox Mica Condenser, .00025 mfd., type 1460 (11)
1— Aerovox Cartridge Condenser, .01 mfd., 400 volts, type 481 (14)
1— Aerovox Metal Case Condenser, .5 mfd., 200 volts, type 260 (8)
1— I.R.C. 150,000 ohm Metallized Resistor—½ watt type F½ (10)
1— I.R.C. ¼ megohm, 1 watt Metallized Resistor, type F-1 (13)
1— I.R.C. 1 megohm, 1 watt Metallized Resistor, type F-1 (15)
1—I.R.C. 2 megohm, 1 watt Metallized Resistor, type F-1 (5)
1— Find-All Short-Wave R.F. Choke (12)
1—*Acratest Closed Circuit Jack, type 7320 (17)
3— Alden Four-prong Wafer type sockets (3, 7, 21)
1— Alden Five-prong Wafer type Socket (16)
1— Amperite with Mounting, type 3-1 (19)
1— '32 type Screen Grid Tube (7)
1— '33 type Pentode Output Tube (16)
1— Find-All Magnetic Speaker (18)
1— Lynch All-Wave Coupler for use with Lynch Short-Wave Antenna Kit (1)
1— Special Lynch "Find-All Globe Trotter" Short-Wave Antenna Kit
1— Drilled Metal Chassis, 9-in. x 4¼-in. x 1¾-in.
1— Roll Corwice Braidite Hook-up Wire—Solid core
1— Screen Grid Clip. 2— Knobs.
3—*Acratest 45-volt "B" Batteries, type 6905
2—*No. 6 Acratest 1½-volt Dry Cells, type 6656
1—*22½-volt Acratest "C" Battery, type 6685
1— Alden Four-Prong Plug
1— Four Conductor Battery Cable

NOTE: Numbers in parenthesis refer to corresponding numbers on diagrams.

* Acratest Products are marketed by Federated Purchaser, Inc., New York, N. Y.

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RADIO'S Practical Data Sheets

DATA SHEET NO. 2

CORRECT PROCEDURE FOR SECURING LICENSE FOR OPERATING RADIO AMATEUR STATION. HOW TO ANSWER THE EXAMINATION QUESTIONS.

Part I of a Series

NOTE

Each month one of "RADIO'S" 100 PRACTICAL DATA SHEETS will be devoted to the problems of securing station and operator's licenses of all kinds. This Data Sheet covers the entire subject of Beginner's License Examination for Amateurs. All you need to know, to get a beginner's Amateur Operator's License, is shown on this page.

VOLUMES have been written on how to secure a beginner's license for operating an amateur station. Yet few people realize that the passing mark of a beginner's examination is but 75%, and that the greater portion of this percentage is applied to the correct answers given to but a relatively few of the simple questions asked. Usually there are 10 questions. Of these, the first six are most important, and, if properly answered, a passing mark will be secured and a license granted. (1) Draw a diagram of the transmitter you desire to operate and identify the parts. (2) Draw a diagram of the receiver you desire to operate and identify the parts. (3) Describe fully the operation of your transmitter. (4) Describe the operation of your receiver. (5) What type of messages have precedence over all others? (6) What would you do upon hearing a distress call? (7) What is the International abbreviation for "STOP SENDING?" (8) What are the regulations regarding secrecy of messages? (9) What are the regulations regarding interchange of amateur communication with other countries? (10) What are the regulations regarding radiation of harmonics? (11) What means are taken to assure that your station is operating on the frequencies prescribed by law? (12) What is the law regarding amount of power used for transmitting?

The first six questions, if correctly answered, will enable you to pass the examination with the required rating. Keep this Data Sheet for reference. It is the "key" to successfully passing the license examination. If you can answer most of the questions on this page you need have no fear whatsoever of failure, provided you can read the code at a speed of 10 words per minute.

Diagrams

YOU can "get by" with the most simple type of transmitter circuit, in spite of what you may have heard to the contrary. The more elaborate crystal control outfit (illustrated below) can be shown, if desired. Take your choice. And as for the receiver . . . the simplest one-tube outfit is just as acceptable as the most elaborate circuit known. So why work too hard when you take the exam?

Operation of Transmitter and Receiver

ANSWER **Question** 3 by merely stating that the transmitter operates as follows:

The alternating current from the 110 volt line is stepped up to supply the plate current and stepped down to supply the filament currents for the rectifier and oscillator tubes. The rectifier tube changes the high voltage AC into high voltage pulsating direct current, which is smoothed out by the filter. The high voltage direct current then supplies the plate power. The negative return is connected to the filament center tap. The key is placed in the center tap of the filament transformer and code signals are made by operating the key. The crystal in the grid circuit of the tube keeps the frequency constant and within the band; the plate circuit being tuned to the same frequency and this arrangement causes the tube to produce oscillations. The antenna circuit is coupled to the plate circuit and is tuned with its proper condenser. The aerial radiates the waves which constitute the signals. The resistor in shunt with the crystal keeps the grid at the proper potential when the tube is oscillating. The R.F. choke in series with the plate supply keeps the R.F. current from flowing back into the plate circuit. The resonance indicator is used to indicate resonance when maximum brilliance of the lamp is shown by holding the lamp in the vicinity of the plate coil. The antenna meter denotes maximum radiation. When both the plate and antenna circuits are properly tuned the antenna meter will give the highest reading and, at the same time, the plate milliammeter will give the lowest reading. The R.F. chokes in the 110 volt AC supply line are used to keep stray radio frequency currents from feeding back into the power line. The fixed condensers across the filament provide a by-pass between the plate return and the filament circuit. The filament of UX-199 tube, in series with the crystal and the negative "B". It acts as a protective device for the crystal, preventing damage from overload. The filament of the tube will burn out when the crystal current rises too high, thus saving the crystal from damage. It is also used to indicate maximum oscillation of the crystal. The brighter the glow of the filament of the UX-199 tube, the more powerfully the crystal is oscillating. The 50,000 ohm resistor in series with the shield-grid of the oscillator tube serves to keep the R.F. out of the plate supply and also stabilizes the operation of the tube by reducing the plate voltage to a proper value.

Answer Question 4 as follows: Signals intercepted by the antenna are carried to the tuning coil, in series with which is a small antenna condenser. The ground connects to the other end of the tuning coil. A tickler or regeneration coil, mounted close to the secondary, provides the "feed back" for the plate circuit. The detector tube rectifies the received signal, which is made audible in the headphones by completing the plate circuit through the "B" battery. The "A" battery lights the filament, which emits electrons to the plate. The "B" battery supplies the high potential for the plate. Nothing else is required for answering this question.

Answer Question 5 by merely stating that distress messages or signals relating thereto, have precedence over all others.

Answer Question 6 by stating that you would stop sending if you heard a distress call and would not resume sending until you were assured that the distress traffic had terminated.

Answer Question 7 by stating that QRT means "STOP SENDING".

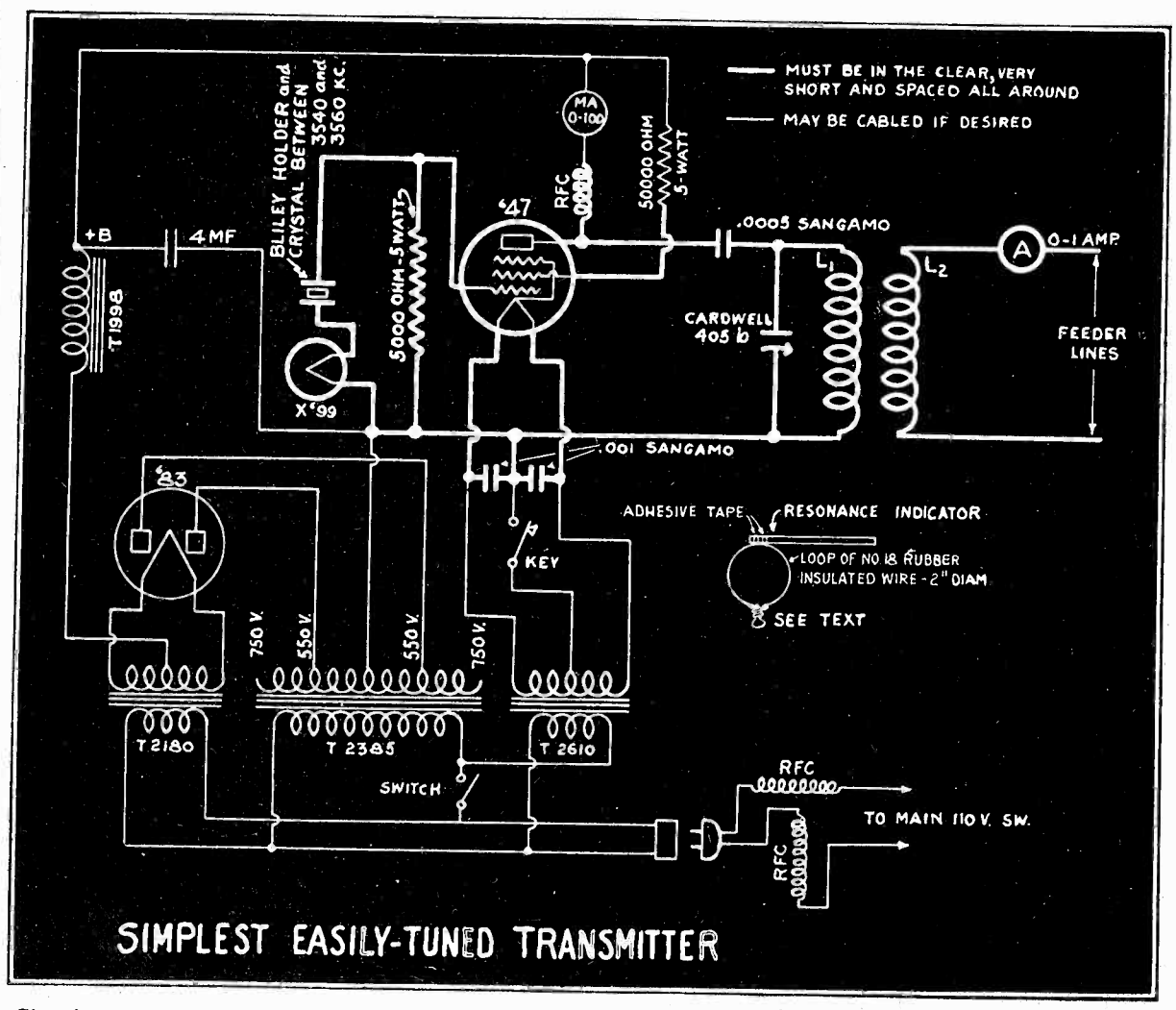
Answer Question 8 by stating that the contents of messages must not be divulged, except to the addressee or his authorized agent or when ordered to do so by a court of competent jurisdiction or authority.

Answer Question 9 by stating that amateurs are forbidden to conduct **message traffic** with any countries that prohibit the same, but that ordinary conversations in plain language can be handled with other amateurs in any country.

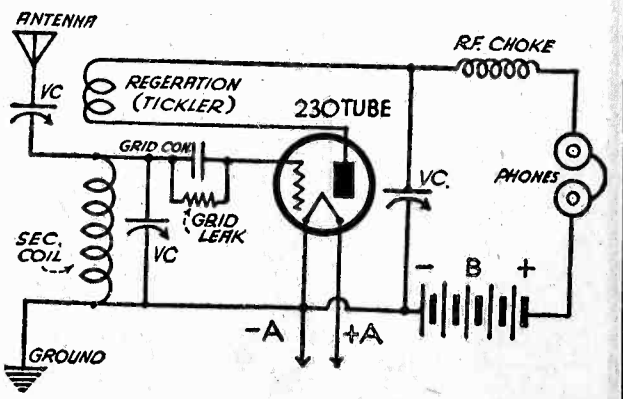
Answer Question 10 by saying that a transmitter should be free from radiating harmonics and that this is accomplished by loose coupling and proper circuit design or by use of a push-pull circuit or the use of wave traps in the antenna.

Answer Question 11 by stating that you know when your station is operating within the prescribed frequencies by checking the frequency with an electron-coupled frequency meter. This is done by operating the transmitter on the frequency to be measured. Place the phones of the frequency meter on your head and explore the dial of the frequency meter by tuning over its scale. When the frequency meter "beats" with the transmitter at approximately "zero beat", you have the frequency setting of the frequency meter which can then be checked against the calibration curve of the frequency meter. If the frequency is found to be out of the band the transmitter must be retuned or otherwise changed.

Answer Question 12 by stating that MINIMUM power must be used to insure satisfactory communication.



Circuit for beginner's one-tube crystal control transmitter, as shown in the "1933 SHORT-WAVE MANUAL" by Wallace. This is an excellent circuit to show when taking your amateur license examination. A less complicated, yet equally acceptable circuit, is also shown.



This diagram is all you are required to show for answering the Question—"Draw a diagram of the receiver you desire to use in your station."

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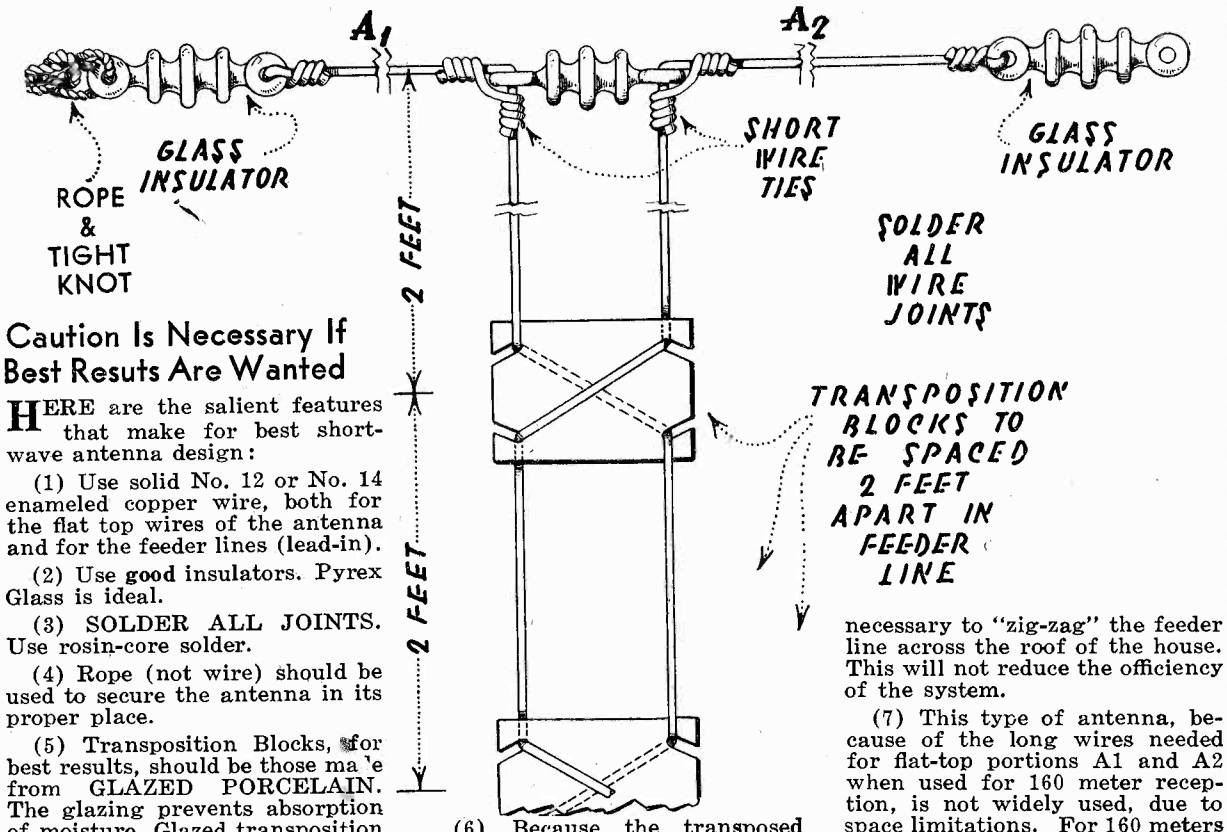
RADIO's Practical Data Sheets

"Tuned Doublet"—One of the Best Short-Wave Receiving Antennas. Transposed Feeders For Noise-Reduction. Methods For Coupling the System To a Receiver.

DATA SHEET NO. 3

ONE of the most successful short-wave receiving antennas is the "Tuned Doublet", shown in the illustration. It consists of two wires in the flat-top portion, each wire of the same length. These wires are marked A1 and A2 in the illustration. At the center of the antenna a "feeder" line (lead-in) is brought to the receiver. This feeder line is "transposed", i.e., every 2 feet the wires are transposed with transposition blocks. This transposition cancels out much noise, which would otherwise reach the receiver. Because this antenna system can be tuned to the wave-bands in which operate the stations you are most interested in listening to, infinitely better reception is secured than when an antenna is used that has "any old wavelength at all". The radio amateur bands are in harmonic relation with each other. Therefore one antenna will serve the purpose for receiving any of the amateur bands. On the other hand, the short-wave broadcast stations are not in harmonic relation with one another and the dimensions for an antenna of this type for receiving short-wave broadcast programs is not the same as that used for amateur reception. The table, below, gives the correct dimensions for both types.



Caution Is Necessary If Best Resuts Are Wanted

HERE are the salient features that make for best short-wave antenna design:

(1) Use solid No. 12 or No. 14 enameled copper wire, both for the flat top wires of the antenna and for the feeder lines (lead-in).

(2) Use **good** insulators. Pyrex Glass is ideal.

(3) SOLDER ALL JOINTS. Use rosin-core solder.

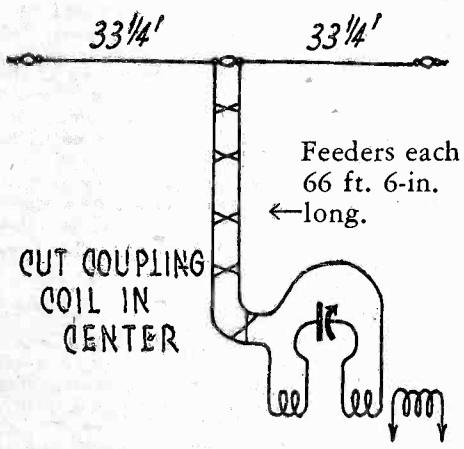
(4) Rope (not wire) should be used to secure the antenna in its proper place.

(5) Transposition Blocks, for best results, should be those ma'e from GLAZED PORCELAIN. The glazing prevents absorption of moisture. Glazed transposition Blocks are manufactured by Fleron, also by E. F. Johnson.

(6) Because the transposed feeders should be 66½ feet in length, it sometimes becomes necessary to "zig-zag" the feeder line across the roof of the house. This will not reduce the officiency of the system.

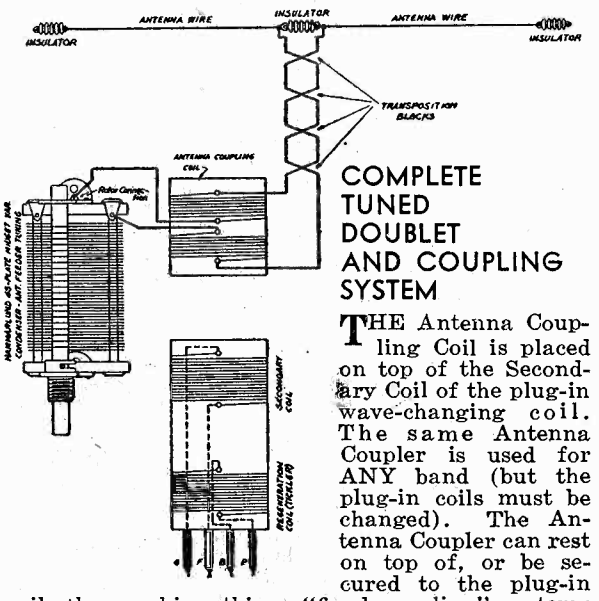
(7) This type of antenna, because of the long wires needed for flat-top portions A1 and A2 when used for 160 meter reception, is not widely used, due to space limitations. For 160 meters the systems shown in Data Sheet 5 should be used.

How to Couple the "Tuned Doublet" to a Short-Wave Receiver



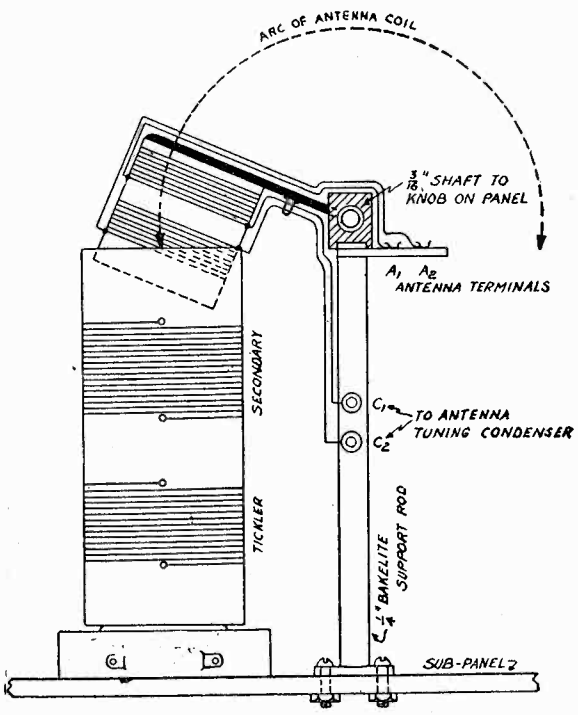
The Correct Coupling System

The feeders of the antenna are tuned with a coupling coil, 1½" diameter, wound with 16 turns of No. 22 DOUBLE COTTON COVERED wire. At the 8th turn, the wire is cut apart and the two ends brought to the terminals of a 43 plate midget variable condenser. This condenser tunes the feeders.



COMPLETE TUNED DOUBLET AND COUPLING SYSTEM

THE Antenna Coupling Coil is placed on top of the Secondary Coil of the plug-in wave-changing coil. The same Antenna Coupler is used for ANY band (but the plug-in coils must be changed). The Antenna Coupler can rest on top of, or be secured to the plug-in coil, thus making this a "fixed coupling" system; or it can be made variable, as shown in the illustration to the extreme right. A 43-plate midget variable condenser tunes the system to resonance.



VARIABLE ANTENNA COUPLING FOR MAXIMUM SELECTIVITY

FOR amateur communication, the variable antenna coupling method is ideal. It gives excellent selectivity . . . "covers-up" dead spots in the antenna. The antenna coupling coil is wound on a 1½-in. diameter form. Wind the coil in two sections, each with 8 turns of No. 22 DCC wire. The connections from the top and bottom turns go to the antenna feeders. The other ends (in the center of the coil) go to the 43-plate variable condenser. The coupling coil is varied by means of a bakelite rod attached to the coil and brought to the front panel of the receiver. Flexible wire should be used for bringing the coil leads to the supporting rod that holds the variable coupling coil in position.

CORRECT DIMENSIONS FOR DOUBLETS

For Amateur Bands

Refer to large illustration at top of this page for identifying A1 and A2

20 METERS	40 METERS	80 METERS	160 METERS
A1 & A2, each 16 ft. 7½-in. long. Transposed Feeder lines 33 ft. 3-in. long.	A1 & A2, each 33 ft. 3-in. long. Feeder lines 66 ft. 6-in. long.	A1 & A2, each 66 ft. 6-in. long. Feeder lines 133 ft. long.	A1 & A2, each 133 ft. long. Feeder lines 266 ft. long.

NOTE: The 40 METER ANTENNA, with A1 and A2 each 33 ft. 3-in. long, and the feeder line 66 ft. 6-in. long, is an ideal compromise all-around amateur antenna for 10, 20, 40 and 80 meter reception. This "compromise" size is most widely used.

For SWL Broadcast Use

An all-around successful compromise SWL antenna of this type would be one with wires A1 and A2 each 35 feet long, and the feeder line 71 ft. long. The feeders can be zig-zagged across the roof. This antenna is NOT suited for amateur reception.

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RADIO's Practical Data Sheets

DATA SHEET NO. 4

Characteristics of the New RCA-800 Power Amplifier-Oscillator Tube for High Frequency Transmitters

THE 800 is a three-electrode transmitting tube for use as a radio-frequency power amplifier or oscillator, particularly at the higher radio frequencies; it may be used at full ratings at frequencies as high as 60 megacycles. The grid and plate leads are brought out to metal caps at the top of the bulb, thus insuring high insulation and low capacity between leads.

Characteristics

General:		
FILAMENT VOLTAGE (AC)	7.5	v.
FILAMENT CURRENT	3.25	amps
AMPLIFICATION FACTOR	15	
GRID-PLATE CAPACITANCE	2.5	uuf.
GRID-FILAMENT CAPACITANCE	2.75	uuf.
PLATE-FILAMENT CAPACITANCE	1.0	uuf.
MAXIMUM OVERALL LENGTH	6⅜"	
MAXIMUM DIAMETER	2 11/16"	
BULB	S-21	
BASE	med. 4-pin	

As A-F Power Amplifier and Modulator—Class B

D-C PLATE VOLTAGE	1250 max.	Volts
D-C PLATE INPUT	85 max.	Watts
PLATE DISSIPATION	35 max.	Watts

Typical Operation: (2 tubes)

Filament Voltage (AC)			7.5		Volts
DC Plate Voltage	750	1000	1250		Volts
Grid Voltage	—50	—65	—85	approx.	Volts
Load Resistance (Plate-to-plate)	6900	12500	21000		Ohms
Nominal Power Output (two tubes)	96	100	106		Watts

As R-F Power Amplifier—Class B (Telephony)

(Carrier Conditions; for use with a Modulation Factor of 1.0)		
D-C PLATE VOLTAGE	1250 max.	Volts
D-C PLATE CURRENT (Unmodulated)	45 max.	Milliamp.
PLATE DISSIPATION	35 max.	Watts
R-F GRID CURRENT	5.0 max.	Amperes

Typical Operation:

Filament Voltage (AC)		7.5	Volts
D-C Plate Voltage	750	1000	Volts
Grid Voltage	—45	—60	Volts
D-C Plate Current (Unmodulated)	45	42	Milliamp.
Peak Power Output	40	56	Watts
Carrier Output	10	14	Watts

As Plate-Modulated R-F Power Amplifier—Class C (Telephony)

(Carrier Conditions; for use with a Modulation Factor of 1.0)		
D-C PLATE VOLTAGE	1000 max.	Volts
D-C PLATE CURRENT	80 max.	Milliamp.
PLATE DISSIPATION	23 max.	Watts
R-F GRID CURRENT	5.0 max.	Amperes
D-C GRID CURRENT	25 max.	Milliamp.

Typical Operation:

Filament Voltage (AC)		7.5	Volts
D-C Plate Voltage	750	1000	Volts
Grid Voltage	—90	—150	Volts
D-C Plate Current (Unmodulated)	70	70	Milliamp.
Power Output	35	50	Watts

As R-F Power Amplifier and Oscillator—Class C (Telegraphy)

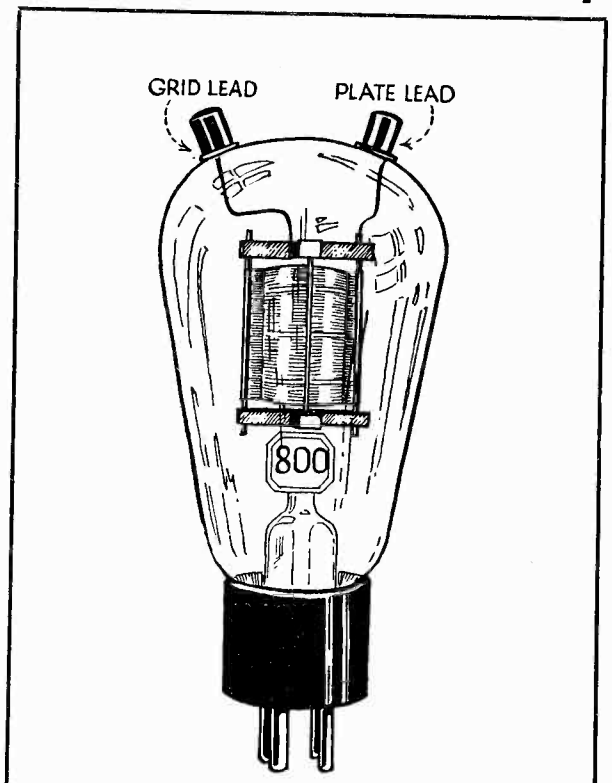
(Key Down Conditions)*		
D-C PLATE VOLTAGE	1250 max.	Volts
D-C PLATE CURRENT	80 max.	Milliamp.
PLATE DISSIPATION	35 max.	Watts
R-F GRID CURRENT	5.0 max.	Amperes
D-C GRID CURRENT	25 max.	Milliamp.

Typical Operation:

Filament Voltage (AC)			7.5	Volts
D-C Plate Voltage	750	1000	1250	Volts
Grid Voltage	—90	—150	—190	Volts
D-C Plate Current	70	70	70	Milliamp.
D-C Grid Current **	15	15	15	Milliamp.
Driving Power **	2.0	3.0	4.0	Watts
Power Output	35	55	65	Watts

* These ratings apply only for operation at frequencies below 60 megacycles. For ratings at higher frequencies, refer to table under APPLICATION.

** Subject to wide variations depending on the impedance of the load circuit. High impedance load circuits require more grid current and driving power to obtain the desired output. Low impedance circuits need less grid current and driving power, but plate circuit efficiency is sacrificed. The driving stage should have a tank circuit of good regulation and should be capable of delivering considerably more than the required driving power.



LARGE PRONGS-FILAMENT
SMALL PRONGS BLANK

Installation

THE **base** pins of the 800 fit the standard, four-contact socket, which should be installed so that the tube will operate in a vertical position. The filament terminals are connected to the two large base pins; the grid and plate leads are brought out to separate metal caps at the top of the bulb. Because of the relatively heavy filament current taken by the 800, the socket should make firm, large-surface contact with the filament pins of the tube; heavy, well-soldered leads should be used for the filament circuit wiring. For socket and cap connections, refer to illustration above.

Flexible leads should be used to make connections to the grid and plate caps so that normal expansion will not place a strain on the glass at the base of the caps. Likewise, the caps should not be made to support coils, condensers, chokes, etc. Under no circumstances should anything be soldered to the caps, as the heat of soldering may crack the glass seals. The flexible leads should be heavy enough to handle adequately the large, circulating r-f current which flows at high frequencies.

The **bulb** of this tube becomes very hot during continuous operation. Free circulation of air should therefore be provided. The installation of all wires and connections should be made to allow at least several inches of free space around the tube in order to avoid trouble from peak voltage effects, and to allow better ventilation.

The **filament** of the 800 is of the thoriated-tungsten type. For filament excitation, it is generally more convenient to use an AC source, although a DC supply may be used. The filament transformer should have a power rating sufficient to supply the current necessary for the filament of the 800, at the rated voltage. A voltmeter should be connected directly across the socket terminals so that the filament voltage may be kept at 7.5 volts. Deviation from the rated voltage may result in a loss of filament emission. With an AC source, rheostat control should be placed in the primary circuit of the filament transformer. During "standby" periods, the filament should be maintained at its rated voltage.

The **grid and plate circuit returns** should be connected to the center tap on the filament winding of the transformer, or to the mid-point of a center-tapped resistor across the filament terminals. In cases where DC is used on the filament, the grid and plate returns may be connected to the negative filament terminal.

The plate dissipation of the 800 (the difference between input and output) should never exceed the values given under CHARACTERISTICS. At the rated maximum of 35 watts the plate does not show any color, even when all power switches are opened with the tube operating in the dark. Under no conditions should the plate show even the faintest tinge of color.

Overheating of the 800 by severe overload may decrease filament emission. Unless the overload has liberated a large amount of gas, the activity of the filament may be restored by operating it at rated voltage for ten minutes or more with no voltage on the plate or grid. This reactivation process may be accelerated by raising the filament voltage to 9.0 volts (not higher) for a few minutes.

A DC milliammeter (0-300 ma. range is suitable) should be used in the plate circuit in order that the plate current can always be known. Under no condition should the DC plate current exceed the maximum values given under CHARACTERISTICS.

In order to prevent overheating due to improper circuit adjustments or to overloading, the plate circuit should be provided with a protective device such as a relay or circuit breaker. This device should instantly remove the plate voltage when the DC plate current reaches a value of 50 per cent greater than normal.

Heavy leads and conductors should be used in all parts of the plate tank circuit, in order that the heating effects of the circulating r-f current will be reduced. These heating effects are especially noticeable at the higher frequencies. Any insulating material, such as that employed in the plate tank condenser, should be suitable for high-frequency operation.

When a new circuit is being tried out or when adjustments are being made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect. It is advisable to use a protective resistance of about 5000 ohms in series with the plate lead during such adjustments.

It should be constantly kept in mind that the rated plate voltage is high enough to be exceedingly dangerous. The greatest care should be taken when handling or adjusting circuits, especially those in which the plate tank coil and condenser are at the DC plate potential.

Application

AS a **Class B Modulator or Audio-frequency Amplifier**, two 800's are used in a balanced circuit, each tube conducting only half the time. The DC plate input power should never exceed 85 watts per tube.

Two tubes, operating under the conditions shown for a 1000-volt plate supply, are capable of modulating 100 per cent an input of 200 watts to a Class C radio-frequency amplifier.

The **input transformer** should be designed to give good frequency response when operated into an open circuit, such as that represented by the grid circuit of the Class B stage when the signal amplitude is small, and also to handle the required input power for a strong signal.

The **output transformer** should be so designed that the resistance load presented by the modulated Class C amplifier is reflected as a plate-to-plate load of 12500 ohms in the Class B stage, for the 1000-volt conditions. Since two 800's will modulate 200 watts, a convenient Class C amplifier would be one operating at 1000 volts and 200 milliamperes. These conditions represent a resistance of approximately $\frac{1000}{0.200}$, or 5000 ohms. The ratio of the output transformer is then $\sqrt{\frac{12500}{5000}}$ or 1.59 to 1, step-down. If a Class C amplifier operating at 2000 volts and 100 milliamperes is used, the equivalent resistance is 20000 ohms; in this case the transformer ratio is 1 to 1.27, step-up. The transformer should be designed with a core sufficiently large to avoid saturation effects, which would impair the quality of the output. It is usually desirable to keep the DC plate current of the

(Continued on Data Sheet No. 5, on Facing page)

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RADIO's Practical Data Sheets

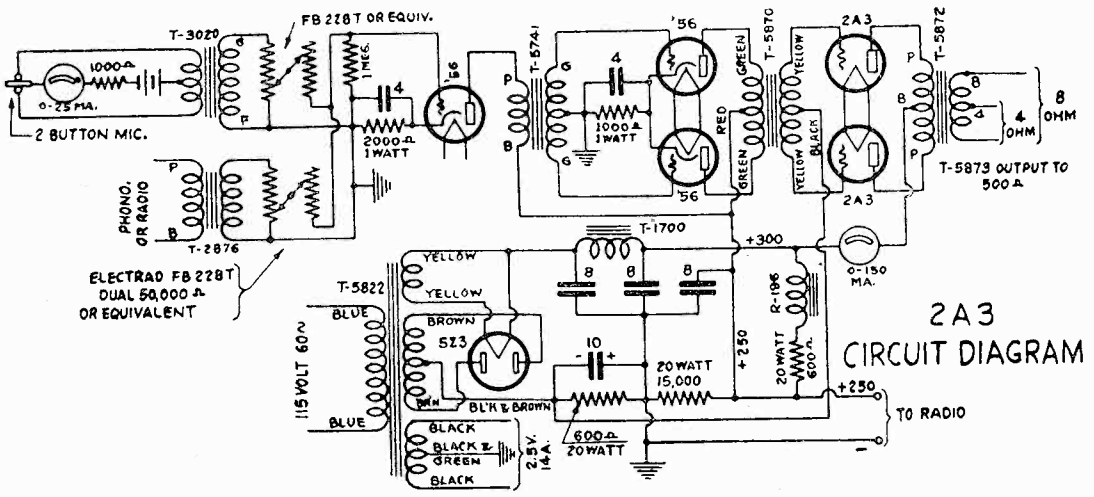
DATA SHEET NO. 5

Push-Pull 2A3 Amplifier Using Thordarson Transformers

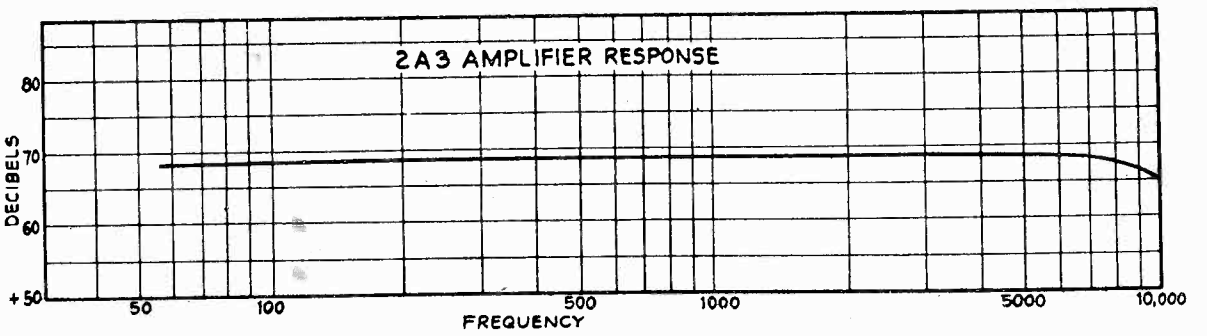
THE new 2A3 power tubes make possible the construction of a Class "A" amplifier that will develop approximately 15 watts of audio power with only 2½% harmonic distortion. The frequency response of the amplifier is as good as those used in most broadcast stations, the variation from 60 to 7000 cycles being a fraction of a decibel. Since the popular definition of the decibel is that it is the unit increase in power that can just be detected by the average ear, no frequency discrimination can be detected by ear. For a moderate power public address or home radio amplifier, this amplifier is unbeatable.

The input is arranged so that a microphone and either a phonograph pick-up or radio may be used at the same time, each having a separate level control so that a musical background may be used for announcements if desired. Dual potentiometers are used as T pads so that the adjusting of one fader does not change the volume level of the other. If desired, either of the faders may be omitted.

It is recommended that the fader system be coupled into a 56 tube which in turn is coupled by means of a high quality push-pull input transformer (T-5741) to a pair of 56 tubes, following this with a specially designed interstage transformer (T-5870) coupling into the 2A3 tubes. The frequency response curve shown was taken from the primary of the T-2876 transformer to the plate circuit of the power tubes, using the above coupling transformers. These measurements were taken at a power level of 15 watts. The amplifier has an overall gain of 68.76 decibels at 1000 cycles from the phonograph input transformer. The gain using the microphone transformer is considerably higher.



2A3 CIRCUIT DIAGRAM



Power Supply

THE power supply unit is of the conventional type using the new 5Z3 rectifier tube. Electrolytic condensers may be employed throughout the filter system since the plate voltage to the power tubes is only 300 volts. The filament winding of the power transformer is designed to carry six additional heaters of the one ampere tubes (56-57-58) in addition to the tubes of the amplifier. Bias for the 2A3 tubes is secured by means of a resistor in the negative lead of the power supply. This makes the bias more stable since it is affected less by changes in plate current than when self bias is used. In case it is desired to supply plate current to the R.F. end of a receiver from the same supply, a 200 ohm variable and a 400 ohm fixed resistor should be used in series in place of the 600 ohm biasing resistor. With a milliammeter in the plate circuit of the power tubes, the bias should be adjusted until the pair of 2A3 tubes draw 80 M.A. without signal input. The amplifier, pick-up and phonograph motor should always be grounded to prevent spurious oscillation. A 200 ohm pick-up will work nicely into the primary of the T-3020 transformer, if it is desired to use a low impedance unit.

As noted on the circuit diagram, the output of the amplifier may be connected directly to the voice coils of the speakers, or by the use of a different coupling transformer, may be operated into a 500 ohm line. The T-5381 transformer should be used at the other end of the line to couple to the voice coils of the speakers in this case.

List of Parts For Thordarson 2A3 Amplifier

	List
T-5822—Power Transformer	**$6.00**
T-1700—Filter Choke—28.6 henries 130 M.A.	**4.50**
R-196 —Filter Choke—29.6 henries 85 M.A.	**3.00**
T-5872—Output—2A3 P.P. to 8 or 4 ohms	**3.50**
T-5873—Output—2A3 P.P. to 500 ohms	**3.50**
T-5870—Interstage 56 P.P. to 2A3 P.P.	**3.75**
T-5741—Input Transformer	**3.75**
T-3020—Microphone Transf.—Double Button	**5.00**
T-2876—Phono Pick-up Coupling Transformer	**3.00**

Full size layout drawings of the amplifier and power supply, each 11-in. x 15½-in., will be sent by Thordarson Electric Manufacturing Co., 500 West Huron Street, Chicago, Illinois, upon receipt of 10 cents in stamps.

RCA-800 TUBE CHARACTERISTICS

(Continued from Data Sheet No. 4 on facing page)

Class C amplifier from flowing through the secondary of the output transformer. This may conveniently be accomplished by the use of a parallel feed arrangement (condenser and choke). If the secondary is to carry the DC plate current of the modulated amplifier, the core should be made larger and include an air-gap, to compensate for the DC magnetization current.

As a **Class B and Class C radio-frequency amplifier,** the 800 may be used as shown under CHARACTERISTICS.

In **Class B** service, the plate voltage is unmodulated DC and the grid excitation is radio frequency modulated at audio frequency in one of the preceding stages. For this type of operation, the plate dissipation should never be allowed to exceed 35 watts.

Grid bias for the 800 as a Class B amplifier should be obtained from a battery or other DC source of good voltage regulation. It should not be obtained from a high-resistance supply such as a grid-leak, nor from a rectifier, unless it has exceptionally good voltage regulation.

For **Class C** service, grid bias may be obtained from a grid leak of about 10000 ohms, from a battery, from a rectifier of good regulation, or from a self-biasing resistor (preferably variable) bypassed by a suitable condenser. The self-biasing method is especially desirable, due to the fact that the grid bias is automatically regulated and that there is little chance of the plate current becoming dangerously high, regardless of whether the r-f grid excitation is applied or not. When the grid leak method of obtaining grid bias is used, there is bias on the tube **only as long as the r-f grid excitation is applied.** For this reason, one of the other methods of obtaining grid bias is generally to be preferred. Since grid bias values are not particularly critical, correct circuit adjustment may be obtained with widely different values.

The **DC grid current** should never exceed 25 milliamperes. The exact value will depend upon individual tubes and circuits.

At **frequencies** as high as 60 megacycles, the 800 may be used at full ratings. At still higher frequencies, the plate voltage should be reduced, the reduction being accompanied by a corresponding decrease in power output. The tabulation below gives the plate voltage rating and approximate output of the 800 at frequencies between 90 and 200 megacycles (wavelengths between 3⅓ and 1½ meters).

FREQUENCY	90	120	150	200	Megacycles
PLATE VOLTAGE (max.) (Class B Telephony (Class C Telegraphy)	1125	1000	875	650	Volts
PLATE VOLTAGE (max.) (Class C Telephony)	900	800	700	500	Volts

If more power output is required than can be obtained from a single 800, two 800's may be used either in parallel or in push-pull. The parallel connection provides approximately twice the power output of a single tube without an increase in exciting voltage, while the push-pull connection gives twice the output, but requires twice the r-f excitation voltage; with either connection the grid bias is the same as for a single tube.

The push-pull arrangement is advantageous in reducing the shunting effect of the interelectrode capacities, inasmuch as these capacities are in series. This reduction is especially desirable when the tubes are operated at the higher frequencies.

When two or more 800's are operated in parallel, a non-inductive resistance of 10 to 100 ohms should be placed in series with the grid lead of each tube, close to the grid cap, to prevent parasitic oscillations. The use of such a resistance will result in a slight loss of efficiency.

Careful handling and conservative operation of this tube will increase its life and will give more satisfactory performance.

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RADIO's Practical Data Sheets

DATA SHEET NO. 6

Rectifier and Filter Systems for Low and High Power

CHARACTERISTICS OF RECTIFIER TUBES. RESISTOR VALVES

80 Rectifier (Full Wave)

5 volt, 2 amp. filament. The most inexpensive Rectifier tube. Suitable for low-voltage filter sytems for low-power transmitters where not more than 550 volts is used, with choke of at least 20 H. However, it is advisable to limit this tube to voltages of 350-400.

83 Rectifier (Full Wave)

Mercury Vapor Type, for higher-voltage. This tube will handle 500 volts and is widely used in amateur transmitter filter circuits. Has 5 volt, 3 amp. filament. Can be used in bridge circuit for higher voltages, as shown below.

5Z3 Rectifier (Full Wave)

5 volt, 3 amp. filament. Ideal for amateur transmitter filters. Will handle 500 volts at 250 MA. Choke input can be used, and peak plate current thus considerably reduced. Improves regulation. Its use highly recommended.

866 Rectifier (Half Wave)

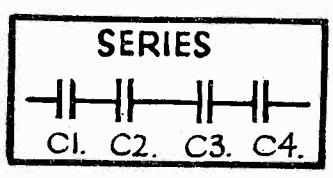
The amateur's high-voltage rectifier. 2.5 volt filament, 5 amps. Will handle up to 7500 volts at 0.06 ampere. Two required for full-wave operation. Plate terminal connects to cap on top of bulb. Can be used in bridge circuit for higher voltage.

SHUNT RESISTOR UNITS FOR IMPROVED OPERATION

In all but the smallest of rectifiers, improved operation will result if the output from the DC end of the filter is shunted by a high resistance unit. This resistance prevents the voltage from rising too high. It also protects the filter condensers and allows any accumulated charge to leak off quickly when the load is taken off. Heavy duty resistors are needed. The table shows the proper values. If heavy duty resistors are not used, the resistors will heat appreciably. The use of these shunt resistors also prevents "shock" to the operator when accidentally touching the high-voltage terminals.

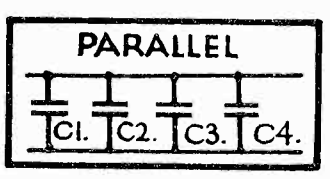
Voltage Output of Rectifier	Resistance of Shunt Resistor	Resistor Rating in Watts	
500 volts	50,000 ohms	50 watts	Approximately
1000 volts	100,000 ohms	100 watts	
1500 volts	150,000 ohms	150 watts	
2000 volts	200,000 ohms	200 watts	
2500 volts	250,000 ohms	250 watts	
3000 volts	300,000 ohms	300 watts	

BANKS OF ELECTROLYTIC CONDENSERS IN SERIES, PARALLEL, OR SERIES-PARALLEL

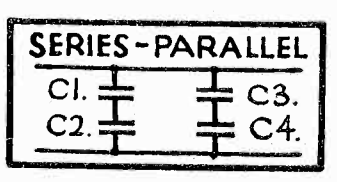


SERIES CONNECTION OF FILTER CONDENSERS.—If C1, C2, C3 and C4 each have a capacity of 8 mfd, each at 450 volts, this circuit arrangement gives a capacity of 2 mfds. at 1800 volts.

PARALLEL CONNECTION — If C1, C2, C3 and C4 each have a capacity of 8 mfd. at 450 volts, this circuit arrangement gives a capacity of 32 mfd. at 450 volts.



SERIES PARALLEL CONNECTION—This circuit arrangement gives 8 mfd. at 900 volts, if C1, C2, C3 and C4 each have a capacity of 8 mfd. at 450 volts.



CHOKES

SOME amateurs use but a single choke in the filter unit, with but one filter condenser. This arrangement has given satisfactory service, although the use of two chokes and two or more condensers will result in better filtration. Chokes should be large enough to carry the milliampere load which is being exerted from the filter. Chokes should be operated below their maximum rating, else they will lose much of their effectiveness and hum will result. Cores and metal cases of chokes should be grounded, or well insulated from ground. Grounding is the more desirable. Chokes should have a low DC resistance; the lower the DC resistance (the inductance remaining the same), the better the performance. Construction of choke coils for transmitters will be treated in a subsequent Data Sheet.

RECTIFIER AND FILTER CIRCUIT DIAGRAMS

Five Circuit Diagrams here show various filter systems used for Amateur Transmitters. The one shown in Fig. 3 is most widely used. C1, C2 and C3 are 8 mfd. 450 volt filter condensers. "R" is a shunt Resistor (see table above) across the output terminals.

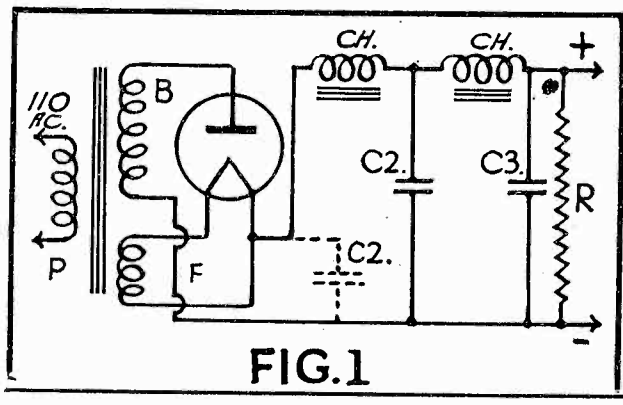


FIG. 1

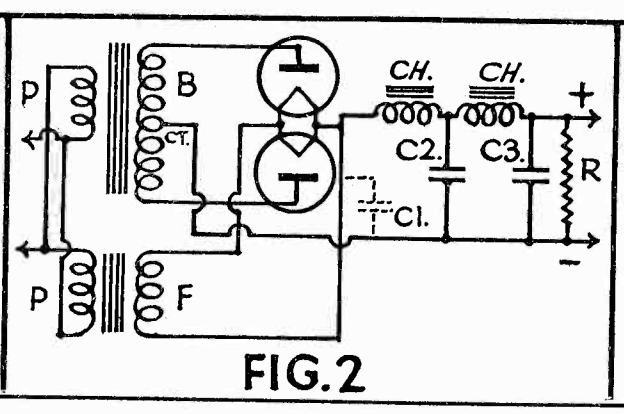


FIG. 2

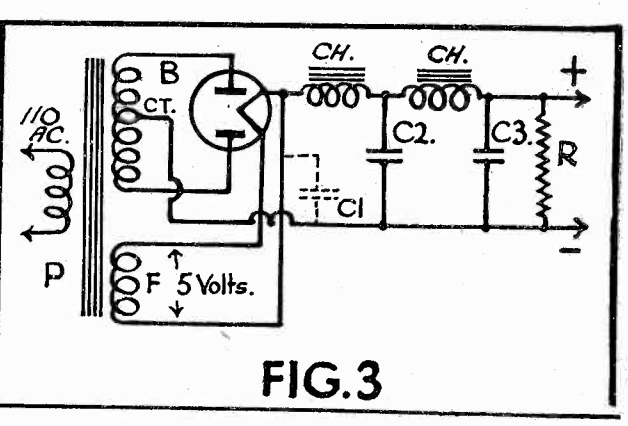


FIG. 3

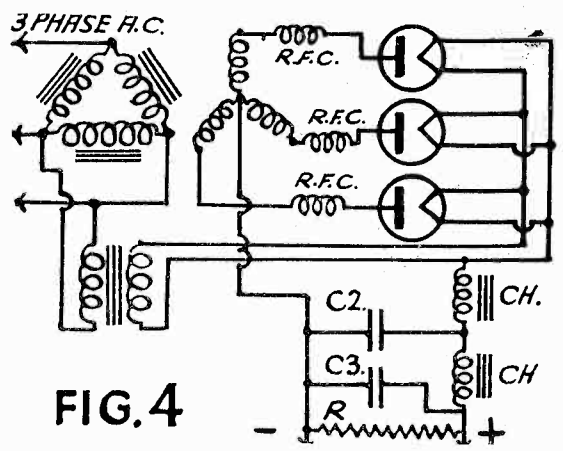


FIG. 4

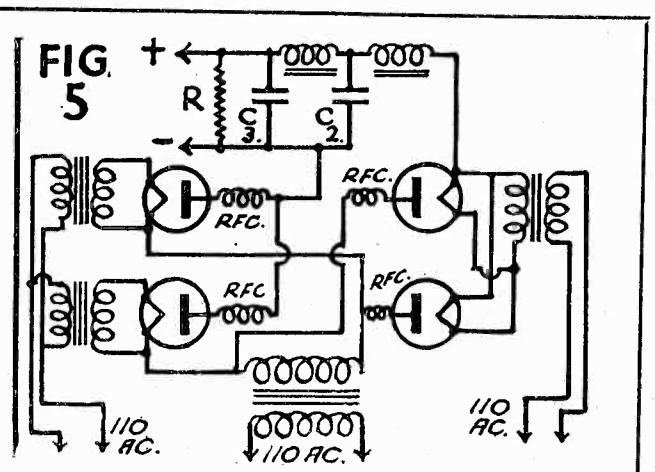


Fig. 1—Half Wave Rectifier, using one '81 tube.

Fig. 2—Two Half Wave '81 tubes as Rectifiers.

Fig. 3—Full Wave Rectifier, using one '80, '83 or 5Z3 tube.

Fig. 4—Three Phase Rectifier for High Voltage. This system uses 66, 66-A, 72 or 72-A tubes.

Fig. 5—Bridge Rectifier using Transformer that has no center-tap.

A bank of 450 volt, 8 mfd. filter condensers (electrolytic) connected in series parallel, is a very satisfactory method for filtering medium power rectifiers.

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THE SUPER-HETERODYNE
Its Theory and Operation

By D. B. McGOWN

CHAPTER V

THE modern de luxe superheterodyne uses several stages of "tuned radio-frequency" amplification ahead of the detector, or mixer tube. The tuned radio-frequency system comprises amplifier tubes and interstage coupling transformers, all operating at the frequency of the incoming signal. The use of several stages of radio-frequency amplification is advantageous for several reasons. Successive stages of tuned circuits between the amplifying tubes provides a high degree of selectivity because signals differing only slightly in frequency from the signal desired will not be passed through the successive tuned circuits. Another factor is the "detecting" or "demodulating" action of the detector or mixer tube, especially when the latter is a triode. The efficiency of the detector as a rectifier, on which its action depends, increases as the input voltage is increased, and hence the operation of the system is improved. The use of several tuned stages also reduces "noise" due to atmospherics (static), extraneous interference from electrical equipment in the vicinity, as well as the rejection of broadly-tuned radio-frequency signals which may be present when the receiver is used in a location close to a powerful transmitter nearby.

The first superheterodyne receivers using radio-frequency amplifiers were built with triode, or three element tubes in the radio-frequency stages. These tubes were used because no others were available. Usually the 27 heater-type tubes were used, although some systems used the '99 and '01A. The operation of any of these tubes in multistage tuned-radio-frequency amplifiers calls for some circuit arrangement in which either the grid or plate circuit, or both, of the various tubes are tuned to the same frequency. When this condition exists, due to the capacity coupling that exists in the tubes themselves, between elements or between coils or leads, or to other stray capacities, feedback conditions take place which may cause oscillation in the radio-frequency tubes and thus the operation of the system as a radio-frequency amplifier will be very unsatisfactory. This effect usually becomes more apparent as the capacity of the tuning condensers is decreased, and the tuned circuits thus become more efficient. The operation of such an unstable amplifier in the "front end" of a superheterodyne is not satisfactory, and hence special means must be taken to eliminate this oscillation.

"Tuned-radio-frequency" receivers were quite popular at one time, and were the subject of considerable research and development to obtain satisfactory amplification by using triodes without oscillation over the entire broadcast band. Two common methods were used. The "neutralizing" method, and the "losser" method, sometimes called the "grid suppressor" method. In the neutralizing method, in order to prevent oscillation due to feedback, another feedback is intentionally introduced so that the voltage set up in the second feedback arrangement is equal in value and opposite in phase to the grid-plate capacity. Referring to Fig. 10 we see a typical tuned r.f. amplifier, but one stage being shown for simplicity. The dotted lines represent C-1, which is actually the grid-plate capacity of the triode tube. The secondary, or grid coil of the next tube is tapped at the point X, which is a point selected where the potential

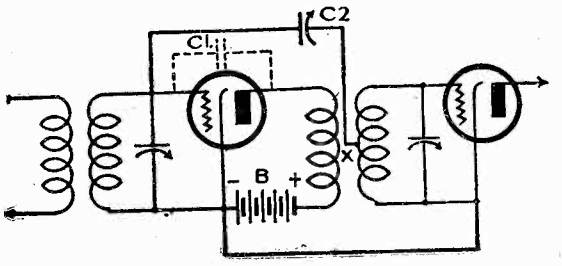

FIG. 10

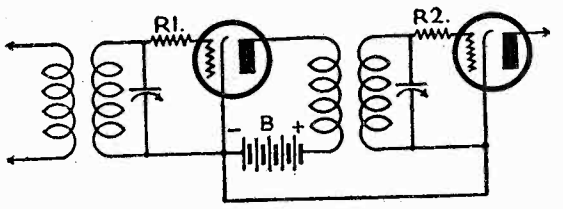

FIG. 11

is equal to and opposite that of the plate. By carrying this potential through a condenser, C-2, back to the grid, the reaction which tends to produce oscillations is cancelled, and the oscillatory condition is stopped. This permits the tubes to operate at radio frequencies, without oscillation taking place. Several other similar methods of neutralizing have been employed, but they all make use, in some form, of the equalizing of potentials at various points in the circuit, by inductance and capacity combinations. They might even be considered as the reciprocal of the regenerative oscillating circuits previously described.

Another more simple system, easier to set up, but which is purely an arrangement for reducing the operating efficiency, is the method of introducing a series resistor in the grid lead. This arrangement is shown in Fig. 11, a single stage radio-frequency amplifier, coupled to the grid of a second stage of similar amplification. It will be noted that in this circuit resistance units R-1 and R-2 are connected between the tube grids and the tuned circuits. The function of these resistors is to introduce so much resistance into the grid circuit that oscillations will be prevented by the high ohmic resistance of the resistor units. In practice, these resistors average about 1000 ohms each, and are connected directly to the grid terminal of the tube socket. While quite effective in suppressing oscillations, they decrease the efficiency of the system materially. They were used, however, in many commercial sets, especially in the cheaper types of receivers. They also provided an "out" for certain manufacturers who, through patent restrictions, were unable to use other methods.

Triode tubes were not particularly well suited for radio-frequency service, chiefly because they had a rather low voltage amplification ratio, and hence gave relatively low voltage gains per stage. Usually, when triodes were used, it was necessary to use three, and in some cases four stages of amplification to raise the input voltage high enough to give the required detector grid swing. This necessitated very careful adjustment of all parts, and also involved the accurate matching of some four or five tuned-radio-frequency stages in order to give the single control feature necessitated by the demands of the trade. The problem of building a receiver with several carefully aligned and matched tuned stages is a complicated one, and does not lend itself to easy and rapid production in factory work. Nevertheless, the problem was solved, and satisfactory receivers were placed on the market.

The development of the "screen grid", or 4-element tube was a very notable step forward for all types of receivers using radio-frequency-amplification. If an additional screen-mesh electrode is introduced into a tube, and placed so it surrounds the entire plate electrode, this "screen" forms an electrostatic shield between the plate and grid. Usually this screen is made positive in potential with respect to the cathode, and this potential is usually about ⅓ to ½ the normal plate potential.

This screen is constantly held at a fixed positive potential with respect to the cathode (or filament), and thus the screen potential is not changed by the action of the received signal. The plate current, on the other hand, is varied, due to the variation of the control grid, which is located close to the cathode.

Because this effect is usually produced in a triode tube by the inter-electrode capacities, and because in the screen grid tube the capacity between the plate and control grid is effectually neutralized by the presence of the screen, the usual statement is made that that grid-plate capacitance between the plate and control grid is nearly zero. Some confusion has arisen because when a screen-grid tube is measured, when removed from a set, there is considerable plate-control grid capacity. This is erroneous. The low plate-control grid capacity condition exists only when the 4-electrode screen-grid tube is set-up in a proper operating circuit, with proper polarizing potentials on the various electrodes.

The amplification ratio, or "mu" of a screen grid tube is very high, indeed, as compared with the usual triode. By amplification factor we mean the measure of the effectiveness of the grid signal voltage relative to that of the plate voltage in effecting the plate current. Expressed in simpler terms, we might say that the amplification factor of a tube represents an approximate equivalent to the voltage step-up ratio produced in a tube, when the grid is supplied with alternating current. This means that, other things being equal, the higher the amplification constant of the tube, the higher the output voltage, with a fixed A.C. input voltage.

In the average radio receiver the input voltage is usually a relatively constant value, depending on numerous factors, chief among them the antenna, or pickup efficiency, and the signal strength of the received signal. If the pickup and input voltage is the same, and the voltage change can be increased inside the receiver, by the use of a different tube, a higher signal output will result. This is exactly what the screen-grid tube permits. It not only allows the construction of a satisfactory r.f. amplifier without extraneous oscillation, but also allows a higher gain per stage in the r.f. circuits. Because the actual numerical gain in voltage is considerable, this condition allows simpler construction and the use of less elaborate equipment to accomplish the same result when screen-grid tubes are used in place of triodes.

Follow this Course Each Month in "RADIO." Future Chapters will deal with Design and Construction of Modern Short-Wave Supers.

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Answers To Last Month's Old-Timer's Questions

(1) The "pump handle" was the name given the knife-switch-like telegraph key used in foreign land stations and on foreign ships, because of its awkward placement at the edge of the operating desk and also because of the very stiff spring which was used. It was necessary for the operators to stand up while sending, which accounts for the choppy and uneven "fists" of many foreign radio operators many of whom, to this day, have not accustomed themselves to the swing of the modern telegraph key.

(2) Living trees were used as receiving aerials by General Squier, Chief Signal Officer of the U. S. Army during the war period. Assisting him in the experiments was Paul R. Fenner, editor of this magazine before the world war, and now an Inspector for the Federal Radio Commission. The experiments with living trees proved that better signals on long waves could be received than when ordinary antennas were used. About half way up the tree a large number of copper nails were driven into it, in the form of a semi-circle. The heads of these copper nails were connected together and a lead-in wire brought to the receiving set. POZ (Germany) on a wavelength of more than 2000 meters was received with greater signal strength than when any other type of antenna was used. Measurements showed that the resistance of the tree was about 5,000 ohms per foot.

(3) The original Poulsen "Tikker" used two vibrating wires of solid gold. These wires were made to vibrate by a buzzer and they opened and closed a circuit to a pair of headphones, shunted with a large condenser. The incoming oscillations were interrupted by the gold wires and the condenser was charged by the oscillations, or discharged by the phones. The resultant note was a rather rough, hissing sound, similar to that of a distant arc transmitter.

(4) The Bellini-Tossi radio goniometer was a radio compass arrangement using two crossed loops. The original form, used aboard ship, had two inverted "V" loops. A secondary coil which formed the input or detector circuit could be rotated inside the crossed coils and the relative bearing of a distant station determined by the difference in pickup from the primary coils. Using much amplification and sensitive apparatus, it is in successful use today on many foreign vessels, and gives admirable results as a radio compass system.

(5) Old-time high-power transmitters used from 100 to 500 KW. These included spark, arc and alternator systems. The high-power Marconi stations used rotary spark gaps which were housed in thick-walled concrete chambers. The noise of the spark discharge was so loud that it could be heard for miles when the spark-gap chamber doors were opened. Contrast this with present-day tube equipment with but a few KW and world-wide range.

(6) The most difficult problem for early radiotelephone experimenters to solve was the means for varying or modulating the carrier. Arcs and alternators supplied high output to antennas but modulation presented a more serious problem. Usually a bank of carbon microphones in series or series-parallel was used in the transmitting antenna circuit. The speech caused direct variations in the output, by a direct variation of the resistance of the microphones. Imagine the embarrassment of the operator, trying to modulate kilowatts of r.f. energy with a few grains of carbon. Yep, them were indeed the good old days.

* * * *

OLD TIMERS QUESTIONS (See next month's issue for answers)

(1) What did the United Wireless Telegraph Operator at "PH" write in his log book regarding the flies that annoyed him while receiving distant signals?

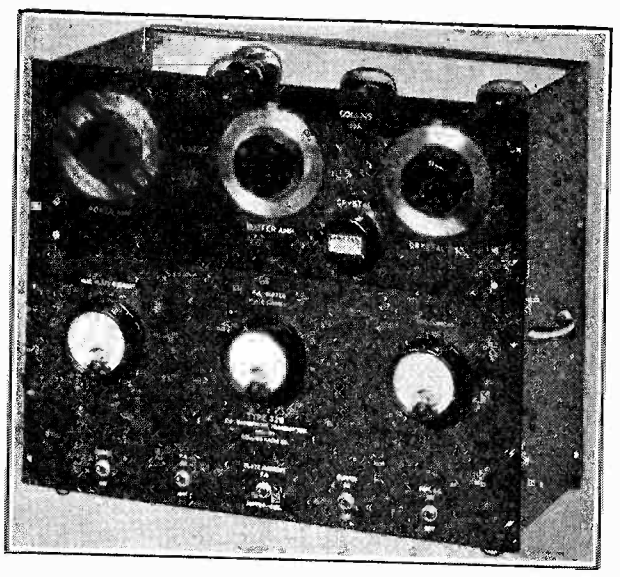
(2) Why were block-and-tackle used to change wavelengths of old-time high-power transmitters?

(3) What happened, in "ye good olde days", when a commercial ship operator was fired by the operating Company?

(4) Why were "Cerusite" detectors secured to shipboard operating desks with bolts and Yale locks? Who was in possession of keys to unlock them?

(5) What phenomena is advanced today as the reason for such remarkable reception with crystal detectors twenty years ago, consistent reception by land stations of ships 6000 miles from shore?

COLLINS NEWS



The popular 32B is making new records every week for international QSO's on 14mc. phone and 7mc. CW, and is setting new standards for quality on 3.5mc. The 32B is the outstanding value in 25 watt crystal-controlled CW-phone transmitters.

The 4A is the latest Collins Transmitter. 20 watts CW output, crystal-controlled with self-contained dual power supplies. ". . . . worked all districts in U. S. and Canada first few weeks of operation." . . . . . "reports QSA5, R6-8, ccdc." — — usual reports from 4A users. And the price is **low.**

Class B Transformers for 830, 800 and RK-18 tubes available.

WRITE FOR FULL DETAILS

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DONALD K. LIPPINCOTT
HERBERT E. METCALF
Registered Patent Attorneys
~ Radio Engineers ~

57 Post Street GArfield 3316
San Francisco, Calif.

The Commercial Brass Pounder

A Column of Interesting News For the Commercial Radio Operator

By WAYNE P. PASCHAL

THE "COMMERCIAL BRASSPOUNDER" is dedicated to the men who have made possible the interest, practicability and success of radio as we know it today. It is for the express purpose of placing before the American public the facts of the Profession, to offset detrimental motives and to create a favorable interest in the behalf of the men who fearlessly serve the needs of our National Communications. The "COMMERCIAL BRASSPOUNDER" will bring you, each month, the latest news of the Profession.

NEWS RECEIVED from the President of the American Radio Telegraphists Association, Incorporated, a National Organization with headquarters in New York City, states the Code submitted by the National Association of Broadcasters calls for a minimum salary of $15.00 per week of forty-eight hours. No stipulations were made concerning overtime, extra-duties, etc. This apparently was agreed to by all stations. A protest will be made by the Operator's Organization, with submission of stipulations along the lines of those in the "Radio Operator's Code" for land stations. This will call for a minimum of $200.00 per month, and a week of thirty-six hours.

THE Airways Transport Industry asks a minimum of $80.00 per month, with no provision for subsistence for operators while flying. This apparently will be the suggested salary for all operators in the industry. This code has been protested by the Operators Association, who suggested a minimum of $165.00 per month, with fifty per cent of the base salary added as subsistence, unless the same is included. According to reports, this suggestion was favorably received by the officials of the National Recovery Administration. Recommendations are yet to be made to General Johnson and President Roosevelt. However, it seems that the Operators Organization is in a favorable position.

No report has been received concerning the submitted code for Radio Operators. Partial reports of this code were carried in this magazine in the issue for August, under the title of "Radiotorial Comment". The code submitted covered all phases of the Radio Industry. There seems to be a consideration that the code for the Operators will be used as a basis of comparison for other codes to be submitted by employers.

THE Federal Radio Commission has informed the Association that it will not consider the lowering of the standards of the Radio Operator, and that no suggestions for other licenses, allowing double duties, will be considered. The Commission is anxious to receive reports from the Association, and will be glad to hear all suggestions. The Commission wants reports of poor conditions, poor equipment and violations of law, whenever possible to report.

IN SAN FRANCISCO two steamship companies have promised reports on the developments of their codes in regard to Radio Operators. The United Fruit Company (Tropical Radio) raised the wages of their operators when it signed the NRA blanket code. Some companies have reported they intend to do nothing until pressure is brought to bear.

HEADQUARTERS of the American Radio Telegraphists Association, Inc., in San Francisco are located at the St. James Hotel, 87 Third Street. A room has been secured for an office, and meeting dates will soon be announced. All operators are welcome. A bulletin and general information service is available. Call at any time; you are always welcome. Dues and registrations can be paid to the authorized representative.

OPERATORS should belong to an organization that is alive, one that is doing something for the betterment of conditions. The standards of radio operators, generally, can be raised only by a national organization. The codes accepted by the National Recovery Administration have assured collective bargaining. The radio operators need such a code.

SPEAKING of organization reminds us of a phrase or paragraph that we ran across in reading a book entitled "Man's Rough Road" by Prof. A. G. Keller. We quote:

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The Commercial Brasspounder

(Continued from Page 30)

"Organization is the culmination of ideas, and efforts of many, into a great thought benefitting the body. It seems that organization is something like an army that overwhelms the enemy, not necessarily through force, or intimidation by overwhelming numbers, but through legislation or suggestion."

This is the way, and the only way, for operators to bring about the much needed "grand-scale" adjustment. The old order changeth, and the radio operator looks to the dawn of a new day.

—

A WELL-KNOWN steamship line plying the east coast is paying its second operators 16 cents per hour for an eighty-four-hour week. Another steamship company pays its operators eighty-five dollars per month, and an extra fifteen dollars for freight work. Some years ago the operator was paid ninety-five dollars a month, and the freight clerk sixty dollars. However, most of the lines pay their operators over one hundred dollars per month for Purser-Operator combination jobs.

—

WE HAVE heard that operators were generally an easy-going lot, easy to mix with, and always willing to help. But we think the limit is reached when a man thinks so little of his profession that he is willing to take a berth with a company paying the total sum of sixty dollars per month, for which he is required to work an eight-hour watch in the engineroom as a wiper, and do a regular radio watch as well. It is understood that this same operator was employed through the company office. He was assigned (by the captain), to the mess-room, where wipers usually eat their meals. He protested, and was placed in the Salon with the officers. Finally the Wiper-Operator decided that he was disliked, and quit the ship.

—

HOW many Intercoastal Operators think about weather schedules on both coasts? When the California and Oregon-Washington coast lightships send their weather, some American Operators open up for a rag chew. The Pacific Coast Lightships send their weather at 8 a.m., noon, and 8 p.m. It will be greatly appreciated if all operators will remain quiet during that period, which is normally not more than ten minutes. Information on this subject is in "Radio Aids to Navigation". It is a good book, costs 75 cents from the government, and tells a lot that the average operator doesn't know. Get a copy, read it, and then think twice before you open up for some "personal QRM".

—

FEW operators know that the Navy and Coast Guard have calls especially designated to raise them? NCU will get any Coast Guard vessel or station. NERK will call any Naval Ship, NQO any Naval Land Station. Imagine an operator, with years of experience, calling "COAST GUARD PLEASE" on six hundred meters (500 kilocycles).

—

IF YOU don't already know, Naval and Coast Guard Ships do not charge for messages received for their personnel. Also, they accept Government Weather reports free for forwarding to the "Observer". It seems superfluous to mention this, but after listening for a couple of months this information should be repeated in each issue.

—

FOR the benefit of operators who are on the beach or otherwise unemployed we repeat that the Federal Radio Commission has announced that no "Commercial License" of any class needs service for renewal, provided it expires before July 1st, 1934, and is presented for renewal before the expiration date. Some operators must like to take exams, judging from the number of expired licenses floating around.

—

NEXT month's column will contain items of personal interest, the doings of well-known operators, and assignments of operators in the various companies. Look for NRA developments that you may not find in newspapers.

—

INQUIRIES for this column, questions to be answered, and other material requiring a reply must be accompanied by a self-addressed stamped envelope. Address all inquiries to the writer, care of this magazine. Material from readers is requested, and will be given every consideration for publication. When sending material for publication please use the "mill."

INTERNATIONAL DX'ERS ALLIANCE

"The I. D. A. is a world-wide Radio Honor Organization, organized solely for those Dx'ers who are interested in Foreign reception on the Broadcast Band. It is restricted in membership, to those having verifications of Foreign Stations on the B.C. Band, and at least 2,000 miles away. Those entering the I. D. A. now will be just in time for the 'International Dx Contest'. Write for monthly Bulletin, the GLOBE CIRCLER, and Application blank, to the International Dx'ers Alliance, Bloomington, Illinois, U.S.A.

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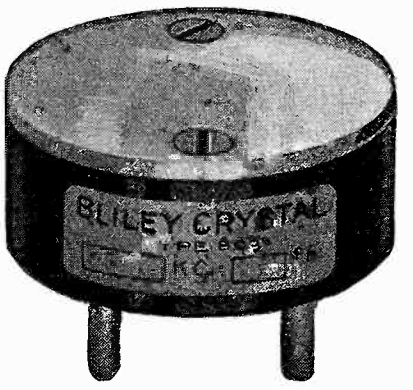

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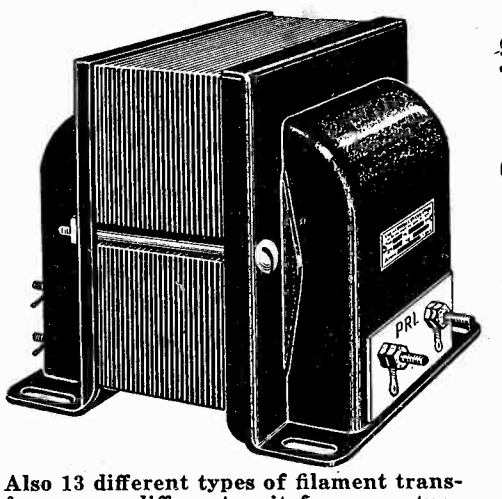

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In Defense of the Commercial, and Amateur, Too

The Editor, "RADIO",
San Francisco, Calif.

Dear Sir:

I am an amateur of the amateurs and have constructed and operated most everything in radio since the first set in 1907 when a spark coil operated a coherer and tapper a few miles away. But I have also found it necessary to earn a living for myself and family and have been also connected with most everything in commercial wire and wireless telegraphy for a quarter of a century.

It happens that, at the present time, my bread and butter come from trans-Pacific traffic which Colonel Foster delights in handling entirely free of charge because certain people in the Orient can not afford to pay for the messages. However, he overlooks the fact that these people are, for the most part, employed and it would seem that perhaps they can just as well afford to pay for the messages as the hundreds of poor fellows "on the beach" at the present time can afford to go without a job. Now the average operator in commercial point-to-point service at the present time handles about three hundred messages per day and when we see that certain amateur stations in the Orient handle two or three thousand messages per month, perhaps we wonder a bit. And I am not speaking for myself. But there is a large percentage of amateurs who are also commercial operators and not a few of them are "on the beach" at the present time. Those who understand the situation are looking for extension of commercial radio point-to-point service as a way out of their difficulties, and some of them are thinking about the "continental frequencies".

However, there is room for all and if you don't believe it, just turn the dial of a good tuner from 15000 to 3000 KC and see the wide open spaces. Therefore, our problem is a common one and Col. Foster's antagonistic tone is entirely unnecessary. Let's pull together. Perhaps a little further thought will cause him to see that when he hears the V slips running, they are paying their way and that great corporations don't pump forty kilowatts into the ether just to make a noise or to annoy the amateurs. Also they don't do it to "hold the frequencies" either, because that is unnecessary. Because of the difference in time, traffic with the Orient is all westbound in the daytime and all eastbound at night, the answering channels must run V's and they must also run V's during transition periods and be ready when needed. Especially during the depression it is very unhealthy for a supervisor to run channels unnecessarily and "it just ain't being did."

Now it was a pleasant surprise to find a familiar "RADIO" cover on the newsstand, and pleasant recollections of Best supers immediately presented themselves and my files show a great many similar covers now yellow with age. More power to you and keep up the good work. We amateurs should have more room and I feel confident we will get it.

But we can stand a bit of housecleaning from the QRM standpoint ourselves. The other night I listened to two high powered ruff stations in the bay region trying to handle a message on forty meters. The receiving station was two blocks from me and I had a very simple portable receiver. I counted the same word repeated more than twenty times very clearly and without noticeable QRM. They spent an hour and five minutes on that message and then I don't believe he had it right. Incidentally, the text was "Greetings By Radio" MIM-MIM MIM MIM. Now it would seem that that kind of thing could as well be handled on some frequency not so badly crowded and with something less than self excited push-pull 500 watters with full power. It would also seem that those folks could get a great deal of enjoyment out of radio without worrying about BPL and traffic totals. I have no objection to messages when they don't jeopardize anyone's living and serve a useful purpose. During the earthquake I came home after eight hours pounding a mill for dear life and with eyes dim from the moving tape and copied and foned quake messages until morpheus got me down. Just the unspoken gratitude of one little old lady paid for all the crystals, tubes and transformers that I own. She didn't know what amateur radio meant, or who I was, but she did know that a voice on the telephone said her folks were safe.

The beginners are going to mean our undoing if we don't look out. High school boys do a lot of different things and surely we should insist for the good of all that they get a fair start with a buzzer and have the ability to copy a message before they start flinging signals across the ocean. If they must make the BPL, let them do it without taking ten times the time on the air necessary to do it and letting Shanghai hear the message they are sending fifty miles.

Now here is a practical suggestion which should help for a starter: The ten meter band can be extended way up into more useful territory without costing anybody a cent or arousing any opposition. In fact, I believe it can go pretty close to 18,000 without much being said or perhaps the FRC would be willing to create a new band from 18,000 to 23,000 if it could be done without jarring Madrid and I am sure we would find a lot of things to do there. Maybe we could show a lot of dumb engineers how to make that band good for something.

The end of the sheet is coming so here's best wishes once more for your valuable paper.

Truly yours,
M. A. FRYE (W6LQ)

●●●

Engineering Data On Side-Bands

Technical Editor of "RADIO",
422 Pacific Building,
San Francisco, Calif.

Dear Sir:

On page 13 of the June issue of "RADIO" I note this question: "What is a beat note, and why is it used?" A day or two ago I sent to the editor of "RADIO" a copy of an Indiana University DAILY STUDENT which gives the result of an experimental investigation along this line.

Some sixty years ago there was a controversy primarily between Koenig and Helmholtz as to the reality of combinational tones. When two tuning forks or two notes are sounded from a siren, the ear will detect a beat note. Koenig maintained that when he used two tuning forks it was impossible to tune the Helmholtz resonator to the frequency of the beat note, while Helmholtz, who used a siren, was able to tune a resonator to the beat note frequency. The same controversy appeared again some two years ago in England in EXPERIMENTAL WIRELESS, in which Fleming states that side bands are mathematical fiction.

Our results show that when two sine waves are added together it is impossible to produce a combinational tone. The combinational tone is one that will be picked up by some linear tuning device, such as a wave meter or a Helmholtz resonator. When two radio frequencies are combined through some non-linear device, such as a modulating tube or a detector tube, a product term is introduced which causes the combinational tones or side bands, which can be picked up in a tuned circuit. Simple addition of two notes will not give us combinational tones, although the ear will distinguish a beat note. In Helmholtz's siren the one tone affects or modulates the other through the common air chamber, thus producing a product term. So Helmholtz was right when he maintained that he could tune a resonator to the combinational tones for his siren. Koenig was right when he maintained that it was impossible to tune the resonator to the combinational tone of two tuning forks. Therefore, there is a distinction between combinational frequencies and beat frequencies.

In order to explain the beat note which is heard by the human ear we must assume that the ear is a non-linear device. In the experiment referred to it was also shown that side bands or combinational tones could be produced by linear devices if they were so arranged as to produce a product term. Simple addition does not produce side bands or combinational tones, while modulation or anything that produces a product term does produce side bands or combinational tones.

Truly yours,
(Signed) R. R. RAMSEY.

●●●

New Book Tells How To Make Extra Money

TWENTY-eight Tested Methods For Making Extra Money is the name of a new book just published by the National Radio Institute, Washington, D. C. This well-known radio training organization evidently realizes that many radio men are so technically minded that they overlook some of the simpler, more practical ways to make money. The twenty-eight ways selected for this book are well within the scope of the average reader of this magazine. Theory is purposely kept out of the picture which makes this a real "how to do it" manual. Instructions are right to the point and are backed up with over eighty illustrations, diagrams, etc., to make the twenty-eight ways as plain as possible. The price of the book is fifty cents, postage paid.

●●●

New Book On Angle Radiation

A. L. MUNZIG, W6BY, has written a complete book on the subject of Angle Radiation. It tells, from both the theoretical and practical viewpoint, how angle radiation effects the propagation of high-frequency signals. The book has rightfully been entitled "R9 SIGS". It deals with wave propagation, effect of fogs, wave distribution, current distribution, feeder design, critical vertical angles, ground and sky waves, and gives constructional data on practical antennas used by the author. It is a book for the amateur, written in his language, by an amateur himself. $1.00 per copy. Published by A. L. Munzig, Box 31, Redlands, Calif.

Short-Wave Station Changes

By "NYDXL"

(All times given are Eastern Standard)

HAVING run through the list of newcomers-to-the-air, it may be well to consider some of the stations which, though they are still on the air, have made alterations in their wavelengths.

HJ3ABF, the former HKF, heard for years on 39.4, is now in operation near 48 m., between 7 and 11 PM; they are heard practically every day, and though not the loudest, they are one of the most consistent Colombians on the air. Their location is Bogota, as the numeral "3" indicates. The Colombian government has taken recent steps to organize the radio systems of its country. For the purpose of assigning calls to amateurs and broadcasters (the two are more or less synonymous, since the use of c.w. has, up until now, been prohibited), the country has been divided into at least five districts, and these classes of stations are assigned "HJ", the number corresponding to their district, and a three-letter call, starting with "AB". These replace the old three-letter, "HK—" calls, which are now used for commercial stations; one exception to this rule is to be noted, namely that of the station of the Observatorio Nacional, in Bogota, which retains the old call, HKE.

A letter from the Trades Union Council in Moscow tells us that REN of that city is now on 45.38 m., instead of 46.6, as was supposed. We are not much concerned with this, however, since the station is not heard with any regularity in the USA, at any season of the year.

RV59, also of Moscow, is on 50.00 m., with 20 KW power, from 2-5 PM daily. This station is operated by the above Council, to whom reports should be addressed. The station is heard quite well in the eastern USA, during the winter months, but not during the summer, since too much light is prevalent for such a high wavelength to come through, at that time of day.

RV15, located in Khabarovsk, on the east coast of Siberia, has recently altered its wavelength to 70.75 m. They have been heard in the eastern USA, but are far more familiar to West Coast fans. At the present time their operation seems to be somewhat irregular.

Station "El Prado", of Riobamba, Ecuador, after a series of comparative tests (in which the members of the International Short Wave Club cooperated and played an important part) on their 39.8 and 45.31 m. waves, abandoned the former about a year ago. Their first transmitter was of 50 watts power, while the present one is believed to be rated at about 200 watts. It is rumored that they will soon have a new one kilowatt job. Their present schedule calls for transmission each Thursday, from 9-11 PM, and despite prevailing summer conditions Prado's enjoyable programs are regularly logged at this time.

VE9HX (the former VE9CF) of Halifax, N. S., is now operating on 48.98 m., as well as 48.80 m. (6147 KC); the latter is merely a test frequency and VE9HX seems to do most of its work, which is at present irregular, on 48.98 m. Reports on this station may be sent via VEIDD, W. C. Borrett, who is the director.

Another prominent Canadian station, VE9GW of Bowmanville, Ontario, has long been on 49.22 m. They now have an xmitter rated at about 200 watts. This station has recently been taken over by the Canadian Radio Commission and is on the air each Monday and Tuesday from 7-11 AM, Thursday and Friday from 11 AM-8 PM, Saturday 3-11 PM, and Sunday 11 AM-8 PM, according to a recent announcement. They do not, however, seem to adhere to this schedule very closely.

Let us now consider the outstanding stations which are heard in the USA at present:

The Empire stations of the BBC, especially GSB, on 31.55 m. and GSF, on 19.8 m., which are heard on the Canadian and West Indian Zone program, are coming in well at this time GSE, on 25.3 m. can be heard on the India, Burma, Ceylon, and Malaya program, from 10-12 AM, while GSD on 25.53 is heard nearly all afternoon.

The German stations, DJB, on 19.737 m. (from 7 AM-4 PM), and DJD, on 25.51 m. (from 11 AM-6 PM), employing antennas directional to North America, are being heard with terrific (!!) volume at present. DJA, on 31.38 m. uses an omni-directional antenna, and is heard with somewhat less strength DJC, on 49.8 m., is believed to be using a directional antenna also, since it is heard with fine volume on this high wave, through severe static. The outstanding characteristic of these stations is their wonderful quality; yet they claim that their maximum modulation is but 50%!

Last-minute tuning reveals a new station, on 49.3 m., in the evenings, around 9-10 PM. Two calls are given—one of these is "CP5". This is very probably the station in La Paz, Bolivia, which was mentioned as being ready to go into operation, in the July issue of the International Short-Wave Clubs publication.

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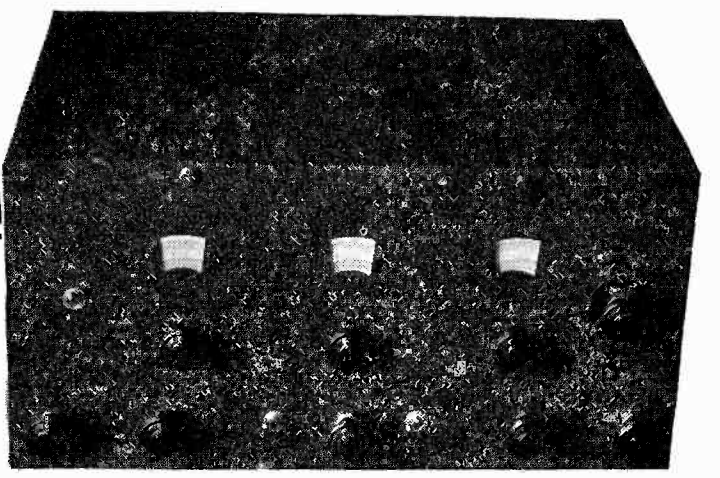

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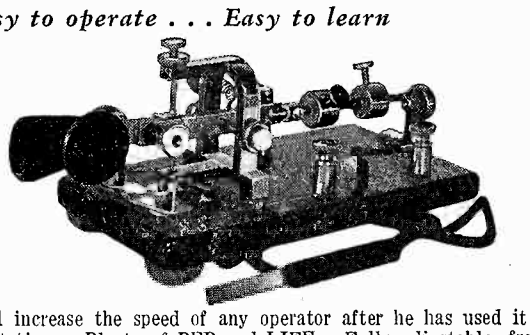

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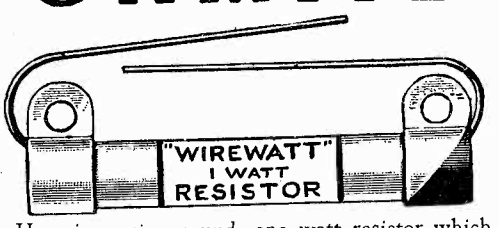

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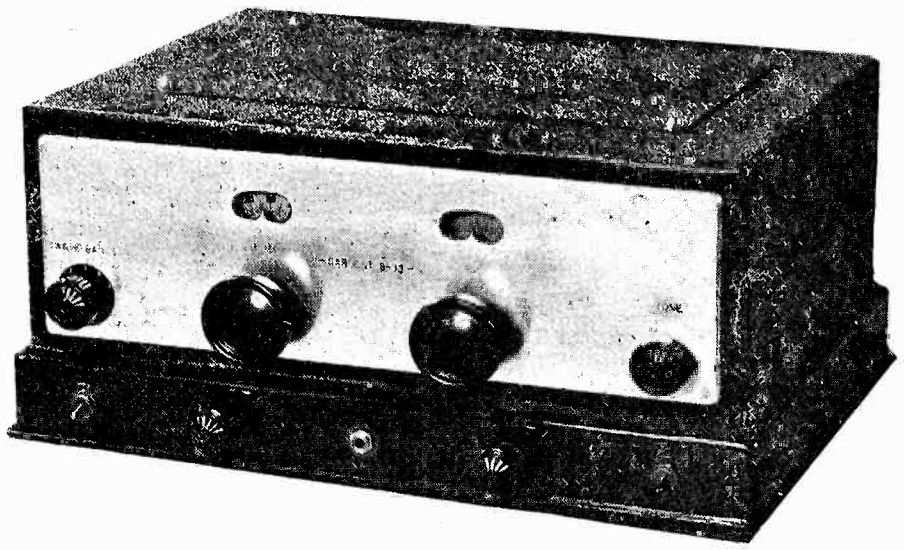

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● In response to numerous requests we are manufacturing the following for separate sale. **Tuning unit with coils, shield, tap swtich, band spreader and condenser. 290 K.C. Oscillator coil, condenser and shield. C.W. Oscillator coil, condenser and shield. Hookup blue print showing schematic wiring and all resistance and capacity values available.** Write for prices. Detailed building instructions are not available.

THE DX SEASON IS HERE . . .

Noise level is decreasing and already the European short-wave broadcast stations are beginning to penetrate to the West Coast. Never before has there been a receiver like the Sargent 9-33 on which to receive them. Due to its exceptionally low noise level stations which were formerly below the noise are now being heard. This is the finest all-wave receiver ever made available to the DX fan. It has every control demanded by the experienced operator, yet is so simple to tune that a novice can run it.

PHONE BAND AMATEURS . . .

Three times the selectivity that is theoretically possible on 465 is given to you by the 175 KC stage of I.F. Phone band amateurs are doing wonders with this receiver and working through interference that has been impenetrable. If you can HOLD your QSO with any set it will be with the 9-33. In most cases you can isolate the station with whom you are working. 70 degrees of the band spread for the 75 meter phone band. All districts heard here on 75 and 150 meter phone.

BROADCAST FANS . . .

Although designed primarily as a Short-Wave Receiver the Sargent 9-33 is excellent on the 200-550 meter broadcast band. Selectivity is the equal of any, and the receiver is MORE SENSITIVE than a great many that are designed especially for this band. There is no receiver that will outdo the 9-33 on Broadcast Band Reception.

LIST PRICE, including Power Pack, less Tubes and Speaker ..... $139 Plus Tax

Usual Trade Discounts apply.

TUBES AND SPEAKER

Tubes required: 2—2A5s, 1—2A7, 1—56, 3—57s, 1—58, 1—80. Speaker, dynamic, push pull output, field resistance 1000 to 1700 ohms, 80 mils. 5-point plug required for speaker connection.

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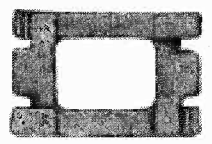

No. 31 Transposition Insulator

No. 32 Airplane Type Strain Insulator

JOHNSON

solves the transposition insulator problem—with characteristic JOHNSON thoroughness. A highly efficient design, fine quality porcelain, fully glazed, and at a surprisingly low price.

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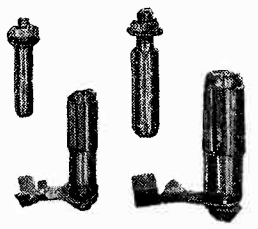
Ask for catalog 9-33-R on these new items as well as JOHNSON stand-off insulators, antenna insulators, transmitting tube sockets, etc.

Sold by practically all good jobbers.



New Plugs and Jacks —the first really designed for transmitting.

Hold the largest inductors without wobble or heating.

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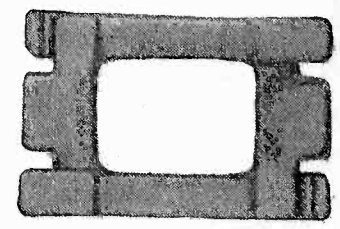
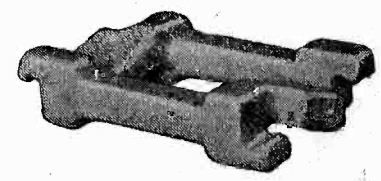
New Products

Transposition Insulator for Anti-noise and Antenna Transmitting Systems

A GLAZED porcelain transposition insulator of novel design for use in the feeder lines of anti-noise receiving aerials and transmitting antennas, is announced by the E. F. Johnson Company of Waseca, Minnesota.





Unlike previous devices for this service, the Johnson transposition insulator keeps the feeder wires in a continuous line throughout their length which eliminates the usual tendency for the feeder system to twist and get out of shape. There are no sharp bends at the point of transposition thus imposing a minimum of strain on both the conductors and the insulator and extending the probable life of the line. The skeleton type construction affords an unusually long leakage path between wires and consequently maintains a high electrical efficiency of the system even under conditions of sleet or wet weather.

Transposed feeders make possible the construction of noise-free receiving systems which function efficiently throughout both broadcast and short-wave bands. The antenna is located as far as possible from power lines and electrical apparatus. Since there is no pick-up on a properly constructed feeder line, it may be brought through intense noise fields without impairing the signal-to-noise ratio at the receiver. Transposed feeders have special advantages in connection with short wave transmitting antennas also. Transposition eliminates radiation from the feeders, assuming proper adjustments, which would otherwise distort the radiation pattern of the antenna itself, and in addition, a balance to ground is secured which improves the efficiency of the system.

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MAIL ORDER SERVICE TO ANY PART OF THE WORLD. STANDARD DISCOUNTS TO AMATEURS.

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National publications reaching millions of people—publications like the Saturday Evening Post, Collier's, the New Yorker, Popular Mechanics, the American Boy, the Chicagoan, Business Week, and so forth—will be used to announce the sensational news of the Kadette Junior. You know what this means. It will make this amazing radio development the most talked about and the fastest selling radio of the year.

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International started the vogue for the AC-DC radio! It swept the country and created sales running into millions.

Now International gives every radio dealer an opportunity to cash in on a brand new idea—the *pocket* radio. The public will be hot for it.

Every dealer—regardless of what makes of radios he carries—will surely want to grab off the sure-fire and immediate profits from this amazing new *pocket* radio.

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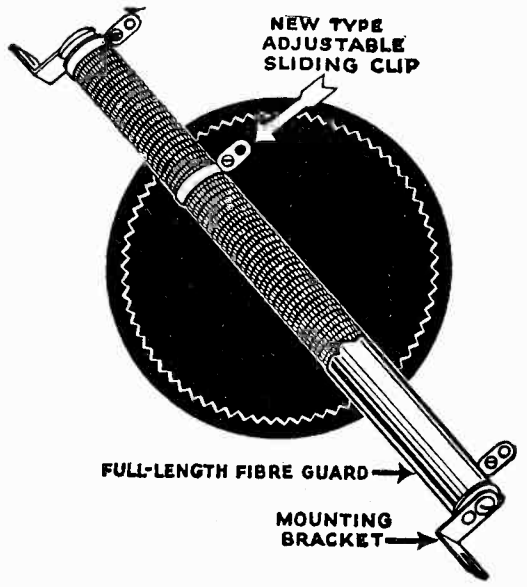

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MADRID

By COL. CLAIR FOSTER

(Continued from Page 5)

of amateur stations to transmit international communications emanating from third parties. The above provision may be modified by special arrangements between the interested countries."

and my critic's published report of Madrid:

"There is no change from a practical standpoint in our communications regulations".

If the Madrid "treaty" will incorporate just what my critic says the words "boils itself down to", (that and no other change from the 1927 wording), the amateurs of America, the public they serve, and the Congress of the United States will have no further cause for worry on this score.

But I tell you right now, fellows, you let the Senate ratify the amateur provisions of the Madrid convention as they stand, and then just you try to handle a message for or from any of the foreign countries with which you have had traffic, and see what will happen to you! The net change in your circumstances will boil down to this: You'll be praying that your wife or your buddy will slip you a hacksaw on the next Visitors' Day.

●●●

Modulation Defects As Seen By the Oscilloscope

(Continued from Page 8)

potential gradients in the tube will show why the effect cannot be linear. Surprisingly enough, this does not sound too bad if modulation is restricted to about 50 per cent.

This undesired fixed-screen condition sometimes appears when the set is supposed to be working with a modulated screen, simply because the screen by-pass has been made too large in capacity.

If the screen ONLY be modulated we have an effect like Fig. 14, with the familiar dull effect mentioned for Fig. 8, plus a very fine chance of burning up the screen.

Fig. 15 shows one of several silly effects which can be obtained by using odd combinations of stray regeneration and filters with incorrect time-constants—that is with such proportions of choke inductance and condenser capacity as will cause a resonance frequency in the audio range to appear and to send into the system additional "bumps" whenever the system is agitated by modulation. Though there seems to be no special reason why filters are more likely to be resonant when used with class B audio systems, this effect is more common with such systems, because they have plate-current variations which tend to aggravate such defects to the point of causing them to be nuisances. The possible combinations are very numerous so that the output may sound like anything at all and deceive one into suspecting one of the other effects shown before. It is like the old machine-shop gag that "You can make things any shape but round on a lathe—yet we use a lathe to make 'em round." In other words, such effects are present in all ordinary modulation systems and we simply aim to make them negligible by using large enough filter chokes and condensers, adequate shielding, careful neutralization, and especially through careful de-coupling of the various plate supplies.

●●●

Actually Heard On the Police Band

POLICE ANNOUNCER: "The holdup men escaped in a blue moon colored coupe, license unknown. Number one was a thin, dark man and carried a gun about six feet tall; number two was short and carried a dark blue steel nickel plated revolver."

And now . . .

Pyranol Condensers

Cornell-Dubilier pyranol-impregnated condensers are available in three standard D.C. working voltages: 1000-volt, 1 to 10 mfd.; 1500-volt, 1 to 6 mfd.; 2000-volt, 1 and 2 mfd. These units feature:

- 50% reduction in cubic volume and weight over previous units, without sacrificing life.
- Non-inflammable impregnator, permitting use in hazardous locations.
- Operation at high ambient temperatures destructive to former ordinary types.
- Leakage resistance and power factor change far less at high temperatures than with other units.
- And best of all, a marked reduction in price because of this newly patented impregnator!

Be sure to look further into the striking features and advantages of Cornell-Dubilier pyranol-impregnated condensers. They'll save you money and provide a better, more lasting and most economical assembly.

Write for data on pyranol-impregnated condensers as well as the new 1933 Cornell-Dubilier catalog covering entire line.

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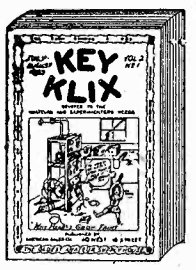

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Funny or Phoney?

(Continued from page 20)

ask for a confirmation of the "transmission" of the message? A business man of ccurse wishes to know if his message has been delivered but is not concerned with transmission. And why should the message happen to be trans-Pacific, the particular amateur traffic that the commrecials have been trying to stop? And how did it happen to be given to the amateur who has been most active in combatting this especial form of commercial interference with amateur rights? And why was the 50 cents in stamps, (legal tender), too much for incidental postage but not so much as to excite suspicion that it might be regarded as "remuneration"?

Any two or three of these circumstances would mean little. We anateurs receive all sorts of peculiar and extraordinary communications, but seldom one in which all the features point to one conclusion; in this case to a trap baited for a definite purpose—to catch an amateur accepting pay. There was nothing wrong with the message itself; an amateur has the perfect right to transmit a message of any character whatsoever so long as he doesn't do it for hire.

Now, if I were sure of my guess—sure that I shouldn't be doing someone a rank injustice—sure that the skeptical nerves of my nose weren't trying to smell too fine, I should publish this communication, letterhead and all. Except that I would have to omit the message itself; its reproduction could be regarded as a breach of the oath of secrecy. But I am not sure, I'm only guessing. So I merely relate the circumstances for the amusement—and, possibly, the prudence—of other traffic-handlers .

On the spur of the moment what I felt like telling the writer was, "I know who put you up to this. You tell 'em to go take a poke at the moon; that I wasn't born yesterday." What I did do was inform the writer that my station was closed for the time being, that I would forward his message to another amateur, that I was away off in the wilds of Canada and in no position to give him any confirmation of its transmission, and that I was returning therewith his 50 cents in stamps. So another member of our trans-Pacific gang got the message, but he missed out on the stamps. Hi.

Far be it from me to join that brigade of ham scribes who are eternally sending out terrifying injunctions to amateurs. In this mystery story you can decide for yourselves whether I guessed right or wrong. Myself, I guess both ways—equally well.

And far be it from me to make the hams any more needlessly scared of the commercials than they already have been taught to be. But there are cases in which it is wise to keep our eyes open and our keys silent.

the THRIFTY TRAVELER WILL LIKE THIS HOTEL

One of the finest hotels in Philadelphia. Away from congestion yet only a few minutes to the heart of the city. Subway entrance in hotel lobby. Every comfort where it is a pleasure to stay on your first visit and a joy to come back for the second. Free parking during the day or garage facilities. Daily rates from $2 single and $3 double.

$2 PER DAY

WM. L FAUST, Manager

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Besides, there is a complete index each month of all material appearing in other radio publications which is of special interest to Service Men.

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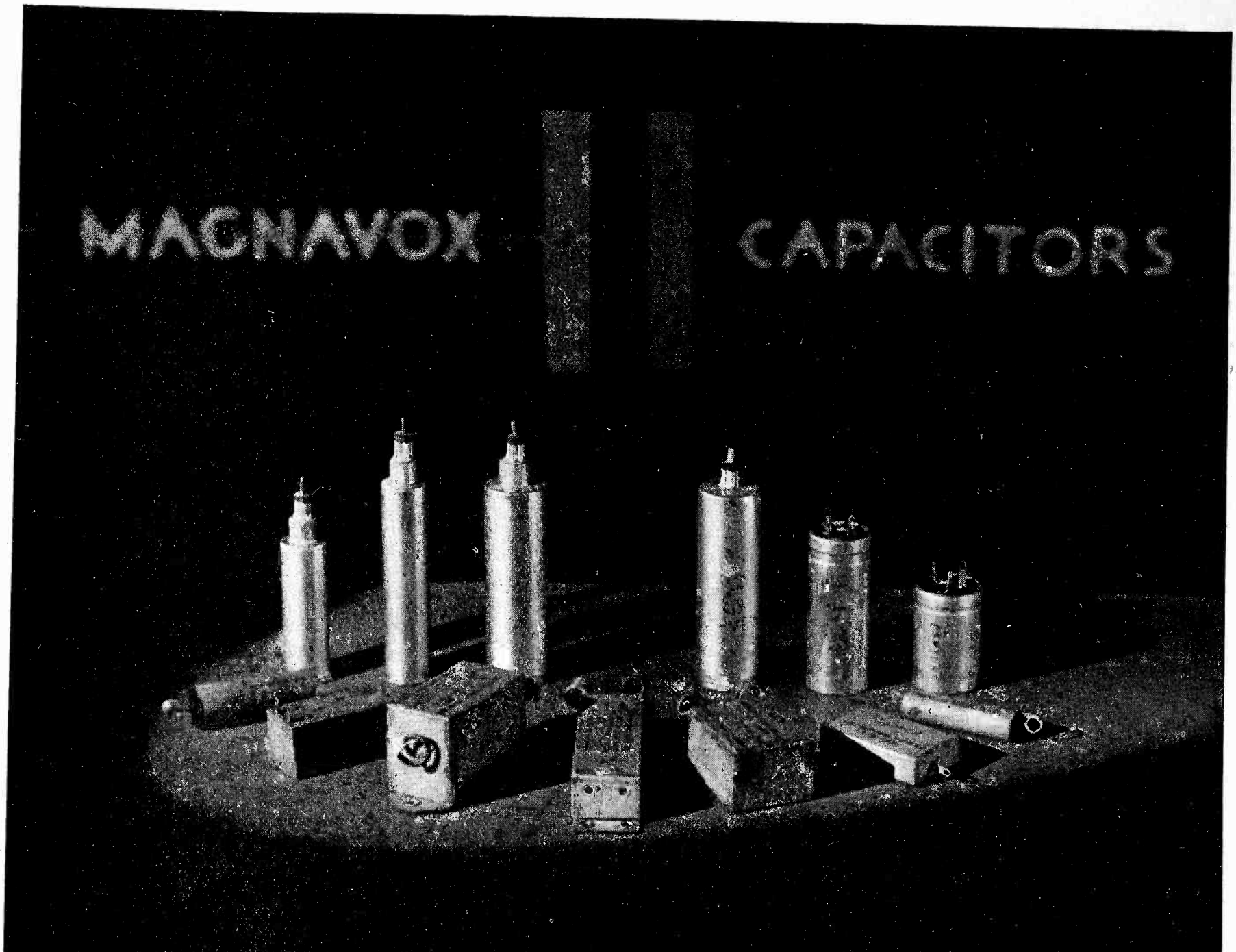

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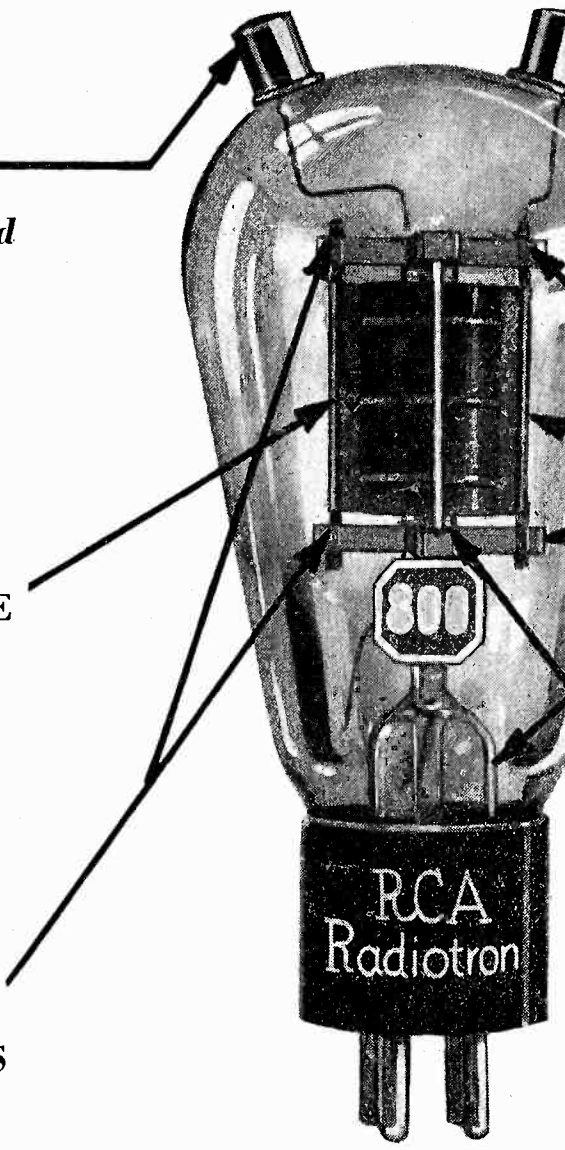

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RCA RADIOTRON CO., INC.

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