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RADIO

ESTABLISHED 1917

SHORT-WAVE AND EXPERIMENTAL

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A High-Quality Low-Level Voltage Amplifier

Globe Girdlers and DX News

The RK-18 Medium-Power Transmitter with a Novel Band-Changing System

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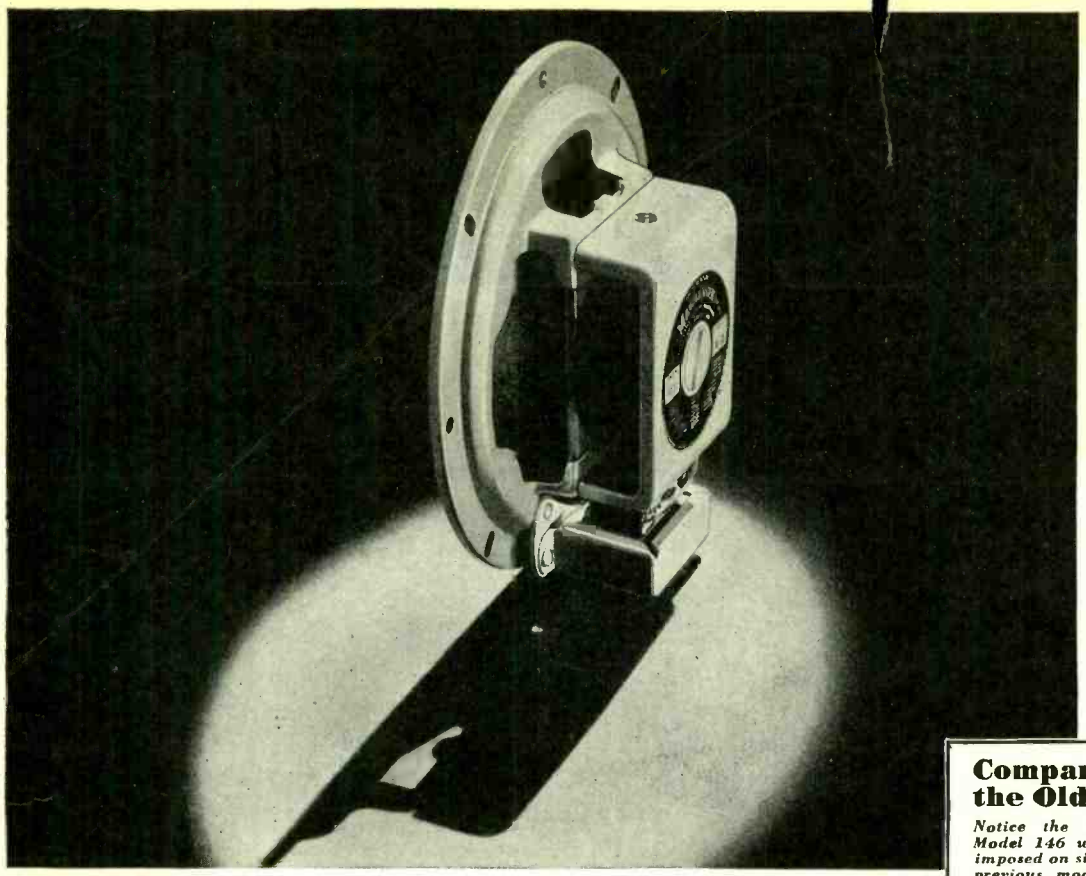
RADIOTELEPHONE DEPARTMENT - - HAM HINTS - - TUBE TECHNIQUE

NEW TUBE CHARTS - - - - AMATEUR NEWS - - - - "SCRATCHI"



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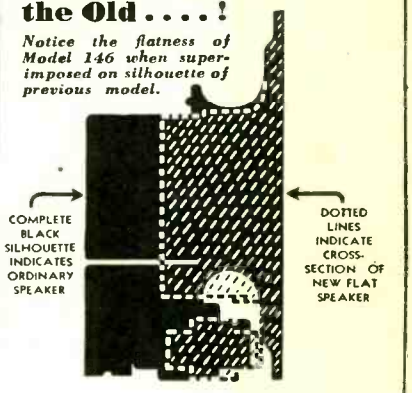

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RADIOTORIAL COMMENT

Who Is a Radio Engineer?

PRESIDENT C. M. JANSKY, JR. of the Institute of Radio Engineers has revived the oft-discussed question as to who is a radio engineer. The answer is as indefinite and unsatisfactory as the answers to the old questions as to "how old is Anne" or "what is Truth?" Hence he does not pretend to answer the question himself, but merely decries the fact that the radio profession has been given a black eye by self-styled experts. In other words, radio engineers have been hired at their own valuations because there is no accepted standard of values whereby they may be judged.

Fortunately, this state of affairs does not and can not exist in amateur radio. An amateur is an amateur not for pay but for play.

Yet he has freely contributed much of the best thought that has subsequently been applied commercially. He has been a pioneer and by actually doing something, has interrupted the engineer who said that it could not be done. He is continually learning more and more about radio waves of less and less length, and often knows more than his professional brother.

The reason for the condition of which President Jansky complains is not hard to find. It resides in the newness of the radio art. Time will soon correct it. Some day there will be as rigid a code of ethics and requisite knowledge for those who would qualify as radio engineers as there is now supposed to be for attorneys and physicians, among the oldest of the professions. And the men who can then best qualify may be found in the ranks of the amateurs today.

●●●

"Always Belittlin' "

AFTER receiving the Madrid Treaty from the U. S. Department of State, Senator Pittman of the Foreign Relations Committee, to whom it was referred, is quoted as saying that he had been informed that there was no opposition to it "except from small groups of radio amateur people on the Pacific Coast." His informant told him that "another group of amateurs in the East favored the treaty." To the contrary, radio clubs and individuals from Connecticut to California have sent vigorous protests to senators.

It is unnecessary here to call such informant by name, and at this late date it is futile to berate him for betraying the best interests of amateur radio. He will recognize that the cap fits him without need for a hatter, just as did one club president who objected to our comment about we-men—and accordingly resigned his job. The only difference is that said informant will not resign.

Commercial Strife

EVIDENCE that the amateur is not the only discontented element in the ranks of radio operators is given by reports of open strike action by the commercial operators against the American Merchant Lines on the Atlantic seaboard. The American Radio Telegraphists' Association complains that some operators are being paid as low as $45 a month for their services. The Lines explain that a recent 25% cut in wages is necessitated by competition from foreign ships. One of the company officials is quoted as saying that they "can obtain fifty operators for every ship at a salary of $10 a month." There is probability of an early adjustment of differences through the efforts of the NRA labor board. Would that there were such a board to settle the amateurs' difficulties!

THE WORLD has been full of catastrophes lately; earthquakes, hurricanes, and floods. It looks like Mother Nature is trying to keep up with the stock market manipulators. In every emergency amateur radio has had an opportunity to make itself useful by supplying the much needed communication facilities. The question now is: Are the Hams in your community prepared?

Here are a few hints on emergency radio preparedness:

1. If you have a radio club, appoint two or more "key men" to whom all others will report.

2. Build a portable club station if possible.

3. Have in readiness a portable power supply, such as batteries, hand-operated generator, gasoline driven motor generator, auto-radio power supply, or similar gear.

4. Build your own station in such a way that it can be moved to the center of activities on a moment's notice. Don't nail anything to the wall. Build it in small enough units so that one man can easily carry each.

5. Do not be afraid to commandeer the first car that comes along with a BC receiver in it, if you need his "juice".

6. Don't try to hog the show. Cooperate. QRT until called upon to open up. Be willing to run errands, if the key man thinks you will serve best in that capacity.

7. Get acquainted with your local Boy Scout leader and Red Cross Units.

8. Inform the telephone and telegraph offices, newspapers, public utilities, city officials, hospitals, churches, etc., of your system, in writing.

9. Remember that you are not trying to make yourself famous, or even doing something for Ham Radio. You are doing your small part for suffering humanity.

Cathode-Ray Tubes

SPEAKING reverently of the devil, they have at last put cathode ray tubes on the market, dubbing them as —903, —904, —905, and —906. These are all of the high-vacuum type with a hot cathode as the source of the high-velocity electrons which constitute the cathode ray. They differ in their diameters, with 9, 5, or 3-in. viewing screens, and in the manner of deflecting the cathode ray, whether by two electromagnetic fields, two electrostatic fields, or by a combination of an electromagnetic and an electrostatic field. The —903 conforms closely to the type of tube which Zworykin developed for his television receiver. Its construction and performance differs slightly from that which Hygrade-Sylvania have made for eventual application to the Farnsworth receiver.

These tubes open a wide field for experimental investigation. They are recommended for use in oscillograph applications which include the determination of wave shapes, measurement of modulation, adjustment of receivers, and study of the characteristics of vacuum tubes. Familiarity with their practical application is an excellent preparation for the advent of television, even where observable phenomena are limited to the wave shapes of code transmissions. In this connection it is of interest to note that the RMA has requested the FRC to reserve a continuous band of frequencies between 40 and 110 megacycles for television broadcasting, recommending a minimum channel width of 4 megacycles.

●●●

Another Amateur Achievement

THE LAST WORDS from the ill-fated Russian explorers of the stratosphere twelve miles above the earth's surface were picked up by an amateur radio operator near Moscow. The press reports fail to reveal his name, which an American probably couldn't pronounce even if it were known. But the honor goes to amateur radio which "works while you sleep."

●●●

1/5th Meter Micro-Waves

THOSE few amateurs who are not interested in DX and in traffic can get quite a kick from experiments with micro-waves. Think of erecting a 1-in. aerial which radiates less power than is needed to light a pocket flash-light! That is what is now being used to protect civil aviation between airdromes in France and England, perhaps thirty-five miles apart. Communication is thereby established either with two-way phone or "teleprinter." The wavelength is about 1/5 meter and QRM and QRN are said to be as rare as a five-dollar gold-piece in an amateur's pocket.

COL. FOSTER'S COMMENT

The Simple Truth

"The simple truth" is not a mere catch-phrase. It is based on the fundamental fact that truth is always and invariably simple. The truth is, to be sure, often obscured. For the human mind can devise countless ways for obscuring the truth by making the lie about it more apparent than the truth. If the lie didn't *look* like the truth it would not be believed; and there would be no use in devising a lie that nobody would believe. So, merely because a statement resembles the truth, is no guarantee that it *is* the truth.

Truth is always simple. From its very nature it can not be complex. No true statement needs the support of complicated and involved argument. The more of such argument that surrounds a statement, the more must one be suspicious of its truth.

A pamphlet entitled "International Message Handling" is being widely distributed. Its aim is to support the author's previous statements regarding the new restrictions of amateur radio made at the Madrid radiotelegraph convention of 1932, and to nullify the amateurs' efforts to have those restrictions removed before the treaty is ratified by the United States Senate.

One of these statements was:

"From a practical standpoint there is no change in our communications regulations."

Another was:

"The Madrid convention takes effect the first of 1934 but we'll never know the difference because it has no effect on us."

♣ ♣ ♣

The simple truth is that the United States Government has never placed on the wording of the 1927 convention any such construction as the author of "International Message Handling" has long sought to place on it.

♣ ♣ ♣

The simple truth is that we amateurs have always exercised our right to transmit messages to any other station, domestic or foreign, that chooses to accept them. If a foreign amateur is forbidden to handle a message it is his business to obey the laws of his own country. It is his business to obey his own laws and our business to obey our own laws. It is not his business nor his country's business to prescribe or limit the conduct of United States amateurs.

♣ ♣ ♣

The simple truth is that, aside from frequency allocations within the international bands alone, the regulation of amateur stations of individual nations has no proper place in the deliberations of an international convention. That subject is one to be determined by each nation for itself.

♣ ♣ ♣

The simple truth is that the United States Government knows we have the right to offer a message, third-party or otherwise, to any foreign amateur who cares to accept it. Likewise that amateur has the right to refuse to receive it, and his government has the right to instruct him to refuse it.

♣ ♣ ♣

The simple truth is that, if the United States Senate were to ratify the amateur restrictions of the Madrid convention, the right of the United States to regulate its own amateur stations would be infringed. Our government would then be forced either to ignore the wording of the convention or start a long and expensive attempt to negotiate private arrangements with other countries.

♣ ♣ ♣

The simple truth is that many thousands of our own people residing or sojourning abroad have long had the inestimable benefit of the free message service of the amateur stations, and that under the Madrid wording, (which the author of "International Message Handling so ardently desires ratified), this valuable free public service would be killed.

♣ ♣ ♣

The simple truth is that our government is well aware of the great number of third-party messages that always have been handled internationally by United States amateurs—especially across the Pacific Ocean. And that, therefore, if the author of "International Message Handling" were right in his claim that every United States amateur who handles internationally an important message is a lawbreaker, the United States Government itself would be a party to such alleged lawbreaking.

♣ ♣ ♣

The simple truth is that under the 1927 treaty we amateurs have always handled messages — third-party or otherwise, "important" or otherwise—with any country that did not forbid its amateurs to do likewise; and that under Madrid's new wording we are told we MUST NOT!

♣ ♣ ♣

The simple truth is that the author of "International Message Handling", in order to prove that he is right, must prove that the United States Government is wrong. Governments are often wrong, but the fellow who starts out to prove it would better be standing on a safer foundation than a banana peel.

♣ ♣ ♣

It is up to the reader of the pamphlet in question to determine whether the author has proved it to *him*. If indeed a reader can wade through its seven printed pages of obscure and involved passages and come through the ordeal with anything but a headache.

CLAIR FOSTER, W6HM.

The Answers to the Flood of Inquiries Regarding The Collins Antenna System

By ARTHUR A. COLLINS

THE recently published data on the use of a pi network to couple a transmitter to an antenna has brought a flood of inquiries to my office from amateurs who are interested in applying this system to their own transmitters. Because the thing is somewhat new to them, each has some particular question or point on which he desires more information. A study of this correspondence makes it possible to discuss the various questions which are raised and to present a brief resume of the important points.

Fist of all is the construction of the coupling system itself. It seems desirable to give some concrete values from which to work rather than to discuss the circuit in a general way. Referring first to figure 1: The inductance L 1 can be constructed using 30 turns of No. 12 enameled magnet wire, wound on a bakelite tube 2½ inches in diameter and spacing the turns so that the toal length of the winding is about 5 inches. Taps can be soldered on the winding about every four or five turns. A convenient method of connecting these taps is to bend a piece of No. 12 tinned buswire into a small "L," scrape off ½ inch of the enamel on the turn and solder the bus bar "L" onto the coil so that the bus bar extends radially about ½ inch. The wire to be connected to this tap can be terminated with a standard phone-tip jack, which will just slip over the No. 12 bus bar used for the tap. If desired, a piece of bakelite tubing can be fitted under the phone-tip jack to provide a convenient handle. For transmiters using 46's, 210's, 830's or tubes of similar power, the variable condensers C1 and C2 can be Cardwell 407B's with a maximum capacity of 360 mmfds. For a higher-powered transmitter a condenser of about the same maximum capacity with a wider spacing will be needed. This is the proper set-up for a single-ended transmitter going into an antenna which has only one feeder wire.

Now referring to Figure 2: L1 and L2 can be exactly the same as described for Figure 1, although about one half as many turns will be used in actual operation since the two inductances are effectively in series. Condensers C1 and C2 can be the same as described for Figure 1, but C2 may be a split stator condenser if one with a sufficient amount of capacity is available.

When series plate feed is used in the final amplifier, a blocking condenser should be inserted in series with "A" in Figures 1 and 2. This can be a fixed mica condenser with a voltage rating equal to approximately twice the plate voltage of the transmitter and a capacity of .002 mfds. or larger.

So much for the constructional details. One point that has come up is how this system can be applied to single-ended transmitters using a split stator condenser in the final tank circuit. The correct connection is shown in Fig. 3a The input terminal of the network must be connected directly on the plate end of the tank circuit. If this connection is used, the neutralization of the circuit will not be upset and very excellent efficiency will be obtained. It should be noted that with this system the filter is adjusted to give input impedances of two or three thousand ohms, which will be the proper load for the class C tube.

Figure 3b shows how a two-wire system is coupled to the same type of an amplifier. The two taps on the plate coil should be placed symmetrically about the center. Their exact position is not critical, although it is sometimes convenient to make the number of turns between the taps equal to the number of turns between each tap and the end of the coil. With this two-wire antenna system the amplifier will remain at exact neutralization when the antenna is connected.

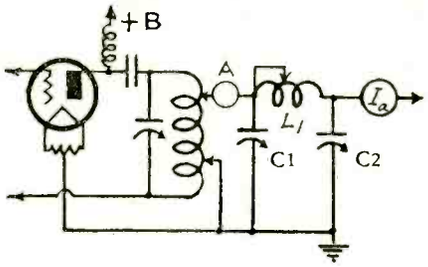


Fig. 1

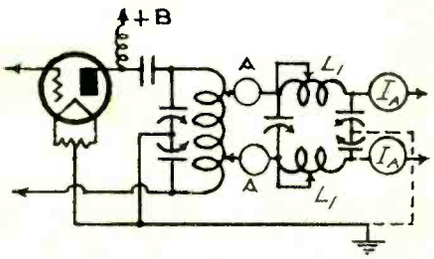


Fig. 2

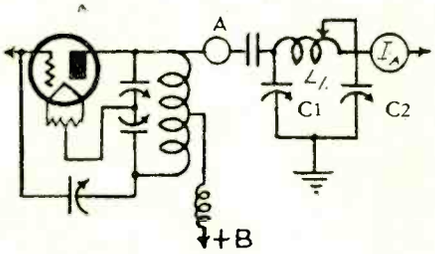


Fig. 3a

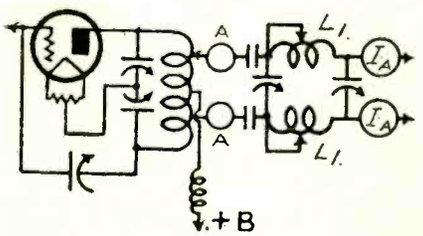


Fig. 3b

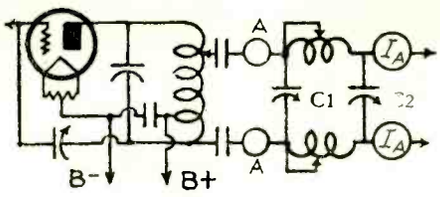


Fig. 3c

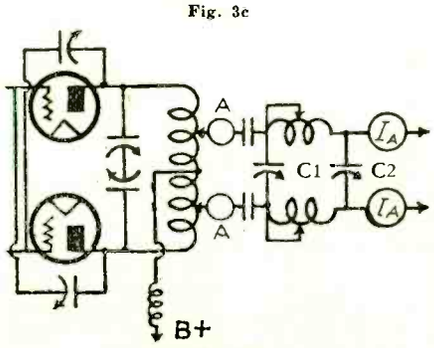


Fig. 3d

Another point is how a two-wire antenna can be connected to a single-ended amplifier of the ordinary type. Figure 3c shows how this is done. This is the circuit used when a "Zepp." or any of the other common types of antennas using two feeders is connected to the ordinary single-ended amplifier. Here the two taps are connected equal distances from the neutral point on the coil, that is, the filament or ground tap. The exact distance between the two output taps is not critical. One or two people have raised the question as to whether it is permissible to draw power off the bottom or neutralizing end of the coil. The fact to point out is that as long as the network is properly tuned it presents a pure resistance to the tank circuit and acts, as far as the tube and neutralizing is concerned, as if a noninductive resistor were connected across part of the tank coil. This does not in any way disturb the capacity balance required for exact neutralization.

All of the circuits shown in Figure 3 are drawn with series plate feed to the amplifier, since this is a common system in high frequency practice. Shunt feed, of course, can be used as well.

Fig. 3 "D" shows the correct connection for using the matching network with a push-pull transmitter. It is usually desirable to use a 2-wire antenna system with a push-pull transmitter. This is the arrangement shown. It is also possible to connect a push-pull transmitter to a single-wire antenna using a coupling network, but this involves some special considerations, which I will not attempt to cover at the present time.

Another small point that caused some uncertainty is why the unused portion of the inductance should be short-circuited as shown in the various drawings. If only five or six turns are not used, it is desirable not to short circuit them, but if, as is usually the case, only a small part of the coil is used, it is very much better to short out the unused portion. Careful measurements of the coil resistance have shown that when the unused part is shorted the resistance is not appreciably higher than if the unused turns were taken off the coil entirely.

A few remarks regarding the adjustment of this system might not be amiss. First of all, it is important to neutralize the final amplifier and tune its tank circuit to exact resonance with the antenna network disconnected. **The neutralization and tuning of the final amplifier should not be touched again after this is done.** In starting to adjust the network it is well to start out with about thirty turns of inductance for 160 meter operation, fifteen turns for 80, eight turns for 40 and five turns for 20. In the circuits using an inductance on each side of the line, about one half this number of turns should be used in each coil.

The next step is to set C2 at mid-scale, connect the network to the transmitter, apply the power to the final amplifier and rotate C1 until a resonance dip is obtained in the plate current to the final amplifier. It will be noticed that C1 apparently tunes the tank circuit much as the tank condenser does.

(Continued on page 29)

Amateur Radio Through Hell and High Water

By ALFRED GERMAIN, W6FCE, Pasadena,
and C. HARVEY HAAS, W6EAH, La Crescenta

IT WAS 10 p. m., New Year's night. Mrs. Germain and Mrs. Haas were at the home of the latter, while W6EAH and I were returning from a wet trip to Glendale in my car. I was driving, unable to see ten feet ahead, taking orders from my companion, who was straining his eyes to see the rolling boulders and trunks of trees that filled the street.

"Easy," he said, in a calm, quiet voice. "Six or eight foot wall of water on our right. Better put her in low and head right into it, or it'll turn us over."

I did just that, and in the nick of time. I did it with a prayer on my lips. One of the flood control men jumped onto the hood, and the other . . . has never been found. The water rushed over the top of the car and out went our lights. The car started backwards, its engine dead. Rocks bounded off the shatter-proof glass of the windows.

Finally the water lowered to the level of the windows. It was time to get out or drown, for the car was filling rapidly. We got out, but what a job it was. We were carried downstream at a terrific rate by the raging torrent. When I was finally able to grab onto something, and pull myself up to a stop, I heard the voice of W6EAH hollering:

"Hella, W6FCE, this is W6EAH. I'm drowning. How are you? Can't talk now. Got a rock in my mouth."

Running, swimming, falling; wet and muddy, we finally found a house that had not washed away. I knocked on the door and asked if we might not stand on the back porch to keep out of the driving rain and wind. It was then 11:30. We only stayed long enough to regain our breaths, then started for the sheriff's office. We found it, in six inches of water. The lights were out and the only telephone lines left were locals between various sections of La Crescenta and Montrose.

We first inquired as to the conditions at Ramsdale and Manhattan streets, and were told that everything was wiped out as clean as a whistle. Then we did worry. We decided to make a run for it and see if it were not possible to find our XXYL's in the sand, rock and ruins of the house.

We headed first for the American Legion Building, hoping to get help in fording the streams that were raging between Montrose and La Crescenta. On our way we met a flood control truck trying to buck the tide. After several failures we hung onto the sides of an automobile that seemed to be headed for Montrose. All was blackness. Another wall of water came down from Oceanview, carrying boilers, furniture, flood control equipment, automobiles, and rocks, one of which we later measured to be six feet in diameter. Light poles snapped like match sticks; the pavement jumped like jelly. The American Legion Building went out with this wall, and many were injured and some killed.

We stood in a doorway for an hour, trying to avoid the bitter cold, until I got the idea that I would like to move to a spot which was lower. W6EAH didn't like the idea, but followed along. We hadn't walked 100 feet when the front of the building, in which we had been standing, collapsed.

Half an hour later the water had gone down to about one foot deep. In our next dash to the sheriff's office W6EAH and I got separated. I got there, but I didn't see EAH until eight hours later. All night long I heard telephone calls for doctors, nurses, medical supplies, and help of every description. The captain, hard-boiled as he was, had a trace of tears in his eyes as he was forced to say that he was marooned, and had no word from the outside world. There I sat, helpless, worried about our wives, knowing how much good we could do if only we could get home and on the air. A man came in and asked the sheriff if he had any information concerning his wife, baby, sister-in-law, and brother. He had gone to the conner drugstore and returned to find his house and all occupants washed away.

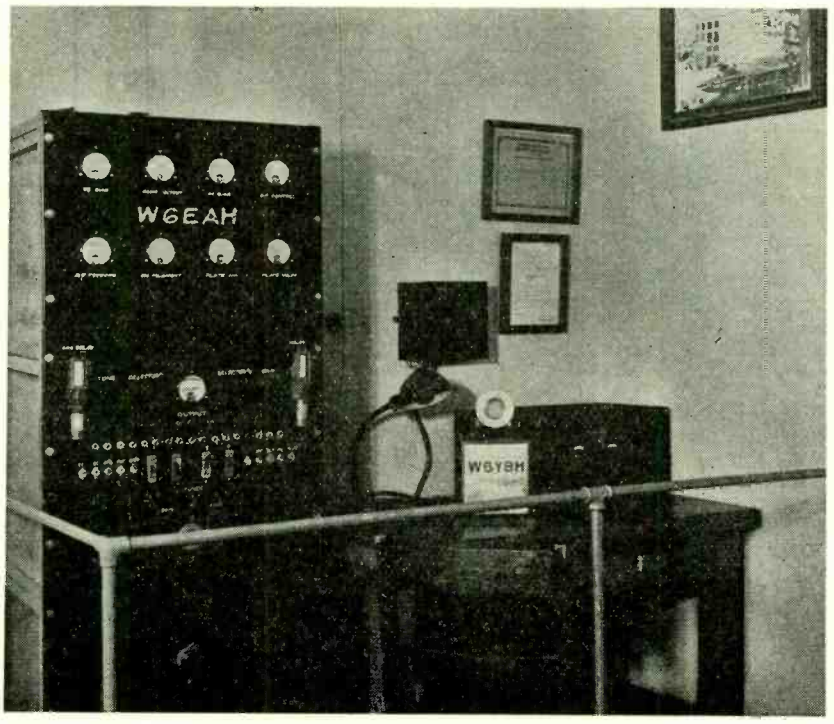
I thought daylight would never come. Why do disasters always seem to come at night? Everything in darkness; telephone call after telephone call, telling of rich people and

Here Are a Few Statistics:

Time of the flood:	12:09 A.M. to 2:00 A.M., January 1, 1934.
Total rainfall:	13 inches.
Known dead:	46
Known missing:	60
Homes demolished:	400
Property damage:	$5,000,000.

(All of the amateur radio work was conducted from W6EAH on 75 meter phone—140 watts input.)

C. Harvey Haas, W6EAH, of LaCrescenta, California. Returning to his radio shack after a miraculous escape from death, he and W6FCE settled down to the unselfish business of handling flood traffic by means of the station shown in the center illustration.



Station W6EAH. Mr. Haas, the operator, is an instructor in electricity at the John Marshall High School, Los Angeles.

Alfred Germain, W6FCE, of Pasadena, California. One of the two amateurs who contributed his service to the unfortunate victims of the Southern California flood. A suggestion for amateur radio operators in times of disaster is in the Radiotorial columns on page 3. Read it.

poor people injured, dying, homeless, and suffering from exposure.

When the first gray streaks of dawn came over the mountains I started again for W6EAH's house, crossing stream after stream, wide bars of silt, mud and quicksand. Twice I stepped into the quicksand, but each time Lady Luck was with me. A tree trunk once, and a great boulder the second time, made it possible for me to pull myself out. In the middle of one of the washes I heard a faint cry for help, and upon investigating, I discovered a young girl, about 17 or 18 years old, against a tree. Her ankle had been fractured so badly that the bone was protruding. She had been in the water in that spot since about 1:00 a. m.; six hours.

I carried her to the bank of the wash and was just in time to meet some flood control workers who made a stretcher out of a door and carried her away. There were no streets and what had once been a residential section was now a great wash.

I struggled across these until I came to a house that had been washed into the middle of what had been a street. I asked a man where Ramsdell and Manhattan streets were. He gave me the directions and on I struggled. Upon arrival I found nothing but ruins of homes and another great wash. I thought I recognized two stone monuments as parts of a house that had been next door to W6EAH. My heart almost stopped beating. I knew the worst. I stumbled on—looking. Tears rolled down my cheeks. I met another man who was looking for his wife.

As I started back I happened to mention the address of W6EAH, and was told that the first party had been mistaken; that I should have gone a block the other way. I was filled with new hope. One more chance. As I turned the corner I could see one of W6EAH's poles; the rear one, on the garage. I walked further, and lo and behold, the other pole came into view. The Eiffel Tower could never have looked so majestic as that, even to a Frenchman.

I ran up the steps of the house and was met by my wife.

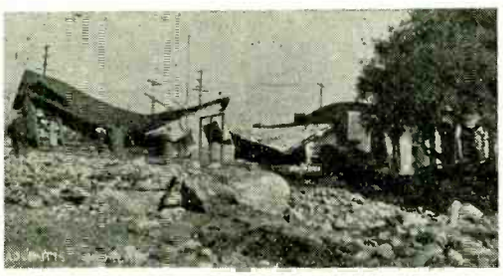
"Hello, honey," she greeted me, "Harvey says there was a flood. Was there really a flood?" (They had not been out of the house.) I couldn't talk. All three of them were there; W6EAH having arrived just five minutes before me. We ate a hasty breakfast, and as we were trying to figure out some method of getting power the lights flashed on. We were on the air!

Our first QRR went out at 8:00 a. m., and from then on believe me we handled traffic! There was a phone next door, and we got hooked up with the Woman's Club House of La Crescenta, and with Montrose. They supplied the traffic, and how. When I got the sheriff at the Club House he said fervently: "Thank God, we have a Chief Eugene Biscalluz, Sheriff of Los Angeles County, that has brains enough to organize something of this sort!" We at once sent a message to A. C. Jewell, undersheriff, telling him we were on the air and ready for business. We took it is it came; messages, press reports, vital statistics, and what have you. We even turned newspaper reporters. We kept the broadcast stations informed as to conditions, names of the dead, injured, and reports of the unidentified. A message received from Captain Prushing, Los Angeles Sheriff's office, read in part: "The amateurs are proving to be a wonderful asset. Fine work. we are proud of you."

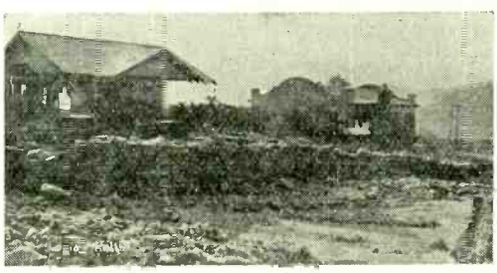
A total of 83 messages, not including news reports were handled. Twenty-seven were answered through land phone from Los Angeles. The station was kept on the air until late that night, January 2. People came with tears in their eyes, asking in apologetic tones if we would please send a message to a relative that one of their loved ones had been lost, killed. or injured. If the good wishes of the people who sent messages from our station mature, I think W6EAH and W6FCE will be happy. We continued on the air until phone service was restored.

At 5:00 p. m. I was advised that a portable station had been erected in the Montrose radio store. This helped to relieve the telephone congestion after it was restored. It was fine work of these boys—they must have had a tough time getting into the area.

Digging for the bodies of victims. Two young girls were found buried under five feet of mud.



All that remained of the Adventist Church when the storm abated. Bodies of victims were recovered from the wreckage.



The Legion Hall, almost washed away by the raging torrent. Here others lost their lives who sought shelter in the building.

A 5-year-old boy was found dead in this automobile, unable to be reached by rescuers until the storm subsided.

AMATEUR RADIO TECHNICAL SOCIETY

A New Body of Amateur Radio Technicians

"RADIO" has been chosen the official organ of the AMATEUR RADIO TECHNICAL SOCIETY. This Society has, as its aim, the desire to centralize and coordinate technical research in the field of amateur radio communication.

It consists of a Contact Bureau, whose General Chairman is Mr. J. N. A. Hawkins, W6AAR, and whose secretary is Mr. Clyde C. Anderson, W6FFP. The activities of the Contact Bureau are divided among Research Groups, each of which deals with one particular phase of amateur technical activity. Each group is under the direction of its own chairman to whom the active members report monthly. The Group Chairman appoints sub-chairmen and reports the activities of his group to the central bureau which publishes a monthly report of progress of the Society. Anyone who desires to further the technical development of amateur radio can become a member.

There are no dues and no initiation fees. A member may apply to the chairman of any group for admission to that group if he can volunteer to undertake some particular piece of research for which he is best fitted.

There are a few GROUP CHAIRMANSHIPS open and those interested in directing a Research Group should communicate with the General Chairman, outlining their qualifications and experience in the phase of amateur radio technique in which they are interested.

The address of the Society is c/o "RADIO", Pacific building, San Francisco, California.

The Society has no interest in amateur politics.

The following groups have already been organized and more will be added as soon as interest in other problems is evidenced by the membership:

RESEARCH GROUPS

1. **56 MEGACYCLES GROUP**
2. **400 MEGACYCLES GROUP**
3. **TELEPHONY GROUP**
   - A. Single Sideband
   - B. Grid Modulation
   - C. Audio Amplifiers
4. **FREQUENCY STABILITY GROUP**
   - A. Crystal Oscillators
   - B. Electron Coupled Oscillators
   - C. Frequency Measurements
5. **SKIP AND FADING GROUP**
   - A. 1.75 MC and 3.5 MC
   - B. 28 MC
   - C. 14 MC
   - D. 7 MC
6. **ANTENNA GROUP**
   - A. Transmission Lines
   - B. Directional Antennas
   - C. Harmonic Elimination
7. **RECEIVER DESIGN GROUP**
   - A. Coil Switching
   - B. Detection
   - C. Shielding
8. **MECHANICAL CONSTRUCTION GROUP**
   - A. Relay Rack Standards
   - B. Portable Equipment
9. **TRANSMITTER DESIGN GROUP**
   - A. RF Amplifiers
   - B. Doublers
10. **POWER SUPPLY GROUP**
    - A. Filter Design
    - B. Tunable Hum
    - C. Keying
11. **THEORY GROUP**

We found our Chevy the next morning; a total wreck along side of the road where flood control workers had towed it with a tractor. A nice new 1933 job sacrificed to the cause. And when we got home we found that my own station had had a foot of water in it.

I am not working at the present time, and am suffering from the depression. but with all my loss I was able to help in my little way. The letters of thanks, received from various people, broadcast stations, and newspapers, gives a lot of satisfaction.

In closing, W6EAH and I would like to express our thanks to stations who so kindly helped us in this calamity: W6CNE, W6ABF, W6CKR, W6BGO, W6EUP, W6EP, W6GYE, W6GNM, W6DDA, W6GIQ, and to all other stations who so kindly remained off the air.

An Improved Design . . . and a New Band Changing System for Raytheon RK-15 and RK-18 Tubes

By the Technical Staff of "RADIO"

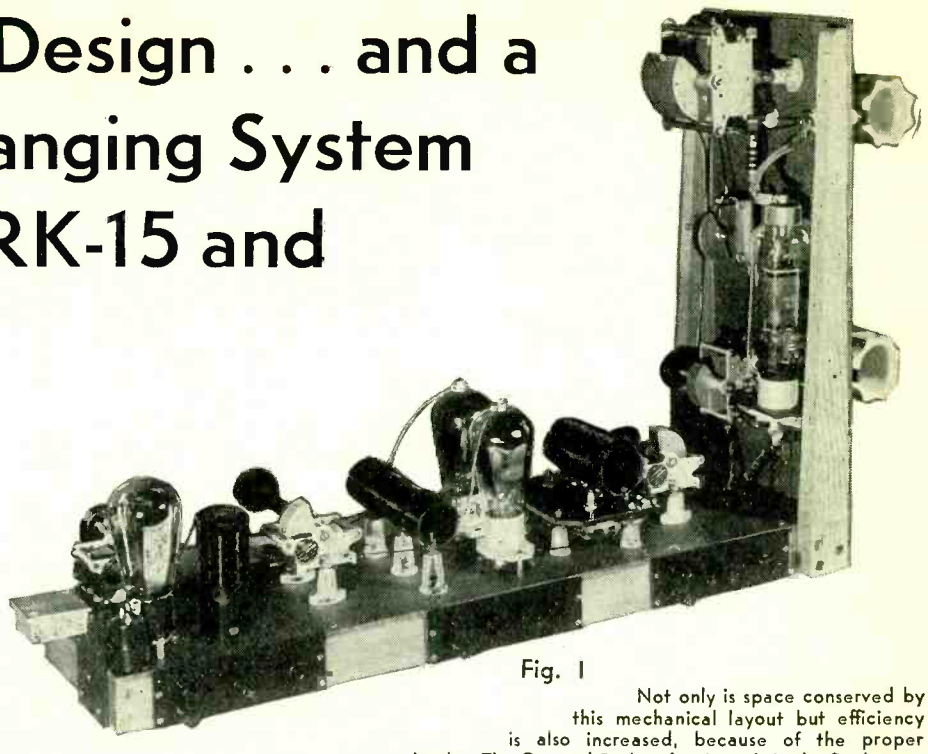


Fig. 1

Not only is space conserved by this mechanical layout but efficiency is also increased, because of the proper leads. The General Radio plug-in coils in the final stage make band-changing simple and easy. Note the ingenious plug-in mounting for the grid coil. This provides the push-pull-to-push-push-change, automatically.

THE introduction of the new medium-power tubes for the amateur has necessitated certain mechanical and electrical changes from the layouts used with other types of tubes.

Many of these new tubes have some of the elements coming out from the top of the tube, and it is quite apparent that the usual layout for tubes with all the leads coming from the base, will not be satisfactory. Unless the components of the stage are rearranged to fit-in with these above-base leads, the advantage of isolation of the plate and grid leads will be largely nullified.

Notable among the new tubes is the RK-18, a so-called medium power tube. We have selected this tube in our final amplifier for a number of reasons. In the first place, the RK-18 is a very easy tube to excite. An example of this is the use of one of these tubes, driven directly by a 7 MC crystal, and in turn used to excite a 354 Gammatron with 800 watts input. All stages ran cool and it is obvious that such performance would not have been possible if the buffer (RK-18), had not been easy to excite, while still delivering lots of swing to the final amplifier. The low internal capacities of this tube make it an efficient amplifier on very high frequencies, in addition to its ability to work nicely on the low frequencies. This fact, and its low cost, justifies its selection over the older fifty-watt type tubes.

While this tube is easy to excite, this does not mean that it will not work more efficiently if proper excitation is provided. It is well to recall that high plate voltage, high bias and high excitation are necessary requirements for high-efficiency operation. All of which brings us to a consideration of the exciting stages in our transmitter.

7 and 14 MC Operation

SINCE this particular transmitter is intended for operation on the 7 and 14 MC bands, the use of a 7 MC crystal is of decided advantage. These crystals are no longer the luxury they once were and, in fact, are now made by a number of manufacturers at a very reasonable price. Wherever a doubler stage can be dispensed with, it is very good practice to do so. Hence the 7 MC crystal. There also exists the mistaken idea in some quarters that the output from a 7 MC crystal is inferior to that of the lower frequency types. This has not been proven to be the case in our experience. It is, of course, admitted that these crystals require a more careful design of the stage in which they work, in order to obtain the maximum output with a minimum strain on the crystal. A tube with a low RF grid current is a virtual necessity. Low plate current is also quite desirable. After trying a number of tubes of various characteristics, we were forced to return to our first love, the 47. This tube seems to be about the best for the purpose available at the present time. Many operators use plate voltages in the order of 400 to 500 for the crystal stage, and while it is certainly possible to do this successfully, it seems rather unnecessary to put such a load on the crystal. The fundamental property of a crystal is to control the frequency of the transmitter. It is not intended to be a power device. High voltages result in heating of the crystal, with an attendant creep in the frequency. We have never operated a crystal at over 300 volts except for experimental purposes, and have not had any trouble in getting sufficient excitation to the next stage. The use of this lower voltage is of further advantage in that it allows the use of regular BCL plate transformers which are very cheap these days.

Considerable experimenting was done to determine the effect of bias on the crystal tube in relation to power output. Apparently, there is little to choose from between battery and fixed-resistance bias. This being so, resistance was adopted because of its convenience and the possibility of its inclusion in the transmitter proper. No battery bias is used on any of the stages, an eliminator and resistance being used instead.

As has been pointed out in previous articles, it is highly advantageous to use a high L-to-C ratio in the crystal tank. High C plays no part in providing additional stability; to use it is simply to waste power that might well be utilized to help swing the grid of the next stage. There is no particular point in attempting to suppress the harmonics from the crystal stage by the use of high C, particularly when all stages are working on the same frequency. Harmonic suppression might be of advantage when working into a doubler stage in order to confine the doubler strictly to one class, i.e., grid or plate. This, however, seems to be of small avail as most doublers work in a hit-or-miss, any-old-system, manner and do a fair job at that. The additional output from the use of low C would offset such an ill effect in any case. Use it!

Many a 47 has been doomed to an early grave because the screen voltage was made too high. Again, extensive experiments with various screen voltages convince us that this voltage is non-critical and values around 100 volts seem to give good output while still giving the tube life a boost. There is absolutely no point in using voltages higher that 125 maximum on the screen.

Link Coupling

IF THERE is any one place in the transmitter where the use of link coupling is of particular advantage, it is from the crystal tank to the grid tank of the following stage. Especially is this true when using a 7 MC crystal. The ordinary capacitive coupling puts such a load on the crystal that it is necessary to tap back so far on the coil, in order to keep the crystal in oscillation, that the maximum transfer of energy does not result. Link coupling automatically establishes the correct impedance match and gives the maximum transfer of energy with the least drain on the crystal stage. Its use is very emphatically recommended. Experiences of many others give added weight to this statement.

The selection of the driver tube (or tubes) for the RK-18 is not a difficult matter, there being a number of tubes suited for this purpose. The first consideration is the ability to stand plate voltages from 400 to 800 volts. The second is the amount of excitation required to run at full output. Since the RK-18 is designed to work at high frequencies, it is obvious that the exciter tubes should also be able to work efficiently at the same frequencies if decent over-all efficiency is to be obtained. To our way of thinking, the selection narrows down to a choice between the '10 and the new RK-15. The RK-15 was selected

because it did not require such a high bias voltage to bias it to the proper operating point, either as a doubler or an amplifier. The RK-15 tube is also easy to excite. In general characteristics it is very similar to the '46, having two grids, which, however, are tied together within the tube and the common lead brought out to a cap on the top of the tube. This isolation of the grid lead has the advantage of lowering the tendency for external feedback and makes complete neutralization a simple matter.

A New Band-Changing Wrinkle

SINCE it was our desire to keep the number of stages down to a minimum and still be able to work efficiently on at least two, and possibly three bands, it was decided to use a modified push-pull arrangement in the buffer stage. Such an arrangement allows the use of regular conventional push-pull for operation on 7 MC, and a power doubler set-up for 14 MC work. Ordinarily, this would necessitate much juggling of tubes and circuit changes. It is accomplished with no particular effort in our transmitter by the use of a simple plug-in arrangement. By keeping the grid circuit symmetrical in push-pull at all times, and changing only the plate circuit connections, this shift becomes very simple. The circuit diagram in Fig. 1 shows how this switch-over is accomplished. Note that the 40 meter coil assembly holds the neutralizing condensers. These condensers are small (two plates), and mount in a very small space.

There are five terminals in the sub-base—the ones numbered 5 and 6 on the diagram go to the two grid terminals. Numbers 1 and 4, the two outside terminals, go to the two plates. One side of the tuning condenser goes to Number 1, and the other side goes to the Number 4 terminal. Number 2 goes to the high voltage. When the 40 meter assembly is plugged in, it connects 3 and 4 together and connects the neutralizing condensers to the two grid terminals in addition to making the conventional connenctios. The result of this is to make the stage conventional push-pull for 7 MC operation. Then the 14 MC assembly is substituted, it connects the two plates (Numbers 1 and 4) together and to one side of the tank, jumps 2 and 3, putting the other side of the tuning condenser and the high voltage on the opposite and of the tank and—Presto! We have push-push with the grids in push-pull and the plates in parallel! The neutralizing condensers once adjusted need not be touched, and therefore band changing in the buffer-doubler stage is a simple thing, with a minimum of readjustment for either band. The push-pull grid circuit requires but very slight retuning when the change is made. This grid coil is made plug-in for no other reason than the fact that operation on 3.5 MC may at some later date be desirable. And now for the final.

The RK-18 Stage

THE RK-18 is a rather unusual tube in physical characteristics — considerably longer than most tubes, and the plate lead comes out of the top. This required a special style of head-scratching in order to figure out how to get a proper arrangement for the leads. The obvious thing would be to lay it on its side—much the same as we used to do with our 204A's in the dim past. However, you may recall, we turned the jug around at intervals in order to equalize the filament sag. We could do this with the '04A because of a symmetrical arrangement of the grid-filament output terminals, but the RK-18 has a four-prong base with two large pins, making a reversal impossible without a screwdriver and a soldering iron. Having already accounted for 26 inches of sub-panel space, we did not feel like adding another couple of feet and thus it was decided to conserve table and save the filament an eventual break by going up instead of out. The photograph in Fig. 2 shows how the RK-18 portion of the transmitter was arranged in the final set-up. This arrangement provides the shortest possible leads, puts the tube in the correct position (upright), and allows the grid and plate tanks to come out of the other side of the panel. The new stand-off insulators made by Birnbach, which are very similar to a tiny lead-in bushing, greatly simplify the construction. These insulators have an insulating collar which insulates the portion of the rod that comes through the panel. Some other Birnbach types are also fitted with a standard jack which takes GR type plugs. Three of these plugs of the larger type serve to support the porcelain G-R coil forms used in the final amplifier. These forms are fitted with a home-made bakelite strip to hold the three plugs, the neutralizing plug and the regular coil terminals. The smaller plugs are used in the buffer plug-in assembly and serve the purpose admirably. One great advantage of this type of plug is that it requires only one mounting hole and once tightened, is entirely self-supporting—no bottom screws to cinch down and crack the insulator.

A double section condenser is used in the final stage for two reasons. In the first place, since the rotor is grounded, hand capacity is conspicuous by its absence. Second, since the neutralizing tap is in the exact center of the coil, both ends are equally hot, which is of advantage in the use of the Collins system of coupling to the antenna. Since this phase is covered elsewhere in this issue by Mr. Collins himself, it hardly seems necessary to enlarge further upon this subject. Perhaps an additional advantage of the split-rotor condenser is that its use eliminates the large bypass from high voltage to ground which is so necessary to complete neutralization in the conventional circuit using a single section condenser.

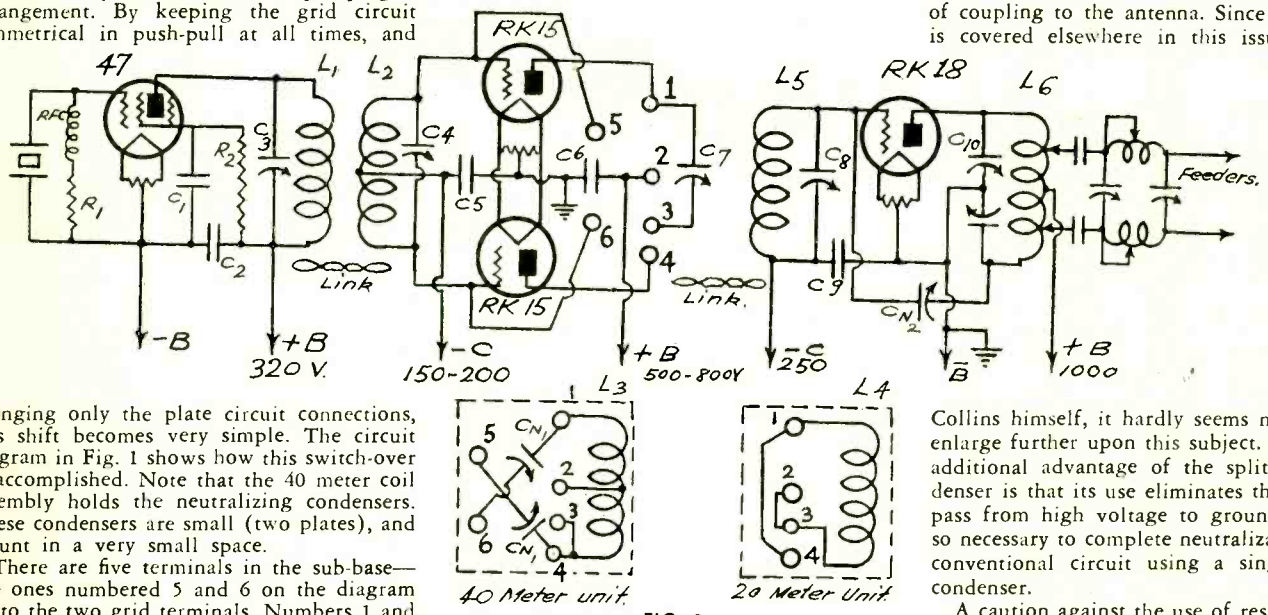


FIG. 2
Circuit diagram and coil-changing system for push-push operation on 20 meters and push-pull on 40 meters.

LIST OF PARTS

C1, C2, C5, C6, C9—.006 mfd. Sangamo fixed condensers.
C3, C4, C7, 8—100 mmf. Cardwell Variable Condensers, Type 404-B.
C10—50 mmf. per section split-stator Cardwell Variable Condenser, Type 512-B.
CN1, (2 required)—3 plate midget variable condenser, Hammarlund or Star.
CN2—Max. Capacity 5 mmfd. Type 519 Cardwell Neutralizing Condenser.
L1 (for 40 meters)—22 turns, No. 18 enameled wire, spaced diameter of wire, wound on 1½-in. Bakelite form.
L2 (for 40 meters)—Same as L1, but center-tapped.
L3 (for 40 meters)—20 turns, No. 14 enameled wire, spaced diameter of wire, wound on 1¾-in. Bakelite form, and CENTER-TAPPED.
L4 (for 20 meters)—10 turns, No. 14 enameled wire, spaced diameter of wire, wound on 1¾-in. Bakelite form, NOT CENTER-TAPPED.
L5 (for 40 meters)—18 turns, No. 12 enameled wire, spaced diameter of wire, wound on 2½-in. form. General Radio form used in laboratory transmitter.
L6 (for 40 meters)—Same as L5, but CENTER-TAPPED.
For 30 meters, L5 and L6 wind HALF the number of turns as shown above for 40 meters.
R1—35,000 ohms, 5 watts.
R2—25,000 ohms, 5 watts.
Center-tap Resistors across filaments are 100 ohm, General Radio.

A caution against the use of resistance bias on tubes like the RK-18 and the 800 is in order. These tubes are not designed to show color on the plates, and the plates do get hot in one awful hurry if, for some reason, they momentarily lose bias, as would be the case if the crystal should suddenly stop oscillating with resistor bias on the final. Eliminator bias is entirely satisfactory, particularly when only two stages are being run off the same eliminator. The changes in voltage due to different grid currents through the B strip can be compensated for by providing a variable adjustment on this B strip.

In operation, it is best to boost-up the excitation to its full limit with the plate voltage on the final set at the desired value. Starting with a cut-off bias, increase this bias up to the point where the output from the final starts to drop off. In this manner we match our bias to our excitation. Use as high a plate voltage as possible and try to get your input with high voltage and not high current. It should be remembered that each time you increase the plate voltage you change the amount of bias necessary to the proper operating point. That is to say, increasing the plate voltage is equivalent to shifting the characteristic Ip-Eg curve over to the left.

Since this shift in the characteristic curve changes the operating point of the tube, it is necessary to increase the bias to re-establish the former operating point. By the

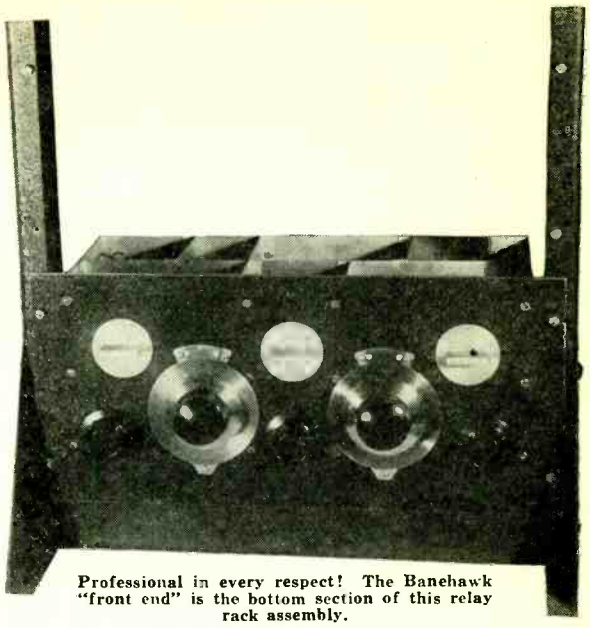
(Continued on page 29)

The Banehawk Super-Heterodyne

By CLAYTON F. BANE and NORRIS HAWKINS

Part III

THE FRONT END



Professional in every respect! The Banehawk "front end" is the bottom section of this relay rack assembly.

THIS article is devoted to the actual mechanical and electrical construction of the RF amplifier, first detector and oscillator stages. Efficient and quiet intermediate amplifiers are becoming common because of their wide development for broadcast use, but the tale in a high-frequency super is told when the signal leaves the plate circuit of the first detector. If a favorable signal-to-noise ratio is not maintained up to this point, the rest of the receiver counts for little, because we can't amplify in the IF amplifier that which we have not heterodyned efficiently. Therefore, we hope that the reader will understand why we take up so much space in discussing the circuits associated with only three out of the eight of more tubes necessary in the complete receiver.

It is hoped that no one received the impression from the photograph in the last issue that this receiver is necessarily any more expensive to build than conventional SS super. The completeness of the chielding adds but little to the cost; all of the iron in the whole front end can be purchased for less than $2.50 at the nearest sheet metal shop. As far as the labor involved in assembling the unit goes, we feel that a glance at the illustrations will convince the most skeptical that the extreme simplicity of the shielding assembly simplifies, rather than complicates the job.

It should be borne in mind that in avoiding the fetish of extreme compactness, we have increased accessibility, and the improved shielding and isolation practically eliminates the weary hours formerly spent in the tiresome process known as "Bughunting."

The Shield Assembly

AS WILL be noted from the illustrations, no chassis is used, in the general sense of the word. Everything is mounted directly on the shields. The shields are made of No. 18 gauge cold rolled steel. Ordinary of #18 gauge cold rolled steel. Ordinary sheet rust on the metal will complicate the plating process. Therefore, make certain that the metal is perfectly clean and free from rust.

The metal can be cut to size and bent at the sheet metal shop. Bending the metal by hand is somewhat arduous, though entirely possible.

After the metal is cut and bent you can proceed with the drilling of the necessary holes. It is best to wait until the metal is completely drilled before being plated, and the pieces are best plated individually, not as an assembled unit. Either cadmium or copper will be entirely satisfactory as a plating material.

A careful consideration of all wiring before assembly will save hours of labor in drilling holes through the shields after assembly. The holes through which the wires pass are large enough so that rubber grummets are used to prevent possible shorts to the shielding. The hole for the tube and coil sockets and the tube shields can be made either with a circle cutter and a drill, or by using a special punch of the right size. If neither a punch nor circle cutter is available, the nearest machine shop can drill all the large holes in less than fifteen minutes. Note that the holes for the coil sockets must be larger than the diameter of the coils as otherwise the coils will not seat firmly in the sockets. If National 6-pin coils are used, get the new square Steatite coil sockets because they are much more rigid than the older oval type which has two mounting holes.

The shield that makes up the sides and back of the shielding assembly is all one piece and slides down over the completed assembly. The removal of this one shield makes the whole receiver accessible whenever it becomes necessary to perform a major operation on the set's "innards." Holes are drilled in this shield for the plugs that bring in the antenna input and IF output and power supply voltages. Standard phone jacks are used as input and output terminals. The authors used a form of concentric transmission line made of low-C shielded cable and terminated in regular plugs, to minimize unwanted pickup of noise, etc.

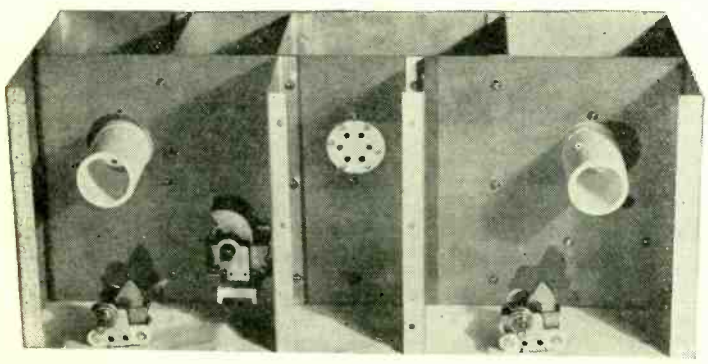
The Front Panel

THE FRONT PANEL follows standard relay rack practice. It is 19 in. wide, 3/16 in. thick and 8 3/4-less-1/64 in. high. In other words, the panel is 8 47/64 in. high. We happened to have a weakness for Dural, but either aluminum or cold-rolled steel would be equally satisfactory and somewhat cheaper. It is entirely possible to use 1/8-in. metal for the front panel, but nothing lighter should be used because the whole assembly is supported from this panel.

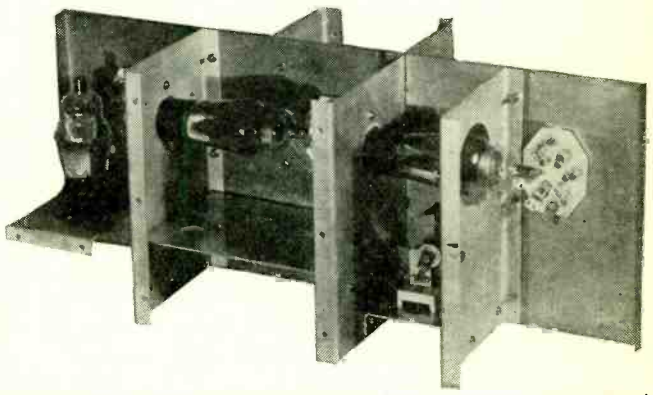
We used a baked crackle finish on the panel but any metal finish that takes your fancy is quite satisfactory. If the front panel is made of steel we suggest that it be plated with either copper or cadmium before applying paint to its surface, as it forms part of the electrical shield and must be bonded to the rest of the assembly.

The covers for the coil openings are not fastened directly to the coil, but are separate. We did this to keep the coils well away from the front panel and to avoid the losses caused by the metal in the cover being in the immediate field of the coil. However, if the covers are made of some material, such as low-loss Bakelite, they could be attached directly to the coil form. A spring strip holds our aluminum covers in place. The thought comes to us that some enterprising manufacturer might make an isolantite coil form with an isolantite cover made in one piece.

If no circle cutter is available to cut the



The "front end" with panel and cover removed. The rigidity of construction and the effective means of shielding allows the construction of a beautiful-appearing laboratory instrument, efficient as well as pleasing to the eye.



The rear view with shield case and tube shields removed. The tubes lay in a horizontal position, making possible the use of extremely short leads, a-la Western Electric. The tube filaments do not sag when tubes are mounted in this position, because heater tubes are used.

coil openings, there is no reason why the holes and the covers could not be square in shape.

The Tuning Condensers

THE 2-GANG condenser that tunes the RF and detector stages is mounted on a metad shelf supported by the same shield that support the RF tube and tube shield. The oscillator tuning condenser is mounted on a bracket, setting it back from the panel and the rotor is insulated with fibre washers. The series band-spread condenser is mounted on the front panel without insulating washers, but a ground lead goes over to the main center shield which is the common ground bus for the whole front end. The antenna trimmer is also mounted on the front panel but grounded to the ground bus. Because the 2-gang tuning condenser is mounted on a bracket, it becomes necessary to provide a bushing in the front panel if a tuning dial is used that does not fasten directly to the panel. One of the receivers used General Radio dials (as shown in the photo last month) and this treatment was necessary in that receiver. The authors used band-spread only on the oscillator tuning, although the RF tuning is exceptionally sharp, due to the regeneration. However, the band-spreading is a matter of personal opinion as, in the last analysis, all forms of band-spreading merely act to increase the gear reduction of the tuning dial.

Mounting the Tubes

THE RF and detector tubes lie on their sides and the sockets are mounted with the heater prongs down for convenience in wiring. The tube manufacturers recommend that the heater prongs be placed on one side so that a line drawn through the two heater pins is vertical, but the experience of the anthors shows that no deleterious effects occur if this suggestion is disregarded. If wafer subpanel sockets (Fibre or Isolantite) are used the hole must be larger than the diameter of the tube socket, for the same reasons as were stated for the coil sockets. The oscillator tube is mounted upright on a shelf as shown in one of the photos.

The bottom view of the unit shows the detail of mounting the B strip and the by-pass condensers. Remember to keep all leads as short and direct as possible. The lay-out of the shields and components is especially designed for short-lead wiring.

The Circuit Diagram

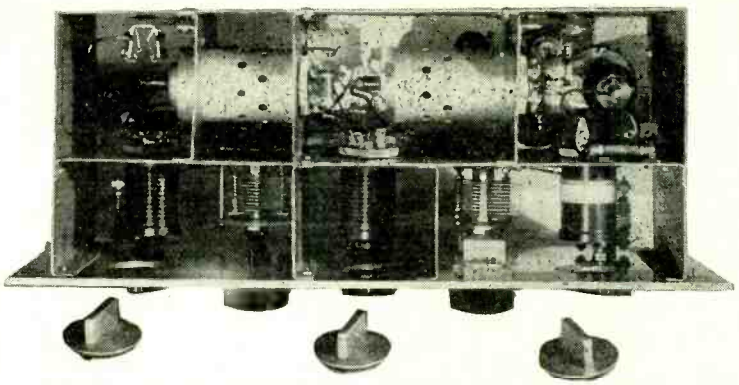
A FEW POINTS about the circuit may be of interest. The reader may be interested in knowing why certain things were done in a certain way. Note that the antenna, if a Marconi type, should be connected to the end of the primary farthest away from the grid end of the secondary. This was done to minimize capacitative coupling to the RF stage. Therefore the only coupling is inductive, which is as it should be to minimize noise pick-up. If a Faraday screen is used with an external filter, as shown in the January article, this precaution becomes unnecessary.

It will be noted that the feedback which provides the screen regeneration is obtained with a cathode coil, rather than by a tap on the grid coil. This was done for two reasons. In the first place, some experimenting with the location of this cathode tap with respect to ground is always necessary for optimum regeneration, and it is much easier to remove turns from this cathode coil than it is to move a cathode tap on the grid coil. The other reason is that an AVC voltage can be impressed on the cold end of the grid coil without any changes except an additional by-pass condenser. With a cathode tap we would be required to use an RF choke to feed either the AVC coltage to the grid, or a choke to provide a DC return to the cathode. RF chokes have no place in a regenerative amplifier which must operate satisfactorily at 2 MC and 30 MC.

It will be noted that all the suppressor grids are directly grounded to both RF and DC. This prevents a great deal of the "crankiness" often associated with trick suppressor grid circuits. The next unconventional point that catches our eye is the source of bias for the 57 first detector. We threw out the conventional cathode resistor as a source of bias because its automatic biasing action opposes the plate current changes that are necessary for efficient and quiet detection. We use fixed bias for the same reason that makes fixed bias desirable in a push-pull 2A3 audio stage.

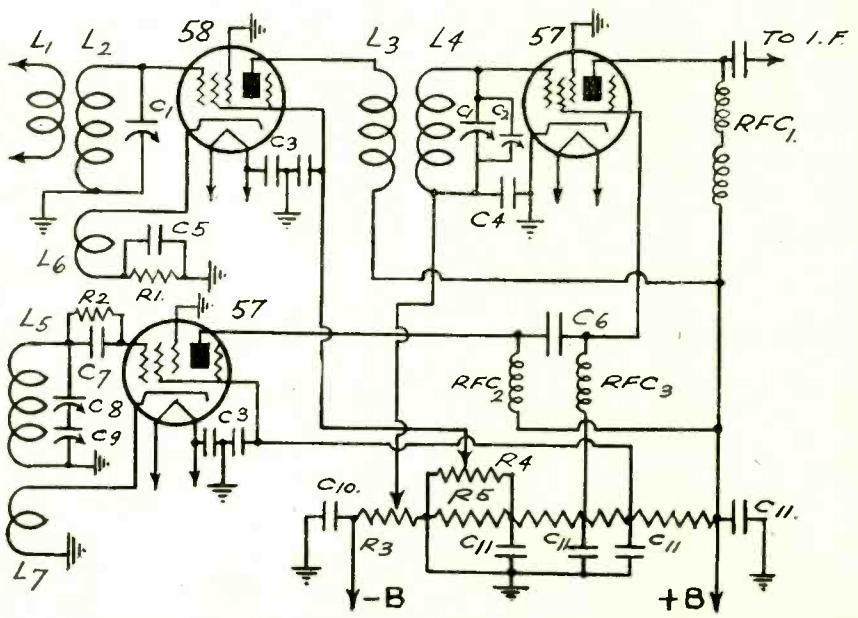
This bias of approximately 6 volts is obtained from the drop across a variable resistor located in the B-minus leg from the power supply. Thus all the plate and bleeder current for the whole unit passes through this resistor and therefore stabilizes the bias on the detector grid. It is highly important that this bias be variable because there is

(Continued on page 32)



Looking down into the "front end". Two of these instruments were built in "RADIO's" Laboratory. One uses Hammarlund parts, the other is built of parts made by National. The power supply and a new type of I.F. Amplifier will be shown in subsequent issues.

CIRCUIT DIAGRAM AND LIST OF PARTS FOR FRONT END OF BANEHAWK SUPERHETERODYNE



C1—Double Section 100 mfd. per section Hammarlund Variable Condenser.
C2—75 mmf. Trimmer Condenser, Variable, Hammarlund.
C3 (4 required)—.01 mfd.
C4, C5—.1 mfd. fixed.
C6—.0001 mfd. Sangamo.
C7—.00025 mfd. Sangamo.
C8, C9—100 mmf. Variable Condensers, Hammarlund.
C10, C11 (4 required)—0.5 mfd. fixed.

40 METER COILS:

L1—9 turns, interwound with L2, No. 30 enameled wire, on Hammarlund 6-prong form.
L2—13 turns, interwound with L1, No. 20 DSC or DCC wire.
L6—Wound on same form with L1 and L2, but on lower end of form, spaced ⅛-in. from L2, 6 turns No. 30 DSC wire.
L3—Duplicate of L1.
L4—Duplicate of L2.
L5—14 turns, No. 20 DSC wire, close wound, on Hammarlund coil form.
L7—Wound on same form with L5, but spaced ⅛-in. from L5, 5 turns No. 26 DSC wire, close wound.

20 METER COILS:

L1—5 turns, No. 30 DSC interwound with L2.
L2—8 turns, No. 18 enameled, spaced diameter of wire.
L6 (on same form with L1 and L2)—5 turns, No. 30 DSC, spaced ⅛-in. from L2.
L3—Duplicate of L1.
L4—Duplicate of L2.
L5—7 turns No. 20 DSC wire, close wound.
L7—4 turns No. 26 DSC close wound, spaced ⅛-in. from L5.
R1—500 ohms.
R2—25,000 ohms.
R3—500 ohms, Variable.
R4—50,000 ohms, Variable. (Centralab).
R5—25,000 ohm "B" strip, 50-watts.
RFC1—450 KC IF Transformer, windings in series.
IF Coupling Condenser—.01 mfd.
RFC2. 3—National Type 100 RF Chokes.

A New Combination

By JOHN L. REINARTZ
Consulting Engineer, RCA Radiotron Co., Inc.

EXPERIMENTAL work dictates simplicity in circuit arrangement as well as economy in the number of parts used if the expense of such work is to be kept within reason. A combination of two tubes which allows frequency changing within a given band and doubles at the same time so as to make fairly certain that there will be little or no reaction between the oscillator and the amplifier would seem to fill the bill.

Two tubes which do this stunt are the 865 and the 800. Both tubes are made for the higher frequency services and are especially adaptable to the 10 and 5 meters bands where most of our experimental work is being performed. Since the 800 is quite a high power tube so far as 10- and 5-meter work is concerned, the suggestion has been made that when it is used on 10 and 5 meters that it be used in an mo-pa system. The improved operation with respect to frequency stability over a self-excited circuit is obvious and needs no comment and is therefore the reason for the combination to be outlined.

Electron stream coupling has not had the attention it deserves; too many amateurs feel that it is beyond their ability and hesitate to experiment with it. The 865 lends itself so well to this form of coupling, besides providing sufficient output at double the exciting frequency, that there is no good reason why it is not used for this purpose in more stations. Just think, an 865 working as an electron-stream-coupled oscillator at 20 meters has sufficient power output to excite one or two 800 type tubes at 10 meters. It is like having a three-tube job, an oscillator, a buffer-doubler and a final amplifier. There is no worry as to whether a buffer-doubler is doing its job well either, since the 865 as an electron-stream-coupled oscillator just cannot help doing a good job and doing it at exactly double the frequency of the oscillating input circuit when the tank of the plate circuit is tuned to double frequency.

Let us look at the characteristics of the 865. The filament voltage is the same as that of the 800, namely 7.5 volts. This is a help as but one filament transformer need be used for the two tubes. The plate voltage that can be applied to the 865 is 750 volts maximum; when used in radio-frequency Class B service, the recommended limit is 500 volts. The screen voltage is approximtaely 120 volts for any applied plate voltage. The power output for the service that the 865 was designed for, namely, a screen grid RF power amplifier, is 16 watts at 750 volts plate potential. As we need but 4 watts for one 800 and 8 watts to excite two 800's, there is plenty of power for our purpose even when we use the 865 as an electron-stream-coupled oscillator.

In an electron stream coupled oscillator the filament or cathode is at a higher RF potential than the screen grid. This is accomplished by so arranging the filament-circuit connection that it forms part of the control grid tuning inductance. This is not hard to do, just take a block of wood and draw a two and one-half inch circle on it, then place nine wooden pegs at equidistant points on the circle and you have the makings for building the well known basket-wound type of coil. Now instead of winding but one wire on this form you wind on two at one and the same time. Use number 20 double cotton covered wire and remember that you must make a loop in each of the two wires at the place where the filament connections are to be. For the 80, 40 and 20-meter bands as the input frequency, the total turns are 24, 12 and 6, with a loop for the filament at the 8th, 4th, and 2nd turn respectively. A 100 uuf. tuning condenser capacity will then allow tuning over the entire range of such a band. Figure 1 shows the circuit connections for the coil to the grid, filament and screen grid of the 865.

If we now connect in the plate circuit of the 865 a tuning system that we know will tune to half the wave length of the grid circuit, we will find on applying power that the plate circuit really works at double frequency without noticeable reaction to the grid circuit. This circuit connection is shown in Figure 2. It helps if the circuit of the plate tank is of the high L type with the tank-tuning capacity down around 50 uuf.

This finishes the master oscillator, and, while it has been designed for use at 10 meters by doubling in the plate circuit of the master oscillator it need not be limited to this use. You may design the control circuit for any frequency you may wish, you may double in the plate circuit or not as you may wish, however, there is less reaction to the grid circuit when you do double and your frequency characteristics will be better.

We now couple on the 800, this presents no especial problem; we merely provide a plate tank for the 800 and see that we have a neutralizing condenser that is really small enough to function for that purpose. Remember that the 800 has small internal capacities and therefore needs a small neutralizing condenser. A good one for the purpose can be made from two pieces of flat brass or copper the size of quarters, one of these pieces is mounted on a hard rubber pedestal that has been cut into a U shape, in a fixed position, while the other piece is first mounted on a number 8 wire that has been threaded wtih a number 8-32 die, this is then mounted opposite the other piece in such a manner that the distance between the pieces can be varied by means of a hard rubber knob on the other end of the number 8 wire, see Figure 3.

For the operation of the 800 at ten meters, attention must be paid to the tank circuit and its connection to the plate-tank tuning condenser. Four turns of ¼-in. copper tubing 2½ inches in diameter will do very well for the tank and the Cardwell type 197-B with mycalex insulation and heavy studs for connections will do nicely as the tank tuning condenser. Just make sure that you have clean, tight connections between the tank coil and the tank condenser.

Remember that you must not attach any heavy parts to the two connections on top of the glass envelope of the 800; use flexible leads and good clips to these grid and plate connections and of course, make them as short as possible. Because the filament current drain of the 800 is 3.25 amperes, be sure to provide ample capacity insofar as the filament transformer is concerned. To have some voltage control, it is usually best to provide a rheostat in the primary connection rather than in the secondary or low voltage side.

No attempt will be made to suggest the form that the antenna system shall take. So much has been said along that line that little if anything can be added. It should be remembered that because you are going to use 1000 volts at the plate of the 800, great care should be used in its handling. It will be safest to use inductive coupling to the antenna circuit in place of any form of conductive coupling to the tank coil especially if the tank coil is at high potential as well.

The main idea of this article has been to point out a way for energizing the 800 with at the same time little or no reaction back to the oscillator part of the circuit to provide a source of stable frequency with the advantages of a doubler-buffer but without the use of a multiplicity of tubes, and to facilitate the use of the 800 in any of the amateur bands and especially at 10 meters.

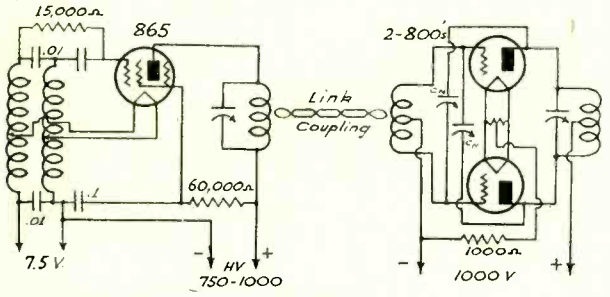


Fig. 2

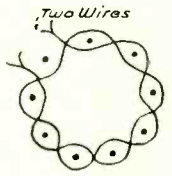


Fig. 1

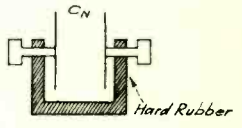


Fig. 3

Efficiency in Grid Modulation

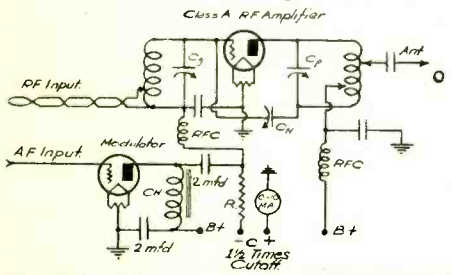
By ROBERT S. KRUSE

SINCE both the efficiency of the plate circuit, and also the harmonic distortion taking place in the stage can be made to vary over a wide range in a grid-modulated stage, a few notes on the subject may not be amiss.

I must begin by pointing out that I have been guilty of unintentionally giving some misinformation on the subject of efficiency for such a stage. On page 13 of "RADIO" for November I gave some figures for the performance of several stages—and unfortunately quite neglected to remember that one of the meters was being used with a 2/1 shunt, and that the reading must be multiplied by 2 to give the truth. The absurdity of the result should have been apparent to me, but was overlooked.

Beginning with the same data, that is with an 852 pair at 4000 volts, properly biased and fed with RF, we have a "resting" or "carrier" input of 333 watts (83 ma. at 4000 volts). With full modulation the input will rise 50% and we shall have 500 watts going into the plates. So far everything is well, although it will be found that we are running the tubes above the maker's rating, simply because the maker's ideas on plate dissipation are needlessly conservative for use when one is only momentarily going up to full modulation, and is mostly working at low levels. (The largest part of all speech is at some 20% of the peak levels). The November article just referred to stated that the carrier was 250 watts—which is of course absurd, 125 being the truth in the matter, and giving a plate-circuit efficiency of 37.5% instead of the impossible 75% stated in the article first referred to. This is about the best performance that we can expect without going into a region where grid current appears, that is by driving the grids positive, or working in class B. Even the 37.5% performance is obtained only if the plate supply system and the driving RF and audio stages are up to their jobs. Before going to the nature of the requirements at these points I wish to go back to the remark about plate losses. Under the "resting" or "carrier only" condition we had an input of 333 watts to the pair of 852 tubes, and an output of 125 watts, manifestly leaving the difference of 208 watts on the two plates. This is 104 watts apiece and differs inconsiderably from the maker's rating for dissipation. Little or no plate color shows.

Now at full modulation, the plate input will increase 50%, that is it will be 500 watts for the two tubes. If the same efficiency persisted the per-plate heating loss would now be 156 watts, which isn't dangerous to an 852 as an intermittent performance, though not exactly right as a steady diet. BUT—recollect that speech seldom goes to 100% modulation, and then but momentarily. Most of the time we are in the region below 30%



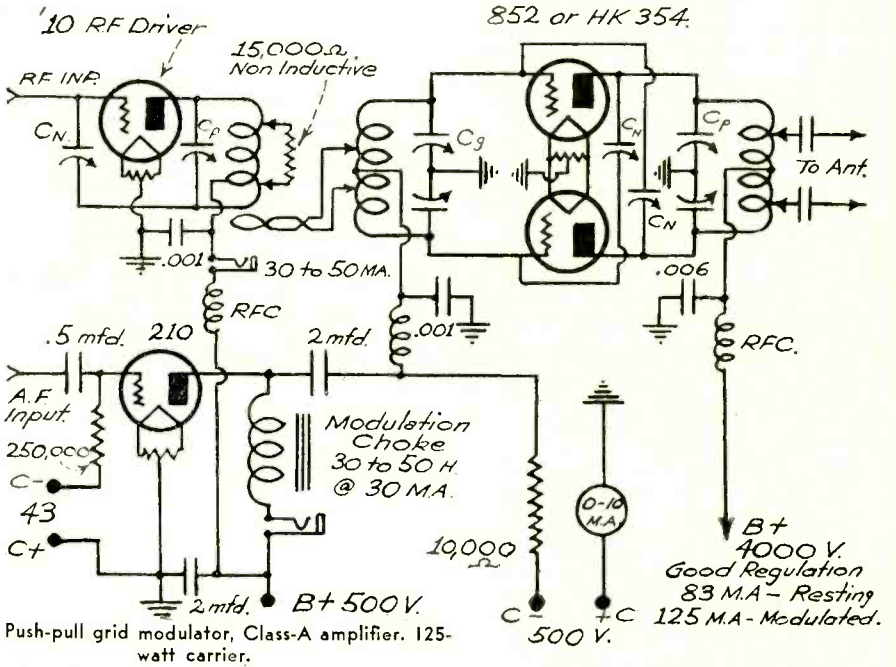
Class-A Amplifier. Carrier equals 35 to 60% of plate dissipation.

modulation and the dissipation is a good deal nearer to the 104-watt heat loss than the 156-watt loss.

Incidentally—the efficiency does increase slightly on upswings so that our max losses are not quite as high as 156 watts.

The Associated Devices

THE STATEMENTS above can be made to stick if the associated devices are all right. Conspicuously the plate supply should have excellent regulation, both dynamically and statically. Good dynamic regulation demands a final condenser of not less than 6 microfarads, better 10. This is expensive at 4000 volts, and it is fortunate that



Push-pull grid modulator, Class-A amplifier. 125-watt carrier.

speech peaks are mainly of a high-frequency type, for which satisfactory regulation can be provided with much less capacity. The criterion is primarily the reactance of the final condenser of the plate supply to the lowest frequency which causes high swings. Here you are fortunate if you have a tenor voice. Harry Frankel would need about 12 mikes! (He's "Singin' Sam" to you.)

That, however, isn't the whole story. While AC demands can be taken care of for the instant by the last filter condenser, this condenser is after all merely a storage device—it can't increase the DC output as must be the case whenever any modulation whatever takes place. From the DC standpoint this condenser is merely holding the fort until the reserves can be sent up—that is until the last filter choke can deliver more power from the rectifier. For that reason it is exceedingly important that the filter chokes be of low resistance, and also that the supply transformer be of low resistance. The exact requirements are a long story but there is a very simple general rule that exposes the really bad ones—run the thing steadily for an hour and then shut down and feel for hot spots. If anything in the rig is really hot you can't possibly be getting good regulation. If everything is cool you may be getting good regulation. Put a DC voltmeter across the filter output and see what happens at full modulation. The voltage should not drop more than 5%. That is **plenty.**

Of course it is not necessary to build a plate supply to get a good preliminary idea. Some manufacturers will be able to state the performance of their rectifier-filter combinations if you give your expected conditions. For example, we should in the present case ask what percentage regulation would be found in their 4000 volt supply between 83 M.A. and 126 M.A., not between zero load and 126 M.A. You can take care of any "soaring" tendency to a large degree by means of a bleeder. In this instance it should draw something like 10 M.A., in other cases some 10% of the "resting" plate input. Hence we should really ask our manufacturer as to regulation between 94 and 136 M.A. Please observe that this bleeder must dissipate about 35 watts. It can't be made out of baby resistors.

The Drivers

IN THE type of operation we are considering, the intention is to draw little or no grid current. However it is an unsafe assumption to believe that this is equivalent to a zero load on the driving stages, both RF and audio. In the first place, a good many high-voltage tubes show grid current before one gets them swung clear down to zero grid. In the second place, even the circuit capacities and the losses in the coupling devices are worth thinking about—not so much because of their power-demand, as on account of their effect in producing phase shifts or undesired resonances in the driving circuits. In typical cases it is found that the audio fidelity may go quite sour, simply because the audio transformer was designed to work into a load, and when without a load except the input capacitance of the modulatees it develops very bad humps and hollows in its frequency-response curve.

For these reasons it is a pretty good idea to start out by loading each half of the audio input transformer secondary (or the one secondary if it has but one) with a dead resistor of 5,000 to 10,000 ohms. This will very effectively swamp the effects just named, and furthermore simplifies the design. We now

(Continued on page 33)

A Super-Heterodyne Converter

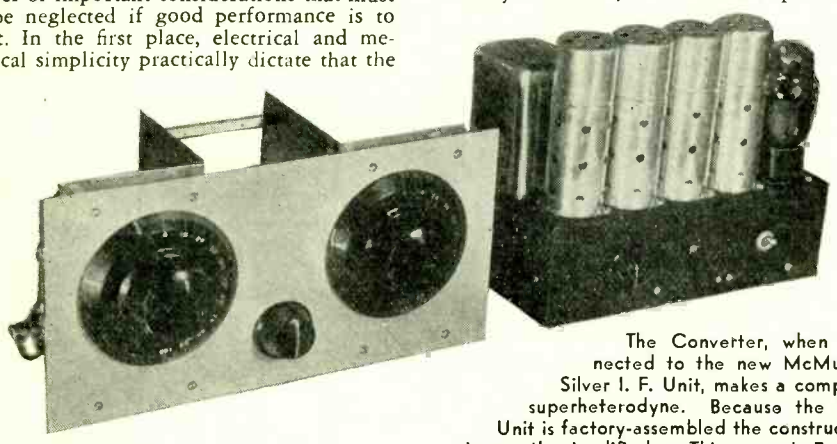
By FARRELL LEWIS

THE demand for some sort of an efficient, low cost converter has prompted us to design one. This unit is quite radically different from anything we have ever seen, and we are sincere in our belief that the performance is equally satisfactory. This, of course, is subject to the limitations imposed upon the unit by the simplicity of construction and the lack of a pre-selection or TRF stage. On weak signals it will not be outdone. Signal-to-noise ratio is also fairly good.

While this unit is intended primarily for use with the new McMurdo Silver IF Amplifier, it will work equally well as a converter, a good BCL set acting as the IF and audio units.

In the design of a "front end," there are a number of important considerations that must not be neglected if good performance is to result. In the first place, electrical and mechanical simplicity practically dictate that the tube complement be confined to not more than two tubes. While a tube like the 2A7 might be used to eliminate one tube by acting in the dual function of oscillator and mixer, the additional circuit complications rather make its use undesirable. By using a separate tube for each function we can have each stage working at maximum efficiency on one job instead of just fair efficiency on both. Power detection, while highly desirable in any receiver has no place in this unit because it is relatively insensitive to weak signals. By no means do we advocate the use of the conventional grid-leak detector with large grid leak and condenser, but rather a sort of power-grid leak detector. This allows comparative freedom from blocking and still allows the use of regeneration to bring up the gain. Let us take up the detector in more detail.

By decreasing the size of the grid condenser to .0001 and decreasing the grid leak to 1 meg., we will have gone far toward proper operation of our detector. In this detector, the plate and screen voltages are both much higher than is customary with grid-leak type detectors. Plate voltages of 180 to 200, and screen voltages of 70 to 100 are about right for this stage. Since we have decided that regeneration is highly desirable, it now remains to consider just exactly how this regeneration is to be added. The conventional tickler in the plate circuit is not particularly desirable, because this plate circuit contains the IF signal component which belongs on the grid of the IF first stage, not wandering around through a tickler winding, looking for a chance to escape. The electron-coupled circuit offers us an out. We can't use it in its entirety, with all the attendant stability, but we can adopt the idea of putting the "tickler" in the cathode circuit instead of the plate. Unfortunately, since we want to couple the oscillator output into the screen, we cannot establish this screen at ground potential with respect to cathode without by-passing our oscillator voltage to ground. This fact makes impossible the opportunity to use straight electron coupling in the detector. We can get a very smooth and satisfactory control of regeneration by varying the screen according to the time-tried method. By adjusting the number of turns on the cathode coil we can get the tube to go into regeneration at the higher value of screen voltage which we want to use. The screen voltage cannot be increased beyond a certain point, else the detector will break into a regular super-regenerative howl with a complete lack of results. We don't want oscillation, but simply regeneration. As to choice of tubes for this mixer stage, we feel that the '57 is a hard one to beat. The main consideration in the selection of an oscillator is **stability.** This is necessary if "pulling" of the detector is to be avoided. The tendency to creep is one that is insufferable. A well-designed electron-coupled oscillator will have neither of these tendencies. The electron-coupled oscillator has the additional advantage of being capable of putting lots of power on harmonics, in turn allowing one oscillator coil to serve on two bands. In adjusting for maximum output on the harmonics, the number of turns in the cathode coil should be increased until the maximum output on the desired harmonic is obtained. An increase in the grid leak is sometimes advantageous. Of course, for proper harmonic operation the oscillator output must be stronger than for fundamental operation. Increasing the oscillator plate and screen voltages can do much in this respect.

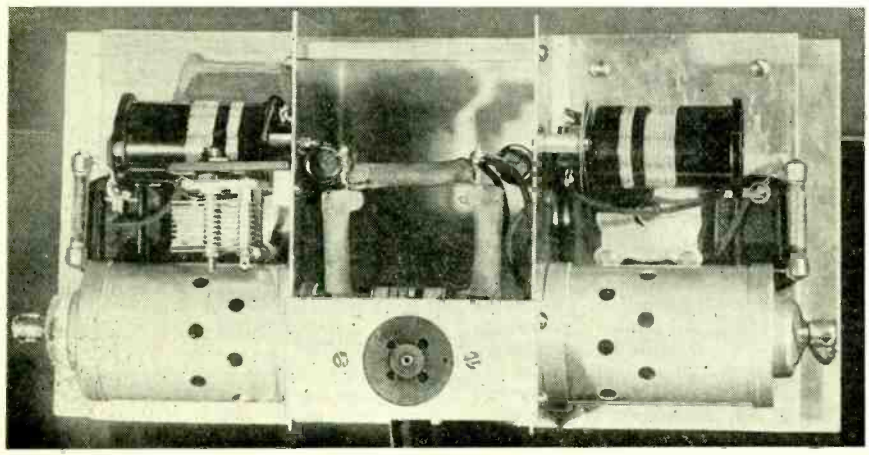


The Converter, when connected to the new McMurdo-Silver I. F. Unit, makes a complete superheterodyne. Because the I. F. Unit is factory-assembled the construction is greatly simplified. This same I. F. Unit will make a super out of any TRF Receiver.

Since the oscillator dial does all the tuning, it is quite essential that some sort of band-spreading device be incorporated in this stage. The simple and wholly effective series system was used in our laboratory model and worked very satisfactorily. It might be said, by way of explanation, that the detector tuning is broad and unless working at the peak of regeneration can usually be left set over a portion of the oscillator range. This, of course, is for broad tuning. To get that weak fellow up out of the background, the detector must be on the nose.

The method of mixing the oscillator and detector output comes in for a lot of consideration, since this is one of the most important functions in a super. Coupling into the screen grid seems to be the one method that works without any difficulty. The main trouble is the fact that it is then not possible to by-pass the screen to ground. In mixing the output of the two stages, it is also well to bear in mind that no other coupling must exist, other than that deliberately intended. This resolves itself down to a problem of providing the maximum of shielding between oscillator and mixer.

In the layout shown in the photograph, we feel we have provided the maximum possible shielding without going into a complicated, expensive, complete inclosure of both stages. In our unit, both stages are widely separated from each other, without in any way increasing the length of any leads. The shields on each stage do not use the panel as one of their sides, but instead are separated from the panel and are only fastened to it at four small surface points. This method of shielding has proven to be the most effective, as the panel does not act as a common lead to



Rear view of the Converter showing symmetrical placement of parts. The tubes are in a horizontal position. This practice is entirely feasible because the tubes have cathode filaments. Note the shielding and wide spacing between Oscillator and Detector.

couple each stage together. It will be further noted that we do not use a chassis in the usual sense. The space between stages serves as a compartment in which to house the various parts usually found under the subpanel. The B strip, made up of three separate resistors, is started from the positive terminal on the power input plug and goes vertically to join another resistor and finally ends up by joining at the negative terminal of the input socket. This gives the shape of an inverted, square bottom letter "U". The by-pass condenser at the positive end of the strip goes directly from the positive end of the resistor strip across to the other side (negative). Other by-pass condensers across the junction of the resistors serve to hold the resistor link in position.

In this layout, symmetry of construction has been observed throughout. This not only makes a simple job of the mechanical construction, since one side is a practical duplication of the other, but serves a very important role in contributing to the performance. By laying the tubes and coils in a horizontal position, we can get the absolute maximum in separation between stages without increasing the length of any lead. Both stages are mounted on "L" shaped pieces of aluminum, and since they are identical in all respects as to the mounting of the parts, one can be laid out and used as a template for the other. The band-spread condenser used in our set is the new Cardwell "Trim Air" type. It is insulated from the metal of the set by means of a bakelite piece, in turn fastened to the wall by means of an aluminum angle. These small condensers can be used with or without a shaft. In one case, a slot in the shaft makes variation possible. In the case of the shaft, a knob with possibly some sort of indicator, can be used. The dials in use happen to have a protruding shaft which joins directly to the condensers. The condensers are set back about ⅜ of an inch from the panel proper. In the case of flush-mounting dials some sort of extension would have to be used. One other feature that is perhaps worthy of mention is the mounting of the grid condensers on small Johnson stand-off insulators. These tiny insulators are usually associated with transmitting apparatus but they serve admirably in this receiver to keep the condensers away from the panel. The photograph will show any other features that might be of interest. The panel is 6 in. by 12 in. aluminum. The "L" shaped sections are 3½ in. on the panel side and 4 in. on the ends enclosing the B strip. The space between sections is 3½ in.

A few words about the McMurdo Silver IF unit are in order. This little unit is nearly, but not quite, a complete super in itself. It consists of two stages of litz wound, air-tuned IF using 58 tubes. A 56 second detector, also Litz wound and air-tuned, works into a 2A5 audio stage. An air-tuned BFO using 57 beats with the second detector. The 2A5 has no output transformer or choke in the unit. This must be added. A switch turns off the BFO for phone reception and a control from the front varies the volume to a queen's taste. This little unit is really a splendid IF portion of a super and excellent results may be expected by anyone contemplating using one for this or any similar receiver.

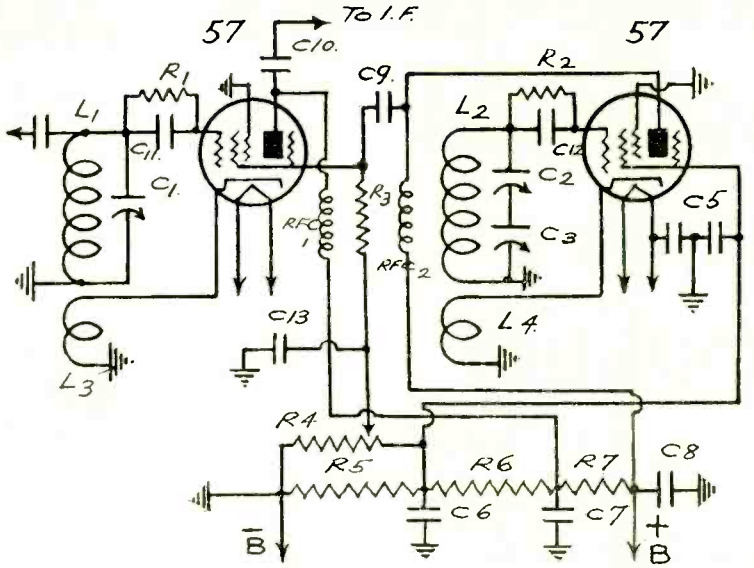
Since there may be some who will wish to use this converter in conjunction with a BCL set, a word about such operation will be given. We have used a shunt-feed connection on the output of the converter so that the voltage is complete on the mixer plate without having to travel through the IF transformer and then back into the power supply plug. In this case, it must be remembered to ground the opposite end of the IF transformer. This will already have been done in the BCL set because you will couple directly into the antenna post, unless the receiver has some dizzy band-pass arrangement or a resistance in the antenna circuit to control volume. In either of these cases it would perhape be better to make certain that your output from the converter is getting into the grid circuit of the first RF stage without being lost in the confusion.

When all of this is dispensed with, you are now ready to do a little listening. The frequency to which your broadcast set is tuned will be your intermediate frequency. Be sure to set the dial to a spot where there is no broadcasting stations or else interference is certain to result. Assuming you can find such a spot and are enjoying signals, it is still necessary to have some form of beat oscillator in order to get CW signals. Such a beat oscillator and its inclusion into a BCL set was described in "RADIO" some months ago. It is well worth looking up. A scheme that is sometimes used with fair results is to tune the BCL set just to the edge of some local BC station so that you get a beat note on CW. This system does not allow much latitude of beat notes, but will do in a pinch.

If image interference is bothersome it can be greatly lessened, if not entirely eliminated, by use of a trap tuned to the interfering signal. In this case, however, the front end must be completely shielded or the signal may be picked up by the coils themselves, thereby nullifying the effectiveness of the trap. In the case of using a BCL set as the IF, you have a rather wide selection of intermediate frequencies so that image can be lessened by changing the IF frequency and moving the repeat point to some other point outside the band in which you happen to be listening.

In conclusion, we would like to say that we feel sure that if the details and data are followed in the design of this unit the performance will be extremely satisfactory.

CIRCUIT DIAGRAM AND LIST OF PARTS FOR SUPERHETERODYNE CONVERTER



C1, C2, C3—100 mmf. Hammarlund Star Variable Condensers.
C5 (2 required)—.01 mfd.
C6, C7, C8, C13—¼ mfd. 350 volt fixed condensers.
C9—.0001 mfd. Sangamo.
C10—.01 mfd.
C11—.0001 mfd. Sangamo.
C12—.00025 Sangamo.
40 METER COILS:
L1—16 turns, No. 22 DSC wire, wound on 1¼-in. Bakelite form.
L3—Wound on same form as L1. 4 turns, No. 28 DCS wire, spaced ¼-in. from L1.
L2—Same as L1.
L4—Same as L3.
20 METER COILS:
L1 and L2 half as many turns as for 40 meter coils. L3 and L4 are same as for 40 meter coils.
R1—1 meg. IRC Resistor.
R2—50,000 ohm IRC Resistor.
R3—50,000 ohm IRC Resistor.
RFC1—Broadcast type RF Choke.
RFC2—National Type 100 RF Choke.

The Inductance Authority

. . . By Edward M. Shiepe, B.S., M.E.E., and published by Herman Bernard, 135 Liberty St., New York City, N. Y. A valuable contribution to the science of radio, for it enables the determination of the inductance required for a specified capacity to attain a desired frequency, the inductance required with variable capacity to achieve a given frequency range, as well as the minimum capacity requirement for the determined inductance to strike the highest frequency of the range. The book also contains 39 large pages of curves, from which can be computed almost every conceivable value of inductance when the capacity is known. Furthermore, a supplemental chart is also supplied with each book; this chart can be read to an accuracy of 1 per cent. Therefore the curves may be used in engineering practice to excellent advantage, and besides they are valuable to all who make or must instruct others to make solenoid coils, such as used by engineers, amateurs, home experimenters, service men, students and teachers. The book, "THE INDUCTANCE AUTHORITY", sells for $2.50, net, with supplement.

THE AERIAL

The wires I've strung for thee, dear set
Are like a shoe-string gambler's bet—
Each strand a sob, each sob a pain,
No sooner up than down again.
I cinched you like a fiddle string
And in the house the lead I'd bring,
And every time a high wind blew
And something snapped, I knew 'twas you,
My aerial! My aerial!

A High-Quality Low-Level Voltage Amplifier

By I. A. MITCHELL*

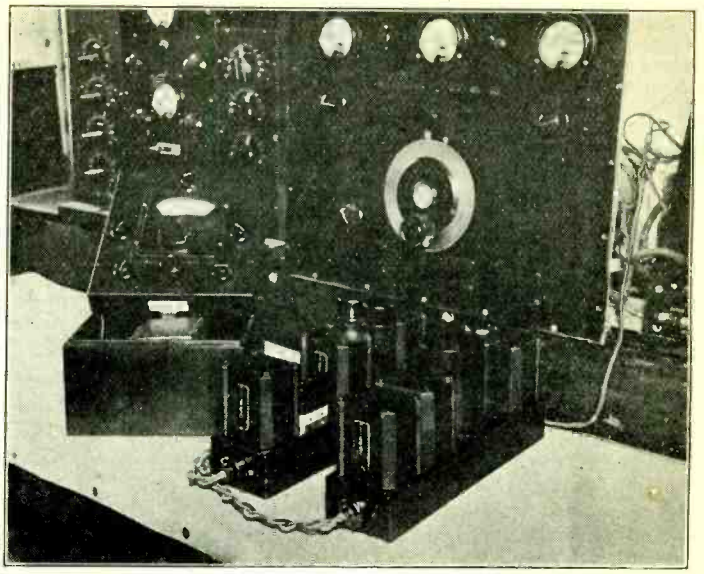


Fig. 1. Laboratory Test for the Amplifier

THE LAST few years have seen a very great increase in the frequency range of audio equipment, from microphone to loud speaker. However, there has been practically a proportionate decrease in the sensitivity of input devices requiring additional gain in the amplification circuits. This is readily apparent when a number of modern types of microphones are compared. A fairly accurate check on modern input devices indicates the following average output levels:

Carbon Microphone	—34 DB
Condenser Microphone	—82 DB
Dynamic Microphone	—88 DB
Velocity Microphone	—97 DB
Crystal Microphone	—70 DB
Magnetic Pickup	—25 DB
Crystal Pickup	—15 DB

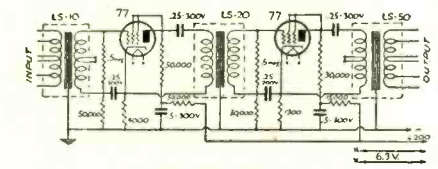
Only average values are indicated, as there is quite a difference in output level for the same type of microphone as manufactured by different organizations. Another factor to consider is the variation in output of microphones due to distance from the sound source and directional effects.

Considering the above as a whole, the necessity for pre-amplification is quite obvious. To allow sufficient range in gain control, an amplification system should have at least 10 DB greater gain than the difference between normal input and output powers. For comparison, let us now consider the output of a number of power amplifiers. (Radio, February, 1934) as commonly used by the amateur:

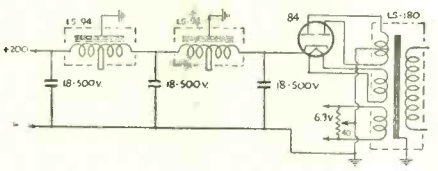
1 245	Class A	plus	24 DB
1 50	" A	"	28 DB
2 245 or			
1 53	" B	"	32 DB
2 50	" A	"	33 DB
2 2A3	" A	"	34 DB (Fixed Bias)
2 WE300A	" A	"	35 DB (Fixed Bias)
2 46 or 59	" B	"	36 DB
2 845	" A	"	38 DB
2 RK-18	" B	"	40 DB
2 800's	" B	"	42 DB
2 211's	" B	"	45 DB
2 203A's	" B	"	46 DB

Based on the above method of determining required amplifier gain, the gain required between a dynamic mike and the output of a pair of 2A3's would be 34 plus 88 plus 10, or a total of 132 DB. If the power amplifier has a gain of 80 DB, it is seen that an additional gain of 52 DB is required in the pre-amplifier.

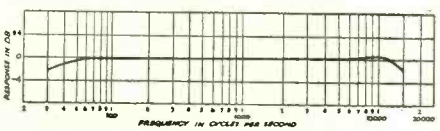
Using the above method of attack, the required amplifier gain for any input device and output power can be quickly approximated.



Power Supply



Circuit of Amplifier Unit



Response Curve

Up till approximately a year ago, practically all pre-amplifiers were battery operated. Continuous research has changed this condition, so that now an all AC operated pre-amplifier is not an impossibility.

One of the important factors in this development has been the improvement in tubes. The 262A is an example of a practically perfect AC voltage amplifier from the standpoint of filament hum. However, an analysis of the more common and less expensive tubes indicates that some of the standard tubes released during the last year are also quiet from the standpoint of AC hum. Notable among these are the 6 V. heater types among which is included the 77 tube used in the amplifier described below.

As is well known, the triode tube properly used is the most clean and stable of amplifiers. It has been found that by connecting up the elements of the 77 as a triode, the resultant amplification factor is 20, the mutual conductance is 1700, and the plate impedance only 12,500 ohms. Hence the adaptability of this tube as a voltage amplifier. At a plate voltage of 180, the negative bias voltage should be 5.7 and the plate current 4.75 MA.

At some time or other, the average transmission engineer decides he wants to make a new piece of apparatus as good as it can be made. In this way, regardless of alterations in other apparatus he has one unit which is permanent and which cannot reflect in quality on standard equipment. This was the thought in mind when the pre-amplifier with AC power supply described below was designed.

General Design Factors

THERE ARE six major factors which must be considered in the design of a quality amplifier:

1. Uniform frequency response.
2. High efficiency.
3. Low harmonic distortion and phase shift.
4. Low hum level.
5. High power output.
6. Flexibility of terminations.

Frequency Characteristic

IN A WELL DESIGNED amplifier practically all frequency discrimination lies in the audio transformers, so that proper choice of these takes care of the first requisite. A laboratory run on the completed amplifier shows a frequency characteristic illustrated in Figure 1. The characteristic is substantially flat from 30 to 15,000 cycles. The decoupling resistors and grid resistors help obtain this uniformity.

Efficiency and Gain

HIGH EFFICIENCY is effected in the amplifier through the use of the 77 tube triode connected as described above. It will be noted that an interstage transformer is used between tubes rather than resistance coupling. This gives us 100% (6 DB) greater voltage amplification. Additional gain can readily be obtained by using audio chokes in place of resistors for parallel feeding the interstage and output transformer primaries. This would give an increase in amplification of respectively 60% (4 DB) and 80% (5 DB).

The overall gain of the amplifier is 53 DB at 1000 cycles.

Harmonic Content

THE HARMONICS in a class A amplifier come from both transformers and tubes. The harmonic content introduced is small in quality transformers where the core materials are operated at proper flux densities and phase shift is maintained at a low

* President, United Transformer Corp.

value. Operating at the low levels encountered in pre-amplifiers, there is a very low amount of tube harmonics.

The amplifier can be operated up to an output of 30 milliwatts, (plus 7 DB) without exceeding a negligible value of total harmonics. By parallel plate feeding the output transformer with an audio reactor, the output power can be increased to 60 milliwatts due to the increase in plate voltage.

Hum Level

THE HUM LEVEL in an amplifier can generally be charged to filament supply, plate supply, inductive pickup, and electrostatic pickup.

A variable resistor across the filament supply is used to balance out filament hum. The plate supply uses a two stage condenser input filter which is highly effective. The chokes shown have an inductance of 200 henries at the normal DC current. 500 volt electrolytic condensers were used in the power supply to afford ample safety factor.

The inductive pickup operating at low levels becomes quite important. The transformers used were housed in a balanced high permeability cast alloy shield having five times the shielding effect of normal cast iron. A metallic inner shield in the case nullifies stray electrostatic pickup effects.

Due to the above conditions, the output hum level was unmeasurable on instruments in the laboratory. When followed by an additional 80 DB gain, the hum from this amplifier could not be heard on a pair of phones.

Universal Features

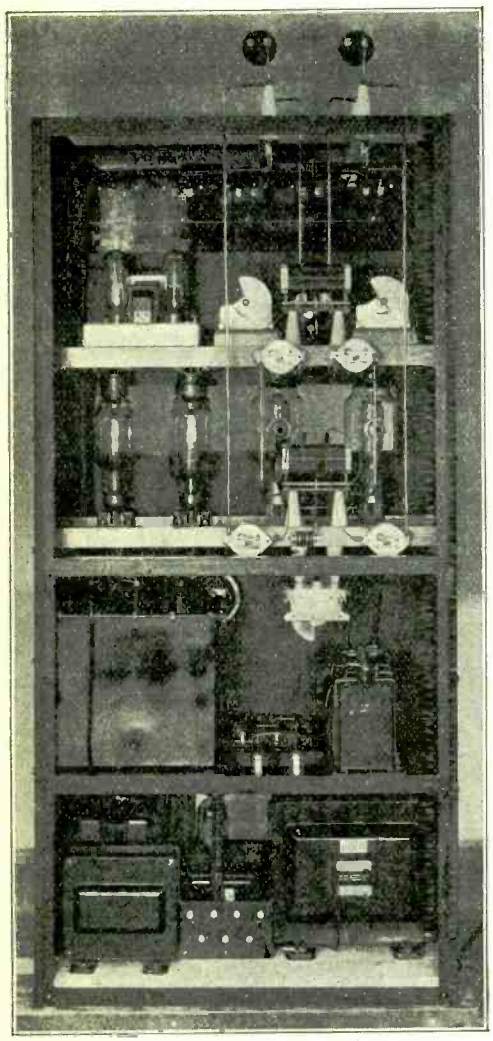
AN AMPLIFIER of this nature can be used for numerous purposes and it was therefore made a distinct individual unit. A universal input transformer was incorporated allowing a number of different input impedances to be used, namely, 50, 125, 200, 250, 333, and 500 ohms. It is evident that a number of different lines can be accommodated individually or simultaneously with this unit.

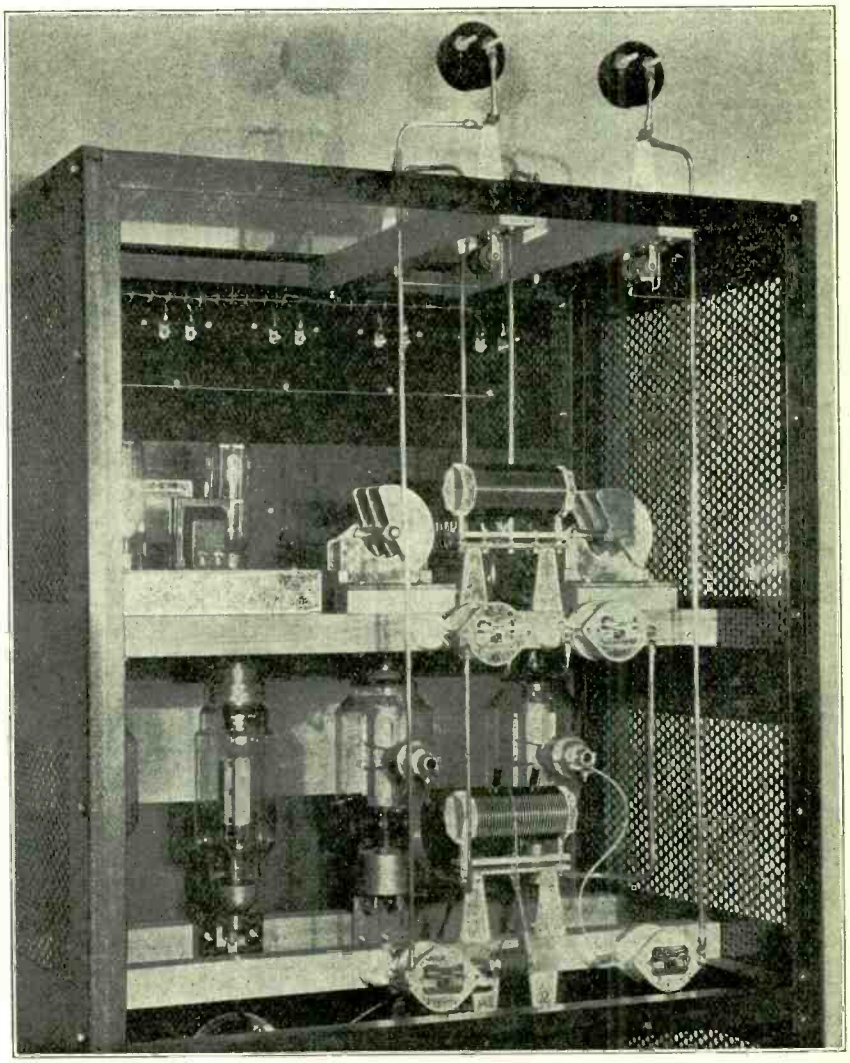
An output transformer incorporating the same universal impedances as the input transformer was employed. Measurements indicated a negligible change in frequency characteristics at any of the various impedances.

The widths of the amplifier and power supply chassis were maintained at 3⅜ in. Coupled with a length of 13½ in. these units are perfectly suited to be mounted on individual rack panels 3½ wide.

A four-prong plug connects the pre-amplifier to its power supply unit. In this way it it also possible to use the pre-amplifier for battery operation as the pre-amplifier and power supply are independent units.

It goes without saying that the complete AC operated pre-amplifier is ideal for use with Velocity, Voice Coil and Crystal type microphones. As a matter of fact the original pre-amplifier, pictures of which are shown, is now in use at the famous Roxy theatre in New York City. This theatre seats 6000 people. It was found that pickup was possible 20 feet away from the Brush crystal microphones which are now being used with this equipment, without increased noise or hum level. Even with singers at this distance from the microphones, the voices can over-ride the orchestra in all parts of the Roxy.





SPECIAL COLLINS 20B TRANSMITTER FOR BYRD EXPEDITION

TWO FEDERAL F-100A tubes are used in push-pull in the class C stage. The plate input to these tubes is normally 1.5 kw. (0.5 ampere at 3,000 volts.) The 750 watts of audio power required to modulate this input is obtained from the two 849 class B modulators. The Federal tubes give excellent account of themselves and operate efficiently in this transmitter on frequencies up to 30 mc. The tubes have plain tungsten filaments which draw 50 amperes at 11 volts.

The picture at the left discloses the power supply equipment on the lower platform. The large plate transformer weighs 250 pounds and is rated at 5 kva. The other two iron core units are plate reactors handling 1 ampere D.C. The rectifier tubes are Federal 375A's. The class B transformer is mounted in an oil tank on the second platform at the left. At the right of this transformer are the Pyranol, 5000 volt filter condensers and the filament transformer for the F-100A's. Immediately above the filter condensers is the plate tank circuit. Standard Collins-Isolantite coil forms are used, since they exhibit lower losses than copper tubing coils, which have more metal in the magnetic field of the coil. The coils are worked at a low value of tuning capacity at all frequencies. Above the large tubes at the right is shown the grid tuning circuit and the one inch spaced neutralizing condensers. The pushpull 845 class A driving amplifier is at the left.

The close-up photograph at the right shows the RF chokes connected between the feeder lines and ground. This provision is necessary in order to drain off the static charges which accumulate on the antenna during the severe Antarctic storms. The equipment used on the previous Expeditions did not have this feature and static splash-overs damaged the apparatus several times during operation. Thermoammeters are mounted externally and are in series with the antenna feed lines.

These illustrations by courtesy of Collins Radio Company, Cedar Rapids, Iowa. Mr. Collins is the Engineer who has made popular the new antenna system shown elsewhere in these pages.

Ham Hints

— By JAYENAY —

Improving the Signal To Noise Ratio In the FBX and Comet Pro.

MANY owners of these two widely-used supers complain that the noise level is about the same with the antenna either on or off. It has been found that by replacing the fixed cathode bias resistor in the first detector (20,000 ohms in the FBX) with a variable resistor of about 30,000 ohms, a remarkable improvement in the signal to noise ratio can be effected. In this manner the bias voltage can be varied until the point of maximum sensitivity is found. W6FT finds that his particular brand of 57 first detector tube works best when the bias resistor is only 1000 ohms (measured value). This sounds wrong somehow, but it certainly works in his case. Sometimes a further improvement can be effected by grounding the cathode and opening the grid return at the ground side of the detector grid coil. The grid is then returned to the power supply side of a 500 ohm variable resistor located in the B minus lead. (Don't forget to bypass the RF back to the tuning condenser). This tends to stabilize the bias and minimizes the bias change caused by the variation in plate current of the first detector. Carrying the same idea still further, a small 6 volt C battery in the grid return works best of all. However, it takes a mighty ear to tell the advantage over the 30,000 ohm variable resistor first mentioned. For those who like a multiplicity of knobs, a screen potentiometer for the first detector might be added. While we are at it we may as well add regeneration, controlled by the same potentiometer. Regeneration can be added in a number of ways; on the "Pro" by adding a cathode tap on the coil, or by winding a tickler winding at the top of the WL coil. In the FBX the construction of the coils makes this tap difficult to add. However, the primary can be used as either a cathode, screen or plate tickler, in which case the RF from the antenna would be fed directly to the grid through a small capacity. The addition of regeneration will increase sensitivity and reduce image interference. Those who are considering building or buying a preselector for these receivers are advised to make the preselector RF stage regenerative for best results. If this is done, the detector is left non-regenerative. When adding the preselector be sure to keep all RF leads as short and direct as possible. This point cannot be too strongly emphasized, as a satisfactory signal to noise ratio cannot be attained otherwise.

●●●

Building the Transmitter

IN THESE days of link coupling we no longer need to accept the compromises formerly forced on us by the short interstage leads necessary with capacity coupling between stages. We can make our coupling links almost any length up to TEN FEET without excessive losses. Of course, few will feel that they want to use ten-foot separation between stages, but all of us have an ultimate yen for some form of relay rack. Why not put each stage on its own breadboard so that we can lay all the breadboards out in a line until we get everything right, and then mount each breadboard in a rack? We might make each breadboard 15-in. long by 8½-in. wide. This allows us to spread each stage out so that all parts are accessible and yet none of the straightforward simplicity of breadboard construction is lost. 17-in. is about the longest baseboard that wil go between the side members of a standard 19-in. relay rack, so if you are looking forward to Rack mounting, keep within this limit.

A piece of strip copper nailed down the middle of each breadboard makes a FB ground bus to which all ground returns can be soldered with the minimum of leads.

This same construction is recommended for power supplies because they will also go into the rack when that great day arrives.

●●●

New Meter Ideas

DON'T fail to write Westinghouse for their new bulletins on special uses of meters for Hams. They have unusual value to the phone man; they show how to indicate carrier shift and overmodulation, as well as other common phone troubles. If you want to know how to get a fairly accurate check on percentage modulation, these bulletins show a simple and effective means of obtaining this all-too-little-known information. Ask for the bulletins on Rectox and Thermal meters for amateur use and please mention "RADIO".

●●●

Peaked Audio Amplifiers

THE CW selectivity of a TRF receiver can be materially improved by the addition of a shunt audio impedance in the grid circuit of the first audio amplifier which is sharply peaked. Too sharp a peak causes all signals to have a hollow sound, which some operators find annoying. However, for those who want to experiment with this form of filter we suggest an 8 henry choke shunted by .01 ufd. This combination resonates at about 800 cycles. The choke may be adjusted by tightening the bolts that hold the core.

Obtaining Fixed Bias From the Oscillator Power Supply

BY GROUNDING the positive lead from an oscillator power supply and leaving the negative "high", as shown in Fig. 1, we have available 250 to 350 volts of negative bias that we can use on buffer, doubler or final amplifiers.

If a buffer or doubler stage is fed plate power

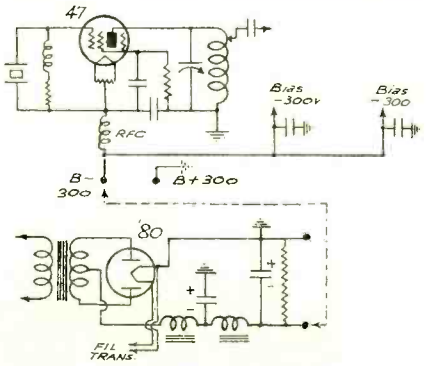


FIG. 1

from the same supply that feeds the oscillator, we must ground its plate tank, as is the plate tank of the oscillator. The filaments must be supplied from ungrounded windings. Naturally we cannot use this source of bias voltage to supply bias to such a stage, as you can't use the output of one power supply for both purposes simultaneously. However, most of us are using 46's as buffers and they need no bias except a small grid leak. When we get along to the higher powered stages using 600 volts or more on the plates, we usually have a separate plate supply, and therefore can use this source of bias to hold those stages down, should the excitation fail.

Just how valuable is 300 volts of bias? In a ham transmitter, how much fixed bias is needed? We only need enough fixed bias to hold down the plate current to our various amplifiers when something is detuned, or the crystal stops oscillating. The rest is best supplied by grid leaks, which are cheap and flexible. 300 volts of negative bias will cut-off the plate current of nearly every transmitting tube now commonly used up to and including an 852 running at 3000 volts without excitation. Therefore, why have any more fixed bias in the transmitter? I'll bite, why?

Note that if the grid current through this bias supply changes while keying, it will slightly affect the oscillator plate voltage. If the variation is too great, a slight chirp may be heard in your note. However, the bias can be used for blocked-grid keying for tubes up to a 203A running at around 1100 volts, without affecting the grid current, provided that the 203A is the final amplifier, or that the tubes following the 203A have a separate bias supply.

If you use electrolytic filter condensers for this power supply, be sure that the polarity is correct. The filament of the rectifier is grounded so that we can use the same winding that we use for our 210's or other tubes by adding a small dropping resistor to cut the filament voltage down to 5 volts.

●●●

How Much Excitation Do I Need To Drive a Given Transmitter Stage?

THE subject of excitation for radio frequency amplifiers contains many variables which prevent one from stating many definite rules. However, it may help to remind you of the general principles.

Remember that all amplifiers which draw grid current require driving POWER. The amplification factor of a tube has little to do with the grid driving POWER, in class B or C stages. We should consider the MUTUAL CONDUCTANCE. The higher the mutual conductance, the easier a tube is to drive. High impedance plate loads require more grid excitation, for a given output. Thus it follows that a high efficiency stage shows less POWER AMPLIFICATION than a stage working less efficiently into a lower impedance plate load. The stage that drives a high efficiency stage must be able to supply about twice the excitation actually required by the driven stage, because otherwise harmonic radiation from the driven stage is materially increased, due to the poor regulation of the excitation voltage. In general, high efficiency class C amplifiers and plate modulated class C amplifiers require that the driver stage shall have a plate input equal to about 40% of the input to the driven stage. For example, W6CUH built a 1000-watt stage using two 852's running at about 90% efficiency. He found that he needed another 852 as driver, running at 400 watts input, in order to obtain this high efficiency. This represents a power gain of about 3 to 1. Thus a pair of 210's running efficiently at 100 watts input require about 40 watts input to their driver. (It is assumed that the efficiency of the driver is between 50% and 66%).)

Doubler stages vary widely but usually show even less POWER AMPLIFICATION than the high efficiency stages mentioned above. A power gain of 2 to 1 is considered good for a doubler stage.

The best compromise between POWER AMPLIFICATION and EFFICIENCY for buffer stages, is found in the class B amplifier, which is biased to slightly above cut-off. Power gains of ten are not unusual and efficiencies of more than 50% can be expected. A high plate voltage and a high mutual conductance will increase both power gain and efficiency. Low loss design is, of course, necessary in all stages.

●●●

Electron Coupling

IN ORDER to obtain maximum stability from an electron coupled oscillator it is necessary to watch certain seemingly minor details. The screen voltage must be supplied from the same power supply that supplies the plate circuit and this screen voltage should be obtained from a tap on a voltage divider, rather than through a series resistor. It is essential that the screen and plate voltages vary together when the line voltage varies, because like changes produce opposing effects on the frequency of oscillation. Whether or not a given percentage change in the voltages applied to the plate and screen causes exactly equal and opposite effects on frequency, depends to a great extent on the tuning of the plate tank. The plate tank should be de-tuned slightly on the capacitive side of resonance (to the second harmonic). Listen to the beat note in your monitor and then vary the voltage output of the power supply. If the beat note changes, try a slightly different setting of the plate tuning condenser. A point will be found where quite wide variations in the supply voltages will make only a barely perceptible change in the beat note. Incidentally, electron coupled oscillators, as used in receivers and Fremeters, are often very sensitive to changes in supply voltages, due to the fact that the plate circuit is untuned. While this type of oscillator represents an improvement over the common tuned grid type, it is not, by any means, all that some claim for it when used in receivers. However, a carefully constructed electron coupled oscillator using a 254B, 282A or 860 will give results every bit as satisfactory as crystal control, EXCEPT for mechanical vibration. If your oscillator is subject to mechanical vibration there is no substitute for crystal control, at the present time. An electron coupled oscillator is somewhat more expensive to build than a crystal circuit, so that economy only results if a rather large tube is used as oscillator, perhaps directly driving a final amplifier with its second harmonc. In this event the extra cost of the electron coupled oscillator is offset by the elimination of several doubler or amplifier stages.

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High Frequency Broadcast Receivers

PHILCO and RCA have finally decided to popularize short wave listening in order to sell their new All-wave sets. This opens new opportunities for the Ham to earn money. The newer All-wave sets are really pretty good, when used with a decent antenna and in a fairly quiet location. Radio dealers are looking for salesmen who know something about the high frequencies to sell and demonstrate these receivers; the ordinary radio salesman is worse than useless because he thinks he knows much more than he actually does. (Go into any store and ask a few questions and hear the weird answers you get). It is not unusual for the purchaser of the new All-wave jobs to spend from ten to thirty-five dollars on a really good antenna and transposed feeders. Why not cash in on some of this easy money? Many service men are in a fog when it comes to efficient SW antennas. We saw one the other day which ran from a Neon sign over to a power pole, and there were 60 nice, shiny transposition blocks in the feeders, located about every four inches. The big laugh came when we found that the two feeders were tied together at the set end, both being connected to the same antenna post on the set.

Almost any Ham would know enough to do a better job than that. (Incidentally, this antenna cost the customer $21.00).

Globe Girdlers

W6FT

CHAS. D. ROE

Los Angeles, California

LET us introduce to you one of the prettiest stations we have had the pleasure of seeing in a long time, the station of Charles Roe, W6FT. If, after looking over the fotos you don't agree with us—well, your station probably looks better than ours.

Before we give you a brief on Charlie's station, let us tell you that we heard him on the air just the other night and boy, what a beautiful note. It turns out that he is using the W6CUH, "Six-bit filter". We just must have a note like that, so think we had better read the dope again carefully.

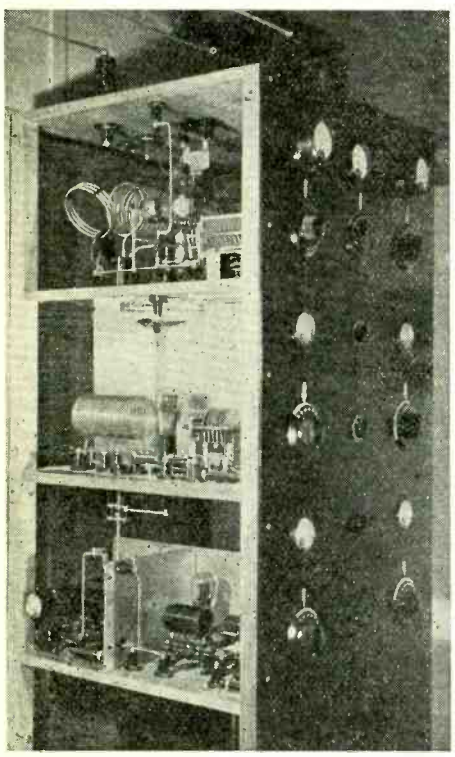
W6FT is one of the real old timers and cut his teeth on a straight gap, way back in 1915. You old timers take a good look at the foto showing the helix and bring back some fond memories. We were puzzled about the duster hanging on the wall in that picture until the janitor told us that it was used to clean-up the mess caused by the spark gap. We only date back 25 years so guess he knows best. Hi!

Charlie went through all the various stages to arrive at the present beautiful layout. Galena, Audiotrons, etc., all held no terror for him and passed by in rapid succession. All this time Charlie had an idea in the back of his mind about the ideal station and at last the finances were brought to the point where this dream came true. An 8 x 10 shack, white stucco and all-tile roof, was built to house the new transmitter. The transmitter is shown in the photo and contains six stages, five of which are used on the 7 MC band and six on 14 MC. A novel switching arrangement cuts the 14 MC doubler into the circuit with a simple twist of a knob. Good, what? The layout is a 47 crystal oscillator, 46 doubler, '10 first buffer, '52 second buffer and a pair of P-P '52's in the final. The 14 MC doubler is another 46. Absolutely no difficulty is experienced in running the final with 1KW input with all stages running stone cold.

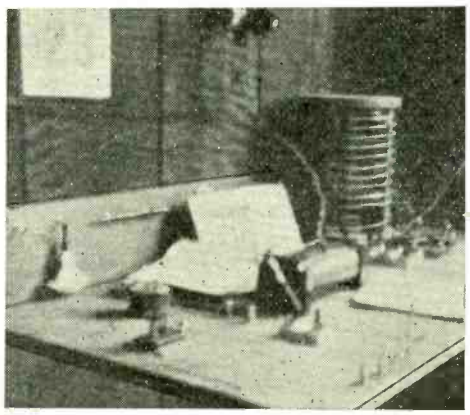
One of the salient points in this transmitter is the shielding between stages. The rack and panel are both made of wood, the panel being tempered Masonite (pressed wood). However, all meters and other high voltage instruments on the panel are at negative potential. Each of the shelves is covered with a thin sheet of aluminum which in turn is grounded to a common ground. All the shielding between stages can be seen in the photographs. The rack itself is screened on the three open sides, each side having two sections of screen. It was found absolutely necessary to ground each screen at the point where the wing nut attaches the screen to the frame, else interaction between stages was prevalent beyond control.

Complete control of the transmitter is had via the remote control box which operates relays mounted on the panel. Separate crystals are available by the simple twist of a switch on this panel, the voltage to the final being likewise variable by the same method. Boy, wouldn't it be great if we all had rigs like this?

A single-wire Hertz has been found to be the most effective radiator in Charlie's particular location. An FBXA super holds down the receiving end, and reception has proven to be excellent. Naturally, such a fine layout has produced considerable DX. WAC and WBE are among the dx and much other notable work has been done with expeditions. Considering the fact that W6FT's operating hours are considerably curtailed because of business, the DX score is a splendid one. Incidentally, old Charlie was responsible for the foto of the DX gang shown in the last issue. Ask him sometime how we all stood rooted to the spot while Charlie's pet camera described a beautiful arc groundward. The way he leaped to save that lens from utter destruction led us to believe that sometime during his life he must have let up on radio long enough to take up the graceful art of the broadjump. Hi! Lots of funny things happened while that foto was being taken. Too bad we can't tell what big Lem (W6MV) did.



W6FT—A beautiful station. 852's in the final. The panel rack is a sheet of Masonite. Looks keen, doesn't it?



"Those were the good old days" . . . when we had no radio laws, no power limit. And in those days Chas. D. Roe was a ham. Here is his rock crusher. 10-mile QSO's were considered DX and a WAC meant "Worked All Comers."

Now to the current DX gossip; and here's a good one to lead-off with . . . On the West Coast, and undoubtedly in the rest of the country also, there has been a great deal of dispute about just what constitutes a DX country and what does not. Arguments are pro and con and no one can get anywhere toward a standardization of the proper listing. Many of us have considered getting together a committee of representative DX me from all over the country to act in the capacity of judges to determine those parts of the world that can be called new countries. This movement has been given considerable impetus by the recent very generous offer of W6CUH and W6QD to act as the official secretaries for such a plan. Obviously, plenty of letter writing will be necessary when the thing gets going, so this generous offer from these men encourages us to see that the thing gets into action without further delay. The tentative idea is to have about six representative DX men (on the Coast as a starter), to act as members of a committee. One list will be made up of the countries whose legitimacy is unquestioned, and another will list the countries about which there is doubt. The committee will then act upon the list and return it to the official secretary who will summarize the results and report to "RADIO", which will publish the official list. In this way, there need be no further confusion and everyone can count his DX countries according to the same set of rules. We will present additional decisions from the committee as soon as they may have occasion to settle any dispute.

Let's hear from the DX gang in the East, Middle West and South as to the interest in participation in a plan of this sort. To our mind, it would be a great idea to have the official stamp put on your list of countries, and maybe we can dig up some sort of official certificate, seal or something, to give to everyone who desires the parchment. Herb and Charlie say that they will keep all the committee reports at their station, handle all the incoming requests and lists, and keep on file a list of the countries of each station that sends in a list for approval. Also, they will issue such forms or certificates as we may decide to use. Are you with us in this plan?

We see that we missed a lot of DX in the W6FFP story last month. Instead of working ZL1AR on merely three bands, he has worked him on four bands. Now ain't that sumpthin'? In addition, as if that wasn't enough, we learn that Andy has just worked his pal, ZL1AR, for the 301th time! W2CC and VK5HG have worked over 687 QSO's with each other. Stop, I tell you!

W6CYY swapped calls with ON4CSL recently, which is notable DX from these parts. Well, we heard CSL anyway.

They tell us that old DX'er G6HP has taken to himself a wife. There goes the famous slogan on his QSL. "Just another sleepless fool". Hi!

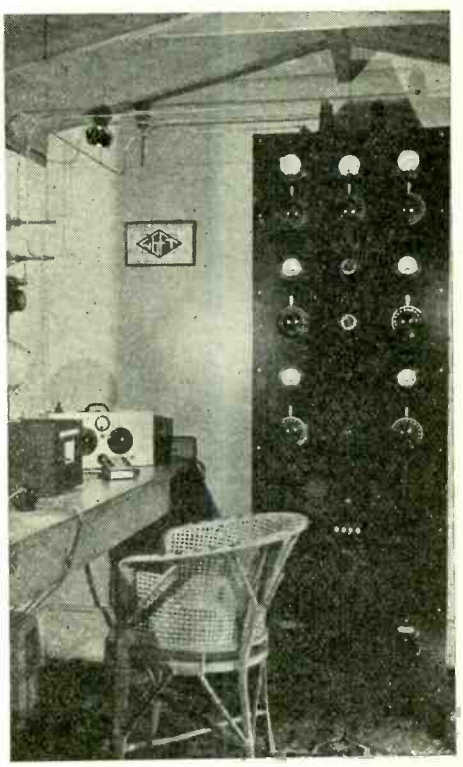
Speaking of G's, did you call all those fellows during the BERU tests like we did?

Note: You East Coast men who are looking for VK's. W6CIS tells us that a flock of VK and ZL stations were heard on 14 MC during the recent BERU tests. Time, about 9 p.m., PST.

G5BY seems to have solved the secret of DX phone. He has been pounding-in on the coast lately. W6BIP says his voice QSA 5, R6. Also R6 at W6WB along with G5ML.

Were we surprised to hear ZS2A tell us that he had a copy of "RADIO" on the table and that he thought it was a great sheet!

(Continued on page 33)



The operating table of W6FT. Note the business-like arrangement.

Radiotelephony

By "LINEAR"

A 20-Meter 50-Watt 'Phone

THERE have been many inquiries for a comparatively simple and economical phone for 14 MC, using one of the new "Forty Watters" in the final amplifier. We show such a phone in Fig. 1. There is nothing untried in this rig and all the adjustments are simple and straightforward. It uses several modern features which, though apparently complex, tend to simplify the process of tuning and adjustment. The use of link coupling between stages practically eliminates all neutralizing difficulties in the final amplifier and enables us to obtain high excitation for the final, even though there are only three stages in the whole rig, and one of these is doubling to 14 MC. The use of capacity coupling to the antenna circuit allows almost any type of antenna to be used and provides easily-variable antenna coupling as well as harmonic filtering. This type of coupling has been used for years for broadcast work and is FB for the high frequencies as proved by W9CXX. The use of the push-push circuit allows us to obtain fairly high efficiency from the doubler stage, which is unusual when doubling from 7 to 14 MC with 46's.

845's were chosen as modulators because they are cheap and not particularly critical as to load impedance, as are most class B stages. As we only need about 50 watts of audio power, a class B stage using 800's or 830's would be operating at from 30 to 50% of capacity, which cannot be considered efficient. The use of the 845's in "extended" class A simplifies the power supply and filter problem because exceptional regulation is not required. The modulator plate current only increases about 50 mills on the voice peaks, so ordinary filter chokes are satisfactory. The rectifier for the 1000 volt power supply can be either two 866's, one RK19 full wave rectifier, or four 83's or 5Z3's in the conventional bridge circuit. A single 5Z3 will provide the 400 volts for the oscillator, doubler and speech amplifier.

The speech amplifier has more gain than will be required by any double button carbon mike, and is stable and of high quality. It might be a good idea to completely shield the 58 and 210 stages if the speech amplifier is located within ten feet of the RF stages. Remember that electrostatic feedback is 8 times as strong at 14 MC as at 1.75 MC, for any given coupling, so use good grounds and plenty of good old mechanical separation to minimize unwanted regeneration.

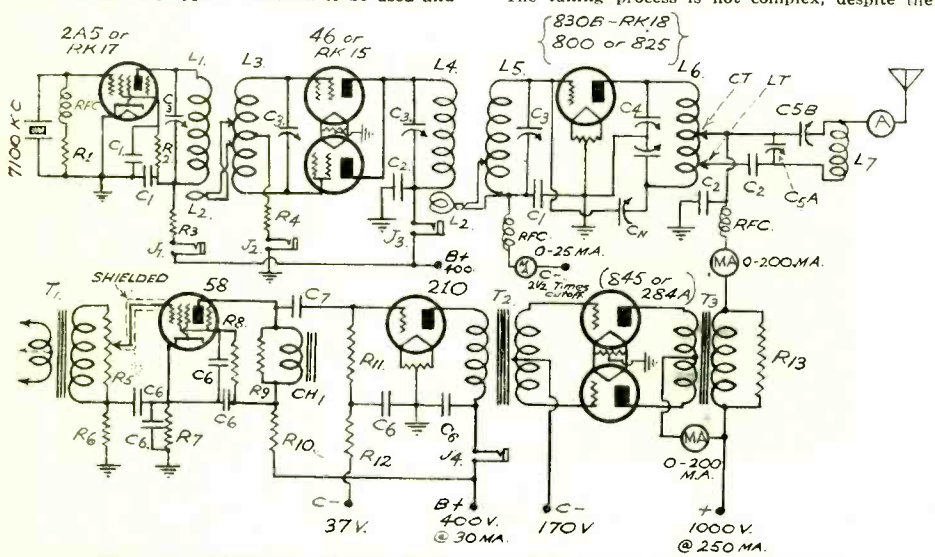
The grid leak for the 2A5 oscillator can be between 15,000 and 50,000 ohms. Use the lowest value that allows the crystal to oscillate easily. 7 MC crystals vary widely, so get a good one. The size of the grid leak on the doubler stage will depend on the amount of excitation you have from the oscillator, and on the peculiarities of your particular 46's. It might not be a bad idea to use a variable resistor at this point, such as a Bradleystat or Resistograd.

The tuning process is not complex, despite the fact that there are seven variable condensers, plus one neutralizing control. Apply plate voltage to oscillator and doublers, but not to the final. Find resonance on the oscillator tank by means of a plate milliammeter at jack J1. The grid circuit of the doubler stage is then tuned to resonance by means of another milliammeter plugged in at J2. Then go back and retune the oscillator tank condenser for maximum grid current, as read at J2. There will be found a slight amount of interaction between the plate and grid tuning controls, but it is not bothersome if the coupling between L2 and L1 is loose enough. It is highly essential that the coupling be loose. It is always surprising to new users of link coupling to discover how effective loose coupling is in transferring energy in this manner. We then transfer our milliammeter from the oscillator plate jack to the doubler plate jack. We then tune the doubler plate to resonance on 14 MC and then tune the final grid circuit with its grid meter M1, as above. With the plate voltage removed from the final, we neutralize in the usual manner. If any trouble is found in neutralizing, change the bypass condenser C2 from the plate tank center-tap to a .006 ufd. in place of the .002 specified. However, this is rarely necessary at 14 MC. After making certain that we have some bias on the final grid, we apply the plate voltage with the load tap marked LT disconnected. After tuning the plate tank to resonance we replace this tap (with the plate voltage off. Hi). NEVER TOUCH THE PLATE TUNING AFTER THIS TAP IS CONNECTED. Always remove the load tap before retuning the final amplifier, if you change frequency or tubes, etc. Apply the plate voltage to the final and tune C5A to resonance, as indicated on the plate milliammeter M2. At this point the mills are probably above or below the 85 to 95 mills recommended for proper operation of this final amplifier. Vary C5B slightly, and retune C5A to resonance. This will change the antenna coupling and therefore the plate mills. Continue this process until the final amplifier draws the proper mills (85 to 95 MA.).

The bias specified for the final stage is 2.5 times cut-off. Divide the plate voltage by the amplification factor, of the tube you use, and you have "cut-off" bias. Then multiply by 2.5. For example: The amplification factor of a certain tube is 10. Therefore, cut-off bias at 1000 volts equals —100 volts. Multiplying by 2.5 we have —250 volts as the correct bias. The DC grid current of the final amplifier does not vary during modulation and the modulators draw no grid current, so an ordinary B eliminator may be used for all the bias requirements on this transmitter.

If all is well only one meter will vary under modulation. That is the modulator plate meter M4. All the others should remain constant. If they do not, look for stray feedback through the power supply or from the antenna field. Improper bias or poor neutralization will also cause "meter wiggle." For those who want to minimize antenna feedback they can move L7, C5A and C5B out into the backyard and thus imitate broadcast practice, but tuning becomes a two-man job. The 2-wire line from the center-tap and the load tap is essentially non-radiating, when properly built and terminated, and can be almost any length up to 500 feet. A .002 ufd fixed condenser in the lead from the center-tap will remove the high voltage from the transmission line, if such a line is used.

Incidentally, the push-push stage gives quite a respectable output on 28 MC and will drive the final satisfactorily at an input of about 40 to 50 watts to the final amplifier. Use minimum C across L4 and L5 and tune the two circuits by moving the turns up and down on the form. The higher mutual conductance of the 830B makes it easiest to drive at this frequency, but the lower grid-to-ground capacity of the 800 and 825 allows somewhat higher efficiency to be realized with these tubes. The bias on the push-push stage is quite critical for maximum output on 28 MC, so utilize the variable grid leak mentioned above.



CIRCUIT DIAGRAM AND LIST OF PARTS FOR 50-WATT PHONE

Constants for L1 to L6 can be secured from the list of parts shown for the RK-18 transmitter elsewhere in this issue.

C1—.001mfd.
C2—.002mfd.
C3—50mmf. Variable.
C4—50mmf. split-stator Variable.
C5—350mmf. BCL Variable Condenser.
C6—0.5 to 2 mfd.
C7—0.1mfd.
CN—Neutralizing Condenser.
R1—15,000 to 50,000 ohms.
R2—25,000 ohms.
R3— 3,000 ohms.
R4—500 to 2500 ohms, variable.
R5—200,000 ohms.
R6—1 megohm.
R7—500 ohms.
R8—0.1 megohm.
R9—0.2 megohm.
R10—15,000 ohms.
R11—0.25 megohm.
R12—0.25 megohm.
R13—0.1 megohm, 10 watts.
T1—Mike to Grid transformer, UNITED TRANSFORMER
T2—Plate to P.P Grids, UNITED TRANSFORMER
T3—Class A Prime Output, 1.25:1, UNITED Stepdown Transformer.

"Be Kind To Your Mike" Week

THE lowly microphone takes more of a beating in the average Ham station, in a week, than it would receive in a broadcast station in a year. In the first place, it is almost always overloaded. All carbon, ribbon and condenser mikes are subject to overloading, and the quality suffers if the overload persists. In the case of a condenser head, a single overload can ruin the diaphragm if it arcs over. Use more gain and untangle your ears from the mike mounting springs. You'll be surprised how much better you sound. Keep your breath away from the mike. It may help cool the mike but it makes a noise that is often mistaken for harmonic distortion, and the moisture does no good to the mike's "innards". Practice speaking with a lighted candle about two inches in front of your lips. (Careful there, Mr. Durante). The candle shouldn't waver when you talk. Try it sometime. All right, now find another match and relight the candle. I told you so. It is said that Caruso could sing loud enough to fill the Metropolitan Opera House and a candle in front of his lips never wavered a bit.

A little practice will clean up your diction tremendously.

Don't talk down to a mike. Place it about a foot higher than your eyes and speak up to it. Your whole vocal system works infinitely better when looking up and the mike also gets less moisture. Strangely enough, all mikes seem to need a little less gain when placed above the mouth than in other positions, given the same spacing between the mike and the speaker's lips.

Never move a carbon mike with current going through it. Observe the maker's ideas in regard to button current; they ought to know. Avoid extremes of heat and cold and treat your mike like a precision instrument, that is what it is supposed to be.

Last, but not least. THINK BEFORE YOU SPEAK—SAY WHAT YOU HAVE TO SAY, THEN SIGN OVER. Practice with break-in. It will cut fully 50% from the present QRM. Arrange your key so that you "Push-to-talk."

Remember that the phone operator has a much greater responsibility than the CW operator, because, in these days of crystal filters, even a properly adjusted phone takes up as much room as ten or more CW stations. Some day, in the not-too-distant future, we are going to have to justify our taking up the room that we do. We will never do it with our present waste of good kilocycles spent in thinking of something to say. The 14 MC phones are generally pretty good in this respect. The man down there usually has something to say, then says it and signs. How about it, gang?

A Midget Monitor

It Does Everything Any Other Monitor Will Do Except Take Up Needed Space

A MONITOR is necessary for the proper operation of an amateur radio station. It enables the operator to check the signals generated by his station, and see that they are within the law. A monitor is a handy thing to check the frequency also. A transmitter can be tuned, if self excited, to a predetermined point in the band with its aid.

The monitor to be described is the second one built. The first one had mechanical difficulties. It was not rigid enough and would not stay tuned to an exact frequency. In the second one all the bugs were removed.

Construction

THE monitor is built in a 4 x 5 x 6-in new type shield can. In the center of the panel (4x6-in) a Hammarlund midget condenser is mounted. On the upper left hand side (rear view) a four-prong socket is screwed onto a special mounting. This socket is for the plug-in coils, and is so located that the coils clear the tuning condenser. The socket for the UX 99 tube is an old spring-base type. The spring base is removed. The rivet in the center is taken out and a 8-32x 1¼-in. machine screw substituted. A ⅜-in. wood block with a hole in the center takes the place of the old base. The screw is long enough to pass through the bottom of the can and the whole thing is thus held in position. An ordinary socket was found too large.

In the lower left hand corner a filament control jack is placed. The center of the hole is ⅞ in. up and ⅛ in. in as measured on the front of the panel. Both the jack and the tuning condenser are mounted directly on the metal panel. An RF choke, consisting of a 1¼-in. winding of number 32 enameled wire wound on a two-inch length of ½-in. wood dowel, is tied onto the back of the jack. The choke is taped for insulation. The fixed condenser is held in position, as well as being grounded, by the lower coil socket machine screw. The A battery is taped to insulate it from the aluminum can. Connections to it are soldered on.

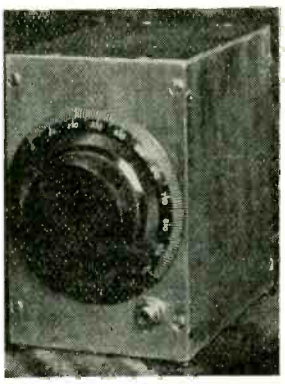
There are only three holes to be drilled in the can. The placement of the batteries and parts is clearly shown in the photographs. The B battery is held in place by a wood block between its face and the side of the can. The block is not shown in the photograph.

Parts List (See Diagram for Legend)

C1, Hammarlund MC 50 S.
C2, .001 mica.
4x5x6-in. Type DM.R.H.Lynch shield can. With socket mount.
VT, UX 199.
A Bat., 2 flashlight cells.
B Bat., Burgess 5156.
Jack, Yaxley long frame nr. 3.
RFC, see text.
Socket, 4-prong.
Socket, 4-prong shock proof.
Dial, 4-in. bakelite.
UX tube bases.
Hook-up wire, screws, etc.

1.75 and 28 MC coils can be wound by consulting coil, condenser charts.

Both coils are wound in the same direction with the plate coil at the top. A space of between ⅛ in. and ¼ in. is sufficient. The spacing and number of turns is not critical. Wind a turn or two extra on the grid coil and cut them off if it is necessary to center the band on the dial. When the coils are finished give them a coat of clear lacquer.



You can hold this monitor in the palm of your hand, yet it does everything any monitor can do. Every amateur should have a monitor if for no other reason than to listen to his own sending.

Operation

WHEN the job is completed plug in one of the coils. Next plug in the phones. The filament of the tube should light and the monitor will oscillate if it is built according to directions. A transmitter a few feet from the monitor should tune in about R7. The monitor will put an R8 signal into a receiver located a few feet away. The wedge on cover may be removed if louder signals are desired. There will be a slight detuning when the cover is removed.

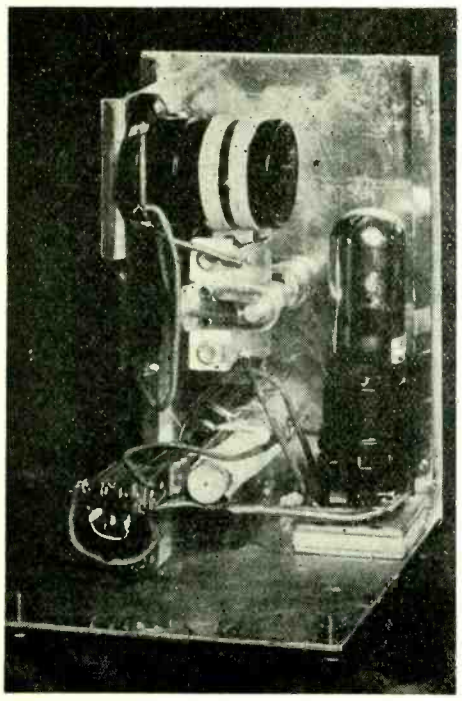
The amateur bands are not spread over much of the dial as the monitor was also intended for a test oscillator. The 14 MC band covers 5½ points, the 7 MC band 8½ points, and the 3.5 MC band 16½ points. It is exceptionally easy to tune in spite of the fact that it has no vernier dial. The fellow who desires band spread can use a tuning condenser of less capacity.

No trouble was had getting the monitor to work. It worked from the first try, and is still going. It is a strong oscillator and there is an absence of dead spots. The B battery should last over a year under average conditions. The A battery should last six months and it only costs a few cents to replace.

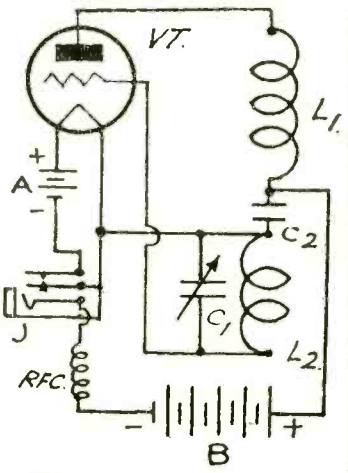
COIL DATA

All coils are wound on four-prong tube bases.

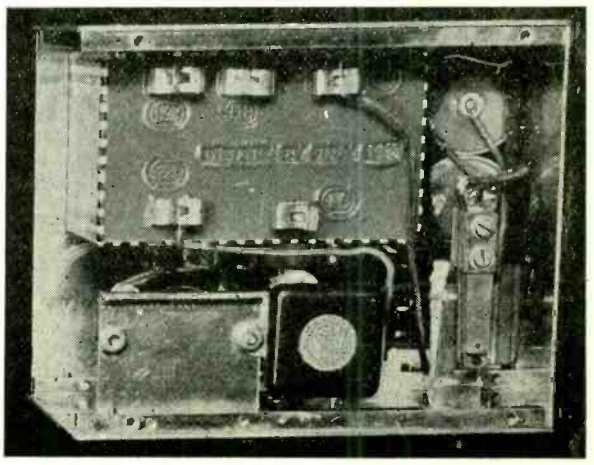
	L1	L2	Wire
3.5 MC	16 turns	30 turns	32 Enam.
7.	11	15	28 DCC
14.	7	7	24 DCC



Rear view of the simple monitor, showing its extreme compactness. The R.F. choke is mounted below the tuning condenser.



The circuit diagram. The phone jack automatically cuts off the voltage supply when the monitor is not in use.



The A and B batteries fit snugly into the small R.H. Lynch shield can. The coil supporting method is also seen from this photo.

Tube Technique

By "JAYENAY"

Sylvania Presents a Husky, High Voltage 212D

THE low plate resistance and high mutual conductance of the 212D type of transmitting tube is a very desirable characteristic for class A, B, or class C use, at both audio and radio frequencies. However, the oxide filament and nickel plate have tended to make this tube unstable at plate voltages higher than 1500 volts. The new edition of the 212D, as made by Sylvania, uses a rugged thoriated tungsten filament and the new graphite plate. Thus the new tube is "Hard" enough to stand 2000 volts on the plate, and 2500 volts may be used at low frequencies, provided extreme care is used to keep the space current and plate dissipation within rated limits. The carbon plate allows a continuous plate dissipation of 250 watts, as compared with 200 watts in usual types of 212D's. The comparatively high interelectrode capacity of the 212D makes its use undesirable at frequencies above 3000 KC, although many amateurs are currently obtaining satisfactory efficiency and stability in the 3500 KC band.

The standard static characteristics of the 212D and the 204A follow:

	212D	204A
Filament volts	14 V	11 V
Filament current	6 A	3.85 A
Plate resist., zero bias	1600 ohms	4700 ohms
Amplification factor	16	24
Mutual conductance	10000 umhos	5100 umhos
Plate dissipation	200 watts	250 watts
Interelectrode capac.		
plate to grid	19 uufds.	17 uufds.
grid to fil.	19 uufds.	18 uufds.
plate to fil.	12 uufds.	3 uufds.

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Tubes In Parallel

FEW Hams have a good word to say for the use of tubes in parallel, either in RF or audio circuits. Push-pull is the accepted favorite. The use of push-pull has much to commend it, but the advantages inherent in the parallel connection should not be overlooked. For example, audio pentodes in parallel often have just as good quality as pentodes in push-pull, because much of the distortion produced by pentodes consists of odd harmonics which are not reduced by the push-pull circuit. Often a better impedance match is possible because the ideal load for a pair of 47's in parallel is only 3500 ohms, while in push-pull the plate-to-plate load impedance must equal 28,000 ohms for best undistorted output. In radio frequency amplifiers the parallel connection sometimes allows us to realize higher plate efficiency without sacrificing ease of driving because we double the ratio of plate impedance to load impedance. It also follows that when we cut the plate impedance in half we double the mutual conductance, which makes the stage easier to excite than its equivalent push-pull cousin. This is especially valuable when we use screen grid tubes in our amplifier. These tubes are often hard to drive in single ended stages, and harder to drive in push-pull, while the parallel connection allows real economy of driving power. Care must be taken to prevent parasitic oscillation. Use 100 ohm non-inductive resistors in each grid lead. While on the subject of screen grid transmitting tubes let me state that it is usually much harder to realize high efficiency above 4000 KC than if a similar high frequency triode were used.

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The 211E As a Class B Modulator

AT THE present time Western Electric 211E's are available for almost the proverbial song. These tubes, in spite of their shortcomings, do a pretty good job in class B amplifiers at 750 and 1000 volts. At 750 volts the bias is —75 volts and the plate to plate load 7000 ohms. A pair of 45's with 300 plate volts are good drivers with the usual class B input transformer of about 3 to 1 step down, driving the grids of the 211E's. Under these conditions the output is about 75 watts. If the plate voltage is raised to 1000 volts the bias should be raised to —100 volts. The plate-to-plate load becomes 8000 ohms and the same input transformer can be used. However, better quality will result if the 45 drivers are replaced by 2A3's in push-pull. Care should be taken at 1000 volts because the tubes take quite a beating at this voltage. However, the 100 watt output is very attractive, and with care the tubes should last for several hundred hours. In a well-known 4 MC phone station, that has used class B 211E's as modulators for the last two and a half years, the owner has kept a very interesting record by means of a watt-hour meter that was "acquired." His tubes cost him $1.50 (slightly used), each, and he finds that his tube depreciation is ten cents per audio kilowatt hour!

The 830B By Sylvania

NOW we have a transmitting tube that is equally desirable at 14 megacycles and at audio frequencies. Its class B characteristics allow very high output and efficiency with a minimum of distortion. It is actually possible to obtain better than 66% efficiency with this tube, at which point the audio output approaches 190 watts, which will completely modulate a 380-watt input to a class C amplifier. No need to mention that with average efficiencies a 380-watt input will enable you to work practically everyone you can hear. This high audio output and efficiency only necessitates a slight increase in the grid driving power over larger tubes, such as the 203A when delivering the same output. The filament rating is the same as the 830. The filament voltage should not be allowed to drop below 10 volts when used at the maximum allowable output of 190 watts of audio power; the filament emission drops off rapidly with any decrease in voltage. The plate lead is brought out of the top of the envelope and therefore it is possible to use this tube at frequencies as high as 40 MC at its rated plate voltage of 1000 volts without fear of insulation difficulties. If suitable protective devices are used, no difficulties should be encountered below 15 MC with plate voltages as high as 1250 volts, for CW use. The 830B is unusual among the so-called "forty watters" in that it is just as desirable at 500 or 750 volts as the good old 210 or 211. Some of the newer "forty watters" have sacrificed mutual conductance in order to get low interelectrode capacities and high voltage insulation. This means that they are harder to drive, when used as class B or C amplifiers, than some of the older types with higher mutual conductance. Their performance therefore naturally suffers when compared with a 210, at 500 volts, and a higher proportion of grid excitation becomes necessary to get high plate efficiency. The high mutual conductance of the 830B makes it even easier to excite than a 210, with any given value of plate load, and the high amplification factor allows us to obtain most of the bias by means of a grid leak. Herewith is shown a table giving the static characteristics of the more common types of "forty watters":

When the 830B is used as a class B audio amplifier at 1000 volts on the plate, the bias required is 33 volts. As in all class B circuits the bias should be supplied from batteries or a specially built rectifier using low resistance transformers and filter chokes, in combination with a husky bleeder to maintain the proper voltage regulation. The plate load should be 10,000 ohms, plate to plate, and only a husky, well-designed output transformer should be used. As 8 watts of driving power must be applied to the grids for maximum output, we should have available about twice that much power for good driver regulation, so a pair of 2A3's or 250's are indicated. The input transformer can be one designed to drive a pair of 203A grids, and with step DOWN ratios of two- or three-to-one will be satisfactory. The usual precautions against parasitic oscillation should be observed and the power supply must have good regulation as the average plate current, INDICATED by the plate milliammeter, will vary from about 30 MA with no signal to 280 MA at maximum output.

7½ Volts On the 6.3 Volt Tubes

THE latest editions of the 6.3 volt series of tubes have a new heater which allows satisfactory life even though quite wide variations in heater voltage are used. It has been found that a 42 (six volt edition of the 2A5) provides a materially increased output as an RF oscillator or amplifier when the heater is operated with 7½ volts on the heater. This use will shorten the life of the tube to a certain extent but we usually shorten this tube's life anyway by using 350 volts or so on the plate, so the 7½ volts on the heater should not reduce it much further. As a matter of fact, the use of 7½ volts on the heater might lengthen the life of the tube when used with 350 volts or more on the plate due to the increased emission of the cathode under these conditions. Certain makes of 2A5's can be run at about 8.3 volts on the heater with the same result but most of the 2½ volt heaters will not stand the beating as compared with the six point three volt types.

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Comfortable Position

WE HAVE been notified that it is perfectly permissible to operate all the indirectly heated tubes in a horizontal position. It has been found that the life of the tube is not decreased when they are lying down. Formerly it was necessary to operate all vacuum tubes in a vertical position so as to avoid shorts, etc. However, it is still necessary to operate most of the filament types in a vertical position, although certain types may be operated horizontally if care is taken to see that the plane of the filament is vertical.

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Gain

THE gain of a screen grid stage of RF or AF amplification is rather simple to calculate, if we know the impedance of the plate load. Let us suppose we have an intermediate frequency amplifier stage which uses a 58 (or 6D6) and which reflects a plate impedance of 100,000 ohms into the tube's plate circuit. The mutual conductance of a 58 is 1600 MMHOS, or .0016 MHOS. To obtain the voltage gain, we multiply the mutual conductance, in MHOS (NOT MICRO-MHOS.) by the plate load, in ohms. Thus 100,000 times .0016 equals a voltage gain of 160. A plate load of 100,000 ohms represents conditions which exceed those usually found in manufactured receivers. If some genius can find a means of obtaining an effective load impedance of 1,000,000 ohms without any serious compromises, we could realize gains of 1600! If this seems slightly difficult, you might try designing a screen grid tube with a mutual conductance of 16,000, which would give the same gain with our present IF transformers. Do I hear someone murmur that there might be some slight tendency toward regeneration in a stage whose voltage gain approaches 1600?

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'46's In Parallel

'46'S are commonly used as buffers and doublers in ham transmitters but no definite measurements of output have been published. While any such measurements would be useful, they are dependent on a wide variety of conditions. Therefore, regard these figures as merely an indication. Collins (W9CXX) has determined that a pair of '46's in parallel with approximately 400 volts on the plate, and excited by a '47 crystal oscillator, have an output of 28 watts on 2 and 4 MC., 25 watts on 7 MC., and 13.2 watts on 14 MC. This output should successfully excite anything up to, and including a 50-watter operating with up to 150 or 200 watts input. A pair of '46's has more output than a single 210 operating at 500 volts or less.

STATIC CHARACTERISTICS

	830B	RK18	800	825
Fil. Volts	10 V	7.5 V	7.5 V	7.5 V
Fil. Current	2.15 A	2.5 A	3.25 A	3.25 A
Fil. Watts	21.5 W	18.75 W	24.38 W	24.38 W
Average characteristics				
Amp. factor	30	18	15	10
Plate resistance	8000 ohms	6000 ohms	10000 ohms	10000 ohms
Mutual conductance	3750 umhos	3000 umhos	1500 umhos	1000 umhos
Max. plate volts	1250 V	1250 V	1250 V	1250 V
Max. plate current	85 MA	75 MA	100 MA	100 MA
(Normal class C2 operation)				
Rated plate dissipation	40 W	35 W	35 W	40 W

Tube and Base Diagrams—Looking Into Tube From Top

It has been customary to show bottom views of Tube and Base Diagrams but many requests have been received for a chart showing Tube Symbols looking into the Tube, or down upon the socket from the Top. Through the courtesy of Hygrade-Sylvania we herewith present such a chart, as well as a Table of General Information.

6.3 VOLT GROUP—For AC or DC Operation

Type	Class	Base	Cathode Type	Rating Fila-ment Amps.	Plate (Max.) Volts	Screen (Max.) Volts
6A4/LA	Pentode	5-3	Filament	0.30	180	180
6A7	Heptode	7-2	Heater	0.30	275	100
6B7	Duo-Diode Pent.	7-3	Heater	0.30	275	125
6C6	Pentode	6-1	Heater	0.30	275	100
6D6	Pentode	6-1	Heater	0.30	275	90
6F7	Pent. Triode	7-5	Heater	0.30	275	100
36	Tetrode	5-2	Heater	0.30	275	90
37	Triode	5-1	Heater	0.30	275	—
38	Pentode	5-6	Heater	0.30	180	180
39/44	Pentode	5-6	Heater	0.30	275	90
41	Pentode	6-2	Heater	0.40	250	250
42	Pentode	6-2	Heater	0.65	275	275
75	Duo-Diode Tri.	6-4	Heater	0.30	275	—
76	Triode	5-1	Heater	0.30	275	—
77	Pentode	6-1	Heater	0.30	275	100
78	Pentode	6-1	Heater	0.30	275	125
79	Duo-Triode	6-5	Heater	0.60	180	—
85	Duo-Diode Tri.	6-4	Heater	0.30	275	—
89	Pentode	6-1	Heater	0.40	180	180

2.5 VOLT GROUP—For AC or DC Operation

2A3	Triode	4-1	Filament	2.5	275	—
2A5	Pentode	6-2	Heater	1.75	275	275
2A6	Duo-Diode Tri.	6-4	Heater	0.80	275	—
2A7	Heptode	7-2	Heater	0.8	275	100
2B7	Duo-Diode Pent.	7-3	Heater	0.8	275	125
24-A	Tetrode	5-2	Heater	1.75	275	90
27	Triode	5-1	Heater	1.75	275	—
35/51	Tetrode	5-2	Heater	1.75	275	90
45	Triode	4-1	Filament	1.50	275	—
46	Tetrode	5-4	Filament	1.75	400	250
47	Pentode	5-3	Filament	1.50	275	275
53	Duo-Triode	7-4	Heater	2.00	300	—
55	Duo-Diode Tri.	6-4	Heater	1.00	275	—
56	Triode	5-1	Heater	1.00	275	—
57	Pentode	6-1	Heater	1.00	275	100
58	Pentode	6-1	Heater	1.00	275	100
59	Pentode	7-1	Heater	2.00	275	275

2.0 VOLT GROUP—For Battery Operation

1A6	Heptode	6-8	Filament	0.06	180	67.5
1C6	Heptode	6-8	Filament	0.12	180	67.5
15	Pentode	5-6	Heater	0.22	135	67.5
19	Duo-Triode	6-6	Filament	0.26	135	—
30	Triode	4-1	Filament	0.06	180	—
31	Triode	4-1	Filament	0.13	180	—
32	Tetrode	4-2	Filament	0.06	180	67.5
33	Pentode	5-3	Filament	0.26	135	135
34	Pentode	4-3	Filament	0.06	180	67.5
49	Tetrode	5-4	Filament	0.12	180	—

MISCELLANEOUS GROUP

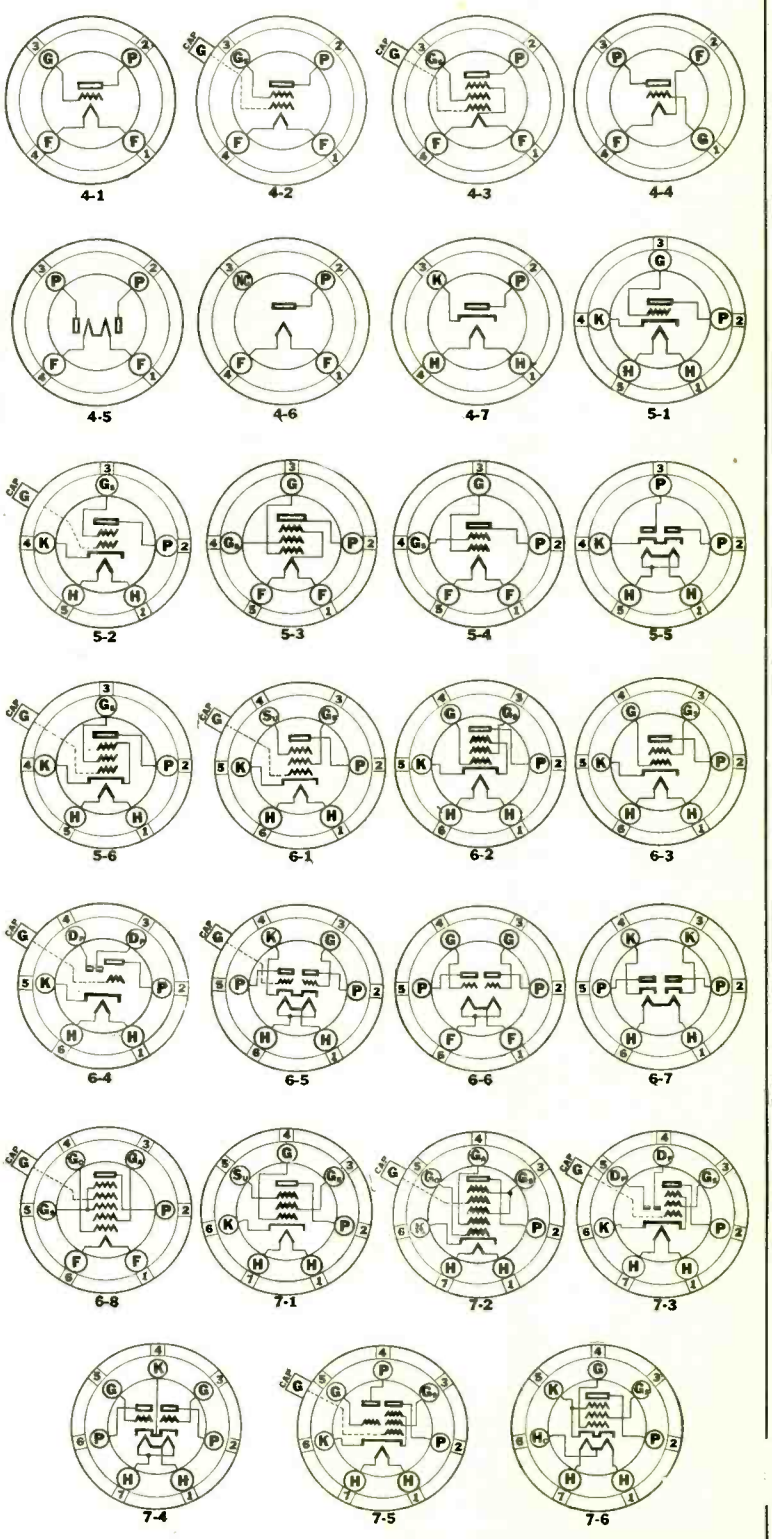
Type	Class	Base	Cathode Type	Filament Rating Volts	Amps.	Supply
00-A	Triode	4-1	Filament	5.0	0.25	DC
01-A	Triode	4-1	Filament	5.0	0.25	DC
10	Triode	4-1	Filament	7.5	1.25	AC or DC
12-A	Triode	4-1	Filament	5.0	0.25	DC
12A5	Pentode	7-6	Heater	12.6	0.30	AC or DC
				6.3	0.60	AC or DC
18	Pentode	6-2	Heater	14.0	0.30	AC or DC
20	Triode	4-1	Filament	3.3	0.132	DC
22	Tetrode	4-2	Filament	3.3	0.132	DC
26	Triode	4-1	Filament	1.5	1.05	AC or DC
43	Pentode	6-2	Heater	25.0	0.30	AC or DC
48	Tetrode	6-3	Heater	30.0	0.40	AC or DC
50	Triode	4-1	Filament	7.5	1.25	AC or DC
71-A	Triode	4-1	Filament	5.0	0.25	AC or DC
X-99	Triode	4-1	Filament	3.3	0.063	DC
V-99	Triode	4-4	Filament	3.3	0.063	DC
485	Triode	5-1	Heater	3.0	1.25	AC
182-B	Triode	4-1	Filament	5.0	1.25	AC
183	Triode	4-1	Filament	5.0	1.25	AC
864	Triode	4-1	Filament	1.1	0.25	DC

RECTIFIER GROUP

1-V	Diode	4-7	Heater	6.3	0.3	AC or DC
5Z3	Duo-Diode	4-5	Filament	5.0	3.0	AC
12Z3	Diode	4-7	Heater	12.6	0.3	AC or DC
25Z5	Duo-Diode	6-7	Heater	25.0	0.3	AC or DC
80	Duo-Diode	4-5	Filament	5.0	2.0	AC
81	Diode	4-6	Filament	7.5	1.25	AC
82	Duo-Diode	4-5	Filament	2.5	3.0	AC
83	Duo-Diode	4-5	Filament	5.0	3.0	AC
84	Duo-Diode	5-5	Heater	6.3	0.5	AC or DC

TUBE AND BASE DIAGRAMS

LOOKING INTO TUBE (or down upon socket) FROM TOP



SYMBOLS

F—Filament
Gs—Screen Grid
Nc—No Connection
H—Heater
Ga—Anode Grid
Hc—Heater Center
P—Plate
Go—Oscillator Grid
□—Top Cap
K—Cathode
Su—Suppressor Grid
G—Control Grid
Dp—Diode Plate

FROM ONES TO NINES

DOINGS OF THE AMATEURS IN ALL U.S. DISTRICTS

Edited by W. E. McNatt, Jr., W6FEW

THIS department would appreciate a W4, W2, W3 and a W5 volunteering their services in supplying some "dope" from their respective districts. Write this department, care of W6FEW, 557 N. Fourth Street, Covina, Calif.

New England Notes From W2DBP

G2DQ and G6RB, the former with only 10 watts input, have been getting across FB on 80 meters.

From Amherst, Mass., comes the news that a new ham club has been formed at Amherst College. Hams certainly seem to be going to college. The Yale Radio Club received as many new members this year as it had old. The Dartmouth Radio Association of Hanover, N. H., have been experimenting with 28 MC portable transmitters—hoping to use them in timing the ski races.

W1BVR replaces W1YU, Bob Wilson, as WLE, First Corps Area net control station (AARS).

A new radio club has been formed in Torrington, Conn. W1DTV president and W1BLQ is secretary-treasurer.

W1XR is the new call for the observatory on Mt. Washington which is 6,250 feet above sea level. 42 MC fone—Mt. Washington, N. H.

Just to prove to our incredulous W1s (Ed. note: Yeah, and W2s, W3s, W4s, W5s, W6s, W7s, W8s, and W9s) that there is such a "thing" as an Asian, W1YU was visited by **Mr. H. B. Wilson, ex-AC8HB, who is anxious to get in touch with old friends while staying in these parts. He may be reached by contacting W1YU.**

If any of you W1s have any "dope" which you would gladly separate from your honorable possession, send it to Rad Williams, W1DBP, 1390 Davenport College, Yale University, New Haven, Conn.

Some New Jersey Dope From W2CZO

W2ETD, Bronx, N. Y., is getting out very fine business on 75 and 160 meter fone with a 25-watt carrier.

W8EOH has been inactive for the past few months due to a serious illness. Fred is up and around now and will be on the air shortly. **He can take it.**

W2DNR is on 80 meter CW again and pounding out a peach of an xtal note—as per usual. Chick has been off the air for about six months due to late working (???) hours.

Quite a few of the East and West coast fone hams are finding a pleasant QSO when they hook W3NK on 75 meters. George is on every morning lining up the gang who form a net similar to the **West Coast gang's "Breakfast Club".**

Along comes W2CGY of Lake Como, N. J. (Whar there ain't no alake, hi.) with a letter received a few days ago from Holland telling him that **quite a few of the 75 meter fone men are being heard over there. The Dutchies have called quite a few Ws, but with no success because they operate around 3700 KC and the Ws don't listen thar. (We bet they do now).**

The Delaware Radio Club held a big hamfest at the Hotel Davenport on February 24th. The gang promised that this hamfest would be the largest gathering ever recorded in the East—that's some "goin!"

W2AD expects to be on 160 meters soon—perhaps he is on now. He has a new rig using class "B" modulation. Andy has been off the air for some length of time getting this rig going, so it ought to be good.

W3CQS slings a little "hash" (here as well as at his Grill).

Willard S. Wilson (Doctor Quack) W3DQ, of Wilmington, Del., is reported to be setting up his rig for 1KW. Looks like he is going to compete with our other first class station, Josh Swartz, W3WX, at Harrisburg, Pa.

Harry Stein, W3CL (Trolley Car Charley) manages to keep up with his traffic record with fine totals and splendid system of maintaining his skeds.

Ed. L. Hudson (W3BAK, Laurel, Delaware), is preparing to take his celebrated radio family to the coming hamfest at Wilmington, Del., previously announced in W2CZO's items. Here's the dope on the family: **Jean, age 9; Dorothy, age 19 (Ahhhhhhh), and Roland, 15—all are licensed. Jean is the little girl who took the cup at the World's Fair Convention last year. (My, what a nice quiet evening that gang must have when they all want to QSO. Brrrrr).**

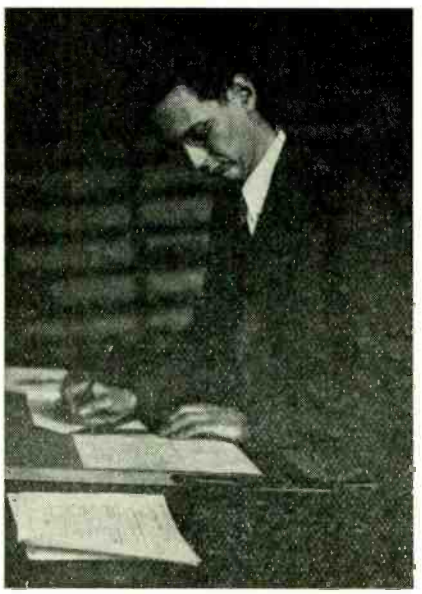
William Delawter, better known as "hay-seed", W3AKX, is still getting up in the wee hours of the morning to work 160 meter DX. He's worked all districts—and, judging by the "sock" he puts out, I wonder if he is giving the BCLs the evening hours—hi.

Joe Harms, W3COP, is working all bands with his rig these days. He handles traffic from the Canal Zone on twenty meters—all in fun, of course.

Dave Bogg, W3UD, can be heard almost any afternoon calling CQ 160"—and works the boys on that band. (What is this guy's formula?) It certainly would be fine if all the 75 meter fone men would join in this friendship between 160 and 75 meter men; the same going for the 160 men. Try it on the last week of the month as a regular time—and see how much fun it is.

WE STOPPED in Cedar Rapids the other day to see Art Collins and W9CXX. Nothing out of the ordinary in that, because we used to drop in at 9CXX back in 1924 and 1925 to see how MacMillan was getting along up at the North Pole. Just another friendly visit, only . . .

This time we didn't call at the house, but at the factory. And, furthermore, we didn't even lamp W9CXX at all, because the operator was too busy building other people's transmitters to show us his own. Well, we didn't ask too many questions—just hung around to see the fun.



ARTHUR A. COLLINS, W9CXX

Byrd is 'way down south, you know, with Columbia Broadcasting System handling the programs out of the Antarctic this winter, and Radio Corporation doing the pick-up stunt on this end as well as handling all the traffic they can get in between decibels.

The transmitter of great capabilities in high-frequency territory is manufactured by an amateur . . . an amateur who held down schedules with the North Pole long before others ever thought of polar communication.

And so Byrd left with transmitters designed by an amateur and built in an amateur's factory. And what's more, the Chief Op and a few of his helpers on the Byrd Expedition are amateurs, too. We look forward to QSO with John Dyer, W1BJD, who is in charge of communication for the Byrd Expedition II, and his operators, including R. D. Watson, W1BGL.

Wilmington, Delaware, boasts of one of the best hams news columns in the district. It can be found daily in the Wilmington Evening Journal every evening and is conducted by Chas. Kane, W3DNI. This column spreads the daily doings of hams in our section and is open to all who have interesting items for publication. (Ed. Note: Gosh! I'll bet he raises "Kane"—scuse it).

Ed. L. Thompson, W3CQS, Salisbury, Maryland, would like to see the government agencies recognize the efforts of the Army and Navy amateur radio reserves by alloting special channels for their drills, enabling them to carry on this important work and encourage enlistment in these services as much as in any regular service and would attract all first class operators who now, due to the congestion, feel like most of us—that it is impossible to drill on the floor of a crowded channel in radio. How about using some of the present Army and Radio frequencies for this work? If you have any suggestion on this idea, send them to the above, care of Thompson's Grill, Salisbury, Maryland. Perhaps we can work out something with the proper connections. No doubt our superior officers have some inclination towards the same thing, but in all probability the request will have to come from our end; the amateurs themselves. (Ed. Note: This department solicits remarks from the reader, also. Let's have the pros and cons of the idea, gang. Send your ideas to the editor, and we'll publish the best letters offering both kinds of criticism).

W5HY, originally scheduled to handle the fifth district, writes:

"Certainly sorry to say that I am tied up with my work in the publicity department of this station (KTAT—Ft. Worth, Tex.), and will be unable to gather any ham material—etc."

Thanks, anyway, Mr. Haling, perhaps there are other fellows of the "fifth" who are interested in handling this section. How about it, fellows? Send your dope to the editor right now.

W6FEW Brings a Little Dope From Southern California

(Wanted: A W6 from the "Frisco" area to give a more complete listing of this "wild" gang of "6s".)

W6EQM, Walt Matney, is the new president of the Federation of Radio Clubs (So. Cal.) which organization is certainly doing wonders. Just an ordinary banquet brought a turn-out of **560 hams** and left a profit of over **$300.00.** The Federation involves almost every club in the Los Angeles section and is doing much to improve inter-club relations by providing hamfests, speakers, etc.

After many years of **GOOD service, Tom Nikirk, W6KA, resigned** from the presidency of the Pasadena Short Wave Club and, at the same time, relinquished his post at the head of the Federation . . . Tom says he's going to devote a little time to the family now . . . sorta retiring, eh, Tom?

W6BPP had his SW-3 stolen while it was in use as a "prop" at one of the "Bell" club meetings; **such a hue and cry**—mixed in with a lot of super-snooping, was raised that **the culprit returned it through another ham. Guess that will teach some of these over-enthusiastic hams to keep their hands on their own key and receiver.** Incidentally, an awfully old spark rig was on the "set"—and when it started up, all the 80 meter **CW fellows present swore it was W6ETJ. Hi.**

An AARS get-together was held at Arcadia **(home of W6AAN, F. C. Martin—DNCS 8th)** with a whole mess of Army ops present. It was a two-day affair (fray?) and all the boys had a veddy fine time—ask some).

W6EBJ has a new rig built—but says between night school, radio, his wife, club meetings and business, he has very little time for pounding brass.

W9BJU-BT6—Covina, is feeling much better after an attack of appendicitis. He's on 160 meter fone.

W6ERC-BT9, Grand Junction, Colorado, sure likes to QSO the gang on the coast. He comes in FB on 80 meters with a '10 in the final.

W6FGT says he has more time for hamming now that he has dropped a couple of courses in school.

And the Pasadena J. C. gang are going to school in tents now. Sorta tentin' on the old scamp grounds, eh?

W6YBB. R. N. Skeeters, of P. J. C., claims he has a crystal circuit which will **quadruple** from **160 meters—and still excite a buffer. WOW. He** and W6BOB worked it out—and it isn't at all complicated.

W6JBP mildly suggested to W6ILV, who complained that he wasn't getting out, that his antenna might be grounded—sure 'nuff—'twas!

W6FFN is still rebuilding.

So is W6AQK . . . **OOPS-W6EQJ is saving his pennies to buy GOOD cigars for the San Gabriel Valley Short Wave Club gang . . . NOW, guess WHY!**

W6CNE is going to make a lot of crooks sore at him . . . he's turned out a REAL midget receiver which clamps onto the Sam Browne belt of the L. A. police patrolmen . . . moreover, it WORKS GOOD.

W7BYR Gives the Dope On the Cow Region

(The following is no BULL!)

W7BYE has returned to the air after an absence of several months and is operating on 80 meters again.

W7CRH manages several skeds although he is very QRL at school. (Wotta man!)

W7BVE took the last O.R.S. contest without competition.

W7EDJ is a new ham in Roundup.

W7BGM and W7CCR are operating the C.C.C. station. WUBL, at Fort Missoula.

W7BVI is pushing out with a new 204-A in the final.

(Continued on page 35)

Table of Static Characteristics of Transmitting Tubes

By "JAYENAY"

THE purpose of this table is to enable the user of transmitting tubes to quickly select the tube best suited for his particular circuit. This table shows the most widely-used applications for the tubes which are listed, and enables the user to compare the excitation requirements, to tell by means of the inter-electrode capacities approximately what size neutralizing capacity is required. That part of the table showing AMPLIFICATION FACTOR enables one to quickly calculate cut-off bias for any plate voltage by simply dividing the plate voltage by the amplification factor. Reading the table from left to right, the designations are explained as follows: TYPE—Manufacturer's designation. FIL. VOLTS—Self explanatory. FIL. AMPS.—Useful in estimating filament transformer requirements. TYPE OF FILAMENT—*Oxide Coated*, a highly-effective electron emitter but useful only at low plate voltages. *Thoriated Tungsten*, probably the most satisfactory all-around filament material for high-voltage use, but with the objectionable feature that it will not stand the abuse for which *pure Tungsten* is noted. However, *pure Tungsten* is relatively inefficient as an emitter of electrons.

PLATE RESISTANCE IN OHMS—A useful value to know when it becomes necessary to either match or mis-match the impedance of the plate circuit to the load. Plate Resistance of a radio tube is the resistance of the path between cathode and plate to the flow of alternating current.

AMPLIFICATION FACTOR—This indicates the voltage gain of the tube when used as a Voltage Amplifier. It is a very unreliable means of estimating relative power amplification. The principal use of this factor is in determining bias requirements. To obtain cut-off bias, it is simply necessary to divide the plate voltage being used by the amplification factor. The result gives the amount of negative bias voltage necessary to reduce the plate current to zero. Thus, twice cut-off is twice this amount.

MUTUAL CONDUCTANCE—(Micro-Mho)—The mutual conductance of a tube is a yardstick of tube performance which combines both plate resistance and the amplification factor, and is the ratio of the second to the first. Thus, if a grid voltage change of 10 volts causes a plate current change of 0.01 ampere (10 ma.) with all other voltages constant, the mutual conductance is 0.01 divided by 10, i.e., 0.001 mho. Thus a millionth of a mho, or a micromho, would equal 0.001 mho times a million, or 1000 micromhos.

Cgp—This indicates capacity between the grid and plate. It is the capacity which must be neutralized in order to prevent self-oscillation in the conventional RF amplifier. In the screen-grid tubes this capacity is reduced to a very small amount by the screen grid, and neutralizing therefore is not usually necessary.

Cgf—This indicates the capacity between the grid and filament. This capacity is shunted across the input circuit of the tube, whether it be a tuned grid tank or the plate tank of the preceding stage. The lower this capacity, the better L/C ratio of the driving tank, and therefore the better the efficiency of the preceding stage, resulting in greater efficiency from the preceding stage. This capacity is an indication of radio-frequency grid current which sometimes reaches dangerously-high values at the higher frequencies.

Cpf—This indicates the capacity between the plate and filament. This capacity is shunted across the plate tank and prevents the use of the extremely low-C which is so desirable for high efficiency.

PLATE DISSIPATION IN WATTS—This indicates the safe value of power which may be dissipated in the form of heat from the plate of the tube. Therefore, the difference between plate input and power output should never exceed this value. This limitation makes it evident that high plate efficiency is much to be desired, because it allows more plate input, and consequently more power output, for a given value of plate dissipation.

BASE—This column gives information on the type of socket to use for a given tube. It also shows if some of the elements are brought out of either the top or side of the glass envelope.

COMMENTS—Under this heading will be found a suggestion for the proper function of each tube. Note that some tubes are limited to operation below the stated frequency. The high-frequency tubes are readily identified. No attempt has been made to specify operating voltages or current. Circuit conditions vary widely, and any such tabulation would defeat its own purpose.

Type	Fil. Volts	Fil. Amps.	Type of Fil.	Plate Res. Ohms	Amp. Factor	Mutual Cond. Umhos	Cgp uufd	Cgf uufd	Cpf uufd	Plate Diss. Watts	Base	Comments
46	2.5	1.5	Oxide Coated	1,650	3.5	2,125	8	5	3	10	Med. 4 Pin	Class A or Self Excited Osc.
46	2.5	1.75	Oxide Coated	12,000*	30	2,500				10	Med. 5 Pin	Class B Audio-Doubler-Amplifier
RK15	2.5	1.75	Oxide Coated	12,000*	30	2,500	7.5	2.7	5	10	Med. 4 Pin+	High Frequency 6
59	2.5	2.0	Oxide Heater	11,200*	30	2,700				10	Med. 7 Pin	Class B Audio-Doubler-Tritet Os
RK16	2.5	2.0	Oxide Heater	2,400	6	2,600	7.5	3.8	6	10	Med. 5 Pin	Resembles 59 Class A Triode
47	2.5	1.75	Oxide Coated	60,000	150	2,500	1.25	8.7	13.2	10	Med. 5 Pin	Pentode Crystal Oscillator
2A5	2.5	1.75	Oxide Heater	100,000	220	2,200				10	Med. 6 Pin	Pentode Crystal Oscillator
RK17	2.5	1.75	Oxide Heater	100,000	220	2,200	1	7.5	16	10	Med. 5 Pin+	High Frequency 2A5
2A3	2.5	2.5	Oxide Coated	765	4.2	5,500	13	9	4	15	Med. 4 Pin	Class A or Self Excited Osc.
WE205D	4.5	1.6	Oxide Coated	3,500	7.3	2,080	4.8	5.2	3.3	15	W E 4 Pin	General Purpose Triode
WE271A	5.0	2.0	Oxide Heater	2,800	8.5	3,035	5.3	6.5	3.8	15	W E 5 Pin	General Purpose-Low Hum Level
210	7.5	1.25	Thoriated Tung	5,450	8	1,550	8	5	4	15	Med. 4 Pin	General Purpose
841	7.5	1.25	Thoriated	63,000	30	450	8	5	3	15	Med. 4 Pin	High Mu 210—Class B Audio—Doubler
842	7.5	1.25	Thoriated	2,500	3	1,200	8	5	4	15	Med. 4 Pin	Low Mu 210—Class A
843	2.5	2.5	Oxide Heater	4,800	7.7	1,600	6	5	5	15	Med. 5 Pin	Resembles 210—Low Hum Level
844	2.5	2.5	Oxide Heater	125,000	75	600	.07	10	8.5	15	Med. 5 Pin†	Resembles 865—Low Hum Level
865	7.5	2.0	Thoriated	200,000	150	750	.05	10	7.5	15	Med. 4 Pin†	Tetrode-Buffer—Doubler
830	10.0	2.15	Thoriated	4,000	8	2,000	9.9	4.9	2.2	40	Med. 4 Pin	General Purpose Triode
830B	10.0	2.15	Thoriated	8,000	30	3,750				40	Med. 4 Pin†	General Purpose—Class B Audio
250	7.5	1.25	Oxide Coated	1,800	3.8	2,100	9	5	3	25	Med. 4 Pin	Class A or A Prime
WE254B	7.5	3.25	Thoriated	75,000	100	1,330	.085	11.2	5.4	25	Med. 4 Pin†	High Frequency Tetrode
WE252A	5.0	2.0	Oxide Coated	1,800	4	2,222	12	6.5	4	30	Med. 4 Pin	Class A or A Prime
WE268A	5.0	3.25	Thoriated	5,000	5	1,000	2.3	5.4	1.1	30	Med. 4 Pin†	High Frequency Triode
800	7.5	3.25	Thoriated	6,800*	15	2,300	2.5	2.75	1	35	Med. 4 Pin†+	General Purpose—Ultra High Frequency
RK18	7.5	2.5	Thoriated	5,400	18	3,000	5	3.8	2	35	Med. 4 Pin†	General Purpose—High Frequency
825	7.5	3.25	Thoriated	10,000	10	1,000	3	2	1	40	Med. 4 Pin†§	Ultra High Frequency Triode
WE211E	10.0	3.0	Oxide Coated	3,500	12	3,425	9	6.3	3.6	65	50 Watt	General Purpose—Audio Only
WE282A	10.0	3.0	Thoriated	70,000	100	1,430	.2	12.2	6.8	70	Med. 4 Pin†	Ultra High Frequency Tetrode
WE242A	10.0	3.25	Thoriated	1,900*	12	6,300	13	6.5	4	100	50 Watt	General Purpose—Below 10 MC.
WE261A	10.0	3.25	Thoriated	1,900*	12	6,300	9	6.5	4	100	50 Watt	General Purpose—Below 15 MC.
WE276A	10.0	3.0	Thoriated	2,000*	12	6,000	9	6	4	100	50 Watt	General Purpose—Below 15 MC.
211	10.0	3.25	Thoriated	1,900*	12	6,300	15	8	7	100	50 Watt	General Purpose—Below 10 MC.
203A	10.0	3.25	Thoriated	5,000*	25	5,200	15	8	7	100	50 Watt	High Mu 211—Below 10 MC.
845	10.0	3.25	Thoriated	1,800	5	3,000	15	8	7	100	50 Watt	Low Mu 211—Class A—Below 10 MC.
WE284A	10.0	3.25	Thoriated	1,900	4.7	2,475	8.2	7	7.8	100	50 Watt	Low Mu 242—Class A—Below 15 MC.
NCB	10.0	3.25	Thoriated	10,000*	37.5	3,750	15	8	7	100	50 Watt	Zero Bias Class B Audio
850	10.0	3.25	Thoriated	200,000	550	2,750	.2	17	26	100	50 Watt+	Tetrode—Below 15 MC.
HK354	5.0	7.75	Thoriated	2,000*	13	6,900	4	9	.4	100	50 Watt†	General Purpose—High Frequency
852	10.0	3.25	Thoriated	6,000*	12	2,000	3	2	1	100	Med. 4 Pin‡+	Ultra High Frequency Triode
860	10.0	3.25	Thoriated	180,000	200	1,100	.05	8.5	9	100	Med. 4 Pin‡+	High Frequency Tetrode
F108A	10.0	11.0	Tungsten	8,500*	12	1,400	7	3	2	175	50 Watt‡+	Ultra High Frequency Triode
F102A	10.0	11.0	Tungsten	5,500	8	1,450	7	3	2	175	50 Watt†	General Purpose—Below 30 MC.
WE212D	14.0	6.0	Oxide Coated	1,600*	16	10,000	19	19	12	200	Spec W E	General Purpose—Below 5 MC.
204A	11.0	3.85	Thoriated	4,700*	24	5,100	17	18	3	250	RCA 250W†	Hi Mu—Below 10 MC.
849	11.0	5.0	Thoriated	3,200	19	6,000	33.5	17	3	400	RCA 250W†	General Purpose—Below 10 MC.
WE270A	10.0	9.75	Thoriated	1,750	16	9,000	21	18	2	350	Spec W E†	General Purpose—Below 15 MC.
571	11.0	10.0	Thoriated	5,000	16	3,200	4	4	1.5	500	RCA 250W‡+	DeForest—Resembles 831
831	11.0	10.0	Thoriated	6,450	14.5	2,250	4	3.8	1.5	400	RCA 250W‡+	Ultra High Frequency Triode
861	11.0	10.0	Thoriated	143,000	300	2,100	.1	17	13	400	RCA 250W‡+	High Frequency Tetrode
F100A	11.0	25.0	Tungsten	7,000	14	2,000	10	4	2	500	Spec FED‡+	Ultra High Frequency Triode
HK255	12.0	17.5	Thoriated	550*	5.5	10,000	2	9	3.5	500	Spec H K‡§	Low Mu—Class A—Below 50 MC.
851	11.0	15.5	Thoriated	875*	20	23,000	55	30	7	750	RCA 250W†	General Purpose—Below 5 MC.
WE251A	10.0	15.9	Thoriated	2,200	10.5	4,770	8	10	6	1000	Spec W E‡+	General Purpose—Below 50 MC.
WE279A	10.0	21.0	Thoriated	1,800	10	5,555	18	15	8	1200	Spec W E‡+	General Purpose—Below 50 MC.

NOTE:—ALL PLATE RESISTANCE VALUES ARE AVERAGE EXCEPT THOSE MARKED * WHICH ARE MEASURED AT ZERO BIAS AND NORMAL PLATE VOLTAGE.

† Means that the Plate Lead is brought out the top.
+ Means that the Grid Lead is brought out the top.
‡ Means that the Plate Lead is brought out the side.
§ Means that the Grid Lead is brought out the side.

Construction and Calibration of the Model 350 J. W. Miller Test Oscillator

By R. T. POUNDS *

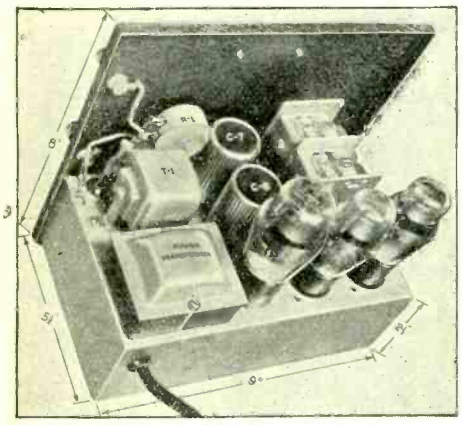
ONE of the most useful instruments for the service man or radio experimenter is a reliable test oscillator. To the service man it represents a great saving in time, and consequently in money, in properly aligning the sensitive and selective receivers of today. The experimenter will find it a distinct advantage in comparing the relative merits of different type receivers or circuit designs.

However, the cost of a good test oscillator has been rather high and, in fact, beyond the means of the average individual. Moreover, many persons hold the impression that an oscillator is an intricate and difficult instrument to construct, when actually, if care is taken to avoid trick circuits and the proper considerations are given the problems involved, it is one of the simplest.

As a general rule, when it is desired to add a new piece of test equipment the first two considerations are its usefulness and its cost. In the case of a test oscillator any discussion of its usefulness at this point would be superfluous. The cost being the next consideration, it would be well to state that in the design of the oscillator to be described every precaution was taken to keep the cost at an absolute minimum, consistent with satisfactory results.

Other requirements affecting the design of the instrument are as follows:

(1)—It must be stable in operation. (2)—Once calibrated there should be no appreciable deviation from the original calibration over a long period of time. (3)—The output should be, at will, either modulated or unmodulated. and it is desirable that the percentage of modulation be made



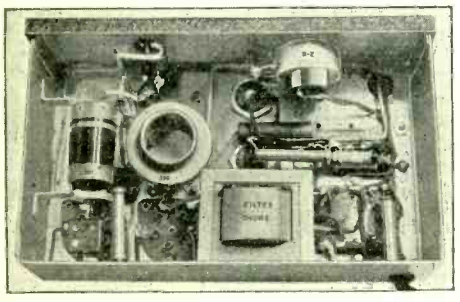
This layout for the parts should be adhered to.

variable. Furthermore the system of modulation must not affect either the calibration of the instrument or, by its nature, produce a broad tuning signal.

It must be well shielded to prevent signal pick-up from any point except at the output, and the output control must give a smooth variation of the signal from maximum to minimum with negligible reactance upon the tuned circuits.

The frequency range should cover the broadcast band as well as all the intermediate frequencies, and this range should be continuously variable.

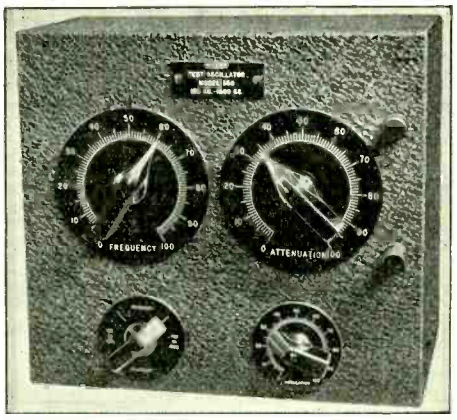
With the foregoing requirements in mind, actual construction of the oscillator was begun and each detail given full consideration. Many types of oscillator circuits were tried and abandoned for various reasons. The circuit finally selected was



The arrangement of parts below the chassis is clearly shown here.

* CHIEF ENGINEER, J. W. MILLER CO., 5917 SO. MAIN ST., LOS ANGELES, CALIF.

an adaptation of the old amateur's standby, namely the Hartley oscillator. The stability of this type circuit has been definitely proven by the fact it has been used in one way or another for several years. The important factors governing the stability of a radio frequency generator are: Com-



A professional laboratory panel assembly for the oscillator.

paratively high L.C. ratio in the tuned circuits; well designed coils; loosely coupled output; the operation of the vacuum tube employed at a level well below the maximum rating.

The coils, first in importance, were designed to fulfill these requirements. The output coupling coils were so proportioned and spaced that the RF power available has proven sufficient for all requirements, and yet the coupling is sufficiently loose that the calibration remains constant with practically any antenna load. As a further assurance of stability, the coils are thoroughly dried by baking and are hermetically sealed by a process known as "flash dipping" in a special compound of highly-refined vegetable waxes. Thus any moisture in either the coil form or the insulation of the wire is driven out, and the coil then protected against further trouble from this source.

To obtain a high L.C. ratio, the tuning condenser employed was a two (2) gang of the type commonly used in the manufacture of midget sets, the two sections being connected in parallel to obtain a total capacity of 700 M.M.F. It is well to note at this time that most of the modern 2-gang condensers available on the market today have a maximum capacity of from 360 to 370 M.M.F. per section, as compared with 350 M.M.F. of the earlier models. However, this will make no difference in the operation of the oscillator because the frequency range was calculated with a maximum capacity of 700 M.M.F. in the circuit, the additional capacity merely extending the frequency slightly.

The operation of the 56 type tube at a voltage of 75 volts (approx.), instead of its rated voltage of 250 volts, safeguards against excessive heating of the tube elements and prevents frequency drift from this source.

The audio oscillator and modulator system are also of the Hartley type, although used in a slightly different manner. Any push-pull transformer may be used, although an inexpensive small core type will give the best results. In fact, if you can find one of the old style push-pull transformers in the junk box, it will suit the purpose. More information regarding the audio oscillator will be given later.

Of all the various schemes of controlling the RF output, the use of a simple potentiometer type has proven most successful.

When the laboratory model of the test oscillator was finally completed and checked, it was carefully calibrated and a curve drawn. The instrument was then put in daily service and was on various occasions used by local service men in their shops as a portable instrument, receiving the usual rough usage that most portable instruments are subjected to. When it was returned to the laboratory, the calibration was again checked and in each case was found correct.

Construction

BEFORE construction work can be started the items listed in the table below are necessary.

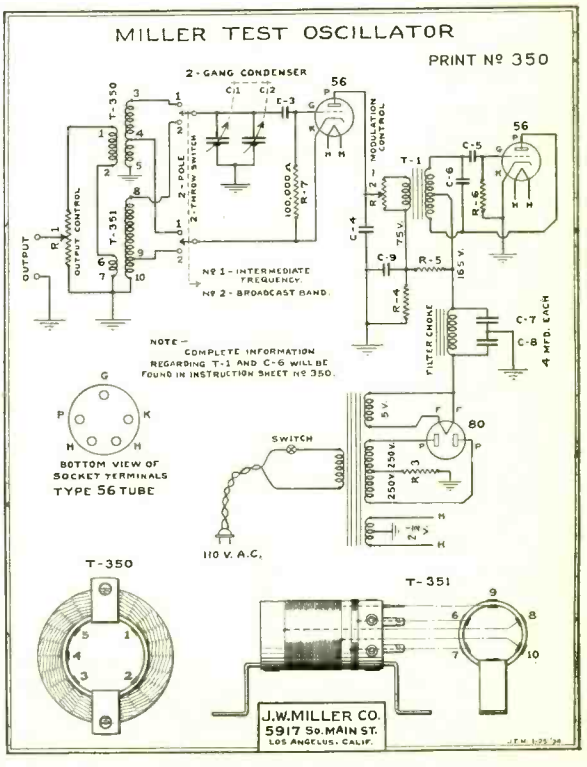
Note

The audio transformer should be of the small core type. In fact, one from the junk box would be satisfactory. The condenser shown across the secondary (C-6) serves to adjust the audio oscillator to the proper frequency and will vary in value for different types of audio transformers; various values should be tried until the audio tone is approximately 500 cycles. The higher the capacity employed, the lower the frequency. IF THE FREQUENCY IS TOO LOW, REPLACE C-6 WITH A FIXED RESISTOR TO RAISE THE FREQUENCY, USING SAME PROCEDURE AS ABOVE.

The actual construction of the oscillator should begin with the laying-out of the metal chassis and case. The parts listed should be placed upon

LIST OF PARTS FOR THE TEST OSCILLATOR

- 1 Miller No. T-350 Oscillator coil. List $1.50.
- 1 Miller No. T-351 Oscillator coil. List 75c.
- 1 Metal case and chassis.
- 1 Two (2) Gang Condenser .00035 each section.
- 1 Filter choke. Any small choke having an inductance of 15 to 30 henries.
- 1 "Pee Wee" type midget power transformer.
- 1 Socket—4 prong.
- 2 Sockets—5 prong.
- 1 D.P.D.T. toggle switch.
- 1 S.P.S.T. toggle switch.
- 1 Dial.
- 2 Binding posts.
- T1 Push-pull audio transformer. (See Note).
- R1 200 ohm potentiometer.
- R2 5000 ohm potentiometer.
- R3 10,000 ohm resistor. (2-watt).
- R4 10,000 ohm resistor. (1-watt).
- R5 10,000 ohm resistor. (1-watt).
- R6 100,000 ohm resistor. (1-watt or less).
- R7 100,000 ohm resistor. (1-watt or less).
- C3 .0001 Fixed condenser. Mica.
- C4 .002 Fixed condenser. Paper.
- C5 .01 Fixed condenser. Paper.
- C6 See Note.
- C7 4 Mfd. filter condenser.
- C8 4 Mfd. filter condenser.
- C9 .1—200 volt fixed condenser. AC cord, plug, and necessary hardware.



a flat surface in the positions shown in the recommended chassis layout and the space required checked against the layout dimensions. It is not absolutely necessary that this particular layout be used, although for best results a similar scheme should be adhered to.

The actual wiring is simplicity itself as the diagram is self explanatory and requires no explanation except that all leads in the tuned circuits should be heavy enough to be self supporting. This is necessary to obtain accurate calibration. All other wiring should be made with good hook-up wire.

Operation

AFTER the unit is completely assembled and wired, the tubes should be inserted and the voltage checked at the various points noted in the diagram. These readings should be made by using a voltmeter of 1000 ohms per volt, or over. Providing this check proves correct, we may now check the operation of the oscillator.

First the modulation control should be turned full "on", the output control full "on" and the output leads connected to the antenna post of a receiver. The frequency range switch should be set for broadcast. Now adjust the oscillator dial until it is heard in the receiver. The output control may now be reduced until the signal is not too loud. If the signal tunes quite broadly, reduce the modulation control to the point where the carrier may be heard with the signal. The audio tone may now be adjusted as previously described.

Calibration

THE oscillator now working, we may proceed with the calibration of the instrument, as follows:

First, a T.R.F. type receiver should be tuned to any station of known frequency at the high frequency end of the dial. (Note: A superheterodyne type receiver may be used for calibration, but to avoid errors due to superheterodyne image response, a T.R.F. type receiver is suggested). This should be done with the oscillator disconnected. The oscillator should now be connected and with the modulation control turned "off" the oscillator dial is varied until zero beat is obtained between the oscillator and the received signal. If no beat can be heard, the received signal is too strong and should be reduced by either disconnecting the antenna or connecting a condenser in series with it. When zero beat is obtained, the oscillator dial reading is noted and the same procedure continued over the broadcast band. Calibration points should be taken at as many points as possible to insure an accurate check of the tuning curve. After the complete broadcast band has been covered, you may continue into the intermediate frequency ranges. As the broadcast band also covers part of the intermediate frequencies, it is necessary to calibrate this section of the dial in the same manner as the intermediate frequency band proper.

The frequency ranges of the oscillator are: Low frequency section, approximate 125 KC to 450 KC; high frequency section 450 KC to 1500 KC; frequencies higher than these may be obtained by using harmonics of the high frequency section. In order to obtain this range, it is imperative that all stray capacities be kept as low as possible. To calibrate the lower frequencies, it is necessary to resort to the use of harmonics, and therefore a word regarding this phenomena would be appropriate.

An oscillating circuit generates not only the fundamental frequency to which it is tuned, but also frequencies which are direct multiples of the fundamental. Thus a circuit oscillating at 200 KC also generates signals at 400 KC, 600 KC, 800 KC, etc. By tuning-in a signal on the broadcast band as, for instance, at 1050 KC, and then zero-beating the test oscillator against it, we know the fundamental frequency to which it is tuned will be some frequency the multiple of which equals 1050 KC. Thus the fundamental frequency would be either 210 KC, 350 KC, or 525 KC. As any of these numbers multiplied by a whole number equals 1050 KC, it now remains to be found which frequency we are tuned to. To do this, advance the modulation control and without disturbing the oscillator dial setting, vary the receiver dial. By noting at what points the harmonics occur, we may readily calculate the fundamental. Thus if as we advance the receiver dial toward the high-frequency end of the dial, the next harmonic occurs at 1260 KC. We know the fundamental frequency is 210 KC, as only this frequency can be divided into both 1050 and 1260 without a remainder. As the band coverage of the oscillator is known, it is a simple matter to calibrate by this procedure.

When zero-beating for obtaining calibration points, the modulation control should be turned "off". For easily locating harmonics, it should be turned "on".

Conclusion

IN USING the oscillator, it should be remembered that some means of reading the output of the set, such as an Output Meter, should be used when the receiver under test is not equipped with automatic volume control. If automatic volume control is incorporated, resonance should be indicated by some means other than the output. A very good method is the use of a vacuum tube voltmeter to measure the A.V.C., bias at the RF, grid returns, or a milliammeter may be inserted in the plate circuit of one of the RF or IF tubes, resonance being indicated by minimum meter deflections.

It is our sincere wish that the information contained in this rather brief discussion will assist you in constructing a really useful instrument. If any further information is desired on any particular detail, we will be only too glad to render any further assistance if you will simply address J. W. Miller Company, Engineering Dept., 5917 So. Main St., Los Angeles, Calif.

NOTE: **If you are interested in receiving data and information sheets of this type in the future, communicate with us at once, giving your correct mailing address.**

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Radiophone Debate

DEBATES are not news, but one held by amateur radiophone between two radio clubs is at least unusual. Recently the Pikes Peak Amateur Radio Association, Colorado Springs, Colo., debated the Greely Amateur Radio Club, Greely, Colo., on the question—**"Resolved: That amateur radio stations of all classes should be limited to an input power of 100 watts to the final stage."** Representing the PPARA were W9EYN, W9FXQ, and W9KI, all transmitting over station W9EYN. For the GARC were W9NEY, W9EDM and W9FQJ, transmitting from station W9FQJ. The judges were W9YL, Boulder, Colo.; W9GYV, Gunnison, Colo.; and W9LYE, Denver, Colo.; who reached a 3-0 decision in favor of the negative, which was upheld by the Pikes Peak Amateur Radio Association.

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Those Russian Commercials On Forty Meters

NOW that the U. S. Government has entered into diplomatic relations with the Soviet Government, something can be done about the QRM caused by the seven or eight Russian commercial stations that operate inside our 7000 KC band. It is now up to us to log these stations for interference with our work, so that a complaint can be forwarded through our State Dept. Log the call, frequency, time in GMT, date and general nature of the transmission (Traffic, calling, V's, etc.). Send your logs to "RADIO" and we will see that action is taken.

I-TAPPA-KEE News

THE AMATEUR'S LEGION OF HONOR

This department is edited by the Hi-Kilowatt of the ITK Radio Fraternity, J. Richard Meloan (Jo) radio W6CGM-W6ZZGM KERN, 1302 "M" St., Bakersfield, California.

All communications concerning the I-TAPPA-KEE RADIO FRATERNITY, as well as inquiries from any amateur as to the Requirements for Membership, should be addressed to I-TAPPA-KEE HEADQUARTERS, either to the Secretary-Treasurer, Kenneth M. Isbell, W6AMR-W6BOQ, 5143 So. 6th Ave., Los Angeles, or to The Hi-Kilowatt, J. R. Meloan, W6CGM-W6ZZGM, 1302 "M" St., Bakersfield, California.

Radio W3VJ Chief Of the Capitol Division ITK

RADIO W3VJ is particularly well known throughout the East and his signals are familiar to the ears of operators in every country and clime. His name is L. Dean Powell of 104 London Ave., Salisbury, Md. Being a modest sort of fellow we were unable to find out, on short notice, much about his achievements. On his ITK application he writes, "Nothing to mention of interest" but we have heard all sorts of things about W3VJ being active in flood and emergency radio communication work. A reliable station always on deck.

Dean is 29 years young and married; a regular fellow, the ITK kind you like to meet. And writes some of the finest letters we ever read. No doubt this talent was gained from wide experience in his occupation as a letter carrier. He knows his letters.

W3VJ

Now let's take a look at his layout and see what we find. In that neatly built transmitter is a xtal 47 osc., 46 buffer-doubler, working into a UV211 amplifier with 185 watts derived from a coupla power supplies. Everything running cool a-la-broadcast. On the wall is a First Class ticket, such as ITK requires for eligibility. We perceive an unusually good monitor-freq. meter above the operating table and on the table is an SW3 receiver which will soon be replaced by a new super. Another look at the wall brings to light a Public Service certificate and a piece of paper signed by the Secretary of the Navy for the President, proclaiming the fact that W3VJ is an Ensign in the USNR. Farther search reveals a fire extinguisher clamped to the desk, no doubt used on the bug or what have you.

Brother Powell enjoys DX and says: "DX cards do not find their way here as often as they should, but maybe the foreign hams have a depression, too." Hours of operation are mostly at night on 3575 and 7150 KC. While Dean doesn't specialize in traffic, all messages are moved quickly. Nothing stays on the hook over 24 hours, even if Uncle Sam has to be called in to help. In conclusion, W3VJ belongs to I.R.E. and is Vice-President of the Del-Mar-Va Radio Club. Holds the degree of Sparks in ITK and is one of our valuable men as Chief of the Capitol Division.

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W6CVL Wins Holiday Contest!

WITH low power and a sincere effort combined with little hope of victory in view of bad receiving conditions, Russ Hossack, W6CVL, up in the High Sierras at Northfork, Calif., rolled up the biggest score in the CQ-ITK QSO contest with a reported score of 432 points. Later we discovered he did not report ITK stations heard, which would have given him an even greater total. Much interest was shown in this contest among all ITK, with many promises of heavier competition in future similar contests. Skip on 3500 KC seemed to be the biggest obstacle, but Russ used his head and took full advantage of every contact made with a traffic exchange and a ragchew, thus getting the most possible points from each QSO. He also made five three-way QSO's, earning extra points.

As reward, W6CVL was sent the prize; a Hygrade Sylvania carbon plate 210 kindly donated by Radio Supply, Los Angeles, and Russ sez in reply "Received tube OK and it sure works FB. Raised input 10 watts and increased output considerably. Please convey my thanks to all concerned. Am all set for the February Speedometer Sky-Miles contest with a 230 osc. at 90 V. and a 230 ampl. with 135 volts." Look out, fellows, or Russ will take you for a cleaning again! Some good prizes are lined-up for future contests.

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New Members

WELCOME these new brothers: W8JE, W6TO, W7COH, W7AJH, W6BVL, W7BJZ, W6UC, W7BDC, W6AZK, W6BVY, W6HT, W6HM, W9BLG, W6JTC, W6GHD, W6ETL, Robert S. Kruse (awaiting new call). W4AAQ-W0DX, VE5-AL, W7AFU, W7GM, WLM-3CXL Capt. Black, W6AMM, W6AVV, W6AJF F. C. Jones, W6ZE, W9KA, W6PH, W6CAL, W8CRA, W6WT-KMPC, W6AGF, VE5BM, W7BNU, W6DQI, W7AHJ (for Sorority), W6LN, W9AOL, W7AVP, W6GUR, W6AOZ, W8CFT, W6CEH, W6BIF, W6CYY, W6DIU. W6BFH, W6BBC, W5JV, W7BHH, W3GE-WRVA, W6FS, W6BCO.

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Division and State Chiefs

W7AVL working sked with W6BOQ, ITK Secretary, with musical background furnished by KFIO, KFPY and KHQ . . . VE5DD Chief of Brit. Columbia says—"You can rely on me to do all possible to foster the ITK spirit wherever and whenever possible . . ." . . . W3VJ is now Chief of the Capitol Division, expects to represent ITK at Wilmington. Del. hamfest and is busy organizing his divisions, particularly interested in Chapters being formed . . . W7AAT on his toes and doing good work for ITK . . . Lyle White, Chief of the Border Division, has his new call and it's W5DWO. Lyle just returned from a trip to Chicago and met some of the old-time ITK who want to come back into the fold and are surely welcome . . . We heard that Louis Huber, W9SU, Central Div. Chief, has about got that date with Betty Boop lined up. Looie has pledged some good men for ITK and many of his old friends are entering our brotherhood . . . W8OQ, Great Lakes Division Chief, ready to appoint State Chiefs but says they must be good . . . W2ADQ has an 80-foot pole (antenna)) and reports that he is special contact station for a treasury-recovery expedition bound for the Carribean . . . W6ZF says: "Friends are the biggest and greatest comfort in living . . . let's take our fellowship seriously." . . . Amen, brother Ronnie. W6AJP announces first meeting of the Reno Chapter. Fb om.

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ITK Station Activities

WESTERN DIVISIONS: W6AUT using 300 watts on 7 mgc . . . W6EFK says "It will be my aim not only to uphold the tenets of this fraternity but to guard carefully its traditions" . . . W6BSV-WUBB at Redding blew his filter . . . W7HX 'Doc' sez: "I dunno how the cowpunchers will like my fraternity pin but I can keep it hid until I go to Washington to consult Roosevelt or sumpin'." . . . W6FTV works on So. Cal. RM net with W6EDW and others . . . W6GHD worked for Marconi Wireless, serving on various ships and at KPH now has sked with AC2RT and tying up with KA1NA and K6EWQ . . . W6DYJ popped two 242's in past month due to arcing neut conds. Needless to say, present condenser has room enough between plates to drive a horse and buggy thru . . . W6DOB active Trunk line station and has fb skeds . . . and has a YF who is a real op (W6AET) and has been for over five years . . . W6DQA is radio salesman on the road in San Joaquin valley. Cum up and see us sumtime . . . W6COJ has new xmtr with Tritet, '10, 800 and PP '52's. That makes 1KW doesn't it, Jim? . . . W6DWE supervising CWA projects and active in USNR . . . W6ZF, Ronnie Martin, busy with S. F. ITK Chapter and doing some fine work . . . W6AWY primed for the Speedometer QRP contest if a '30 will take 350 volts . . . W7AMA did excellent work in Northwest flood emergency and expects to be an ITK member soon . . . W7COH has been a ham since 1906 and we will publish dope on his most interesting history soon . . . VE5BM, Syd Woods, using an xtal controlled fifty on 7 mgc. Syd was op on the S.S. Anyox which ran the Hudson Bay Co.'s supplies up into the Arctic last summer until the ship had tuff luck with the ice and came back with a hole in her keel . . . W6CGM reports success with the Collins Antenna system . . . W6BOQ on the air regular from either his own station or that of W6DOB's. W6ETL led the whole ARRL for traffic totals a month ago.

EASTERN DIVISIONS: W9DBW spent most of the month working on the new fone-cw transmitter at W9IO-W9YA, Univ. of Iowa; also has developed a new compact speech amplifier, universal in application, fidelity curve flat from 5 to 12,000 cycles. Gain 4200 for two tubes!

W2BYY reports the usual activity and good work and will aid ITK in New Jersey as its State Chief.

W8DED most enthusiastic about ITK and has pledged many good men in the eighth district.

W9AOL is one of the original 1926 Charter Members and comes back into the reorganized ITK with reborn ambition.

W9AFN rebuilt W9LW's station, also built several special short wave receivers of his own design for other hams; fb dx results. Rebuilding his own transmitter with best parts money can buy. Will use 1KW with two 849's PP in final. Typical qsls this month were from HAF3FF, FM4AA, VP5PZ.

W8JE handles much of the Byrd Expedition traffic and is an important link in the special network for clearing Byrd's traffic.

W3CQS has a new Collins 150B transmitter. He writes Ham News for R9.

W9DZG, Earl Linder, at E. St. Louis, Ill., was an old-timer when the Hi-Kilowatt built his first crystal set in the same town and that was 13 years ago. Earl had the first Schnell spiderweb receiver in town, too, by the way, and it was a sensation in those days.

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Phone Men, Attention!

ITK is not engaged in the controversy between key men and phone men, neither does ITK slight the fone man by being an organization of "traffic hounds". This fraternity is widely representative of every phase of radio and does not in its membership requirements discriminate against the phone man. ITK now has some fone men in its membership, but to be so eligible these men must pass the 20 wpm code speed requirement and be open to traffic, that is, not refuse a message that can be expeditiously handled. We welcome the fone man who can pass these requirements and who is a real amateur. A man does not have to be a "traffic hound" to be eligible to ITK, although traffic is the backbone of our fraternity and we have a most excellent traffic network. We do not overlook the amateurs' main claim to public recognition by reason of public service.

●●●

ITK Air Meetings

ITK "Periods of Communication" or air meets are designated for the following two periods: Period "A", 3-5 p.m. CST and Period "B", 10-12 p.m. CST on every Thursday. All bands, preferably 3.5 and 7 mgc. Get on the air with your station during either or both of these periods, if possible, and communicate informally with other fraternity stations. Call CQ-ITK and answer this same call. Don't forget to sign ITK at the end of each transmission as identification (normal practice). Important ITK broadcasts and dispatches will be originated during these periods.

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Special Classes Of ITK

YL operators (also XYL and OW) are eligible to the ITK Sorority providing they can pass the regular requirements. There seems to be not a few feminine hams who can handle the code as rapidly as any of the boys and who are not at all short on radio knowledge.

"ITK Foreign Legion" is a name designation for foreign members. Membership to ITK is open to eligible amateurs of all nations.

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Traffic Chains

'ROUND THE WORLD CHAINS will be the pride of ITK. Present plans call for 48-hour message service 'round the globe, as nearly around the globe as possible, in consideration of European non-participation in radio traffic activities. Several circuits now in operation are these:—Circuit "A", W6FFP-ZL4AO-G2LZ-W9AFN-W6FFP. For traffic, a jump is made around G2LZ. Circuit "B", one-day service from East Coast to China, or around the world via W1CRA-W6CII-AC2RT. This often works in one hour. Some speed! W6CII also has one day delivery from Egypt to Southern California. W6CUU and W6GXM will be part of two more Trans-Pacific trunks to the Orient.

NATIONAL TRUNKS — A tentative Pacific Coast trunk extending the length of the United States from San Diego to Vancouver, B. C., is composed of principal trunk line stations W6EFK-W6BMC-W6ETJ-W6FAC-W7DXD-W7AVL-VE5DD.

SPECIAL TRAFFIC FREQUENCY for ITK trunks is 3645 KC-7290 KC. All trunks will work on these frequencies. The higher freq. will be used for the long hops, particularly on the transcons and transoceanics. A special 14 mgc frequency is used when necessary. All TL stations have xtals ground to these exact frequencies.

Collins Antenna System

(Continued from page 5)

After the first adjustment of C1 to restore the circuit to resonance it probably will be found that the minimum plate current to the final amplifier is either too high or too low for normal operation. C2 should then be reset and C1 again adjusted for resonance. A differential setting of the two condensers will be found where the transmitter works into exactly the correct load. It is important that the condensers always be readjusted for exact resonance as indicated by minimum plate current. It may be found that it is impossible to load the final amplifier heavily enough in some instances. If this condition exists, the load can be brought up to normal by decreasing the value of inductance in the circuit and increasing the capacity of the condensers by a corresponding amount to restore resonance.

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RK-18 Transmitter

(Continued from page 9)

same token, it is further necessary to increase the excitation to overcome this additional bias. So it goes. This juggling act will result in the maximum output if carried to its ultimate conclusion, the limiting point being where the excitation can no longer be increased. The criterion for these adjustments is the antenna ammeter. After all, what we want is the most output possible without exceeding the plate dissipation of the tube. It hardly seems necessary to mention the fact that the final tank should have a high L to C ratio. It is possible that the use of a tank of larger physical dimensions would lead to slightly better results. However, the coils in use, wound with No. 10 wire, have an excellent form factor (length to diameter). It would be advisable to increase the spacing between turns on the 14 MC coil so that the length would be approximately equal to the diameter.

The transmitter is mounted on a Masonite panel, 7 by 26 inches long, which is in turn supported by a 1½-in. frame. The vertical section is 20 in. high, Masonite panel. No reliance is placed upon these panels for insulation. All components are mounted upon stand-offs and all of the high voltage leads go through the baseboard via the porcelain collars built into the Birnbach insulators. The threaded rod on the end of these insulators make excellent supports for by-pass condensers and other wiring below deck. A No. 8 bus runs the entire length of the chassis and all ground connections are soldered to this bus where they come through the subpanel. This very largely removes troublesome potential differences in the various ground leads. All sockets are of isolantite and are mounted up from the base with small collars. Since the tubes are all isolantite based, no trouble from the old "blistering" can occur in either socket or tube. The RK-18 socket is mounted on two brackets which fasten to the vertical section. It is perhaps well to mention that these brackets should extend some little distance in order to allow a free circulation of air around the tube—a necessity to proper cooling.

All terminals come out of the back of the base-board which is slotted to take the post strips which are mounted on pieces of bakelite. Each stage has its separate terminal block; the common negative comes out to a post on the center terminal strip.

A variable resistance, 10,000 ohms, in the C-bias lead instead of the regular C-battery on the RK-15 stage has been found to give a very fine control of the C-bias, resulting in greater output than obtainable when the

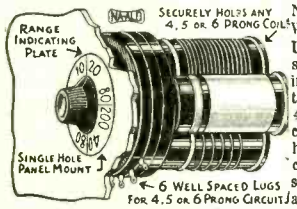
(Continued on page 33)

NEW ALDEN PARTS

705SWS BAND SPREAD S-W COILS

Simplifies tuning by spreading out the S.W. bands. Secondaries tapped for most efficient operation. May be easily substituted for the 704 SWS Coils. Precision wound on beautiful new improved forms. Coils have UY bases.

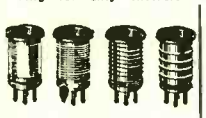
705SWS Band Spread S.W. Coils. List pr. $2.50 Set.

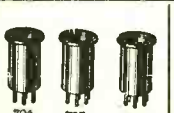


New No. 700 S.W. Coil Selector Unit instantly swings any coil into circuit by turning knob. All 4, 5 and 6 prong coils are rigidly held by the specially constructed sockets without adjustments of any kind. Knob and indicator on face of panel show which coil is in circuit. Simple—compact—rugged—electrically efficient. Don't fail to use it in sets you are building and new equipment you are designing.

No. 700 COIL SELECTOR UNIT without coils.
List Price $3.50

Precision wound coils with the convenient gripping-ring for easy insertion and removal from socket.





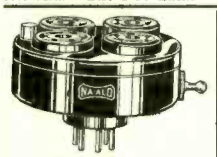
704SWS Set of 4 coils; 10-200 meters; 2-circuit
List $2.00

706SWS Set of 4 coils; 10-200 meters; 3-circuit
List $3.50

704BCS Set of 2 coils; 100-550 meters, matches above
List $1.50

706BCS Set of 2 coils; 100-550 meters; matches above
List $2.00

Color coded easy-grip ring coil forms. 1¼" diam. x 2" winding space. No. 704 4-prong coil form, No. 705 5-prong coil form—List 25c Each. No. 706 6-prong coil form—List 30c Each.



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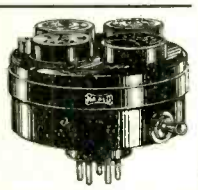
Checks over 120 new tubes including the small sevens in your present tube checker. If checker has no fil. voltage switch, adapter 954-SGL, list $1.25, is also required.



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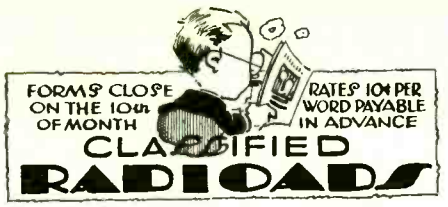

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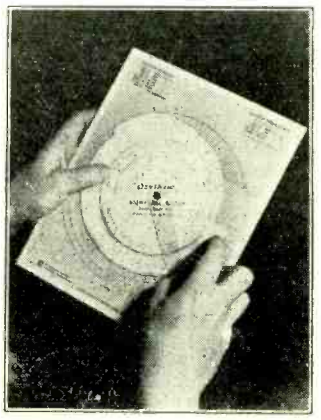

Frequency
Wavelength
Coil diameter
Coil length

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Gives answers in DIRECT VALUES to problems involving wave length, frequency, inductance, coil sizes, capacity, wire sizes, number of turns. No knowledge of mathematics necessary, no juggling of decimal points, no charts, no tables, no curves. Range extends from 2 to 600 meters.

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The Banehawk Superheterodyne

(Continued from page 11)

quite a difference between different 57 type tubes. The bias is adjusted by means of a screwdriver through a hole in the top shield, and once set will need no adjustment until tubes are changed. A mis-adjustment of this bias control will result in a tremendous increase in noise with a violent drop in signal strength.

Literally hundreds of coupling methods between the oscillator and first detector have been tried. Let us not recall the weary hours spent in changing and trying, except to say that the Heising double choke method of modulating the detector screen gave the best all-around results.

The output of the detector is prevented from leaking to ground through the B strip by passes by means of a rather unusual IF choke in the plate lead. Many chokes were tried at this point, but the best results were obtained from two 465 KC IF coils connected in series. These coils are mounted on the same dowel and their coupling was adjusted for maximum choking effect. The windings must be connected with proper phasing, else their inductances will neutralize.

The oscillator uses a separate cathode coil for the same reason that we used such a coil in the RF stage. The 25,000 ohm grid leak is shunted ACROSS the grid tank, rather than across the grid blocking condenser, because it stabilizes the oscillator.

We found that the extremely effective shielding between the oscillator and detector made it a little difficult to obtain sufficient oscillator voltage to fully modulate the detector. This condition is highly desirable but rarely found in conventional superheterodynes. In fact, some builders comment proudly on the fact their supers work well without any coupling circuit at all! Thus they claim that they have avoided all coupling difficulties! Why use shielding at all?

We find that a full 250 to 275 volts is necessary on the oscillator plate and about 150 volts on the oscillator screen to get full output. It is highly important that the screen voltage be obtained from a voltage divider rather than from a series resistor in order to prevent changes in line voltage from affecting the oscillator frequency.

Note that the heaters are by-passed separately for each tube. This was found necessary to remove the last vestige of interlock, even though the heater leads were twisted and shielded in Belden cable. The B strip is bypassed with .5 ufds at each tap. ALL bypasses should be non-inductive.

Any difficulty experienced with obtaining proper regeneration, particularly on 20 meters, is very likely due to the fact that the antenna is coupling too closely to the RF grid coil. Loosening this coupling, either by moving the antenna coil away, or in the case of a single wire antenna decrease the coupling capacity in series with the antenna lead. In general, it has been found that the "cathode winding" must be quite close to the RF grid coil. If these precautions are taken no trouble from this source will be experienced.

If the unit is to be used as a TRF receiver with the phones or audio amplifier connected to the plate circuit of the non-regenerative detector, the double IF choke should be replaced with a 100 to 400 henry impedance. No other changes are necessary and the performance will be a revelation to those who think that they have listened to good TRF receivers. The use of the separate tunable high frequency oscillator to provide the audio beat note allows a signal to noise ratio that must be heard to be appreciated.

The authors wish to avoid the use of superlatives in describing the performance of this receiver but let us say that as a complete TRF receiver, this unit is second only to the superheterodyne it becomes when connected to a suitable IF, second detector and audio amplifier unit. As a superheterodyne? Well, let us be conservative and say that an R2 signal within 500 cycles of our own 1 KW transmitter (which is on the same table as the receiver) can break through, even though we might not read the signal 100% with our key down. This is with the crystal filter in the series position, of course. Sensitivity? We can read anything above 33 DB, approximately, below one microvolt per meter absolute. Of course, the noise level varies with frequency, in ours as in every other location, but if the noise level is below 35 DB below one microvolt for a 50 cycle band width, all the sensitivity can be used. The set noise itself is under 40 DB below one microvolt absolute.

Globe Girdlers

(Continued from page 29)

VP5PZ has been standing the whole country on its ear with his new 500 watt crystal rig. Wonder if the 90-foot sticks are still in use? He was readable 70 feet from the cans at WB the other night on sked. He asks us to say that he can't answer everyone in the US that calls him but that he hopes to get around to 'em all sometime. Yes, VP5PZ is the old NJ2PZ from back in '28.

The reason we have not heard VS6AH roaring through these mornings is that he is now in England. Not permanently, we hope.

A mighty good bet for some good DX should be SU1CH who has recently put in 200 wats, MOPA, and a FBX7 receiver (thanks to the T&R Bulletin for that dope). We believe that W6QD worked this same station within the last month. FB!

W6HM tells us that ZS2F is using 6 watts input. Boy, isn't that one for the book? But—we understand from W6MV that ZS2A—THE ZS, is using a pair of '45's in push-pull for his final amplifier. Now, we wonder!

The nominations for Globe Girdler so far stand as follows: W1CMX, W1CH, W1LZ, W1ZI, W1AF, W1SI, W2BSR, W3AG, W6BYB, W6BAX, W6WB, W7BB, W9GFZ, F8PZ, and ZS2A. Each of the above have received votes. Taking this list as a basis, let's either have votes for them or else some new nominations.

W3BBB says he has nearly 70 countries (is that correct?) and still no ASIA.

Since many of the east coast stations are particularly interested in working ASIA to complete their WAC, it might be a big help to some of them if dope were published in this column each month as to the time that the Asian stations are coming through on the Coast and Middle West. Particularly would this be of value on 14 MC. Along the same lines, a list of those difficult European and Northern African stations for the Coasters might be helpful. Send in your dope.

Someday, maybe, we will have an International Test where the final score takes into consideration the number of hours spent on the air. The present affair just about eliminates the man who must work to eat. Unless one is on 23 hours a day, or engages in that gentle practice of springing some "Ringers" in the form of additional operators, there is hardly a hope of placing. Since working DX is very largely a matter of personal pride, this last-mentioned practice is difficult to understand. Anyway, here's a lot of luck to all in the coming dog fight.

Well, here's the start of the new DX column. Since a great many have asked for it there must be considerable interest in the subject. We can't possibly know all the latest news, so help the game along by sending in your dope each month.

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J1 Calls Changed To J2

On February 1st a new call system was inaugurated in the Tokyo (Japan) district. The J1 prefixes have been cancelled. All calls which formerly started with J1 now start with J2 beginning with J2A. The former J1DO is now J2GX; J1EE is now J2HI; J1DM is now J2GW; J1EK is now J2HE; J1DV is now J2HV.

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RK-18 Transmitter

(Continued from page 29)

coarse C-battery or fixed-resistance bias is used. It is well to by-pass the variable resistor with a fixed condenser of ¼ to ½ mfd.

If trouble develops from oscillation when the 20-meter push-push RK-15 stage is in operation, parasitic chokes in the grid leads should remedy the difficulty. If oscillation then still persists, changing the relation and length between grid and plate leads should effect the cure.

A detailed discussion on the adjustment is, to our way of thinking, an insult to the reader's intelligence. However, a few words about the coupling links would perhaps be in order. To begin with, an examination of the diagram will show that no tricky coupling loop is used to couple the crystal to the push-pull grid circuit of the buffer. A single turn loop on either end has proved to be entirely satisfactory and is really non-critical as to its exact placement on the coils. Coupling to one side of the push-pull tank or the other does not result in any noticeable unbalance. The loop can be best adjusted toward the cold end (center) of one side, and then left alone. The other loop on the crystal tank is, in our particular case, about equidistant from the hot and cold ends, perhaps favoring the hot end slightly.

Coupling from the plate tank of the buffer is best accomplished by coupling from either end of the tank, the loop on the grid coil being approximately in the center of the coil.

Efficiency in Grid Modulation

(Continued from page 13)

KNOW that our load is essentially this dead resistor as long as no grid current is drawn. We also know that the audio peak swing is to be ⅛ of the bias voltage, hence can calculate the audio power demand at full modultaion. Since there should be surplus audio power it is suggested that the system be calculated to supply about twice what is strictly necessary. This greatly improves the audio regulation and helps the fidelity. It is of course necessary that the audio coupling transformer be designed to handle the requisite number of milliwatts—or more.

Similarly the tank circuit of the driving RF tube should be loaded with a resistor dissipating 1 or 2 watts.

If excessive audio distortion be encountered it is well to suspect some one of the things which have been mentioned, mismatched tubes, or stray regeneration, likewise RF getting into the audio system.

Osockme, Japan,
January 23, 1934.

Honorable Idiotor of "RADIO",
Who promulgate high efficiency
material from low efficiency equipment:

Your respectable reader Scratchi have recently become recovered from severe case of radiofrequencyitis, which result from becoming entangled in positive plus "B" connections of power supply which were mistakenly marked "negative" because of wrong manufacturers' stamping on binding post top head.

To overcome such layups in future it become determined here that Scratchi shall use kill-proof radio freakquency choking coils in all plus "B" terminals which remain positive. Honorable sawbone medical specialist who make visit to shack inform me it become cheaper to use such choking coils rather than spend inflated Yens for substitute arms, legs or other limbs.

Thus it become decided here that Scratchi wind himself some choking coils. Diligent search through hundreds of textbooks prove that average writer thereof recommend that glass tubes be used upon which choking coils shall be wound. But here in Japan we have no stores which sell such glassy tubing so it behoove Scratchi to make search of 5 & 10 & $17.00 stores to find suitable material of tubing glass to proceed with winding process.

Search of store soon become successful when Scratchi stumble upon excellent substitute for glass tubing by spotting with Japanese Eagle Eye one great pile of small glass tubes in which are contained caustic soda sticks for after shaving use which keep men from bleeding to death. Upon label on such glass tube it says Styptic Pencils. Scratchi have never have Styptic Disease, so I carefully depose contents inside glass tube into ash can and proceed to wind coils on outside of tube.

With hundreds upon and under other hundreds of turns of fine thin wire Scratchi wind beautiful appearing choking coil and connect in proper place in plus "B" lead. Rapid adjustment of transmitter and Scratchi go back on the air with short "CQ" which last for three hour or slightly more. Brother amateur in Nagasaki fire back with revengeful retort which say that signals from Scratchi station are heard on nine different points on the dial. "Use more and bigger radio frequency choking coils", say my QSO friend. But Scratchi become infuriated with this and reply—"Go to Halifax. Buy yourself receiver with only one point on dial and you will not hear my signals in nine different places". "Aw, put your fingers across filter condenser terminal and press key with your foot", come back my good-natured friend. Fearful of intervention by Government radio officials, Scratchi terminate such belligerent QSO by telling honorable Ham friend to connect his tank coil to headphones and listen to the birdies sing.

However, such QSO impress fact upon Scratchi that all must not be well with home-made choking coil. Whereupon I open door to welcome entrance of long-no-see friendly amateur from next door who come in to find out where profane language emanate from. When he open up shack door, uncountable number of flies also come into shack with him. He look all around shack, with long neck, like most amateurs usually have, and begin admiring everything from stand-up insulators to falling down tank coil winding.

"That is wonderful DX-ing you have been working", say my brother amateur friend. He look up on wall and see large map with many thousands of black spots upon it. Scratchi chuckle with glee and remark that such large thing on wall is not dx-amateur-map-of-the-world of stations which Scratchi work, but just plain big piece of fly paper which are full of deceased QRM—causing flies which have far too often fooled Scratchi into thinking that I was listening to raw-AC stations on the continent which transmit pure DC power only when Honorable radio inspector takes vacation and listens in.

Scratchi chase flies all out of shack, and next-door amateur friend, too, and proceed to write this letter to you, Honorable Editor, hoping that some enlightment will come from your pen as to how to make proper RF choking coils. But before letter become half finished, Scratchi find that flies all come back into shack again, so instead of writing letter to you today I shall first proceed to make Faraday Screen to put on door to keep flies away. Hoping you will do the same, I am,

Your esteemed reader,
Scratchi.

From Ones To Nines

(Continued from page 24)

Ex-W7ANR has a Comet "Pro" and is building an FB rig. He also expects a new license soon.

W7BUJ will be on with a 203-A crystal soon.

W7ANT moved his 852's to 20 meters.

W7EAI and W7EAL are new hams in Helena.

W7ASB moved to Missoula from eastern Montana.

W7BVE is getting out to the Philippines and Alaska.

W7AAT and W7COX (SCM and wife) operate separate stations under the same roof. (At the same time?)

W7EAQ and W7EEH are new hams in Missoula.

W7AOD, CCR and BJZ are going strong in Missoula.

W7EDD in Bonner's Ferry has a new license.

W7TU is doing fine with low power . . . fone.

The Helena and Missoula Radio clubs are no more, but Great Falls still keep their organization running smoothly. FB, FB.

W8FMF Sends His Dope From Niagara Falls

The boys from Niagara Falls, Rochester, and Buffalo surely enjoyed themselves at a recent hamfest held by the Buffalonians in their home town. Among the attractions were first a good dinner, **topped by a talk by Dr. Woodruff, who brought along some of his admirable gadgets, then, a talk by Jim Lamb. Mr. Lamb's discussion covered his development of the Tri-Tet oscillator—which was as interesting as it was helpful.**

Rochester couldn't let this hamfest occur without reciprocating so the next week they held an equally enjoyable hamfest. Seems as though the old rivalry between the Rochester Amateur Radio Association and the Buffalonian's Club still exists.

Niagara Falls, with new hams springing up everywhere, is organizing the Niagara Falls Radio Club. Let's see this gang go as high on the ladder as the other two clubs have.

160 meter fone activity in the eighth district can be judged by the ever-increasing QRM alone, hi.

W8JE and the Army net are still active. **Joe handles traffic for Byrd via NY1AB.**

W8GIJ-8BJO has moved, but is back on the air for more traffic.

W8BME has a FB new rig. So has W8FMF.

W8EXA has moved to Illinois—W9OQB—and he sure pounds in on the West coast awfully early in the evening. W8LIM gets a new ticket. W8AMZ working W1MX-W1BMX at M. I. T. More next time.

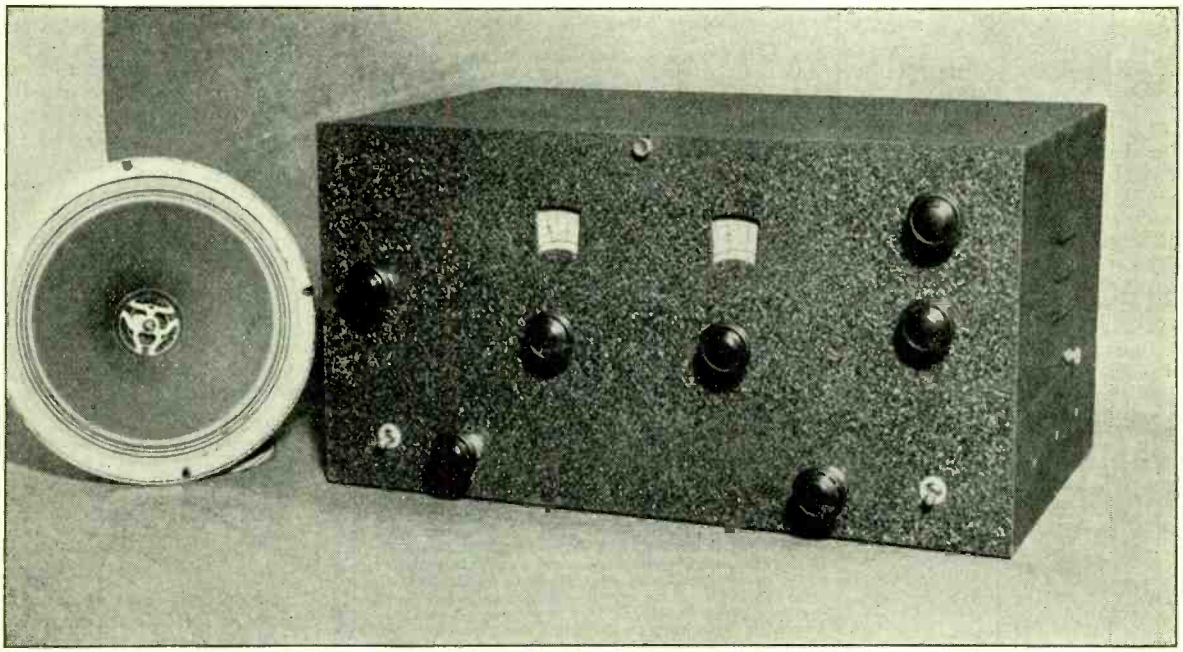
W9OP Hies Us a Little Irish From the Mid-West

Some of the local nines are sneaking in a little RAC once in a while and are reporting more DX when operating that way. . . tsk, tsk, tsk—the naughty boys! They say, "Well, if the sixes can get away with it, why not we?" You answer that. (Ed. note: O.K. Tell the boys to use PDC on their receivers and keep their aerials away from power lines carrying AC then they'll hear PDC sixes).

W9PPD may have a newly issued call—but don't let that make you think he's newcomer—notatall—notatall. Has been in the game for yars and yars. Has been commercial lately. **Hehehehe, W9BLI is a bridegroom now-a-days, YL is practicing to be a radio widow.** W9PPD built a S.S. receiver that gets 'em; propped it alongside W9OP's FB-X and out-performed it hands down. W9OP sells his FB-X and studies sickle sgingl—er, sugIle siggle, siggle suggle—oh, well, S.S. circuits.

McMURDO-SILVER

5B SUPER IS WINNING NEW ACCLAIM EVERY DAY



From a western publisher comes the following comments as a result of test and operation by Colonel Clair Foster (W6HM) on the new 5B Single Signal Super:

> "Colonel Foster liked that 5B so well that, when KA1LG asked him what super was best to buy, the Colonel told him to buy the 5B."

Among many other enthusiastic comments from users of the 5B the following from Mr. L. P. Stowe, W4CEI, is representative:

> "Your 5B receiver set up here last week and working very fine; the more I use it the better I like it. I was interested in the receiver only as a ham receiver and it's the best set that has ever been my privilege to operate, both on phone and on CW. The selectivity on phone is almost unbelievable with the xtal in the parallel position, and on code the variable pitch OSC and the S.S. xtal filter makes solid copy more the rule than the exception."

Specifications 5B Super

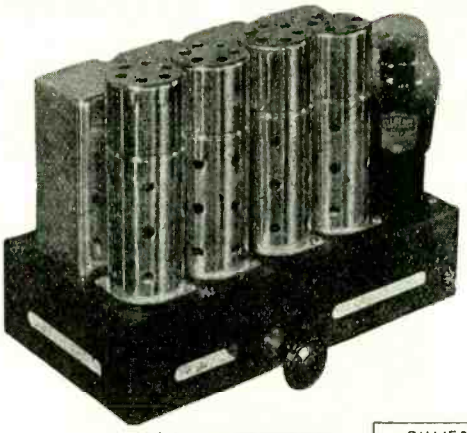
Circuit — Eight - tube superheterodyne.
Tubes—'58 tuned r.f., 2A7 1st detector — E.C. oscillator, two '58 tuned i.f.s., '58 audio beat oscillator, '56 second detector, '59 output, 5Z3 rectifier.
Range—1550 to 30,000 kc. — five amateur bands on one dial.
Tuning—One main illuminated vernier tuning dial, smooth and easy, directly calibrated in megacycles. Band spread tuning anywhere in range — amateur, broadcast, commercial. 100 degree band spread 20 and 40 meters—200 degree spread 80 and 160 meters.
Wave Length Change—Same, positive, 6-gang wave change switch approved by Admiral Byrd and used in his four MASTERPIECE IIs.
I.F. Amplifier—Dual air tuned, Litz wire . . . 465 kc.
Beat Oscillator — Electron coupled '58. Beat note pitch adjustable from front panel.
Sensitivity—Better than one microvolt absolute.
Selectivity—Circuit designed, built and adjusted for crystal resonator, without crystal, band width 21 kc. 10,000 times down. With crystal, absolute single signal (50 cycles wide).
Power Output—3 watts undistorted. Supplied complete with Jensen dynamic speaker, and head phone jack on front panel.
Shielding—100% perfect, all parts individually shielded. Overall cabinet shield easily removable with six thumb nuts.

PRICE $59.70

net to amateurs with eight guaranteed and tested Raytheon tubes. Each set complete with selectivity control, crystal switch, phasing condenser and crystal socket—ready for insertion of crystal. Add to above price $9 net for Bliley crystal with holder, and complete crystal alignment—complete price, ready to go single signal with crystal, $68.70.

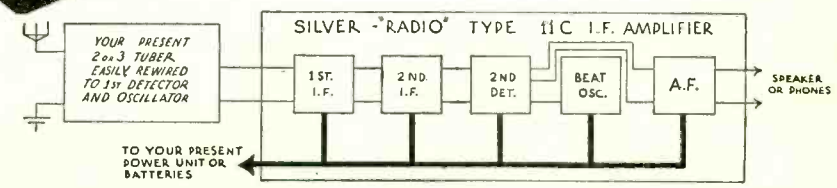
SEND 3c

stamp for new complete catalog describing above items, E. C. Frequency Meters, New Airplane Dials, Relay Racks, R. F. Chokes, Audio, Power and Filter Transformers, and a host of new and interesting amateur and commercial apparatus.



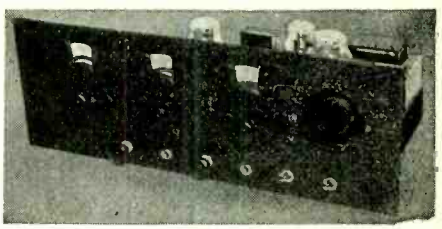
For Only $12.60

Make an Advanced Super Out of Your Present Two or Three Tuber!



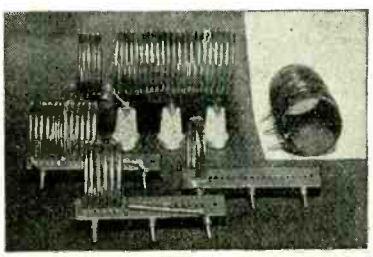
Now $12.60 makes an up-to-the-minute superheterodyne out of your present shortwave receiver! Think of it—all the sensitivity, selectivity and freedom from noise of the most advanced type of superheterodyne is yours for $12.60 without the loss of one cent's worth of parts in your present two or three tuber. Is that the answer to the amateur's dream . . . or is it the answer. For exactly $12.60 you can buy from your dealer or direct from the laboratory the new Silver "RADIO" air-tuned i.f. amplifier kit fully assembled—wired and aligned if you desire—all ready to connect right up to your present set and turn into a superhet with only a couple of hours work!
The basis of this change is the new Type 11C 465 kc. Two Stage Air-Tuned I.F. Amplifier, audio beat oscillator, second detector and audio stage illustrated above. Developed by RADIO magazine's technical staff and McMURDO SILVER, it is the perfect i.f. amplifier for any superhet.
With it you use your present tuned r.f. and detector circuits as detector and oscillator with only a few wiring changes, and presto—you have the latest and best superhet for a cost of only $12.60. No matter if your set is factory or home built, you can make the change in a jiffy. No matter if it's battery or A.C. operated—just order the 11C amplifier for 2 volt battery or 2.5 volt A.C. tubes and the job is as good as done. And your wholesale price is only $12.60 assembled but not wired, or $3.60 extra for wiring and exact alignment to 465 kc. Send in your order at once, get the thrill of operating an advanced, up-to-date superhet, and watch your DX jump 1000%. The 11C amplifier comes complete with full instructions for converting existing sets, and full dope on single-signal crystal filter addition so simple it's a "push-over."

"Tritet" Five Band Oscillator-Amplifier



This unit is essentially the "Tritet" five band exciter, developed by James Lamb of QST put into practical and simple commercial form on a 7-in. by 19-in. black crystalline aluminum relay rack panel and 10" deep steel chassis. Type 9A oscillator amplifier, complete with choice of three plug-in coils permitting operation on any one amateur band, with two tested 59 and one 5Z3 Raytheon tubes, list price, $84.50. Set of six additional plug-in coils permitting operation in all five amateur bands at will, list price $10.00.

Copper Tube Transmitting Inductances



Type 18 inductances are wound with ⅛" O.D. nickel-plated copper tubing spaced 3/32" between turns to a 2½" diameter and rendered extremely rigid by means of tight fitting linen base bakelite clamps, which also carry three contact plugs. For antenna coupling a special Johnson standoff insulator is provided carrying on a rotable pin a six-turn antenna coupling coil provided with flexible leads for circuit connections. This 18F antenna coil is suitable for the 1.7, 3.5, 7.0 and 14.0 and 28.0 MC amateur bands with series and parallel antenna tuning. Type 18 copper tube inductances for any amateur band, $3.00 each, list. Johnson type 205 glazed porcelain standoff jack socket, per set of three for 18A, 18B, 18C, 18D or 18E inductance, list price $.75.

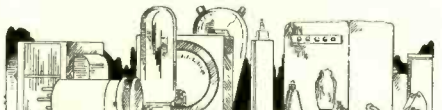
McMURDO-SILVER, INC.

1741 BELMONT AVE. CHICAGO, U. S. A.

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

RADIO BUYERS' GUIDE

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



NEW PRODUCTS

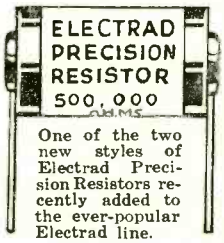
New Crystal Set

THE Insuline Corporation of America, 23-25 Park Place, New York, N. Y., is introducing a new crystal set.

Among its features are that it is encased in bakelite, has full vision dial and automatically lights as soon as the dial is put into operation.

The cat's whisker is controlled by a knob under the dial knob. Height 6½-in. by 2¼-in. deep.

●●●

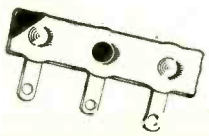


One of the two new styles of Electrad Precision Resistors recently added to the ever-popular Electrad line.

Electrad Precision Resistors

Precision resistors for meters, resistance bridges and other measuring devices where absolute accuracy is a paramount consideration have just been announced by Electrad, Inc., 175 Varick Street, New York, N. Y. Complete information can be had by writing the manufacturer.

Electrad Center-Tap Resistors



THESE center-tap resistors are made in a convenient small size. They are 1½-in. long, ⅛-in. thick and ⅜-in. wide. They are color coded, made in values from 10 ohms to 200 ohms and the center-tap is accurate to plus or minus one per cent.

Maker—Electrad, Inc., 175 Varick Street, New York City.

●●●

Vitreous Enameled Power Rheostat

A POWER rheostat of unique design is illustrated in the Electrad advertisement on page 27. This unit is very ruggedly constructed. The shaft and bushing are insulated. The wire winding is rigidly held in place by vitreous enamel which also covers the refractory base. The contact shoe, of special metal graphite composition, contacts the wire wound element on the outside diameter. The rating is 50 watts with total resistance in circuit and standard resistance values ranging from 1 to 5000 ohms.

Maker—Electrad, Inc., 175 Varick Street, New York City.

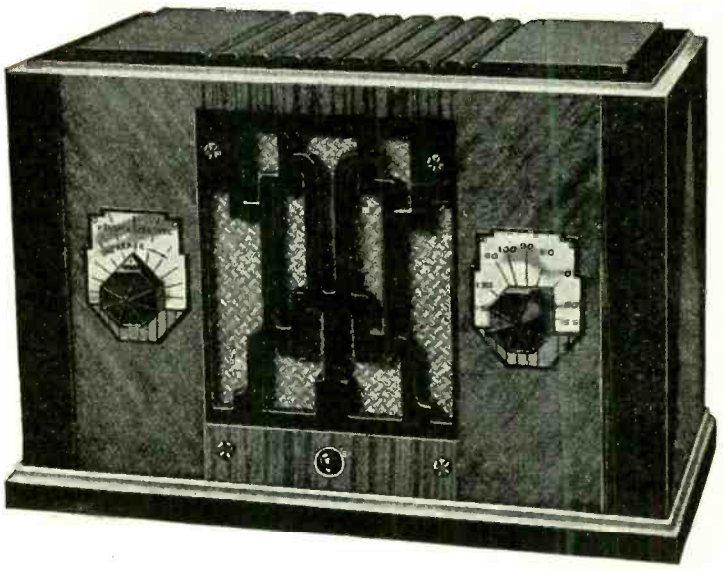
BEAUTY with a SALES PUNCH

these ULTRA-MODERNE CROSLEY Radio Receivers

EYE-COMPELLING beauty . . . irresistible design . . . amazing values, these Crosley sets lend a sophisticated note that is showing itself in every contemporary walk of life . . . architecture, dress, art, for instance. These models have been designed with a beauty that meets this growing demand.

Now . . . every taste can be satisfied—the Crosley standard line for those who lean toward the conventional . . . the Crosley Ultra-Moderne for the more daring. All Crosley models are exceptional values and incorporate latest radio developments.

The Crosley Ultra-Moderne models have exceptional news value. They're new, different . . . they attract customers into your store . . . give you an unusual opportunity to sell Crosley Radio receivers. Your Crosley distributor will gladly give you details.

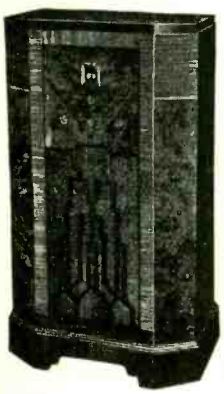


The Crosley TRAVO De Luxe

This 4-tube Superheterodyne operates on 110-volts D. C. or any cycle A. C. Has satinwood overlay front, with zebra wood overlays above and below the grille. The base is black and silver. Has pilot light, attached antenna, full floating moving coil electro-dynamic speaker. Requires no ground. The tubes are: one type 78, one type 6F7, one type 38, and one type 12Z3. Dimensions: 8" high, 10⅝" wide, 5" deep.

$19.95
COMPLETE WITH TUBES

The Crosley Dual Seventy
Lowboy



A 7-tube Superheterodyne with dual range (police, amateur, aviation and standard broadcasts) and automatic volume control. Equipped with a tone control and full floating moving coil electro-dynamic speaker. Tubes: 3 type 58, 2 type 56, 1 type 2A5, 1 type 80. Dimensions: 38" high, 22½" wide, 11" deep. This chassis is also available in a table type cabinet for $45.00.

$59.50
Complete with Tubes

The Crosley Dual Twelve
Moderne

A 12-tube Superheterodyne employing dual range, static control, automatic volume control, continuous (stepless) tone control, full floating moving coil electro-dynamic speaker. Tubes: 3 type 58, 1 type 2B7, 5 type 56, 2 type 2A5, 1 type 80. Dimensions: 38¼" high, 23" wide, 11¾" deep.

$85.00
Complete with Tubes

The Crosley Dual Fiver

The front of this cabinet is of V-matched Prima Vera, having decorative pilasters, zebra wood overlay above the grille and base of modernistic fluting. A 5-tube Superheterodyne with dual range—completely stabilized. Has illuminated dial and full floating moving coil electro-dynamic speaker. The tubes are: Two type 58, one type 57, one type 2A5, and one type 80. Dimensions: 13⅝" high, 11¼" wide, 7¾" deep. This chassis is also available in an attractive Lowboy console cabinet for $39.50.

$26.00
Complete with Tubes

Montana, Wyoming, Colorado, New Mexico and west, prices slightly higher.

THE CROSLEY RADIO CORPORATION

POWEL CROSLEY, Jr., *President*

CINCINNATI

Home of "*the Nation's Station*"—WLW

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

CROSLEY RADIO

UTC

UTC Linear Standard Audio Components Meet the Most Rigorous Requirements for Maximum Tonal Fidelity

ACOUSTICAL ENGINEERS agree that an audio system should be capable of amplifying the audio spectrum from 30 to 15,000 cycles to obtain utmost faithfulness and realism in reproduction.

To insure such a wide frequency range in completed amplifiers, LS audio transformers are linear from 20 to 20,000 cycles.

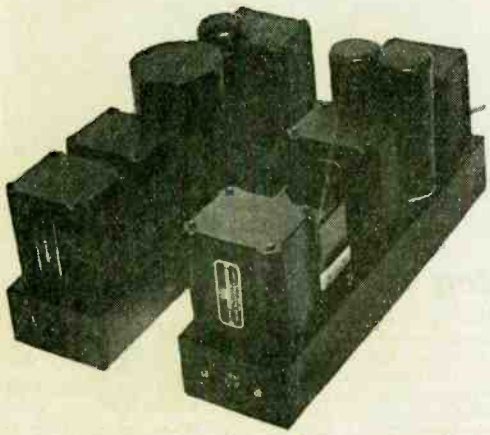
Because of the vastly increased tonal range available with such transformers, the possibility of noise or hum pickup must positively be eliminated.

To make possible a noise-free, hum-free high fidelity amplifier, UTC LS audio units are housed in balanced high permeability cast alloy shields having five times the shielding effect of normal cast iron. As a further precaution against stray electrostatic pickup effects, each low level audio transformer has its own inner metallic shield separated distinctly from its enclosed case.

UTC engineers have not spared any expense to make the Linear Standard series the finest quality line available. That is why Transmission and recording engineers are reaching new professional heights in wide range fidelity reproduction.

Do you intend building amplifying equipment for use with the new velocity, voice coil, or crystal type microphones? Do you wish to use the new crystal and dynamic tweeter reproducers with your power amplifier?

Here is a five stage A.C. operated audio system just designed for the purpose.



PRE-AMPLIFIER SPECIFICATIONS

- AC or DC operation.
- Two stages of transformer coupling, parallel fed.
- Uses two type 77 tubes triode connected.
- Frequency response linear from 30 to 15,000 cycles.
- Input and output terminations 50, 125, 200, 250, 333 and 500 ohms.
- Overall gain 53 D.B.
- Power output + 7 D.B.
- Power supply uses 84 indirect heater rectifier.
- Voltage output 200 Volts D.C., 6.3 volts A.C.
- Filter: Two stage, 400 Henrys, 54 mfds.
- Filter safety factor 100%.
- Audio and power sections on individual metal decks for rack or portable case mounting.

UTC Linear Standard Units Used Are:

1 LS-10 multiple input lines to single grid.
1 LS-20 single plate to single grid.
1 LS-50 single plate to multiple lines.
List price $40.00. Dealers net price $24.00.

Linear Standard Power Supply Units for Above

2 LS-94 High inductance filter chokes.
1 LS-180 Power and filament supply transformer.
List price $30.00. Dealers net price $18.00.
Pre-Amplifier and Power Supply metal decks completely drilled.
List price, each $5.50.
Dealers net price $3.30.

SPECIFICATIONS—MAIN POWER AMPLIFIER

- Input will match 50, 125, 200, 250, 333 and 500 ohm lines.
- Output will match 500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5 and 1.2 ohms.
- Three balanced push pull stages. Tubes used: 4 56, 2 2A3, 1 5Z3, 1 82.
- Stable fixed C bias for output stage.
- Undistorted class A output 15 watts.
- Gain: plus 80 D.B.
- Flat frequency response from 30 to 15,000 cycles.
- Trap resonant filter rectifier circuit increases filtering efficiency 400%.
- Audio and power sections on separate drilled, heavy gauge metal decks.
- Completed sections may be used either for vertical rack mounting or installed in portable oak cases.
- All LS audio filter and power components fully shielded and doubly sealed against adverse tropical climatic conditions.

UTC Linear Standard Components Used Are:

1 LS-12 Multiple input lines to push pull grids.
2 LS-22 Push pull 56 plates to push pull grids.
1 LS-55 Fixed bias 2A3 plates to broadcast and voice coil lines.
1 LS-90 Trap resonant smoothing choke.
1 LS-91 Trap resonant input choke.
1 LS-94 High inductance C bias choke.
1 LS-70 Heavy duty plate, filament and C bias supply transformer.
List price $136.00. Net to dealer $81.60.
Complete set drilled metal decks for audio and power sections, engraved terminal bakelite connectors.
List price $16.50. Net to dealers $9.90

UTC transformer kits, drilled decks and associated components now available through your local distributor.

Full constructional wiring layout prints furnished with each set of parts.

Write for the new U-1000B bulletin—full of carefully designed and tested amplifier circuits for Class A and Class B amplifiers from 1 watt to 1000 watts power output. Free for the asking.

UNITED TRANSFORMER CORPORATION

266 CANAL STREET — NEW YORK, N. Y.

Exclusive Pacific Coast Distributors Carrying a Complete Stock of UTC Products.

UPPER CALIFORNIA

Offenbach Eelctric Co. — 1452 Market St., San Francisco
E. C. Wenger Company — 1020 Oak St., Oakland
Coast Radio Co. — 1106 Market St., San Francisco
SEATTLE, WASH.—Seattle Radio Supply Inc. — 2319 Second Ave.

LOWER CALIFORNIA

Pacific Radio Exchange Inc. — 729 S. Main St., Los Angeles
Radio Supply Co. — 912-14 S. Broadway, Los Angeles
Coast Electric Co. — 744 G St., San Diego
Prest & Dean Radio Co. — 400 American Avenue., Long Beach