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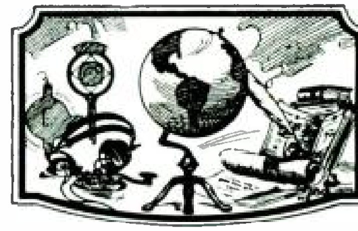
RADIO with the EDITORS



Diathermy Furor

Not at all unexpected was the storm of protest received from several manufacturers of radio-therapy equipment as a result of the diathermy article in April RADIO. The objections were many and varied, but it was obviously a plain case of "pain in the pocketbook".

Two manufacturers objected that the tubes specified would not give sufficient power for the needs of the physician. One of these manufacturers until recently was foisting off on the unsuspecting medical profession a machine utilizing a pair of carbon plate 210's! A third manufacturer claimed that the machine described was dangerous, inasmuch as 1400 volts gave much more power than needed, and intimated that if we knew the first thing about diathermy machines we would have designed it to work at 1000 volts instead of 1400 volts.

All of the objectors were unanimous in the opinion that we do not know the first thing about construction of diathermy machines and should "stick to our knitting". But their assumption falls down from two standpoints: First, a diathermy machine is simply a short wave transmitter and who should be better qualified on their design than the engineers of a technical radio magazine? Second, of all the commercially-built machines we have had the opportunity to examine, every one had more or less of a tendency to go out of oscillation under certain conditions of loading; nearly half of them used raw a.c. on the plates; and only two were capable of more power output than the machine described in RADIO. To get this greater power, equipment of a size all out of proportion to the additional output was resorted to. Certainly the greater power is no engineering achievement under those circumstances, and more than 200 watts output is very seldom required anyhow except for special applications.

Our stand on the lack of justification for more than one meter was attacked bitterly, excepting by those manufacturers using but one meter. We simply point out that conversation with two different doctors well-versed in the use of diathermy revealed that the proper way to gauge treatment is by the reaction of the patient and the temperature of the part of his body under treatment, *not* by noting the value of r.f. circulating current flowing through the

[*Continued on Page 86*]

On the Road to Cairo

In 1938 the Cairo Conference will be faced with a problem such as has not been presented at any previous gathering of the International Frequency Grabbers. Heretofore a Conference has consisted of a series of meetings to determine how much territory can be allocated to commercial interests; the Cairo Conference will be the first to face a new bulwark . . . not the feeble "requests" of feeble amateurs for a wee slice of ether pie, but a formidable *demand* that the privileges of the amateur be given wider recognition. At no previous time in amateur radio history has such a determined effort been made to prepare for what is to come . . . an International Conference. Thus competition in the radio amateur publishing field has brought about a condition from which great benefits will be derived. It has been said that competition is the life of trade; likewise, in this instance competition among amateur publishers will be the direct means of bringing about one of the greatest and most effective weapons for the protection of amateur radio, *aggressiveness*!

No longer will it be possible for an amateur delegate to self-appoint his way to a conference. The next time, a man will be sent who has first been approved by the king-pins of amateur radio. No man would risk his reputation by asking to be sent to a conference without adequate qualification. Thus, when a new light in amateur radio shines at the Cairo Conference, a feeling of uneasiness will undoubtedly prevail among those who have long dreaded the "requests" which the amateur has made. Fortunately for amateur radio, the drive on Cairo which was instituted by RADIO and *R/9* two years ago, and which has continued with unabated fury ever since, has made itself felt in the far corners of the world.

RADIO has merely taken the stand of the informer and the reformer. In so doing, it has aroused the amateur to action. Obviously such a prolonged, consistent campaign would soon have a telling effect on those who formerly assumed self-styled leadership of the amateur ranks. It is safe to predict that these men will not "be among those present" at Cairo. Because their past record was so openly exposed to the entire world, there are few who would choose to see these self-same men again among

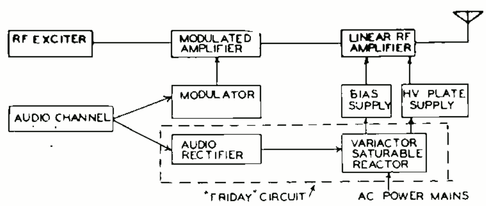
[*Continued on Page 87*]

A New, High-Efficiency Linear Amplifier

By J. N. A. Hawkins, W6AAR

A new wrinkle applied to linear amplifiers which greatly increases the output from a given tube, effects a saving in power, and results in 60 percent unmodulated plate efficiency. All the advantages of a controlled carrier linear amplifier from a power standpoint, and yet the carrier remains constant. The system is based on what the author tentatively terms "dynamic shift".

The first step toward the principle of dynamic shift in a vacuum tube amplifier occurred with the invention of the class B audio amplifier by Gordon and Barton working independently. The idea behind class B audio amplification was to find a way to cut down the input and plate loss to a power amplifier when no signal is present on the grid. The plate efficiency of a class A amplifier is zero when no signal is present on the grid. Thus *all* the plate input must be dissipated from the plate as heat when the amplifier is resting, and low overall output efficiency results. The class B audio amplifier makes the signal on the grid release the flow of plate current from the plate power supply so that the plate input and plate loss is low when the amplifier is resting. Strictly speaking, the class B audio amplifier is not a dynamic shift amplifier, as the bias axis is fixed. However, the objective behind the dynamic shift class BC linear amplifier is exactly the same as that which mothered the invention of the class B audio amplifier. The idea is to reduce the unmodulated plate loss by increasing the unmodulated plate efficiency and by reducing the plate power input. In the class B audio amplifier the input is reduced in the resting condition by reducing the d.c. plate current, keeping the plate voltage constant. In the dynamic shift linear amplifier the plate current is kept constant while the d.c. plate voltage is reduced when unmodulated.



Block Diagram of Expanding Linear Amplifier System

The first real use of dynamic shift amplification came when the Bell Laboratories developed the "ground noise reduction amplifier" for use in sound-on-film recording in the motion picture studios. Normally, a film sound track is recorded by modulating a fixed light source both up and around a mean value of light. In other words, the unmodulated sound track receives one half the maximum peak value of light available. Then sounds alternately increase and decrease this average light value. It was found that the background noise could be greatly reduced by reducing the unmodulated light on the track; so a resting bias was placed on the light gate to shut it nearly to zero. When an audio signal comes along through the recording amplifier, part of the signal is rectified and applied to the light gate so as to oppose the resting bias and open it up to its normal operating point of one half the peak value. Thus there is a dynamic shift in the axis about which the light values vary. This axis shift occurs in accordance with the syllabic modulation (0 to 20 cycles per second) in the signal to be recorded, whether voice or music. R.C.A. developed a similar dynamic shift device for their

SCOOP

The new Hawkins expanding class BC linear amplifier effectively doubles the output obtainable from a conventional class B amplifier, and probably will result in a radical change in the design of phone transmitters. 200 watts of carrier may be obtained from a pair of 211's without the necessity for well-regulated power supplies or more than 15 watts of audio power. In this new system the average carrier amplitude is constant and is entirely independent of the modulation. We believe broadcast stations will look with interest on this new development which will cut tube costs 50% in the final linear amplifier.

The figures given in the tables are quite conservative, and for amateur use may be exceeded considerably with certain types of tubes, much as is being done with controlled carrier linear amplifiers. When resting, a controlled carrier linear amplifier operates at reduced input, but at *reduced efficiency*. The expanding linear amplifier works at reduced input when resting, but at *increased* efficiency, and the average carrier does not vary as it does in the controlled carrier system.—Editor.

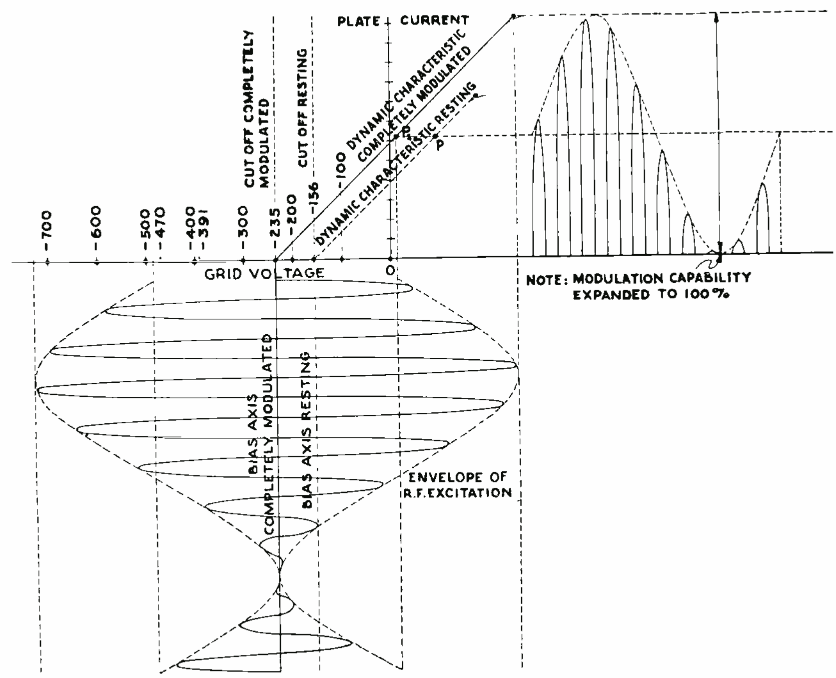
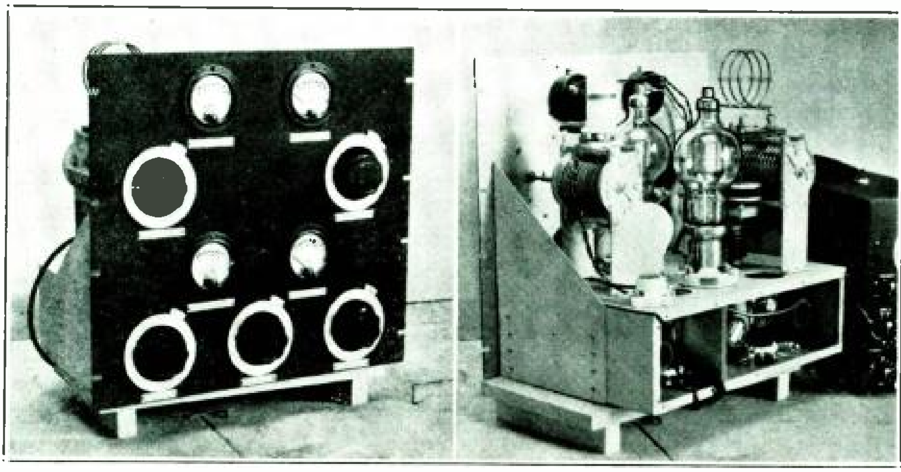


Figure 1
The Class B Expanding Linear Amplifier, 100% Modulated

type of film recording which "blacked out" the unused portion of the sound track.

The next application of the dynamic shift amplifier was the compandor developed by the Bell Laboratories for use on their transatlantic telephone circuits. Volume range of a communications channel describes the range in sound amplitude that the system can handle. The minimum value is set by circuit noise, and the maximum value is set by the overload, or distortion point. The volume range of the human voice is somewhat greater than the volume range of the transatlantic telephone circuits; so the compandor is used to compress the volume range at the transmitter and to re-expand it again at the receiver so that the distant listener hears approximately the same volume range as the sender puts into his telephone. Volume range compression and expansion both utilize dynamic shift amplification, although the two work in opposite directions. In the range expander (which also is used in the new R.C.A. electric phonograph) the gain of the audio channel is controlled by the incoming signal. When no signal is present the gain is low, due to high resting bias. When a signal is applied to the input of the expanding channel, part of it is bypassed to a rectifier which applies the syllabic components to buck the bias voltage which controls the amplifier gain. The larger the signal the *higher* the gain. Thus a loud sound is amplified more than a weak sound and if two sounds applied to the amplifier input had a loudness ratio of five, they might come out of the channed with a loudness ratio of twenty or more. Thus note that volume range expansion works exactly opposite to the automatic gain control system used in most modern receivers. The autogain circuit in a receiver is really a special form of volume range *compressor*. It tries to bring all signals to the same level. Therefore, to a certain extent, autogain utilizes the principle of reverse dynamic shift.

Controlled carrier modulation utilizes dynamic shift amplification in exactly the same manner as the various systems used by the motion picture industry to reduce ground noise on sound tracks. However, the object is to reduce QRM and resting plate loss and not to reduce ground or background noise; but the dynamic shift process takes place in the same way. Some of the audio signal is rectified and used to control the average carrier output of the modulated amplifier. This syllabic variation in average carrier output, in turn controls the input and output from a linear class B amplifier which



Experimental Linear Amplifier Being Tested in the "Radio" Laboratory

follows the modulated stage. Controlled carrier modulation has one disadvantage in that variation in average carrier output usually distorts the received signal in a receiver using conventional automatic gain control. The dynamic shift linear amplifier is simply a controlled carrier system without any syllabic variation of the carrier.

The bias shift class A audio amplifier (see RADIO for June, 1935, page 21) utilizes a rectifier circuit to increase the bias at low signal levels and thus cut down the resting plate loss. This amplifier is strictly class A as plate current flows throughout the cycle and the use of the push-pull circuit is unnecessary to reduce even-harmonic distortion, as the distortion is approximately the same as in any class A amplifier. This is one of the simplest applications of the dynamic shift principle.

The class BC linear or bias modulated amplifier, developed by the writer in 1933, also is a form of dynamic shift amplifier although it is not analyzed in the same manner. The shift in bias axis does not occur at a syllabic frequency rate but at an audio frequency rate, which greatly simplifies mathematical analysis.

The analysis of dynamic shift is still rather complex although it looks as if the conception and its analysis may become greatly simplified by a method which we hope to be able to present in the near future.

In any case the operation of the expanding class B linear amplifier may be visualized by imagining the presence of a good man "Friday", who stands watching the volume level indicator on a phone transmitter and who "cranks up" the bias and plate voltage on the linear r.f. amplifier as the volume level indicator swings up. Thus the linear amplifier is allowed to put out undistorted peaks of 100% modulation when required, but the input is way down when resting so that the tubes actually can dissipate less heat resting than they do when running wide open. The man "Friday" has to keep his wits about him because he has to increase the plate efficiency of the linear amplifier when unmodulated by reducing its modulation capability in order to keep the average carrier amplitude constant. However, this is not difficult to do if the "Friday" circuit is properly adjusted.

A block layout of a typical transmitter using an expanding linear amplifier is shown in diagram A. Note that the rectified audio signal is used to control the plate and bias voltage to the linear amplifier. The voltage outputs of the plate and bias supplies must vary together in order to maintain the fixed bias at the cut-off value.

The plate and bias voltages are varied together by means of a saturable reactor (Variactor) whose a.c. winding is in series with the 110 volt a.c. line which supplies power to the plate and bias transformers for the linear amplifier. See figure 4. When direct current flows through the saturating winding on the primary reactor it reduces the a.c. voltage drop across the reactor. The more d.c. the lower the voltage drop. Thus the saturable reactor affords a convenient means of dropping the line voltage to the primaries of the plate and bias transformers. The d.c. controlling current is obtained by rectifying some of the audio output of the mod-

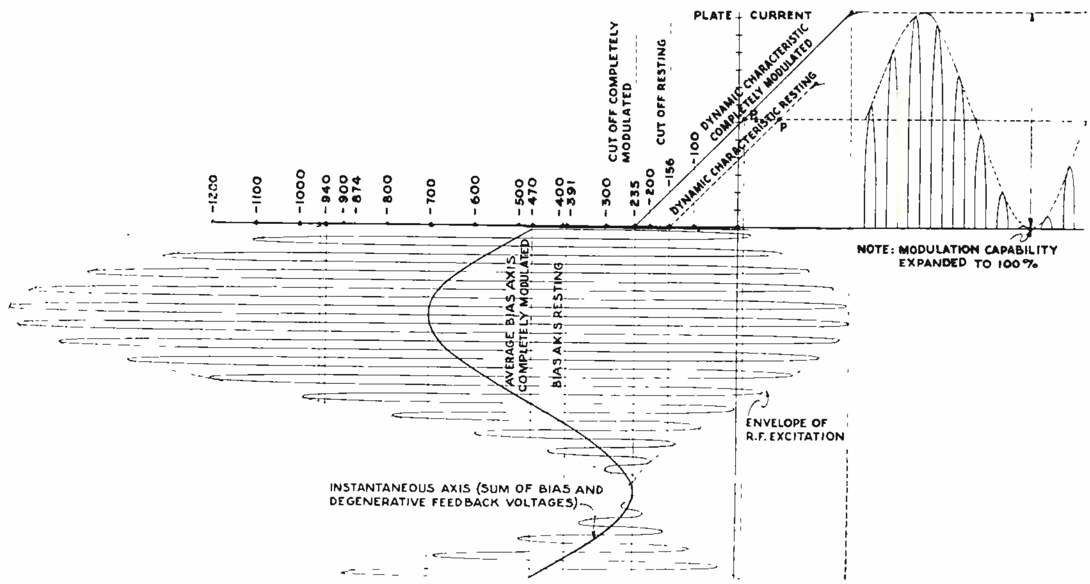


Figure 2
The Class BC Expanding Linear Amplifier, 100% Modulated

ulator and applying it to the saturating winding. This is quite similar to the Variactor system of effecting carrier control. For more data on the theory and construction of these saturable control reactors see RADIO for March, 1935.

The Expanding Linear Amplifier

Figure 1 shows a graph of a conventional class B linear amplifier, completely modulated. The operating point on the dynamic characteristic (solid line) is P_1, and as it is just halfway up the characteristic, the amplifier has 100% modulation capability and the *average* plate efficiency is three quarters of the maximum *instantaneous peak* plate efficiency. As the maximum *instantaneous peak* plate efficiency of a class B amplifier has a theoretical limit at 79.17% and a practical limit at about 66%, the maximum attainable *average* plate efficiency under complete sine wave modulation is about three quarters of 66%, or 50%.

Ordinarily, when a conventional class B linear amplifier is unmodulated the *average* plate efficiency drops to one half of the *instantaneous peak* value. Thus few class B linear amplifiers with 100% modulation capability have an average unmodulated plate efficiency above 33%. However, if the modulation capability is purposely limited to some value below 100% modulation the unmodulated plate efficiency can be materially increased.

The unmodulated average plate efficiency is related to the modulation capability by the following formula (applicable only to class B operation):

$$\mathrm{Eff}_R = \frac{6600}{100 + M_c}$$

Where Eff_R is resting, or unmodulated plate efficiency and M_c equals percentage modulation capability.

Thus if the modulation capability of a linear amplifier be purposely limited to 66%, the *average unmodulated* plate efficiency becomes 40% instead of the 33% unmodulated efficiency which was obtained with 100% modulation capability. The expanding class B linear operates with 66% modulation capability (16.6% axis shift) unmodulated, but *the modulation capability is expanded up to 100% when the amplifier is modulated.* Thus the use of dynamic axis shift allows the class B expanding linear amplifier to utilize the advantages of low modulation capability when resting, yet allows full sideband output when completely modulated. This feature means a net increase of about 33% in the class B linear r.f. carrier output that can be obtained from any given tube. This limitation of modulation capability to 66% in the resting condition is effected by reducing the d.c. plate and bias voltages 16.6% under the maximum values used when the amplifier is operating completely modulated.

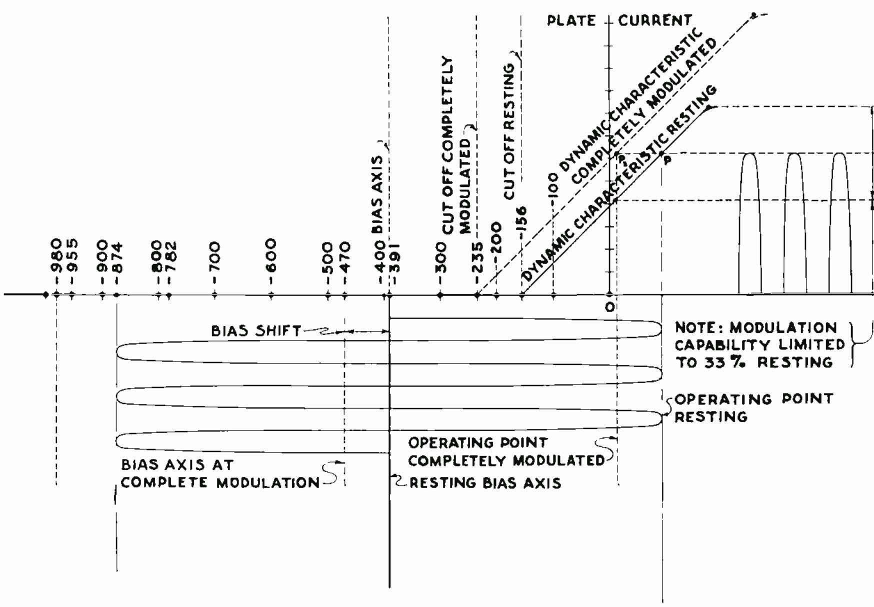


Figure 3
The Class BC Expanding Linear Amplifier, Resting Condition (Axis Shift 33%)

This represents an axis shift of 16.6% and is the optimum value for *class B* operation. This amount of axis shift was determined by formulae to be given later. The point is that the d.c. plate power input to the final stage should usually decrease from the completely modulated condition to the resting condition by an amount of power equal to the maximum sideband power output when completely modulated. If this is done the plate loss resting will be the same as the plate loss completely modulated. If *less* than 16.6% axis shift is used the plate loss resting will be greater than the plate loss when completely modulated and the power output will be limited by the unmodulated loss. There is no point in using more than 16.6% axis shift and reducing the resting plate loss below the loss completely modulated, as no increase in power output would result.

The following table shows typical maximum operating conditions for a single 211 used as a class B expanding linear amplifier, observing the maximum plate loss limitation of 100 watts dissipation.

Note that by using the expanding class B linear amplifier the maximum unmodulated carrier output which can be obtained equals about two thirds of the rated plate dissipation of the tube used. As this output can be obtained now from the conventional class BC amplifier (non-expanding), there is little advantage in the use of the class B expanding amplifier. It was considered necessary to discuss it, however, to show the tremendous advantage in the use of the expanding class BC amplifier.

EXPANDING CLASS B OPERATION
(TYPE 211)

	Completely modulated	*Resting 16.6% shift*
Modulation capability	100%	66%
Plate efficiency (average)	50%	40%
Carrier output	66 Watts	66 W.
Sideband output	33 W.	0 W.
Plate loss	100 W.	100 W.
D.c. plate input power	200 W.	166 W.
D.c. plate current	150 Ma.	150 Ma.
D.c. plate voltage	1333 V.	1111 V.
D.c. bias voltage	—110 V.	—90 V.

The Expanding Class BC Amplifier

A class BC amplifier differs from a class B amplifier only in the use of an unbypassed cathode bias resistor across which a degenerative *audio* feedback voltage is developed which improves the linearity and plate efficiency of the class BC amplifier over the class B amplifier. (EDITOR'S NOTE: See a complete discussion of class BC operation on page 68 of this issue.)

The great advantage of expanding class BC operation and normal class B can best be seen by the following examples. Using a 211 type of tube it is found that about 50 watts of carrier output is all that can be obtained operating as a normal class B linear amplifier. The use of expanding class B amplification allows about 66 watts of unmodulated carrier, while the use of expanding class BC amplification allows 100 watts of unmodulated carrier to be obtained from the 211 type of tube. The gains in output possible through the use of expanding class BC operation are even more marked with the 150T-354 type of tube, where the *momentary* plate loss can be 150% of the normal tube loss rating without any damage.

The operation of the expanding class BC linear amplifier can best be seen by the two curves of operation, figures 2 and 3. In figure 2 the amplifier is shown operating fully modulated. This curve is exactly the same as that for any conventional class BC linear amplier. The amplifier uses the dynamic grid voltage, plate current characteristic indicated by the solid line. The operating point is P_1 and the average bias, when completely modulated, is 470 volts. (The d.c. plate voltage at this point was slightly over 2800 volts for this particular set-up.)

Note the point P on the characteristic indicated by the dashed line parallel to the solid line characteristic (figure 2). This is the op-

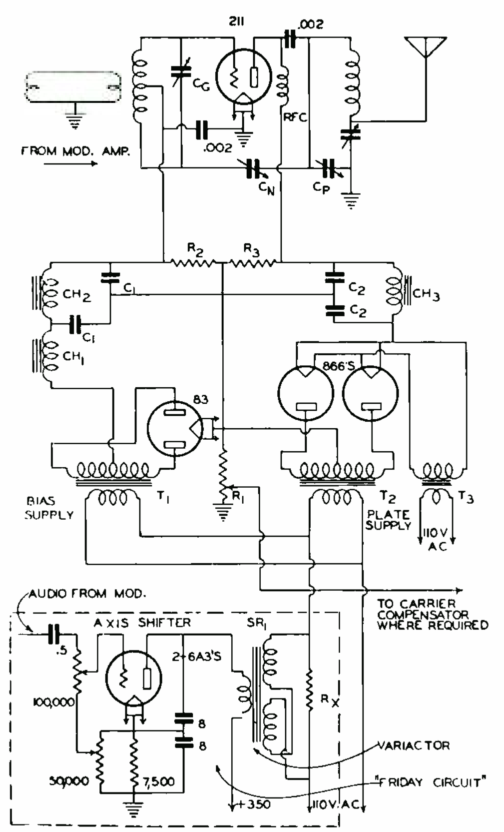


Figure 4

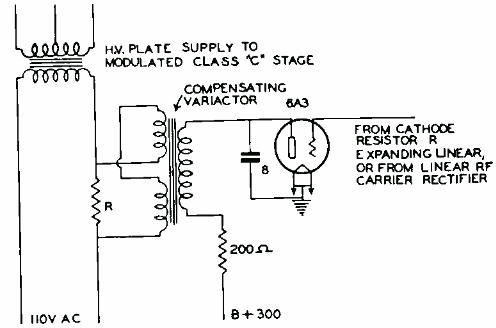


Figure 5
Carrier Compensator (Required Only Under Certain Conditions).

erating point when the transmitter is unmodulated. The dashed characteristic is that of the resting or unmodulated condition, thus indicating the dynamic characteristic shift between the resting and fully-modulated conditions.

Figure 3 shows a curve similar to that of figure 2 except that the transmitter is resting, or unmodulated (33% axis shift), while figure 2 shows the 100% modulated condition. Note that the total bias is now only 391 volts, (plate voltage about 1900 volts, resting). The operating point on the resting dynamic characteristic is the point P. Note that the points P and P_1 represent the same average value of plate current. Thus the *average* d.c. plate current (as measured on a meter) is the same resting or 100% modulated. As the plate load impedance (antenna coupling) is the same resting or completely modulated, constant plate current means that the average carrier amplitude remains constant and independent of axis shift.

Note that the average r.f. excitation voltage is the same in the resting and the completely modulated conditions, but that the average d.c. grid current is *greater in the resting condition.* Thus the average load on the driver stage is greatest when unmodulated, which is just the opposite of the conventional linear amplifier. It follows that less artificial stabilization of the driver load is necessary with the expanding linear amplifier than with conventional linear amplifiers.

The operating point P on figure 3 represents point of 60% average plate efficiency when unmodulated (assuming 80% as maximum class BC positive peak efficiency). If the point P were just halfway up the dynamic characteristic (halfway between plate current cut-off and the diode bend, or quasi-saturation points), the modulation capability would be 100%. However as the point P is three quarters of the way up the characteristic the maximum modulation capability in this resting condition is only 33%. The modulation capability could have been maintained at 100% for the resting condition but then the average d.c. plate current would have dropped to two thirds its completely modulated value and the same drop would occur in carrier amplitude. Thus the result would be simply controlled carrier. 33% modulation capability in the resting condition ensures that a steep-front audio signal will not catch the modulation capability napping and cause over-modulation (flattening of the positive audio peaks).

The resting plate voltage in the set-up described above is 33% under the maximum plate voltage applied during periods of 100% modulation. In other words, the plate voltage increases 50% above the resting voltage when completely modulated. This represents an axis shift of 33%.

As the maximum output from the expanding linear amplifier is usually limited by plate loss in the completely modulated condition, it is always necessary, when designing such an amplifier, to start with the 100% modulated condition and then work backwards to determine the resting conditions. Thus we will define dynamic axis shift as a percentage *drop* in plate voltage and bias from the completely modulated condition, rather than a percentage rise above the resting condition.

It should be noted that the 33% dynamic axis shift discussed above is an arbitrary choice. The shift can be anything between zero shift and 50% shift. The shift can not exceed 50% and still keep the carrier constant. The following table (applicable only to class BC operation) shows the effect of various percentages of axis shift downward from 100% modulation on the plate efficiency and modulation capability in the resting condition.

CLASS BC OPERATION

Percentage drop in plate and pack bias voltage (axis shift)	*Resting plate efficiency (taking 80% as peak)*	*Resting modulation capability*
0 %	40 %	100%
20.83% *	50 %	60%
25 %	53.3%	50%
33 % **	60 %	33%
50 %	80 %	0%

* The 20.83% axis shift is recommended for those tubes whose plate loss limit may not be exceeded even momentarily.

** The 33% axis shift is recommended for those tubes whose plate loss limit may be exceeded momentarily under voice modulation by 50%.

The relationships shown in the preceding table were obtained from the use of the following formulae from which the resting plate efficiency and resting modulation capability can be obtained for any degree of dynamic axis shift.

$$\mathrm{Eff_R} = \frac{100\ \mathrm{Eff_p}}{100 + \mathrm{M_c}}$$

$$\mathrm{M_c} = 100 - 2\mathrm{S}$$

$$\mathrm{Eff_R} = \frac{50\ \mathrm{Eff_p}}{(100 - \mathrm{S})}$$

Where $\mathrm{Eff_R}$ equals resting, or unmodulated plate efficiency.

$\mathrm{Eff_p}$ equals maximum attainable instantaneous peak plate efficiency.

$\mathrm{M_c}$ equals percentage modulation capability.

S equals percentage dynamic axis shift downward from 100% modulated to resting condition.

Note that these formulae can be applied to either expanding class B or expanding class BC operation by inserting a suitable value of $\mathrm{Eff_p}$, which is taken as 80% for class BC operation and as 66% for class B operation. These values will be about right for operation of most tubes at or slightly above normal rated plate voltage. This means about 750 volts for a 210 or 801: about 1250 to 1500 volts for tubes of the 800 and 211 general types, and at least 1750 to 2000 volts on the higher-voltage low C tubes such as 150T, 354, HF300, etc. 852's will require at least 2500 to 3500 volts to make them get up and really go due to their rather high average plate resistance at lower plate voltages.

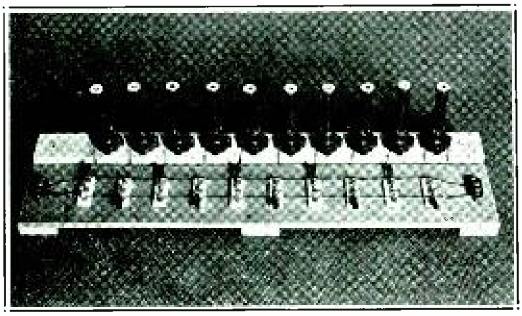
With an axis shift of 33% downwards the plate loss is least in the resting condition and rises 50% under complete sine wave modulation. As the unmodulated plate efficiency is 60% with this much axis shift the maximum carrier power output will be one and a half times the resting plate loss on the tube used in the expanding linear amplifier. The tube has to be able to stand the additional plate loss which occurs during modulation without damage. All the tantalum plate tubes and some of the moly and carbon plate tubes will stand a momentary overload of 50% above rated plate loss.

[*Continued on Page 74*]

Building the Big Rheostats

By Robert S. Kruse

It was certainly a mistake to show the big rheostats or "load racks" to over two thousand amateurs at a recent radio meeting. Altogether too many have written for further details, and for photographs! The photographs should of course have been in the January RADIO article, but unfortunately were damaged in transit.



The 1 kilowatt "number one" rheostat. 55 steps from 10 to 1000 ohms.

Bill of Materials for the "Number One" Rheostat

Baseboard 34" x 6" x 1/2" (soft wood).
Socket strip 34" x 2 3/4" x 7/8" (dressed) soft wood.
- 2 cleats (better 3) 9" x 2 3/4" x 7/8" (dressed) soft wood.
- 12 woodscrews 1" no. 7 flathead for assembling wooden frame.
- 15 feet of no. 16 bare wire.
- 20 woodscrews, 1/2" no. 6 nickled roundhead for switches.
- 20 woodscrews 1" no. 8 flathead steel or brass for sockets.
- 10 porcelain base s.p.d.t. midget switches.
- 1 or 2 terminal strips with standoff spacers and screws to match.
- 10 resistance units with Edison screw base.
- 10 lamp receptacles. Porcelain base not recommended. If possible use the new bakelite type with bakelite terminal cover retained by spring snap-ring (commonly available).

Bill of Materials for the "Number Two" Rheostat

- 1 baseboard 28" x 6" x 1/2" soft wood.
- 3 cleats 2 3/4" x 7/8" x 6" soft wood.
- 10 lamp receptacles as for number one.
- 10 feet of no. 16 bare copper wire.
- 2 lengths of "spaghetti".
- 2 binding posts or one-terminal strips.
- 5 porcelain base s.p.s.t. midget switches.
- 10 woodscrews, 1/2" no. 6 roundhead nickled for switches.
- 20 woodscrews, 1" no. 8 flathead for sockets.
- 9 woodscrews, 1" no. 8 flathead for assembling wood frame.

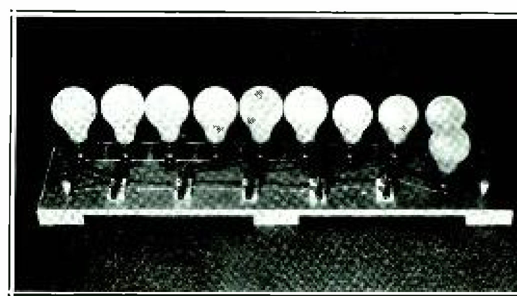
Therefore to escape writer's cramp and to keep down the bill for photos, we'll go over the story again briefly, with pictures.

The "Number 1" Rheostat

The affair that looks a little like a row of factory chimneys is actually an easily-made rheostat with 55 steps and large wattage-dissipation ability. The chimneys are Ward-Leonard Edison-base resistors, available in a number of resistances and wattage ratings, and easily exchanged in the bakelite receptacles which hold them, though intended for ordinary lamps. The particular type of receptacle used is especially convenient. Using 100 ohm units the rheostat ranges from 10 ohms to 1000 ohms in 55 steps, while the safe wattage dissipation slides down and up again as shown by figure 1, the variation being different from that of other sorts of rheostats, though they all vary in some manner. (Consider the way the ordinary rotary rheostat burns up at one end.) If the units are 100 watters the lowest dissipation is 100 watts and the highest is 1000 watts, 10 units being used.

Child's Play

As was said in the January article, the 55 switch positions can be learned in 5 minutes. Looking at the photo and at the diagrams ap-



The "number two" rheostat. About 390 watts, 20 steps.

pearing as figure 2 we see that there are 10 switches, each with a single blade, but double throw. The resistors are all connected between switches as shown at figure 2A.

Now we start to throw switches. In figure 2B we put switch No. 10 in the "up" closed position and have all 10 resistors in series. Now we run through an ordinary 10-point-rheostat range, by closing the switches "up" one after the other in the order 10, 9 (this is figure 2C), 8, 7, 6 . . . . . . 1, at the end of which we have one resistor across the line. We have come from 1000 ohms to 100 ohms.

At this point ordinary rheostats start to jump too fast, but this one has 45 more points left!

Leaving no. 1 closed "up" we pull all other switches and as in figure 2E close the no. 10 switch "down", then proceed switch-after-switch until we reach the arrangement of figure 2F, which is 50 ohms at the 19th rheostat step. Unlike the usual rheostats, the current-carrying ability is now on the way *up* (which is what we need as the current is getting bigger, of course).

Once more the switches are "pulled" except no. 1 and no. 2. Now no. 10 is closed "up" and we are off once more. Eventually we arrive at figure 2G, with 10 ohms, able to dissipate a kilowatt. This is the 55th and last step.

That is about all except the list of material, which is at the beginning of this paper.

The "Number 2" Rheostat

The other rheostat, with the lamps used as resistors, corresponds to the diagram appearing as figure 3. It is more limited in its uses as it has only a parallel range (20 steps instead of 55). For most amateur uses it is convenient to use cheap lamps having wattage ratings as marked in figure 3. The switching scheme is as follows:

Switches closed (see figure 3)	*Relative current (approximate only)*
A	1
B	2
A,B	3
B,C	4
A,B,C	5
A,D	6
B,D	7
A,B,D	8
B,C,D	9
E	10

Now keep E closed and re-run the first nine arrangements, ending up with:

A,B,C,D	20

The demerits of this rheostat are that the circuit is repeatedly "jumped" back and forth instead of proceeding steadily in one direction as does the number 1 rheostat. It is also much easier to get mixed up, as the sequence is not straightforward in this number two rheostat, even though 5 switches do seem to be simpler than 10.

There is nothing to keep one from using lamps in the number 1 rheostat, though one defect of lamps should be noticed: Their resist-

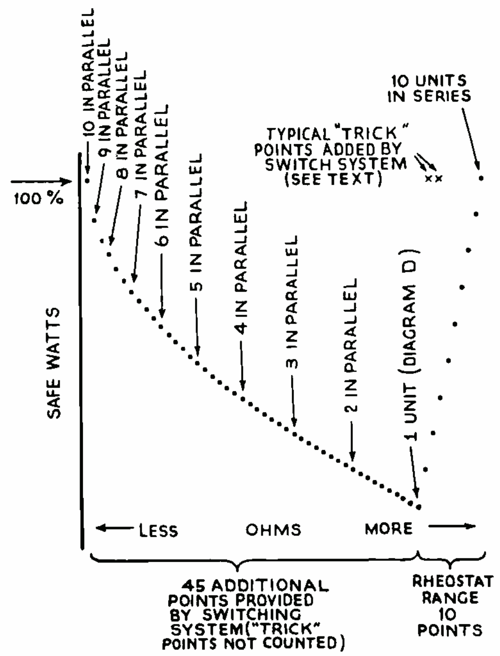


Figure 1
What can be done with 10 resistors in the circuit of figure 2.

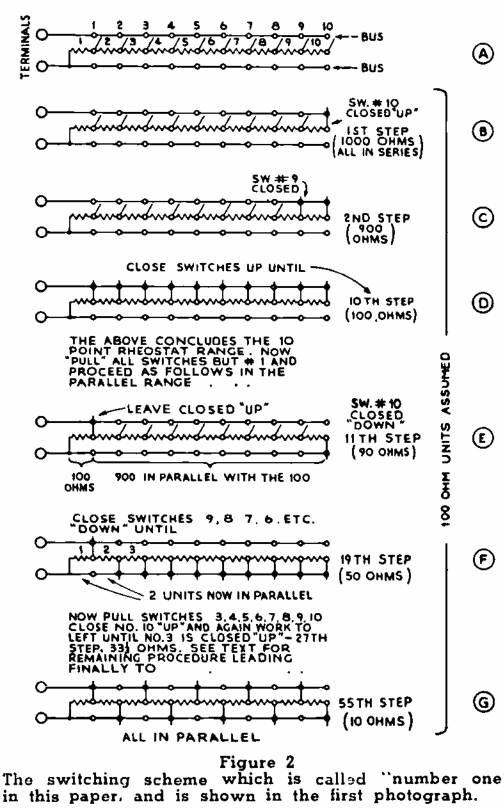


Figure 2
The switching scheme which is called "number one" in this paper, and is shown in the first photograph.

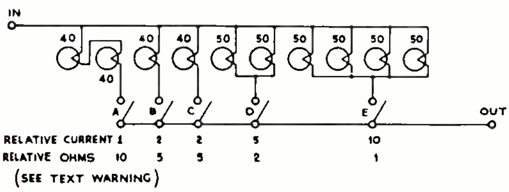


Figure 3
The more limited or "number two" switching scheme. This is shown in the second photograph.

ance changes widely with the current, which is to say that the actual resistance is never known. With the resistance units there is no such uncertainty.

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TO THE WIVES OF HAMS

By One of Them

I don't know you personally, Mrs. W7XYR or you, Mrs. VE5KZ, or you either, Mrs. W4JPQ, but we all know to an amazing degree of accuracy just what happens when our husband turns from a man into a ham; even as did Dr. Jeckell into Mr. Hyde. True, he does not sprout teeth and new hair after quaffing a vile potion, but he does grow glassy of eye and forgetful of time when he beholds a super-tube or a split stator condenser. Then, dear madam, you have a species apart from the rest of mankind—a ham.

This odd creature isolates himself in a corner of your home and calls it "the shack". He plasters the walls with innumerable gaudy cards from all corners of the globe (that is, if he's lucky). Around the "shack" run thousands of wires in mad profusion. Should you peer behind the cupboard, abundantly decorated with hundreds of little knobs (he affectionately dubs it a "transmitter") you would see a mass of light globes with wiry intestines; there would be sockets with green thread around their waists and lots of little "condensers" bearing a marked resemblance to a fish scale that swing back and forth like a cradle—also on the front of the cupboard are speedometers that seem to have the jitters, and so would I if forced to such permanent close proximity with the receiver. Of all the soul-tearing sobs of mankind, none can quite equal the receiver in the act of receiving. From its black body will suddenly rip a shrill piercing scream of pain (the neighbors accused him of beating me). It will sob in great gasping breaths as though a long, jagged wire had torn loose and was stabbing it through the heart. Panting hoarsely it will sink into a low rasping cough, then finally give up the spirit entirely, only to scream with anguish anew in a moment or two.

Your ham will then perhaps rub his hands in fiendish delight and proceed to babble in a strange vernacular, calling himself by a formula, comprised of letters and numbers, and *you* are labeled the x.y.l. Incidentally, "x.y.l." means x young lady. How I ground my teeth in helpless rage the first time I heard that. He then, with invariable regularity, calls his fellow ham "old man" (even if 14 years old) and drones for hours on the subject of CQ. He complains of "fading" and of some one on top of him, then offers a wild conglomeration of technical excuses for the elements.

But, my pretty, this is naught; a mere trifle. Have you ever been motoring of a Sunday afternoon and have him "succumb"? No? Then let me reveal all. He will be drawn, even as a moth to a flame, to a tall, thin pole, perched precariously on someone's roof; and then he'll start to produce symptoms. Before you know it, he slides from the car and barges to the front door (providing he has not spotted the "shack" elsewhere) and knocks. A stranger appears. They gaze intently into each other's eyes. Finally one will speak the magic sentence containing ham dialect. If the other returns in like argot, then you, my patient, are doomed. You watch the golden sun wallow in the west—you watch the playing children homing as eventide approaches—you feel the cool fingers of the night breeze creep around ankles and neck. You sit on your left leg; you sit on your right leg; you concentrate on the front door; you concentrate on your husband. The gnawing pain of hunger is heightened by the aromas of Sunday repasts floating through the atmosphere; you wish you'd stayed home; you wish you'd brought your knitting; *you wish he'd come*! Eventually he will—and the solo QSO that follows may be in any vocabulary you wish and with absolutely no more QRM from him than from a field mouse. But next Sunday you accompany him for a ride again (against your better judgment), and (repeat Scene II).

—*Mrs. W7APU.*

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W9SG has offered an 80 meter crystal to the amateur who sends in to the *Podunk News* (monthly bulletin of the Egyptian Radio Club, affiliated with the A.R.R.L.) the best solution towards curing the "ills" at Hartford. We understand the name of the winner will *not* be announced in *QST*.

The "333" Transmitter

By Frank C. Jones

For quick band change, this transmitter is about the simplest medium power rig you can build. Through the use of an 803, to cut down excitation requirements and dispense with the necessity for neutralization, a minimum of adjustments are necessary when changing bands. A novel exciter arrangement makes it unnecessary to change coils or do any switching in that unit when going to another band. Only the 803 stage requires retuning. It uses 3 type 53's into an 803, works on 3 bands; hence "333".

The large r.f. pentode tubes of the 803 or RK28 class are excellent for medium powered c.w. transmitters where quick band change is desired. The transmitter illustrated has several interesting features in the exciter unit which simplifies the problem of quick change over the three popular bands of 80, 40 and 20 meters.

The exciter has three 53 tubes with "unity" coupling between stages and series link coupling a la Lampkin style. This arrangement provides upwards of ten watts on 80, 40 or 20 meters depending upon the frequency selected by the tuned grid circuit of the final stage. A push-pull 53 crystal oscillator provides more output than the usual 53 oscillator-doubler circuit and also puts less strain on the crystal. Two push-push doublers follow the crystal oscillator. These stages have their grids in push-pull and plates in parallel, so that the plate tank circuit receives a kick of r.f. power each cycle instead of every other r.f. cycle as in most doubler circuits. The efficiency is higher, and more output can be obtained from a 53 or 6A6 in this connection than in any other doubler circuit using a 53, 46 or 59 tube.

The link circuit has approximately two turns around each exciter stage and terminates in two turns around the final stage grid coil. One of these turns is over the 20 meter section and the other over the lower end of the section not used on 40 or 20 when band switching. This gives fairly uniform grid drive on all three bands, running from 15 to 22 ma. under load. The exciter links are made of no. 14 wire mounted on stand-off insulators and the twisted pair link portion out of no. 19 hook-up wire. The exciter coils were made plug-in so as to make the exciter unit universal, allowing three band output on any consecutive bands from 160 down to and including the 10 meter band.

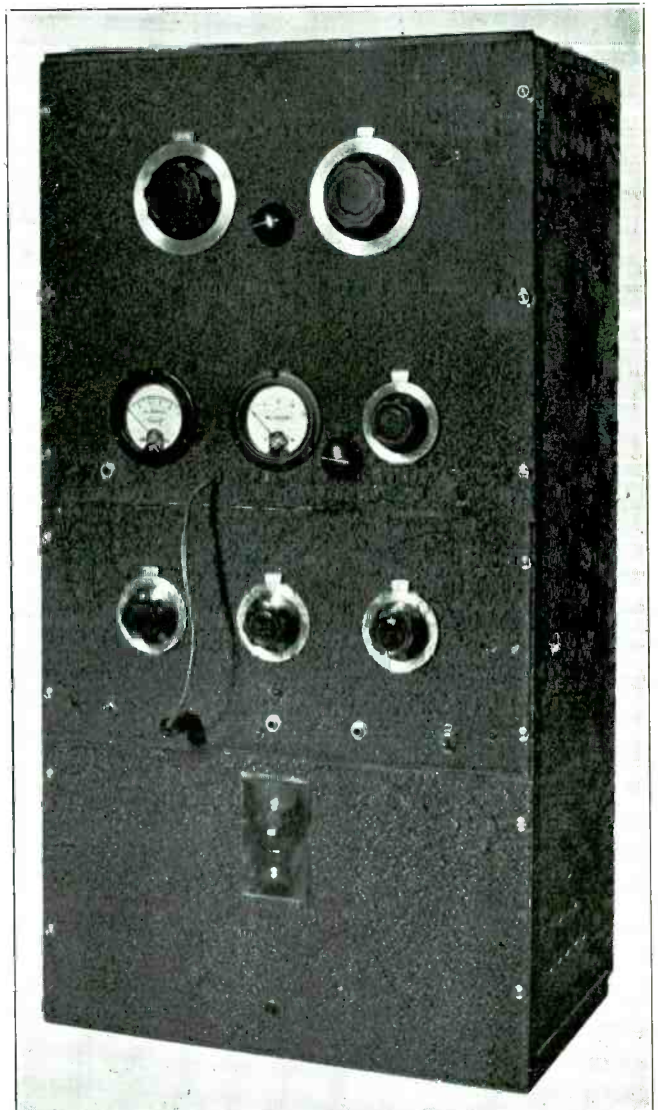
The doublers have their grids driven by close coupled untuned grid circuits with approximately unity coupling to the tuned plate coils. Too many grid turns will cause excessive regeneration and self-oscillation at the doubling frequency due to an inductive grid reactance. The turns shown are satisfactory from this standpoint. Grid bias is obtained from a combination of grid leak and cathode resistor in each doubler stage.

Cathode or self-bias is also used in the final stage to provide a good portion of the total grid bias. This protects the large and relatively expensive r.f. pentode tube. An added precaution is in the form of a 250 ma. overload relay in the filament center tap lead, which opens the primary circuit of the high voltage supply in case of bias failure or short circuit.

Another 2½ volt a.c. relay was incorporated into the exciter plate voltage supply and high voltage supply in order to allow remote control operation. The relay control switch can be mounted near the c.w. key. The latter keys the primary side of the high voltage supply and therefore no key clicks are radiated. The filter system does not put tails on the dots when sending at normal speeds.

The transmitter has a simplified antenna network of the π type for the elimination of harmonics. The best antenna for this transmitter is either an end-fed 132 or 135 foot wire, or a single-wire-fed Hertz 135 feet long. The feeder should connect to a point 22 feet off center in order to work effectively on all three bands. Two such antennas at nearly right angles will allow transmission or reception in all directions. In connection with this system of plate tuning, an interesting problem arose. The shunt feed r.f. choke has to work effectively on 3 bands, harmonically related. Two other r.f. chokes tried worked fine on 20 and 40 meters but overheated and burned out on 80 meters after a few minutes of steady output. The 500 ma. choke shown stood up all right in these tests.

The output runs from 150 to 200 watts with conservative values of screen and plate voltage. The exciter provides plenty of grid excitation to the 803 tube; so no buffer stage is needed. An 80 meter crystal which has its harmonics within the 40 and 20 meter bands controls the

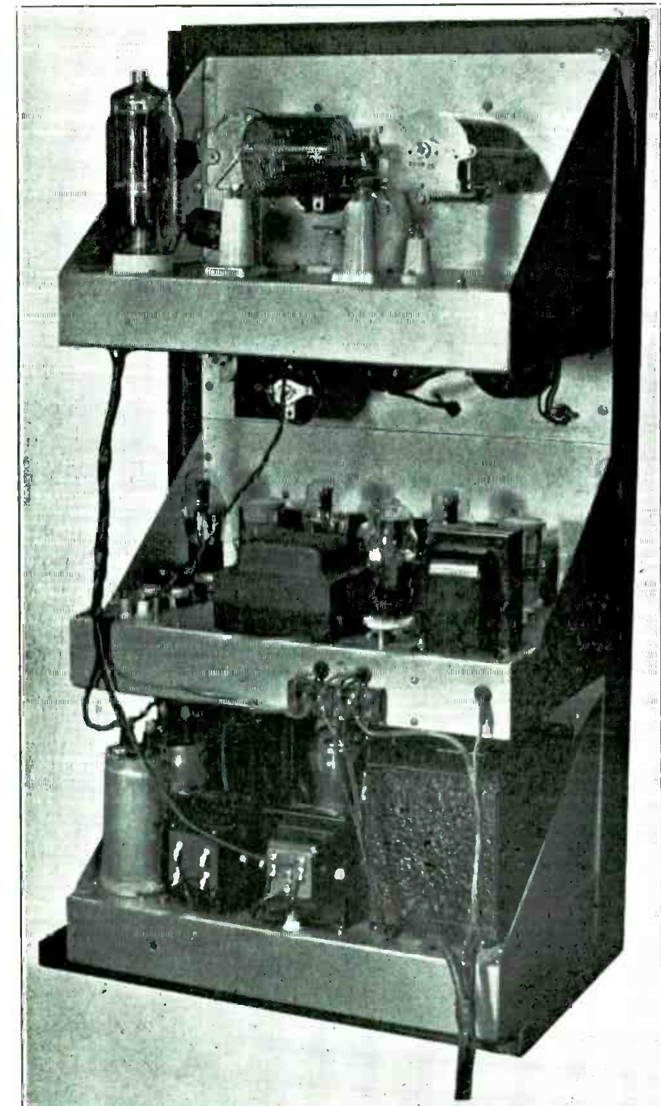


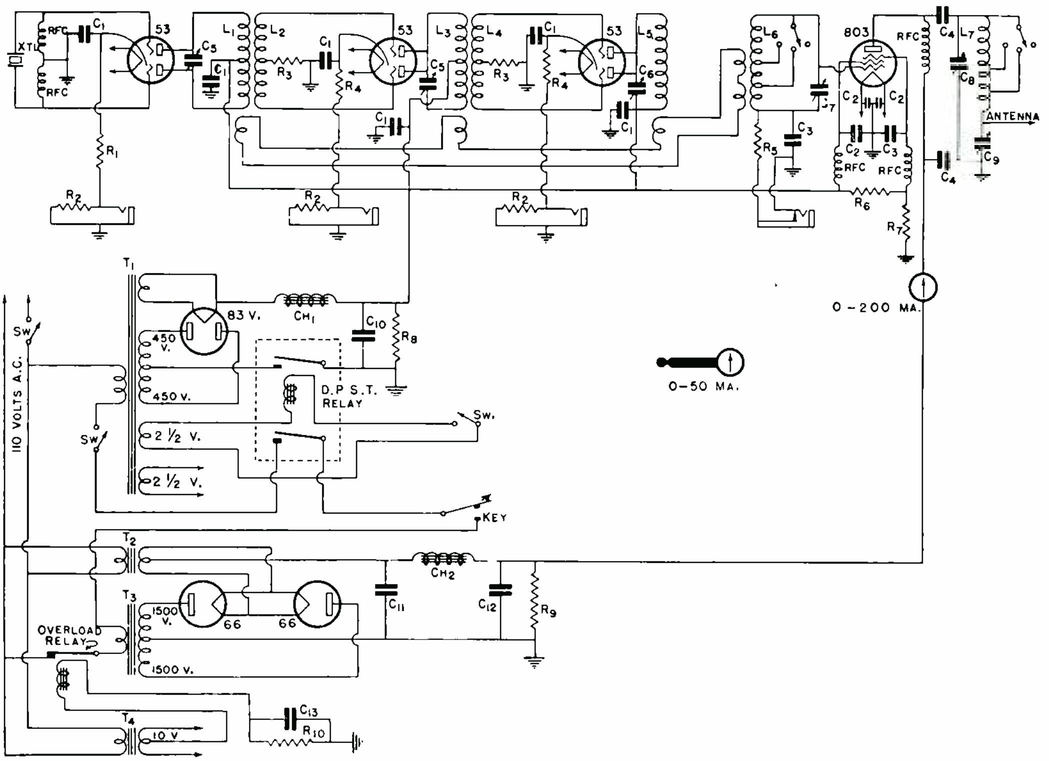
Left:

Front view of the 53-803 transmitter. By careful design, both symmetry and short r.f. leads have been made possible.

Right:

Back view with dust cover removed, showing mechanical construction. The transmitter is entirely self-contained.





The Wiring Diagram of the 53-803 Transmitter

C_1—.01 μfd. 600 v.
C_2—.006 μfd. mica. 1000 v.
C_3—.002 μfd. mica, 1000 v.
C_4—.001 μfd., 5000 v.
C_5—100 μμfd. midget
C_6—50 μμfd. midget
C_7—50 μμfd. midget, double spaced
C_8—100 μμfd., 6000 v. spacing
C_9—330 μμfd., 3500 v. spacing
C_{10}—16 μfd. electrolytic, 500 v.
C_{11}—1 μfd., 3000 volt
C_{12}—2 μfd., 2000 volt
C_{13}—8 μfd. electrolytic, 500 v.
R_1—750 ohms, 5 watts
R_2—1 ohm, 5 watts
R_3—10,000 ohms, 10 watts
R_4—350 ohms, 5 watts
R_5—2000 ohms, 5 watts
R_6—50,000 ohms, 20 watts
R_7—25,000 ohms, 5 watts
R_8—40,000 ohms, 20 watts
R_9—100,000 ohms, 100 watts
R_{10}—250 ohms, 40 watts
CH_1—20 hy., 200 ma.
CH_2—20 hy., 150 ma., 5000 v. insulation
T_1—900 v. c.t., 2½ v., 2½ v., 5 v. (200 ma. rating)
T_2—2½ v. 10 amp., 5000 v. insulation
T_3—3000 v. c.t. at 200 ma. (1500 r.m.s. each side)
T_4—10 v. at 4 amps.

frequency at all times.

No speech amplifier equipment was included as this set was designed primarily for c.w., or as an exciter for a high powered final amplifier stage. The suppressor grid connection comes out to a connecting block at the rear of the middle chassis, and an external modulator could easily be connected into the circuit and a negative bias applied for suppressor grid modulation. The cathode resistor is by-passed with an 8 μfd. condenser, and adequate power supply filters are used to allow phone operation without any modification at a future date.

The transmitter is built into a 3 foot relay rack with the main power supply on the bottom panel, the final amplifier on the top, and the 53 exciter and its power supply on the middle chassis. The top panel is 15¾ x 19, the middle 88¾ x 19, and the bottom 10½ x by 19 inches. The top and bottom chassis measure 17 x 12 x 2¾ inches while the middle one is 17 x 10½ x 2¾ inches. A rear cover 12 inches deep, with ventilation holes, covers up the rear of the transmitter and provides personal protection against contact to high voltage leads. It also adds to the appearance of the complete transmitter.

Tuning up such a transmitter is not complicated. The push-pull crystal oscillator is tuned for maximum output as indicated by maximum grid current to the final amplifier on 80 meters. The doublers are then tuned for a dip in cathode current, and of course for maximum final amplifier grid current on 40 and 20 meters. This grid circuit has to be tuned to each band by means of the proper setting on the band

COIL DATA
For 53-803 Tank Circuits

L_1—40 t. no. 24 d.s.c. c.t., space wound dia. of wire, 1½" dia. form.
L_2—30 t. no. 24 d.s.c., interwound with L_1.
L_3—20 t. no. 20 d.s.c., c.t., 1½" dia., wound to occupy 1⅝".
L_4—14 t. no. 20 d.s.c., interwound with L_3.
L_5—9 t. no. 18 e. on 1½" form, wound to occupy 1½.
L_6—40 t. no. 20 d.s.c., 1½" dia., wound to occupy 2½", tapped at 6 t. (for 20 m.) and 14 t. (for 40 m).
L_7—25 t. no. 14 e., 2¾" dia., 8 t. per inch. Tapped at 4 t. (for 20 m.) and 11 t. (for 40 m.)

Interwound coils start at center tap and are wound turn for turn out towards ends.

switch and tuning condenser. Once the three dials on the exciter unit are set properly, no retuning is necessary when band switching from 80 to 40 or 20 meters. Only the grid and plate circuits of the final amplifier need to be tuned to resonance: the grid for maximum grid current and the plate for a dip in plate current. The antenna tuning is set for normal plate load (at the dip), and generally this condenser is set towards maximum capacity.

About 10 seconds are required to switch to any band from 80 to 20 meters. And isn't that fast enough for most anybody?

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The B.E.R.U. Tests

By F. Charman, G6CJ

The British Empire Radio Union test is held the four week-ends in February. There are two contests: first the two-week high power contest, and second the two-week low power (not over 25 watts) contest. The scoring basis has no multiplier but works on zones and is arranged to attract as many QSO's as possible. The beer usually goes to somebody who can make good use of 14 mc. and keep busy the whole 24 hours of the day. Thus the VK and ZL stations are well up as they are in summer conditions and can keep going whereas we are almost in winter and have to make more use of 7 mc. where the QRM is bad, from an Empire point of view. We are shut down for about 8 hours of the day by darkness—and nothing but "W", which blocks out any B.E.R.U. signals that might be about.

This year conditions for G were fairly good for the first half, though the 7 mc. band was so active that it was difficult to get through to ZL when W's were on. Personally, I use directive antennas arranged to prevent the W's hearing me or my hearing them well at such time as I can do well in the opposite direction, and in this way I can work VK up till 2200 G.m.t. on 7 mc. This gives me a few hours' advantage over people who have their dials full of Yanks, and the same sort of help is had on 14 mc., though there are times when I want to go both ways at once but cannot, and thus have to schedule my operating.

The best log in G makes about 100 QSO's, but the VK's double this. During the 25 watt tests conditions were inferior apart from power reduction, and many a G had only a few contacts right through. We did not use 3.5 and 28 mc. much as there is no point as long as one has not run out of stations on the other bands, and very few of us do that (though I did fairly well with my directive antennas and got very short of VK's and ZL's before the end).

It is very interesting to compare with other years. I find great differences between this and the two preceding ones, which made my schedule of operating very different this year. On the whole I think there has been a progressive improvement in conditions over the three years.

The results of the VK-ZL contest are at hand, and I find that a little science applied to antennas has given me a place of distinction, though I pitted my little fifty watts against several hundred elsewhere. I was well aware of the properties of directive aerials but it was not till I read of some in Radio that I developed enthusiasm, and the great truth dawned upon me. The extra 3 db gain is nothing, but what about the lower angle radiation due to an inherently more directive system? That was it. It gave me on the average an extra two points anywhere *over* 5000 miles, and has brought my WAZ claim up to about 36 zones!

A Contest Receiver

I might add that in these contests I have in addition to this advantage, a fiendish device in the shape of a superhet with *two* r.f. mixer tuners which can be fed instantly, either or both, into the same i.f. Thus I can have two bands at immediate command, or better, *two signals on the same band*. With the help of a pair of oscillators to sit as markers on signals, I can chase four signals at a time and hear any two together (though I can't quite copy them both at once!).

*Orchard Cottage, Stoke Poges, Bucks., England.

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With most of his antenna down on the ground, W8MFV carried on a one-hundred percent QSO with W9TDH, 30 miles distant.

A "Sectional" Phone-C.W. Transmitter

By FRANK EDMONDS* *and* I. A. MITCHELL**

In tests transmitted for "Radio", the transmitter here described, without the linear amplifier, delivered signals of a strength which at 60 miles compared with those of other stations in the same vicinity but with materially higher powers on "plain" carrier. The fidelity of modulation was very good.

The transmitter described below was designed:

1) so that the average amateur can build it.
2) so that increased power does not entail discarding of parts or making changes in the original units.
3) so that economical tubes may be used and a minimum of operating trouble encountered.

The units of the transmitter are panel-mounted, permitting easy assembly in a standard steel cabinet. The scales and circuit designations are engraved directly on the panels, which does away with the necessity for using nameplates and individual dials. Now we can forget the panels, turn the set around, and start looking into the back of it, to see what it really is.

The R.F. Unit

In the rear-view photograph, the upper chassis and panel carry the r.f. unit with its integral power supply. This unit uses a 2A5 tube pentode-connected as a crystal oscillator. To permit keying of the oscillator without chirping, the screen voltage is taken from a power-supply bleeder-tap rather than through a series resistor. Both this and the next tube are provided with cathode resistors for safety.

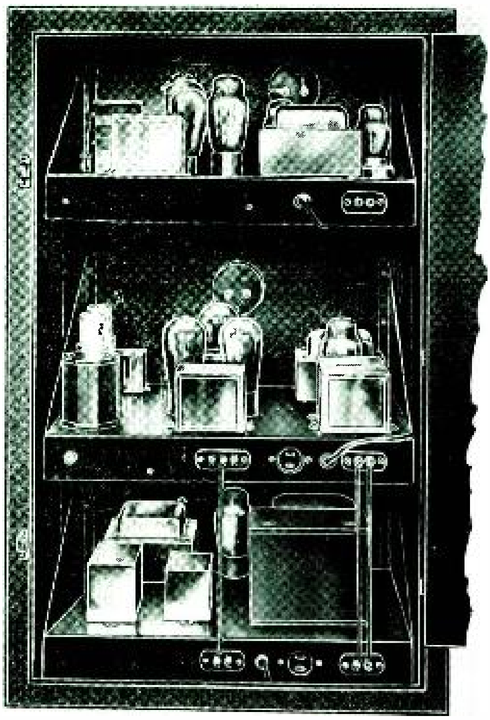


Figure 1
Rear view of the transmitter with the carrier-control unit but without the 200 watt amplifier.

The second tube is also a pentode-connected 2A5. This tube serves as an r.f. amplifier and frequency multiplier. It excites easily and is even a better tripler than a doubler. Even as a doubler its output is large enough to drive the third stage to higher inputs than the tubes can stand. The 2A5 amplifier is neutralized by a 10 μμfd. variable condenser whose setting is so un-critical that it may be left at half-capacity.

This stage is in turn capacity coupled to the third stage, which uses a pair of 46 tubes in the high-μ connection (grids tied together for each tube). Because of the zero-bias characteristics of the 46 when so connected there is no danger of drawing excessive plate current should excitation fail. The stage is cross-neutralized in the conventional manner. It is easily neutralized and remains so when changing bands. It delivers good output on all bands.

A single 0-10 ma. meter is used to measure the d.c. grid and plate currents. Meter shunts are permanently connected into the circuits to be measured, and as each shunt has been given the proper resistance for that circuit, the meter range is automatically correct when switched across that particular shunt by the 5-position switch.

Having completed assembly of this unit the

*River Road, Grand View, N. Y., W2DIY.
**Engineering Department, United Transformer Corp.

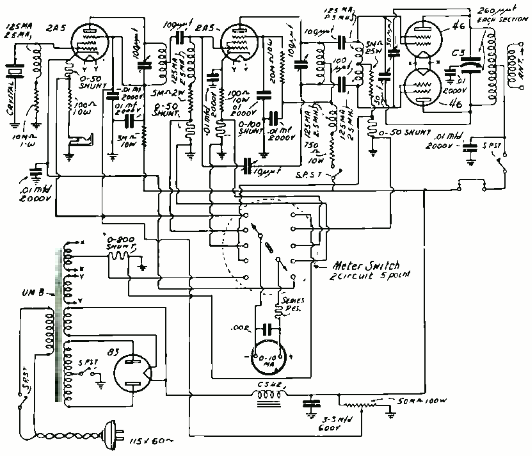


Figure 2
The R.F. unit, with integral power supply.

amateur has a neat and dependable c.w. transmitter of about the physical size of an average receiver, and using low-priced tubes.

The Modulator

To go to voice operation a modulator unit is added, to plate-modulate the last stage of the r.f. unit. This is the middle panel-and-chassis assembly in the photograph. It has its own power supply and may be used with any transmitter requiring 25 audio watts. The gain is 96 db, on the basis of 500 ohm input to 500 ohm output, though it would show up as a greater voltage if taken at the (actual) 5000 ohm output. The wave form is good even when the output is driven to 30 watts. Provision is made for both crystal and 2-button carbon mikes, with a current supply for the latter. A meter in the plate-supply lead to the final stage warns against abnormal operation.

The circuit is a conventional one, using a 57 pentode resistance-coupled to a 57 triode which is resistance-capacity coupled to the primary of a transformer driving a class A 46 tube (low μ connection) which drives a class B pair of 46 tubes.

However, the unit does provide several unusual conveniences. The output transformer provides for feeding into either a class C stage or a line. The provision for several sorts of microphones has been mentioned. There is also an a.c. outlet on the chassis, controlled by the same switch as the audio unit itself. The r.f. unit may be plugged into this, simplifying control and avoiding double plugs or similar makeshifts. Also, the class B output stage is provided with space for a 3 volt bias battery. The purpose of this battery is to reduce the static ("resting") current into the class B 46 stage and thus permit a greater carrier variation when we go to controlled carrier.

Carrier Control

Carrier control may be provided by the addition of the third, or lowest unit, which may be switched out at any time if "plain" carrier is wanted. One of the beauties of the controlled carrier system is that you can load up the (r.f.) 46's to a point where they would be troubled by "creeping" if used on constant carrier. This is done by automatically varying the plate voltage of the class C (r.f.) 46's so that at all speech levels almost full modulation is obtained—that is, the plate voltage (d.c.) is at all times about what is needed to accommodate the modulation at that moment.

This controlled plate voltage does not come from the power-supply integral with the (top) r.f. panel, but is taken from the bottom, or control unit, which contains the necessary auto-transformer and "variactor" as well as another plate-supply whose output is controlled by these devices. A number of articles have been written on the system of control used in this unit, but just to keep the idea before you, it is briefly:

The varying plate current of the class B audio stage is passed through one winding of the CV-2 "variactor" and causes a varying degree of magnetic saturation in this unit. This varies the reactance of the variactor, and as it is in series with the primary of the plate-supply transformer (now feeding the class C stage),

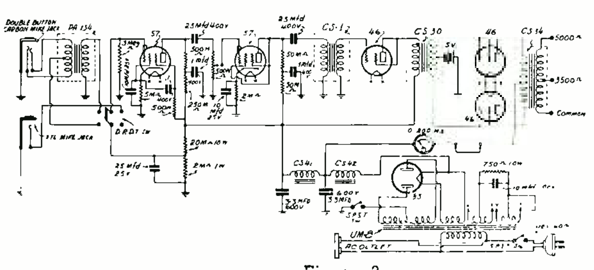


Figure 3
The audio system, also useful with other transmitters.

this transformer receives a varying a.c. input voltage and in consequence supplies a varying plate voltage to the class C stage. The reason for the auto-transformer is that the variactor always causes some voltage drop, even at high speech levels; therefore more than 115 volts is necessary to start with, and accordingly the auto-transformer is interposed to step up the line voltage.

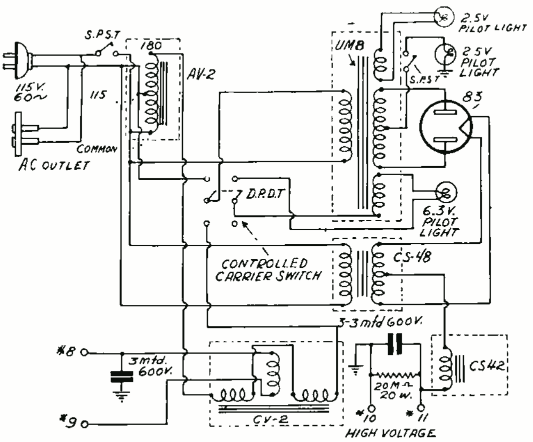


Figure 4
The carrier control unit whose power supply feeds the last stage of the r.f. unit when using controlled carrier.

The "Final" Amplifier

Increasing the power output of a small radiophone by adding a stage of r.f. amplification *after* the modulated stage is always interesting to consider; but when it is done with constant carrier the addition is not very economical, because of the very low efficiency of such a stage (for constant carrier). The carrier output for a class B r.f. pair of 852 tubes at 3000 volts is only 80 watts, *constant carrier!*

With controlled carrier the picture is entirely changed. Since full input now exists only at full modulation, which is normally not maintained when speech transmission is being used (whatever the case might be for music), we can work the tubes at higher input than would be possible with constant carrier.

As shown in the diagram, the final amplifier uses push-pull 852 tubes driven through a coupling link by the class C, modulated stage. As has been said the carrier output for the 852 pair in constant carrier is 80 watts, but for the same tubes operating under controlled carrier conditions the *effective* unmodulated carrier ("equivalent carrier") is better than 200 watts. The allowable plate ratings may be safely exceeded because the tubes only draw plate current proportional to the speech input and have a chance to cool off much as tubes used in a class B audio system.

Plate Supply

The plate supply to the 200 watt amplifier stage uses a pair of 866A rectifiers, a swinging input choke, and a 2 microfarad, 5000 volt condenser. The output voltage is adjustable up to 3000 volts at current drains up to 300 ma. The condenser is operated conservatively, as it is cheaper to buy one good condenser than to replace. Both the 866A and 852 tubes are protected by an overload relay of the hand reset type.

This unit also contains the bias supply for the 852 stage. It has been designed to give exceptionally good regulation so that the bias does not rise excessively when excitation is applied to the 852 stage.

The antenna coupling device of this stage is of the conventional low-pass filter type, except that it has been found advisable to leave the unused turns of the coils open rather than short-circuited, to reduce eddy losses.

A cathode ray oscilloscope has been designed to fit into the power unit with provision for both trapezoidal and envelope patterns. It is, however, completely self-contained, and may be used on any transmitter.

Amateurs who already have on hand a pair of HK354, HF200, 150T or similar tubes may use these tubes in the linear amplifier by incorporating a few minor changes, such as filament voltage and bias voltage.

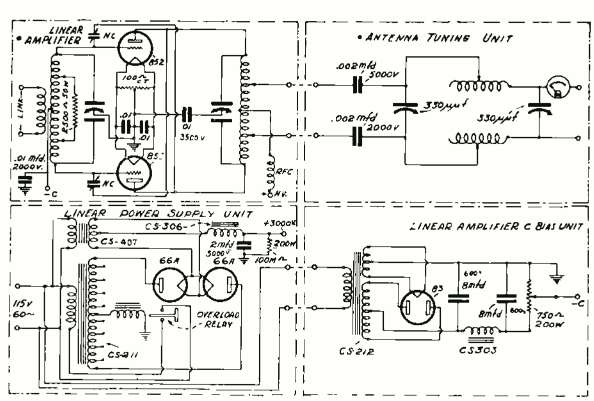


Figure 5
The 200 watt amplifier. (80 watts for constant carrier.)

◆

VQ4CRO sends along some notes of interest to hams operating phone stations in the 14 mc. band. He reports that at regular intervals throughout the year "W" phones come through with R9 volume only to fade completely out for periods of a month or more. During these times when "W" stations are not heard "G" stations are present in great numbers. During May and June it is expected that "W" hams will again be putting loud signals into Nairobi.

Self-Excited Oscillators

Part II, The Hartley Oscillator

In figure 1 is shown the fundamental Hartley oscillator circuit. The grid and plate are connected to the extremities of the tuned circuit. As L_g and L_p are parts of one tightly coupled coil, the relative a.c. grid and plate voltages are determined entirely by the placement of the variable cathode (ground) tap on the coil.

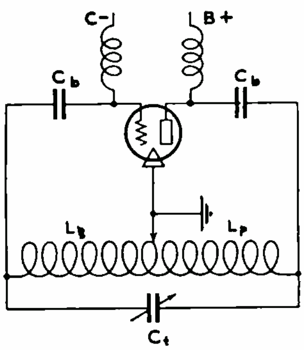


Figure 1

Thus moving the cathode tap on the coil over toward the plate end of the coil will cause a larger part of the a.c. tank voltage to be applied to the grid, increasing the a.c. grid excitation. The frequency is determined by the tank coil L_g,L_p, in parallel with C_t.

The Hartley oscillator is widely used in various applications at all frequencies up to about 75 megacycles. When the higher C tubes are used it is often more desirable to use some form of the Armstrong above about 10 megacycles, but with the new tubes with very low interelectrode capacitances the Hartley has many advantages clear down into the ultra-short-wave region.

In figure 2 is shown a simple Hartley oscillator using series feed of the negative bias and the high voltage plate potential. In this circuit, as in that of figure 3, the negative bias is provided by the drop across a grid leak resistor. Figure 3 shows a slightly-different series-feed version of the fundamental Hartley circuit. The circuit shown in figure 3 has the advantage that the tank inductance needs only be tapped and not split into two parts.

In figure 4 is shown the shunt fed version of the tuned-grid Hartley, or, more strictly: the "Feed-back oscillator". This type is used in autodyne receivers and test oscillators, but is not used very much where large amounts of power are desired from the oscillator.

The circuit shown in figure 5 is quite similar to that of figure 4 but is termed the tuned-plate Hartley, or the "reversed feed-back oscillator". It is subject to the same disadvantages as the oscillator of figure 4. The main advantage of the oscillators of figures 4 and 5 lies in their simplicity and the fact that one side of the tuning condenser is at ground potential.

In figure 6 is shown the Meissner version of the Hartley. The main advantage of this oscillator lies in the fact that there are no d.c. potentials on the tuned circuit, thus allowing one side of the tuning condenser to be grounded. This circuit used to be rather widely used in the oscillator circuit of superheterodyne receivers, as it allowed one side of the trimming and padding condensers to be grounded and also allowed special precautions to be taken toward stabilizing the oscillator voltage output fed into the first detector over the tuning range of the receiver.

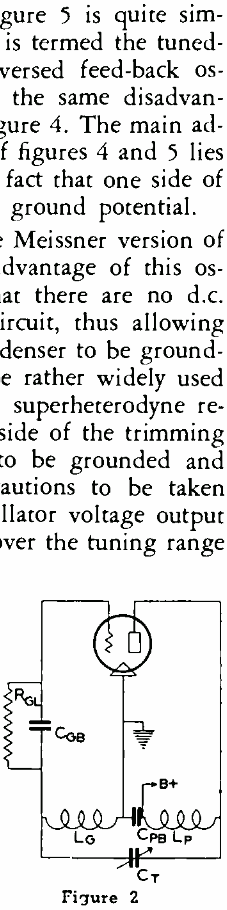


Figure 2

The simplest form of push-pull Hartley is that shown in figure 7. The plate voltage is series fed to the center tap of the plate tank coil while the bias voltage is shunt fed through individual r.f. chokes in each grid lead. The radio frequency feedback is obtained by the crossed grid leads, which are tapped on the tank coil. Adjusting the position of these taps varies the r.f. grid excitation. This oscillator is highly useful and is much to be recommended for both communications and diathermy work.

In figure 8 is shown the Dow-Hartley, or the electron-coupled Hartley. It requires the use of a screen grid or pentode tube. The screen acts as a partial anode for the frequency-determining portion of the circuit consisting of L_g,L_f and C_t. The load tank, which is usually tuned to some integral harmonic of the frequency-determining tank, is C_tL_p.

The main advantage in the various Dow oscillators lies in their freedom from frequency changes caused by changes in applied plate voltage. When the plate tank reactance is adjusted slightly off resonance it is found that a given proportionate change in the d.c. voltages applied to the plate and screen cause equal and *opposite* changes in the frequency of oscillation. Thus if the screen voltage is fed from a voltage divider across the source of d.c. plate potential, wide changes in applied plate potential will cause practically no change in the frequency of oscillation. It should be noted that the plate or load circuit *must* be tuned slightly away from resonance for this stabilization to be effective. The ordinary electron-coupled oscillators used in receivers and test oscillators seldom use a tuned plate circuit, so are practically no more stable than the ordinary triode oscillators.

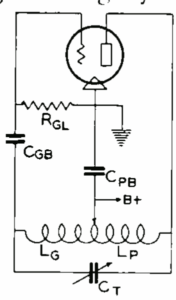


Figure 3

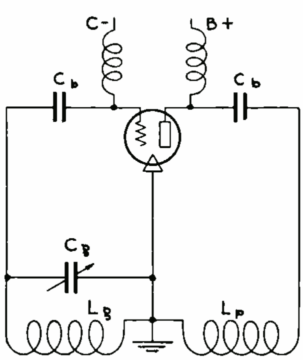


Figure 4

Another fallacy commonly believed about the electron coupled oscillator is that changes in load resistance or reactance reflected back into the plate circuit have relatively little effect on the frequency-determining circuit. This is not true for two reasons. In the first place the portion of the grid coil marked L_f is just as much in the plate circuit as if it were directly in series with L_p. It is in the cathode circuit and thus all the plate current, d.c. and r.f., passes through it. The second reason is that the anode of the oscillator's frequency-determining circuit is only *partially* the screen. In fact, most of the feedback present on the control grid of the screen grid tube comes from the bottom end of the plate tank C_tL_p.

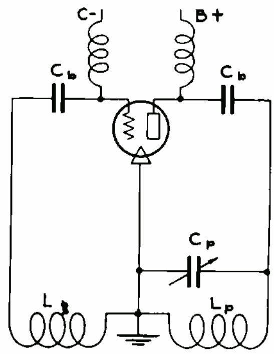


Figure 5

This is shown more clearly in the Hawkins modification of the Dow oscillator shown in figure 9. This circuit is practically identical

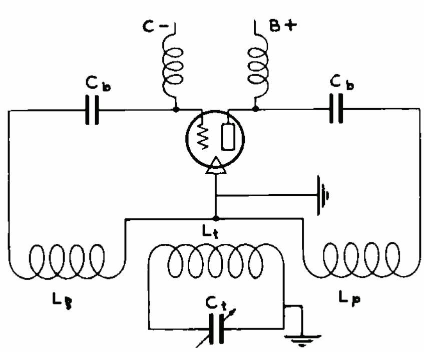


Figure 6

in every respect with that of figure 8 except that the ground reference point has been moved from the screen grid to the cathode. It is desirable to operate the cathode, or filament, of the higher-power pentodes and screen grid tubes at ground potential (to r.f.) in order to eliminate the bulky and expensive filament chokes required in the standard Dow oscillator. The circuit looks quite different but the instantaneous r.f. and d.c. tube potentials are exactly the same as they were in figure 8. Thus the oscillator operates in exactly the same manner. While developing this circuit it was felt that if the screen grid supplied all the feedback for The oscillator the r.f. return back to the cathode from the plate circuit could go directly

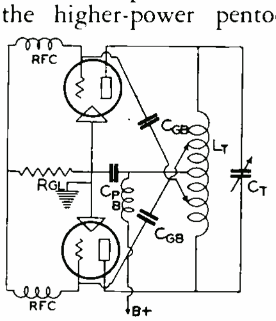


Figure 7

back to the cathode or ground point. This would allow one side of the plate tuning condenser to be grounded. *However,* it was found that the circuit would no longer oscillate when loaded, as the screen current would drop down to a very low value as soon as the

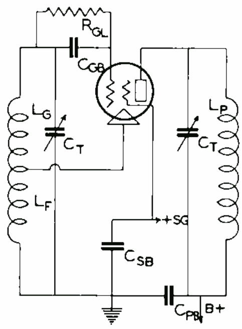


Figure 8

plate voltage was applied. The circuit would oscillate well as long as there was no plate voltage applied but as soon as the plate voltage was applied some extra feedback from the plate circuit had to be applied to the feedback portion of the grid coil in order to keep the circuit oscillating. Thus neither side of the plate coil is at ground potential, with respect to r.f., and it is highly desirable that link coupling rather than capacitive coupling be used between the plate circuit and the load.

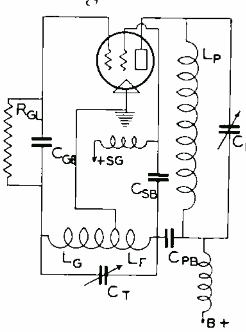


Figure 9

The circuit shown in figure 10 differs from that shown in figure 9 only in the method of feeding the d.c. voltage to the screen grid and plate. In figure 9 shunt feed is shown and in figure 10 series feed is used. The resistor R_X which is dotted in figure 10 is only necessary if it is desired to use a voltage divider rather than a series dropping resistor in order to obtain screen voltage from the plate power supply. The dropping resistor is satisfactory for most applications, though if the oscillator is keyed the voltage divider minimizes keying chirps.

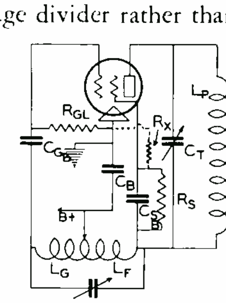


Figure 10

In figure 11 is shown the simplest form of Hartley oscillator for use on the ultra high frequencies. This oscillator is stabilized by means of a resonant line type of tank circuit which is characterized by low losses and a high circuit "Q". This means that the oscillator resists changes in frequency caused by changes in tube voltages or loads, and it is becoming more widely used every day.

The tubing which comprises the tank circuit is approximately a half wave long, less the effect of the capacity loading caused by tapping the tube elements on the tubing. The grid tap on the tubing is varied in order to adjust the grid excitation. In general the Armstrong or

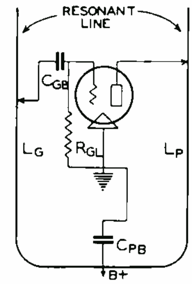


Figure 11

"tuned-grid-tuned-plate" type of rod-stabilized oscillator has certain advantages over the Hartley version and will be described in a later article.

In figure 12 is shown exactly the same idea as in figure 11 except that a conventional tank coil is used in place of the resonant rod or tube. This type of oscillator is often used at the very low audio frequencies in order to get good sine-wave output from the oscillator. It is simply an expedient to get high Q in the tank circuit without the use of high C.

In figure 13 is shown the common "unity-coupled" oscillator. This practically amounts to a push-pull Hartley with the grid taps out on the ends of the plate coil. The use of two coils, one inside of the other, is simply to allow

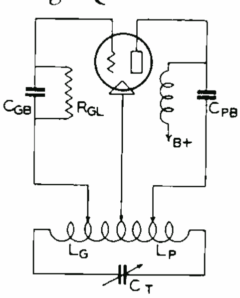


Figure 12

series feed of both the grid and plate voltages. The tank circuit often consists of copper tubing for the plate circuit with insulated wire threaded inside of the tubing for the grid coil. This circuit is very critical to adjust due to the fact that there is no means of adjusting the grid excitation. Thus it is efficient and stable only when low μ tubes are used as oscillators. The plate voltage and the load must be very carefully adjusted so that the tubes receive just the right amount of grid drive for the load used.

The plate efficiency of this type of oscillator is usually quite low and about its only justification is simplicity.

There are other types of Hartley oscillators, but the foregoing includes practically all of the important ones.

[*Continued on page 95*]

"Hell and High Water"

By Robert S. Kruse

During those terrible days in March when 15 eastern states were torn by flood and storm, heroism became commonplace. The last efforts of staggering body and exhausted mind were given freely in selfless aid—not a few times here and there, but thousands of times. There was no hero of this disaster; there were (without a word of exaggeration) ten thousand heroes.

There were, of course, also mean, selfish and thoughtless men. There were looters, and on the whole they seem to have reaped swift vengeance from people too harried to tolerate thieves. There were idiots whose witless curiosity brought their cars into highways needed for urgent transportation. There were selfish people who needlessly used the dwindling supply of food, water and gasoline.

But on the whole the human race need not be ashamed of its showing in the floods of 1936. No age, nor sex, nor trade, nor organization can with any fairness claim special distinction in this matter. It would be silly and conceited to do so. We turn to amateur radio's part only because that is our own special field—and not with any thought that it deserves one word of praise over that due those brave people who, organized or individually, fought disaster and who now are engaged in the last portion of the thankless and often horrible task of ordering and rebuilding.

Radio's Part

By common consent it was early in the emergency acknowledged that communication must be kept open at all costs. Limited supplies of fuel and oil were, beyond the uttermost necessity, made available to communication companies to permit them to carry on the tradition of communication, to keep the circuit working. More than a few telephone exchanges operated with fire engines pumping water out of the building as it seeped through sandbags frantically piled by volunteers. Those fire engines worked in flooded streets, sometimes jacked up onto hasty platforms and served by hip-booted men. In a few cases their fuel came by boat. The operators kept up the tradition of the service, as did the line and inside men. Sometimes the service went under for a few hours, but not for long. Usually some lines went to work again soon.

That is not the story of a town; it is the composite story of a hundred towns in 15 states. Emergency power was provided by storage batteries from automobiles now useless in flooded streets. All manner of charging equipment was rigged up. One town used an old street car motor driven by a discarded auto engine, the whole thing being on a garage roof, out in the pounding rain and tearing wind with two half-drowned men taking turns keeping it running more or less.

The telegraph firms did as well; the railroads performed their own special sorts of miracles; and by no means forget the truck driver, the policeman, the coast guard—who went 50 and 60 miles inland on rivers not ordinarily navigable and now armed with every type of floating danger—nor the medical services, nor . . .

But ours is a story of communication, and we will stick to that. The broadcast stations, supported by strenuous efforts of the power companies, did inspiring service in directing aid, quieting rumors, issuing warnings, and otherwise removing the terror of uncertainty. Again it would be unfair to name any one station, for this would manifestly be the rankest injustice to some other station. They all, management to assistant operators, may look back with quiet pride.

Most commercial radio services had less opportunity to do things outside the usual order of business, and beyond an increase in the emergency type of message their work went along regularly insofar as power-supply permitted. The communication system of the police and military organizations carried a similar increase of load without any actual necessity for a swift change of procedure such as the broadcasting stations so magnificently accomplished.

For the amateur radio station it was altogether another matter. Here was no network of telephone wires with which auxiliary communication could be accomplished and procedures of broadcasting changed. Instead each station was referred pretty largely to its owner's initiative and good sense, with whatever cooperation he might through good fortune get from the power company, the local police and the city fathers. This cooperation was not by any means always forthcoming. For instance: Mr. Gerald Coleman of W8FRC was denounced as the author of a dam-bursting rumor and ordered to stop transmitting. It is interesting to note that the news commentator, Boake Carter, at his next broadcast whole heartedly condemned the city for this action, defended Coleman's stand in staying on the air on the ground that his license was federal and not local, and asserted stoutly that Coleman's transmission of the information was based on information not original with him but being shouted about the streets before W8FRC mentioned the matter.

Beyond that all the stories that have ever been told about emergency amateur radio could be repeated with different names and calls attached to them. None the less it would once more be silly and unfair to do this, since every band, voice and c.w., was alive with emergency amateur radio work, and it is far more fair to name no names at all than to list a hundred or two and overlook others of whom one does not happen to have heard, or who have not been willing to report their work for fear of appearing immodest.

At RADIO's eastern laboratory, quite literally hundreds of stations were heard doing their very best to help. Not all of them were doing it usefully; some were frantically calling for someone to send them emergency messages, and in so doing were causing far more harm than good. But on the whole, interference was much less than one might think. Stations got off the air promptly when asked to. During one afternoon when the air seemed clear a test was being sent to RADIO by a manufacturer in accordance with a schedule previously arranged. That test never was finished; it went overboard for keeps as soon as a flood-distress station asked for the channel. There has been some "grousing" about amateur radio stations serving (as many did) to transmit news to papers. I do not share the opinion that this was harmful. It was much better for distressed relatives outside to know what was going on. Not all the anxiety was in the flood territory.

The Naval Radio Reserve and the Army-Amateur network both did excellent service, yet the finest thing about the whole participation of radio in this awful business was the ability of amateurs to use their stations intelligently, to turn with the need of the hour on their own initiative and with nothing but their own good heads and hearts to guide them. For once it was possible to believe that amateur radio really has the emergency value of which we have heard so much.

Not a very large part of all this was in the form of "message traffic". There was often no time to contort urgency into dry messages, but the facts got through, even though a "traffic total" will never be possible. Some even helped, and helped greatly, without touching key or microphone. They aided other stations to keep on the air; they helped to receive or they stayed out and let the track remain clear. Even remote districts helped in this way.

Amateur radio "came through" in time of stress. For such an exhibition of performance under fire, we can, as a group, feel justly proud. The individual amateurs who so nobly responded and endured danger, privation and physical hardships for the sake of the public will not all receive public acclaim and glory. Theirs must be the reward of unsung heroes; the satisfaction that results from a job well done, the inner glow that comes only from unselfishly helping our fellow men.

◆

W2HNX offers the following suggestion:

"In my box of tools, I include a pair of six-inch forceps. I find it the handiest tool I've ever used. The jaws are notched or knurled for a good grip. I bought them some years back for 50c at a chemical supply place and they are known as flesh forceps (otherwise an overgrown tweezer). They are far better for holding wires when soldering than pliers, as the latter are sometimes too large for tight places. Being long enough, the fingers are seldom toasted by the iron. When it comes to retrieving a lost screw or nut from a narrow spot, nothing like this tool does the job so well. As for putting a nut on a screw in a tight place, these forceps are par excellence. For every time I use the pliers (and I have nearly a half dozen kinds) I use the forceps twice."

◆

Our foreign correspondents report that it is almost impossible to raise "W" phones by answering their CQ's. Apparently the United States amateurs do not listen outside their own phone band after a CQ, with the result that foreigners operating phones in other sections of the band are not heard. There seems to be little trouble in maintaining schedules with "W" stations in the 14 mc. band, but foreigners seldom raise a "W" after calling him.

Notes on Multivibrator Adjustment

By BERNARD EPHRAIM*, E.E.

Numerous inquiries have been received by the writer regarding the "Harmonic Oscillator" appearing on page 292 of the 1936 edition of the *Radio Handbook*. The following notes have been prepared with a view toward clarifying the complexities of the circuit.

Frequency Determination

The fundamental frequency of the multivibrator cannot be determined from formulae employed in determining frequency in other types of oscillatory systems. However, the fundamental frequency may be closely approximated by computing the relaxation-oscillation time constant of the system. The constant may be determined from the following equation:

$$T = RC \log \frac{V_1}{V_2}$$

where C is the total capacity in the circuit; R, the total effective resistance in series with the capacity; and V_1 and V_2 the initial and final voltages, respectively, across the condenser.

Another method for calculating the frequency of the system, while not as accurate as the above, consists of simply taking the CR product of the grid circuits. Expressions for calculating frequency by this method are:

$$F = \frac{1}{(C_1 + C_2)\,R}$$

$$F = \frac{1}{(R_1 + R_2)\,C}$$

where F is the frequency in cycles; C, the capacity in farads; and R, the ohmage of one of the grid leak resistors.

Applying one of the above equations, take the following example:

If a multivibrator had grid leak resistors of 20,000 ohms each, condensers of 500 micromicrofarads each, the frequency could be determined by the following solution:

$$F = \frac{1}{(C_1 + C_2)\,(R)}$$

$$= \frac{1}{(500 + 500)\,(20{,}000)}$$

$$= \frac{1}{(10^{-9})\,(2 \times 10^{4})} = \frac{1}{2 \times 10^{-5}}$$

$$= \frac{1}{.00002} = 50{,}000 \text{ or } 50 \text{ kc.}$$

Note on Technique: To find the value of the grid leaks for some specific frequency when the value of the condensers is known, use the following method.

(1) Take the frequency in cycles and divide into 1; this gives the time constant in seconds.

(2) Divide the time constant by the *sum* of the condensers in farads; the result gives the value of each grid leak resistor in ohms.

Synchronizing Technique

Prior to entering into these notes, it may interest the reader to learn that the conditions under which synchronism occurs differentiates the multivibrator from other types of oscillatory systems. In the case of the multivibrator the phenomenon of "resonance" is completely absent; hence, no "drawing effect" of forced synchronization takes place as the multivibrator frequency approaches the control frequency. Another point of difference is that the "band width" of the relaxation frequency is approximately an octave wide; this unique property permits synchronization to occur anywhere over the octave region.

There are many methods by which it is possible to synchronize a multivibrator with an external controlling device. Of the miscellaneous technique involved, the most practical and satisfactory procedure of insuring positive control is given below. Before proceding, the following preliminaries should be observed:

(a) It is prerequisite that the frequency of the multivibrator be slightly lower than that of the controlling device.

(b) It is not practical to synchronize with harmonics much greater than 15 times the fundamental of the multivibrator.

(c) The control device (if any) regulating the magnitude of the injected control voltage

*Editor, the *Radio Handbook*, San Francisco.

should be advanced to approximately the half-way point before synchronizing.

(d) If the injected voltage is too low, the multivibrator will not fall into step with the controlling frequency. Low control voltage can be detected after an attempt is made to synchronize by simply rotating the condensers in the multivibrator over a small arc of normal setting. If the frequency remains stable during this manipulation, the voltage is of the proper magnitude. On the other hand, if the frequency should "wobble" or "creep" (not jump to a higher frequency) the control e.m.f. must be raised to a higher value.

Synchronizing at Fundamental Frequencies: To control the fundamental of the multivibrator proceed as follows:

(1) With an oscillating receiver or heterodyne wavemeter, pick up the controlling frequency with the multivibrator turned "off" and note the strength of two successive harmonics on the detecting apparatus.

(2) Carefully adjust the receiver to zero-beat with the controlling frequency.

(3) Turn "on" the multivibrator.

(4) Now, by varying the control of the oscillating receiver or heterodyne through two previous harmonic settings, an appreciable increase in the strength of the harmonic points should be detectable. No other carriers should be heard between the respective harmonic settings; if there are any present, simply vary the control voltage or rotate the condenser setting on the multivibrator until the unwanted carriers are eliminated. When the proper condition is recognized, it is possible to rotate the condenser setting over a small arc of control without introducing any changes in the fundamental frequency.

Synchronizing with Harmonics of the Multivibrator: To control the multivibrator by an integral harmonic of its fundamental, first, adjust the values of the condenser until the relaxation-frequency is approximately equal to some submultiple of the controlling frequency, then proceed as follows:

(1) With an oscillating receiver or heterodyne wavemeter, pick up the controlling frequency with the multivibrator turned "off" and record the *position* of two successive harmonics heard on the detecting apparatus.

(2) Turn "on" the multivibrator.

(3) Vary the control on the receiver or heterodyne between the two harmonics noted and *count* the number of carriers heard *including* the first and second harmonic points. The number counted should be exactly equal to the number derived by dividing the control frequency by the relaxation-frequency. When this condition is obtained, the system is synchronized with the harmonic selected.

(4) To test the stability of control, vary the condensers on the multivibrator over a small arc of normal setting while listening in on the receiver or heterodyne. No excursions in frequency or changes in harmonic count should be detectable between the settings previously recorded.

◆

Ambulances Now Radio Equipped

A new use for radio communication facilities will be inaugurated in Evanston, Ill. when General Electric engineers equip one of the city's ambulances with short-wave transmitting and receiving apparatus, enabling doctors to keep in immediate touch with police and hospital officials. The ambulance radio equipment will be part of a two-way radio system also to be installed in 10 Evanston police prowl cars.

During a police chase or in an emergency in which the ambulance is used, if the driver of the radio car desires to get in touch with police headquarters or the hospital he will merely lift a telephone from a hook on the instrument panel, and a 15-watt transmitter mounted in the car will go on the air, putting him in immediate touch with headquarters.

Valuable time can be saved in relaying word ahead to the hospital regarding the condition of a patient, whether or not to have the operating room in readiness for quick use on arrival, or the summoning of special doctors, all of which now must await the arrival of the ambulance at the hospital.

Fifteen-watt transmitters and suitable receiving equipment will be installed in the ambulance and prowl cars. Mobile transmitters and related motor-generator power-supply units will be concealed in the cars, while the receivers will be located like conventional auto sets under the cowls. A 15-watt transmitter and receiver will be located at headquarters.

◆

One contemporary monthly has raised the question of which name should be applied to the instrument, *test oscillator* or *signal generator*. We are inclined to think, in view of the inroads made by slang and monosyllables, that time will take care of that. Hasn't electricity become *juice*; radio-frequency, *soup*, and so on?

Low Loss Tank Circuits

By J. N. A. Hawkins, W6AAR

The recent development of relatively inexpensive high voltage transmitting tubes with quite low interelectrode capacitances allows very high plate efficiencies. Class C plate efficiencies of 75 to 85% on 14 megacycles are easily possible, and plate efficiencies between

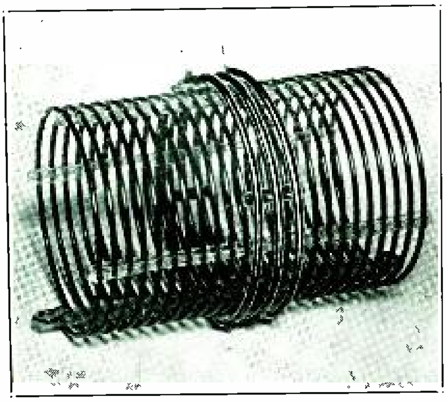


Figure 1
A well-designed tank coil: good form factor and minimum of supporting material.

66% and 80% are attainable on 30 mc., by using low C tubes, high plate voltage, and low loss tank circuits.

Tank circuit losses still can be quite high unless precautions are taken to minimize coil loss and corona loss at the high frequencies. The first step toward obtaining high plate efficiency is to use the proper value of L to C ratio in the final amplifier plate tank circuit. The formula for determining the required tank capacitance is:

$$C = \frac{520{,}000\ Q}{f.K.R_b}$$

where *C* is the required capacitance of the tuning condenser in *micro-micro-farads; Q* is the Q of the circuit (5 for c.w., 10 for phone, and 15 for self-excited oscillator use); *f* is the frequency of operation in *megacycles; K* is a constant (K is 1 for single-ended grid neutralized, K is 4 for single-ended plate neutralized, and K is 6.6 for all push-pull amplifiers); and R_b is the d.c. resistance of the plate to filament path of the amplifier. In other words, R equals d.c. plate voltage divided by d.c. plate current (*in amperes*) of the amplifier.

The table shows various values of C at different frequencies and plate voltages and for the three different types of amplifiers: single-ended grid neutralized, single-ended plate neutralized, and push-pull. Note that the table gives the capacitance required for phone operation only.

For c.w. use divide the indicated capacitance given in the table by two, and for use in a fairly stable, self-excited oscillator multiply the indicated capacitance by 1.5.

The indicated capacitance is that which should be in the circuit when tuned to resonance at the operating frequency, not just the maximum capacitance of the tuning condenser. The tank coil should be pruned so that the circuit resonates with approximately the required amount of tank capacitance. The stray

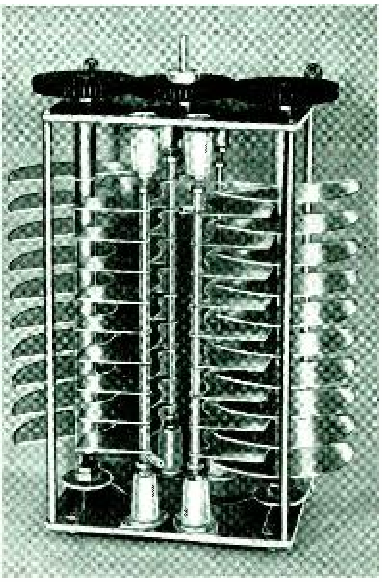


Figure 2
Split-stator condenser of new design, 100 μμfd. per section, 1500 volt rating.

wiring and tube capacitance can be subtracted from the total capacitance indicated in the table in order to determine the tuning capacitance. However, the stray circuit capacitance is rarely large enough to affect matters except at the ultra high frequencies.

The best test for the L/C ratio of a tank circuit is slowly to tune the tank through resonance, meanwhile observing the output or an-

PLATE TANK CAPACITANCE FOR PHONE USE

D.C. Plate Volts E_b	D.C. Plate Amps. (Loaded) I_p	Grid Neut. Plate Tank Cap. C_{gn}	Plate Neut. Plate Tank Cap. C_{pn}	Push Pull Plate Tank Cap. C_{pp}	FREQUENCY BAND	D.C. Plate Volts E_b	D.C. Plate Amps. (Loaded) I_p	Grid Neut. Plate Tank Cap. C_{gn}	Plate Neut. Plate Tank Cap. C_{pn}	Push Pull Plate Tank Cap. C_{pp}
375	.025	200	50	30	1750 KC.	1500	.100	200	50	30
375	.050	400	100	60		1500	.200	400	100	60
375	.100	800	200	120		1500	.400	800	200	120
750	.050	200	50	30		3000	.100	100	25	15
750	.100	400	100	60		3000	.200	200	50	30
750	.200	800	200	120		3000	.400	400	100	60
375	.025	100	25	15	3500 KC.	1500	.100	100	25	15
375	.050	200	50	30		1500	.200	200	50	30
375	.100	400	100	60		1500	.400	400	100	60
750	.050	100	25	15		3000	.100	50	13	8
750	.100	200	50	30		3000	.200	100	25	15
750	.200	400	100	60		3000	.400	200	50	30
375	.025	50	13	8	7000 KC.	1500	.100	50	13	8
375	.050	100	25	15		1500	.200	100	25	15
375	.100	200	50	30		1500	.400	200	50	30
750	.050	50	13	8		3000	.100	25	6	4
750	.100	100	25	15		3000	.200	50	13	8
750	.200	200	50	30		3000	.400	100	25	15
375	.025	25	6	4	14,000 KC.	1500	.100	25	6	4
375	.050	50	13	8		1500	.200	50	13	8
375	.100	100	25	15		1500	.400	100	25	15
750	.050	25	6	4		3000	.100	13	3	2
750	.100	50	13	8		3000	.200	25	6	4
750	.200	100	25	15		3000	.400	50	13	8

tenna current and the d.c. plate current. Maximum output r.f. current should be obtained at the same tuning point as minimum d.c. plate current. If they do not coincide, there is too much inductance and not enough capacitance in the circuit. If there is too much capacitance in the circuit the minimum unloaded plate current of the amplifier stage will not go down low enough when the antenna or load is disconnected from the amplifier. The minimum unloaded d.c. plate current should drop to less than 10% of the normal loaded value, if high plate efficiency is to be obtained. For a somewhat more complete discussion of the L/C ratio in a tank circuit see RADIO for September, 1935, page 22.

Tank Coils

About the best tank coil that can be made, at the present time, uses either one-eighth inch copper tubing or large copper wire supported by thin strips of celluloid, Victron or Mycalex. See the coil of figure 1. These coils are wound on a wooden form which is removed after the cement which holds the wire to the supporting strips hardens. The old tank coils made of large copper tubing are found to have materially more loss resistance than the newer, wire-wound coils, and the larger sizes of wire will easily handle the required circulating current without excessive heating. The better wire-wound coils use steel-core copper wire to minimize changes in inductance with changes in temperatures and also to provide greater mechanical strength.

The length of the best coils will be about 1.5 times the coil diameter. Theoretically a "square coil" with length equal to diameter has a slightly better form factor, but this is offset by the longer leads which must be used with a "square" coil in order to keep it farther away from its associated tuning condenser. However, coils with a length twice the diameter are quite satisfactory. The coil should be kept away from metal chassis and breadboards in order to avoid induced losses, and care should also be taken to keep the fields from two coils in the same transmitter from interlocking and producing undesired feedback and two-spot tuning. If the coils are designed to plug in for band changing, care must be taken to use large and well-fitting plugs and jacks to avoid losses at the coil terminals. Only a fraction of an ohm of series resistance can cause a material loss.

R. F. Leads

The connecting leads in the tank circuit should be, where possible, of eighth-inch copper tubing and all joints should be soldered. The leads, both in the tank circuit and from the tube terminals, should be as short as it is humanly possible to make them. It has been found that cutting as little as one inch off the plate lead in a 28 mc. amplifier has cut the unloaded d.c. plate current in half. Plate and grid leads have appreciable inductance and capacitance and these stray reactances have a surprising effect on the higher frequencies. They often have a very disturbing effect on the neutralization of the circuit.

Tubes

For *amplifier* use at the high and ultra-high frequencies there is no such thing as a tube with too-little interelectrode capacitance. The less, the better. Note that the really important interelectrode capacitance in a vacuum tube which adversely affects the operation of the circuit is *not* the grid-to-plate capacitance, but the *input* and *output* capacitance (the grid-to-ground and the plate-to-ground capacitances). Of course, the plate-to-grid capacitance has a small effect on the input and output capacitance, when a stage is neutralized, but the other two capacitances have much more effect on the circuit.

Above 7 megacycles, the mechanical layout of the amplifier has much more effect on its losses than has the electrical circuit. It does not make much difference whether grid or plate neutralization is used. Use the type of neutralization which allows the shortest r.f. leads to be used. Sit down and study all your parts before starting construction. Move the tube, coils, and condensers around and visualize where the hot leads are going to go. A little study of this kind will make a great deal of difference in the output and efficiency and is much more worthwhile than arguing over the relative merits of various neutralizing schemes or split-stator condensers.

The rules for obtaining high efficiency and output can be summarized as follows: Short plate, grid, and tank leads; heavy, solid, and direct conductors (avoid stranded leads); enough "C" to allow sharp tank tuning, loaded; enough "L" to allow unloaded plate current to drop to 10% of loaded value; high plate voltage; filament voltage at rating or 5% high; high bias and excitation; perfect neutralization without degeneration.

(Photos courtesy Decker Mfg. Co. and Audio Products Co.)

◆

REPEL THE INVADERS

It is well known that commercial stations of various nations hope someday to divide up the present ham bands. For some time commercial stations in Europe and in the U.S.S.R. have been consistently operating in the 160 and 75 meter bands. The longer we let them sit there the harder it will be to dislodge them.

The following stations have been logged in the amateur bands and every ham should try to log them with time, date, character of transmission, etc. These reports should be turned in either to RADIO or to *QST*, care Mr. F. E. Handy.

VP3MR on 7080 kc	British Guiana
JAX 7285	Japan
JEHO 7120	Japan
JAY 7200	Japan
XGJ 7070	China?
EA8AB 7200	Spain
CR6AA 7177	
HB9B 3770, 7022, 14,044 kc	
XU5X 14,300	
XE1EX 3880	ship
ORZY 14,150	ship
K1OAB 7005, 14,010	ship
DZH ?	
LZA ?	

There are undoubtedly many more such stations handling commercial traffic in the amateur bands. The point is that a definite record of all such illegal transmissions must be placed in the hands of the government before it can present an official complaint to the country concerned.

◆

The chimes used at CFAC in Calgary as station identification are the corresponding notes on the scale, C, F, A, C.

A Compact Kilowatt

By JAYENAY

A simple and economical one kilowatt c.w. transmitter capable of 750 watts output on 10, 20, 40 and 80 meters. Total overall cost less than $200 without meters.

There are literally hundreds of different one kilowatt c.w. transmitters (composite) scattered all over the world and no two of them are alike. All, by definition, can be made to draw a kilowatt input from the final power supply. In some cases the actual power output on the fundamental frequency may be 900 watts; in others it may be only 500 watts. All of them represent, in some measure, some form of scientific achievement. However, it should be emphasized that there is a wide difference between a *scientific* achievement and an *engineering* achievement. The scientist tries to get the best possible result. The engineer, on the other hand, tries to get the best result *at a reasonable cost.* Until costs are taken into consideration one is not dealing with practical engineering but with purely academic science. All of us have dreamed, at one time or another, about our own pet idea of the perfect transmitter. However, if dreams are to come true, then idealism must be tempered with considerable practical cost accounting.

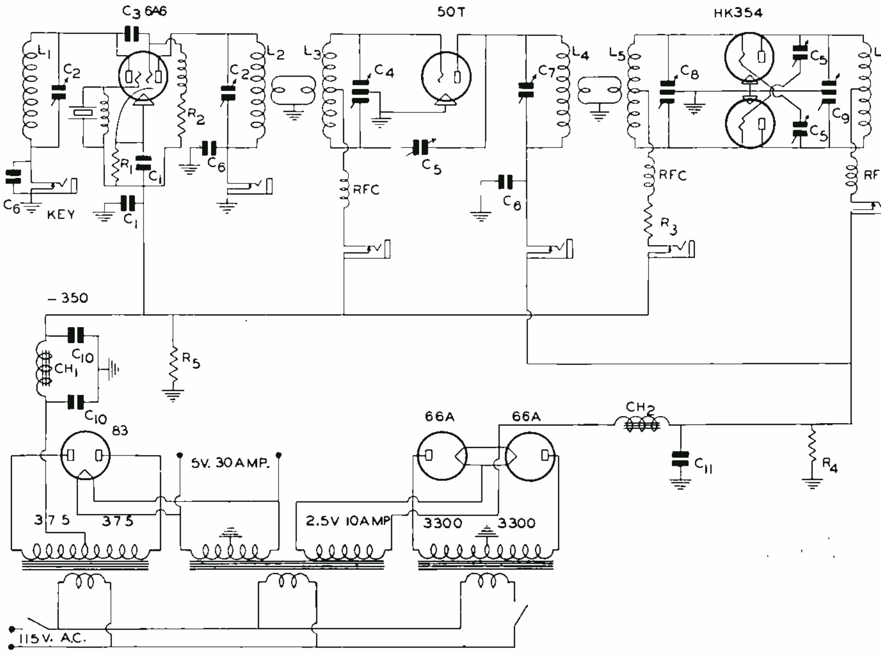
The transmitter shown herewith actually cost $187.75 to build. This is the cost of the parts including hook-up wire, breadboards, and all the miscellaneous bits of hardware that usually never get counted. These are Pacific Coast prices. All of the parts were bought new at retail and these costs should be duplicated anywhere in the U.S.A. Even to play it safe and allow for shipping charges to out of the way localities, $200 is the absolute top. $17.50 was allowed for the high voltage plate transformer, a conservative allowance. You can wind your own for about $7.50; you can get another ham to do it for about $12.50; or you can buy a new one for about $15.00. In this particular transmitter the plate transformer was a 2 kw. pole transformer purchased from a junkman for $5. In many cities the standard price for second-hand pole transformers averages about $1.50 per kilowatt of capacity. Incidentally, don't pick up a pole pig of less than about 2 k.v.a. capacity as most of the second-hand ones of from 750 to 1500 watt capacity will have such poor voltage regulation that bad key thumps will be produced. If a new transformer of standard make is purchased it should be able to give 400 ma. at 3300 volts (6600 center tapped).

The rig is simple and standard practice throughout. It starts out with a 6A6 oscillator-doubler in the regular Jones exciter. As the low voltage power pack acts also as the bias supply for the buffer and the final stage, note that the filament of the 83 low voltage rectifier is grounded. Thus positive is grounded and negative is "high", which puts the cathode of the 6A6 about 350 volts above ground. Thus it is a good idea not to ground the 6.3 volt heater winding on the 6A6 directly, although a .01 µfd. mica bypass will help to eliminate any noise in the receiver when the key is up. The oscillator portion of the 6A6 is keyed in the B plus lead, as any transmitter without full break-in in this day and age is old fashioned.

Capacitive coupling is used into the doubler portion of the 6A6, and it is a good idea to double on all bands, even 80, as it helps to eliminate keying chirps arising from feedback from the buffer and final stages into the oscillator.

The doubler portion has about 10 watts output on 80, doubling from 160; about 8 watts on 40; about 7 watts on 20; and about 5 watts on 10 meters. On 10 meters it is desirable to use one of the new 20 meter crystals, as the 6A6 gets very "unhappy" when operated as an oscillator and quadrupler from a 40 meter crystal. It can be done with regeneration and it has been done, but requires considerable juggling.

The doubler is link coupled to the 50T buffer, which operates on the same frequency as the final amplifier. Several hams who have built similar rigs using a 50T to drive two 150T's or 354's make two bad mistakes and then find themselves shy on excitation to the final stage. First, they run the 50T on 1000 or 1500 volts instead of the full 2500. Remember that the *power gain* through a tube goes up very fast as the plate voltage is raised. Then the second bad mistake is to use *too much* bias on both the buffer and the final amplifier. The buffer must be operated for *maximum power gain* and *not* maximum plate efficiency.



The General Wiring Diagram

C_1—.01 µfd. paper
C_2—75 µµfd. midget
C_3—100 µµfd. mica
C_4—100 µµfd. per section, 2000 volt spacing
C_5—Two 4" square plates, variable gap
C_6—.002 7500 volt mica
C_7—50 µµfd., 6000 volt spacing
C_8—150 µµfd. per section, 3500 volt spacing
C_9—100 µµfd. per section, 7500 volt spacing
C_{10}—8 µfd. electrolytic
C_{11}—2 µfd., 3000 working volts
R_1—400 ohms, 10 watts
R_2—50,000 ohms, carbon
R_3—3000 ohms, 50 watts
R_4—100.000 ohms, 100 watts
R_5—5,000 ohms, 50 watts
CH_1—30 hy., 150 ma.
CH_2—5-25 hy. 400 ma. swinging choke

Therefore its grid bias should be just "cut-off" and no more. Also, the final stage should not be biased beyond twice cut-off. Even at 1.2 times cut-off the power output was over 700 watts with a kilowatt input (20 meters). There is just about enough output out of the 50T to allow proper excitation of the final stage (75 grid ma.) through twice cut-off bias. The important point is that the bias on the final stage should be just enough to allow 65 to 80 grid ma. to flow. It is much better to run at low bias and proper grid current than high bias and very low grid current (neutralized amplifier working on fundamental). Grid neutralization is used on the buffer to allow a somewhat cheaper plate tank condenser to be used and still keep the fixed neutralization advantage of the split stator condenser type of tank. Grid neutralization also eliminates any tendency toward the degeneration which robs so many plate neutralized split-stator stages of a good deal of their available excitation. The buffer is link-coupled to the final amplifier and the final stage is link-coupled to the antenna coupler, which may feed any type of antenna.

Incidentally, the tubes in the final amplifier could just as well go in parallel instead of push-pull with some slight reduction in overall cost. The 354's have such low shunt input and output capacities that they can be paralleled even on 10 meters without any particular difference in operation, except for the increase in even harmonics in the output.

However, as even harmonics are becoming quite troublesome and as the F.C.C. is sending out a large number of discrepancy slips for this reason each month, it was decided to use push-pull.

There is very little else about the rig that needs much comment. The circuit diagram should be self-explanatory.

Don't forget to keep all grid and plate leads as short as it is possible to get them. A three inch lead on 10 meters is too long, and there is no excuse for it where the grid and plate leads are as highly accessible as they are in most of the newer high frequency tubes.

Investigating Committee Minority Report

At the request of many amateurs interested in the policies of amateur radio, we reproduce herewith the minority report of the committee (consisting of New England's Bailey, Chairman, Hudson's Hill, and Central's Roberts) which was appointed at the last meeting of the A.R.R.L. Board of Directors to investigate the many charges against the League's administration which have been made by a large number of amateurs, both in clubs and as individuals, and which have been brought to public light by RADIO and *R/9*. The majority report (a "whitewashing" affair) has, for some unknown reason, been copyrighted and therefore is not reproduced here.

MINORITY REPORT

By E. A. ROBERTS*
Director, Central Division, A.R.R.L.

It might have been assumed that the Investigating Committee, appointed by the Board at its last meeting, was competent to make a thorough investigation. The report which the Board has received from the two other members of the committee, does not show it came from "super-investigators" and I believe it will be challenged by the amateurs at large when it gets into circulation. Both the majority and minority reports should be available to the membership on request, and this minority report will not be copyrighted.

The majority report shows that they just made a "pass" at an investigation and then "ran out". The criticism that will follow this report as "not worth a rap" will be discouraging to the two signers, and will be just like a little breeze that peeps into a calm spell, but which ends up as a regular "he" cyclone.

The chairman† got off on the wrong foot by taking a sunerior attitude that he was the only one to be heard and considered—also did the other member of the Committee who wrote, "Roberts, keep your temper" in reply to my endeavor to get the investigation started.

My first letters to Bailey† went unanswered, and my later letters, calling for certain investigations, were ignored if he was not in accord with the contents, claiming that he had not received them.

The chairman seems to have been willingly influenced by his close friend the Secretary. It is my impression that Warner was kept advised of what was going on in the committee meetings. It was stated by some leading amateurs that the entire investigation would end in nothing more than a "whitewash of Warner" and you can now form your own conclusions as to whether it is or not.

You might ask the question—who was the member of the Investigating Committee who went to Hartford before the committee meeting of August 30-31, 1935 in Cleveland, and spent the day and night with Warner, and what was the object of the visit? Also, at the meeting of the committee held at the Hartford headquarters—why was my portfolio handled while I was out to lunch and what was the motive?

Now for the majority report. The report shows a change in date on Page 13, from December 1935 to February 17, 1936. This would indicate that the report was mimeographed about three months ago. The work was done at Headquarters and written by Secretary Warner from notes offered by Chairman Bailey, and some of the recommendations I made were deleted, although I understood they were to be included in the report, if I signed it. If my signature had been attached to the report it could then have been sent out, as "hunky-dory" and the "boon-doggling" would then have been complete.

I wrote Chairman Bailey that I thought we were going to have some difficulty over Warner's salary, as I could not agree to any $12,000 figure and I believed that the amount should be reduced to $7200—as that is all he is worth. He will never get another kilocycle for the amateurs and more frequencies is what interests the amateur.

First portion of report, "Analysis of Article by Foster[1] in the Magazine *Radio*"; I wanted the name of Foster deleted[2] because there was no sense in attacking Foster when he was not here to answer the charges. I consider this unfair. If it was still necessary to answer Foster's statements made against Warner, it would have been just as effective to refer to the former *Radio* articles.

I recommend that the chief paragraph regarding Mr. Hebert be deleted entirely and the following be substituted:

> Therefore the committee recommends that Mr. Hebert be relieved from further duties in the field, as he has requested with the commendation of the Board for the more than twenty years of faithful service he has rendered to the League, and that he continue his duties as office-manager and credits and collection manager at Headquarters, and that his present salary continue unless changed by the Board at the next meeting.[3]

I wrote Bailey: I believe the Communications Department of the League should take charge of the field contacts but would not insist upon it if it was not sustained; I am willing that it be taken over by the Secretary, but not by the assistants. I believe the Secretary and other heads of departments should get out into the field and represent the League. If we are going to create a better understanding throughout the country among the amateurs, we have got to use the best and most influential representatives we have at Headquarters.[4]

[*Continued on Page 91*]

*W8HC, 2699 Endicott Road, Shaker Heights, Cleveland, O.

†G. W. Bailey, Chairman of the Investigating Committee, 74 Webster Road, Weston, Massachusetts.

[1]The late Colonel Clair Foster, W6HM, gentleman, ham, and the grand old fighter of and for amateur radio.

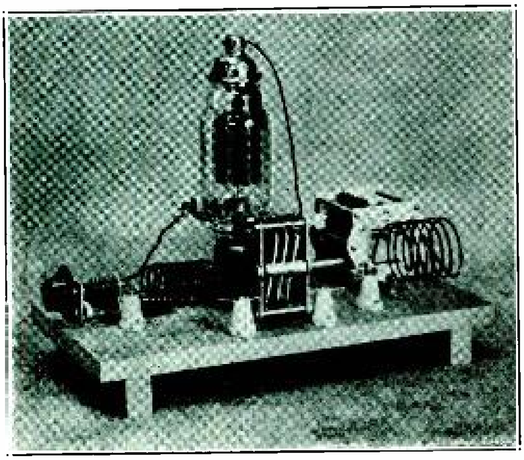
[2]Col. Foster's name is mentioned 26 times in the first five pages.

[3]The majority report recommends a salary of $4000 per year, and specifies that his duties as office and credit and collection manager are to be under the direction of the Secretary (rather than under his own direction as Treasurer?).

[4]The majority report recommends that three Assistant Secretaries be appointed, that two be on duty in Hartford and the third spend about one-third of his time in the field.

Ten Meters in Ten Minutes

By Herb Becker, W6QD



The breadboard high-power regenerative 10 meter doubler. A visitor dubbed it an "outboard" 10 meter unit, because it is just "clamped on" to a regular 20 meter transmitter.

After two days of the dx contest had rolled by, it became quite obvious that unless one could take advantage of the 10 meter band he might as well pull switches and go fishing. The rig at W6QD could have been put on 10 meters, but it would have entailed considerable "cutting into" the works, and would have required considerable time. Besides, the rig is designed for quick 20-40 meter change, and to put it on ten would have meant the sacrificing of this valuable feature. It was decided to stick to 20 and 40 rather than do anything that would slow up the band-changing procedure.

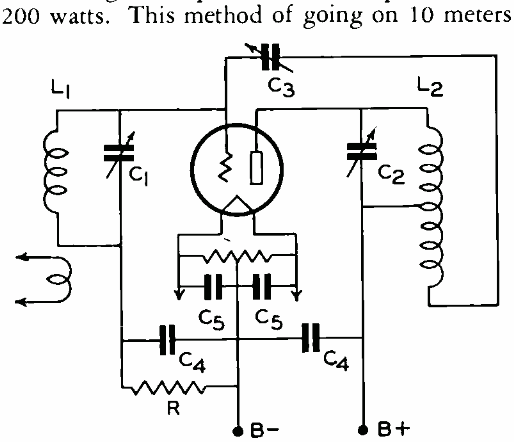
But the third day we made the mistake of listening on 10 again, and after hearing the local boys working the world down there nothing would do but that we muscle in on some of the choice stuff they were working.

Then an idea dawned. After much scurrying around the neighborhood to collect enough parts without having to make a trip to the city, enough stuff was carried off underneath the old overcoat to put together the circuit shown in the diagram. True, it is not a thing of beauty, but there wasn't time for such refinements as nice appearance. The main thing was to get it built and working. In fact, the parts were mounted and wired in a little over 10 minutes. The only thing that we missed fire on was the grid coil, which was found to be a little large. It was cut down to the number of turns specified in the diagram and the rig really went to work. The actual output was found to be in the neighborhood of 300 watts, and the tube did not get excessively warm so long as the stage was being keyed. Considering the frequency and the fact that the tube was doubling, this was really something to write home about.

The 10 meter unit was put on a shelf near the final stage of the regular transmitter, and to go on 10 meters it was merely necessary to disconnect the antenna from the 20 meter final, couple the link from the grid of the HF300 to the final plate coil of the twenty meter transmitter, and pound the key. This took less than 30 seconds.

Efficiency and Excitation

The extremely good doubler efficiency was partly due to the great abundance of excitation available. But dropping the excitation to a value corresponding to an 834 or 50T 20 meter driver stage still permitted an output of over 200 watts. This method of going on 10 meters should appeal to amateurs who have 20 meter rigs which they do not wish to "disturb". Also, it allows almost instantaneous band change. The 20 meter rig and the 10 meter doubler may be left alone when once set; it is not necessary to retune when tying on the high powered doubler stage.



The High Efficiency Doubler
C_1—35 μμfd. midget, 3000 volt spacing
C_2—50 μμfd., 6000 volt spacing
C_3—35 μμfd., 6000 volt spacing
C_4—.002 μfd., 5000 volt mica
C_5—.002 μfd., 1000 volt mica
R—50,000 ohms, 75 watts
L_1—9 turns no. 10 wire, 1½ in. dia.
L_2—7 turns no. 10 wire, 2½ in. dia., tapped at center.

With about 2000 volts (if sufficient excitation is not available, it may be necessary to use less plate voltage) on the plate of the HF300, tune C_2 for minimum plate current, after first adjusting C_1 for maximum grid current with the plate voltage off. The antenna is then coupled to L_2 (preferably inductively) and loaded up as much as is possible without the HF300 showing more than a suggestion of color during keying.

Primary keying was used on the HF300 unit, as this method is used on the regular transmitter and has been found very satisfactory.

Other tubes may be used in the doubler, but the HF300 was found particularly adapted for this use because of its high μ and low interelectrode capacities.

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The F.C.C. Looks Ahead

At a meeting on Friday, April 3, 1936, the Commission approved a recommendation of the Chief Engineer for an informal engineering hearing before the Commission en banc on June 15th for the general purpose of obtaining information concerning the problems involved in the allocation of frequencies to the various classes of service.

In this memorandum the Engineering Department reported that radio, by reason of recent technical progress, has arrived at a cross-roads in its application to the service of the public and as a result thereof the Federal Communications Commission is confronted with some pressing problems of basic importance, the successful solution of which will constitute another milestone in the history of communications.

The Engineering Department states that in its opinion the foremost important technical radio problems requiring the attention of the Commission are as follows:

> "1. Providing new radio frequency channels for public services in classes of communication other than broadcasting, as well as providing for all classes of radio service in the interest of safety of life and property.
>
> 2. Frequency allocation improvements to the existing broadcast structure—550 to 1600 kc.
>
> 3. Visual broadcasting (television and facsimile).
>
> 4. Oral broadcasting on frequencies above 1600 kc.
>
> Peculiarly, the solution of these four broad problems is so intrinsically interrelated that not one of them should be decided upon without consideration of the other three."

The Chief Engineer stated that of the problems confronting the Commission, visual broadcasting perhaps most complicates the situation by reason of two factors, namely:

> "1. The technical requirement for an extremely large portion of the limited ether spectrum, thus restricting the amount which would be available for services other than broadcasting.
>
> 2. The economics of visual broadcasting, including the possible economic effect it may have upon existing aural broadcasting and the existing receiver manufacturing industry, as well as the newspaper and motion picture industries.

If more data were available with respect to these two factors of visual broadcasting, the Federal Communications Commission might have sufficient detailed information to warrant its proceeding immediately with confidence in the solution of the other three radio problems on a more permanent basis; but visual broadcasting is still deep in the experimental status from both technical and economic standpoints.

The other three problems are not quite so complex as visual broadcasting, and while there is still insufficient data regarding wave propagation in large portions of the spectrum, there is enough information relative to propagation in certain portions of the spectrum to permit more definite progress along specific lines, and in this connection at present there appears to be a need for opening new portions of the spectrum in the service of the public. Furthermore, the possible intrenchment of various developed services, particularly those of the Government, by vast expenditures of money, is a factor of compelling importance."

The Engineering Department stated that of the various courses of action available to the Commission, it believed that the most sound course for the Commission to pursue in its solution of the pressing radio problems was "to proceed upon the doctrine of 'evolution and experimentation' by encouraging development and use of frequencies along definite lines as may be indicated from time to time from accumulated data, and by holding informal hearings as necessary to facilitate progress in detail."

The more important specific recommendations of the Engineering Department were as follows:

> "1. In new allocations or in reallocations of radio frequencies to services or to stations within services, proceed on the basis of 'evolution, experimentation and voluntary action' rather than by radical and enforced costly changes. Modifications which do not involve large expenditures or are necessary requirements to keep abreast of the technical art should be accomplished.
>
> 2. Encourage communication development along specific lines as may be indicated from time to time from accumulated data and from evidence secured from such informal engineering meetings as may be necessary to facilitate progress in detail.
>
> 3. At a date in 1936, preferably in May or June, to be determined later, hold an informal engineering hearing before the Commission en banc for the purpose of:
>
> (1) Determining in a preliminary manner the most probable future needs of the various services for frequencies above 30,000 kc.
>
> (2) Securing for the public and the Commission a keener insight of the conflicting problems which confront the industry and the regulatory body in the application of the new frequencies to the service of the public.
>
> (3) Guiding experimentation along more definite lines as may be justified from the evidence presented at the hearing.
>
> (4) Reviewing frequency allocations to services in the radio spectrum below 30,000 kc.
>
> (5) Assisting the Government in its preparation for the International Telecommunications Conference at Cairo in 1938.
>
> The Interdepartment Radio Advisory Committee should be invited to attend this hearing.
>
> 4. Delay permanent allocation of frequencies above 30,000 kc. to various classes of service until after the hearing mentioned in 3. above, and also until after an executive order on the allocation of these frequencies to Governmnt services has been decided upon.
>
> 5. In the meantime the Engineering and other interested Departments should prepare minor modifications of existing regulations for experimental operation above 30,000 kc., to be effective immediately, and so designed as to encourage progress and at the same time avoid illogical "intrenchment" pending final determination of the allocation of these frequencies to various commercial services.
>
> 6. Encourage standardization of visual broadcast transmission performance by authorizing the Engineering Department to cooperate with the Radio Man-

[*Continued on Page 83*]

"What Voltage Will You Have?"

By Chas. W. Cover,* W8KVJ

Did you ever stop to consider the advantages of having a choice of line voltages ranging from 10 to 120 volts in 10 volt steps? Of course one can always *cut* voltages by using series resistance, but this method represents a loss of power and does not permit good regulation.

Most amateurs shy from winding plate transformers because of the large number of turns of small wire required. But did you ever stop to consider that a 120 volt step-down autotransformer has but a single winding, needs no especial care in the way of insulation, and requires but 200 turns or so of large wire that is much easier to wind than number 28 or number 30? Winding a plate transformer may be a job all right, but a 120 volt autotransformer is "duck soup" once a suitable core or core material has been obtained.

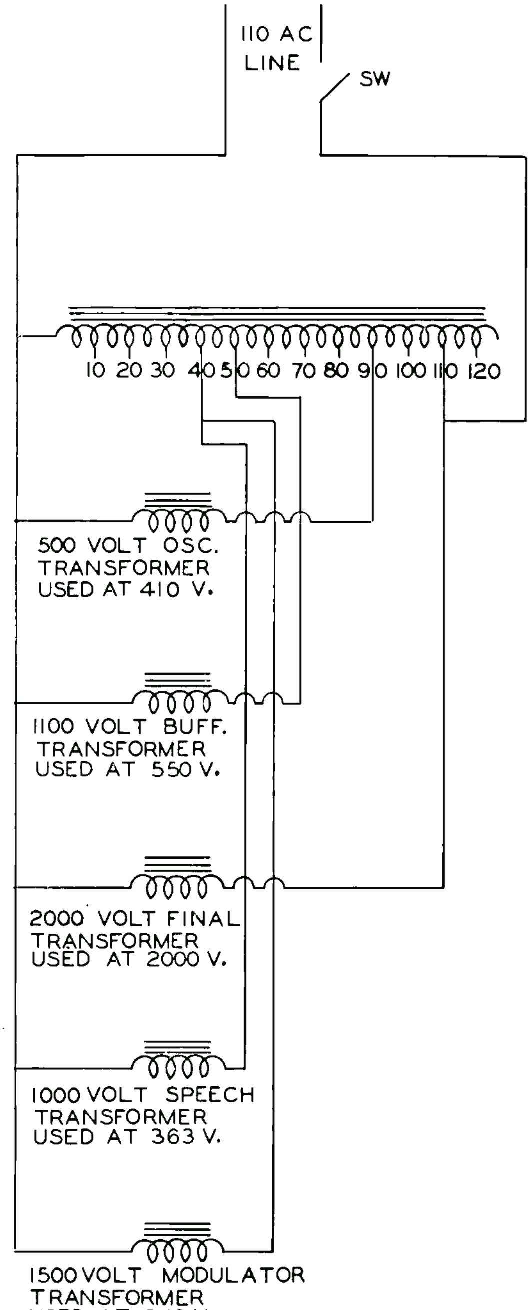
With a husky autotransformer giving one a choice of voltages for the different transformers in the "rig", one may buy plate transformers for higher voltages than are actually needed at the time, and then one may still use the transformer at a later date when going to higher power, the ambition of most any normal amateur.

Another very useful feature is that it allows one to reduce power (without affecting voltage regulation) when tuning up the transmitter. Also, one may adjust the plate voltage on each buffer stage to where just the right amount of input is drawn for that stage.

By a simple switching arrangement, one may QRP on local QSO's to almost any desired input on an instant's notice. Very few stations show such consideration when working local: they say it is "too much trouble to cut power". With an autotransformer and a switch or two it is no trouble at all.

Then too, sooner or later you are going to want to use a 10 volt filament transformer on 7½ volts, or a 7½ volt one on 6.3 volts. It *can* be done with series resistance, but the autotransformer method is simpler and better.

The system as used here consists of the autotransformer with two G.R. jacks for each tap of the autotransformer. In this way more than one plate transformer may be served from the same tap on the autotransformer.



Autotransformer Hookup as Used at W8KVJ

*1618 Hoge Ave., Zanesville, Ohio.

Construction, as has been mentioned, is not in the least difficult. The transformer used here was built oversized so that the rig could grow to a kilowatt without the autotransformer becoming too small. Besides, it is just as easy to build a big one as a small one, and the materials cost but little more.

The core consists of straight laminations, equal amounts of 2 x 2 and 2 x 5. The cross section is 5 square inches (2" x 2½"). The core should be preferably high and at least medium silicon steel so that losses will not be excessive. Good silicon steel may be bought quite reasonably and is very much superior to stove pipe iron. For the method of building up the core refer to any handbook or periodical giving data on transformer construction. This has been covered many times and need not be gone over here.

The winding for this core was made of number 9 wire. 220 turns were wound on, with every 20th turn tapped and brought out to two G.R. jacks. Other methods of making switchable connections may be used, but the plug-jack method has been found very handy. To QRP I merely take the plug for the final plate transformer and plug it into a lower voltage jack.

The actual hookup of the transformer as used at W8KVJ is shown in the diagram. The hookup is self-explanatory.

◆

The Farnsworth Multipactor Tube

Mr. P. T. Farnsworth, of high-definition cathode ray television fame, recently demonstrated a number of his new secondary emission multipactor amplifier tubes based on the experimental tubes used in the original demonstration described for the first time in RADIO for September, 1934.

These new tubes utilize the same principle of secondary electron emission from a coated anode-cathode that characterized his first demonstration. The new tubes are greatly refined and can be used for any of the ordinary triode, tetrode, or pentode tube functions. They act as oscillators, amplifiers, and detectors with overall efficiencies comparable to conventional types of tubes. The Multipactor tube uses no heated cathode as a source of electrons. The electron flow is initiated by photo-electric emission from a prepared surface after which the emission is continued by alternating cycles of secondary emission between two parallel surfaces which alternately act as anodes and cathodes. The effective anode from which the load current is taken is a third, ring-shaped element which picks up electrons from the two sources of secondary electrons. There are sometimes other electrodes placed in the envelope to provide focusing of the electron stream as well as to provide various controlling functions similar to that of grids in conventional hot cathode tubes.

One special multipactor tube is designed primarily for use as an oscillator. The frequency-determining tank circuit is well isolated from the load circuit and changes in load have little effect on the frequency of oscillation.

The main use for the multipactor lies in a low-level picture frequency amplifier where thermal tube noise prevents the use of hot-cathode preamplifier tubes. The multipactor has an inherent noise level at least 20 db below that of the best hot-cathode tubes available at the present time. As the picture impulses from the Farnsworth Oscillite (pick-up tube) are extremely weak, it is quite important that quiet preamplification be used to get the picture signal up to usable levels.

The idea of amplifying by using secondary emission was first suggested by Hull about 1917. Farnsworth probably made the first dependable amplifier using this principle, as the early tubes were so unstable as to be almost useless. Recently Dr. Zworykin developed a multi-stage amplifier tube using this same general principle; so unless RCA and Farnsworth pool their patents there may be an argument as to who got there first.

The Multipactor tube is interesting from a commerical radio standpoint in that it may be capable of generating patent-free oscillations. Practically all available oscillator circuits are patented and controlled by one patent group. Speaking of patent-free sources of high-frequency oscillation suggests the idea of shock excitation of a very high Q tuned circuit such as a quartz crystal by means of a low frequency buzzer (as suggested by Lamb) in order to get around the oscillator patent situation.

From the amateur standpoint the Multipactor tube may have economic advantages in frequency multiplication or modulation but it is probable that Multipactor tubes will be rather expensive at first.

◆

KGMB has got all the "bugs" out of their transmitter, but are now bothered with lizzards. It keeps the technicians busy preventing the tiny two-inch creatures from getting themselves cooked in the transmitter.

28 and 56 Megacycle Activity

[Reports and other material referring to the 28 and 56 mc. bands, should be sent to E. H. Conklin, W9FM, Assistant Editor of RADIO, 512 No. Main St., Wheaton, Illinois, who will correlate and assemble the data for publication. Reports should *reach him* by the 22d of each month.]

◆

28 Megacycles

The International Contest in March provided an opportunity to check ten meter operation relative to other bands for ease—or difficulty—in raising dx. At W9FM the VK quota was filled promptly on March 13 and 14 around sunset. On Saturday the 14th, Europeans were still being heard at 3 p.m. Eastern time, a condition which had carried over from the latter part of February. The next day, Sunday, was excellent and opened to allow a contact with LU9AX before 8:30 a.m. The Europeans were heard shortly thereafter, and lasted until about 4 p.m. with excellent signal strength.

Contrasted with this was the condition of the 14 mc. band. This band for several weeks while 28 mc. was so good, was opening in Illinois at 7:00 a.m. for Europe, an hour earlier than the average over the past two years. Signals were weak until early evening when they rose to high levels and stayed in until just a few hours before sunrise. Even J's were heard around 3 to 4 a.m. Mid-day signal strength was superior on "ten".

This "summer" condition on twenty meters tended to disappear over the next few days, the band opening later and closing to Europe earlier—except for stations in Spain and Portugal which always seem to come through longer than more northern Europeans. With this decline in 14 mc. conditions, 28 mc. passed out for Europe and Africa, which may be the first really bad period since last autumn. The W6's still worked J's while Australian and South American conditions were unchanged. From early reports we learn that conditions to the east were poor but gradually improved until Sunday, March 22. On this day, ZS1H came through fine, followed later by the Europeans, ZS2A, ZE1JJ, FA8BG, and some others. We looked for SU1SG but apparently he was not on the air the second Sunday of the contest. Good strength for the Europeans did not occur until noon, and lasted for several hours. Even so, the Africans and Spaniards remained the best.

We have for some time felt that ten meter work to Europe will largely be a winter affair due to summer absorption which could cause weak signals from three to six months of the year. The condition of the path to Japan could be similar except when daylight is too short in December and January. The lack of east-west inter-continental work in the southern hemisphere between October and March partially confirms this thought. It will be interesting to check the prediction during the coming month; the basis for it was outlined in *R/9* for October, 1935, in the article entitled, "Propagation of Short Waves from the Eastern U.S.A."

Best Time for J's

By the date of this issue of RADIO we expect that contacts with J's will thin out. Because of a feeling that the east coast could work J's better if the latter were on the air earlier, we put the question up to Kunio Shiba, J2HJ, and received this reply:

"You urge us to get on earlier in the morning so as to make Eastern amateurs able to QSO Asian stations. Yes, we will do our best to have the pleasure of QSO with Eastern stations, but in spite of CQ-ing within an hour after sunrise, there comes no answer, though I can hear numerous strong phones of W. Perhaps our weak sigs merge into QRM. In November last year I could contact W2, W4 and W8 at about 2230 G.m.t. (5:30 p.m. Eastern time) so I expect we can QSO in early March at that hour."

From Frank South, W3AIR, we learn that a new four element broadside beam for receiving and transmitting brings in the J's—as predicted by J2HJ. Frank worked all continents on March 11 in six hours, starting with OE1ER at 12:50 p.m. and finishing with J2HJ at 6:49 p.m. His phone w.a.c. (40 watts) was completed with J3FK.

Station Reports

HJ3AJH: To March 10, twenty-seven countries were worked on "10" from this location, 9000 feet above sea level. The best contact was VK6SA, who becomes the first VK6 to contact South America on *any* band. It appears now that South America, VK's hardest continent to work, will become the easiest with the opening of 28 mc. Have QSO'd thirty VK's with frequent contacts between midnight and 2 a.m. local time. The band is frequently open for VK-ZL from 4 p.m. to 3 a.m. J2HJ has been heard often but only R3, usually fading for twenty minutes or so between 6 and 8 p.m. W and VE are good from 8 a.m.

to 6 p.m., with W9 best and most consistent. Europeans and North Africans good around 8 a.m. and noon, lots of fading in between. Have yet to hear ZS1H on 28 mc. Using HRO; transmitter, two 800's with about 35 watts input. QSL under cover care of L.C.R.A.

J2HJ: West coast contacts continue in March. Eastern U.S.A. worked often in November and March. Using two 203A's on 28 mc. and lower frequencies. Expect to replace 203A's with 860's.

G6NF: Worked all W and VE districts when QSO VE5EO on March 5.

LU1EP: The band has been f.b. for W during the March contest.

K7PQ: Have worked some W's during the contest.

W2DTB: On the week-end of March 22, European signals were well below par. LU9AX, LU9BV and LU1EP were the best South Americans. HJ3AJH and OA4J were R6 all day long. ZS2A and ZS1H were audible from 1300 to 1900 G.m.t. ZU6P also came through around 1700 G.m.t. FA8BG and CT3AB were R6 throughout the day. VK3CP, VK2LZ, VK3HL and ZL2KK were the only ones heard from Oceania. ZL2KK came through around 2100 G.m.t. and held up until 0000 G.m.t., during the last hour of which the VK's were heard. No J's.

W3AIR: Completed phone w.a.c. March 11. Did one on c.w. in six hours. The new four element broadside array is the answer to the Asia question.

W9ISU: Conditions good in early March. VU3DV heard with a.c. note about 9:30 a.m. central time, March 1. Got R9 from D4ARR on March 10, although I was using only a 203A *quadrupler*.

W9KPD: Up to March 16 the 28 mc. band had not been dead since at least last November. Europe comes through every morning from 7 to 11 a.m. central time. On March 2d I was QSO VU3DV (India) making me the first w.a.c. in Fort Wayne. This is probably the first W9-VU QSO on 28 mc. (W9NY worked VU3DV on the 3d for a half hour beginning about 8 a.m. central time.)

W5EHM: On February 20, I heard or worked K6, VK and ZL after 8 p.m., unusual here in Dallas for the season and time of day. Lots of K6 stations are coming in, also K4DDH on phone. Other phones heard through March 3 are G5BY and OZ2M. Most of the European work in the above period was done between 9:50 a.m. and 12:30 p.m. Central time.

W6KB: All continents except Asia have been worked; am using a horizontal half wave antenna with a twisted feeder.

W7AMX: The band was "hot" March 1 to 5 inclusive. Worked all continents but Asia in *three* hours on the 5th, but couldn't find an Asian. During the first part of the March Contest, all continents except Europe and Africa were worked; the latter were not heard.

W7AVV: 28 mc. up to March 9 has been just about as steady and reliable as the rest of the bands now. I hear all continents quite regularly and have worked them all a couple of times. The band is full of W stations every day from early morning until about dark. VK and ZL come in until about 7:30 p.m., Pacific time. Sev-er K6's really hang through here on phone: K NJV, K6MVV, K6NEK, K6FJF and K6BAZ. K FJF puts through an R9 signal with only 6 wa s input. HJ3AJH is the most consistent So h American now. EA4AO is the best Eu opean. ZS1H still comes through every morn-in

G6ZU: Got going on ten meters during the early pa of March. On March 5 worked a number of W stations; on the 6th hooked U9AV in Or k, Siberia. Among others heard on Sunday th 8th were W6GRX, W6GRL, and YR5CP. Th e hours after dark on Friday the 13th was QS) W7ESN.

G6CJ: Major accomplishment in early March was w. c. in 3¾ hours. The band now holds up till ab t 2100 G.m.t. (4 p.m. Eastern time). On M ch 11 I thought I had worked all W dis-tri s but found that I had overlooked working on of the W8's that were rolling in.

W9TB Made a number of contest QSO's on 28 mc used a regenerative preselector with an ac tube, to boost weak signals, ahead of an HI).

W6VB Worked HB9J for first HB-W6 QSO. He d OE1FH, OK1AB, D4GWF, F8CT, EA AO. Am still calling the last one, who is hy ar the loudest European. Hear ZS1H weak at round 8 a.m. Pacific time. LU, OA, CP, H etc., come through later in the day. Japan is eard from 2 to 5 p.m., during which time VK stations are at their best. Am driving an HI 54 with an RK20.

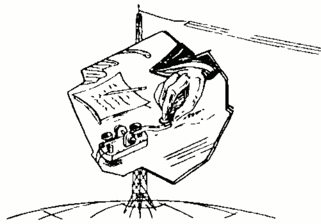
ON4N All continents heard in January; all U.S.A. dis icts. W7ALA on phone, W6BAM and W WB on code, heard. 51 W's worked out of 11 heard. Using 50 watts into a pair of 46's; SW for receiving.

W9NY Worked VU3DV (28.6 mc.) for a half ho March 3, about 8 a.m. Central time. Heard J3 on February 29 from 5:40 to 7:10 p.m.; an J2HJ on March 4 from 5:40 to 6:20 p.m.

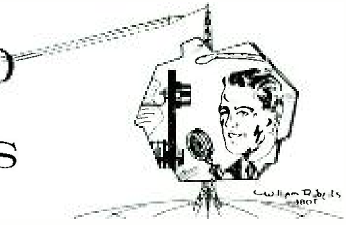
F. C arman, G6CJ, decided that the 27-day cycle c solar activity should favorably affect the 28 nc. band on March 8, and "fired up" the rig He raised VK3BD at 0945 G.m.t., U3AG at 0955, LU9AX at 1007, ZS1H at 1120, U2AU at 1140. Then an interminable wait fo the first W or VE to show up—which was W DCK at 1325. Elapsed time: less than 3¾ ho rs. His transmitter uses only 50 watts input t a power doubler, probably operating at arou d 30% efficiency. The antenna is a vertical doublet with single wire feed; it is 1½ waveler gths high.

We ould be particularly interested to see several ogs covering a number of months, with observa ons satisfactory to work out the correlation between band conditions and solar activity a d rotational period. The mean lunar month 29 days, 12 hours, 44 minutes, 2.87 seconds —about 29.53 days to you—while the sun's m an rotational period is 25-38 days; the

[Continued on Page 90]



CALLS HEARD AND DX DEPARTMENTS



Numeral suffix indicates "R" strength. Send Calls Heard to Calls Heard Editor*, not ***to Los Angeles.***

Robert Douglas Everard, Westgate House, Gt. Gransden, Sandy Beds, England
January 7 to February 7, 1936

(3.5-3.9 mc. phone)

W 1ADM; 1BR; 1CND; 1FCE; 1LI; 1QV; 1ZK; 2HYP; 2KR; 2QY; 3AXR; 3BJ; 3DKX; 3DMR; 3DQ; 3DRO; 3DRY; 3EFS; 3FJU; 3FVF; 3NK; 3UD; 4ALD; 5MS; 8AY; 9ETT.

(7 mc. phone)

CN8MI; CN8MN; CN8MW; EA3FF; EA3JZ; EA3LY; EA6AD; EA8AJ; FA8BE; FA8CC; FA8CF; FA8QC; FT4AG; FT4AJ; TI1AF; TI2OFR; VP2CD; VV5AM; YR5IY.

(14 mc. phone)

W 1ACQ; 1AGW; 1AJZ; 1AKR; 1ATD; 1ATS; 1AWD; 1AXA; 1AZN; 1BDN; 1BHY; 1BIC; 1BR; 1BSN; 1BVS; 1CAV; 1CHG; 1CND; 1COJ; 1CRW; 1DEO; 1DFI; 1DHS; 1DNL; 1DSK; 1ERO; 1ESU; 1HEM; 1IAS; 1IFD; 1IFE; 1IGE; 1ILQ; 1IQY; 1IYI; 1KJ; 1KK; 1QV; 1UH; 1VA; 1ZD; 2ADI; 2ADJ; 2ADV; 2AIH; 2AIQ; 2AYJ; 2RBI; 2BFB; 2BG; 2BSD; 2BYP; 2CFU; 2CLA; 2CLS; 2CMT; 2CZP; 2DA; 2DH; 2DOZ; 2DPA; 2DX; 2DZJ; 2ECE; 2EDT; 2EDW; 2ELO; 2EOY; 2ETD; 2EVI; 2EUG; 2EWA; 2EXN; 2EYY; 2EZC; 2FAR; 2FLO; 2FUP; 2FYD; 2GDU; 2GFH; 2GKO; 2GMG; 2GNT; 2GOQ; 2HAU; 2HBJ; 2HFS; 2HGN; 2HMD; 2IWT; 2IXY; 2JJ; 2KR; 2OJ; 2QZ; 2UK; 3ABN; 3ACX; 3ADM; 3ADO; 3AER; 3AHS; 3AID; 3AN; 3AVL; 3BDI; 3BFH; 3BLQ; 3ROF; 3BUH; 3CC; 3CEI; 3CKT; 3CNY; 3CRG; 3CUB; 3DEK; 3DPC; 3DPN; 3DQ; 3EHY; 3EOZ; 3EXE; 3FBF; 3LN; 3LP; 3MD; 3PC; 3ZX; 4AGR; 4AH; 4AHH; 4BTR; 4BYY; 4COT; 4CPG; 4DBC; 4DFU; 4DLH; 4DQD; 4DQZ; 4DW; 4EC; 4FK; 4OC; 4ZF; 5AHK; 5ERP; 5FEI; 6KM; 8ADU; 8ATH; 8AVD; 8CDW; 8CHT; 8CNA; 8CPC; 8DFB; 8DLD; 8DW; 8HAF; 8HER; 8HTX; 8IHY; 8IMF; 8IV; 8IY; 8JOC; 8KQ; 8KQQ; 8LFE; 8LPI; 8MDU; 8ZA; 9AID; 9ARK; 9AYH; 9BG; 9BPK; 9DXP; 9FDI; 9FJ; 9HLG; 9JSZ; 9KBM. — CO2HY; CO2RA; CT1BY; EA3ER; EA8AF; G2XV; HI5X; HI6O; HI7G; I1TT; K4DDH; LA1G; LA1V; LA2Y; LA2Z; LA4N; OK2AK; OK3VA; OZ7T; OZ9Q; SU1RK; TI2AV — VE 1AW; 1CR; 1DC; 1DQ; 1DT; 1ET; 1GR; 2BE; 2BQ; 2CA; 2EY; 2HY; 3EO; 3GO; 3HC; 3JV; 3IT; 3IX; 3LL; 3NF — VO1H; VO1I; VP2CD; VP9R.

K. Yuasa, J3FJ, 3-Chome, Kamomecho, Naniwaku, Osaka, Japan

(28 mc.)

W 4EF-2; 6AWT-8; 6RAM-4; 6CKW-2; 6DHZ-7; 6DIO-3; 6EPZ-3; 6EWC-5; 6FM-8; 6GRX-5; 6JN-5; 6JNR-6; 6JPU-7; 6KIP-6; 6RH-6; 6VQ-4; 7AMX-6; 7AVV-7; 8CRA-4; 9NY-5 — PK3ST-4 — VK 2HY-7; 2HZ-6; 2LZ-7; 3BD-8; 3BQ-4; 4BB-7; 4EI-9; 4GK-8; 5KL-4; 5SU-5; 5WJ-4; 6SA-8 — VS6AH-6; ZL2KK-4.

Wayne Cooper, W6EWC, Box 59, R.R. No. 1, Santa Barbara, California
December 1, 1935 to January 31, 1936

(28 mc.)

W 1AEP; 1AF; 1AFD; 1AFU; 1AHI; 1AJZ; 1AKE; 1ANA; 1APL; 1APU; 1AQD; 1ARC; 1AUR; 1AV; 1AVJ; 1AVV; 1AYX; 1RBT; 1BHJ; 1BJP; 1BNM; 1BMN; 1BU; 1BUX; 1RVL; 1BZE; 1CAA; 1CJH; 1CTW; 1CTZ; 1DBE; 1DF; 1DHE; 1DQD; 1DSZ; 1DSY; 1DUK; 1DVR; 1DZE; 1EBR; 1EFQ; 1EHT; 1EOG; 1EWD; 1EWF; 1FJM; 1FOZ; 1GBE; 1GVE; 1HDQ; 1HQN; 1HRX; 1HSF; 1HWP; 1HX; 1HXW; 1IQZ; 1LZ; 1ME; 1NW; 1RA; 1RB; 1RN; 1SZ; 1WV; 1ZR; 1ZE; 2AAL; 2AER; 2AFF; 2AFU; 2AIW; 2AMM; 2AOG; 2AOL; 2AWF; 2AXS; 2AYB; 2AYJ; 2AZL; 2BCR; 2BDZ; 2BHM; 2BQK; 2BYD; 2CDG; 2CJM; 2CTK; 2CZB; 2CZV; 2DVV; 2DYN; 2DYR; 2EWH; 2FAR; 2FF; 2FWK; 2GJB; 2GJK; 2GPV; 2GUD; 2HFM; 2HFS; 2HIJ; 2HQY; 2HYS; 2JN; 2JZ; 2MB; 2SZ; 2TP; 2UK; 2VL; 3AIR; 3AJV; 3AUC; 3BEU; 3BIW; 3RPH; 3BQJ; 3BVN; 3BYF; 3BZ; 3BZB; 3COP; 3DX; 3EMF; 3EMM; 3EVT; 3EXW; 3FAR; 3FCU; 3JM; 3PC; 8ANN; 8ANO; 8AON; 8APB; 8APQ; 8BCT; 8RFU; 8BKP; 8BOK; 8BSW; 8CHO; 8CRA; 8CTE; 8CYW; 8DHC; 8DLT; 8DSE; 8DSU; 8DVX; 8DYK; 8EQ; 8FDA; 8FCW; 8FQF; 8FSK; 8HGW; 8IBM; 8IIL; 8IRC; 8IXS; 8IY; 8JIN; 8JLQ; 8JV; 8JVR; 8KOL; 8KTW; 8KQ; 8KZH; 8LEA; 8LVR; 8MAH; 8MWL; 8MQQ; 8MYF; 8NK; 8PCZ; 8ZY — CO6OM; EA4AO; F8CT; F8OL; FA8BG; FA8IH; G5BY; G6RH; HJ3AJH; J2HJ; J2LU; J3FK; K5AC; K6CRU; K6CGK; LU6AX; LU9AX; LU9BV; OA4B. — VE 1BR; 1CO; 1DQ; 1DZ; 2EE; 2HS; 2OC; 2TX; 3DU; 3EA; 3MJ; 3PL; 3WA; 4EL; 4EM; 4GW; 4HA; 4IG; 4IZ; 8NI; 8QY; 8RO; 8SH; 8TR; 8TV; 4UM; 4UN; 4UY. — VK 2EO; 2HZ; 3RD; 3BQ; 3CP; 3JJ; 3KX; 3YP; 4AP; 4BB; 5JC; 5ZC. — VO1C; VO4Y; VP5PZ; XE1AA; XE1AG; XE1CM; XE1CZ; XE1FL; XE1N; XE2CG; ZL1FT; ZL1GX; ZL2RG; ZL2KK; ZL3DJ; ZL5JC; ZS2A.

Ishiro Terumichi, J2LK, 344-6 kitashinagawa shinagawa, Tokyo, Japan

(7 mc.)

W 1GF-5; 3ST-3; 5ADZ-6; 5AFU-5; 5CQO-6; 5DSH-3; 5EHM-7; 5ZF-7; 8ZX-4; 9AEN-6; 9AVO-5; 9BJH-6; 9CES-4; 9CXI-4; 9LNF-5; 9PAO-4. — CR7AJ-5; D4BEC-5; D4BOC-5; D4CAF-7; D4UAJ-5; EA5BC-6; F8LA-4; F8LX-3; FM4AB-5; FM4AF-5; HAF3BZ-4; HS7RI-6; LU2EG-6; LU4DC-6; MX2A-9; OE7JH-5; OH3NP-5; OH5NR-6; OH5NZ-7; OK1AB-5; OK1ZR-4; SP1BB-5; U3CV-5; U3QT-5; U5AH-5; VE1FN-6; VS3AE-5; X2C-8; YT7VN-4; ZS1BB-6; ZS1Z-7; ZS2X-3; ZS6AF-3; ZS6AL-7; ZS6AV-3; ZT6AC-3; ZT6AC-5; ZU1L-3; ZU1T-5; ZU6P-6.

(14 mc.)

W 1AQH-4; 1BUX-8; 1CMX-7; 1CQR-5; 1CUN-4; 1GF-7; 1GUX-3; 1HUO-7; 1LZ-6; 1TS-8; 2AIF-6; 2ARB-4; 2BHW-3; 2BHZ-5; 2BSR-5; 2RVJ-5; 2BWF-7; 2CVJ-3; 2DIB-7; 2DEU-7; 2DEW-3; 2FHI-6; 2FLG-5; 2FVT-7; 2GKR-4; 2OA-5; 3QP-4; 4BBP-5; 4RBR-3; 4CEN-8; 4DHZ-9; 4KE-3; 5AFV-5; 5BEQ-4; 5BNO-5; 5CAE-7; 5EGA-5; 5LA-7; 8BOF-4; 8CNZ-5; 8CRA-9; 8CXC-5; 8DGP-8; 8DGR-5; 8DHC-6; 8DVS-5; 8FBW-7; 8FSK-8; 8GQU-3; 8GSZ-5; 8GWE-6; 8JJW-8; 8OE-6; 8ZY-7; 9ABB-3; 9ADN-8; 9AEN-4; 9ARL-8; 9RIB-6; 9BMD-3; 9DBC-7; 9DKU-6; 9DTW-3; 9FLH-6; 9FQC-5; 9GCG-7; 9IF-5; 9IPP-5; 9MIK-4; 9MIN-7; 9NNZ-5; 9PST-3; 9QT-7; 9TB-7.— CE1AP-6; CP1AC-7; CX1RZ-3; CX1CG-5; CX1CX-3; CX2AK-7; D4BBN-5; D4BGA-5; D4MDN-5; EA5AF-4; ES7C-3; F3CX-4; F8ED-6; F8EJ-3; F8PZ-7; F8RJ-6; F8WB-4; FB8C-6. — G 2AO-2; 2YP-5; 5BD-3; 5CG-4; 5GQ-7; 6DL-3; 6QX-3; 6VP-5; 6WY-4. — HAF3H-3; HAF9GC-5; HC2JM-3; K5AA-4; LA3C-7; LA3I-4. — LU 1AD-5; 1CA-3; 1CH-6; 1EP-6; 2AM-7; 4DQ-6; 5DJ-5; 5FT-6; 5IL-6; 6AP-6; 6AX-8; 6DJK-5; 6ER-6; 7AX-8; 7EF-5; 7FD-6; 9AF-6; 9BV-8. — OA4J-6; OA4Q-4; OE1ER-7; OE7EJ-8; OE7JH-5; OH3NP-3; OH3OJ-5; OK1FF-3; OK1JC-4; OK2OP-3; ON4AU-6; ON4MD-4; ON4SD-4; OZ7HL-7; PAOAZ-5; PAOCE-5; PAODC-4; PAOJMN-3; PK1DF-6; PK1RI-7; PK2KO-6; PY1IF-4; PY2QB-3; PY3CF-3; PY3CJ-7; SM2VP-5; SM7VI-4; SM7YO-4; SP1BQ-2; SP1LM-5; SU1RK-4; SU1RO-3; SX3A-5; U3DX-4; U4LH-5; U6AH-6; V8AC-3; VE2EE-5; VE2EW-5; VE4GE-3; VS1AJ-6; VS3AC-5; VU2DK-6; X1AO-4; YL2BR-3; YR5AP-5; ZE1JM-3; ZE1JR-5; ZE1JU-5; ZS1H-9; ZS4U-5; ZS5Z-5; ZS6B-5; ZT6K-3; ZT6W-5; ZU1C-5.

(28 mc.)

W 2BQK-6; 2DTB-8; 2TP-7; 5QL-6; 6ANN-6; 6BAM-5; 6CXW-5; 6DIO-6; 6EWC-6; 6JJU-9; 7CHT-7; 8CRA-9. — VE4LK-6. — VK 2HZ-5; 2LZ-6; 2NM-6; 3GK-7; 4RB-7; 4EI-4; 5HG-6; 5JC-6; 6SA-7. — X1AY-5; ZL1AJ-7; ZS1H-3.

Alice Bourke, W9DXX, 2560 East 72nd Place, Chicago, Ill.
February 10 to March 10

(28 mc.)

D4ARR-6; D4CSA-5; D4GWF-5; D4QET-4; EA4AO-7; EA4BM-5; F8CT-8; FA8BG-7; G2PL-3; G5KG-5; G6RX-6; G6TT-6; K4AOP-6; LU9AX-5; OA4B-8; OA4J-5; OH5NG-5; OK1AW-4;

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*George Walker, Assistant Editor of RADIO, Box 355, Winston-Salem, N.C., U.S.A.

OK1BC-5; OZ2M-6; OZ7KG-7; PA0AZ-5; PA0FX-4; SM6WL-5; VK3YH-4; VK5HM-5; VP5HM-5; VP5PZ-9; XE1AA-6; XE1CM-5; XE2N-6; ZU1C-4.

(28 mc. worked)

F8EO-6; G5BP-5; G5RS-6; G6CL-6; G6DH-6; G6LK-5; G6NF-6; G6RN-5; HJ3AJ-6; OK2HX-6; ON4AU-6; ON4JR-5; X1AY-6; ZS1H-6; ZS2A-6.

Erwin Shaffer, W8AGU, Penfield, N.Y.
January 1 to February 18

(28 mc. phone)

G5BY; G6GO. — W 6AQK; 6CIN; 6GMN; 6DRL; 6DWK; 6ETX; 6EWE; 6IRX; 6LYD; 6NFA; 6PN; 6PQ; 6UUN; 7AST; 7AVV; 7IF.

(28 mc. c.w.)

CR6A; EI8B; F8JI; FA8IH. — G 2IO; 2JH; 2OA; 5IS; 5JW; 5VU; 6CL; 6DL; 6HL; 6LK; 6NF; 6RH; 6ZU. — LU2ABL; ON4LX; OZ2O; PA0AZ; XE1CM.

HJ3AJH, QSL under cover, care Liga Colombiana de Radio Aficionados, Box 330, Bogota, Colombia
December, 1935 to March 10, 1936

(28 mc. worked)

CM2FA; CP1AC; CX1CC; D4ARR; D4CSA; D4GWF; EA4AO; F3KH; F8EO; F8VS; FA8BG; G2PL; G5IA; G5OJ; G6DH; HB9J; K6CRU; K6KSI (Guam); K6MVV; LU1EP; LU3DD; LU9AX; LU9BV; OH2UM; OH5NG; OK1RC; OK2AK; ON4AU; ON4NC; ON4JB; OZ7KG; PA0AZ; VK2AE; VK2AS; VK2EO; VK2HY; VK2LZ; VK3BD; VK3BQ; VK3BW; VK3CP; VK3HK; VK3HM; VK3JJ; VK3KR; VK3KX; VK3MR; VK3NM; VK3OC; VK3YP; VK4AP; VK4BR; VK4EI; VK4GK; VK5IB; VK5KL; VK5LJ; VK5ZC; VK6SA; VO1N; VP5PZ; VE1CM; YM4AA; ZL1CD; ZL1DV; ZL1GX; ZL3AB; ZL3DJ; ZL4AO. **All W and VE districts.**

Arthur H. Bean, W7AMX, 5626 N. Maryland Ave., Portland, Oregon
March 1 to 5 inclusive

(28 mc.)

D4ARR; D4GWF; EA4AO; F3KH; F8CT; F8KJ; F8OB; F8WK; FA8BG; G2IO; G2NH; G2TM; G5BP; G5KG; G6DH; G6GS; G6LK; G6NF; G6OY; HR9AO; HJ3AJH; OA4J; ON4NC; OZ2M; PA0AZ; PA0PN; SM6WL.

J. C. Patterson, W5EHM, 4148 McKinney Street, Dallas, Texas
February 20 to March 3

(28 mc.)

CM7JP; CP1AC; CT3AB; D4ARR; D4CSA; D4GWF; F8WK; FA8BG; G5BP; G5BY; G5KG; G5WP; G6NF; G6QB; HB9J; HJ3AJH; K4DDH; K6CRU; K6GCL; K6KSI (Guam); K6MVV; LU9AX; OA4J; OK1RC; ON4JB; ON4NC; ON4PA; OX2M; PA0APX; PA0AZ; VK3BD; VK3MR; VK3YP; VK4AP; ZL3DJ.

C. J. Nolf, ON4NC, Chateau de Rameignies, par Thumaide, (Hainaut), Belgique
January, 1936

(28 mc. phone)

W 1CGY; 1DBE; 1DZE; 1HVS; 1KH; 1NW; 2AIW; 2AOG; 2AYJ; 2BCR; 2CDL; 3AIR; 3AUC; 3FAR; 3PC; 3ZX; 4CJ; 7ALA; 8ANN; 8MWL; 8NK; 9BHT.

(28 mc. code)

CN8MQ; D4ARR; EA4AO; F8CT; G5FV; G6DH; G6LK; G6NF; G6WY; LU9AX; OH3NG; OH5NG; OH7NR; OH7NC; OH7ND; OH7NF; OH7NJ; OK1BC; PA0AZ; SU1JT; SU1RO; SU1SG; VE3ER; VE3MJ; VE3TD; VE3WA; VK4EI; VO1N; VU2BG. — W 1AAK; 1AEP; 1AF; 1ANA; 1BXC; 1CTW; 1DF; 1DHE; 1DUK; 1DXL; 1EHT; 1ELR; 1EWD; 1EWF; 1FH; 1GXK; 1HWP; 1IQZ; 1LZ; 1ME; 1RA; 1WV; 1ZE; 2ACY; 2AFF; 2AFU; 2AOL; 2AVZ; 2CPA; 2DFU; 2DTB; 2FBA; 2FF; 2GYL; 2GUX; 2HFM; 2SZ; 2UK; 3BIW; 3BPH; 3RRZ; 3BVE; 3BVN; 3BYF; 3BZR; 3CGU; 3CKT; 3DBX; 3EMM; 3ENX; 3EPR; 3HC; 3JM; 4AGP; 4AH; 4DDP; 4BBR; 4CDC; 4DAA; 4DCK; 4EF; 4MR; 4SV; 4TZ; 5AFX; 6BAM; 6WB.

R. H. Jackson, G6ZU, 54 Prince's St., Stockport, England
March 5 to 13

(28 mc.)

CM2RA; CN8MQ; LU9AX; U9AV; VE3ER; VE3KF; VE4IG; VO1N; W1EWF; W1GZL; W1ZI; W2BZB; W3AUC; W5AFX; W5BEE; W5ER; W5JV; W6AIX; W6DGW; W6GRL; W6GRX; W7BYW; W7ESN; W8BTK; W8CRA; W8MMW; W9BEZ; W9RHT; W9BPM; W9BTX; W9BYE; W9DMA; W9EPI; W9IH; W9HUV; W9ISU; W9JFB; W9LF; YR5CP; ZS1H.

Mike Watson, W4CYA, 626 North Spring Street, Winston-Salem, N.C.
January 5 to February 5

(7 mc.)

CT1IL-6; CT2BJ-6; CX2BK-6; D4CSA-8; D4HCF-7; D4JZI-6; D4NXR-8; EA3CZ-6; EA7AO-7; EA8AN-6; F3HS-5; FA8JO-7; FQ8NB-4; G2FP-7; G2LC-6; HAF8A-6; HB9AC-7; HR9AS-8; HC1FG-9; HC2MO-7; HH2X-8; HI7G-7; HK4FW-5; HR1UZ-9; K5AI-8; K5AM-8; K6KVX-8; K7ANQ-5; LU1CH-4; OA4AI-6; OK1KV-4; SM5WZ-5; SM7RV-9; SP1HM-6; SX3A-4; U2NE-5; VP4KE-8; XE1DX-7; XE1GH-5; YR5NP-3; ZL2AS-4; ZL4CK-8; ZN2M-5; ZT6K-7.

Fred E. Gilfilian, VQ4CRO, P. O. Box 460, Nairobi, Kenya, East Africa
January 2 to January 5, 1936

(14 mc. phone)

W 1DIP-7; 1ZD-9; 2BSD-8; 2EDW-8; 3AHS-7; 3APO-9; 3COP-7; 3EHY-6; 4AH-6; 8CDR-7. — VE3HC-6.

(14 mc.)

W 1RB-5; 2AAL-6; 2CIQ-6; 2CZV-6; 2GIZ-6; 2GUM-5; 2KL-5; 3ADQ-7; 3BRK-6; 3CHG-7; 4FT-7; 8AZI-7; 9LIK-6; 9MRW-5. — VE1ET-6.

Alois Weirauch, OK1AW, Mestec Kralove, Nr. 9, Czechoslovakia
January 1 to January 31, 1936

(28 mc. phone)

W2AOG-8; W3AUC-8.

(28 mc.)

W 1AAK-6; 1AF-7; 1CQY-8; 1DZE-3; 1EHT-5; 1ELR-6; 1EWD-5; 1NW-6; 1ZE-8; 2ACY-4; 2BCR-8; 2CPA-5; 2CUZ-7; 2DYK-6; 2SZ-8; 3DBX-8; 3DQP-6; 3FAR-7; 3HC-6; 4AGP-4; 4MR-8; 5AFX-5; 7FLU-6; 8CRA-7; 8EBS-6; 8LEA-8; 8MWL-9; 9BHT-6; 9CYT-4; 9LF-9; 9MCD-6; 9SPB-6; 9TGN-6. — CN8MJ-4; CN8MQ-6; CP1AC-6; CT1KR-4; CT1OI-5; G2PL-8; LU9AX-4; OH7NC-7; OH7NF-7; SU1JT-9; VE1DQ-4; VE2AB-4; VE2EE-4; VE3DU-5; VE3MY-8; VE3TD-9; VK3RQ-6; VK3NM-5; VK4EI-4; VO1I-5; VO1N-8; ZS1H-6; ZT6K-8.

Andre Goubet, F8PA, 37 ter Rue Foch, Maisons - Laffitte, France
January 26 to February 10, 1936

(14 mc.)

W 1AAG; 1AQH; 1AXW; 1BHQ; 1CGB; 1CGM; 1DUJ; 1DZE; 1ELW; 1EWF; 1GXC; 1HWP; 1IFY; 1WT; 2AFU; 2AMQ; 2CWE; 2EVR; 2FNK; 2GUM; 2GWE; 2GYL; 3CVK; 3DDE; 3DM; 3EHY; 3ERP; 8CN; 9VJI. — CT1CT; CT1KR; CT1LC; D4CAA; D4CRM; D4SXR; D4XCG; EA3EW; EI8B; ES1C; F8EB; F8PY; HB9AQ; HP9X; J1SA; LA2B; LA2P; LA2Y; LA3J; LU5AN; LY1AD;

[Continued on Page 84]

DX

By HERB. BECKER, W6QD

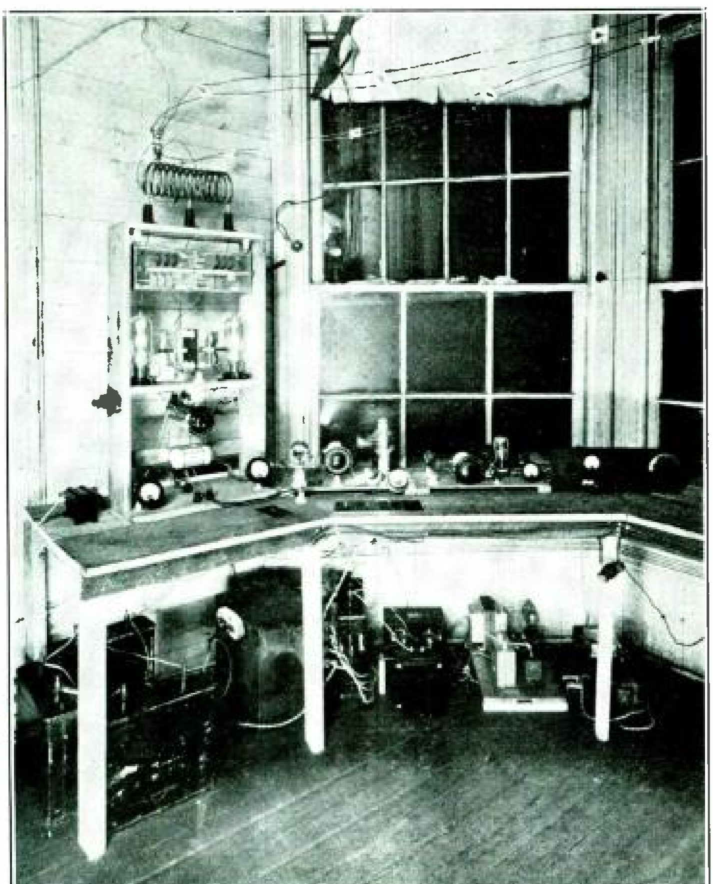
Readers are invited to send monthly contributions for publication in these columns direct to Mr Becker, 1117 West 45th Street, Los Angeles, California.

All right, fellows, you might just as well turn off the filaments, tip back in your chair, and prop your feet up on your desk as you will have to be comfortable to wade through this. Rather than fuss around and make a lot of remarks about one thing or another, I'd better dive into some of the dx contest stuff. That's what most of you want to know; so here goes. First, I would like to say that all scores mentioned are not guaranteed to be absolutely accurate, as some were passed along by other hams, others were obtained first hand, while others were just picked up from QSO's. If anyone is slighted, I want him to know that no offense is meant.

A few of the scores: W1FH 66,000; W1ZI 52,000; W1CMX 41,500; W1TS 42,000; W1BUX 35,000; W1SZ 52,000; W2UK 78,500; W2DC 51,700; W2BYP 70,000; W3SI 75,800; W4DHZ 91,000; W5EHM 41,800; W6GRL 58,000; W6CXW 50,000; W6KRI 41,000; W6GRV 38,000; W6NKY 35,000; W6CUH 34,900; W6AWT 22,000; W8ZY 32,000; W8BTI 30,000; W8JIN 28,000; W9TB 61,000; W9IJ 45,000; W9FM 30,000; W9TJ 25,100. A few of the boys outside of the U.S.A.: EA4AO 105,000; G6NJ 30,000; ZL2KK 88,000; EA4BM 52,000; EI8B 45,000 (2 ops).

W4DHZ

Dave Evans, W4DHZ, really did himself proud. Can't figure out where he ever found so many points, but I guess he just crawled into that receiver and dug 'em out. Those 91,000 points came from working 9 countries on 80; 39 on 40; 57 on 20; and 30 on 10 meters, using a multiplier of 135. Even so, Dave seemed a little disappointed, explaining that he could have had a few thousand more if he hadn't been sick for a day or so and that his antenna was down for a day and a half. He worked all continents on 10, 20, and 40—needing only an Asian on 80. All zones but two were contacted, which really is covering this old Globe. In Dave's rig were a couple of HK-354's in push-pull with around 994.683 watts input. "Band changing in a hurry" was worked on for days before the test so that no time would be lost, with the result that he could change bands in a minute or two. The receiver used was one of these new ACR-175 supers. The other receiver shown in the picture is one of his own design, and, although small, really did drag 'em in. I suppose he sat there with one phone on his left ear, on the 40 meter band, while the other was pouring them into his right ear from 20 meters. Almost forgot to mention that Dave is nearly a native Californian now. A few days after the contest he pulled out of good ol' Atlanta, and after riding on five different trains he landed in Tucson, Arizona, where I met him. We attended the Arizona State Convention . . which, by the way, was a real dinger. Upon arriving at Los Angeles he couldn't wait to pound some brass, so we did a quick QSY to the shack. If you guys hear anything screwier than usual coming from QD you can just bet it will be Dave. Oh yes, getting back to dx . . . He got a big bang out of the whole contest and is ready to try it again. Wotta guy.



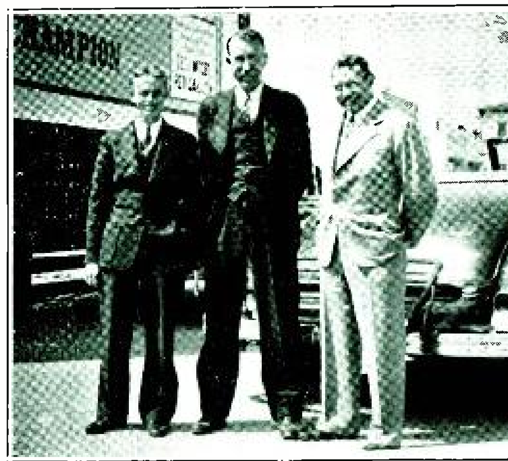
W4DHZ, 91,000 points for an all-time U.S.A. high. An 852 drives two 354's on 10, 20, 40, and 80 meters.

W6GRL

Doc Stuart, W6GRL, seems to have the Indian sign on the W6 gang, as this is the second straight year that he has come out with high points . . . that is, of course, as far as the West Coast is concerned. This year Doc ran up 58,000 points, working 20 countries on 10 meters; 48 on 20; 33 on 40; and 2 on 80 meters. He still claims he can't hear 'em up there in Ventura. You see, he only has five V beam antennas (covering every point on the globe) and that probably explains why he can't hear anything. He, too, worked all six continents on all bands but the 3.5 mc. band. His transmitter is about the same as last year except that a few changes were made to facilitate quick QSY. In the final he is using four 852's in push-pull parallel. This set-up allows Doc to use a full kw. when he grid modulates for fone on 10 meters. Yes, that's right . . . *fone*! The receiver is the same old FBXA which has been worked over, and from the way he snags these dx birds, I guess it must be perking very well . . . although GRL with that R9, y.l.-fetching smile of his will modestly (?) say, "Can't hear a thing up there." Doc also said that if it hadn't been for the fact that he had to yank a few teeth a couple of days during the test, he would have run up a score.

W9TB

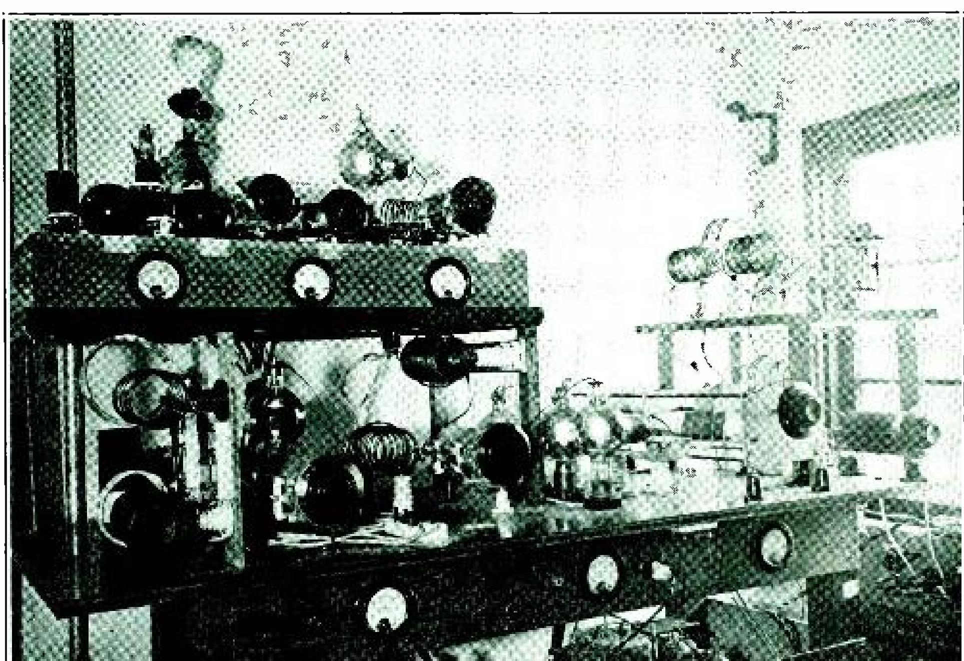
W9TB wound up with a total of 61,000 points, which is a sizable score in any language. Countries were 7 on 80 meters; 22 on 40; 55 on 20; and 22 on 10 meters. Multiplier came to 106. 6 WAC's were made and 2 FBTOC's. A funny thing happened while Ewald was QSO VK3MR: He received a report of 359 from the VK and thought that unusual. He began to investigate, and I guess that extra pull on his antenna rope had been just too much for the insulator, as his antenna was lying flat on the ground, hi. His rig consists of four 860's in push-pull parallel, and works swell on 80-40-20, but not so hot on 10. His chief headache is VU2CQ, and he has plenty of company, too. W9TB is consolidating with W9DRN very soon, and then will have a separate rig on ten.



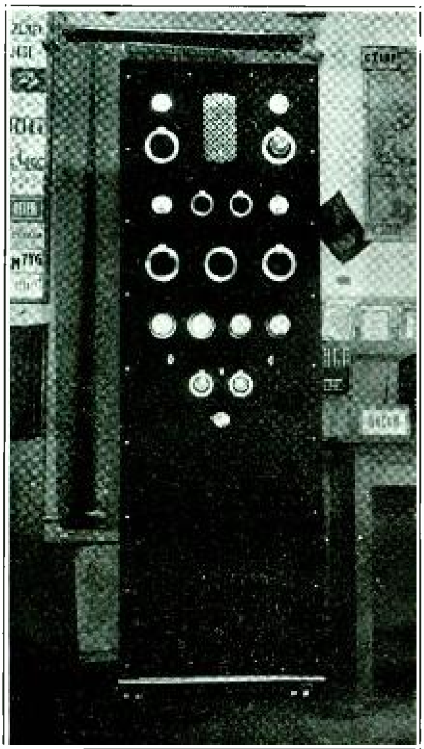
Dave Evans, W4DHZ (left) and Chas. Stuart, W6GRL (right) pose with W6QD while visiting "Radio".

W2UK

Tommy Thomas, W2UK, finished up with 78,500 points from 68 different countries worked on the 10,



W6GRL, high point station for the West Coast, uses four 852's which are grid modulated for 10 meter phone. The 60 watt Mazda lamp seen in the upper left of the photo is NOT being used as a doubler! 58,000 points.



W6CXW, operated by Henry and Sam Sasaki. They worked night and day to complete this new transmitter in time for the contest. It winds up with a 354 driving two 150-T's. 50,000 points.

20, and 40 meter bands. The rig uses two 852's in p.p. with a kw. input. Grid bias modulation is used for fone. The receiver is a RME-69. Tommy agrees with hundreds of other hams that the 20 meter band is becoming a mess, what with the fones outside of the U.S.A. spreading all over the c.w. portion of the band. W2UK says he had a lot of fun even with all the boys tuning up their bugs during the best dx hours.

W6CXW

Henry and Sam Sasaki, W6CXW, scored a total of 50,000 points, which is mighty good for the West Coast. Year in and year out these fellows are the most consistent dx-ers I know. It is seldom they miss any of the choice dx that comes through. In this contest Henry won (or lost) the coin toss, and did the operating. It was OK with Sam as it gave him a chance to see more of his y.l. Henry worked his 112th country, and for Zones he has 39 . . . just one more to go. They have a new transmitter using two 150T's in the final stage, kicked by an HK-354. They had to step on it to get this new rig completed in time for the test, but they made it as the score will testify. The receiver is a Comet-Pro. For the antenna set-up a V beam is used, also a single-wire-fed Hertz. W6CXW was on all but the 80 and 160 meter bands.

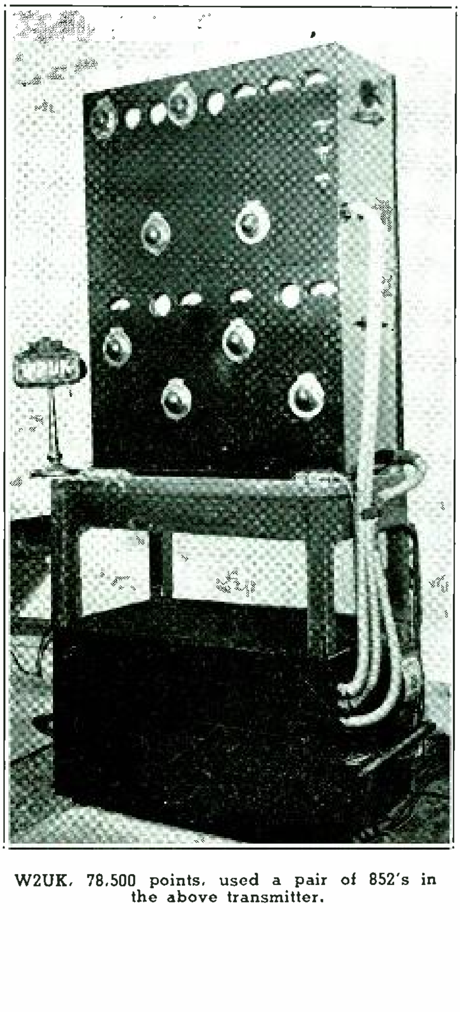
Say gang, here is an account of the contest as observed from an East Coast station's standpoint. There are several reasons why W8CRA wasn't in the test very much. One of them might have been the y.l. situation . . . but this time it was far from that, as the following narrative will bring out. Good ol' Frank was busy covering the test for the dx department of RADIO, and the following is taken word for word from his original penciled notes. Personally, I think it brings out the true spirit of a contest, and I cannot see where there was much left out. All of these notes were made during the progress of the dx test. All times mentioned are in e.s.t. Test started 7:01 p.m.

THE 1936 INTERNATIONAL DX TEST FROM START TO FINISH

By FRANK LUCAS, W8CRA

6:45 p.m., Friday 13th, 1936—W1SZ making a sked with U3QE for 7:01 p.m.—and the U petered out on the sked. U2NE asking when the test would start (as if he wouldn't soon find out). . . Logged at 6:50-6:55 p.m.: VK3WW, U3QE, KA1LB, LU6BJ, VU2BG, ZU5X, and ZT6K (you count the W's) all holding their prey till after 7:00.

7:01 p.m.—WOW! A 1400% increase in stations, key clicks, a.c. notes, tuning up, the groan of those powerful sixes—SU1SG and his steady stream of contacts—VQ8AB with that splattery, castor oil note,



W2UK, 78,500 points, used a pair of 852's in the above transmitter.

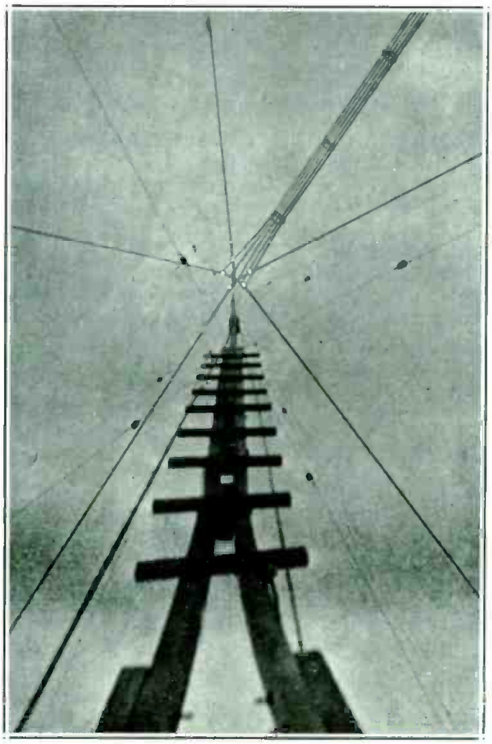
and not knowing about the test—SP1DE best on 14 mc. SP1DT on 40. VS6AK with his terrific sock and punk receiver only making the fellows sore . . . "YM4AA Danzig, with tears in my eyes" . . . XU3ST, XU8HW, XU1B, XU8AL, XU3DF, XU8AG making the East coasters scramble all at once (pardon, please, I got all six of 'em). J2LB, KA1DS, KA1ME, KA1AN whooping it up—U2NE batting away.

With those notes, why didn't the XU's keep their old prefix, "AC"? W1's, 2's, 3's making everyone look sick for the first couple of days . . . YT7MT not doing so hot in the fone band. How was your average the first hour????—EA8AO, EA8AF fighting it out side by side—CT1BY R9 on fone. Where was HC1FG this year?—A W9 asking CM2DO for his QRK after receiving his number o.k. FM8D, old F3SMI in Martinique pounding away . . . A W8 giving ZB1C "101262", and with his T9 note did he get sore! Ask him. ZB1H slow but sure—VK6AF, J8CA, and XU1B CQ-ing by the hour with no replies . . . which goes to show that fellows don't look for dx in a dx contest—LA6A right in there—Again VS6AK's 599 sig giving out 339—PK3BX best PK3—GI5QX making a grand stand for his country—VU2CQ must have forgotten to turn on his receiver as usual (let's get together and buy him one). OM2RX doing plenty of justice to everyone—PK4DA best PK4—EA4AO best EA and swell op. Ten meters just as hot as twenty and making some of the elusive dx easier to get—OK2AK best from "OK-land"—Looks like G6NJ in England this year—Thought all D4's were on the Rhine, but no, they were on the air (phew!).—D4ARR outstanding on three bands.

HJ3AJH holding Colombia; OA4J, Peru—FA8BG doing great on 10—And those cockeyed W fones would keep blasting away—That W1 with those bad parasitics . . . and did ya hear those big W6's crawl out from under one another? Contest, a time when a CM is as worthy as a VS7 if you happen to need one. Of the PAO stations seems like an even break; none of 'em missed much—VK6FL best VK6—VK7JB best VK7, and VK3JK topped all VK's for sock—W8CRA not raising a thing—W2UK going to town working the good stuff—J2HJ R9 plus—ZE1JS coming through early in the morning. VS6AX and SM5SX raising plenty of commotion—XU1B best XU—VS6AH going after honors with snappy operating and a fine sig . . . FB8AB in a terrible spot and didn't hear him much — KA1ME working VK's—EI4G, never heard of him before—KA1AN boring through W fones on his frequency—ON4UU calling OM2RX on the opposite end of the band; wotta long shot that was—W6GRL having it over everyone on his frequency.

That W9 signing OP3X must have felt like two cents when caught. — VQ3FAR coming through at 9:00 a.m. How does W1CMX spot so much good dx?

[Continued on Next Page]



Worm's eye view of W6GRL's five-way V-beam antenna system (photograph retouched to show detail). Each leg is 270 feet long and 70 feet high. Any adjacent pair may be fed from the transmitter on any band.

Operating position at W4DHZ, showing the ACR-175 and the 7 tube home-constructed receiver which were both used in the contest.

—ZS2A after it again—ZS1AH with a swell sig—KA1LB coming through at 4:30 p.m., CQ-ing South America . . . how could he???? U9AL creeping 30 degrees on the dial—U9AV's crystal was easy to copy—ZD8A quit after W3CHG told him the test was on, hi . . . LU7EF another snappy QSO—CE4AD slow but sure—CT3AB best CT3—OE6DK and OE3FL a tie with their sigs—OZ2M and OZ3FL fighting it out—G6QX working plenty of W6's and W7's . . . FA8GK, wotta note—VP2TG always QSA—YL2FR only YL heard—LY1J having things his own way except for TDC . . . NY2AB and his swell sending. . . . From the sound of their notes, some of the foreigners must have been using keyed diathermy machines for transmitters.

Did you notice around 4 p.m. every day how unstable your receiver would get? So many fellows keying that it must have made the voltage fluctuate all over the country—the only "I" heard was I1IT—D4QET not so much in demand as when he was TS4SAX—HAF2D and HAF3D even with their sock.—'Twas better to be up in the band than on the edge—ES1C winding up a 24 (?) minute CQ—TF3AG heard just once. . . . W4EF keeping W4DHZ worried—F8OK, G6WN, PA0UN, D4GAD, OZ2M, G5QY, ZS1H, D4ARR, FA8BG, VK3YP, LU9AX, LU1EP and scores of others with their 10 meter wallops.—Where was ON4AU, G5BY, and J2GX?—Digging down in the fourth layer for dx and finding W6QD, hi!—J2LB and J2ME out for it again.—There seemed to be no limit to the band's edge. Contest must make them into "rubber bands".

CP1AC came on in the middle of the week . . . and say, did the gang haunt him? He didn't do much operating though. SU1RO is a little behind but going to town just the same—FA8BG and his clever operating; he must have a terrific score . . . CM7AC coming right along—VP7NB operating a little . . . VP7's always seem to be elusive as the deuce in a contest. . . . VP6YB and VP6MO battling away—EA1AB right in the thick of it along with EA4BM. Then ON4CRM in Belgian Congo playing with his key one afternoon. . . . wonder why no CQ from him?— ES7C not raising many . . . VO3HM getting oodles of answers. Ah! here's YR5AA . . . (yes, I called him too). VS6AH came through one evening right through that QRM on the low frequency end of the band.

Those Canadian fones spoiling plenty of good dx—and those 'Koobans' didn't help things much either. Boy oh boy, CX1CG and CX2AK out for honors, with CX1CG holding the lead. F8TQ should have plenty of points. We won't forget XE1AM and his famous fist. . . . Morning and evening, VU2BG.

Did ya hear that wobbly creeping sig on the high frequency edge . . . huh? Well, that thar, my friends, was LX1AS and it took a solid hour to nurse him outta the mess . . . VP1MR, another multiplier—Counted 42 stations calling SU1SG after one short CQ. K7ELM and K7PQ nailing them "1-2-3" . . . Both real ops, PQ has the lead. After it's all over you won't hear a dx station on for months, I'll bet—OZ7Z and HAF2G always busy—LA3B and LA2B side by side burning it up. Looks like a split there.

VU2LJ didn't have his good xtal note; guess something blew up— Ol' OH3NP must never sleep . . . F8EO's sig will not be forgotten on all bands—VK3PG's 201-A stepped right along with the best

FLASH

W6KRI WAC in 44 Minutes

On the morning of April 8th, W6KRI worked J5CE, ZT1Q, VK3VW, YV2AV, W5COU, ON4AU for W.A.C. in the remarkable time of 44 minutes. Two of these stations were on the same frequency and were worked at the same time.

of 'em. . . . Even W8KPB crawled off the edge. The 17th seems like a swell day for an EI QSO. They are all on, with EI8B putting all he has into his sig to keep ahead of EI9G and others. . . . A W4 fone laying J8CA cold every morning, and wotta shame that is. The wallop of W8HWE's sig is really something to write home about. VS6AQ was just dx-ing—W4ZH laying for the choice stuff—KA1US taking things easy and smooth—SM7WS, another good SM QSO, and this fellow SM6SS all mixed up in that high frequency edge QRM. . . . OH6DH, a rare OH district, was plowing along, and get this one . . . here's W5BEE, a fone hound, on c.w.

How didja like copying that sig of CR7GD in all that QRM? EA7AV sounded like he gave his rig a shot of Fletcher's Castoria. . . . And where was that CT2 gang?—CN8MQ taking his own sweet time. It's a miracle how FR8VX got by with two nice, long, juicy CQ's—and did you notice how the European hams were QRMing GMR . . . Hi. Who said power was everything? Of all the D4 calls why didn't one choose D4USA and save that troublesome "CQ-USA"?—Someone was chopping SP1DE till he sounded like *despite* . . . hi. SU5NK for that third SU contact . . . ZS4U doing OK for "ZS-land".

Hear W3SI on almost any frequency—ZE1JE, weak but in there just the same. OK2OP must have plenty of trouble judging from those various notes—PK1MX's fone R9 calling a W2 and no soap from the W2—VS6AG must have ditched his new bride for a few days 'cause heard him a lot. . . . CM2BC's band-spread note covering 30 degrees . . . LU1EP with a potent sig on 10. ZP2AC had no idea of what it was all about—and that bunch of K6's were sure piling up points. . . . CE1AQ still uses a 201-A—J2KJ with great sock and J2CL coming through on 20 at 2:00 p.m. I1TKM opening up on Thursday—VQ3FAR having QRM from hyenas and asking for dope on numbers and rules, hi.

Thoughts after a nice long call . . . "Aw shucks! I used to work dx with this thing." The first prize should be a nice soft bed and a pint of ether. Naw, not that kind. Swell to wake up and find your antenna down due to heavy sleet, snow, and plenty of wind. This happened for five mornings. Western Pennsylvania hams had to go off the air from Wednesday on; no power. . . . Here it is Friday, March 20th and have heard 88 countries. . . . HH5PA staying clear of numbers. . . . VO1P running like clock work. HAF7A takes the "slow CQ" prize—Say, didn't that limit of 3 make you sore when 40 or so J's were coming through? Oh well, it's OK though, as a bunch of VO's showed up this year. Most of the VP9's and HP gang stayed on fone and didn't bother—Quite a few PY's on but didn't hear PY1AW.

[*Continued on Page 78*]

OH3NP, Hameenlinna, Finland

This station, which is owned and operated by Mr. E. W. Granqvist in Hameenlinna, Finland, is without a doubt one of the most popular dx stations on the air today.

The radio activities of Mr. Granqvist date back some twelve years, when in 1924 he started by building broadcast sets. After considerable time had been spent along this line he ventured forth into the ham game. Toward the end of 1927 OH3NP finished his first ham receiver, a 2 tube Schnell. His first transmitter was completed early the next year, and in March 1928 he was ready for his first QSO. It seems as though 3NP had a great deal of difficulty raising many fellows with his little QRP rig. The transmitter at this time consisted of two Telefunken RE-134 receiving tubes using 120 volts on the plates at only 4 watts input. Being like all hams he wasn't satisfied; so rebuilding was next on the schedule.

By the summer of 1928 a new rig was ready to set the world on fire. Using the same tubes in parallel, Hartley circuit, and 240 volts on the plates, an input of 10 watts was obtained. With this setup all Europe was worked, together with Siberia, China, Algiers, and Egypt. Then as Walle Granqvist says, "After several Hartleys were tried, I heard that the t.p.t.g. was a better circuit; so on April 3, 1929, I started to build one up. It worked OK but all I could work were Europeans." In August 1929 Walle obtained two Philips TB 04/10 tubes, and then . . . on September 17th with a chemical rectifier, 400 volts r.a.c. and 24 watts input, he hooked up with VTVVZ in Quetta, India, for his first QSO with the new rig. Then in close order came PK2AJ and ZL1AS, the latter being a difficult country for Finland.

Always showing progress, it was now time to build a new receiver. At the end of 1930 a t.r.f. job with detector and audio was in use. It was really a fine receiver and without a doubt was all that a ham could want. In Walle's own words, "January 1931 I started to build my first crystal-controlled transmitter using four stages, but when it was finished I could get no crystal, hi. At last in September I received the crystal and could get on the air." This rig consisted of a c.o. TB-04/10, f.d. TB04/10, f.d. RV-218, and a p.a. RV-258. The last two tubes were Telefunken a.f. type.

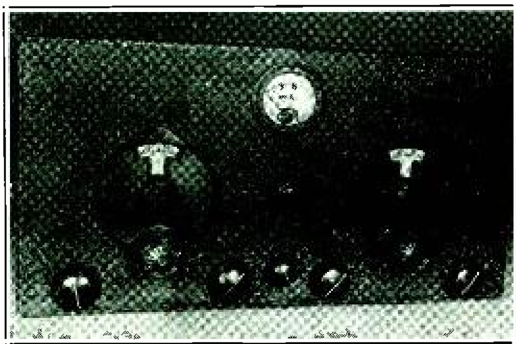
[Continued on Page 77]

The "Traffic Ten," DX Inhaler DeLuxe

By LLOYD M. JONES, W6DOB

No fancy frills, no "doo dads", every component justified from a performance standpoint, this superhet may be constructed with but a few simple tools at a fraction of the cost of a manufactured receiver giving comparable results. It may be duplicated "from scratch" for $50 including cabinet and power supply, less if you have any kind of a "junk box".

For the c.w. operator working in the 14, 28, and 56 m.c. bands and living where auto ignition, dial telephone clicks, and other types of noise render reception nearly impossible, the receiver described herein is a real step towards eliminating the noise. There is nothing "new" about this receiver; it uses a combination of good



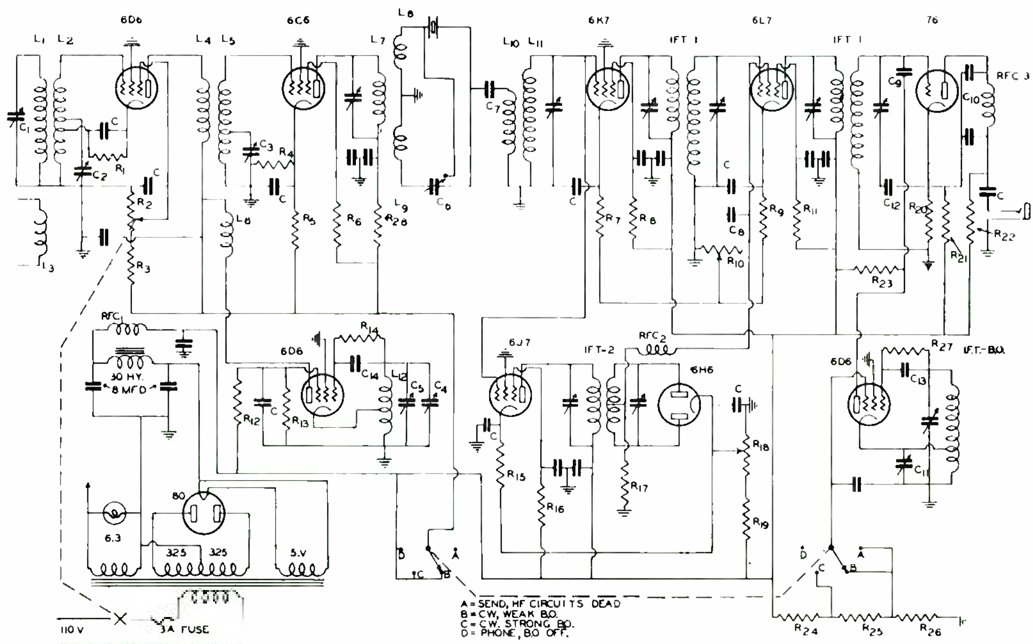
Front Panel Layout of Controls

systems which have been published many times heretofore. The set was built for the ultimate in performance on the above mentioned bands. Rather than single dial control, band switching coils, etc., two-dial tuning and plug-in coils are used. Both glass and metal tubes are used, the glass type for economy, and the metal type for desirable characteristics not obtainable in the glass line. Three of these sets have been built, with not the slightest trouble encountered in making them work. In each case, upon completion of wiring and tuning on the set, signals were heard, and a few minutes in aligning the set finished the job.

Construction of Cabinet

The chassis and cabinet and shield partitions were made at home with the aid of square, hammer, scribe, tin snips, a few blocks of 1" x 2" pine, four 4" C clamps, and an old piece of plate iron for an anvil. 20 gauge body steel was used throughout. The finished chassis is 17" x 10" x 2½" outside dimensions, and is bent in the same manner as the cabinet. The cabinet was made by bending one piece of 40"x10" to fit around the chassis, which allows a back bend of 1½" at each end. At the top of each corner bend, it is necessary to cut out a piece (90 degrees) to allow a smooth joint when bent into position. To make a smooth corner, it will help if a no. 36 drill is used to drill a hole at the apex of the angle before it is cut out. Using a little care with one's measurements, and with all scribe marks on the inside of the cabinet-to-be, it is only a few minutes' work to bend the chassis and cabinet and lid-mounting. This is done by placing the strips of 1" x 2" pine on each side of the work and *on line* with the scribe work, clamping them securely with the C clamps. Care should be taken to keep the clamps clear of the band. Use a hammer or mallet and proceed to bend the material slowly from one end to the other, taking precaution not to make too large a bend at any one point, as this would leave waves due to stretching. The rear piece used to fasten the hinge and top lid is 2" x 16" and bent so that one inch will be at the rear and one inch on top, leaving an opening 14" x 5½" in the rear for ventilation. The lid is 8½" x 16". The miscellaneous controls are used to fasten the cabinet to the chassis in front, and 6/32 bolts are used at all other points. The hinge for the lid may be purchased from a hardware store and should be 15" long. The two shields for the r.f. and translator stages are 3" x 5", and 5" high. The oscillator shield is 5" x 5", and 5" high. The crystal shield can is 2" x 5", and 3" high. All shields are mounted by spade bolts, which are riveted thereto with the same size rivets as those used in fastening the wafer sockets to the chassis. The power transformer hole was cut with a cold chisel, and socket holes cut with a circle cutter, which may be obtained at your radio or hardware store for about $1.75 if you do not already have one. After cutting the various pieces, lay each piece on the flat anvil and hammer out all kinks, etc. Do not worry about hammer marks, as the paint covers them. The crackle paint used is prepared by NaAld, obtainable at most radio stores.

*547 West 106th St., Los Angeles.



The General Wiring Diagram

C—0.25 μfd. 200 volt
C_1—35 μμfd.
C_2—75 μμfd. midget
C_3—75 μμfd. midget
C_4—Rebuilt midget: one rotor, two stator
C_5—Same
C_6—Same
C_7—30 μμfd. trimmer
C_8—50 μμfd. fixed mica
C_9—See text
C_{10}—100 μμfd. fixed mica
C_{11}—75 μμfd. b.o. trimmer
C_{12}—25 μfd. 25 volt electrolytic
C_{13}—(Part of b.o. unit)
C_{14}—100 μμfd. fixed mica

Unmarked condensers are .01 μfd.
R_1—1000 ohms, 1 watt
R_2—25,000 ohm wire-wound potentiometer
R_3—25,000 ohms, 10 watts
R_4—5,000 ohms, 1 watt
R_5—Approx. 60,000 ohms (see text)
R_6—100,000 ohms, 1 watt
R_7—360 ohms, 1 watt
R_8—100,000 ohms, 1 watt
R_9—360 ohms, 1 watt
R_{10}—10,000 ohm wire-wound potentiometer
R_{11}—100,000 ohms, 1 watt

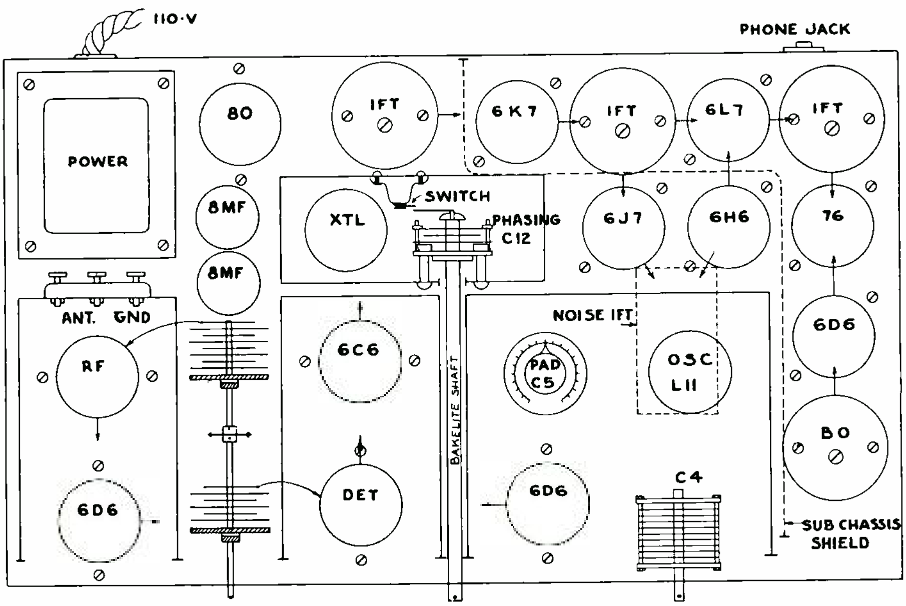
R_{12}—25,000 ohms, 10 watts
R_{13}—25,000 ohms, 10 watts
R_{14}—50,000 ohms, 1 watt
R_{15}—360 ohms, 1 watt
R_{16}—100,000 ohms, 1 watt
R_{17}—100,000 ohms, 1 watt
R_{18}—5,000 ohm wire-wound potentiometer
R_{19}—50,000 ohms, 1 watt
R_{20}—5,000 ohms, 1 watt
R_{21}—Approx. 70,000 ohms (see text)
R_{22}—50,000 ohms, 1 watt

R_{23}—5,000 ohms, 1 watt
R_{24}—50,000 ohms, 1 watt
R_{25}—100,000 ohms, 1 watt
R_{26}—50,000 ohms, 1 watt
R_{27}—(Part of b.o. unit)
R_{28}—1,000 ohms, 1 watt
RFC_1—2½ mh. pie wound choke
RFC_2—16 mh. shielded r.f. choke
RFC_3—10 mh. shielded r.f. choke
SWITCH—2 gang, 4 point
IFT_1—Air-tuned i.f.t., 465 kc.
IFT_2—Same for diode
IFT_{BO}—465 kc. beat osc. coil

It is merely brushed on smoothly, according to instructions on the can, and put in the gas range oven set at about 100 degrees F. After thirty minutes, have a look to make sure that all is well, and if it looks "well done", remove the set to a convenient place for a day or so of drying. Take care that the oven does not get too hot while baking, lest it make the finish dull instead of bright. Paint any or all parts you wish except the under side of the chassis, which would hinder soldering the grounds. So much for the chassis and cabinet.

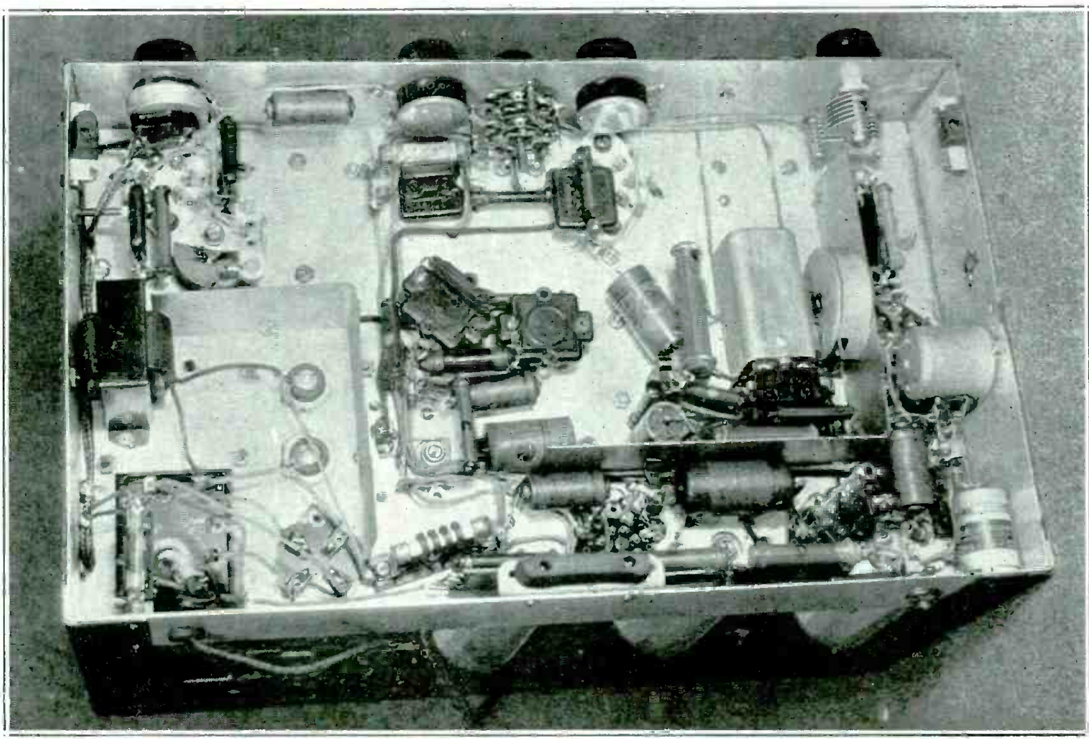
The Circuit

At the higher frequencies it is quite necessary to use regeneration in the r.f. stage in order to realize any gain, and since the signal-to-noise ratio of the set itself is more or less determined by the first stage, it is desirable to have a variable front panel control of the regeneration. This takes the place of the r.f. cathode control used in many sets, and should not be considered an added control. The r.f. translator coils are wound on forms marked on a screw-cutting lathe (belonging to a friend) and then notched deep enough to hold the wire with a three-cornered file. The lathe tends to chip the forms if the actual notching is tried with it. The r.f. translator coils are made as high L/C as possible for the maximum amount of voltage gain, and tuned with 75 μμfd. condensers across only enough turns to effect cov-

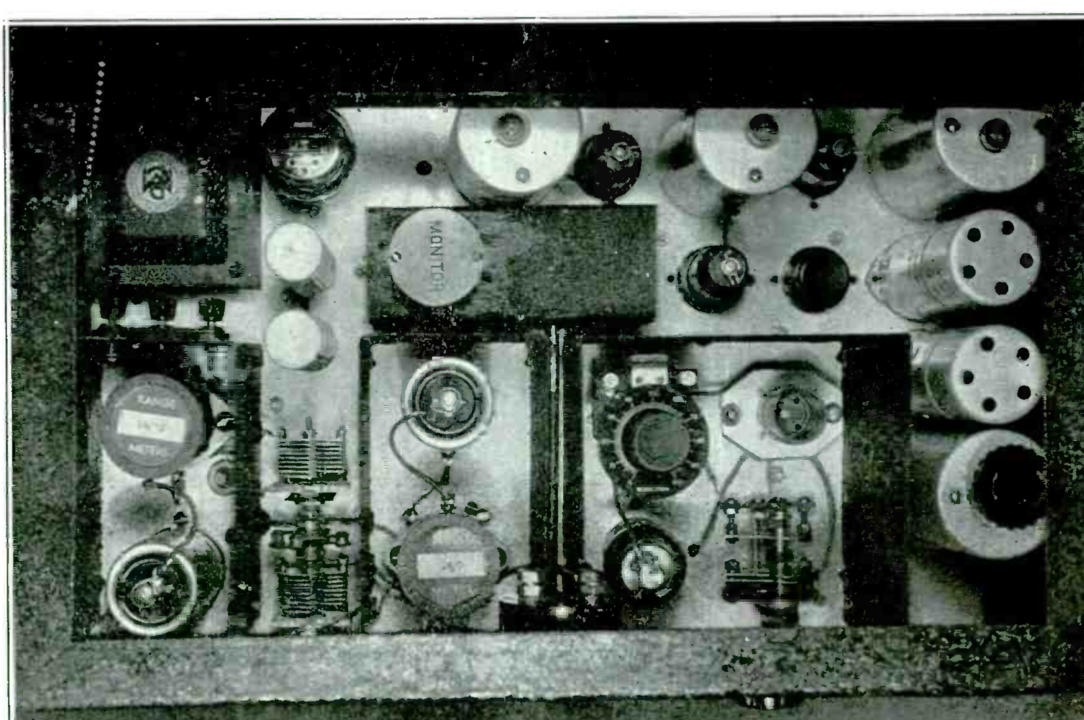


Chassis Layout, Top View, Drawn to Scale

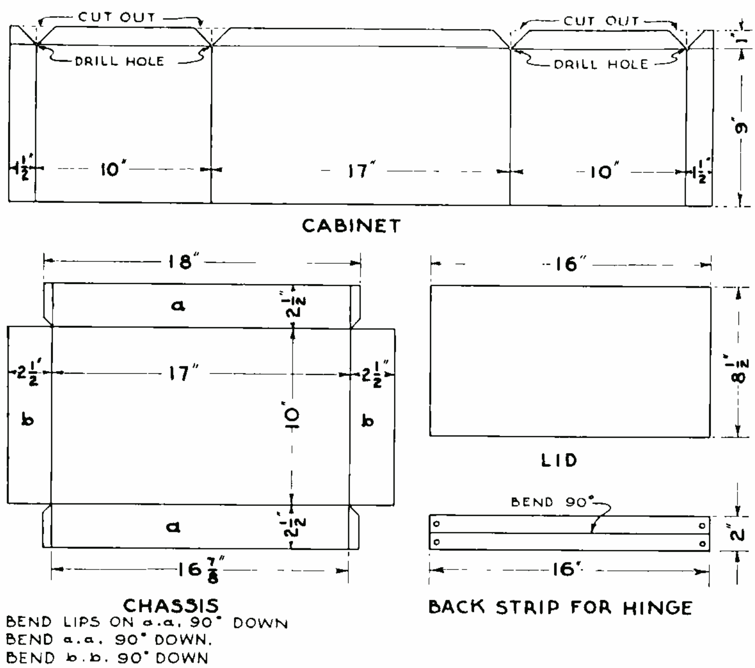
erage of the bands used. The oscillator coil is wound on a small, four prong form, and uses high C for extreme stability. Oscillator harmonics of 7 mc. are used for the 28 and 14 mc. bands, and the harmonic of 14 mc. for 56 mc. The use of a harmonic reduces the tendency towards "pulling" of the oscillator-translator circuits. There is plenty of output from the oscillator and one need only worry about stability and mechanical rigidity of the oscillator. Hence two-dial tuning, and no worry about making the front end track nor a compromise in L/C ratios of the r.f. translator and oscillator as in the case of single dial tuning. Single dial control is also somewhat impractical with r.f. regeneration. Three-winding coils are used in the r.f. translator. The tuned circuit, C_1-L_1, acts as an antenna trimmer, and at the same time tracks the two coils, L_2 and L_5 (over small limits), by compensating for the r.f. 6D6 plate and plate lead capacity to ground of L_4. In other words, L_1 reflects the same load to L_2 as L_4 does to L_5, assuming that L_2 and L_5 are of the same inductive values, and ignoring the small loading effects that L_3 and L_6 might have. C_1 is mounted through the chassis between the r.f. tube and coil, and is adjusted by means of a screw driver. A slot is cut in the end of the condenser shaft with a hacksaw. The r.f. cathode tap is adjusted so that the r.f. stage will start to oscillate (antenna connected) when about 70 to 90 volts is applied to the r.f. screen grid through R_2. The padding condenser, C_5, is of 150 μμfd. and is used to spot the band on the tuning dial so that complete coverage of a band may be obtained. It is well to adjust this padding condenser by listening to your own crystal oscillator, or some commercial who might serve as a "marker" station, so that accurate logging of stations may be had for future use. Inductive coupling from the oscillator to the translator is used so that the proper voltage input may be had on each band, and is coupled through the winding, L_6, at the base of the coil which corresponds to the antenna winding, L_3, on the r.f. coil. The number of turns of L_6 is determined only by experiment, as will be described in the adjustment of the set. Fixed bias is used on the translator in order to maintain a fixed value for maximum conversion of average signals. The crystal filter in this receiver was made from a standard, air-tuned Hammarlund i.f. transformer by removing the primary winding, L_7, and condenser from the can, and putting mica washers on each side of the primary winding to form two winding slots, each one about the same width as the winding, L_7. Eighty turns of no. 30 d.s.c. were wound in the same direction in each slot, and the outside of one winding, L_8, and the inside of the other winding, L_9, connected to ground. L_8 is used for the crystal voltage, and L_9 for the



Bottom View, Showing Sub-chassis Layout of Parts and Method of Mounting



Top View of the Receiver. Note the Simplicity and Neatness of Layout



SHIELD MATERIAL

2—5" x 13" (r.f. transformers)
1—5" x 16" (oscillator)
1—3" x 15" (xtal shield can)
1—2" x 5" (top for xtal can)
1—2" x 15" (noise circuit can)
1—2" x 10" (power supply shield)

All 20 gauge body steel

phasing, or neutralizing voltage. This unit, L_7, L_8, L_9, and tuning condenser, mounts in one end of the home-made crystal shield-can, with a hole in the chassis to permit screw driver adjustment of the L_7 tuning condenser. The crystal itself was mounted by means of a five-prong wafer socket directly above. The remaining portion of the can is used to mount the three-plate Cardwell phasing condenser, C_6, insulated from the shield can to reduce capacity to ground of the stator as well as the rotor. The shorting switch is made by soldering a small piece of spring brass to the end of the rotor shaft and fastening a second contact on a small ½" standoff insulator, the switch being closed when C_6 is set at minimum capacity. The output from the junction of the phasing condenser and crystal is fed through a 50 μμfd. condenser, C_7, to the low impedance winding, L_{10}, which consists of another 80 turns of no. 30 d.s.c. wire, wound directly over the original secondary winding, L_{11}, of the i.f. transformer, and the inside lead grounded. L_{10}, L_{11}, and condenser are mounted in the top of the Hammarlund shield can. Isolating the primary and secondary windings in separate shield can allows for better elimination of images while using the crystal. When the crystal is not in use the low impedance windings, L_8 and L_{10}, (an impedance of approximately 10,000 ohms as compared to 100,000 ohms, more or less, of a resonant circuit) merely act as a link-coupled circuit and no gain is lost. The purpose of the low-impedance windings is to provide better impedance match to the crystal, which has roughly 10,000 ohms impedance at 465 kc. This circuit is probably the most efficient and selective of any crystal filter circuit in use.

The new noise suppressor system* used in the receiver does much towards helping many types of interference, especially the "spark" type. Although the two do not go hand in hand without special modifications of the silencer circuit, it is possible to use *either* the crystal or noise suppressor in this set and go through almost any kind of noise and copy that dx station that is only R2 or R3. In a *few* cases when using the crystal, it is possible to help reduce the noise by using the noise suppressor as connected here. The noise suppressor i.f.t. is a small Hammarlund for diodes with the two windings jammed close together by cutting the cardboard form from between the two windings with a razor blade and inserting a wooden dowel for support. The unit is mounted underneath the chassis with the open end facing between the 6J7 and 6H6 sockets. Note the shield between the 6J7 and 6H6 tubes

*Lamb adaptation of the Scott-Taggart system, various modifications currently shown in *QST*.

COIL DATA

L_1	L_2	L_3	L_4	L_5	L_6	L_{12}
14 mc. 8 t. no. 26	16 t. no. 14 cath. tap	10 t. no. 26	8 t. no. 26	16 t. no. 14	7 t. no. 26	13 t. no. 16 cath. tap 5¼ t.
28 mc. 4 t. no. 26	8 t. no. 14 cath. tap ⅓ t.	6 t. no. 26	4 t. no. 26	8 t. no. 14	12 t. no. 26	same coil
56 mc. 2 t. no. 26	2 t. no. 14 cath. tap ½ t.	2 t. no. 26	2 t. no. 26	2 t. no. 14	5 t. no. 26	3 t. no. 16 cath. tap 1⅓ t.

TAP FOR TUNING CONDENSERS C_2, C_3
14 mc., 4½ turns; 28 mc., 1¼ turns; 56 mc., ⅓ turn.
(All taps are counted from ground end.)

and the regular i.f. circuits. This is quite necessary for maximum noise suppression and isolation of the two separate circuits on the same frequency, which otherwise might cause regeneration and instability. The second detector uses fixed bias with grid injection of b.f.o. voltage by means of two pieces of hookup wire twisted together for about one inch, the exact amount to be determined by measurements or a listening test, to be described later. Referring to the photo, the left dial tunes the r.f. translator, while the right dial tunes the oscillator. The controls on the bottom row, from left to right respectively, are as follows: r.f. regeneration control; i.f. volume control; send, b.f.o. on, b.f.o. off; noise suppressor control; b.f.o. vernier adjustment. The a.c. switch is controlled by the r.f. regeneration control. The small dial directly under the second detector cathode meter is the crystal phasing and off/on control, which couples to the phasing condenser by means of a small bakelite shaft between the translator-oscillator shields. The meter is there merely because it was in the way laying in the junk box. The power supply is simple and as long as one does not use any power tubes it is entirely adequate, since there is no detectable hum in the earphones. Power tubes are unnecessary, since the second detector output is more than ample for comfortable earphone use. One side of the heater transformer is grounded. One heater lug of each tube socket is soldered to the chassis for simplicity in wiring, and eliminates the need of heater by-pass condensers. The suppressor grid lugs are also soldered to the chassis. Plenty of tie-points are used for simplicity and neatness of wiring. Note that the power transformer and 80 tube are placed at the rear left of the chassis and the h.f. oscillator at the front right, for heat isolation, which helps reduce the oscillator drift. The placement of other parts was chosen for short leads and convenience.

Adjustments

Once the set is ready for adjustment the regular routine of aligning the i.f. and crystal units may be followed. Detailed information has been published many times so need not be gone over here. However, too much emphasis cannot be placed on the fact that one should *actually follow* the instructions in order to obtain best crystal filter performance. It is not uncommon to find operators who have failed to learn how to use their filter or realize the great benefits it offers. The writer has actually found operators who would cut in their crystal and even though the noise would drop considerably in relation to the signal, the signal also dropped. Examination would show that the beat oscillator was off tune or the set not properly aligned and the operator, not knowing what a real filter sounded like, would condemn the filter as "n.g." The only practical and sure way to align a crystal filter is to remove the crystal from the receiver, and set it up as an external crystal oscillator. Roughly align the i.f. circuits to the crystal oscillator. Then as a final touch-up, couple a small amount of its output to the grid of the translator and adjust all the i.f. trimmers for maximum second detector cathode current. By means of the i.f. volume control, keep the second detector cathode current adjusted to about .5 to .8 ma. (If the i.f. volume control is too far advanced, the second detector cathode current might be as high as 5 ma., which would probably ruin a 0-1 ma. meter.) Even this method is not exact since a crystal used as a parallel resonator may be a few hundred cycles different than when used as a series resonator. However, it will be found that the selectivity of the i.f. transformers is broad enough to allow for this difference. At any rate, the signal should not drop when the crystal is used as compared with the signal without the crystal. As an example, in the set described, with the crystal *off*, a steady incoming carrier may be adjusted to read 0.7 ma. at resonance, and with the crystal *on*, the same signal will actually read 0.9 ma. second detector plate current. Of course with the selectivity of the crystal the background drops very noticeably, and at first one would suspect the actual signal of doubling its volume even though it may have actually dropped slightly.

Set the noise control on the *off* position (maximum resistance). Adjust the second detector 76 cathode current to 0.2 ma. (no signal nor b.f.o. input). With the b.f.o. *on*, adjust twisted wire coupling, C_9, to 0.21 ma. cathode current, or more if you desire a loud beat (of course other values will hold for different types of tubes). For each set of coils the translator tube should be adjusted to 0.2 ma. (no signal nor oscillator input). Then determine the proper number of turns on the translator coil to increase the cathode current to 0.6 ma., *only after you have tuned in a signal for maximum signal strength by adjustment of the r.f. translator tuning dial*, which is to say that the r.f. translator is tuned to the incoming signal and the oscillator is either higher or lower by the amount of the i.f. used. The nearer you tune the r.f. translator to the oscillator frequency the greater will be the reading of the translator cathode current, or visa versa. The antenna trimmer adjustment, C_1, will be easy to find by listening to an incoming signal and adjusting it for maximum response, *with the same dial settings* as those used while adjusting the translator cathode current as just described.

After the set is working properly as a straight superhet and with crystal in the *off* position, start your car, buzzer, or other device which will produce a spark-gap type of noise (electric shaver used here). Then advance the noise control (decreasing cathode resistance in the 6J7/6H6 circuit) and tune the noise i.f.t. trimmers for *minimum* noise. The exact setting of both trimmer condensers of the i.f.t. is critical for maximum suppression.

Operation

As stated earlier in this article, the receiver's signal/noise ratio is usually determined by the first stage. Therefore, one should try to run the r.f. regeneration close to the oscillating point, where there occurs an enormous amount of amplification. The i.f. volume should be set to comfortable output. When bad noise (auto, dial phones, etc.,) is present, a little experimenting will be needed to find the optimum setting of the i.f. and noise controls for maximum noise suppression. This setting is by no means critical. The noise suppressor control should have no effect upon the incoming signal other than to *stop the noise* until a point is reached ("threshold") where the incoming signal or set noise blocks the receiver. After using the set for a few days, the operator will become accustomed to the various controls and will find it no more difficult to operate than any other type of receiver.

Results

As for results on weak signals, the writer has QSO'ed Europeans and Africans on 14 and 28 mc. when they were R2, QSA 5 at a time when backing off on the noise control would have literally knocked the phones off one's head, from some model T warming up while its master ate breakfast. Then again, some Europeans and Africans have been logged as an honest R9 (the second detector cathode meter is a 0-5 ma. one and they made the needle hit the pin). The noise/signal ratio was such that the needle would return to 0.4 ma. when they stopped sending. EA4AO, F8EO, F8CT, EA8AF, FA8BG, SP1DE, and OK2IC are some of the more consistent "pin bangers". On 56 mc. of course, the set will not hold the s.e.o. modulated "wobbulators". It makes them sound like a fingernail drawn briskly across about one inch of window screen. On the other hand, extremely steady signals of the T9X type are readily received with as much ease as on 28 or 14 mc. Harmonics of 28 and 14 mc. stations from all W districts have been copied on 56 mc.

◆

A small hole drilled at the end of a crack in sheet steel will stop it from growing longer.

Flood Activity

Because of the utter impossibility of naming every amateur worthy of mention in connection with the recent floods, we have taken one part of the country as "typical" of what transpired in hundreds of cities throughout the east and are giving an account of the part amateur radio played in that community. Thousands of other amateurs whose calls are not mentioned here did just as fine work and deserve equal credit: both space limitations and the fact that many have hidden their lights under a bushel make it impossible to describe their work or even to list them. We turned on the spotlight to give amateurs in other parts of the country a picture of what took place in badly flooded territory: the spotlight just happened to fall on New Hampshire, from which one of the most connected and coherent accounts was received through the courtesy of W1CME.

In the worst disaster in the history of the State of New Hampshire, amateur radio played a most important part. With wire services disrupted in all directions and the capital city of Concord virtually isolated from the rest of the state, the Governor called upon New Hampshire amateur to coöperate for the benefit of the State's citizens. Although complete details will never be known because of the reticence of some of the amateurs who took part, such material as is available furnishes a brilliant record. Beginning with the Governor's call on a Wednesday night, the amateurs stuck to their posts—many with battery powered rigs—until wire communication was restored the following Monday. A summary of the activities of the principal stations follows:

The Governor called W1BFT in Concord for radio communication to as many New Hampshire points as possible. W1BFT called QRRNH on 3750 and was answered by W1TA in Nashua, W1ANS in Milford, and W1IP, W1FFL, and W1CME in Manchester. He then called W1APK in Pembroke by land phone and asked him to get the New Hampshire 75 meter phone stations lined up for a tie-in with the 80 meter c.w. net.

In the meantime, W1AVJ installed a receiver in the Governor's office in Concord and, with the help of relief operators, maintained continuous watch on 3755 kilocycles, this frequency being adopted as the New Hampshire State frequency.

After the failure of electric power, W1JJD's push-pull 45 rig was revamped to use 10's with B battery supply, and, with a receiver that was converted to battery operation, resumed traffic. W1BFT and W1AVJ were in almost continuous operation for four days.

Assisted by W1IJB, W1APK worked both phone and c.w. with his high power phone rig until the power failed. Then the oscillator was used with battery power and the station thus kept on the air. This station is credited with saving a life by taking a message relayed by wigwag across the Merrimac river and relaying it to Concord, where an ambulance was dispatched in response to the message.

W1IOC in Boscawen ran a police line and at the risk of his life waded across a half-submerged bridge to secure materials for an emergency transmitter, which he constructed by the light of a candle. The transmitter he built supplied the only communication to four towns for several days.

In Manchester, the Merrimac and Piscatiquoag rivers divided the city into three sections, each isolated from the other until amateur radio got on the job. W1EFE set up a 5 meter outfit in the steeple of a church and worked all sections of the city, providing the only contact for the section in which he was located. Five meter equipment was set up at all American Legion Posts and the State Armory. The A.R.R.S. stations on 3709 handled a large amount of urgent Red Cross traffic.

At the Amoskeg dam, W1HFO and W1HJM manned 5 meter equipment for direction of the C.C.C. boys who were sandbagging the dam and power station to prevent their being swept away.

W1BII and W1FTJ handled many rush messages for the telephone company and in that way helped speed the restoration of telephone service.

W1CME handled 1326 messages and over 11,000 words of press in 83 hours on the air.

In Nashua, W1BCT and W1GEY handled traffic on 160 and 75 meters as long as the power held out. Then they dismantled their rigs and took them to a tire shop where diesel electric power was available. Hurriedly stringing an antenna, they got on the air again and maintained 24 hour watches for several days.

Credit should also go to the s.w.l.'s who were tuned to the 75 meter phone band and delivered many messages that were broadcast to

[Continued on Page 78]

A Quarter Kilowatt on Four Bands, Rapid QSY

By Le Roy Moffett, W9IJ*

Last month we showed the instantaneous band-change system in use at W6CIN. "Swell," was the response, "but I can never hope to have a rig like that. Show us something we can build at a reasonable price that will do the same thing on a smaller scale." W9IJ has worked out just such a rig, and it beats anything we have yet seen for a moderate power unit.

Oh! So YZ1DX was only answering stations on the high frequency end of the band and *I* was calling him on the other end of the band! Perhaps *you* stay on one band for months at a time? If you have a high moment of inertia, like the writer, you do, perhaps, and are justified. If you have to enlist the help of the neighbors and the dog to switch bands, there is an excuse for one-band operation. Here's one answer to the problem, one that removes the excuse.

Front View of the Complete Exciter.

After a perusal of the current literature on the subject our head went round and round and the following conditions were decided on as being an answer to the problem: 1) All crystals in one band to give a greater number of "repeat" points in the other bands. 2) Crystals lightly loaded to give frequency stability. 3) Doubling at low levels where efficiency is of no consequence. 4) Pentode amplifiers to secure a good power gain and at the same time eliminate the complications of neutralization. 5) A minimum number of controls should be used consistent with reasonable efficiency and, of course, band switching.

The Crystal Exciter Unit

This unit is mounted on a standard 19" x 8¾" x ⅛" relay-rack panel and a 17" x 10" x 3" chassis. The milliammeter is mounted in the upper-center of the panel. To the left is the 802 tank selector switch, Sw_3. Below is the 802 tank tuning condenser and to the right is the crystal selector switch, Sw_1, while below it is the dial for the ganged doubler condensers. The 802 grid switch, Sw_2, is mounted in the lower center. The jacks from left to right are: 802 plate, 802 cathode, 28 mc. doubler-plate, 14 mc. doubler-plate, 7 mc. doubler-plate, and the 3.5 mc. crystal-plate jack. To the right is the crystal heater switch, Sw_4. The key and meter are brought out on plugs. The keying plug is normally patched in the 802 cathode jack.

Referring to the chassis from above we see the two crystal holders in the upper-left and center; to their right are the ganged condensers for the crystal and doublers. The crystal selector switch is mounted on a strip of ½ inch brass above the crystal tank condenser, and a ¼ inch shaft runs to a bar knob and dial on the front panel. To the right is the combined crystal 7 mc. doubler 6A6 tube and in the corner the 3.5 mc. coil. The doubler coils are staggered so as to reduce coupling between stages.

First, moving towards the front of the panel, is the 7 mc. coil; below it the 14-28 mc. 6A6 tube; to its right the 14 mc. coil; and next to the panel the 28 mc. coil. The ganged condensers are opposite their respective coils.

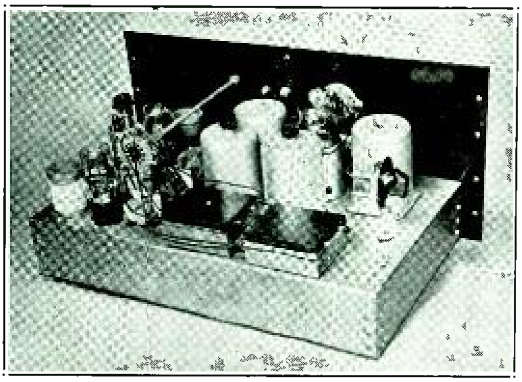
Around the 802 tube are grouped the tank coils for the stage. The 7 mc. coil and shield-can are mounted to the rear of the 802 tube. To the right of this coil-can is the 3.5 mc. coil-can; the 28 mc. coil-can is mounted to the left of the tube and the 14 mc. coil-can to the right. Between the 802 and the panel is mounted the 802 tuning condenser, C_7, with the tank band switch, Sw_3, above. These two are mounted on a ½ inch brass strip formed to make a

*4125 Main St., Downers Grove, Ill.

bracket so as to mount to the chassis. The screw that holds this bracket is used for the common ground return for the 802 stage, and all by-pass condensers and r.f. ground returns are brought to it under the chassis. The plate blocking condenser, C_{20}, and RFC_{10} are mounted by their leads directly to the condenser and switch assembly. The output coupling condenser, C_8, is mounted to the rear of the 28 mc. coil on a small mounting bracket and stand-off insulator. This allows a short lead to the grid of the 803 stage, when the 803 unit is mounted above this unit.

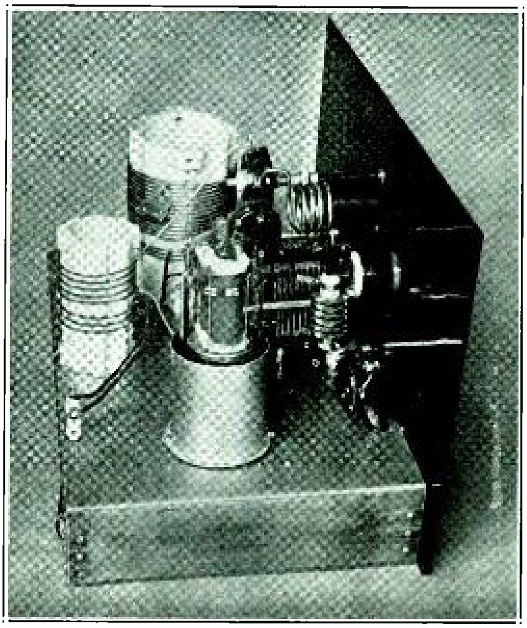
Referring to the wiring in the chassis, we have R_1, C_{17}, R_2, C_9, C_{10}, R_3, R_4, C_{18}, R_5, C_{11}, C_{12} and R_6 mounted on a bakelite strip. This assembly is mounted by means of screws to the chassis below the ganged tuning condensers. Most of the wiring on this strip can be done before mounting in the chassis. Common grounding points are used for each 6A6 tube.

The crystal holders are rather massive in order to give them a large thermal capacity (in order to cut down frequency drift). They have been used at W9IJ for over two years and have proven satisfactory. Each is 3¼" x 3" x 1" and was machined from brass stock and one face lapped. Four one-inch holes were cut in a piece of 3/16-inch bakelite to form a holder for the crystals. This piece is screwed to the brass base. In the picture of the top view of this unit the construction is shown. The dust covers



The Low Power Unit. Note the Special Crystal Holders.

can be removed easily to allow changing of the crystals. The dust cover is cut the size of the brass block from 3/16-inch bakelite. Small phosphor bronze "fingers" were cut to hold the top plates against the crystals and make electrical contact to them. The "fingers" were

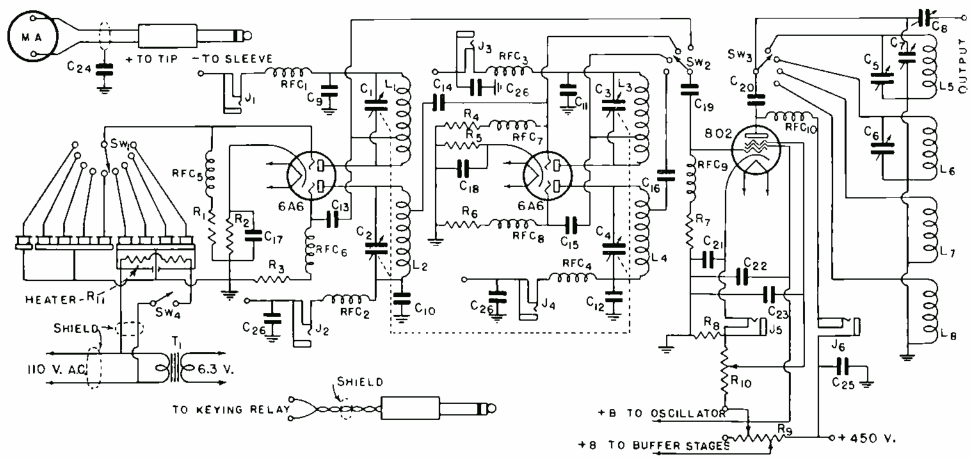


Side View of the 803 Stage. Note the Tube Shield.

mounted by screwing them to tapped holes in the bakelite holder. Leads are soldered to the "fingers", which can be seen protruding from the holder. A hole was cut in one of the brass holders and a heater resistor inserted. This is enough to drift an X cut crystal plate from about 7004 to 7000 kc. or to get you out of a bad QRM spot. Retuning of the crystal tank condenser will also give a small order of frequency control. A socket for additional crystals has been provided between the 3.5 and 14 mc. coils.

The four-ganged crystal and doubler condensers are mounted individually by brackets to the chassis. Care should be used in lining the condensers up in order to get a free-running gang unit. Flexible couplings are used between the condensers. They will be found especially convenient when the doublers are being adjusted for maximum output. The tracking of the ganged unit is secured by approximately halving the capacity and inductance of the circuit each time the frequency is doubled. The condensers and inductances used give tracking over the amateur bands close enough for practical purposes.

The plate coils for the 802 stages are mounted in shield cans having a diameter of 2.5 inches and a length of 3¾ inches. The 3.5 and 7 mc. coils are supported by the midget tank trimmer condensers mounted and ground-



The Crystal Exciter Unit

R_1—5000 ohms, 1 watt.
R_2—250 ohms, 2 watts.
R_3—20,000 ohms, 1 watt.
R_4—12,000 ohms, 1 watt.
R_5—1,000 ohms, 3 watts.
R_6—12,000 ohms, 1 watt.
R_7—12,000 ohms, 1 watt.
R_8—500 ohms, 10 watts.
R_9—4,000 ohms, 50 watts, semi-variable.
R_{10}—15,000 ohms, 25 watts, semi-variable.
R_{11}—1,500 ohm flat card type resistor.
C_1—100 μμfd. midget air condenser.
C_2—50 μμfd. midget air condenser.
C_3—25 μμfd. midget air condenser.
C_4—15 μμfd. midget air condenser.
C_5—75 μμfd. midget air condenser.
C_6—50 μμfd. midget air condenser.
C_7—35 μμfd. midget air condenser.
C_8—75 μμfd. midget air condenser.
C_9—.01 μfd. mica.
C_{10}—.01 μfd. mica.
C_{11}—.01 μfd. mica.
C_{12}—.01 μfd. mica.
C_{13}—.001 μfd. mica.
C_{14}—.001 μfd. mica.
C_{15}—.0005 μfd. mica.
C_{16}—.001 μfd. mica.
C_{17}—.01 μfd. mica.
C_{18}—.01 μfd. mica.
C_{19}—.0002 μfd. mica.
C_{20}—.002 μfd. mica, 5,000 volt.
C_{21}—.01 ufd. mica.
C_{22}—.01 μfd. mica.
C_{23}—.001 μfd. mica.
C_{24}—.01 μfd. mica.
C_{25}—.01 μfd. mica.
C_{26}—.001 μfd. mica.
C_{27}—25 μμfd. midget air condenser.
$J_{1\text{-}6}$—Short jacks.
MA—0-100 ma., 2⅛ inches in diameter.
Sw_1—Rotary tap switch, 10 point, single circuit.
$Sw_{2\text{-}3}$—Rotary tap switches, 4 point, single circuit.
Sw_4—Toggle switch.
$RFC_{1\text{-}10}$—Midget pie-wound r.f. chokes.
T_1—6.3 volts, 2.5 amps., filament transformer.

ed to the top of the coil shield can. The 14 and 28 mc. coils are supported by small stand-off insulators in the cans. The ground return leads from these two stages are brought out through the chassis and run to the common ground point for this stage. The plate leads are brought out through small rubber grommets near the top of the cans.

The 802 tube shield was so cut that the shield extended up to a point level with the bottom of the internal tube shield. Extensive use has been made of by-pass condensers and r.f. chokes to isolate the circuits and keep the r.f. where it belongs. Some of the r.f. isolating and by-pass condensers can be dispensed with, perhaps, without harmful results, but C_{25} was found to clear up the original trouble encountered with feedback. It was found that feedback was present when the milliammeter plug was patched into the doubler jacks. It will be noted that the milliammetter is mounted near the r.f. plate leads of the 802. This coupling from the plate to the milliammeter and leads back into the plate circuit of the doublers, via the meter cord, couples into the grid circuit of the 802, and is a source of feedback. The milliammeter leads should be shielded and the shielding grounded and the meter by-passed to ground to clear this source of trouble.

The voltage on the doublers should be set to 300 volts. This will require about 900 ohms on R_9 from the plus end for a 400 volt supply, and about twice this for a 500 volt supply. The 802 screen-grid and crystal-plate tap is adjusted for 235 volts. This will require about 1400 ohms on R_9 from the doubler voltage tap. The suppressor voltage is adjusted for 35 volts under operating conditions. This will require approximately 3000 ohms from the cathode tap on R_{10}.

The unit is lined up at the highest frequency to be used, in this case 28 mc. The small trimming condenser mounted on the 14 mc. coil, should be set near maximum capacitv. The crystal and each succeeding doubler stage tank condenser should be adjusted to resonance as denoted by minimum plate current. The output of the 802 stage may be checked with a 10 or 15 watt lamp or the d.c. grid current of the following stage. About 50 μμfd. of the output coupling condenser, C_8, is used on all bands, but it may be necessary to reduce this to about

COIL DATA
Crystal Exciter Unit

Coil	*Band*	*Total No. Turns*	*Tap From Ground*	*Turns per Inch*	*Diameter*	*Wire Size*
L_1	3.5 mc.	28 2/5	10 4/5	20	1.5 inch	22
L_2	7 mc.	17 2/5	12 4/5	14	"	16
L_3	14 mc.	7 2/5	5 4/5	10	"	16
L_4	28 mc.	4 2/5	3	5	"	14
L_5	3.5 mc.	30	—	20	"	16
L_6	7 mc.	18	—	14	"	14
L_7	14 mc.	11	—	6	1.25 inch	14
L_8	28 mc.	2.5	—	5	1.25 inch	14

30 μμfd. on the 28 mc. band in some cases to keep the plate current of the 802 stage within rating.

The trimming condenser, C_{27}, across the 14 mc. coil is used to correct the detuning effect caused by shunting the 802 grid circuit across the coil for 14 mc. output. This effect is of no importance on the other bands but, for maximum output, it is necessary to trim when changing bands from 28 mc. to 14 mc. or vice versa.

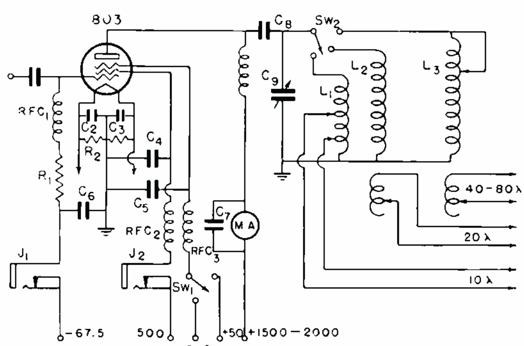
The minimum crystal plate current is about 8 ma. and the plate current for the doublers varies from 11 to 16 ma. when driving doublers and 25 to 35 ma. when exciting the 802 stage.

The 803 Stage

The front panel of the 803 unit is a standard rack-mounting panel 19" x 12¼" x ⅛". The chassis is 17" x 11" x 3".

The front view shows the plate milliammeter mounted on the left, the plate condenser dial front and center, and the patching milliammeter on the right. This milliammeter may be patched in either the control or screen grid packs. To the right of the jacks is the s.p.d.t. toggle switch. This switch can be used to put a plus voltage on the suppressor grid for c.w. or in the other position for suppressor modulation. Placing a negative voltage on the suppressor is a simple way to QRP or to reduce the plate current for tuning. The three-point band switch is mounted above the dial.

Observing the unit from the rear we find the large 3.5-7 mc. coil mounted on the left. A flexible lead and clip short out 6 turns on the "hot" end for 7 mc. operation. A small "L" piece of wire has been soldered to the 7 mc. tap, to facilitate the shorting operation. If



The 803 Stage

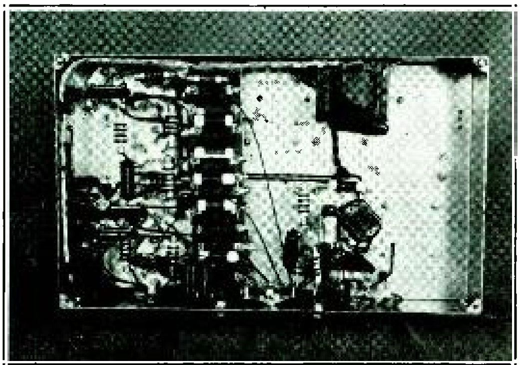
RFC_{1-3}—Midget, pie wound chokes.
R_1—2000 ohms, 10 watts.
R_2—100 ohms, center-tapped, 10 watts.
C_1—.001 μfd. mica.
C_2—.006 μfd. mica.
C_3—.006 μfd. mica.
C_4—.002 μfd. mica.
C_5—.002 μfd. mica.
C_6—.006 μfd. mica.
C_7—.001 μfd. mica.
C_8—.002 μfd. mica.
C_9—100 μμfd. split stator, 6000 volt.
Sw_1—s. p. d. t. toggle switch.
Sw_2—3 point, r.f. switch.
MA_1—0-50 ma.
MA_2—0-300 ma.

a four point band switch is available, it would be just as well to run the 7 mc. tap to the switch point, i.e., not to short out turns. The difference in efficiency will be of no consequence. The three link turns are wound on the bottom end. A clip is used to select the required number of turns. The link leads are brought out to the two small stand-off insulators mounted to the rear of the coil. The 14 mc. coil will be observed to the rear of the tank condenser.

Winding the Coils

These coils were first wound on a "shaping" form, about a half inch smaller than the coil-form, with no. 12 hard drawn wire. Upon releasing the winding tension the coils expanded to the correct size. They were then threaded on the coil-forms.

The tank condenser control is extended to the front panel by means of an isolantite flexible coupling and a piece of 1/4 inch bakelite rod.



Bottom View of the 6A6-802 Unit.

The band switch is supported by means of a 1/2 inch brass strip to the "hot" stator plates of the condenser. This strip also is used as a connection to the switch arm. A flexible coupling and piece of 1/4 inch bakelite rod is used to extend the switch control to the front panel. The switch rod is brought through a bushing to the front panel. The plate blocking condenser is supported by a no. 10 wire lead to the "hot" stator plates. The 28 mc. coil is supported at one end by the "ground" stator plates and the other end of the coil is soldered to the 28 mc. switch point. This will allow very short leads. Output coupling is obtained by clipping across the required number of turns on the ground end of the coil.

An attempt was made to use the 14 mc. coil for 28 mc. operation but due to the high tube capacity and length of the connecting leads it was found that only one turn could be used on the coil on 28 mc. This was not consistent with our personal idea of a tank coil. Our experience with 28 mc. is that this band is a problem unto itself and proper consideration should be given to circuit design if reasonable efficiencies and proper operation are to be expected.

The r.f. choke is supported by the plate meter terminal, and an r.f. by-pass condenser is mounted directly across the meter terminals. The shield around the base of the tube was made by cutting the top from a coil-shield can having a diameter of three inches.

The view of the under side of the chassis is self-explanatory. It should be noted that all leads are shielded and that the shielding is grounded. All the by-pass condensers from tube to ground are grounded at a common point. The grid blocking condenser is supported by the wiring to the socket and the other end to a stand-off insulator, which is the input terminal.

The extensive shielding of the leads and the isolating of circuits in this stage has paid the expected dividends. No trace of coupling between the grid and plate circuits, via the wiring or otherwise, is noticeable.

Screen and plus suppressor voltages for this stage are obtained from a potentiometer. A rather heavy bleeder current is recommended to give good voltage regulation if a lower powered stage, as the 802 stage, is keyed. A 40,000 ohm, 200 watt, semi-variable resistor is suggested for a 1600 volt supply and a 50,000 ohm resistor for higher voltage supplies. The taps are adjusted to give 500 volts on the screen and 50 volts on the suppressor for "key-down" conditions. The negative voltages for the control grid and for the suppressor are obtained from a common bank of small bias batteries.

The coil values have been so chosen that almost the full value of the tank condenser is used on 3.5 mc., a little less than half scale on 7 mc., quarter scale on 14 mc., and about one-fifth scale on 28 mc.

COIL DATA

803 STAGE

L_1 - 3.5 - 7 mc.,	14 turns for 3.5 mc., 6 turns shorted out for 7 mc., 3 turn link wound on ground end of coil. Wound 6 turns per inch, diameter 4 inches, no. 12 wire.
L_2 - 14 mc.,	5 turns wound 3.5 turns per inch on 2.5 inch form of no. 12 wire, 3 turn link.
L_3 - 28 mc.,	3.5 turns wound 3 turns per inch, diameter 1.5 inches, no. 8 wire. Coil extended 3/4 turn from ground end to give a balanced pick-up for the output line.

The 803 stage is used to drive a 1 kw. final amplifier at W9IJ. As might be expected, this unit will "kick" the final in the most approved W6CUH manner. However, from 100 to 150 watts has been found to be plenty of driving power for this final. For exciting the 1 kw.

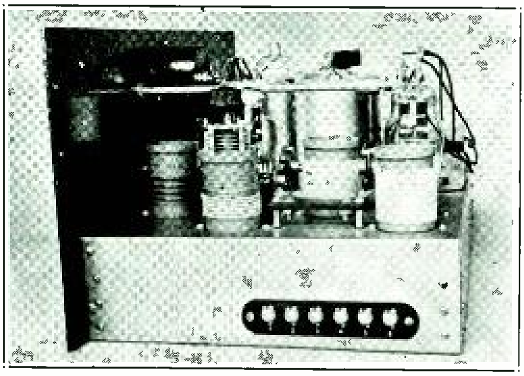
stage, two or three turns are used on the pick-up coils and one turn on the grid tank link. The balanced grid tank of this stage is switched similar to the 803 stage.

The 803 unit can be link coupled to the antenna feeders via any of the standard tuning units, such as the Collins low-pass filter or the regular "zepp." tuning arrangement. If a non-resonant transmission line (one properly terminated in its surge impedance) is used to feed the antenna, it can, of course, be fed from the pick-up turns on the amplifier.

No trouble was had in getting the full rated output from the stage. If trouble is experienced with getting the stage to take the load properly, the d.c. voltages should be checked on the grids, especially the screen grid.

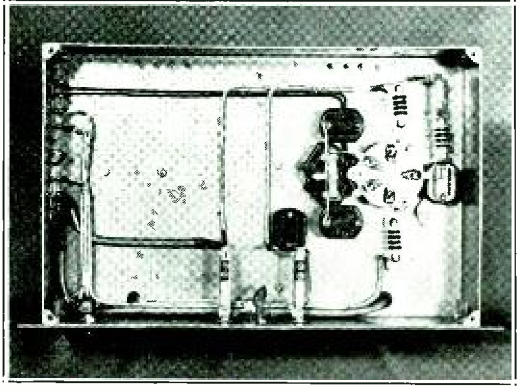
A few suggestions, perhaps, will not be amiss. It is not advisable to allow even momentary overload on a tube as expensive as the 803; it is better to buy more or bigger tubes and run them within the manufacturer's ratings. If two tubes are used it would be better to operate them in push-pull, if frequencies as high as 14 or 28 mc. are to be used, due to the high inherent tube capacity of this type of tube.

In practice it will be found that the adjustments of the crystal-exciter unit are not at all critical. About half of either the 14 or 28 mc. band can be covered at W9IJ, without appreciable loss of efficiency, by merely retuning the grid tank of the 1 kw. final amplifier, the plate tank, and the antenna tuning. From experience it has been found that when the frequency change is much greater than this, it is advisable to retune the stages, unless a considerable drop in efficiency and output power can be tolerated.



Side View of 6A6-802 Unit, Showing Coil Arrangement.

We wish to thank Mr. Conklin, W9FM, for the photos of the "rig".



Bottom View of the 803 Unit.

In conclusion we can only say that the units have lived up to expectations and that we feel repaid for our efforts. They can be duplicated by following this article with but a fraction of the effort expended in the "cut and try" part alone on the original model.

◆

REPLACING VOLUME CONTROLS

Reviewing the experiences of thousands of service men in handling volume control replacements, George Mucher of Clarostat offers the following "don'ts":

Don't attempt to replace C-bias and antenna C-bias controls before checking:

1. Control tubes for "shorts".
2. Bleeder resistor (if used).
3. Whether original control has a built-in bias resistor. In such cases use external bias resistor if exact duplicate control is not available.

Don't attempt to replace screen grid control before checking:

1. Control tubes for "shorts".
2. Screen by-pass condensers for "shorts".

Don't attempt to replace plate circuit tone controls before checking series condensers for "shorts". Due to high a.c. voltages generated across control on loud signals, we strongly recommend the use of wire-wound controls for such applications.

Failure to heed the foregoing "dont's" may result in burned-out controls.

Don't cut shaft and solder lead wires before checking control action. Failure to observe this precaution is sufficient cause for dealer to refuse replacement.

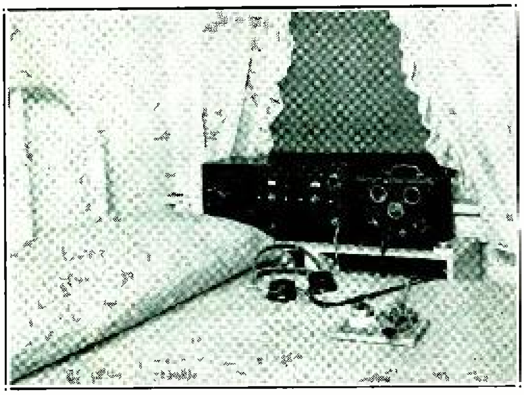
Don't attempt to replace with other than recommended tapers.

W6BGC Goes "Lazy X"

By Maurice E. Kennedy,* W6BGC

Did you ever get up from a nice warm bed to light the heater in the shack to get in some early-morning dx? Have you ever tossed in bed for half the night with insomnia? Are you occasionally confined to your bed with the flu or some minor malady for a few days? Then get busy and install "bedroom control".

As one grows older and more encumbered with the duties of commercial radio, the ham station often fights a losing battle with the dust and cobweb hazard. In view of this fact, and with the memory of early morning Trans-Pacific dx back in '26 and '27 spurring me on, I excited the old gray matter to full Class C with the following result.



"When Old Rockin' Chair Gets You"
Beside the operator's bed is the "remote" receiver. Note the extension key and plate voltage control switch.

Remote control systems of various types had been attempted before, and some actually operated the transmitter to a fair degree of success. However, a morning's dx was usually spoiled by constant fear of something melting in the transmitter or that the shack in the back yard might be in the process of cremation. Occasionally one of the relays would stick and spoil a perfectly good QSO, forcing the operator to climb out of bed, and after groping in the darkness for a bathrobe, go dashing out to pry the contacts apart. This was several years ago when good relays cost money, and we usually attempted to build them from old telegraph sounders or odds and ends from the station junk box. It was necessary to operate these relays from a storage battery which had a habit of being dead on the mornings the best dx came through.

*415 West Lexington Drive, Glendale, Calif.

With the low cost of modern a.c. relays, the author again decided to try a high-class remote control system, and this time it worked like a charm with "nary a miss".

After selecting three suitable relays, they were mounted nearest the switches they were to parallel, thus permitting complete control of the transmitter direct or from the remote operating location.

The actual wiring of the relays is very simple, as the contacts merely parallel the regular switching and keying controls of the transmitter's power supply. The relay field coils are operated from 110 a.c. and are controlled from the remote operating position beside the operator's bed.

A heavy wire stretched between the shack roof and the upper portion of the window casing of the bedroom supports the three-pair lead cable in telephone-cable style, with small pieces of wire being looped around the cable and the supporting wire at intervals of two or three feet. This control cable should be sufficiently high to be free from mechanical injury and out of the way. A short cable will require no further attention.

Turnbuckles may be placed at each end of the supporting wire to compensate for any stretching if the cable span is over thirty feet between supports.

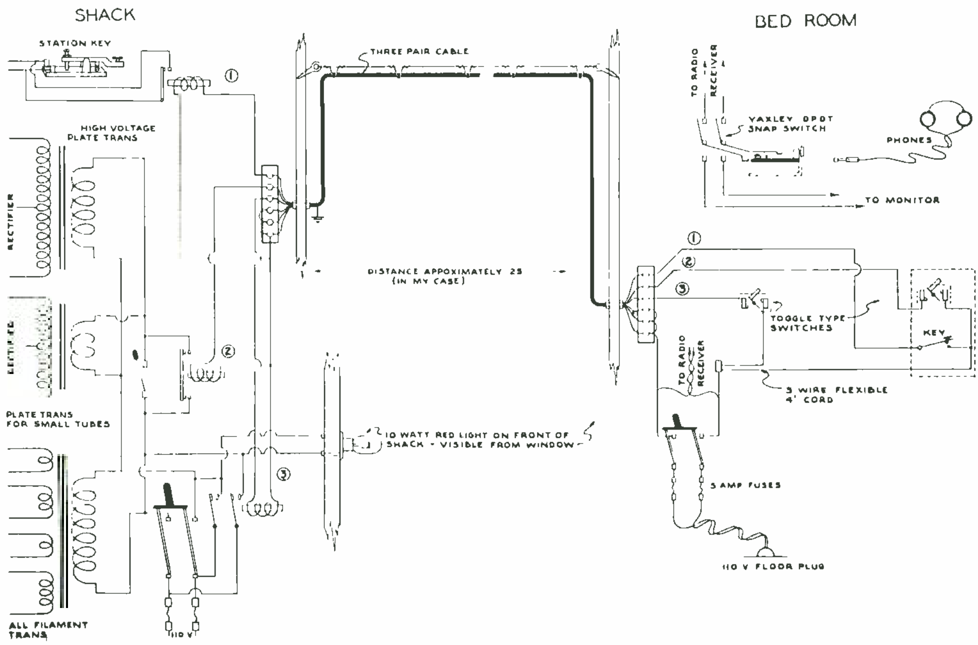
A convenient entrance for cable, antenna, etc., may be accomplished by drilling the required number of holes in a board to be inserted in the narrow opening of the window. This provides entrance to the bedroom without injury to walls or floor.

The remote receiver need not be elaborate, as the QRM on the 7 mc. band in the early morning is very slight, and due to the skip effect, local signals are usually not as loud as Trans-Pacific dx.

Headphone operation is necessary in my case to prevent disturbing other members of the family.

The problem of listening to your own signals for good keying is easily solved with a monitor wired as shown in the diagram to feed the same headset used for receiving.

[Continued on Page 83]



Wiring of the Remote Control Relay System

Showing a Corner of the Shack: 40 Meter Transmitter and Direct Operating Position.

Efficiency Modulation in Simple Terms

By J. N. A. Hawkins, W6AAR

The whole subject of efficiency modulation seems to be rather hazy in the mind of the average phone man. The advantages of class BC operation over the older class B system of efficiency modulation are becoming more widely appreciated. Several new ideas are presented herewith, and although ordinary linear amplification will probably be succeeded by the new expanding linear amplifier described in this issue, a thorough understanding of the principles of grid modulation is essential in order to get the idea behind the new expanding amplifier. Inasmuch as this article was prepared several months ago it includes nothing on dynamic shift amplification, and perhaps a general qualification should be made to the effect that the statements made in this article apply only to steady-state or constant-axis amplifiers and the limits of efficiency and output do not apply to dynamic shift or expanding amplifiers.

"Grid Modulation"

All low-level modulation systems can well be classified under the general heading of *grid modulation*. Suppressor grid modulation of a pentode is obviously grid modulation as is the system known as grid bias modulation. The operation of a radio frequency amplifier as a class B or BC linear amplifier also is a form of grid modulation. Perhaps it best could be termed *grid excitation modulation*. As far as the operation of the amplifier tube is concerned there is practically no difference between grid bias modulation and grid excitation modulation. In the grid bias modulated amplifier the grid excitation is held constant while the d.c. bias voltage is varied by the audio signal. See figure 2. In grid excitation modulation, or linear r.f. amplification, the d.c. grid bias is held constant and the amplitude of the grid excitation is varied by the audio signal. See figure 3. The result, as far as the amplifier grid and plate circuits are concerned, is the same in either case.

There is very little difference in cost, linearity, or adjustment between grid bias and grid excitation modulation, but what difference there is seems to favor grid excitation modulation, or the linear amplifier system, at the present time.

Amplitude Modulation

Amplitude modulation of any wave involves a variation in the peak amplitude of the carrier wave so that the envelope of the resultant modulated wave is similar to the waveform of the audio, or modulating, signal. When a carrier wave is completely modulated (100% modulated) the unmodulated amplitude of the wave is alternately doubled and then reduced to zero. The amplitude of a wave corresponds to the r.f.

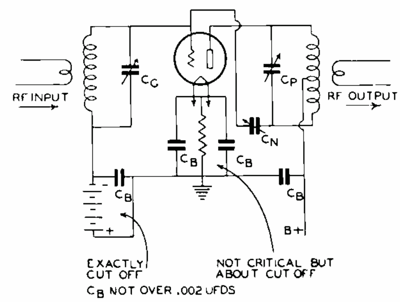


Figure 1
Class BC linear amplifier. The cathode bypass resistors must not be over .002 μfd.

voltage across the antenna that is radiating the wave. Thus when the amplitude of the carrier wave is doubled the r.f. voltage across the transmitting antenna is also doubled. As an antenna is effectively a pure resistance, doubling the voltage across it also doubles the current flowing through it (by Ohm's law). When the voltage and current in any resistive circuit both double, the *power* in that circuit has quadrupled. Thus complete modulation of a carrier wave causes the *instantaneous* power in the antenna (or output circuit) to vary between the limits of zero power and *four times* the normal unmodulated carrier power. Note the word *instantaneous*; it must be carefully distinguished from *effective* power. By integrating out the instantaneous variations in carrier power caused by 100% modulation it is found that the effective power (averaged over one audio, or modulating cycle) has been increased exactly 50% over the power in the unmodulated carrier. A 50% increase in average power output equals a 22% increase in effective antenna current. (Note that for the purposes of this discussion pure, sine-wave modulation is assumed.)

It is this 50% increase in average carrier power that is supplied by the output of the audio modulators in a plate-modulated phone transmitter. In a high level modulation system this is done by increasing the plate input to the class C modulated amplifier 50%, which increases the r.f. output in the same degree due to the fact that the conversion, or plate efficiency, of a class C stage is relatively independent of plate input, when operating properly. Thus the audio modulators in a plate-modulated transmitter are really modulating the plate power supply of the class C stage, and not the class C stage itself. Thus plate modulation is often called *power modulation.*

Grid, or Efficiency Modulation

It is a fundamental of grid modulation that the *average* plate input (as indicated on a d.c. plate meter) to the modulated amplifier must not vary during modulation. Thus if the average plate input remains constant and independent of modulation, the 50% increase in average power output of the modulated amplifier which occurs during complete sine-wave modulation can only be obtained by *increasing the average plate efficiency of the grid modulated amplifier 50%.* Thus all grid modulation systems are *efficiency* modulation systems. The average plate input to the modulated amplifier remains constant, but the efficiency of conversion of that input into r.f. power output is varied at an audio frequency rate by the modulating voltage applied to the grid bias supply in grid bias modulation, or to the preceding amplifier in grid excitation modulation.

So far the grid modulated amplifier has been analyzed only from the standpoint of *average* variations in plate efficiency and power output that occur during modulation. The instantaneous power output of the grid modulated amplifier must swing up to *four* times the unmodulated carrier, then down to *zero* power, then back to the unmodulated value, during periods of 100% modulation. This quadrupling of instantaneous power output results from two separate causes. First, the *instantaneous* plate efficiency varies, during complete modulation, from the normal unmodulated value up to twice normal, then down to zero efficiency and then back to normal.

The variation in plate efficiency accounts only for a doubling in instantaneous power output during complete modulation. The rest of the increase in the power output comes from the fact that the *instantaneous* plate current is also varying at an audio frequency rate between the limits of twice normal and zero current. As the plate voltage is constant the instantaneous plate power input varies exactly with the plate current so that doubling the instantaneous current doubles the instantaneous power input. The

Instead of presenting a table showing operating constants for all tube types and at all possible plate voltages (which would be awkward), the following formulae may be used to derive all the unknown constants for class BC operation from the factors that are generally known in advance, such as maximum allowable plate dissipation, μ of the tube to be used, and available plate voltage. From these factors may be determined the unknown factors such as d.c. battery bias, resistance of the cathode bias resistor, optimum d.c. plate current, and carrier power output.

Unknown Factors:

W_{IN} = d.c. plate input power, in watts.
W_{OUT} — r.f. unmodulated carrier power, in watts.
I_P = average d.c. plate current, in amperes.
E_{CCO} = negative battery bias equal to theoretical cut-off, in volts (½ total bias).
R_K = cathode bias resistance, in ohms.

Known Factors:

E_B = d.c. plate supply voltage, in volts.
W_{PL} = rated plate loss, in watts.
μ = amplification factor of tube used.

Formulae:

$$W_{IN} = 1.66\ W_{PL}$$
$$W_{OUT} = .66\ W_{PL}$$
$$I_P = \frac{1.66\ W_{PL}\ (1 + \mu)}{\mu\ E_B}$$
$$E_{CCO} = \frac{E_B}{1 + \mu}$$
$$R_K = \frac{E_B^2\ \mu}{1.66\ W_{PL}\ (1 + \mu)^2}$$

instantaneous plate current varies directly with the instantaneous plate efficiency and when both have been doubled (during 100% modulation) the r.f. power output has been quadrupled. It should be noted that the variation in plate current between zero and twice normal occurs at an audio frequency rate, not a syllabic rate, and thus good voltage regulation in the plate power supply is not necessary. When the plate current drops to zero, energy is stored in the last filter condenser. When the plate current doubles, this stored energy is given up again and as the plate voltage is constant, this variation in

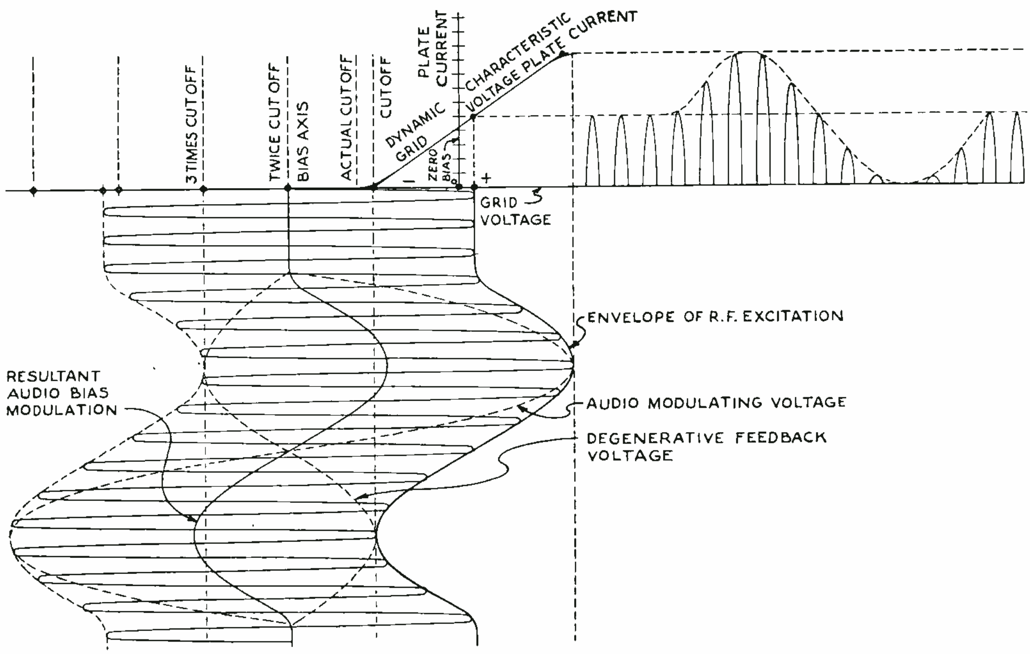


Figure 2

Class BC bias modulation (no audio bypass on cathode resistor). Note the two forces working on the grid bias voltage: the audio modulation voltage and the degenerative feedback voltage, working in opposite directions. The degree of degenerative feedback is dependent on the value of unbypassed resistance in the cathode circuit.

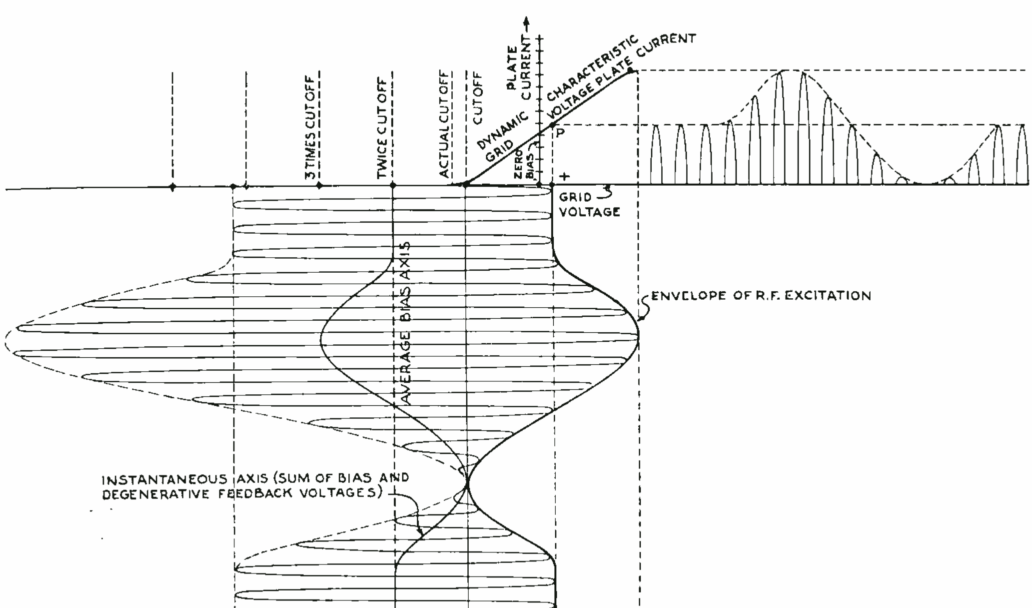


Figure 3

Class BC linear or excitation modulation. Here there is only one force working on the bias: the a.f. variation in current through the unbypassed cathode resistor (degenerative feedback). Contrary to widespread belief, there is no "modulation gain" in a class BC linear amplifier. This should be apparent from study of the above curves.

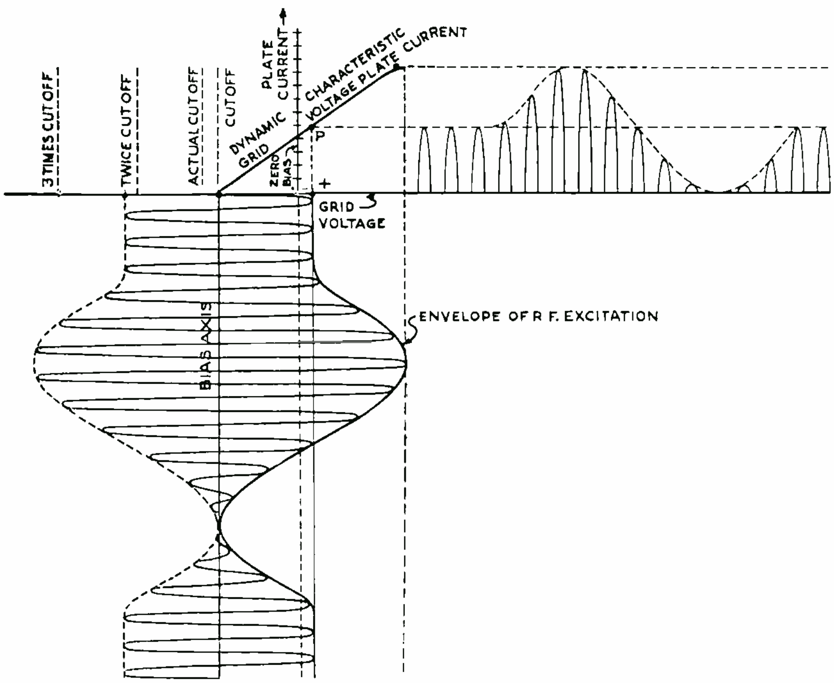


Figure 4
Conventional Class B Linear Amplifier Curves, Shown for Comparison.

plate current causes no variation in the *average* power drawn from the plate power supply, although the *instantaneous* plate input alternately doubles and drops to zero. This explains how the instantaneous power output of a 200 watt grid modulated amplifier can swing up to 800 watts on the *instantaneous* (audio) peaks although the average d.c. plate input is only 500 watts. It must be noted that the last filter condenser in the plate supply hum filter should be large enough to take care of the audio frequencies that pass through it.

In pure class B operation of a linear amplifier the bias is made equal to theoretical cut-off, or d.c. plate voltage divided by the μ of the tube used in the amplifier. The plate current is not actually cut-off when a tube is biased to this point, as no practical vacuum tube has a constant μ clear out to the cut-off point. However, only a small amount of plate current flows at theoretical, or projected, cut-off and for most purposes it can be assumed that actual and theoretical cut-off coincide.

In the class BC amplifier fixed bias equal to cut-off is used, and in addition, there is a cathode bias resistor used which supplies additional bias. The additional bias supplied by the cathode bias resistor is not critical and can be almost anything from half cut-off to several times cut-off. However, the best compromise value for the medium μ tubes (μ between 8 and 16) seems to be about cut-off. Thus the total bias (fixed plus cathode) should equal about twice cut-off. The *fixed* bias should be well bypassed to audio frequencies and the bias source should have good voltage regulation, particularly if the amplifier is to be driven hard into the positive grid region. The fixed bias is rather critical for minimum amplitude distortion, and once set it should be left alone. If it is desired to experiment with bias, vary the cathode bias but leave the fixed bias alone once it has been set for a given plate voltage. There is one very important thing about the cathode bias that must not be overlooked. The cathode bias resistor *must not be bypassed* for the audio frequencies. A radio frequency bypass across the resistor may be used but it should not be over .002 μfds. Placing an audio bypass across the cathode resistor short circuits the degenerative audio feedback voltage which appears across the cathode resistor. This degenerative feedback voltage is what keeps the amplifier linear even though the average total bias exceeds cut-off. This feedback voltage varies directly with the plate current. It alternately adds to and subtracts from the bias voltage. On the modulation peaks, when the instantaneous plate current is twice its average value the instantaneous cathode bias doubles, and when the plate current drops to zero a half cycle later, the cathode bias also drops to zero. This is shown in figures 2 and 3. Thus if a given amplifier uses cathode bias equal to cut-off (total bias twice cut-off) the total instantaneous bias swings from its normal unmodulated value of twice cut-off up to three times cut-off, then down to cut-off, then back to twice cut-off during each audio cycle of complete modulation.

It should be noted that the degenerative feedback voltage (audio) which appears across the cathode bias resistor is deducted from the plate voltage and thus also appears as a degenerative voltage in the plate circuit. The effect of this voltage can usually be neglected in practical applications and calculations, except where very low μ tubes are used in the amplifier. In other words, to simplify calculation the actual plate voltage on the tube (supply voltage minus instantaneous value of voltage across the cathode resistor) may be assumed as constant under modulation, though it is not strictly so.

The use of degenerative feedback in the class BC amplifier allows high peak and unmodulated plate efficiency to be obtained and even improves the linearity of the amplifier over the conventional class B amplifier. The power gain through the class BC amplifier is somewhat less than through a comparable class B amplifier but the reduction in overall power gain is slight and the increase in output, efficiency and linearity is well worth the slight loss in gain.

It should be mentioned that there is no modulation gain through a class BC linear amplifier. No matter what the total unmodulated bias may be, if the fixed bias is equal to cut-off, the preceding stage must be completely modulated if the class BC amplifier output is to be completely modulated.

Due to the fact that the d.c. grid current flows through the cathode bias resistor of a class BC amplifier it is desirable to keep both the cathode bias resistance and the d.c. grid current low in order to avoid audio distortion arising from changes in bias with grid current flow. To keep this distortion low it is desiraable, therefore, to use a tube with the highest possible transconductance, as cathode bias resistance and d.c. grid current both vary inversely with the transconductance of the tube used.

As the instantaneous peak plate efficiency must be able to double in order for the amplifier to have 100% modulation capability, the unmodulated plate efficiency must be adjusted to *not more than one half* of the maximum attainable peak plate efficiency.

The theoretical maximum peak efficiency of a class B amplifier (one biased to cut-off) is 79%, as the angle of plate current flow remains constant at 180°. Thus one half of this peak value equals 39%. Practical class B amplifiers rarely exceed about 66% peak efficiency, and 50 to 60% peak plate efficiency is more common in practice. Thus the unmodulated plate efficiency of a practical class B amplifier ranges from about 25% to 33%.

The class BC amplifier can have almost any desired angle of plate current flow between 180° and 0° merely by increasing the degenerative cathode bias. Therefore, like a class C amplifier the theoretical maximum peak plate efficiency is 100%.

For reasons of driver and power supply cost the peak plate efficiency is usually held at about 80%, which allows a maximum unmodulated plate efficiency of half this value, or about 40%. With average tubes of medium μ (between 8 and 16) this requires a total bias equal to between two and two and a half times cut-off.

The variations in plate efficiency and plate current that must occur during modulation are caused by superimposing the audio frequency modulating voltage on the d.c. grid bias voltage, or on the r.f. excitation voltage. See figures 2 and 3. As the grid must be allowed to swing somewhat positive (with respect to the filament) at least during modulation, it will intercept electrons from the filament, causing d.c. grid current to flow. If the power output is to be free from distortion this flow of grid current must not be allowed to change the negative bias on the tube. This necessitates a very low resistance d.c. grid return to ground.

The r.f. driver is best stabilized by connecting a tungsten filament lamp across either part of the driver plate tank or else across the low impedance coupling link which transfers energy from the driver plate tank to the grid tank of the modulated amplifier. Of course, a resistor of any convenient value up to about 5000 ohms could be used in place of the tungsten filament lamp, but the lamp is usually more convenient as well as self-adjusting due to the temperature-resistance characteristic of a tungsten filament.

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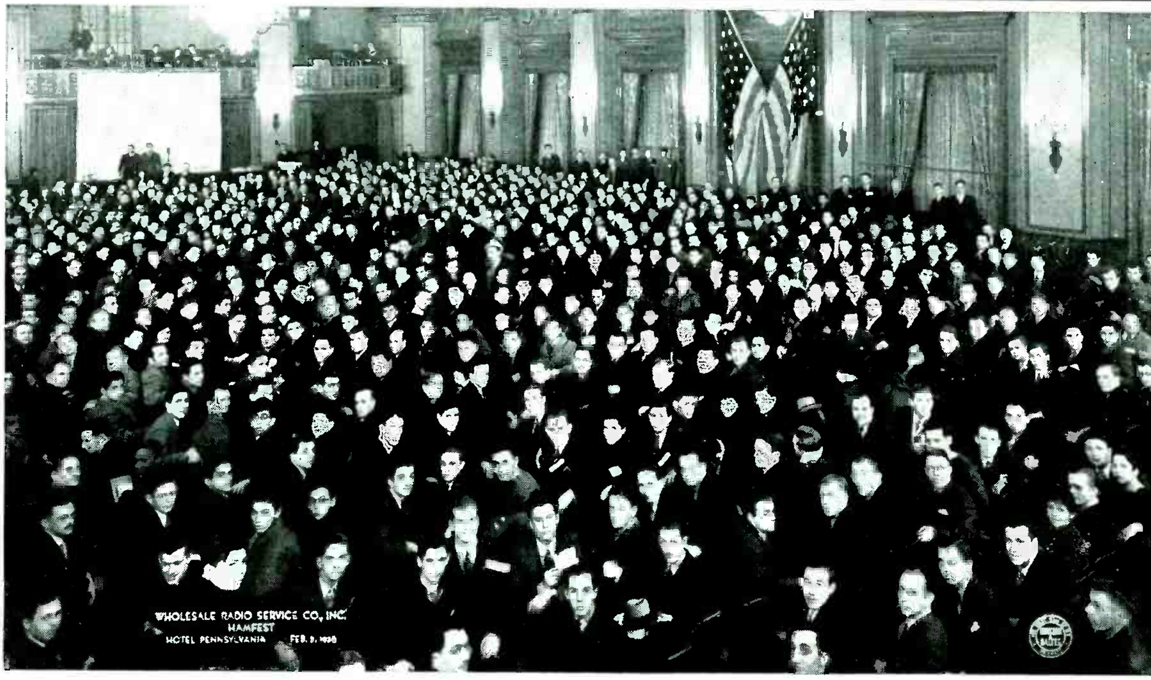
W1CAV has been using the same S-tube rectifiers in his transmitter since 1923!

2214 HAMS *Can't* BE WRONG!



On February 3, 1936, an event took place that had the hams in and around New York talking in their sleep. It was a ham fest held in New Yorks' famed Hotel Pennsylvania, originated and sponsored by Wholesale Radio Service Company.

Sure we expected a crowd. We figured we had lots of friends and the program looked mighty interesting. But we didn't expect the crowd that jammed the hall to capacity. They filled every available seat; packed the aisles and, if it had been an old fashioned hotel, they probably would have perched on the rafters!

And what a talk fest it was! After the speakers got through we talked about everything near and dear to the heart of a ham. Some of us are still hoarse from trying to shout louder than five or six other fellows sitting near by who had exactly the same idea.

We're sorry—really sorry—that all of you fellows couldn't be there. Maybe some day we'll build a hall in the exact center of the U.S.A. that can seat forty or fifty thousand hams; install some P.A. equipment (we have lots of it around, you know) and dare you fellows to do your worst.

Anyway, we feel pretty cocky about the swell turn-out. It was nice to see all the hams come out in full force, and they *didn't* come for free eats. They came because they *knew* and *liked* Wholesale Radio Service Company. They've known us for years. Most of them are our customers. They know we sell anything and everything for the ham (careful shopping has taught them that our prices are LOW) and they know that Wholesale's service is the fastest, most reliable in the radio game. Most important, they get what they want when they want it, because we handle *all of the nationally known lines.*

Oh yes, before we forget, 99% of the hams have our 68 page exclusive Ham Catalog. If you haven't a copy, *be sure to write for catalog No. 60 to-day—it's FREE!*

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Expanding Linear Amplifier

[Continued from Page 14]

When using those tubes that should not be operated with more than rated plate loss at any time, there is no point in using more than 20% axis shift. *With 20% axis shift the plate loss is the same resting or completely modulated.* The increase in plate input during modulation (25% *increase*) is approximately equal to the increase in r.f. output from the amplifier caused by the presence of sidebands.

The following table shows typical conditions for a single 211 tube operating with 100% modulation, resting with 20% axis shift and resting with 33% axis shift.

EXPANDING CLASS BC OPERATION
TYPE 211
100 Watts of Carrier Output

μ 12
Max. plate loss .... 100 watts
Max. plate current .... 150 ma.

	Completely Modulated	*Resting 20% shift*	*Resting 33% shift*
Modulation capability	100%	60%	33%
Plate efficiency (av.)	60%	50%	60%
Plate input power	250 W	200 W	166 W
Carrier output	100 W	100 W	100 W
Sideband output	50 W	0 W	0 W
Plate loss	100 W	100 W	66 W
Plate volts (net)	1666 V	1333 V	1111 V
Plate mills	150 Ma.	150 Ma.	150 Ma.
Pack bias	—135 V	—108 V	—90 V
Cathode bias	—135 V	—135 V	—135 V
Cathode bias resistance	900 to 1000 ohms	....	....

The 20% axis shift is generally most satisfactory except where the last possible watt of output is desired, when the 33% shift may be used, assuming the tube used can stand an increase in plate loss during modulation. 20% shift requires less rectified audio power to saturate the primary reactor in the 110 volt line to the plate and bias supplies of the expanding linear amplifier. Also a cheaper saturable reactor can be used. Unless the bias supply is carefully designed and built there will be difficulty in making the bias and plate voltage "track" over a wide range of axis shift.

There is no point in exceeding 33% axis shift as it is rarely desirable or necessary to reduce the resting plate loss to lower than 66% of the plate loss fully modulated. Most users of linear amplifiers would be perfectly happy if they could keep the *unmodulated* plate loss down to the value at 100% sine wave modulation, let alone dropping it below 66% of that loss!

As tubes of the 150T-354 and HF300 type can easily stand 50% overloads in plate loss momentarily without shortening their life, the following table is based on 33% axis shift. Note that 225 watts of carrier output is obtained with this amount of axis shift.

EXPANDING CLASS BC OPERATION
TYPE 150T-354
225 Watts of Carrier Output

μ	12
Max. continuous plate loss	150 watts
Max. intermittent plate loss	225 watts
Max. plate current	200 ma.

	Completely modulated	*Resting 33% shift*
Modulation capability	100 %	33 %
Plate efficiency (av.)	60 %	60 %
Plate input power	563 W.	375 W.
Carrier output	225 W.	225 W.
Sideband output	112 W.	0 W.
Plate loss	225 W.	150 W.
Plate volts (net)	2813 V.	1875 V.
Plate ma.	200 Ma.	200 Ma.
Pack bias	—235	—156
Cathode bias	—235	—235
Cathode bias resistance	1170 to 1200 ohms	....

If it is not necessary to get the last possible watt of output, the use of 20% axis shift is suggested. At 20% dynamic axis shift the maximum attainable carrier power output is 150 watts. The following table shows operation with 150 watts of carrier output for both the 20% and 33% values of axis shift. It will be evident that there is no particular advantage in the use of 33% axis shift under the conditions shown below.

EXPANDING CLASS BC OPERATION
TYPE 150T-354
150 Watts of Carrier Output

μ	12
Max. continuous plate loss	150 watts
Max. intermittent loss limited to	150 watts
Max. plate current	200 ma.

	Completely modulated	*Resting 20% shift*	*Resting 33% shift*
Modulation capability	100 %	60 %	33%
Plate efficiency (av.)	60 %	50 %	60%
Plate input power	375 W.	300 W.	250 W.
Carrier output	150 W.	150 W.	150 W.
Sideband output	75 W.	0 W.	0 W.
Plate loss	150 W.	150 W.	100 W.
Plate volts (net)	1875 V.	1500 V.	1250 V.
Plate ma.	200 Ma.	200 Ma.	200 Ma.
Pack bias	155 V.	125 V.	105 V.
Cathode bias	155 V.	155 V.	155 V.
Cathode bias resistance	750 to 800 ohms		

These values given above indicate maximum values of output at the lowest usable values of plate voltage. Other combinations of plate voltage and current may be used but the following limitations must be kept in mind. The maximum *average* plate efficiency for class BC operation when completely modulated will rarely exceed 60%. Thus given the rated plate loss on the tube to be used it is easy to calculate the maximum allowable plate input. Once the allowable plate input is known the plate voltage, plate current, and pack bias voltage for the completely modulated condition can easily be determined. Remember that with 115 volts a.c. line voltage, the voltage on the load side of the saturable reactor used to effect axis shift

[*Continued on Next Page*]

[*Continued from Last Page*]

will usually be from 70 to 90 volts *when the reactor is completely saturated.* Unless a primary autotransformer is used the plate and bias pack transformers will have to give desired maximum plate voltage with from 70 to 90 volts on the primary side. We hope to be able to present curves on all available saturable reactors soon which will simplify matters greatly in power supply design for the expanding linear amplifier.

When the expanding linear amplifier first began to dawn it was felt that the zero bias triodes such as the 838, 805, RK31 and the ZT4B would provide an ideal answer as no pack bias would be necessary and only the plate voltage would have to be varied. It was a fine idea and we haven't given it up yet, but we found that the zero bias tubes are zero biased to cut-off at one value of plate voltage only (zero plate voltage, strictly speaking!). Thus shifting pack bias is just as necessary with the "zero bias" group as with the lower μ types. Also, due to the materially higher grid current in the zero bias group, the bias and plate supplies are very hard to make "track" over the range of axis shift. The point is that the d.c. plate current won't stand still as the axis shifts on the high μ tubes. However, we are working on a compensation circuit, one example of which is shown in figure 5, to exercise a secondary reverse axis shaft over the grid excitation applied to the linear amplifier. The compensator circuit can be actuated by either the d.c. plate current on the linear stage or by rectifying some of the r.f. output of the linear stage. Thus if the d.c. plate current or the average carrier amplitude start to rise when the rig is modulated, the compensator causes a slight reduction in grid drive on the linear stage and backs the output off enough to flatten out the average carrier output. It is, in effect, automatic gain control applied to the modulated buffer stage that feeds the linear amplifier. Very little compensation is necessary under normal conditions as most variations are under 10%.

The compensating control can be applied to the class C modulated buffer in a number of ways. The simplest way is to use another saturable reactor in the primary side of the plate supply to the class C stage. See figure 5. As little control is needed, this reactor would be quite cheap.

The ramifications of dynamic shift, including bias modulation, are so numerous that they will have to wait until next time.

◆

Dry-battery power costs ten dollars per kilowatt-hour!

◆

W8KMV is our latest nominee for short name honor. His last name is *Ax*.

Hams Across the Sea

[Continued from Page 51]

The first VK for OH3NP was VK4GK on September 28, 1931; first South American, PY2BO, May 22, 1932; then came PK6AQ, YV3LO, VU2LJ, J1EE, J1DO and at last his first U.S.A. contact, W1RY, on June 17, 1932. Walle had this to say about it: "But very sorry there was no W on his card . . . just 1RY, hi." Then in rapid succession came QSO's with CE1AI, LU3OA, K5AA, AC9GH, OA4U, VE1BV. In the summer of 1932 he settled down to work some real dx, and to date OH3NP has worked 575 different W stations for a total of 972 QSO's covering all districts. Over 4000 QSO's with dx men throughout the world are in his log.

At the present time Walle is planning on a new transmitter and receiver. The rig will end up with an RK-20 in the final amplifier stage, while the receiver will be a 6-tube superhet. He says the input will be around 90 watts, "but that could not be QRO compared with the W stations, hi." The antenna in use is a single-wire-fed Hertz 66 feet 9 inches long, 40 feet high, and with the feeder tapped on 9 feet 4 inches off of center.

Walle says he has noticed there are a great many hams who are dentists in the U.S.A., he being a mechanical dentist himself. OH3NP has this to say, "I am very interested in amateur radio, and am not married. I have no time for OW QRM, hi." Being an officer in the Civil Guards, two nights each week are used in that work.

From Walle's description, we gather that Hameenlinna must be a pretty good place in which to live, also a good QRA for a ham. The population is about 8,500. There are quite a few very interesting points about Hameenlinna, but the main one seems to be a castle which dates back into the thirteenth century.

Walle is very anxious to work 10 meter stations in the U.S.A., and points out that while he is allowed on 10, 20, 40, and 80 meters, Finland does not permit amateur operation in the 160 meter band. Generally speaking, conditions for dx are best in the Spring. So crank up your rig and give Walle a call, the next time you hear him. When summer rolls around it will be harder to get through.

◆

W8LDM, W8LDN, and W8LDO are all named *Miller*.

Flood Activity

[*Continued from Page 59*]

them. In one instance, an s.w.l. aroused an operator who had fallen asleep at the key, after a broadcast had been made requesting someone to go to his home and get him on the air to take several urgent messages and supply some information.

Dx Contest

[*Continued from Page 50*]

PY2BX and PY2BU were the best bets—CT1JU seems to have Portugal sewed up . . . HB9J's sig was wonderful on all bands—FT4AF showed up on 40 for a while . . . Heard a W9 calling ET8FA on that band. PZ1AA got on just to see how much power he could make the gang use, and did W6CXW let him have it one evening!—VR2FF did a fine thing in staying on.

Here it is almost over and in the last minutes everyone is using tricks to get those last precious points. W6CUH chases some guy . . . think K4DDH . . . for two hours on 10 meters and gets him few minutes before close of test. Both 10 and 20 were a mixed-up scramble during the last hour, although not as bad as last year when they were all on 20.

Best sigs from each country: VR2FF, OM2RX, PZ1AA, VQ8AB, CR7GD, TF3AG, FR8VX, EA8AO, VQ3FAR, ZE1JS, VP2TG, J8CA, ZD8A, ZB1C, VP7NB, K4AAN, U2NE, FT4AF, VP4TC, SM7UC/SM5SX, PK4DA, EA4AO, ZS1AH, XU1B, U9AV, CT1JU, K4KD, SP1DE, KA1LB, OA4J, ZP2AC, HP1A, LA1G, GI5QX, YN1AA, ZL2KK, VO1N, PA0UN, CN8MQ, XE1AM, FM8D, CT3AB, FB8AB, LX1AS, LY1J, YL2FR, VQ4CRH, YT8MT, PK3BX, J2HJ, VP5PZ, I1IT, EI8B, VU2BG, HAF2D, VS6AK, HH5PA, K6CGK, G6NJ, D4ARR, F8EO, OH3NP, ES7C, SU1SG, HC2MO, HI5X, OZ2M, YM4AA, OK2AK, CM2AD, TI2FG, HJ3AJH, CE7AA, NY2AB, VP1JR, PY2BX, CP1AC, VU2LZ, VP9R, ON4CRM, VP6MO, LU1EP, OE3FL, VK3JK, ON4FE, FA8BG, K7PQ.

Nearly forgot; listened on 56 mc. for a couple of hours, but as far as dx was concerned it was as deserted as a street in a Scotch city on tag day.

Contest Notes

W6KRI with 41,000 points worked 14 new countries in the test . . . had 80 before it started and ended up with 94. A few of his new ones are YL8S, PZ1AA, VO8N, VQ2ETA, ES1R, SX3C, VP9B, TF3AG. The VQ2 was raised on a CQ dx . . . what a long shot! PZ1AA wanted to know what all the numbers were for, hi. . . . LY1J stayed in bed too long and missed the W6's. . . . W3BZD in Baltimore raked up 25,000. . . . W3AYU had bad luck in blowing up four '66s and a couple of transformers. . . . W3EPR made FBTOC. . . . W3CDZ added 18 new countries to his list . . . in the test he made 101 contacts, 40 countries for w.a.c. first time, 17,100 points, and rated a QSL from the Grand Island gang for off frequency . . . (and I know of a few others who did, also).

W8ZY with his 31,700 points operated only 45 hours and worked a flock of nice stuff, including VQ3FAR for country nr. 97 . . . W9TJ, Bill Atkins, with a total of 25,100 points did some fine work, but particularly is his station interesting. W9TJ is located on a farm and isolated from a source of a.c., but is a swell QRA for dx. He is using an 830 in the final at about 150 watts, and for the high voltage he uses a combination of B batteries and Edison B cells . . . 1200 volts. In the test Bill worked 53 countries on 14 and 28 mc., with no operation on 7 mc. Shortly after the contest closed, on March 28th to be exact, he made w.a.c. in 1 hour and 30 minutes . . . this on 14 mc. Boy, that's not wasting much time.

Well, well, here's W6GAL . . . You know he belongs to the famous "210 Club" . . . In the contest George says he didn't get very far with his QRP, but I think he did darned well. With a total of 12,200 points he worked 38 countries and added 4 new ones to his list, making 89 in all. George used his fone to some advantage in the contest by snagging T12RC, VP9R, CO8YB, NY2AE, H16O, and OA4AA . . . 2 way 14 mc. fone. TF3AG was GAL'S 35th Zone and . . . now hold your seats . . . because his 36th Zone was ZC6CN. ZC6CN for a W6 is real dx . . . His frequency was 14,402 kc. Nice going, George. Bill Dickman, W3BXJ, was doing some good dx until his tens went . . . Someone said that W3JX calls only Asians (not a bad idea at that if you can hear 'em) . . . W9CVL has been hearing some nice stuff back there: KA's, U1BL, YM4AA, VS6AK, VR2HC, F3OCO, VR2 Fiji and F3 Tahiti . . . A year ago W3EYS didn't have one country . . . today he has 58 . . . but still waiting for his big moment . . . an Asian . . . By the way, how about those Zones? Let's hear from all of you sleepless dx owls . . . how many Zones have you??? . . . W3SI rolled up 75,800 points and was off a couple of days due to flood waters in and around his various rigs . . . Chas. says he is "sore as h—l" because for 15 years he has been working CM's and for 15 years he has been trying to squeeze a QSL card out of one of those guys . . . but n.d. yet . . . Dunno why he wants it but . . . oh, say Dave, send Charlie one of yours . . . Tom Hall W3ZJ, was a recent vistor at W4DHZ and W4CBY . . . W3EYS, Beanie Burnett, sure did himself proud by raking in 44,000 points . . . look out for him next year . . . W3CZO went to the hospital the second day of the contest . . . appendicitis. Too bad. W3FXB really hears some dx no one else can . . . especially when he has a few beers under his belt . . . Ah! At last a word from the long lost W7's: W7BYW with 18,175 points worked 38 countries on 40, 20 and 10. W.A.C. 5 times, once in 8 hours. To some of you lugs this may not sound like very much but up there in Twin Falls, Idaho, it's really 'sumpin'. Thanks, W7BLT, for the info. Come on you W7's, kick through with some of that choice dx you've been working . . . W9KG, although an old timer, has only been after this stuff called dx for exactly a year, but in that year's time he has worked 31 Zones, 77 countries

[*Continued from Last Page*]

and is still hot after 'em . . . New stations for Keat are OH5NR, PK2KO, VP4TJ and U9AV, CT3AN, SP1DE, YM4AA, PZ1AA, FA8BG, SM5UU, SU1SG, LY1J . . . Ye Gods, whatzis . . . another W7 heard from . . . our old friend W7AMX, Art Bean. Giving a little dope on conditions he says the best time for European stations seems to be during the daylight hours. A few of the choice QSO's for Art are LZ1A, r.a.c. on 14,370 kc.; YM4AA, d.c. 14,396 and 14,130 kc.; YM4FS, T9 14,275 and 14,120 kc.; YT7AQ, T8 14,005 and 14,330 kc. The YT is in Jugo Slavia . . . Another good one is I1IT on 14,340 kc. W7AMX made W.A.C. on three bands recently when he hooked OK1BC on 7 mc. . . . .Thanks, Art, for the above . . . Let's have more.

"What Is a 'Big Shot'?"

W4CQR says that this column devotes too much space to the big shots. Now the question is . . . what is a big shot? One definition is "the other guy". Says he worked VV2AA on 13,390 kc. . . . which rumor has it is a fishing smack off Florida. Other stations worked include U9AV, U9AL, U3CI, HK1Z, FB8AB, FB8AG, and OH3NP. With his 50 watts he really has been doing some nice dx. VQ8AF also was hooked by CQR and is a nice one to get out of the way.

Before it slips my mind I'd like to ask all you birds who do not think the QRP dx man is getting a square deal to get off the dime and write in some news for this department. We've got the space as I've said before, and it's up to us to use it . . . It's like our bands; if we don't use 'em they'll take 'em away from us. . . . But all joking aside; remember, we can't print news that we don't have.

G2ZQ made 18,000 points in the contest, 26 Zones . . . but didn't get on ten meters at all. Johnny was only on for a few days of the test as his y.l. came down from college, and as 2ZQ says, "Pounding brass in those circumstances is just a waste of time." Not a bad idea at that. W9PK with 9 watts worked 11 VK's and 2 K6's in one night on 14 mc. with three R8 reports. CE7AA will be on sometime in the future with a couple of 150T's . . . W6AWT worked his 112th country in hooking up with VQ3FAR . . . worked 44 countries for 22,500 points in test. His rig uses a pair of HK354's in the final . . . W6ITH used both fone and c.w. in this contest, which was his first crack at this type of competition . . . made 13,200 points . . . w.a.c. 5 times, and worked a flock of new stations.

ZL4BT has moved to Sydney, Australia, according to ZL4AO. This breaks up that ZL4 gang, as old ZL4AI is now G5ZZ. W9IJN worked ZZ3A, who is *not* the same as ZZ2A . . . but just a fraternity brother, I guess . . . There seems to be a whole fleet of 'em now . . . W5FNA worked a bunch of 'em: SM7RV and SM2R, XOHIT . . . guess he gets them all . . . W3BBB worked him a J . . . W3EVW worked XZ4F, another scow . . . W8CRA is going in for romance . . . an SP for a change.

W3ANH wasn't on much in the contest . . . reason being a new baby girl at his house. Johnny is doing nicely it is reported.

I've just been informed that if I don't finish this up PDQ, I'll be sitting here reading a copy of May RADIO . . . without a dx section in it.

I wish yo'all (I must be getting that "yo'all" stuff from Dave, hi) would check your maps and find out how many Zones you have worked and send in the information as soon as possible. When enough have been accumulated they will appear in this column, and in that way we can get an idea of what's going on. Now I must check up on Dave to see what kind of trouble he is getting into. He found out how easy it was to work a W9 from my QRA and has assured me that with a few changes we can start after some real dx, a W8. Don't know what's wrong with the guy . . . He walks around with that dreamy look in his eyes . . . I know he isn't still asleep from the contest . . . Maybe some little gal in Decatur, Georgia, can give the answer.

◆

From W6FFF comes the following bid for assistance:

"Listening to dance music on the b.c. receiver has made me wish there were a way to attenuate the music so that one could understand the remarks of the dancers as they pass by the mike. I have a hunch these remarks would be much more interesting than the music. Kindly refer the problem to your department that is working on Boyd Phelp's audio transformer with the foreign language primary and American secondary."

◆

Why Not?

Unbreakable meter faces.
Illuminated meter dials.
Window-box UHF transmitters.
"Bugs" that make the dashes automatically.

"GLOOMY SUNDAY"

'Twas the end of the contest and all through
the shack,
Rose the odor of ozone and charring shellac.
20 was lifting and 10 had dropped out,
But 40 was hot; so with a great shout,
Our hero jumped up and retuned the rig,
As a G5's CQ made the phones dance a jig.
One call, then ten, and as many tens more,
Yet still the G scorned the bottles' deep roar.
To hex with a filter; if d.c. won't work,
Then a.c. he'll get; so with a big jerk,
The two mikes five thousand were tossed on
on the floor,
And back at the G he went roaring once more.

J's and VK's, HC and PY
And others rapped in but were promptly passed
by.
The limey was lazy; his rag chews were local;
Our hero was wild; his blasphemy vocal.
"Mr. God," prayed our hero, "I don't wish to
trouble you,
But I'll try to reform if he'll call TEST 'W'".
I'll be fat as a goose; on all six I'll be hittin',
If you'll wangle a contact for me with Great
Britain."
And wonder of wonders, a brief QRZ;
Then the Limey stood by and a short "three
times three"
Brought an answering cheep from the far
shores of Dover,
As the chime of the clock showed the contest
was over!

—*Linear*

◆

Why Not Such Contests, Too?

For those who like marathons, the W/VE DX contest is, at the time of writing, in full swing. Such contests have the merit of speeding up the key work and operating standard generally of the younger and inexperienced participant. The idea fits in admirably with American amateur radio, where traffic handling is comparatively open and unrestricted. In Australia and other British territories, where message handling in a third-party sense is taboo, such contests can have no value other than the one mentioned. Admittedly, the participant meets a lot of new DX friends, but it is only a fleeting glimpse, so to speak, involving a hurried interchange of serial numbers.

Far better would be contests conducted on experimental lines, such as the solving of technical problems associated with transmitting and receiving apparatus, set by a number of examining stations, the answers to be given in rotation within a limited time. Key and 'phone stations could take part with equal interest.

—*The Bulletin* (Sydney).

◆

Allen Fairhall, VK2KB, managing director of Australian broadcasting station 2KO will arrive in the U.S.A. in the middle of May with a "brand new 'o.w.'" (honeymoon). He expects to drive across continent to New York, and is anxious to meet the many friends he has made in this country by amateur radio.

ALWAYS TAKE THE SHUNT OFF ON METER READING DAY

The cost of free electrons is mounting day by day,
Epecially as the contest is now in fullest sway.
The power trust is cheerful, with our hero back on ten,
And the singing watt hour meter mocks the bluebird in the glen.
"What wots the score if the score of watts if more than I can stand?"
Our hero cried with last month's bill from power trust at hand;
But a tip from "Helpful Henry", of knowledge dark and deep:
"Juice is dam expensive but copper wire is cheap.
A shunt across the meter really slows that tattler down;
30 seconds work, my friend, and you can go to town."

When laws of economics and laws of mortals clash,
The mortals take the hindmost and the devil takes the cash.
Our hero being human, cried out to darkest Satan:
"Get thee behind me, *but push,* for hot dx is waitin'."
Dx rolled in from far and near, and mighty was his score;
Reports were good; the log was full; but our hero cried for more.
The bottles' golden blaze and the pole pig's lusty grunt
Were merely an inducement to go add another shunt
To the all but useless meter, loafing gently in its box,
Whose sluggish perambulations the flaming final mocks.

Deep in oil the 72's were mounted in the sink,
And neighbors' lights for miles around gave forth a mighty blink.
The tank coil nearly melted, and the transmission line was hot
As our hero slowly keyed his "West Coast" kilowatt.
Time was ,and weeks rolled by, and our hero's heart was light,
But a cruel interloper came stealing in the night—
A minion of the power trust, on meter reading bent,
Observed the shunts; "Aha," cried he, and straightaway he sent
A notice to the law to come and get our hero dear
And send him up the river for the balance of the year.

And so it was: the Judge was stern, and our hero is in hock,
And he'll stay there too, a year, no less, as measured by the clock.
His mighty pole has fallen, and dust is on his bug,
But there is joy on "40" since our Hero's in the jug.
So take heed, fellow amateurs, if you would be free and gay;
Always take the shunt off on meter reading day!

—LINEAR

◆

A new 64-page catalog featuring a large assortment of radio receivers, public address amplifiers and systems, radio service replacement parts, electrical appliances and electrical refrigerators, has been brought out by Wholesale Radio Service Co.

Copies are obtainable free of charge from their main office at 100 Sixth Avenue, New York, or any branch office.

The F.C.C. Looks Ahead

[Continued from Page 39]

ufacturers Association and licensees of experimental television stations in forming a committee of the industry to endeavor to arrive at a recommendation with respect to ultimate standardization.

7. Encourage the development of coaxial cables for the purpose of transmitting visual broadcast programs between television broadcast stations which will be ultimately licensed by the Commission.

8. Continue the policy of granting visual broadcast station licenses on an experimental basis only and making more stringent requirements as to active work on the part of licensees.

9. At the proper time in the future, if there is sufficient accumulated data with respect to visual broadcasting, and after it has been decided what the allocation of frequencies above 30,000 kc. should be, promulgate visual broadcast transmission performance standards, provided the Radio Manufacturers Association's recommendations are satisfactory. If they are not satisfactory, hold a public hearing to determine what standards should be adopted.

10. After standards have been adopted, continue the policy of keeping visual broadcasting on an experimental basis until sufficient data has been accumulated with respect to the economic factors of visual broadcasting, as well as the possible economic effect on other broadcast services and upon other industries such as newspaper and motion picture.

11. Continue to encourage aural broadcasting on an experimental basis on frequencies above 30,000 kc. until such time when sufficient data is accumulated with respect to this particular service, as well as television and other services. When data as to the technique of this type of broadcasting is understood, and when the needs of other services, including television and facsimile, are known to a sufficient extent, the Commission should consider the desirability of commercial aural broadcasting on frequencies above 30,000 kc."

The Chief Engineer stated that the general hearing for June 15th was for the purpose of guiding the Commission and the communications industry in the next progressive steps that may be necessary in the development of communications and in order that the Commission and the industry might avoid pitfalls that might be involved in premature intrenchment resulting from large investments, which might serve as a handicap in making an orderly allocation of frequencies to various commercial and government services in the future.

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W6BGC Goes "Lazy X"

[Continued from Page 66]

The photographs show quite clearly the simplicity of the system. The illustration shows the key and plate control switch mounted on a small piece of wood. This is connected to the cable terminal strip by means of a flexible cord and may be held on the operator's knee, or you may even try the proverbial "keying with the left foot" stunt. The main a.c. and filament relay control switch may be seen fastened to the top of the bedside operating table in front of the receiver.

The monitor-oscillator together with the receiver power supply is located on a small shelf under the table.

The many advantages of a ham station that may be operated either direct or by remote control are numerous. For instance, the operator may suffer short periods of insomnia, and it is a shame to waste such valuable dx time. After several attempts, the author has developed the art of sleeping with one eye shut while exchanging salutations and audibility reports with Js, XUs, VKs, etc.

Calls Heard

[Continued from Page 45]

LY1J; OH2PS; OH3NP; OH5NG; OH5OA; OH7NI; OH8NA; OH8NF; OK1AA; OK1BC; OK2DF; OK2KJ; OK2KO; OK2PL; OZ3FL; OZ7FJ; OZ7G; OZ7N; OZ7SJ; PA0TSK; SM5UM; SM6VX; SP1CS; SP1CY; SP1DE; SP1EB; SU5FL; U1AB; U1AN; U1CN; U5AN; U8CC; VE1B; VE1HJ; VE2EE; VE3HC; VK2NY; VK2VU; VK3EG; VK3FO; VK3JK; VK3RE; VK3XP; VK5HG; XZA7C; YL2BG; YR5JS; YR5VC; YR5VI; YT7KP; ZA1H; ZR1H; ZC6CN; ZL—1FE; 1GX; 1UP; 2FA; 2JA; 2KK; 2OQ; 3AB; 3JA; 4FO.

Paul Bauman, W9IJN, 3520 35th Avenue, Minneapolis, Minn.
February 12 to March 12

(28 mc. phone)

OA4B.

(28 mc.)

CM2FA; CP1AC; EA4AO; FA8RG; F8EO; F8VS; G2PL; G5BY; G6LK; G6QB; G6ZU; HJ3AJH; K5AL; K5AY; LU9AX; OA4J; OH5NG; OK1BC; OZ2M; PA0AG; VK3BD; VK3YP; VP5PZ; ZS1H.

T. J. Wakimoto, J3FK, 873 Kami-Kosaka, (near Osaka) Japan
February 2 to 16

(28 mc.)

W 6BAY; 6BW; 6BNU; 6CWJ; 6CXW; 6DIO; 6EAV; 6EWC; 6EZB; 6FMY; 6FQY; 6GCX; 6GOY; 6GZU; 6HR; 6IOJ; 6JJU; 6JN; 6JNR; 6KBD; 6KJG; 6FZY; 6VB; 7AVV; 7BYW; 7IFM; 9UIG. — K6CRU; OA4B; OK1RK; VE5BI. — VK 2EO; 2HZ; 2LZ; 3BD; 3BQ; 3CP; 3YP; 3ZC; 4EI; 5AI; 5WK; 5ZC; 6SA. — ZL1CD; ZL1DV; ZL1GX; ZL3AJ.

E. De Saedeleer, ON4DS, 103 Avenue Lippens, Knocke, Belgium
February 7 to March 1

(7 mc.)

W2EGC-8; W3AGI-8; W3FGK-8.

(14 mc.)

W 1AU-6; 1BXC-6; 1CFC-9; 1FSN-8; 1GOU-9; 1HWP-8; 1WV-6; 2AIW-9; 2AZB-8; 2BHM-8; 2CUQ-8; 2FHM-6; 2GFZ-6; 3EQA-7; 3ENX-8; 8DKC-8. — LU6JR-6; VE1BA-6; YM6AF-8.

◆

A fairly decent job of poising unbalanced meter movements, where one of the poising weights has been lost, can be done by applying enough white lead (with a tooth-pick) to pinch hit for the missing weight.

HAMFESTS AND CONVENTIONS

Wisconsin

The Milwaukee Radio Amateurs' Club will hold their thirteenth annual QSO party, May 16, 1936, at 6:30 p.m., in the Elizabethan Room of the Milwaukee Athletic Club, N.E. corner Mason and Broadway.

Mr. E. A. Roberts, W8HC, A.R.R.L. Director of the Central Division, will give a vital talk on Amateur Radio. The program will also include Dinner, Refreshments, Prizes, Entertainment and a revival of the "Loyal Order of the Derby".

Reservations $2.00.

For information and reservations write to:
Herbert L. Baker, W9GSP, Secretary
3922 N. 24 Place,
Milwaukee, Wis.

Texas

The Radio Amateurs of Abilene are inviting all the Hams in Texas to be with them for a Hamfest in Abilene on the 25th and 26th of April, the affair to be staged in the Textile building in West Texas Fair Park on South 7th and Portland Ave. Will start gathering up the clan about 5:00 p.m. on the 25th.

There will be no speech making, but just a gathering of good-fellows, for discussions on their different radio problems, etc.

Kentucky

On May 23, 24, 1936, the 7th Cavalry Brigade (Mechanized), Fort Knox, Kentucky, under the command of Colonel Bruce Palmer, and in conjunction with the Louisville Amateur Transmitting Society, will act as host to the amateur radio operators of the Middle West. This will be an official Kentucky convention of the Central Division of the A.R.R.L. Special low rail rates will be in effect.

Men attending the convention will be quartered in Army barracks and fed in Army messes at a cost of $2.50 for quarters (one night), five meals and a registration fee of 50c. People attending who wish to bring their families can be quartered and messed in the Central Mess for about $2.50 per day, and of course there are plenty of hotels in Louisville, 32 miles away.

Pennsylvania

The U.H.F. Club of Philadelphia will hold its first annual hamfest on Saturday, May 16th. For information drop a postcard to W3AUY, or listen for Westinghouse W3XKA on Tuesday nights (55.5 mc.) if you live in or near Philadelphia.

Wisconsin

The Fox River Valley and Affiliated Radio Clubs will hold their fourth annual picnic and hamfest at Round Lake, Wis. on June 21. Round Lake is located 1 mile west of Dundee and 25 miles west of Sheboygan, Wis. Program will include ball games, contests, free eats (and beer!), prize drawing, and dancing.

Michigan

The Central Division Radiophone Association is sponsoring a hamfest to be held at the Hotel Tuller in Detroit on June 14th. Everyone is invited, amateurs and y.l.'s and ex-y.l.'s and s.w.l.'s alike.

Free Handbooks!

Each month we will pick at random from the latest callbook several amateur calls and list them somewhere on the "Marketplace" page among the classified ads. If the holders of the calls listed will drop a postcard to RADIO to the effect that they have noticed their call, they will be mailed free a copy of the 1936 *"Radio Handbook"*. This card must be postmarked before the 15th of the month on the cover of the issue in which the call appears.

QRP DX RECORDS

When VK3PG first started transmitting in 1933 he had several QRP contacts with VK3NQ, who was interested in QRP records. Using the 80-meter band, and with the stations 90 miles apart by air line, 3NQ called one day, employing only an old dry cell showing half a volt for plate supply. The signal was R2/3 at 3PG, with fading, but distinctly readable. Time was 15.30 e.s.t. Since then 3PG has devoted most of his time to 20-meter dx, with 180 volts of B battery for plate supply and a 201'A as p.a. in a "Groyder lock" transmitter. Usual input is 3½ watts and maximum 4 watts.

In January, 1935, w.a.c. was achieved with this power, and between February and November that year contacts with stations other than VK and ZL numbered 350. Over 50 countries were worked, and all continents five times. 3PG reports having raised Europeans with a shade over one watt. In May, 1935, he contacted PAOAZ in Holland at 3 p.m. local time, getting a report of QSA5 and a request for power-reduction tests. Input was reduced to 2 ma. at 45 volts, and to 3PG's astonishment the Dutchman reported no difference in the signal. The transmitter was then tried with 22½ volts on the plates, but oscillation failed. On the following day, the transmitter was made to function on the 22½ volts, but after opening up on 45 volts the Dutchman reported no signals at reduced voltage.

With normal power of 3½ watts, 3PG has been reported R9 from W6KRI, R8 from Japan, Jamaica and the Philippines, R7 from Belgium and R6 from several European countries. South African and South American reports have been under these, but still around Q5 R6. VK3PG is a dx QRP station making the most of his antenna system. Having plenty of ground space, being on a farm in Casterton (Vic.), he uses a directional V array 52 feet high at the apex and sloping to 30 feet at the open ends of the V.

Length and clear surroundings appear to contribute to the good results obtained, for as much as 330 feet of radiator has been used in each arm of the V with improved results. The moral is that the country amateur with space available and plenty of wire can do the trick on low-power dx, particularly on 20 meters, but the city amateur, unless he owns a lot of land in a good location, is handicapped, and must turn to power for his results. The old rule of "a good antenna is more than half the battle" still holds good, whatever the radio application.

—VK2NO in *The Bulletin* (Australia).

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Diathermy Furor

[*Continued from Page 7*]

cords to the pads. Measurement of this current may facilitate initial adjustment, but this is offset by the fact that many physicians will be inclined to take altogether too much stock in the meter reading and not pay enough attention to what is happening to the patient. The r.f. meter may be incorporated, but it is a refinement not necessary for proper treatment.

We were accused of showing contempt for the medical profession, and of doing them "untold harm". But we have received a large number of letters from doctors, mostly in the country and small communities, expressing their appreciation of an article that enabled them to get a diathermy machine built at a price they could afford. Thus this means of treating the sick has been made available to a greater number of physicians than would have been the case otherwise. As for our expressing "contempt" for the intelligence of the physician, we merely are aware of the average doctor's lack of radio knowledge. That is no reflection on his professional ability. One of our best technical men doesn't know his liver from his gall bladder; that does not mean he is not a good radio man.

One manufacturer tried to make much ado about the patent angle. However, there is nothing to worry about from that standpoint just so you don't go into the manufacturing of the machines on a large scale. There is no law that prevents you from building a machine "to order" at so much an hour, the doctor paying for the parts. Most of the composite police transmitters in use today were built that way to get around patent difficulties.

Several requests have been received for information on a "radio knife" (for bloodless surgery) attachment for the diathermy. We hesitate to give the data because of the dangers involved and because many doctors condemn their use. We will state, however, that such an attachment may be used with this machine the same as with any similar diathermy machine of commercial manufacture.

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On the Road to Cairo

[*Continued from Page 7*]

those in attendance at the next conference . . . in fact, they could ill-afford even to ask that they be sent to Cairo. Wise is he who stays in his place, once he has been *put* in his place.

No living person could accomplish *less* for the amateur than has been accomplished at some previous frequency-grabbing gatherings. No living person would relinquish, at this time, what was relinquished years ago, "in the interests of commercial development." Do you, Mr. Amateur, ever stop to think what RADIO has done to enlighten *you* as to the true status of your cause? We ask no thanks, want none; you must do your part to help make *certain* that none but the brave will represent the amateur at Cairo.

A short time ago a "Cairo Survey" was under way. Deplorable is the fact that such few amateurs have participated in this survey, a contemporary amateur publication says. Less than fifty amateurs played an active part in this work. And the amateur world is roasted over the coals for not showing more interest in what is termed as its ultimate salvation. Why so few amateurs have taken part in the survey check

[*Continued on Next Page*]

[Continued from Last Page]

is easy to understand, by those who have been in amateur radio long enough to understand!

In the first place, it is the Congress of the United States alone which can assure U.S. amateurs of their place on the air. This the amateurs have been told, over and again, in these pages. That is one reason why there is practically no interest in the Cairo Survey. In the second place, there is no need for such a survey, no matter how severely some may denounce us for advancing such a declaration. Reading the contemporary amateur press one learns that it is necessary to report how much of the commercial activity in the short wave spectrum is useful, economical, and practical. Amateurs are asked to log the stations, state how many hours in a day these stations are on the air with traffic, how much of the time is devoted to *v*-wheeling, free-wheeling, and squealing, etc. Congress can easily subpoena each owner of a commercial station to bring to the proper committee complete station logs, showing how much of the station time is devoted to genuine traffic handling. Therefore, what folly to ask the amateur to spend 24 hours of his daily time for a spotty recording of this matter for a "Cairo Survey". The information is readily obtainable on demand; why make a sucker of the amateur?

Let us therefore devote our time and our attention to the Congress, from whom more can be expected in a single day than can ever be had from all of the amateurs in the world combined. It is time that the amateur face this matter fairly and squarely, no longer permit himself to be misled by being asked to participate in utterly useless and childish endeavors, and to devote his time to a non-effective cause; whereas, on the other hand, a tremendous amount of good can be more quickly accomplished by merely banding ourselves together and going to our Congress for aid.

Everybody who reads RADIO knows that the commercial bands are idle for a goodly portion of the time and that the money expended for oil to grease the *v*-wheels represents a greater sum of money than that which is received during those hours when no traffic ticks from the tape. That's old stuff! And, knowing that the conditions exist, why investigate them? The thing to do is to get *action* . . . and action comes only from those who have authority to act for us!

Any body of amateurs can appear before Congress and request of it the same hearing which would be accorded any other body of citizens, large or small. In this instance, strength is not represented numerically; a good cause has often been brought to bear fruit by the efforts of a lone few men, whereas, on the other hand, organized groups have sometimes utterly failed in accomplishment, simply because the lawmakers were fully aware that the organized group represented a job-holding or racketeering outfit of one kind or another. Send a delegation of sincere amateurs to Congress—send men who understand amateur radio, not men who are in it for the mere sake of holding high-salaried jobs, and you will not need worry at the reception which will be given them when their requests are made.

Let no amateur believe that it is our desire to weaken the structure of A.R.R.L. The organization, large in numbers, yet representing only one licensed U.S. radio amateur in three, according to its own disclosures, cannot be expected to wield the big stick in Congress which can be more effectively made to strike home if all amateurs, A.R.R.L. members or no, band together in a common drive on the Congress of the United States.

Rather than waste our time on surveys that can accomplish naught (and which, if the surveys disclose no "holes" to which displaced stations might move, will constitute a beautiful weapon for our enemies) let the amateur devote this same time and effort to persuading his Congressman to bring about the appointment of a committee to investigate the activities of commercial traffic handling on the short waves. Then, with this record a part of the official line of business of the Congress, it will be made evident to every Congressman that something is decidedly rotten in the method of frequency allocation. Far more effective would it be to have the Congress supplied with its own facts, by its own committee, rather than to trust to the reports which a small group of amateurs may make to a job-holding publishing house. Congress understands the publishing business, it understands organizations, cliques, leagues, and rackets only too well. And, likewise, it understands human nature. The more effective method of convincing our Government that we are forced to squat in an unjustifiedly narrow ether lane is to urge the Congress, at its forthcoming session, to bring about the means whereby an official Governmental investigation be made of commercial short wave activities.

It is altogether likely that such a movement would be decried lustily by those in control at Hartford. The A.R.R.L. administrators would not fit into this picture, you see. But let's come forth with the cold facts . . . even though it may hurt . . . The Congress of the United States begins where the Hartford crowd leaves off, and we will accomplish more by going to those who make the laws, than by paying tribute to those who everlastingly try to sell us the proverbial cat in the bag.

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It seems that the longitude and latitude are not enough for the F.C.C.; they want also to know *how high up*. A commercial station has been granted permission to move its transmitter from the 5th floor of the building in which they are located to the 4th floor of the same building.

Article Contest

We wish to thank all those amateurs who have sent in contest-manuscript. Because of the large number of entries received, it has taken longer to go over all of them than had been anticipated. So many excellent ones have been discovered that the judges are going to experience considerable difficulty when the time comes to narrow the selection down to one. The winner will be announced next month.

RADIO TOWER MAKES RAIN

If the Government should ever contemplate a Drought Control Administration, we may yet see forests of radio towers rearing their heads in the barren places if the recent rain-making experience of Cincinnati's Station WCKY offers any guide.

That the phenomenon produced where all previous efforts have failed in coaxing the healing waters from the sky is vouched for by Charles Topmiller, chief engineer of Station WCKY. It must be noted that the results were not due to any attempt to produce rain, but were the aftermath of the erection of a new 350-foot Vertical Radiator.

When the slender steel tower had been raised and guyed into position, rain clouds in passing struck the upper reaches of the tower. Immediately rain started falling for a radius of thirty feet around the tower, and the precipitation occurred on four consecutive days.

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Scratchi wants to know what he is offered for one slightly used spilt-stator condenser, 100 μμfd. It spills over every time he modulates his rig.

28 and 56 Megacycles

[Continued from Page 43]

period at a given latitude on the sun differs from other latitudes, increasing from the equator to the poles, and in latitude 60° is greater than at the equator by about 20 per cent. Sun spots occur only in two zones extending from about latitudes 0° to 30° on either side of the equator, being in the higher latitudes at the beginning of the cycle. Thus, the correlation is not an entirely simple problem!

56 Megacycles

J2HJ will be glad to arrange with some U.S.A. station for 56 mc. schedules. He is using a pair of 800's on 56 and 112 mc. Several W stations with a few hundred watts of crystal controlled signal on 56 mc. might arrange their schedules to include J2HJ.

W7AVV is putting twenty watts into a low powered 56 mc. crystal controlled rig, and using his ten meter superheterodyne on "five", but no real dx worked yet.

W9NY spent six weeks calling on "five" with low power, but without success. He will continue his work. We suggest using one of these G.E. electric clocks that will turn the set on and off at any 15 minute points in twelve hours, thus permitting some time for the YL.

W6JJU, XE1AY, W6DOB, W3SI and some of the other migrants to 56 mc. promise concentrated work now. W3SI claims a whole kilowatt on 5 & 10. Get in touch with them for schedules and help by listening. A good share of the work is planned for week-ends.

Another member of the 56 mc. dx group is G6CJ, who is putting a crystal controlled rig on the air on about 56,300 kc. mostly. The receiver is a crystal gate superhet (sniggle siggle to you); so don't expect "five meter" QSL cards from him if you are using a self-excited phone. He will try mainly for W-VE contacts. As an aid to picking him up, he will excite the ten and five meter aerials simultaneously.

Don't forget, when 28 mc. is coming over as short a distance as 400 miles, 56 mc. may be good at 1000 or 1500 miles; also, that dx on "5" might come through whenever other W stations can be heard on "10". The best time will probably be some time after the sun has passed the midpoint of the path, or 9 to 11 a.m. Eastern time for Europe and somewhat later in late spring and early summer.

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Minority Report

[Continued from Page 37]

"There shall be an Executive Committee consisting of the officers of the League which shall meet from time to time to conduct the affairs of the League *within its jurisdiction*. The Committee shall keep a record of its meetings and actions and shall report at every meeting of the Board of Directors."

I recommended that the following words be added to the Constitution, Article 4, Page 2, at the end of said article: "Nothing in this section shall operate to prevent any director from publishing a division bulletin and from accepting advertising, or from maintaining a subscription price to cover the actual cost of printing and distributing such a division bulletin." The majority report makes this same recommendation but does not make provision for incorporating it in the Constitution.

The majority report states: "We believe that should it be necessary to elect a new President or Vice-president, he should be chosen from a group of men who have passed the test of approval by members of the League, as expressed by their election to the Board of Directors. Therefore, with reference to Article III, Paragraph 2, we recommend that the words 'from among their number' be inserted after the words 'Board of Directors'."

I disagree with the recommended method of selecting the President and Vice-president from the members of the Board, or "from among their number" as stated, and believe that the President and Vice-president should be chosen from the membership, and should be elected by mail similar to the method of electing the directors, and the nominations should be made by petition as in the case of directors.

I believe it is not essential that the annual meeting of the Board of Directors be held in the city in which Headquarters is located, and that "in the city in which the Headquarters of the League is located" should not be inserted (as recommended by the majority) after the words "annual session". Also in connection with this, all the meetings of the Board held in Hartford should be held in the headquarters building, and not at a "club" building four miles away. The reason for doing this as was brought out in conversation with Chairman Bailey, was to prevent any remarks made in the Board meeting from being overheard by

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any member of the staff at Headquarters. But I do not believe that this is the main reason. The reason behind this unusual strategy is, in my opinion, that the Secretary is always on the alert against a clash in opposition to his authority. It seems to me that it is intended that the Directors shall be kept as far away from Headquarters as possible. Also the rental paid for the headquarters office is too high when proper consideration is given to other factors such as the value of the property and its location. The rental paid should secure the use of the entire building. This is a two-story building and the ground floor is not suitable for business.

If this[5] is adopted it would be left to the discretion of Headquarters when there should be a meeting. I believe that special meetings of the Board should be called when a quorum of members of the Board demand it.

In one place the report of the majority remarks that motions appropriating surplus can only originate in the Board of Directors.

The Secretary's report of the Executive Committee meeting of December 6, 1935 informs us that Warner had taken upon himself to resurrect an unpaid account due to the then Vice-president Stewart, who had made no claim for it; Warner had made up this account by digging up some old correspondence dated between October, 1923 and August, 1927, amounting to $733.76, and which the Executive Committee ordered paid from *surplus*. It was a surprise to me to learn that the Executive Committee could pay funds out of surplus without the consent of the Board. This was evidently done and if this is permissible, we should take such steps as will prevent its repetition. I called Bailey's attention to this but received no answer.

I was glad to bring about a change in the handling of ballots. Chairman Bailey would not believe that the outer envelopes were opened when the ballots were received at Headquarters. He promised to write me about this but did not do so. Anyway, the adoption of this method [not opening the outer envelopes] will prevent any question of tampering with the ballots, and this change the Board will no doubt approve. I understand that at the last election in December, this plan was used, even though it did take longer to sort and count the ballots.

I recommended to Bailey that our plan of legal representative be changed and that a General Counsel be appointed to devote his entire time and effort to Washington legal matters and such other contacts as we have at the Capital. Also he should represent us at foreign meetings, as Bucharest and Cairo. His main activities should be centered upon getting more frequencies for our congested amateur bands. He should be made an officer of the League and located at Headquarters; the Secretary should be instructed to place at his disposal such information as has been gathered by our contacts in representing the League.

I recommended to Bailey that a plan for close supervision of the work of the Headquarters staff by committees of the Board of Directors be established, that the following committees be appointed from members of the Board, that every member of the Board be appointed on one or more of these committees according to his ability or experience fitting him for filling such a position and that they report their activities to the Board whenever they deem it necessary, but shall make a report at every annual meeting of the Board.

1. *League Policy Committee*: To supervise Legislation, International Matters, Washington contact matters, and any other matter affecting A.R.R.L. policy on amateur radio problems.
2. *Finance and Operating Committee.* Supervise financial operations, expenditures, leases, rentals, etc., together with supervision of the accounting department.
3. *Publication and Advertising Committee.* Supervise League publications, and League advertising policy.
4. *Membership Committee.*

[5]The Constitution requires quarterly meetings of the Board to be "called"; three of such meetings are customarily called and adjourned for lack of a quorum. The majority recommend that the Constitution specify that such quarterly meetings "may be" called.

5. *Technical Committee.*
6. *Communications Committee.* Supervise Communications department and propose field contact plan.

There is no doubt in my mind that some changes should be made in the management of League headquarters. The Secretary has held this position too long. It is a mistake to retain any member of the staff, when he has lost his influence with the membership. In the Central Division Convention held in Cleveland August 30-31, we showed the headquarters film, and every time Warner's picture appeared on the screen it was booed by a large number of amateurs present. Later at a meeting of the Amateur Radio Society of Northern Ohio (an affiliated club and the sponsors of the last Central Division Convention) a vote was taken on Warner, and out of 44 members present, 29 voted for the removal of Warner and only one supported him, 14 not voting. In a hamfest held by the Cambridge Radio Club, Cambridge, Ohio, with an attendance of about 300, a vote was taken on Warner and only two favored him, the rest voting to dismiss him.

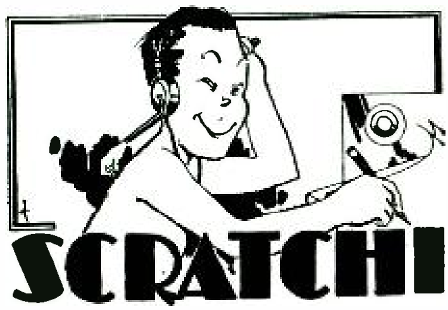
I have found this sentiment exists throughout the Central Division. The question is: Shall we ignore this demand? Each director knows what his own division's problems are and how the members there feel about the Secretary. I believe a change would build up the League. There is a reason why out of about 45,000 amateurs we have less than one-fourth of them enrolled in membership. We would have more influence at Washington if our membership were more representative in numbers of the amateurs in the United States. We have others on the staff that could fill this position. There is Handy, Budlong at Headquarters and many others in the membership that have distinguished themselves at being competent to fill this position. Shall we consider making a change at the next Board meeting?

While we are reviewing so many important plans, we should consider moving headquarters to a more central point at an early date. The old reason for retaining the League at West Hartford was due to President Maxim's residence there, but this sentimental reason no longer exists. West Hartford is not central. It is not convenient for directors' meetings. It is not a central mailing point. A central point would be more convenient, more accessible, more influential, and bring the League in closer touch and contact with the West, Middle-West, and South, and would benefit the greatest number of its members. Also it would give the League a broader outlook and increase its membership to move it into Ohio, Illinois, Indiana, or Missouri.[6]

With every effort of two persons of equal intelligence to use cold logic, they sometimes reach different conclusions even when reviewing the same subject. The conclusions of other Board members may be different from mine. I have tried to fill the position to which I was appointed at the last Board meeting, to the best of my ability; to keep unbiased, unprejudiced and sincere; to make this a careful and thoughtful report.

I would appreciate reactions to my independent report.

[6]Points in Western Missouri are approximately half-way between the geographical center of the country and the center of population (at present in Southern Indiana, but moving steadily Westward).

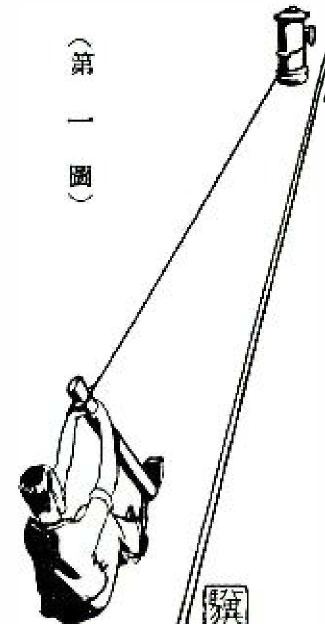


Osockme, Japan,
April 1, 1936.

Dear Merged Editor of
RADIO with nther sheets,
and Sirs:—

Scratchi have take it unto himself to act as your Hon. ambassador to make attempts for merging Japanese and Chinese radio papers with Hon. RADIO. I are sure that you should have Chinese and Japanese writings departments in your magazine each and every other months and at occasional intervals in between, so that all of your two subscribers here in Lands of Rising Sun and Falling Daughters will make more benefits from readings from such.

Land of China are making much progress of recent dates. I are just return from trip to Hankow and I are presented with keys to city and invitations come with suddenness for Scratchi to make speeches at radio clubs. I make much success and advice of Scratchi are solicited for advisability for make take out patents on many new contraptions which Chinese hams have developing. One such patent idear are shown in forthwith picture which are to be put on same page with this letter from Scratchi so people will know what I are talking about. Such picture come from currents issues of China Radio magazeen and are reprinted with permissions. It are Chinese patent applied for amazing discovery of new Hankow Wire-Stretching Systems. As are seen from picture, radio ham simply take long piece of wire and make tie unto fire hydrunt. He then take hammer and knock out hole in concrete sidewalks, and



不曾再伸長○所以在裝置天線之前
續，可以使天線拉長後，裝在天空

put handle stick in such hole. Sitting down please and he then pull like hell. (See picture for pulling directions.) Strong ham can thus make piece No. 12 wire look like catswitskers and save more than 40% usual somewhat discount on wire cost by stretching 25c piece of wire to very near 50c worth length.

Scratchi believe such method are patents applied for and have great merits. I take such invention home with me and try it on fire hydrunt in front of my house next door. I sit on sidewalk and pull on wire. What do you think make happen, Hon. Ed? Banzai!!—fire hydrunt are pulled out of hole, Scratchi pull so hard. Water shoot up in air Geysewer, and entire streets become inundated with flood. Scratchi make quick jump for nearest mountain top and send in rush call for fire department. Large fat fireman come on scene and sit on hole where hydrunt once have been, and stop up leak. He say he will make continue to sit there for 30 days at ten yen per day and force Scratchi to pay him salary for such sitting posture as good teaching lessons to tie wire unto Mt. Fujiyama next time instead of around fire hydrunt.

It appear that, as are more usual, Scratchi are again get stung. It are timely now for Scratchi to make PS notations for explaining purposes of Chinese writings which are below picture of wire puller herewith on page. Such things say in American language that it are advisable for ham wire stretcher to first tie ten fire hydrunts together into serious, for more safety protection against hydrunt blowup. Amount of money which can make save by such wire stretching process are colossus. I may suggest you try same some time, Hon. Editor, and I make promise you will not become patent soot litigationed by Chinese paper which give great scoop on such clever new ham money savings skeem.

I are not stretching the truth. Hon. Ed., only the wire.

I remain as I were in future,

HASHAFISTI SCRATCHI.

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Self Excited Oscillators

[*Continued from Page 27*]

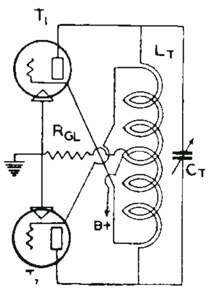

Figure 13

A Hartley oscillator, and in fact, all oscillators should be tuned up with a d.c. milliammeter placed in the d.c. grid return for initial adjustment of excitation, as well as one placed in the d.c. plate supply lead. The grid meter indicates r.f. grid excitation, and normally the d.c. grid current should approximate from 10 to 20% of the d.c. plate current (depending on the μ of the tube or tubes used).

It is impossible to get much plate efficiency and output without proper grid excitation and it is lack of grid excitation that usually causes diathermy oscillators to stop oscillating, transmitters to become unstable, etc. The grid drive *decreases* as the loading of a conventional oscillator is increased. If the loading is increased enough the grid drive drops to the point where oscillation ceases, at which time the output and efficiency drop to zero and the d.c. plate input swings up to a dangerous point. This is based on the assumption that grid leak bias is the sole source of bias, and the tube is not of the "zero bias" type.

It is highly desirable, therefore, to provide a sufficient amount of grid drive in all oscillators. This improves the efficiency at maximum load, and also increases the frequency stability.

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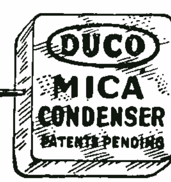
SUN SPOT DATA FROM NAA

Data on solar activity are broadcast daily from NAA, Arlington, at 2230 G.c.t. (5:30 p.m. e.s.t.). Preceded by "URSI", sun spot data are given by the letters "SOL" followed by a five-number group. The first number is the day of the week. The second two numbers indicate the number of sun spot groups. The last two numbers indicate the total number of spots.



BUYER'S GUIDE

Where to Buy It

CALIFORNIA—Fresno

Ports Manufacturing Co.

3265 E. Belmont Ave. Radio W6AVV

National FB7-SW3 and Parts; Hammarlund, Cardwell, Bliley Crystals; Johnson Insulators
Distributors RCA-DeForest Transmitting Tubes

Established 1914 *Send for Wholesale Catalog*

CALIFORNIA—Los Angeles

Radio Supply Company

912 So. Broadway

THE AMATEURS' HEADQUARTERS OF THE WEST

All Nationally Advertised Parts for Receiving and Transmitting Carried in Stock at All Times. 9 Licensed Amateurs on Our Staff.

CALIFORNIA—Oakland

Radio Supply Company

2085 BROADWAY

Hammarlund, Yaxley, Carter, National, Johnson, IRC, Cardwell, Miller, Morrill, Flechtheim, Triplett, Haigis Transceivers.
W6GFY

CALIFORNIA—San Francisco

OFFENBACH ELECTRIC COMPANY

1452 Market Street

"The House of a Million Radio Parts"

Hammarlund and National sets and parts
RCA and EIMAC Tubes.
Arcturus Receiving Tubes.
Trimm Phones, all types.
Johnson Antenna Feeders, Insulators, Transposition Blocks.

ILLINOIS—Chicago

CHICAGO RADIO APPARATUS CO., Inc.

Established 1921

415 SOUTH DEARBORN STREET
(Near Van Buren Street)

ALL SUPPLIES FOR THE SHORT WAVE FAN AND RADIO AMATEUR
QUOTATIONS FREELY GIVEN ON ANY KIT OR LAYOUT

Short Wave Receivers Taken in Trade
Get our low prices

PARTS REQUIRED FOR BUILDING EQUIPMENT SHOWN IN THIS ISSUE

The parts listed are the components of the models built by the author or by "Radio's" Laboratory staff. Other parts of equal merit and equivalent electrical characteristics may usually be substituted without materially affecting the performance of the unit.

●

The "Traffic Ten" Receiver

C_1—Hammarlund MC-35-S
C_2, C_3—Cardwell "Trim Air" 75 μμfd.
C_4—National SE-150 (rebuilt)
C_5—National SE-150
C_6—Cardwell "Trim Air" (rebuilt as described in text)
C_7—Hammarlund MEX-50
RFC_1—National 100
RFC_2—Miller 16-MH (shielded)
RFC_3—Hammarlund CH-10-S
Switch—Yaxley, 2 gang, 4 point
IFT_1—Hammarlund ATT-465
IFT_2—Hammarlund T-465-CT
IFT_{BO}—Hammarlund ATO-465
Power trans.—Metal Products type 6230
Dials—"K-K" 4 inch
Unmarked Condensers—Aerovox type 1450

CHICAGO—Illinois

Mid-West Radio Mart

520 South State Street

Rex L. Munger, W9LIP, Manager
America's Amateur Headquarters

ILLINOIS—Chicago

NEWARK ELECTRIC CO.

226 WEST MADISON STREET

The Best at Lowest Prices—Write for Complete Catalog

NEW MEXICO—Albuquerque

WM. H. ALLEN CO.

BOX 641

DISTRIBUTORS OF NATIONALLY ADVERTISED RADIO

NEW YORK, N. Y. 227 FULTON ST.

SUN RADIO CO.

Complete Stock of Amateur Radio Supplies at Wholesale Discounts

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PENNSYLVANIA—Philadelphia

M & H Sporting Goods Company

512 Market Street

PENNSYLVANIA—Pittsburgh

CAMERADIO COMPANY

603 GRANT STREET

WASHINGTON—Spokane

Spokane Radio Co., Inc.

611 First Avenue

The Marketplace

(a) Commercial rate: 10c per word, cash with order: minimum, $1.00. Capitals: 13c per word. For consecutive advertising, 15% discount for 3rd, 4th, and 5th insertions; 25% thereafter. Break in continuity restores full rate. Copy may be changed often as desired.

(b) Non-commercial rate: 5c per word, cash with order; minimum, 50c. Available only to licensed amateurs not trading for profit; our judgment as to character of advertisement must be accepted as final.

(c) Closing date (for classified forms only): 25th of month; e.g., forms for March issue, published in February, close January 25th.

(d) No display permitted except capitals.

(e) Used, reclaimed, defective, surplus, and like material must be so described.

(f) Ads not relating to radio or radiomen are acceptable but will be grouped separately.

(g) No commissions nor further discounts allowed. No proofs, free copies, nor reprints sent.

(h) Send all Marketplace ads direct to Los Angeles accompanied by remittance in full payable to the order of Radio, Ltd.

(i) We reserve the right to reject part or all of any ad without assigning reasons therefore. Rates and conditions are subject to change without notice.

CRYSTALS—80 and 160 meter bands 95c. A stock of 1,000 crystals insures you prompt delivery. New type shielded holder 60c. Fits standard five prong socket. White Radio Laboratory, Sandpoint, Idaho.

COLLECTOR trades radio parts, engineering counsel, mechanical, electrical, stamps; build xmitting equipment for violins, violas, violincellos, bows any condition. W2FED.

W9SQB may write for free Handbook.

SPECIAL "ultra-de-luxe" copies of the 1936 "RADIO HANDBOOK", bound with Vellum Cloth, front cover and backbone stamped in imitation gold. These "ultra-de-luxe" handbooks are printed on heavy, coated enameled paper, bound like a regular text book. A magnificent job. Price $2.50, prepaid. Pacific Radio Publishing Co., Pacific Bldg., San Francisco, Cal.

A free Handbook to W5MX.

GUARANTEED TRANSFORMERS and chokes. Power supplies, modulation equipment, microphones, amplifiers, preamplifiers, etc. Universal class B transformers, 100 watts, pair $8.00. Racks and panels, all sizes. Amperex tubes. Langrick Radio Engineering Service. W6PT, 626 Maltman Avenue, Los Angeles.

FOR SALE: One Westinghouse 500 volt d.c. motor generator set in good condition, $18.00. Motor is 110 volts a.c. W9CDE.

One Handbook free to W1AKF.

SELL: 852's, 1 Kw. Transformer, Crystals, Holders, Old UV202's, 50 watter, Generator, 300 miscellaneous parts. Illustrated list. Lane Jackson, Independence, Missouri.

One Handbook free to W6KYG.

SELLING OUT: Transmitting tubes, transformers, 1000 v. Edison "B", mounted crystals, holders, blanks, SW3, 300 Miscellaneous parts. Illustrated list. Lane Jackson, Independence, Mo.

TRANSFORMERS REWOUND and built to specifications. Very best quality materials and workmanship. Ecoff Transformer Co., 1929 Forest Ave., St. Louis.

W7APH may write for free Handbook.

RELAY rack 30 watt *controlled carrier* phone, 120 watt c.w.set. Uses pair of RK20's in final amplifier driven by two 53's. Complete with 80 meter coils, built-in power supply, tubes, and $50 broadcast type carbon mike. Sell for $145. Frank C. Jones, 2037 Durant Ave., Berkeley, Calif.

SPECIAL 866B's—$3.75. 866's—$1.65. Guaranteed six months. F. B. Condenser mike heads $10.00. 100 watt Universal Class "B" transformers $8.00 pair. Langrick Radio Engineering Service. W6PT, 626 Maltman Ave., Los Angeles, Calif.

SELL—New Sr. Speed-ex key guaranteed. $6.00. W7FFJ.

WE build most any size steel cabinet to house that gadget you are building. R. H. Lynch, 970 Camulos, Los Angeles.

RACKS, cabinets, shield cans. Send for circulars. R. H. Lynch, 970 Camulos, Los Angeles, Calif.

A free Handbook to W9LNO.

RAW QUARTZ—finest quality, for the manufacture of piezo crystals. Largest, most complete and varied stock in America. Brazilian Importing Co., Inc., 6 Murray St., New York City.

TRANSCEIVER cabinets. Send sketch for price on size you want. R. H. Lynch, 970 Camulos, Los Angeles.

SELL McMurdo Silver fifteen tube Masterpiece receiver, Sampson two fifty amplifier. Glenn Watt, Chanute, Kans.

CUSTOM-BUILT TRANSFORMERS, chokes—power and audio. Our reputation assures quality. May we quote? Baker Engineering, Fort Wayne, Indiana.

DANGER! High voltage card (red and blue), 10c; CALLBOOKS, $1.25. Bliley 14 mc. crystal, $7.50. W8DED, Holland, Mich.

WANTED: Old radio sets or parts for ham antique collection. All letters answered. W6LM.

QSL SWL Cards, neat, attractive, reasonable. Samples free. Miller, Printer, Ambler, Pa.

SUPER-SIGNAL, the new crystal supreme, $5.00. Information on request. Also V, AT, and X at popular prices. W1BD.

To W3BAS a free Handbook.

QSL's, 300 one-color cards $1.00. Samples, 2143 Indiana Avenue, Columbus, Ohio.

CRYSTALS and blanks. X or Y cut; 1750 to 2000; 3500 to 4000; close to your specified frequency $1.35. Blanks, unfinished 60c. Bill Threm, W8FN, 4021 Davis Ave., Cheviot, Ohio.

POWERFUL "T-9" dependable X cut 40 meter crystals: $1.50 within 10 kilocycles, $2.00 within 5 kilocycles, $2.50 for exact frequency—postpaid; also 80's same prices. Written guarantee, calibration card and instructions with every crystal—you must be pleased. Mention ad. "Eidson's", Temple, Texas.

WANTED—Used Collins fone transmitter, 100 watts or less. State all details. W8PNF.

GENERAL ELECTRIC dynamotors 24/750 volts, 200 mils., $25.00. Two for 1500 volts $40.00. Westinghouse 27/350 $10.00. 500 Watt, 500 cycles, $10.00. List. Harry Kienzle, 215 Hart Blvd., Staten Island, New York.

TRANSFORMERS, chokes, all types. Reasonable. Guaranteed. Special universal class B inputs and outputs 100 watts audio—pair $8.00. California Radio Labs., W6CYQ, 2523 South Hill Street, Los Angeles.

To W8CRZ a free Handbook.

FINE QSL's! SWL's! Samples. W9UH Press, 2009 Fremont Street, Chicago.

QSL's, 300 one-color cards $1.00. Samples. 2143 Indiana Avenue, Columbus, Ohio.

NATIONAL AGSX receiver. Full set A, B, C, D, and E coils. Rack mounting, power supply, permanent magnet speaker. $95 f.o.b. Remler condenser microphone, special "bomb" amplifier. A beauty, perfect condition, $35.00. W6APU, 428 No. Maple Drive, Beverly Hills, Calif.

NEON TUBES, four inches, for RF testing, Oscilloscopes, special lengths made to order. Postpaid (U. S., Canada) $3.00. W8AXB, GLOMU SPECIALTIES, 3411 Harrison Avenue, Cheviot, Ohio, Dept. B.

CRYSTALS—40 meter band X cut $1.85. Guaranteed satisfaction or money back. 80-160 bands $1.50. Omaha Xtal Labs., 501 World Herald Bldg., Omaha, Nebr.

WANTED: Edison storage "A" batteries, UX852s. Grote Reber, Wheaton, Illinois.

LARGE STOCK new and used equipment for sale by Southern Ohio's only amateur owned amateur business—Jos. N. Davies, Box 602, R.R. 9, North Bend Rd., Mt. Airy, Cincinnati, Ohio.

POWER Supply 1100V—150 ma.; 500V—85 ma.; 7½V—3A; 2½V—10A; 5V—3A; Fil. C.T., $22.50. 5 Meter receiver $12.95, 10M Converter $10.95. Transformer manufacturers to specifications. All equipment completely built. Write for further information. Precision Radio Laboratories, 109 E. 94 St., Brooklyn, N.Y.

COMPLETE VOLUME "RADIO" 1935, 12 issues. Not many of these left. Better order now. $3.00 for the entire year's volume. Order from Pacific Radio Publishing Co., Inc., Box 3278, San Francisco, U.S.A.

CRYSTALS: SATISFACTION OR MONEY BACK. 160-80 meters within 10 kilocycles Y-cut $1. X-cut $1.35. Wright Laboratory, 5859 Glenwood, Chicago, Ill.

WE have our PR-16 and can make deliveries. Used sets and parts. List Free. W9OC, Spencer, Iowa.

DOWN GO PRICES AS POPULARITY GOES UP!

RCA-203-A	formerly $17.50. NOW	$15.00
RCA-211	formerly $17.50. NOW	$15.00
RCA-845	formerly $20.00. NOW	$16.00
RCA-838	formerly $18.00. NOW	$16.00
RCA-860	formerly $35.00. NOW	$32.50
RCA-866-A	formerly $5.00. NOW	$4.00
RCA-868	formerly $6.00. NOW	$5.00
RCA-918	formerly $6.00. NOW	$5.00

COMPARE these prices—see your savings on these famous types, each one of which now is available to you for less than ever before. At these new low prices you cannot afford to be without the assurance of reliable tube performance RCA gives you. Take advantage of these new prices and use RCA tubes in your transmitter.

RCA

AMATEUR RADIO SECTION

RCA Manufacturing Co., Inc., Camden, N. J.

A SERVICE OF THE RADIO CORPORATION OF AMERICA