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Eleventh Year—526th Issue

April 23
1932

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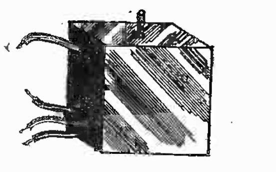

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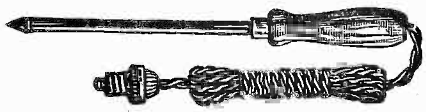

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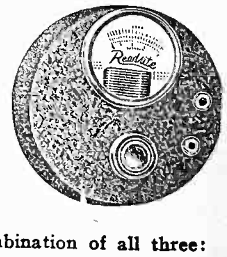

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ELEVENTH YEAR

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Ultra Frequency Tests

Mystery Converter Experiments Outlined

By Herman Bernard

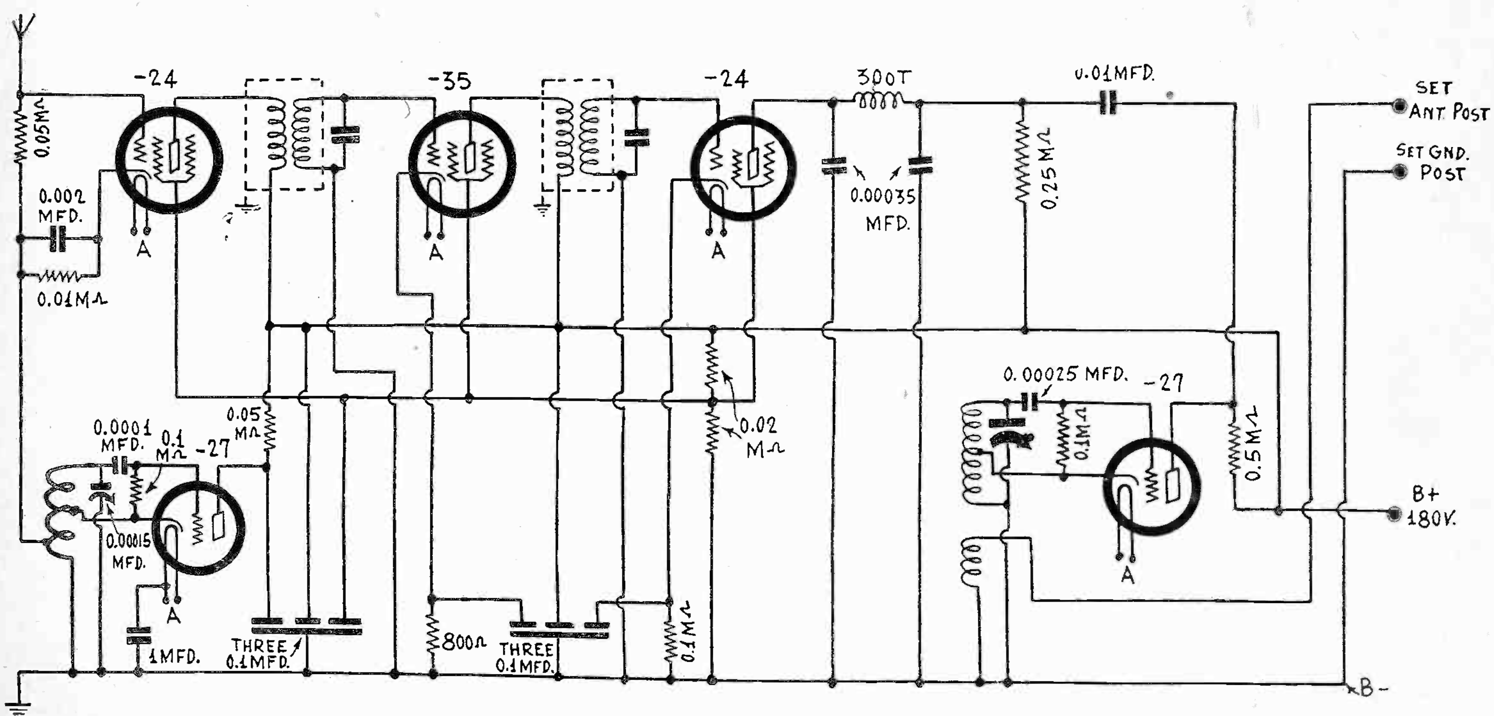


FIG. 1

A 15-545 meter converter, using no switches or plug-in coils, and only one manually tuned circuit. It embodies the principle of the mystery superheterodyne. The two plate circuit bypass condensers, at coil terminals, dispense with other filters.

THE mystery superheterodyne has been discussed in these columns for several weeks. Beginning with two circuits to the same general purport, readers were asked to speculate as to its purpose. Many sent in the correct solution which, in brief, is that all waves are received by the modulator tube that is connected to aerial. A 20,500 kc-40,000 kc oscillator, manually tuned, beats with the modulator frequencies, picking out one at a time, of course, and signal frequencies from 20,000 to 500 kc are received. Notice that only one condenser is used for tuning and no switching or plug-in coils are used. The intermediate frequency would be around 20,000 kc.

Reason for Third Detector

Now, at this frequency there might not be enough selectivity, nor yet sufficient amplification, so the circuit showed in addition a fixed frequency oscillator, say at 20,400 kc for a second intermediate frequency of 400 kc, so that the usual stages may be included at that level and lead into what would be the third detector.

Some experiments are being conducted, however, at an intermediate frequency of about 20,000 kc, with amplification included at that frequency. If the circuit can be made to work properly, the second intermediate frequency may be obtained readily from a broadcast receiver, and the mystery all-wave converter would cease to be a mystery to readers.

In Fig. 1 the upper left-hand tube is the modulator or first detector, the lower left-hand tube is the variably tuned oscillator, and the second and third tubes to the left of the modulator are the intermediate amplifier and the second detector or demodulator.

Experimenters may desire to avoid another ultra frequency circuit and this can be done in connection with the mystery circuit by making the second oscillator oscillate at the second intermediate frequency. The modulation is introduced from the

(Continued on next page)

(Continued from preceding page)

second detector. On way of doing this is shown in Fig. 1. The audio frequencies are impressed on the plate circuit, while the grid circuit radiates the intermediate frequency as thus modulated. If the tuning of this grid circuit is at 530 kc or 1,550 kc, then one has an all-wave converter, say 15 to 600 meters.

Obtaining the B Voltage

The diagram shows B voltage but no B supply. If you have a set with pentode output tube or tubes, the screen voltage, which is maximum B, may be picked up, and a resistor used to drop the voltage to around 180 volts. About 2,000 ohms will suffice. A 3-watt resistor should be used.

Many will have to perform experiments at ultra frequencies without any definite knowledge of the frequencies. However, a general idea is obtainable from the fact that the inductance is known, the minimum stray capacities can be estimated (around 30 mmfd. to 40 mmfd. is a good assumption) and the tuning capacities are known.

For setting up the circuit as shown in Fig. 1 the variably tuned oscillator coil may consist of 1½ turns of wire wound on a 3-inch diameter form and then removed from the form. The wire is of the hollow copper tubing type, 3/16 inch in diameter, or thereabouts, and is familiar to operators of transmitters. It can be bought in coiled form at about 10c. a turn in some radio stores. One end of the winding can be connected near the tuning condenser stator lug, the grid condenser being between this lug and the coil, while the other end of the wire is anchored to the chassis. To make the coil parallel with the chassis some elevating bushing or other device is used, to attain the same height as that of the lug previously mentioned. Also this keeps the coil far enough from the aluminum or other metal panel. No trouble about oscillation stoppage was encountered in the variably tuned oscillator with the nearest part of the coil circumference 1.5 inches above an aluminum chassis top.

Winding Intermediate Coils

The intermediate coils are wound with 4.5 turns of No. 18 enamel wire for secondaries, while the primaries are wound beside them on the same form, ⅜ inch away, and consist of three turns of No. 28 enamel wire or other insulated wire. The diameter is 1 inch. The coils are put in shields of the same type as used in midget sets, either aluminum or a zinc composition, although copper, which is hard to obtain, is preferable. The shields used were 2 1/16 inches in diameter.

Some may recoil at the thought of shielding at the high frequencies involved. The shield losses come to mind. The great reduction in amplification is to be considered. But in point of fact the intermediate amplifier oscillated, which showed that perhaps the shields did not do so much shielding, after all.

In fact, oscillation could be stopped by placing the hand within about one foot of either intermediate coupler. By moving the hand back and forth the familiar plop was heard twice, once when oscillation stopped and again when it was resumed. This immediately suggested itself as a possible source of modulation. If body capacity and resistance could influence the radio circuit, perhaps concentration on the second detector, which was oscillating too, would result in modulation of sound. So I ran phone two leads past a door, shut the door, stayed outside with phones on head, and asked my wife to talk at the second detector tube. Her lips were about 1.5 feet from the tube, I could hear her on the earphones. Then I removed the phones and listened while she talked. I could hear her dimly. Evidently modulation was taking place, but there was not much sensitivity.

Opens Up a New Field

The change in the density of the air, due to the sound waves emitted by her, evidently effected the modulation. If such a system is actually reduced to commercial practice it should prove valuable, as a microphone would at last appear that had no frequency discrimination, one that had constant impedance. The experiment holds much promise.

The intermediate channel was oscillating, and this had to be stopped. A grid suppressor was tried, between coil and grid cap of the intermediate tube, but, as might be expected, this killed everything. Then the biasing resistor was increased beyond 800 ohms, also the bypass condenser was left off this resistance at all values above 800 ohms that were tried, and finally the circuit stopped oscillating, although continuing to amplify. This condition is just what is desired, but is not easy to attain. The trouble at these high frequencies is that with oscillation the amplification, even from one tube, may be tremendous, and that the next condition, after some preliminary adjustments, is that there is neither oscillation nor amplification.

Besides the remedies suggested, it is also practical to reduce primary turns to 2, or to increase the separation between primary and secondary, or do both, in regard to the two intermediate coils.

Adjusting the Intermediates

The tuning condensers across the secondaries of the intermediate coils are simply equalizers, and may be of 20-100 mmfd. capacity, used near minimum. The reason for using the relatively high capacities, 20-100 mmfd., was the desire to approach the maximum capacity of the variable condenser used in the manually operated oscillator.

This condenser was turned to just a bit below maximum capacity, and a milliammeter was put in the plate circuit of the second detector tube.

The intermediate frequency was lined up with the frequency of the oscillator by adjusting for maximum deflection. An insulated screwdriver has to be used. If the Hammarlund equalizers are used, the thick brass plate goes to grid and the thin phosphor bronze lug to ground. In this way body capacity effects are at a minimum.

After the adjustment was made, one turn was taken off the oscillator coil, the tap relocated at center, and then there was full assurance that the intermediate frequency was in fact always lower than the oscillator frequency, since it was lower than the lowest oscillator frequency. This precaution should be taken against having the frequencies cross to guard against image interference and stoppage of reception over a band that includes the intermediate frequency. The 1½ turn specification includes the removal of the one turn just specified.

Use of Parallel Condenser

Another way of arriving at the same general result would be to use an oscillator coil of two turns, in the beginning, and put a small fixed condenser, say a 20-100 mmfd. equalizer, set near minimum, across the oscillator condenser, line up the intermediate channel with the oscillator condenser at or just below maximum capacity, and then remove the small parallel condenser.

Under the conditions outlined the inductance of the secondaries of the intermediate coils will be less than the preliminary inductance of the oscillator. The reason for this was frequency stability, as experience shows that stability is better when the capacity is large. If there were any considerable trouble in attaining amplification this method could not be followed, but the intermediate amplifier oscillated, which denotes that amplification limits have been exceeded. There is no objection, however, to trying a greater inductance on the intermediate secondaries, and smaller capacities, and at the same time using at the beginning a smaller oscillator coil, say 2 turns.

A little difficulty was experienced at first in getting the high frequency oscillator to function all over the dial. The special oscillator hookup finally was excellent even to the highest frequencies. Just how high the frequency may be will depend on many circumstances, but we do not need anything greater than about 40,000 kc, or lower than 7.5 meters, and the oscillator will stand up at a higher frequency or lower wavelength than those, probably to around a little more than 1 meter.

Coupling of Mixer Circuit

The coupling between oscillator and modulator may be effected by returning the antenna resistor to the oscillator winding. This return is made to a point between the tap and ground. By connecting one end of a 20-foot piece of wire to the oscillator between tap and ground you can experiment to determine the point where oscillation stops. Earphones in the oscillator or output circuit will disclose stoppage. Then return just a bit farther, toward ground, when oscillation prevails, test for its retention all over the dial, and then accept this point as the coupling joint. Otherwise a condenser of 0.6 mmfd. may be connected between the oscillator and modulator grids, or two pieces of bell wire, 4.5 inches long, twisted together, one end of one piece to one grid, the other end of the other piece to the other grid. The two wires are the plates of a tiny condenser. Test for discontinuity, so that you do not conductively couple the two grids.

One side of the heater circuit has to be grounded. It is practical to ground both sides with moderately large condensers or one side with a much larger condenser. The radio frequencies will take the path of least resistance. When 0.002 mfd. was used on one side only, oscillation stopped at a mid-position of the dial, but when 1 mfd. was used oscillation prevailed at all dial settings. Just why this should be, comparing two condensers both virtually short circuits to such high radio frequencies, is not clear.

The oscillator is fairly free of the usual shot noises heard in short-wave systems. The reason seems to be the grounding of the plate. In fact, the plate is a non-reactive circuit.

Dial Problems

The dial used had a reduction ratio of 5-to-1 and each of the 100 divisions was legible to one part in 10, so the reading was to one part in 1,000, but the frequencies were so high it was difficult indeed to hold the dial at a desired resonance point. For instance, when the intermediate channel was lined up as previously explained, the condensers across the secondaries of the intermediate coils could be set fairly well, but when the dial of the oscillator was turned, it was next to impossible to stop it at the point that gave greatest swing of the meter needle. One could pass the point ever so slowly and see the meter reach greatest swing, but could not finally establish the oscillator tuning just there. For instance, as the hand was withdrawn from the dial the slight friction might change the dial setting ever so little—and ever so little might mean a few thousand kilocycles. So it is advisable to have a dial that not only reads at least as closely as the one mentioned, but one that can be manipulated to a finer point, that is, has a greater reduction ratio, and preferably is not of the direct drive type. Then withdrawal of the hand from the dial would not necessarily change the setting.

It seems strange to talk about detuning caused by hand withdrawal and yet not to consider body capacity, but this was not an instance of body capacity. The field was explored and it was found that no serious static or inductive field existed in this particular region when the hand was moved between the back of the dial and front frame of the condenser.

Greater Arc of Condenser

It would be preferable to have a condenser that turned through a greater arc even than 270 degrees, which was the limit of the condenser used, as then the frequencies would be spread out a little more, and every little bit helps. Therefore a condenser is being made by hand that turns 324 degrees, and if a belt-type dial is used with scale that divides this span into 500 divisions, with a true vernier of 20-to-1 ratio, the readings can be taken to one part in 20,000, which ought to be pretty good, especially where the rotation is within 36 degrees of the total circle. It does not seem practical to get much greater than 324 degrees rotation, because of the gap between the terminals of the stator plates necessary to accommodate the rotor plates for minimum capacity setting.

The second oscillator, the one generating the wave for the broadcast receiver to amplify, may consist of 135 turns of No. 32 enamel wire on 1 inch diameter, to be tuned with a knob-driven midget condenser of 0.000325 mfd., which will cover the broadcast band, all but four channels. Or, if a fixed frequency is to be used, for a low frequency setting of the receiver use 200 turns of the same kind of wire on the same diameter, and tune with the 20-100 mmfd. equalizer, or, for a frequency near the other extreme, put on 50 turns of the same kind of wire on the same diameter. The tap is at center in either case.

Has Confidence in Mystery Circuit

I WISH to compliment you on the mystery circuit, for I believe that it is a real invention.

I may be presenting a rather radical solution, but I am assuming that this is quite a good circuit. I am assuming that one rotation of the dial covers signal frequencies of from 20,000 to 550 kc. Quite a spread, but I believe it possible and without repeats, as I shall show.

First, we could cover the bend easily with an intermediate frequency of from 2,000 to 5,000 kilocycles, but with two disadvantages, one a minor one and that is that there would be a dead spot in the vicinity of the intermediate frequency, but that could be chosen so that it would fall in a place where few or no stations operated, the other is a major one, that a station would be heterodyned both above and below the intermediate frequency and differing from it by the oscillator frequency at the same time. Therefore, we would have repeats and this solution must be discarded.

This brings us to the conclusion that the intermediate frequency must be outside the band to be received and we know that it is high, and must be on account of repeats, therefore it must be higher than 20,000 kc.

Let us figure out how much higher. We have a 360 degree rotation. The coupling condenser between the oscillator coil and the modulator grid is 0.000006 mfd. The oscillator coil is coupled to the oscillator grid through a condenser and the grid circuit is completed through a resistance so that the grid current of the oscillator tube does not introduce a high minimum capacity across the tuned circuit of the oscillator. Accordingly all the distributed capacity of the coil and wiring and the minimum capacity of the condenser and the capacity which might be introduced by the coupling to the modulator should not amount to over 30 mmfd. The inductance to capacity ratio of the tuned circuit must be high to get the tube to oscillate at high frequencies. Accordingly, as we need a frequency ratio of only a little better than 1-to-2 (20,000 to 40,000 kc) a capacity ratio of 1-to-5 ought to be enough to cover that band and insure oscillation at all frequencies. So a 150 mmfd. condenser would be ample, and a smaller one possibly practical.

Therefore we can build an oscillator that will cover with one 360 degree rotation of the dial a frequency of from 20,500 kc to 40,000 kc, and we can use an intermediate frequency of 20,000 kc. By using the difference between the signal frequency and the oscillator frequency for the intermediate frequency we can cover a band of from 500 to 20,000 kilocycles and all of the repeat points will be higher than the intermediate frequency or where they will do no harm.

Also the smaller of the three chokes will be so designed that it will act as a choke only to frequencies below 20,000 kc and will therefore suppress any repeats that might be picked up from stations of greater than 20,000 kc. The two other chokes will be designed to cover the broadcast band and the space between the broadcast band and the effective range of the smaller choke.

The second intermediate amplifier might operate on any frequency from 2,000 kilocycles to 175 kilocycles, for there is but one intermediate stage and there are double tuned intermediate frequency transformers and some filtering. So since we have placed our first intermediate frequency at 20,000 kilocycles we had better place our second intermediate frequency as high as practical. Screen grid tubes work well at 1,600 kc and the circuit shown works well at that frequency and 1,600 kc is high enough to beat well with 20,000 kc. Transformers are readily available so there is no need of making it greater than 1,600 kc. In fact, 400 kc would work just as well, but 175 kc would be too low a frequency.

The objection that so great a coverage with 360 degree dial rotation would make the set too hard to tune can be met by using a dial designed for Stenode Radiostat and having a reduction v gear of 200-to-1. The oscillator circuits shown would be stable enough so that the stations would not fade out on account of the oscillator frequency varying.

ORA G. FRETZ, Box 65, Wapanucha, Okla.

Mr. Fretz has solved the circuit correctly and also has avoided pitfalls. Since he offers the pat solution it can not be called radical, although that characterization well applies to the circuit itself. The objection to a first intermediate frequency falling within the manually-operated oscillator's range is not so serious, as he says, but we are opposed to it, especially because of image interference that he mentions. We hinted to another correspondent to think of Washington crossing the Delaware. The idea was that the oscillator and first intermediate frequencies should not cross. What capacity condenser to use for manually tuned oscillator will depend to a considerable extent on how low the total minimum capacity can be kept. If the minimum is 30 mmfd. and that high a minimum seems unavoidable, then Mr. Fretz's selection is pat again. We compliment him on his thoroughgoing solution.

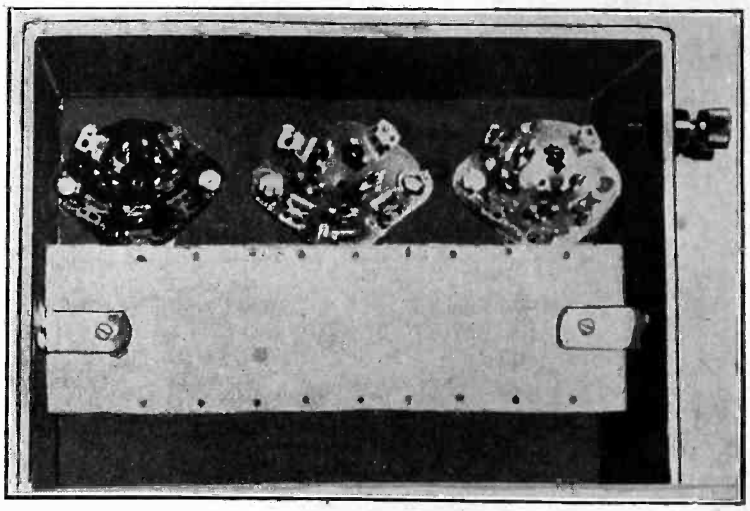
* * *

Honorable Mention

Others who made well-considered solutions of the mystery circuit were:

J. B. Straughn, 1756 California Road, N. W., Washington, D. C.
A. C. Parkhurst, care Shelton Radio Service, Shelton, Wash.
George Carton, 720 South Minnesota Avenue, St. Peter, Minn.
Otto Spinner, 439 East 136th Street, Bronx, N. Y. City.
W. M. Jackson, Wilson, Okla.
H. R. Hooper, 16732 Log Cabin Ave., Detroit, Mich.
W. L. Humphrey, 114 Wrightsville Ave., Wilmington, N. C.

A Pivot Mounting for an Insulation Strip



How an insulation strip is mounted to permit pivoting.

It has become popular to use an insulated strip for mounting resistors and small condensers used in constructing a set. The oblong insulator is drilled so that pigtail ends may be slipped through the holes and resistors or condensers soldered to their destinations. This method makes for greater neatness.

In soldering these parts in place it is handy to be able to do the work with the intended joints exposed, and then turn the insulator around, so that the leads will then be on bottom and the units themselves will be visible alone at top. Also for any servicing or testing it is better to have the insulator reversible in this way.

If a right angle bracket is affixed at each end of the insulator, the free holes in the brackets meeting panel holes, so bolts and nuts can be used, the insulator can be pivoted on the bolts. The panel nuts ordinarily would have to be loosened for this purpose.

SERVICE SHEET No. 4—*TROUBLE CURE*

LOCATING A BREAKDOWN

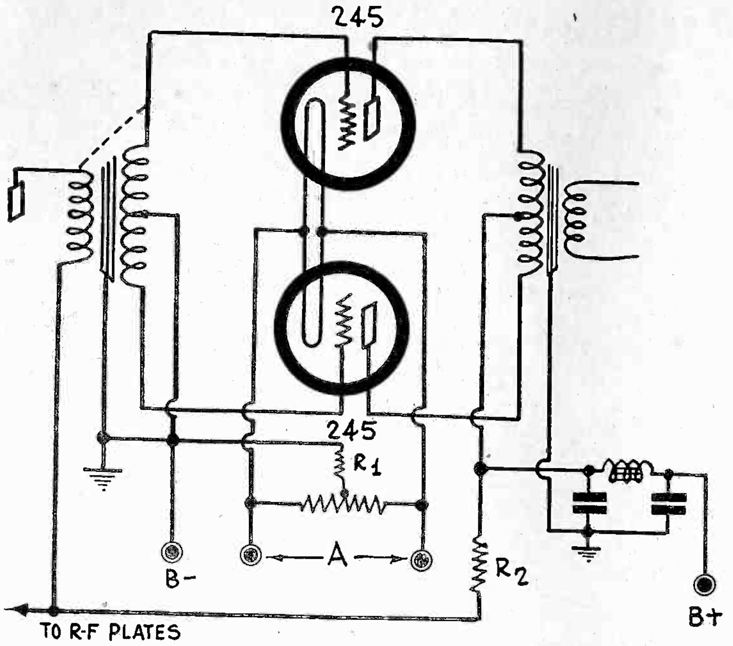


FIG. 1
The output stage of a commercial receiver with push-pull illustrating at what point an unusual defect had developed. The short, represented by the dotted line, lowered all voltages and made the grid of one power tube positive.

SERVICE men often encounter difficult problems in attempting to restore defective receivers into working condition. In one case involving a popular radio receiver the first sign of breakdown was a decrease in the amplification and this was followed shortly by a great deal of smoke, with a complete breakdown. Inspection of the set disclosed that the 280 rectifier was in a highly inflamed state. Everything so far pointed to a short somewhere, a short in the B supply. This was traced to one of the electrolytic condensers. The condenser was replaced and the rectifier tube behaved normally, but that was all that did behave normally. What to do?

Inspection of the power transformer disclosed that this had suffered severely during the heavy load caused by the short, and that most of the tar had melted out. Of course, it had made a nasty mess. This was cleaned out and a new power transformer was installed, almost identical with the first.

Still No Go

When the power was turned on everything seemed all right except that the set would not play well. It was weak and was in about the same condition that it had been before the general breakdown occurred. All voltages were approximately 50 volts below normal. With that exception there appeared nothing wrong on first test.

By a process of elimination the source of the trouble was confined to the last stage, a push-pull stage with two 245 tubes, with a probability that it might be in the tube ahead of that, a 227 coupled to the output stage with a push-pull input transformer. The circuit of this part is reproduced in Fig. 1.

The 245 tubes were biased with an 850 ohm resistor R1 and the field coil of the loudspeaker was used as the second filter choke. Only this part of the filter is shown. R2 was a resistor in the voltage divider to drop the voltage from 300 to about 180 volts.

Measurement of the plate current in the power stage showed that in one tube the current was approximately normal and that in the other it was practically zero. Yet the bias, measured across the resistance R1, was more than it should have been. That is, it was 60 volts instead of 50 or less. In view of the fact that there was current in only one tube and that the plate voltage was much below normal the measured bias should have been less rather than more than normal. The voltage measured from ground to one plate was 250 volts, whereas that from ground to the other tube was less by the expected drop in the primary due to the plate current.

A Baffling Problem

So far the problem was baffling. But when the voltage between the filament and each grid was measured with a high resistance voltmeter unexpected differences appeared. On the grid of the tube previously supposed to have been normal the bias was positive, whereas on the other it was highly negative. This suggested measuring the voltage drop in the secondary winding. On one side there was a high voltage drop in such a direction that it made the grid positive. In the other side there was no drop. Therefore the tube that had previously been thought to be normal was the one out of adjustment, whereas the other appeared to be all right, except for excessive negative bias.

If a grid is positive without respect to ground there must be a current flowing through the winding from grid to ground. This might be due to leakage through the insulation on the socket or in the transformer, from a point where the voltage was positive. The socket tested all right. Hence the voltage was measured with a high resistance meter from the plate of the first tube to ground then from the grid to the defective side of the output circuit to ground. The voltages were the same. The conclusion was that there was a short in the coupling transformer, either from the plate side or from the B plus side of the primary to the grid. The transformer was removed and tested out of the circuit, and the expected short appeared. It was between the plate side of the primary to the grid, as indicated by the dotted line in Fig. 1.

Circuit Works

A new transformer that tested all right was substituted for the defective one and when the power was turned on the set played as well as it had ever done.

It is difficult to see why the transformer should have broken down in this manner, since the voltage between the points in question had never exceeded about 200 volts. But it is likely that the heat that developed in the set had softened the tar in which the transformer had been immersed and that the two leads, which were close together at the place, had been attracted to each other by the electrostatic force. Or it may be that the insulation had become charred and that the carbon formed acted as a good conductor.

It was the use of a high resistance voltmeter in measuring the bias on the power tubes that led to the correct solution in this case. The use of an ordinary circuit tester failed entirely to point to the trouble. Indeed, it misled the service man for some time, for the defective side of the push-pull circuit appeared to be in normal condition.

But why was the bias on the second tube so high that no current of appreciable value flowed in its plate circuit? The current in the defective side was high enough to establish a negative bias on the other side more than sixty volts and this bias was too high for the effective plate voltage on the tube.

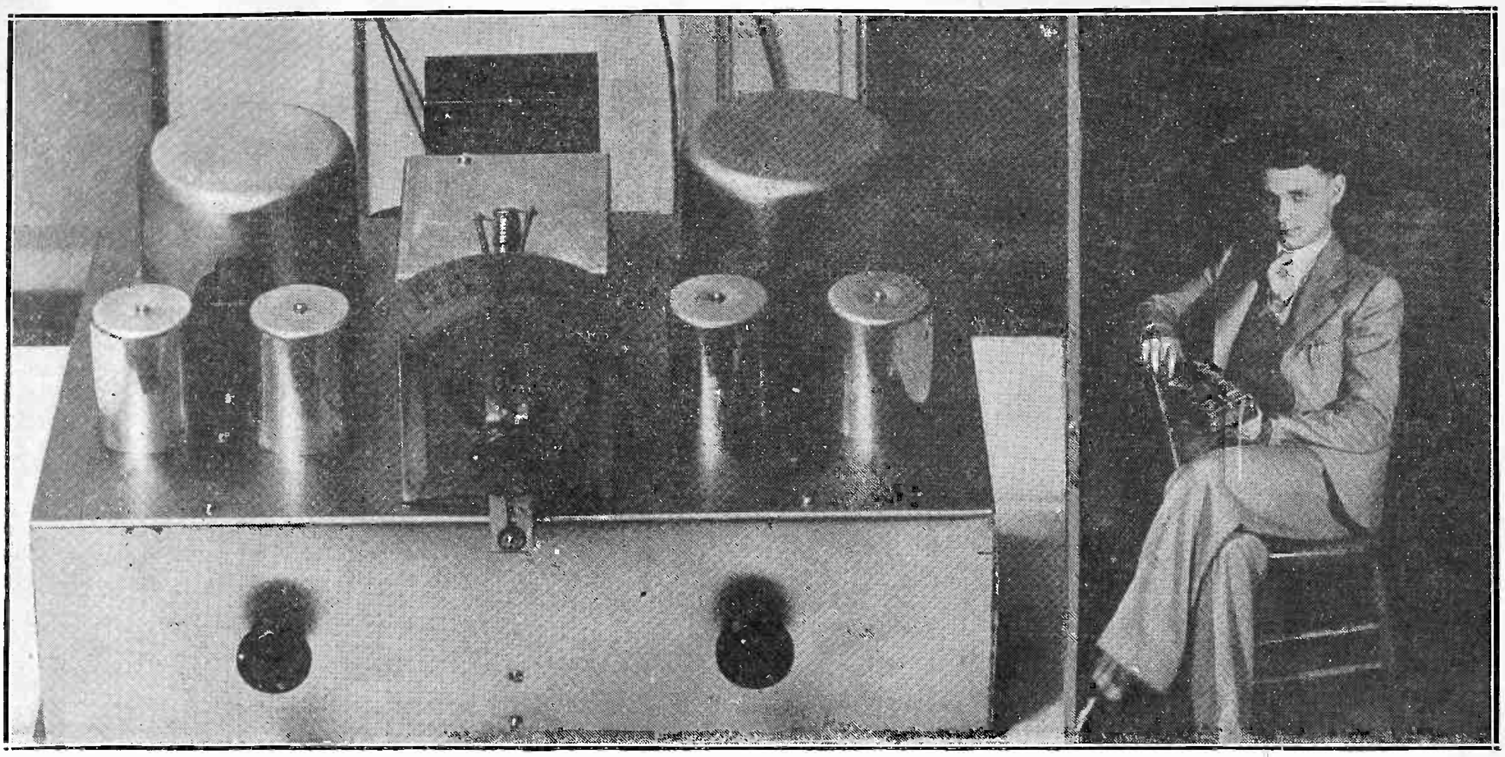
Low Plate Current

Another point that at first required thought was that there was no strength in the field of the magnetic speaker. In view of the fact that the voltage throughout was low, it is clear that the plate current in all the tubes was low, and practically zero in one of the power tubes. Since the field depended entirely on the plate current of the set as a whole, the current in the field coil was only a small fraction of what it should have been, and therefore the speaker was weak.

New Set Uses No Tubes

Inventor, 21, Keeps Technical Data Secret

By Jack Cejnar



The latest model of a tubeless receiver said to provide selectivity, excellent tone and ample volume. At right the inventor, Ernest Patrick, holding a three-gang condenser as used in the set.

A TUBELESS radio receiver, a-c operated, the invention of Ernest Patrick, 21-year-old Kentucky mountain boy, now a resident of Columbus, Ind., is announced. His set is the result of six years of experimenting.

Announcement of the tubeless set was made by the Strotz Tubeless Radio Corporation, 203 North Wabash Avenue, Chicago, on Patrick's 21st birthday. The Strotz corporation has acquired the rights to the device.

It is reported that the tubeless receiver can be manufactured at a cost of $6 and that it operates on less than half the power now needed for the average tube-operated set.

The technical details are being kept secret by the inventor and his backers.

Result of Six Years' Work

The new set is reported to have plenty of volume and sharp tuning. Long distance reception is reported as a regular thing.

Because of the simplicity of its construction the tubeless radio virtually is said to be fool-proof.

Patrick is removed only ten years from the covered wagon transportation of the hills of Kentucky. Born at Glasgow, Ky., in 1911, he was taken to Indiana in a covered wagon by his parents in 1921.

The tubeless radio represents the success of experiments made mostly in a basement of his farm home. One day he flipped a switch and received the thrill of his life when the tangle of wires in front of him suddenly resulted in reproduction. That was his first crude tubeless radio set.

He improved this set until its performance interested radio engineers who dropped in to verify reports. A syndicate of business men from Chicago, Ill., and Bedford, Ind., purchased an interest in the invention and financed Patrick's endeavors. He was furnished with a well-equipped laboratory and given $250 a month and expenses.

Report by British Physicist

The syndicate retained Dr. Bruce Morgan, British physicist, to assist Patrick in an advisory capacity. After testing out the tubeless radio Dr. Morgan said:

"In reducing his theory of radio reception without the use of vacuum or any other type of tube to a practical working basis, Ernest Patrick has made what I consider to be the most valuable contribution to the radio art and the radio public since the introduction of radio broadcasting.

"If this new tubeless radio receiver had been available in 1931 it could have saved the radio public more than $69,000,000 spent for radio tubes alone, during the year.

"My own experience in operating the set proves that the radical principle Mr. Patrick has evolved will cut the current consumption to about one-half of what is required to operate receivers of the conventional kind. Having no tube filament barrier to interfere, programs are brought in instantly at the touch of the dial, and each turn of the dial brings in the desired station at its full strength without the slightest delay.

"As may be readily understood, the absence of tube noises creates smooth, vibrant, mellow and very natural tonal depths which characterized the tubeless principle in comparative tests made with sets employing tubes. Extraneous noises and static are also reduced to a new low level almost beyond all comprehension. The economy and satisfaction that this tubeless radio will confer upon the public everywhere is self-evident and will, I believe, materially widen the use and enjoyment of radio."

As constructed at present the tubeless radio is 18 inches long, 12 inches wide and 6 inches high.

Short Wave Club

The following is a list of new members of the Short-Wave Club:

Roy L. Small, 34 Lothrop, Detroit, Mich.
S. Richard Keller, Jr., The Laboratories, Vicksburg Sanitarium, cor. Crawford and Monroe Sts., Vicksburg, Miss.
Caryl P. Baldwin, 402 Center Street, Bangor, Maine.
A. H. Linss, 313 W. Wash., Oklahoma City, Okla.
Charles A. Brickner 1110 E. Washington St., New Castle, Penna.
H. M. Robinson, 5165 Jefferson St., Philadelphia, Penn.
J. Y. Marshall, Jr., 6427 Drexel Ave., Chicago, Ill.
Arthur Brinkman, R. F. D. 2, Box 84, Hinsdale, Ill.
Carl E. Shiplett, 606 Esther Ave., Vancouver, Wash.
Ray T. Schoell, 4541—44th St., San Diego, Calif.
James Bennett, 1565 Eastern Parkway, Brooklyn, N. Y.
James Soltesz, 45 Lexington Ave., So. Norwalk, Conn.

Short Wave Editor, RADIO WORLD, 145 *West 45th St., New York.*

Please enroll me as a member of Radio World's Short Wave Club. This does not commit me to any obligation whatever.

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Ohmmeter Range Extension

External Battery and Resistance Must Be Used

By Conrad J. Brooks

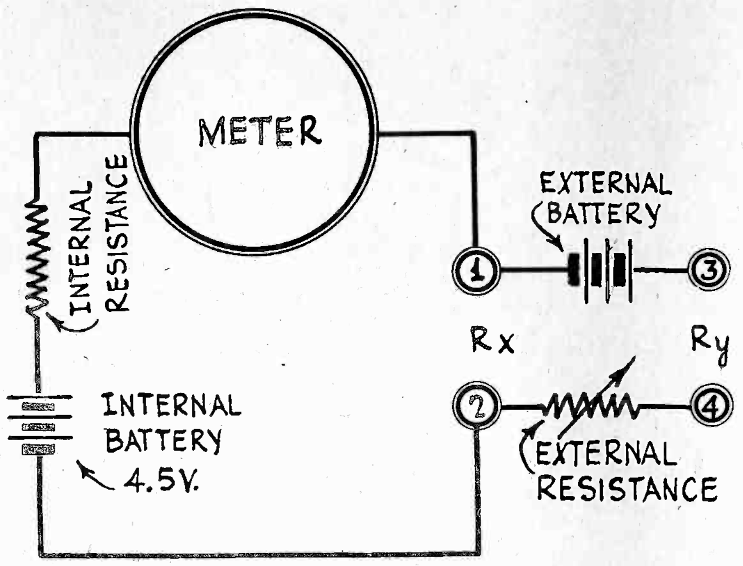


FIG. 1

The circuit of an ohmmeter which can be used with or without external battery and resistance. To measure the external resistance after experimental adjustment join terminals (1) and (4) and read resistance on the scale.

CERTAIN direct reading ohmmeters have a single, comparatively low range, say from zero to 10,000 ohms. Naturally, they cannot be used directly for reading resistances of higher value. But it is often desirable to use them for extending the range. How may this be done?

Chances are that we do not know anything about the internal values of the meter except that a battery of a certain voltage is built in. Before we can extend the range of the meter we must know the internal resistance of the meter, and this can always be done provided we have another battery and a variable resistance of suitable value.

The question of how to connect the external battery immediately arises. There are only two terminals on the meter available and one of them is positive, the other negative. But we do not know which is which. With the aid of a d-c voltmeter we can quickly determine the polarity of these terminals. As soon as we have done that we can connect the external battery. We must connect so that the voltages of the two batteries add up, not so that they buck each other. To do this we cannect the plus of the external to the meter terminal that shows to be negative with the volt-meter test.

Do not connect the other terminal of the external battery to the meter also, for that would be disastrous to the ohmmeter.

Finding the External Multiplier

When the external battery has been connected, on one side to the ohmmeter, connect a variable resistance in series with the battery and then the free terminal of the variable resistance may be connected to the meter, provided that the resistance is high enough. To play safe set the variable resistance at maximum.

Now vary the resistance until the reading on the meter shows zero resistance, or full scale from the voltage or current point of view. We have now the proper external resistance for the particular external battery, but we have no idea just how much resistance we have. If we want to put in a fixed resistance in place of the variable we must know the exact value. If we are satisfied to leave the variable in, and to leave it alone, we don't have to go any further except to find out what multiplier to use in reading the scale.

Suppose we decide to leave the variable resistance, and to leave it strictly alone after we have obtained the correct adjustment. We can then find the proper multiplier. Suppose that we know the voltage of the internal battery to be v and that of the external to be V. Then the total voltage in the circuit is v+V. But the scale is adjusted for a voltage of v. Hence the multiplier is (v+V)/v. Every resistance indication is therefore to be multiplied by this ratio to give the correct resistance.

Examples

Let us take a few examples to illustrate. Let the voltage of the internal battery be 4.5 volts and that of the external battery 22.5 volts. Therefore the total voltage is 27 volts. The multiplier is 27/4.5, or 6. Hence every reading should be multiplied by 6. An ohmmeter reading up to 10,000 ohms will therefore read up to 60,000 ohms. Again, suppose the external battery voltage is 45 volts, the internal remaining as before. The total voltage is now 49.5 volts and the multiplier ratio is 49.5/4.5, or 11. Now the range of the ohmmeter has been extended to 110,000 ohms. Of course, the external limiting resistance will not be the same in the two cases, but they are obtained in the same way in both cases.

Now suppose we do not want to leave the variable resistance in the circuit but that we want to find its value so that we can substitute a fixed resistance of the same value. Simply take the variable resistance, as adjusted, and measure the value on the ohmmeter without the external battery in the circuit. The correct resistance is therefore indicated on the ohmmeter.

Again let us take an actual example. The internal battery had a voltage of 4.5 volts and the external one of 22.5 volts. The maximum value of the variable resistance was 30,000 ohms. This was adjusted to the proper value and then it was measured with the internal battery alone. The indication was 1,400 ohms. This, therefore, is the proper fixed resistance to use when the external battery is 22.5 volts and the internal 4.5 volts, for this particular ohmmeter only, of course.

Determining Internal Resistance

These data are sufficient for determining the internal resistonce of the meter. The multiplier ratio is 6, obtained from the voltages, and the ratio of the total resistance to the internal should have the same value. Let the internal resistance be R. Then we have (R+1,400)/R equals 6. Solving the equation we obtain R=280 ohms.

Now we have two methods of obtaining the necessary external resistance in the case when the external battery voltage is 45 volts. We can do it in the same way we found the first resistance. That is, we can adjust to the proper resistance experimentally and then measure the exact value on the ohmmeter. Or we can make use of the internal resistance already found and the multiplier ratio obtained from the voltages. The multiplier ratio is 11 and the internal resistance is 280 ohms. Hence we must add a resistance to 280 of such value that the ratio of the sum to 280 is 11. We obtain R=2,800 ohms. That is, when we double the voltage of the external battery we also double the external resistance. However, we do not double the multiplier.

Advance is Made with Super-Regenerator

Taming the wild circuits of radio is a measure of the advance of the art. At first the receivers of broadcast waves were regenerative, but it was desired to get rid of the squeal, so tuned radio frequency became popular, with squealing at higher frequencies of the band corrected to some extent by eddy current loss systems that hurt sensitivity. Then the neutrodyne was invented, and there was considerable improvement, squealing being squelched, with only small drop in sensitivity.

The super-regenerator was another wild one. For nearly ten years it was considered as almost untamable. At least it was not mastered. However, recent requirements of television, and other purposes, accelerated experiments with the super-regenerator, so that several workers in this field report stable results. Sensitivity is high, volume great with few tubes. There is only one variably tuned circuit, which makes for simplicity. The system permits one to press beyond what otherwise would be the spillover. The paralysis of the tube's operation is prevented by the introduction of another oscillating frequency. At first low frequencies for the breakdown purpose were introduced, and considered necessary, but were audible, hence objectionable. Now inaudible frequencies are used, above 10,000 to around 35,000 cycles.

A 3-Tube Battery Set

Adapted for DX Reception with Headphones

By Burton Williams

OCCASIONALLY there is demand for sensitive receiving circuits to be used with headphones only. Sometimes they are desired by one member of a family who desires to listen to distant stations when the other members prefer to receive local programs on the regular set. Sometimes they are desired by invalids and at other times they are desired for use in conjunction with laboratory work where beats between extremely feeble oscillations are to be detected. In most cases such receivers are desired to be battery operated so that there is absolutely no hum present.

A receiver of this type may simply be the r-f amplifier and detector of a regular receiver. It is necessary to have several tuners in order to get adequate selectivity for the distant stations and it is necessary to have at least two r-f amplifiers in order to get high sensitivity. It is not necessary to have any audio frequency amplification because the output of a detector tube is ample for a pair of head phones.

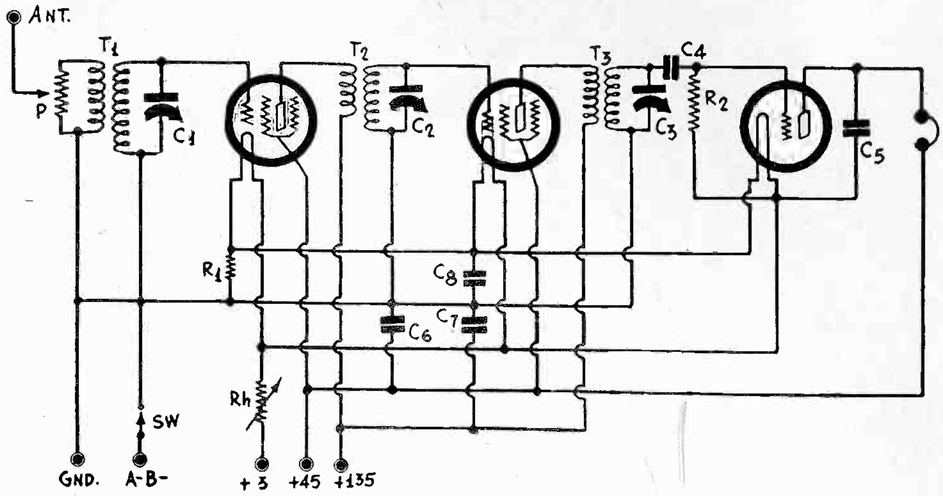


FIG. 1

A sensitive three-tube receiver for use with head phones only, or for use in front of an audio amplifier.

Therefore a circuit like that shown in Fig. 1 is quite suitable for the purpose.

Small Tubes Used

The most suitable tubes for a set of this kind are the new 2-volt tubes, and two 234 and one 230 will suffice. The r-f pentodes are used for high radio frequency amplification and the 230 for effective detection when working into a headset. Each of these tubes requires a filament current of only 0.06 amperes so that the total current for the three tubes is only 0.18 ampere. Now a No. 6 dry cell will deliver a current of 0.25 ampere for a considerable time so that we are well within the limits of this cell. However, the voltage of one cell is only 1.5 volts and we need two volts. Hence we have to connect two of the cells in series in order to get the necessary voltage.

We have one volt in excess of requirements. This we can make use of as bias for the two radio frequency amplifiers by putting a resistance R1 of 5.5 ohms. Since a resistance of this value is not easily obtainable we can use 5 ohms, or even 4 ohms, and then use a rheostat Rh for making finer adjustments. This should have a value of six or ten ohms. The use of the rheostat and a lower value of R1 than necessary allows some variation to take up changes in the voltage of the filament battery. It also provides a volume control.

While a filament switch Sw is indicated in the circuit this is not needed when the rheostat is used because the power may be turned off with the rheostat. If Rh is not used and R1 has the value of 5.5 ohms, the switch should be used.

Plate Voltage Supply

The plate current requirements are extremely light and only a small size B battery need be used. However, to make the r-f amplifiers work efficiently we should have at least 135 volts, requiring three 45 volt units. The two plates of the r-f amplifiers should be returned to the maximum voltage and the plate of the detector should be returned to the 45 volt tap. In the drawing of the circuit the screens of the two r-f amplifiers are connected to the 45 volt tap also, but if desired they may also be connected to the 90 volt tap. Ordinarily the total plate and screen current will not exceed 10 milliamperes, so that a small B battery should last a long time.

Condenser and leak type of detection is used because this is more sensitive than grid bias detection when the tube is followed by a headset. C4 should have the usual value of 0.00025 mfd. and R2 the usual value of 2 megohms. C5, the bypass condenser across the phones, should have a value of 0.0005 mfd.

The Tuner

The tuner in the circuit is typical of tuners used in midget receivers. There are three identical shielded midget coils T1, T2 and T3, and one gang of three 350 mmfd. tuning condensers. Both the condenser and the coils are standard and are easily obtained.

We must have a good volume control in the receiver and the most suitable in a battery operated receiver is a high resistance potentiometer, P, connected across the primary of the first r-f transformer. In order to retain the selectivity of the first tuned circuit, the resistance of this potentiometer should not be less than 10,000 ohms. It has been found that if the antenna is connected to the slider of the potentiometer the noise in the set will be less than if the ground is connected to the slider. Hence it is better to make the connection as indicated in the drawing.

Three large bypass condensers are used in the set. C6 across the 45 volt supply to the detector should have a value of not less than 0.25 mfd. C7 across the entire battery should be smaller than one microfarad, and C8 across R1 should be 0.25 mfd. In case the screens of the two r-f tubes are returned to the 90 volt tap, another condenser of 0.01 mfd. should be connected from the screens to ground.

Using Circuit Ahead of Amplifier

By adding a two-stage audio amplifier to this circuit it can be used for operating a loudspeaker. This amplifier may be either transformer or resistance coupled, or a combination of the two methods. If transformers are used the first audio tube should be a 230 and the last tube should be a 233 power pentode. The two added tubes will require an additional filament current of 0.32 ampere and for that reason two No. 6 dry cells will no longer suffice to deliver the required current. At least two more, and preferably four more, should be used.

LIST OF PARTS

Coils

T1, T2, T3—Three shielded midget type r-f transformers for tuning condensers

Condensers

C1, C2, C3—One gang of three 350 mmfd. tuning condensers
C4—One 0.00025 mfd. grid condenser
C5—One 0.0005 mfd. condenser
C6, C8—Two 0.25 mfd. bypass condensers
C7—One 1 mfd. bypass condenser

Resistors

P—One 10,000 ohm potentiometer
R1—One 5.5 ohm ballast resistor (or 4 or 5 ohms of Rh is used)
R2—One 2 megohm grid leak, pigtail type
Rh—One 6 or 10 ohm rheostat

Other Requirements

Sw—One filament switch (optional if Rh is used)
Three four-prong sockets
Two grid clips
One dial for condenser gang
Eight binding posts

Push-Pull Oscillator Reduces Sho
Symmetry in Re

By Conrad

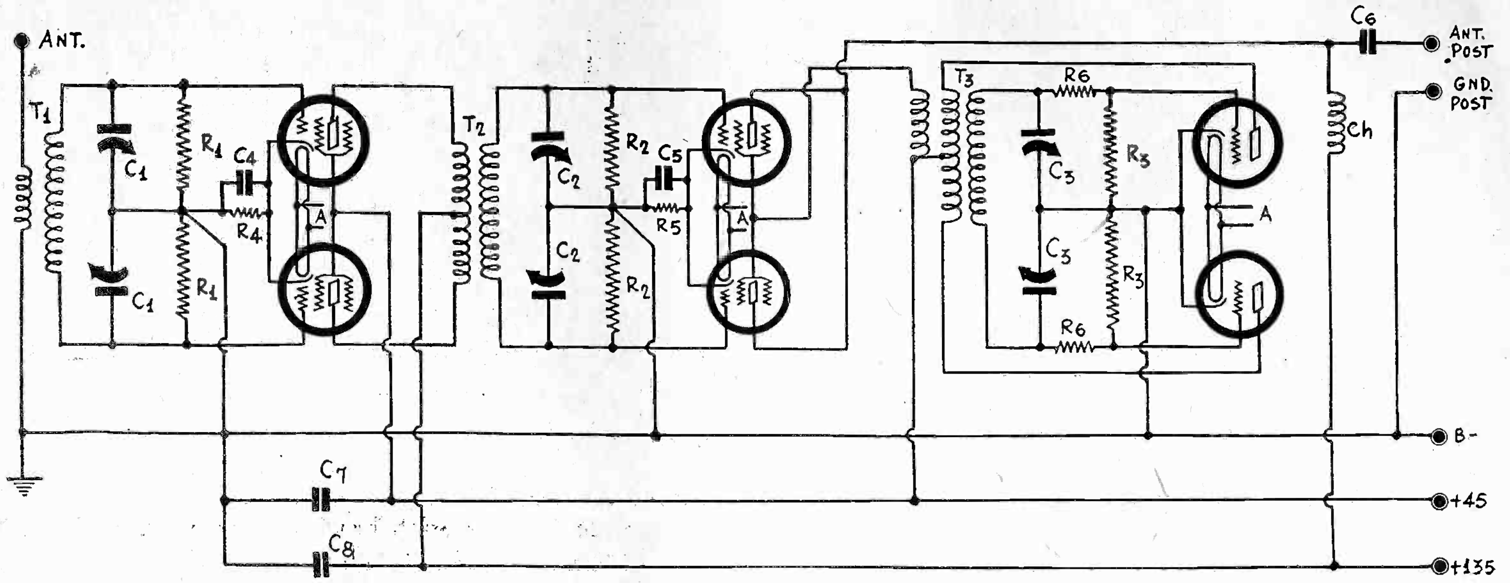


FIG. 1.
A symmetrical short wave converter in which noi se in the power supply and even order harmonics are suppressed.

[*A short-wave converter, exceptionally quiet in operation, using push-pull, has given excellent results to its designer and constructor, R. J. Hersman, Molton Hotel, Birmingham, Ala. The symmetrical electrical aspects constitute an important contribution to short-wave reception, he feels, because noise always has been troublesome, and here is a means of reducing it considerably. Mr. Hersman submitted his circuit, which is given diagrammatically herewith in substantially the same form.*—EDITOR.]

IT IS well known that many short wave receivers and converters are noisy. Not only do they intensify noises inherent in all amplifier circuits but they also amplify external noises to a great degree. Many of these noises can either be eliminated or greatly reduced by employing push-pull, or symmetrical, circuits. A symmetrical circuit is divided into two parts with respect to ground in such a manner that one of them appears like a mirror image of the other in respect to ground. Any voltage existing in one side at any point is represented by an equal voltage, but in opposite direction, at the corresponding point in the other side of the circuit. Thus if at a certain instant the grid of one stage is five volts positive the grid of the other tube in the same stage is five volts negative, both measured with respect to ground, or to the point of symmetry. The currents are also similarly related. If the current in one tube is increasing at a certain rate at a given instant, it is decreasing at the same rate in the other tube of the same stage.

Noises Balanced Out

A push-pull or symmetrical amplifier or oscillator is characterized by the fact that the generation of even harmonics is prevented. Since more than half of the total distortion is contained in the even harmonics more than half the distortion is suppressed. This is the chief advantage of a push-pull audio frequency amplifier. In a radio frequency amplifier the elimination of the distortion is not so important except that it does reduce noises in the output, particularly noises of the heterodyne type.

Another fact about a push-pull circuit is that variations in the power supply are suppressed. Any disturbance in the power supply is impressed on the two tubes in phase. If the disturbance is a momentary increase in voltage the voltage on the two tubes is increased by the same amount. But this increase is not reflected in the output, at least not as a first order effect. That is, the change may result in a small change in the output but not a change of the same order of magnitude as the signal. The effect is very clearly brought out when the plate voltage contains a strong hum. If the stage contains only one tube, the hum is amplified and reaches the loudspeaker, but if it contains two tubes in a symmetrical circuit no hum is evident. It is balanced out by the push-pull circuit.

It does not matter what the nature of the disturbance may be. If it is a radio frequency signal, or a noise, or a slow fluctuation in the voltage, it is bucked out in the symmetrical amplifier. Therefore if the supply voltage contains noise, which it usually does, the noise will not reach the loudspeaker if the circuit is push-pull. This, no doubt, is the chief reason why a symmetrical amplifier is relatively free of noise as compared with a single sided amplifier.

Modulator Not Push-Pull

Not only may the amplifier be push-pull but also the oscillator. Even harmonics will not be generated because although they may be contained in the tickler winding they will not appear in the secondary or tuned winding because they will induce equal and opposite voltages therein. Likewise, any disturbances in the power supply will not result in any modulation of the generated voltage. Therefore if an unmodulated voltage is impressed on the detector the output of that detector will be relatively free of the noise. It is a fact that if the oscillator contains noise or any other modulation, that noise or modulation will be turned over to the modulator and the output signal will contain it.

Although the detector or modulator in a converter or super-

LIST OF PARTS

Coils

T1—One r-f transformer or set of such transformers.

T2—One r-f transformer with centertapped primary, or set of transformers.

T3—One oscillator transformer, or set, with centertapped tickler and pick-up.

Condensers

C1,C1, C2,C2, C3,C3—Six 350 mmfd. tuning condensers (the first four may be ganged).

C4—One 0.01 mfd. condenser.

C5, C7, C8—Three 0.1 mfd. condensers.

C6—One 0.001 mfd. condenser (not needed if a transformer is used for Ch).

Resistors

R1,R1, R2,R2, R3,R3—Six 100,000 ohm grid leaks (each pair should be accurately matched).

R6,R6—Two exactly equal 5,000 ohm resistors.

R4—One 150 ohm bias resistor.

R5—One 15,000 ohm resistor.

Other Requirements

Seven binding posts or the equivalent.

Four grid clips.

Six five-prong sockets.

One subpanel.

t-Wave Noise; t of Circuit Boosts Improvement

Krissen

heterodyne may contain two tubes connected in push-pull on the input side, it is not possible to connect them in that manner on the output side. If the signal voltage available for the modulator is divided equally but in opposite directions between the two tubes in the circuit, the detected output of the two tubes will be in the same phase. This is detection or rectification. But the outputs of the two tubes will be added and averaged. As to absolute magnitude of the output, we get about the same whether we use one tube or two in push-pull on the input side, but we get less distortion out of two tubes, assuming equal voltage across the entire tuned input circuit.

Condensers in Series

In Fig. 1 we have a converter circuit that is symmetrical up to the grids of the modulator stage and in the oscillator. For such a circuit we need many more parts. Thus in the first tuner we need two equal tuning condensers C1, connected in series and grounded at the common or connected rotors. Likewise we need two equal grid leaks R1. Similarly we need two equal condensers C2 in the input of the modulator and two equal condensers C3 in the oscillator. Other equal pairs are the two grid leaks R2 in the modulator, two resistors R6 in the oscillators, and two equal grid leaks R3 in the oscillator.

In Fig. 1 the two screens of the modulator are connected together and the lead from them is run to a pick-up coil coupled to the oscillator. Likewise the two plates are connected together and run to a choke Ch and a stopping condenser C6. It is clear that the voltage induced in the pick-up coil is impressed in such a manner as to change the effective screen voltage on the modulator tubes. From what has been said about variations in the power supply we might conclude that there is no pick-up and hence no modulation. But it will be remembered that there is a second order effect. The detected component is of this order, and in particular the detected component of the signal is due to the second harmonic generated in the plate circuit of the modulator. Therefore, even though the pick-up voltage is impressed on the two modulator tubes in phase, it results in an output. If it were not for the pick-up voltage the output of the two detector tubes would be pulsating current, the pulsations occurring at a rate twice the frequency of the signal voltage. When this is modulated there is also a fluctuation in these pulses which would constitute ordinary detection. But when the screen voltage is varied by the voltage in the pick-up coil, there is imposed an additional variation in the output, and this will occur at a rate depending on the difference in frequency between the signal and oscillator voltages. In other words, an intermediate frequency will be generated. There is no symmetry in the plate circuit of the two modulator tubes.

Intermediate Output Votage

A voltage will build up at the intermediate frequency across the choke coil Ch, which should have a value suitable to the particular intermediate frequency used, and this voltage may be impressed on an intermediate frequency amplifier, or on a radio frequency receiver in case the circuit is a converter.

It is true that a voltage as the signal frequency, or twice that frequency will also build up across the choke coil. This may be prevented by connecting a condenser across the choke, a condenser such that it will have a low impedance at the high frequency and a high impedance at the intermediate frequency. A better arrangement is to tune the coil to the intermediate frequency. Instead of using Ch and C6 as output coupler we can substitute an intermediate frequency transformer, either one with tuned primary or one with both windings tuned. Such an arrangement will increase the detecting efficiency of the modulator. It is recommended if the circuit be tried that this type of output coupler be used in preference to the choke and condenser method. Suitable coils can be had in many different frequencies, such as 175 kc, 400 kc, 465 kc, and 1,600 kc.

Exact design constants of this circuit are not available, but a few suggestions may help those who care to attempt building the circuit to find out its superiority over a single sided converter. Only the coils need special attention and they are described below.

Pointers on Coils

Since the tuning condensers are 350 mmfd. and since they are connected in series, the effective tuning capacity in each circuit is 175 mmfd. Hence the coils must be designed for this capacity. This applies to the tuned windings of all the coils.

The first coil has only two plain windings just as any other r-f transformer. However, the primary should be wound near the middle of the tuned winding and directly over it. The ground end of the primary winding should terminate at the center of the secondary.

The primary of T2 should contain a tap at the center point, and the winding should be disposed in such a way that the center is directly over the center of the secondary. That is, it should be over that point of the secondary which is effectively grounded. The center turn of this winding is grounded in effect though not actually.

The tickler on T3 should be disposed exactly the same way as the primary of T2, or the tap on the tickler should be over the center turn of the tuned winding. The pick-up winding on the oscillator should be put over the tickler and near the center of the coil. The number of turns cannot be given without first specifying the intermediate frequency and frequency range to be covered. For an experimental circuit it is of little importance. It should be stated, however, that the primary of T2 should contain twice as many turns as if it were to be used in only one plate circuit. The same applies to the tickler, and the total tickler may contain about 2/3 as many turns as the tuned winding. The pick-up about 1/10 as many turns as the tuning winding.

Designer Reports Results

"The push-pull oscillator works exceedingly well," said R. J. Hersman, designer of the circuit.

"It seems to me that the push-pull oscillator is the solution to the noise problem as relating to local interference. I have tried half a dozen commercial converters and they are great noise machines, especially if connected to a sensitive set at a high intermediate frequency. Anyone who tries out my circuit, especially including the push-pull oscillator, with a really sensitive broadcast receiver, will think that the combination is dead, there is such quietness. With the r-f, detector and oscillator properly tuned you hear a slight rushing noise and if you hit a station you hear the carrier without the whistles and screeches.

"I do not advise using a broadcast receiver with a short-wave converter unless the receiver has at least three screen grid tubes, and if a superheterodyne, two stages of intermediate with tuned grid, tuned plate.

"The push-pull circuit is not a cure-all for static, in general, but for circuit noises and such local static as emanates from electrical machines.

Use of Oscillator Dial Alone

"I use an intermediate frequency near the frequency of WBZ, Springfield, Mass. (990 kc.). If a broadcast receiver has plenty of pep the volume is so loud when the converter is worked that the volume control has to be retarded. Then you reach a satisfactory level for reception, and also get rid of such noise as the receiver might contribute, especially as most volume controls cut down the sensitivity as well as the input. I have adjusted my receiver to tune in Rome on 25 meters at satisfactory volume, and by turning only the oscillator condenser, very slowly, I have brought in W8XK, Pittsburgh, 24 meters, 5GSW, Chelmsford, Eng., 25 meters, and several code stations, all at satisfactory volume.

"The same thing happened on 49 and 31 meters. The first station I brought in, using the push-pull oscillator, was within one point on the dial of W1XAZ, Springfield, Mass. The station was broadcasting voice and instrumental music, all German, and announced the time as 'Acht und halb,' which is 8:30. I looked at my watch. The time was 2:30 p.m. So I figured the station to be Koenigswusterhausen, on 31 meters. No local noise was heard.

Sensitivity Comparison

"Users will find that r-f and detector are not too sharp, but that the oscillator is sharp, depending on how sharp the receiver itself is. The converter will bring in VK2ME, Sydney, Australia, at 2 a.m. Sunday with volume set at satisfactory noise level for 49 meter stations in the United States. American, Central American, Canadian, Cuban and South American stations come in like tuning in regular broadcasting stations of from 5,000 to 50,000 watts at distances of from 500 to 1,500 miles. In other words, W9XAA, Chicago, 500 watts, comes in, day or night, at Richmond, Va., with volume comparable to WENR, Chicago, 50,000 watts, at 8 p.m. 12-RO, Rome, 25 meters, 3 to 5 p.m., comes in with volume comparable to WSM, Nashville, Tenn., 5,000 watts, 600 miles from Richmond, 9 p.m."

A Combination Receiver: 110 Vo

Battery-(

By J. E.

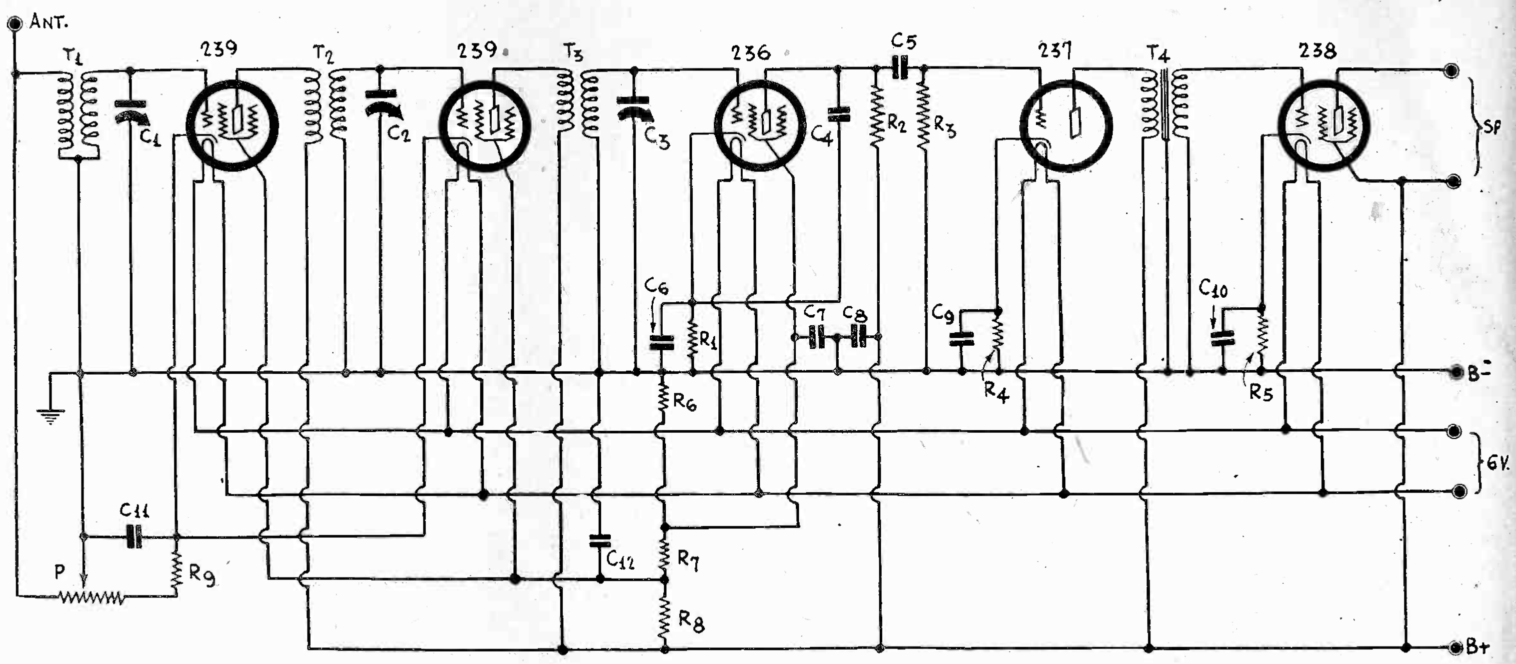


FIG. 1

The circuit of a five-tube t-r-f receiver suitable for use either as a portable or a home receiver. Six-volt heater tubes are used throughout.

REQUESTS have been made that we publish a t-r-f receiver that can be used either as a portable or as an a-c receiver at home. It is comparatively easy to comply with these requests provided by portable we mean a set that can be operated with a storage battery so that we can use automobile type tubes.

A portable receiver really should be built with the smallest tubes available, so that the power requirements will be consistent with the demands of portability. But these tubes are of the filament type and therefore cannot be used on alternating current. Hence we have to select automobile type tubes, for these are the smallest indirectly heated tubes available.

The receiver should be designed so that the B supply may be either a power pack or a battery and so that the filaments may be heated with either direct or alternating current. A circuit of the type shown in Fig. 1 meets the requirements. It will be noticed that the heater circuit is entirely independent of the receiver circuit proper. Thus we can impress either alternating or direct voltage across the 6 volt terminals of the heater circuit.

LIST OF PARTS
(Fig. 1)

Coils

T1, T2, T3—Three shielded midget r-f tuning coils for 350 mmfd. condensers.
T4—One audio frequency coupling transformer, ratio about 1-to-3.5.

Condensers

C1, C2, C3—One gang of three 350 mmfd. tuning condensers.
C4—One 0.00025 mfd. condenser.
C5—One 0.1 mfd. condenser.
C6—One 0.25 mfd. condenser.
C7, C11, C12—Three 0.1 mfd. condensers in one case.
C8—One 4 mfd. bypass condenser, or larger.
C9—One 0.5 mfd. condenser.
C10—One mfd. bypass condenser.

Resistors

P—One 10,000 ohm potentiometer.
R1—One 30,000 ohm resistor.
R2—One 250,000 ohm resistor.
R3—One 1 megohm grid leak.
R4, R5—Two 1,200 ohm resistors.
R 6—One 2,000 ohm resistor.
R7—One 16,000 ohm resistor.
R8—One 5,000 ohm resistor.

Other Requirements

Four grid clips.
Five UY (five-prong) sockets.
Seven binding posts.
One double pole, single throw switch (not shown).

Hum From Heater Circuit

When alternating current is used on the filaments there will naturally be a certain amount of hum carried over to the signal circuit, just as there is in any a-c operated receiver. To minimize this we can use exactly the same expedient as we use in ordinary a-c receiver, namely, balance the filament circuit with respect to ground by means of a center-tapped transformer winding or by means of a center-tapped resistance connected across this winding. In either case the center would be connected to the grounded sides of the signal circuit.

Since this center-tap device is not needed when the circuit is operated with a storage battery, it is not necessary to put the center-tap in the receiver but rather on the transformer, which is a part of the B supply.

Most of the bypass condensers are needed in both cases, and for that reason they are shown in Fig. 1. When a battery is used, C8, the condenser across the entire battery, need not be very large, but when a power pack is used it should be at least 4 mfd. Hence a condenser of this capacity can be built into the circuit as shown in Fig. 1. If any additional capacity is desired when a power pack is used, it can be connected in that device. In Fig. 2 is a circuit of a power pack that is suitable. The last bypass condenser is omitted because it is included in the receiver.

Design of B Supply

The B supply circuit, shown in Fig. 2, should supply enough voltage and current, not only to operate the receiver, but also the field of a dynamite speaker. Since most present day power transformers deliver a greater voltage than is needed by the receiver we can, if we use one of these, put the field coil in series with the supply and use it as one of the filter chokes. There is a dynamic speaker which takes a voltage of about 100 volts, with a current of about 40 milliamperes. If the field of one of

s A-C for Home Use, perated Portable for Trips in Car

nderson

these is connected as the second choke, and if we adjust the current so that the total current through the filter is 40 milliamperes, the B supply should deliver a voltage of 100 volts in excess of the voltage required by the tubes in the receiver. Since the maximum voltage required by any of the tubes in the set is 135 volts, the output voltage of the rectifier should be 235 volts. Of course both higher and lower voltages may be used, but this value should be used as a basis of adjustment. No harm results if the current through the field is considerably higher than 40 milliamperes.

In case the tubes in the receiver do not draw enough current for the speaker field, it may always be increased by putting a shunt resistance between B plus and B minus, on the B supply rather than on the receiver. The same effect could be obtained by selecting suitable values for resistances in the voltage divided, but if we make these resistances low to obtain sufficient current, the drain will be too high when we use the receiver on dry cell batteries. Hence we design the voltage divider so that the total current will be small when the receiver is powered with batteries and then use the shunt across the line to make the current sufficient for the field when we use the power pack.

Speaker for Battery Operation

It is because of current economy that only one 238 power tube is used in the receiver. This saving is not needed when the power pack is used but it is very desirable when a battery is used. With a good speaker sufficient undistorted output can be obtained with a single tube.

When the set is used on B batteries we cannot use a dynamic speaker, since we have no current for energizing the field. It would be too heavy a drain on the battery to connect the field across that. However, if we have a good sized storage battery for the filament supply, we could use a speaker with a 6 volt field, the type used in automobile receivers. But even this is not advisable unless we have a ready means of recharging the battery, for example, the generator in an automobile.

We have several types of speaker that can be used which do not require any field current. We can, for example, use an ordinary magnetic speaker. There are some available which are quite sensitive. Again, we can use an inductor dynamic, which is just one form of magnetic. Again, we can use a permanent magnet dynamic speaker, sometimes known as the moving coil magnetic speaker. This type is often used with portable sets.

Special Power Transformer

The power transformer required for the power pack is not standard, for there are few transformers available having a 6 volt winding, nor many having a 7.5 volt winding that will deliver the necessary current and at the same time have the other necessary voltages. But a suitable transformer can always be obtained from a transformer manufacturer. It may cost a few cents more than a stock transformer, but that extra cost is small compared with the cost of an extra set.

Anybody who is handy and has a power transformer otherwise suitable can easily change one of the windings to give the proper voltage. Suppose there is a 2.5 volt winding on the transformer. This winding is undoubtedly on the outside so that it can easily be removed. In taking off the turns count them. Then using the same size wire, or a somewhat smaller size, put on another winding having more turns. The number of turns to put on is determined from the number of turns removed and from the original voltage and the desired voltage. If the desired voltage is 6.5 volts and the original voltage was 2.5 volts, the turns should be increased in the ratio of 6.5/2.5 or 2.6 times. Thus, if 30 turns are removed, 78 turns should be put back on. For center tap either bring out a lead from the middle turn or use the center-tapped resistance method of getting at the center of the winding.

Since a 280 rectifier tube should be used in the power pack, one of the windings should give 5 volts. This does not have to be center-tapped, but if it has a tap it should be used.

On-Off Switch

The necessary chokes and condensers in the power pack are indicated on the drawing in Fig. 2. In case there is no center-tap on the 6 volt winding and a resistor is used instead, it should have about 20 ohms on each side of the tap connected to B minus.

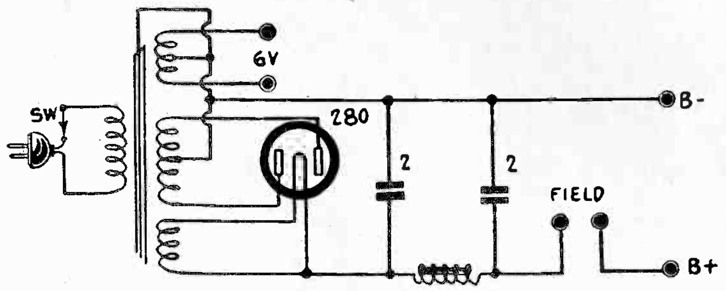


FIG. 2
A circuit of an A, B, and field supply for the circuit in Fig. 1 when it is used on a 110 volt a-c line.

When the circuit is used with the power pack the entire set can be turned on and off with the line switch Sw in the primary of the power transformer. When it is powered with a storage battery and a dry cell battery, it is necessary to use two switches, both of which can be operated with one control. One of these switches should be in the filament circuit and the other in the high voltage circuit. The reason for the necessity of two switches is that if one were not placed in the high voltage circuit the voltage divider would continue to draw on the B battery even after the tubes had been turned off. Small single throw, double pole switches suitable for this purpose are standard and easily available.

The Receiver

The receiver employs a straightforward t-r-f circuit that has been tried in many successful receivers. There are two radio frequency amplifiers, both 239 pentodes and three tuned circuits, all controlled with the same dial. The detector is a grid biased 236 working into a resistance coupler. The detector is followed by a 237 audio tube and this in turn is followed by a 238 power tube.

The three r-f transformers T1, T2 and T3 are of the midget type wound for 350 mmfd. tuning condensers. The diameter of the form is one inch and each tuned winding contains 127 turns of No. 31 enameled wire. The shield can over each coil is 2.125 by 2.5 inches and may be had either in aluminum or zinc. The primaries may be had in almost any number of turns, ranging from 25 to 90. The smaller number is preferable when a fairly good antenna is available. This applies to a portable as well as a home receiver because a portable can always be provided with an adequate antenna. In case the set is to be used in an automobile the larger number of turns should be used. But in that case the selectivity will not be satisfactory when used in the home on a regular antenna. Of course it is always possible to use a very short antenna.

Controlling the Volume

The volume is controlled by the method employed in most modern sets, that is, by a combination of bias control and input voltage control. It is recommended that the resistance of the volume control potentiometer P be made 10,000 ohms so that its resistance will not unduly reduce the selectivity of the first tuned circuit. A 5,000 ohm potentiometer does this to a marked degree.

A limiting resistance R9 of 150 ohms is used in the common

(Continued on next page)

LIST OF PARTS

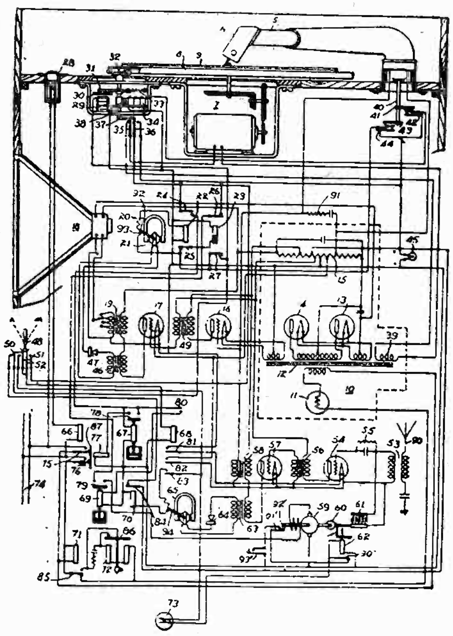
(Fig. 2)

One power transformer, 350 volts each side center high voltage winding, one 5 volt winding, and one 6 volt winding.
One 30 henry choke coil.
One four-prong socket.
One line switch.
Two 2 mfd. bypass condensers.
Six binding posts.

(*Continued from preceding page*)
nection with a broadcast receiver, including a mounting panel, a vacuum detector tube mounted exteriorly adjacent to one end of said panel, a removable inductance unit containing secondary and tickler coils also mounted exteriorly of the panel in closely spaced relation with the vaccuum tube, a condenser grid leak unit mounted upon the reverse side of the panel in closely connected relation intermediate the tube and inductance mountings, a choke coil located in intimate relation with the tube mounting, whereby said elements form a closely associated group, a tuning condenser and a regeneration control condenser located on the reverse side of the panel in distantly spaced relation with said group of elements, and control knobs for said condensers located on the face of the panel in closely spaced relation with the margin of the panel whereby the operator's hands, when operating such knobs, will be positioned beyond the limit of the set with only his fingers overhanging the panel.

* * *

1,852,878. RADIO APPARATUS. John E. Gardner, Chicago, Ill., assignor to Grigsby-Grunow Company, Chicago, Ill., a Corporation of Illinois. Filed Aug. 17, 1926. Serial No. 129,717. 3 Claims. (Cl. 250—20.)

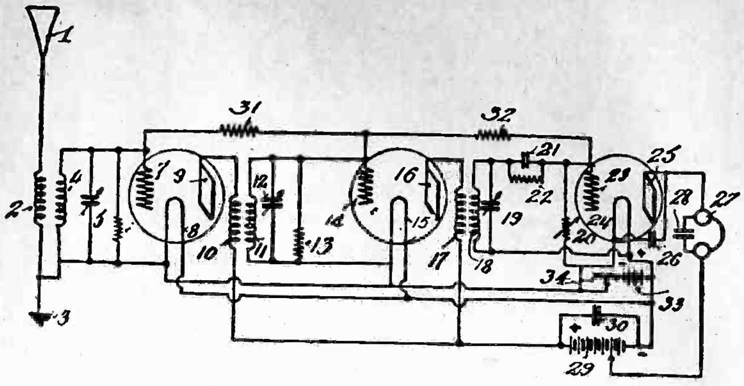


3. In a radio system, a receiving apparatus, a source of operating current for said apparatus, a switch for connecting said source to said apparatus, a magnet for operating said switch, and means responsive to the cessation of broadcast signals for energizing said magnet to operate the switch.

* * *

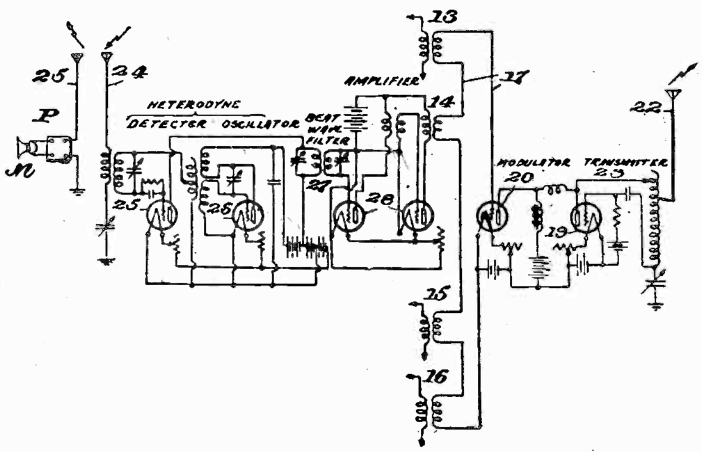
1,850,110. RADIO CIRCUIT. Wolff Kaufman, Paterson, N. J., assignor to Samuel E. Darby, Jr., Palisade, N. J. Filed Mar. 5, 1927. Serial No. 172,999. 8 Claims. (Cl. 250—20.)

1. In a radio receiving system the combination with a plurality of three electrode audions each including a grid, plate and filament, an input circuit for each audion including grid and filament and an output circuit for each audion including plate and filament, of a series connection between each grid including resistances only.



* * *

1,851,495. RADIO BROADCAST DISTRIBUTION. Edward E. Clement, Washington, D. C., assignor to Edward F. Colladay, Washington, D. C. Filed Aug. 5, 1927. Serial No. 210,911. 2 Claims. (Cl. 250—15.)



1. Apparatus for multiplex relaying of radio signals comprising a plurality of separate frequency changing receivers, each including a separate tuned collector circuit, an oscillator and a tuned first detector circuit, the frequency of said oscillator being adjustable to produce a constant frequency beat from high frequency waves received a common collecting circuit, a separate filter coupler tuned to the beat frequency of its own receiver, and connecting each receiver with said collecting circuit, a high frequency generating, modulating and radiating apparatus connected with said collecting circuit, whereby a plurality of separately received signals may be relayed as multiple modulations upon a single carrier wave.

Answers to Patent Questions

"Patent Applied For"

DOES THE STATEMENT "Patent Applied For" on a manufactured article afford some measure of protection?—F. M. Frank, Jacksonville, Fla.

Yes, although the statutory marking has to do only with the issued patent. However, "Patent Applied For" should always be put on articles made and sold under a pending application for its restraining effect on competition as well as for the advertising prestige which it gives the article.

* * *

Employer's Rights

MY EMPLOYER insists I must assign my patent to him on the ground that it was developed on his time and the patent filed at his expense. The patent is outside his business and has since proven of great value and I wonder if the law requires me to do this.—G. G., Harrisburg, Penna.

No. The employer may obtain from you only a shop right or license to use the invention, unless there has been previous specific understandings.

* * *

Improvement Patent

WHERE ONE obtains a patent for an improvement on any machine would the owner of the patent covering the improvement have the right to buy the patented machine in the open market, attach his patented improvement and resell it?—F. H. W., Jonesboro, Ark.

Yes. As long as you buy the article in the open market you have paid for the right to use it and in effect have a license for that one article under any patent covering it. You can therefore add safely any improvements of your own and resell it. However, if I were you, I would first be sure that there are patents which cover the machine you would have to buy in the open market, as sometimes the claims of the patent do not read upon the article as marketed and therefore the patent does not cover it, or other considerations arise.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, Radio World, 145 West 45th Street, New York, N. Y.

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E. L. Santos & Co., Att. E. L. Santos, Importers and Exporters, 7-11 Water Street, New York, N. Y.
C. A. Marschak, 2325 Beale Ave., Altoona, Pa.
Frank A. Koehler, 166 Glen St., Brooklyn, N. Y.
Fred A. Roslyn, c/o Plymouth Theatre, Worcester, Mass.
William Banks, R. R. No. 1, Whipple Rd., Canton, Ohio.
Jos. F. Monahan, 6756 Irving Ave., Chicago, Ill.
H. C. Lares, Handley, W. Va.
Lloyd Aulinson, (Radio tubes) 310 N. Clairmont Ave., Winston-Salem, No. Car.
Robert C. Hollatz, 822 Meinecke Ave., Milwaukee, Wisc.
Boyd McCoy, Box 96, Lafayette, La.
Stanley B. Szafranski, 2012 W. Roger St., South Bend, Ind.
R. Nockin, 1423-2nd St., Santa Monica, Calif.
Dr. C. S. Neeley (short wave sets and parts) 86½ Howell St., Hillsdale, Mich.
Larry Feiereisen, R. E., The Radio Shop, 2029 East Fifth Street, Superior, Wisc.
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Alex Kaval, 841 W. 33rd St., Chicago, Ill.

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Split Anode Oscillators

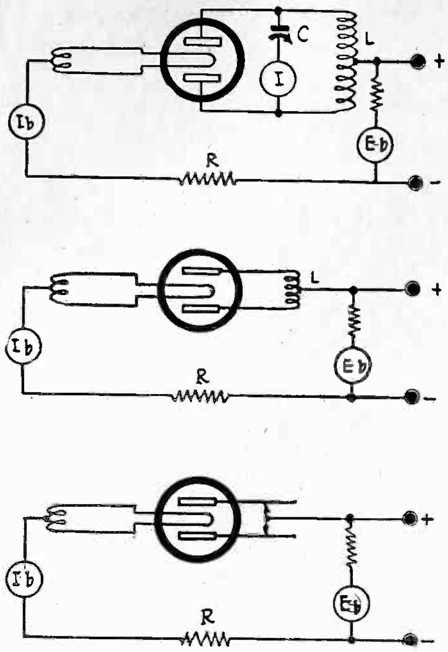

FIG. 1002
Three ultra-high frequency oscillators utilizing a split anode tube to generate oscillation.

WILL YOU kindly publish a few circuits capable of generating extremely short waves?—F. W. R., La Crosse, Wis.

One short wave circuit was published in the April 16th issue of RALIO WORLD. This circuit will go down to a few meters using an ordinary three-element tube. You will find the circuit on page eight and a picture of the oscillator on the front cover. To reach still shorter waves you may make use of the split anode tube in one of the connections illustrated in Fig. 1, 002. Of the three circuits the third is capable of generating the highest frequency and the first the lowest. In all three cases the frequency is higher than that obtainable with an ordinary oscillator incorporating a three-element tube.

* * *

Metal and Short Waves

PLEASE LET ME KNOW whether it is contrary to rules to use a metal chassis for a short-wave receiver, especially as frequencies to 30,000 kc (10 meters) are to be tuned in—K. O. F., St. Paul, Minn.

No. Several commercial models of converters and receivers use steel for the chassis, and respond well. An ultra frequency oscillator was built in our laboratories on an aluminum chassis, with coil 1.5 inches away from the chassis top, and oscillation was excellent at all dial positions.

* * *

Needs New Tubes

I HAVE AN OLD a-c Atwater-Kent set. The tubes in it have not been changed in three years, except that I did get a new rectifier (280) about a year and a half ago, and put in a 171 output tube that was not, however, new. Gradually the volume has been declining. The plate current in the power tube reads 12 ma, and I understand it should be around 20 ma.—J. F. D., Fresno, Calif.

Obviously you should treat yourself to a new set of tubes. The rectifier emission probably is quite low, which would result in a lower plate voltage on all tubes than originally intended, and also would cause all plates to give low current readings. Gradual decline of sensitivity is characteristic of tube deterioration. Many letters such as yours are received, showing that many persons are asking entirely too much in tube life. Tubes are very low-priced now and there is every indication that soon there will be an upward revision of tube prices, so act now.

* * *

Brevity This Time

THANK YOU for printing an article April 16th on the simplification of padding. It helped me considerably. However,, without intending to kid you at all, I would like a short, concise statement of how to pad the oscillator in a 175 kc superheterodyne, so I could memorize the brief explanation.—M. V. E., Portland, Me.

Your letter does sound something like the old joke, revamped to read: "Thanks for the careful explanation about padding. There is only one thing I'd like to ask you, if I may. Just how would one go about padding?" However, don't memorize yet, and be assured that we are very glad to print a concise explanation again. Now start memorizing. Work the receiver as a t-r-f set. This requires connecting the control grid coil terminal of the first detector instead to the same position of the second detector, removing the intermediate coil connection from second detector. Establish the two extreme tuning points, 1,500 kc and 550 kc, or as near thereto as possible. Use broadcasting stations if you must. An oscillator is preferable. Restore to a superheterodyne. Then line up the intermediate channel at 175 kc with an oscillator. Set the oscillator parallel trimming condenser at position of about half its capacity. Turn to the setting for the low frequency test (550 kc) and adjust the series padding condenser in the oscillator circuit until response is loudest. Then turn to the high frequency setting and adjust the parallel trimmers across first detector and r-f tuning condensers for lineup, but do not touch the oscillator trimming or padding condenser.

* * *

Converter Tracking

IN TRYING to design a short-wave converter for the manual and mental exercise its gives me, and the joy I expect to get out of short-wave reception, I am using a two-gang condenser. But I find that the oscillator outruns the modulator, therefore padding seems necessary. Please state how this should be done. I have no great experience in these matters nor have I any oscillators at hand.—T. R., Roanoke, Va.

It is better not to try to pad so many circuits, if you are inexperienced. Padding one is not hard, even for a novice. Padding five might prove an ordeal. Besides, there is an easy way out. Assuming that you use regulation capacity, say 0.00014 mfd., in each gang section, put a variable trimmer across the modulator of the same capacity. In that way you may use two identical secondary coils for the oscillator, for any one band, don't have to figure out inductance, etc., or do any padding, and will not be annoyed by the manual trimmer, because except on very weak signals it does not tune sharply, not for high frequencies need it be changed much in capacity, but left at or near minimum. For 1.25 inch diameter the secondary to bring you into the top (frequency) of the broadcast band may consist of 50 turns of No. 28 enamel wire on 1 inch diameter. The condenser would produce a frequency ratio of about 2.3-to-1, so the other coils might have 20 turns of No. 24 enamel, 9 turns of No. 18 enamel and 4 turns of No. 18 enamel.

* * *

Audio Transformer Ratio

REGARDING the four-tube battery-operated short-wave receiver to work a speaker, described and illustrated in the April 9th and 16th issues, with full-scale pictorial diagram April 16th, can you tell me whether it is imperative to have any given ratio for the two audio transformers?—Y. T., Miami Beach, Fla.

No. You may use any ratio from 2.5-to-1 to 5-to-1. More volume is to be expected the higher the ratio, within these limits, although the difference is not such as to justify you buying higher ratio transformers if those you have are at least 2.5-to-1.

* * *

Checking Calibrated Oscillator

I HAVE REASON to think that the calibration of my oscillator, which tunes from 100 to 200 kc. has changed. Can you suggest any method of checking it against broadcast stations of known frequency?—W. H. C., Boise, Idaho.

There is a very simple way of checking the calibration, by beating harmonics of the oscillator against broadcast stations. If you tune in a broadcast station of known frequency and then couple the oscillator to the receiver, the harmonics of the calibrated oscillator will be against the fundamental of the broadcast frequency tuned in. Suppose, for example, that you tune in a 600 kc. frequency. Turn the calibrated oscillator dial until you hear a squeal and then set at zero beat. Note the frequency on the calibration chart. It should be 200, 150, 120, or 100 kc. You should get a check at any one of these settings of the calibrated oscillator, or at all of them. If you get a check at all you are reasonably sure that the calibration has not changed. If it has, you also get a measure of the amount of change. To make a thorough check you can select some other broadcast station and check with that at as many points as possible. You might, for example, check at 700 kc. With this you should get zero beat at 175, 140, 116.6, and 100 kc. For any other broadcast frequency divide that frequency by 2, 3, 4, 5, and so on, and there should be a zero beat for every frequency thus obtained lying within range of the calibrated oscillator.

(*Continued on next page*)

(From preceding page)

Looking for a Portable

I AM LOOKING for a five-tube portable receiver using the two-volt tubes. The set should use two 234, two 230, and one 233 tube. Batteries should be used for A, B and C voltages. If you have a circuit of this type will you kindly publish it in your Q. and A. columns?—F. W. J., Pueblo, Colo.

In Fig. 1,003 you will find a circuit like this, which has been designed for a portable set. One improvement may be effected by connecting the antenna to the slider of the 10,000 ohm potentiometer P and making the ground connection to one end. The tuning coils are standard, shielded t-r-f midget coils for 350 mmfd. tuning condensers. The grid leak, the stopping condenser, and the bypass condenser in the plate circuit of the detector have the usual values of 0.00025 mfd., 2 megohms, and 0.0005 mfd., respectively. The condensers across the voltage supplies should be about one microfarad each. If the tubes specified in the question are used and the filament battery voltage is 3 volts, the value of R2 should be two ohms. In case a headset is to be used it may be connected temporarily where shown. The filament current will be about 0.5 ampere. Therefore if dry cells are used, there should be at least two in parallel to get the necessary current capacity, and two in series to get the necessary voltage. It is more economical to use more than two in parallel.

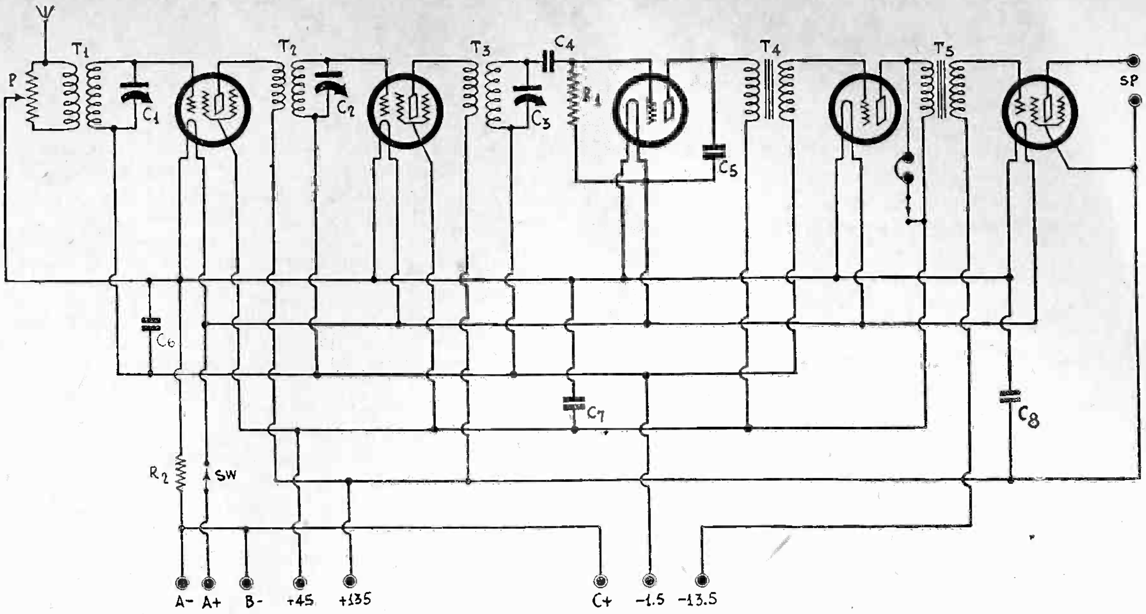

FIG. 1003

A five-tube portable receiver designed for 2-volt tubes and battery operation.

* * *

"Pistol Range" in Short-Wave Sets

CAN YOU TELL ME what are the cause and cure of crackling noises and seeming pistol cracks heard in a short-wave receiver? I would not ask if this trouble were experienced in one set only, but I have found the same trouble in various sets I have built.—H. W., Tuxedo, N. Y.

This is still a mystery. Many stunts have been tried to get rid of this nuisance. The usual alibi is that a short-wave set is noisy if it is sensitive, and is quiet if it is not sensitive, so which would you prefer? This, however, is only partly true, and is discussed from another angle in the answer to S. G., of Yonkers, N. Y. Some ground has been gained toward the solution of the problem. A large laboratory failed, nevertheless, in its efforts, which consisted of using heavy wire for the main inductance, and winding fine wire around it, at right angles, grounding the fine wire at every quarter turn of the thick wire. It is assumed, but not definitely known, that the interferences of which you complain is that caused by the shot effect of tubes, which is an irregularity of cathode emission. All circuits that have oscillation, and all short-wave designs include oscillation or regeneration, should have a leak and condenser, even in such part, though the bias is maintained negative. The condenser may connect from socket grid to tuning coil and stator joint, and be 0.00025 mfd. to 0.0001 mfd. The leak may be from grid of socket to grid return, and should be 0.1 meg., unless it modulates at the high frequencies, whereupon use 0.05 meg. (50,000 ohms). Oscillators with grounded plate circuit are in general quiter than those using other types. The modified Hartley oscillator described last week and shown in another form this week (page 3) represents the grounded type of oscillator. One reader, R. J. Heisman, Molton Hotel, Birmingham, Ala., reports that he had much trouble with noise with all short-wave converters when worked with sensitive broadcast receivers until he used a push-pull osclIator, and then he was amazed at the quietness, though sensitivity was undiminished. Forms of frequency stabilization or voltage stabilization tend to reduce the noise resulting from irregularity of emission.

* * *

Seeks Radio Career

I DO NOT KNOW anything about radio, but have a fair understanding of direct current electricity and low frequency a-c. Do you think it advisable for me to study to be an operator or repair man, and can this be done at home? I am twenty-three.—K. H., Orange, N. J.

It is entirely feasible to obtain a good knowledge of radio at home. For particulars address R. C. A. Institutes, Inc., 75 Varick Street, New York City.

* * *

Making a Simple Audio Oscillator

WILL YOU KINDLY explain how to construct a simple audio oscillator that will generate a single frequency? This oscillator is to be used for modulating a radio frequency oscillator which I already have. If possible I should like to construct my own coil.—G. H. B., New York, N. Y.

Take two honeycomb coils such as are used in 175 kc. intermediate frequency transformers. Mount them on a soft iron core of the same size and shape as the wooden core on which they are usually mounted but put them close together. Connect them in series aiding. Connect a small condenser across the two coils and connect as in Fig. 1A, page 3, April 9th issue of RADIO WORLD, the cathode going to the junction of the two coils. C5, the grid condenser, may be 0.1 mfd. and the grid leak R2 100,000 ohms. Connect 45 volts or more between the plate and ground. The condenser C4 across the two coils should be increased or decreased until the frequency desired is obtained.

* * *

Noise in Short Wave Converters

THE NOISE in a short wave converter that I built is terrific just as soon as I try to get any distance. I have been able to pick-up many remote stations but the noise is so great that they are not pleasant to listen to. Can you suggest the cause of the noise and a remedy?—S. G., Yonkers, N. Y.

Some of the noise is undoubtedly due to circuit noises, the amplification necessary to get the distant stations being so great as to bring out all the noise. When this is the case everything should be done to increase the signal pick-up so that the tubes will not have to amplify so much to bring the signals in. Much of this may be done by tuning the r-f stage to the signal frequency desired. Another cause of noise is overloading of the detector by the oscillator. Reduce the coupling between the two tubes. Any set becomes noisy when the amplification is too great and this is especially the case when there is an oscillator in the circuit. If the signal voltage on the mixer is very weak in comparison with the oscillator voltage on the same tube, circuit noises are greater than when the two voltages entering the mixer are about the same.

* * *

Coil Data for Shiepe's Oscillator

YOU PRINTED an article by E. M. Shiepe in your March 26th, 1932, issue in which you stated that the coil data for the oscillator would be forthcoming. If you are now ready to supply these data will you please do so?—P. E. W., Detroit, Mich.

This modulated-unmodulated oscillator, neon tube supplying modulation, B supply built in, wave changing by switching, uses a special 360-degree condenser, and a dial that rotates throughout the full circle. The condenser has a capacity of about 10 to 375 mmfd., but other capacities bring the total maximum to about 400 mmfd. maximum. For 2" diameter.

Inductance in Microhenries	*Lowest Frequency in Kilocycles*	*Number of Turns*	*Kind of Wire*
2,800	150	260	No. 28 enamel
325	450	85	No. 24 enamel
36	1,350	20.5	No. 18 enamel
3.9	4,050	7	No. 18 enamel
.43	12,140	2.3	No. 18 enamel

Each of the windings is center-tapped, the cathode of the oscillator tube connected to the tap. There will be a sufficient frequency overlap, as a frequency ratio of 1-to-3 is assured, though actually it is a little greater.

* * *

Cost of a Search

WHAT IS the cost of making a patentability search on an idea to see if it is patentable?—L. N., Phoenix, Arizona.

$15.00. A description and sketch of your idea are required.

STATION SPARKS

By Alice Remsen

The Vaudevillian

"For Big Time"

WEAF, Wednesdays, 8:00 p. m.

To London, Leeds and Liverpool I wend
my joyous way;
To Kalamazoo and Timbuctoo I wander
while I may.
I board a train in Germany and wake up
in Paree.
Each and every ocean's a familiar to me.
I know the "Gate" in 'Frisco; I know the
"Loop" in Chi;
I know Vienna's "Prater" and London's
dear old "Cri."
The boulevards of Paris sound to my
weary feet,
And in the Cafe de la Paix I have my
special seat.

I hang my drops in Palaces, in Queens
and Empires swell;
I pack my props in Orpheums, in Bijou
Dreams as well.
I dress in R-K-O towns—room, bath and
velvet chairs;
I dress down in the cellar, or up six
flights of stairs.
I play them all, both big and small, in-
cluding "tanks and sticks."
I know a lot about the game, I'm up to
all the tricks.
I "Sprechen Deutsch" and "Parlez vous"
enough to get me by,
In our profession one soon learns to use
both ear and eye.

I eat my breakfast on a train, or in a one-
armed chair;
I eat my dinner at the Greek's, my night
lunch—Lord knows where!
I open on a Sunday when baggage fails
to come;
I play split weeks and one-night stands,
and sometimes lay-off some.
For I'm an Internationalist, I play in
vaudeville,
I roam the byways of the world, I know
them all—but still—
It's great to go home now and then, to
shake pals by the hand,
And breathe the air of childhood days
in one's own motherland.

—A. R.

* * *

And if you want to get into the atmosphere of vaudeville tune in on the Stanco program "Big Time," Wednesdays at 8:00 p.m., WEAF, and listen to the joys and sorrows of Johnny Hart, vaudeville artist. as played by Jack Arthur. Johnny is a naive, lovable character; and Mr. Arthur plays it well, and without too much exaggeration. The dialogue is well written. The author must know vaudeville, as it is very true to life. Tune in; you will enjoy it.

* * *

Ralph Colucchio, the Swell Guitarist heard on the Bourjois Evening in Paris program, does not complain of depression. Ralph is heard no fewer than twenty-six times weekly over the air—twelve times with the Prince Albert quarter hour, four times with Singing Sam; three times with Lucky Strike, three Sweetheart programs, and one each with Evening in Paris, R-K-O, Chase & Sanborn and Blue Coal. Outside of that Ralph doesn't do a thing except obtain the autographs of radio stars for his banjo head. His right name, by the way, is Raffaele Giusseppi Colucchio; you guessed it—he's Italian—and a fine musician and a nice chap.

Another Radio Act, Georgia Burns and Gracie Allen, in addition to weekly radio appearance with Guy Lombardo's orchestra, makes five vaudeville appearances daily. On Monday evenings, the act broadcasts from the Columbia studios, then make a mad dash in order to return to the theatre in time for the final appearance of the evening. So as to lose no time, Gracie eats a sandwich between fun-making over the strains of Guy's musicians and George is busy seeking his coat and hat and is putting them on during the last lines of comedy. Then you should see them streak out of the studio to the elevator, which is always obligingly waiting for them.

* * *

Ann Leaf, Nicknamed "Little Organ Annie," has composed another opus, "Blue Hours." Ann also wrote the theme song used on her programs, "Song of the Midnight."

* * *

If You Have Enjoyed Tom Terris, famous world traveler, in his movie shorts, "The Vagabond Director," you will be interested to know that you may now hear him over Station WOR, every Sunday evening at 9:30, EST. He is supported by a cast of six, including John Barclay, well-known radio actor and baritone. The program is sponsored by the U. S. Steamship Lines.

* * *

Wee Willie Robyn, well known to radio listeners through his years of singing on the Major Bowes Capitol program, has succeeded Jack Arthur as the "hero" on "Footlight Echoes," a WOR feature. Jack has gone commercial on another program.

* * *

In Addition to His Appearances Over the NBC Network, John L. Fogarty, that sweet-voiced Irish minstrel, will be heard on the Sweetheart program over WOR every Thursday at 9:45 a.m.

* * *

Marcella Shields, Walter Scanlon and Billy Murray are another NBC act to do a weekly program over WOR, Friday at 8:30 p.m. The entertainment consists of comedy dialogue and songs, with Roger Bower doing his famous master-of-ceremonies bit.

* * *

Florenz Ziegfeld Is Bringing Plenty Of "Names" to Radio, but even he is not showman enough to realize the obnoxiousness of planted advertising, and that the use of Patricia for advertising purposes was the height of bad taste.

* * *

Milton Rettenberg's Beautiful Wife recently celebrated their fourth wedding anniversary by attending five of Milton's radio programs. Of course, there was a supper-dance afterwards.

* * *

Among the Most Prized Possessions of Pancho, Columbia's South American orchestra leader, are a watch given to him by Rudolph Valentino and a ukelele autographed by the Prince of Wales.

* * *

Sidelights

BRAD BROWNE and TED HUSING constituted the original announcing staff of WABC when it became the key station of the Columbia network . . . MARIA CARDINALE may now be heard on two Sunday programs—Golden Blossoms over WJZ at 7:00 p. m. and Footlight Echoes over WOR at 10:30 p. m. . . . And now MR. and MRS. PETER DIXON have received over two hundred calendars, because in a recent episode of "Raising Junior," Ken Lee, (played by Peter) complained that there wasn't a calendar in the house. . . . MILDRED BAILEY has a passion for jade . . . JACK FULTON walks two miles every morning before he eats his breakfast (when on earth time does that boy get up?) . . . WALTER WINCHELL, EDDIE CANTOR and GEORGIE JESSEL are natural born leaders. They all began their careers as ushers in an uptown theatre in New York City. . . . JACK DENNY was born in Greencastle, Indiana. . . . ANDY SANELLA is an enthusiastic aviator and organizer of the famous Albatross Club at Roosevelt Field. . . . LEE SIMS likes to run a speed boat. . . . BABY ROSE MARIE won her first prize for singing when she was two years old. . . . WILLARD AMISON made his first public appearance as a singer when he was twelve years old before a mass meeting of two thousand people. . . . SINGIN' SAM recently celebrated the second anniversary of his entry into radio. . . . DON VOORHEES went to school in Allentown, Pa. . . . MAX SMOLEN, conductor of the Evening in Paris orchestra, conducted many New York theatre orchestras before he went into radio. . . . VERNA OSBORNE, soprano of the Moonbeams trio, has a beautiful new car.

* * *

BiographicalBrevities

A FEW FACTS ABOUT PLAYBOY BROKENSHIRE

Like many other people, I was very pleased to hear that Norman Brokenshire was back on the air again. To my mind he is one of the announcerial aces of the air, possessing an unctuous style particularly his own, with a suave and gracious personality that registers marvelously over the air.

Norman was born at Murcheson, Ontario, Canada, on March 10th, 1898. His father was a minister and school teacher; and as a boy, young Norman walked three miles each morning to fire a furnace in the little Canadian schoolhouse. His early ambitions wavered around fur trappers, mounted policemen and ski-jumpers. Unable to make up his mind he became almost everything else. His father's calling took him to Cambridge, Mass., and then Hallowell, Maine, where Norman turned the parsonage shed into a printshop. He did a good business, too, running two other printeries out of work.

The World War broke up the family and Norman got a job as a gumshoe inspector in a Maine footwear factory, detecting nails that stuck up inside the shoes. The job gave him calloused fingers, so he quit to go to Boston and advance his schooling. He had many jobs after that—a man's chauffeur one day, his private secretary the next, and eventually a famous master of ceremonies—which happened thus: Norman came to New York with an air reduction company, but he craved expansion, so he read want ads every Sunday and answered a plea for an announcer. It was at the old "Broadcast Central." Four hundred others answered it, but Norman was bowed in as one of "radio's original four horsemen"; he has been bowing ever since as the bending gracious gentleman of radio, the eternal Sir Walter Raleigh, and has made himself famous for his ad libbing in the studio and at many notable events on the Atlantic seaboard.

He may now be heard announcing the Chesterfield program over WABC, every Monday, Tuesday, Thursday and Friday, at 10:30 p. m.; and Wednesdays and Saturdays at 10:00 p. m.; and on Society's Playboy program, Wednesdays at 10:30 p. m. EST. Tune in and you will be greeted by Norman's famous "How do you do, ladies and gentlemen, How DO you DO!"

A THOUGHT FOR THE WEEK

WHAT A GREAT SUMMER this is going to be for radio! There's that big world championship fight in June—and millions will want the best there is in radio for this event; and not a bad tube will be tolerated. Then there are the coming conventions of the two big political parties, preceded by talks by the leaders of both sides and followed by an election that is going to be fought hard and strenuously! In addition, the big broadcasting chains are making unusually comprehensive plans for reporting baseball and other major sports. No, indeed; there'll be no letup in interest in radio during the months which formerly were given over to static and its twin sister, uncertainty.

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The First and Only National Radio Weekly
Eleventh Year

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Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor; J. Murray Barron, advertising manager

March of Events

By HERMAN BERNARD

THE hardest task in program building is to supply humor, as is evident from the failures. When persons listen day after day to the "comedy" without ever once risking a laugh, you must naturally suspect the "comedy," and not the listeners, who have been known to laugh on occasion.

The air is full of puns, and that is about as far as most humor goes. The exceptions are notable and one does not readily forget them. It is very hard to keep fun going day after day. If one may cull from the flowers of a quarter of a century of entertainment, as Florenz Ziegfeld is doing in a current Sunday night feature, the modest demand, thirty minutes a week, and the abundant supply, twenty-five years, pave the way to readier results. And then there is Ziegfeld, with an entire show business he has built around himself.

The daily grind entertainers are handicapped, but puns followed by razzing mouth noises or an orchestral discord do not accomplish much. No one probably laughs at the puns quite so much as the punsters themselves.

It is hard to be funny. Some who succeed in the daily press can't make a go of it on the air. Humor that has to be seen to be appreciated won't do if it can be heard only.

The rising level of entertainment value in radio programs is due only to the entrance of stage and screen artists, producers, musicians and the rest of the gay company that makes the show business. In fact, radio, talkies and stage are all show business. The idea that radio is something quite different is disproved by the success that the trained and gifted showmen make of their air productions, contrasted with the outcome of dabblers' efforts.

How long would a comedy run in a theatre if the jokesters ran on night after night before a laughless audience?

Many listeners must think that an advertiser who allows the lowest form of humor to predominate his radio program probably also lends an ear to inferiority in his factory.

But now there is Ziegfeld to show them all how it may be done in the grand style. Will Rogers recently said that all other musical comedies were imitations of Ziegfeld shows, and if all other air offerings of the revue type are imitations of the current Chrysler program, who could complain?

* * *

THE midget set has come in for some abuse from the trade. The complaint is that there is a very small margin in it. Not only is the price low to start with, but competition is such that dealers have altered their otherwise fixed policies to move midget sets at the only prices customers are willing to pay. The request now is that the manufacturers concentrate more on console models. However, the dealers should not forget that they will not sell what they can not sell and that trying to convince the manufacturers to flaunt economic requirements will not change the situation, except to cost the manufacturers some money they can ill afford. Trade conferences do not decide the public mind.

* * *

THE trade is anxious about television, as it sees therein the possibility of a boom. Television is one of the rare examples of the public actually asking for something before it is ready for them. However, in a larger sense, the public always does that. The need for the cotton gin existed before the fact of the gin was made known by Whitney, its inventor. Kerosene lamps were nuisances, although necessary, and after the first skepticism was over the electric lamp of Edison was found to be just what the public needed and wanted. However, television has been disclosed in its experimental form, the public has had its peep and asks for more.

Just now television is interesting principally experimenters. Those who build their own sets are the lookers of today. There isn't much of entertainment value to be viewed, but enough to engage the experimenter's fancy, and delight him as he watches improved results of his own handiwork.

Television as a commercial entity, however, is not here yet, and nobody knows just when it will be here. A good scanning system is necessary, but this has been accomplished by some. Greater illumination from neon lamps is also needed, and there is much room for improvement, so that pictures projected on a large screen, say 5x6 feet, will not be too diffuse, as they are now. Then there should be good television sets, with greater sensitivity than the run of today's receivers. As important as anything else is the necessity for programs of high entertainment value. Radio itself started with poor programs and poor sets, but has risen to superb accomplishments. So television, off to a poor start, but better now than it was even six months ago, may be expected to rise to a position of prominence and wide public acceptance. The results obtainable now do not interest the layman, and until the layman is interested the expected boom will not mature.

Better Results on Short Waves

RADIO has always been like a diver trying to find bottom. The earliest broadcast receivers reminded one of an expedition of exploration. Finally the industry settled on a tuned radio frequency design which came to be almost standard, some of the sets, however, embodying neutralization, while a few superheterodyne models were being marketed. Then receivers became very generally supers.

So, in the short-wave field, after many experimental trials, the diver is at last getting somewhere near rock bottom. The new models of short-wave converters and receivers (with broadcast range included in the receivers) work much better than their predecessors, and may be the big claims made for last year's crop will apply to next year's with better fitness.

It is most encouraging to find the short-wave designs of both home and factory construction so much better. Once it was considered a suitable subject for boasting if one got European stations now and again. These days a fellow tunes in other continents and never says much, if anything, about it. When overseas reception becomes casual, short-wave reception is where all of us want it to be, in the field of dependable service.

"Minority" Circuits

A RESPONSIVE public has met enthusiastically the series of articles published in these columns on direct current line-operated receivers. This type of set, like the battery-operated receiver, usually comes in for little attention, although there are many thousands of families in this country that must use batteries or line d-c. Because the greatest public is that which has use for a-c receivers, this type gets the most publicity, and while we would like to print still more about battery-operated and d-c line-operated receivers, we can not too sharply upset the economic proportion.

However, those interested in the two classes that may be termed special receivers at least know that attention is being paid to their wants, and it must be confessed that letters from readers have prompted the publication of two or three more such circuits than would have appeared otherwise. So the letter is still an effective instrument, and if readers will write in, telling what they would like to see published, in the way of circuits, every effort will be made to comply with their requests.

More Small Firms

THERE are more radio concerns now than there were a year ago. Responsible employes let out by larger concerns formed smaller ones. They also had certain advantages, in that they could fill small orders at a profit, and by operating in limited geographical areas cut down distribution costs and expedite deliveries, two valuable improvements. Also the smaller concerns had no tremendous overhead, no large inventories, and could concentrate on accounts that did not dally too long in making payments. Thus we have among us a large number of small concerns, some of which no doubt will grow into large ones, and perhaps become serious competitors of the firms from which they became detached.

Big business is not the only business there is in the United States.

BRITISH PORTABLE SOLD HERE

J. M. McGuire & Co., 1476 Broadway, who specialize in portable radio sets, are now offering the British Reese-Mace Portable. Everything is self-contained. The case looks like luggage. The Ansley a-c and d-c universal receiver is handled.

NEW AMATEUR BANDS REDUCE FORMER SPANS

Washington

As a first step toward what is believed to be an effort to confine the amateurs on the ultra frequencies the Federal Radio Commission has issued an order, now in effect, restricting amateur activities.

The so-called 80-meter band has been curtailed. Where formerly it extended 500 kc it is now confined to 100 kc. The former band was 3,500 to 4,000 kc (85.66 to 74.96 meters) and the present confinement is to 3,900 to 4,000 kc (76.88 to 74.96 meters). Also the 20-meter band has been halved, so that at present it is 14,150 to 14,250 kc (21.18 to 21.04 meters). For both the 20-meter and 80-meter bands, restricted to telephony, special licenses are required, based on extraordinary ability.

In the so-called 150-meter band the span has been halved, also, and the present confinement is to 1,875 to 2,000 kc (159.9 to 149.9 meters). This band, as well as the 56-60 megacycle band (5.354 to 4.997 meters) is unrestricted. The ultra frequency band is used for short distance telephony, but may be used for other purposes, including television and code transmission by amateurs, as may the 150-meter band.

The amateurs are expected to be restricted eventually to the ultra frequencies, with more bands in this region than the one at present allotted, as it is believed the lowest amateur band will be assigned to police.

The assignments to amateurs, starting with 300 meters, have been increased steadily in frequency, each increase accompanied by doubts of the reliability of the new span.

Station Changes

Changes in the list of stations by frequencies, made since the publication of the list in the March 26th issue, follow:

630 kc, WOS, Jefferson City, Mo. Change owner to Missouri State Marketing Bureau.

860 kc, KMO, change frequency to 1330 kc, and power to 250 w.

1010 kc, KGGF, new location, Coffeyville, Kans. (Instead of South Coffeyville, Okla.)

1010 kc, WORK, York, Pa., York Broadcasting Co. 1KW. New Station.

1120 kc, KRKD, new location, Los Angeles, Calif. (Instead of Inglewood, Calif.)

1200 kc, WABI. Change owner to Universalist Society of Bangor.

1130 kc, WJJD. Change owner to WJJD, Inc.

1310 kc, Delete WFDV. See 1500 kc below.

1310 kc, KRMD, Shreveport, La. Change owner to Radio Station KRMD, Inc.

1310 kc, WEBR, Buffalo, N. Y. Change power to 250W. (*) Max. day power.

1330 kc, Insert KMO, Tacoma, Wash. KMO, Inc. 250 w.

1360 kc, WCSC, Charleston, S. C. Change ownership to South Carolina B'dc'g Co., Inc.

1420 kc, KGKX, Sandpoint, Idaho. Change owner to Sandpoint B'dc'g Co.

1500 kc, WFDV, Rome Ga., Rome Broadcasting Corp., 100 w. Frequency changed from 1310 to 1500 kc.

Price Increase Expected on Tubes

The tube industry is preparing for some important changes. While tube factories are operating at much less than their capacity, they have been doing a considerable business without, in general, showing a profit. Dealers as well as field workers of the companies have reported the necessity for an upward revision of tube prices, and this is expected to be announced before the Fall season starts.

Also, it is said that some new a-c tubes will be announced, making the pentode available for radio frequency amplification, in a special tube design, as well as offering a companion general purpose tube and a mercury vapor rectifier not replacable in sockets intended for use of the —80 tube.

NEW SCHEDULE W2XAD, W2XAF

Schenectady, N. Y.

With the approach of Summer and the arrival of the daylight saving period, the operating schedule of WGY's short-wave stations is altered to give maximum service over a maximum area.

This year, as last, there will be an overlapping of schedules, that is, for one hour daily, 5 to 6 p. m., EST, both W2XAD and W2XAF will be on the air. The schedule follows:

W2XAD, 15,330 kc, or 19.56 meters, 3 p. m. to 6 p. m., EST, daily except Saturday and Sunday. On Saturdays and Sundays W2XAD will go on at 1 p. m. and remain until 6 p. m.

W2XAF, on 9,530 kc, 31.48 meters, daily from 5 p. m. to 11 p. m.

W2XAD, the day-time station, will use an antenna directed on Europe, and W2XAF's signals will be radiated by an antenna directed on South America.

The greater part of South America is passing through its Winter season, when daylight saving time becomes effective in North America. With the exception of western part of South America practically all the continent is in time zones from one to two hours later than Eastern Standard Time. All these factors complicate efforts to provide South American short-wave listeners with maximum service.

Buddy Rogers Welcomed by Whiteman and Vallee

Buddy Rogers, who turned from moving pictures to radio, is in full musical swing at the Hotel Pennsylvania, New York City, where his California Cavaliers broadcast each Monday, Wednesday and Saturday over an NBC-WEAF network.

Although a newcomer to broadcasting Rogers succeeds Rudy Vallee as director of the Pennsylvania's Grill Room orchestra.

Rogers was recently welcomed to radio in a special program during which Paul Whiteman spoke from New York and Rudy Vallee sang from Pittsburgh. Lew Conrad extended New England's welcome from Boston and Charlie Agnew's orchestra played from the Edgewater Beach Hotel in Chicago.

POLICE GROWTH TO SEND VISION TO ULTRA BAND

Washington.

Preliminary preparations are being made to accommodate an expected increase in the number of police departments using radio as a means of crime prevention and detection. At present there are about 70 police stations, including municipal and State police, and even marine police and fire activities, but at the existing rate of increase the number is expected to exceed 100 next year.

The present police transmitters are largely assigned to frequencies not far from those of the low frequency television band, and therefore it is expected that the television frequencies will be turned over to the police eventually for their alarm service, and that television will be assigned exclusively to the ultra frequencies.

"Plenty of Room" on Ultras

This intention was expressed informally at the Commission's office, and it was said that there may be some change in the assignments to amateurs, although not for quite a while. While no definite information was given, it is believed that the same general scheme as applying to television will be proffered in respect to the amateurs, because on the ultra frequencies "there is plenty of room."

That additional frequencies will be needed by police activities next year is taken for granted at the Commission's office, and the idea is shared by the International Association of Chiefs of Police which, at a convention, adopted a resolution asking for a greater number of frequencies for police work. The Board does not think such extra frequencies are needed now, as a system is in operation whereby land wire telephony warns of an impending police transmission, so that other police agencies sharing this wave, in the same area, will stand by until the announced transmission is completed.

The eight frequencies now assigned to municipal police work are 1,712, 2,414, 2,422, 2,430, 2,442, 2,450, 2,458 and 2,470 kc. State police use two other frequencies, 1,574 and 2,506 kc.

Television Announcements Soon

Power allowed is based on population. Where the population of the area served is less than 100,000 the power is limited to 50 watts. Up to 500 watts may be used if the population exceeds 700,000.

While large cities have adopted police radio, in general the smaller cities have been more progressive in this respect, excepting that Chicago was a forerunner in police radio work. New York City adopted police radio only a few months ago, while Baltimore, Md., 800,000, has no police radio yet.

Knowing what is the Commission's attitude, television stations are doing more work on the ultra frequencies. It is expected that soon the Columbia Broadcasting System will be in this region regularly. The National Broadcasting Company is experimenting almost exclusively on ultra frequencies. Short Wave and Television Corporation, of Boston, and DeForest Jenkins Company, of New Jersey, are expected soon to announce regular schedules on the ultra frequencies, with improved television transmission.