A Practical Neutrodyne Receiver

By ALLAN T. HANSCOM

This article explains the action of the neutrodyne circuit in a manner which can be grasped by the novice. Its formation is described stage by stage, followed by complete constructional details for the building of a receiver of this type.

It is unfortunate that so many good circuits are labeled with such formidable titles. The name "neutrodyne" is usually enough to scare the average radio fan. A neutrodyne circuit, as commercially developed, is, however, a great deal more simple to understand than the regenerative or reflex circuit.

The average fan is not interested in the higher mathematics of a circuit but he does like to know the size of the parts so that he can put one together to obtain results.

Fig. 1 represents a simple type of non-regenerative hook-up. By varying the condenser the natural wave-length of the set can be altered. This is exactly the diagram of the first stage of the neutrodyne.

In Fig. 2, another stage exactly like the first has been added. In this case the first tube acts as a radio frequency amplifier and the second tube as a detector.

It will be noticed that the plate circuit of the first tube is not tuned, but that the grid circuit of the second tube, as well as the grid circuit of the first tube, are both tuned and in reality make the two stage filter through which the incoming signal must pass.

Fig. 3 represents three stages exactly as outlined above and this is the scheme of the neutrodyne after we add the neutralizing condensers which will be considered later.

In Fig. 3, there are two stages of radio frequency amplification and the detector, each stage being tuned by a variable condenser in the grid circuit. This circuit would give wonderful results if it were not for the internal capacity coupling between the plate and the grid circuit of each radio frequency tube. This internal capacity is neutralized by the combination of capacity and inductance; the inductance being the windings of the air core radio frequency transformers R. The capacity necessary for the average vacuum tube is very small and is usually about equal to two circular plates \(\frac{34}{32}\)" in diameter separated by \(\frac{1}{32}\) of an inch. This is only approximate and the proper value may easily be found. Other types of condensers for this purpose are shown in Fig. 4.

The radio frequency transformers can be made by winding 80 turns of wire on 3" tubes with a tap taken off at the 20th turn. It is preferable to use cardboard because it is an advantage to have a close coupling between the coils and the primary, which is inserted inside. The primary consists of 20 turns of wire on a tube which will just clear the tube

Fig. 4

Several Ways of Making the Neutralizing Capacities.

at least 6" apart and at such an angle that a line drawn at right angles to the axis at the end of the winding does not intersect the winding of the adjoining transformer. See Fig. 6. Note the relative position of primary and secondary windings.

Neutralizing Condensers

Since the variable condensers used are connected between the grid and the filament, it is possible to connect the grid to the fixed plates and then mount the other small movable plate on the back insulated portion of the condenser. By this means a very small change of capacity can be made in the neutralizing circuit. See Fig. 7.

After the proper value of this capacity is found, it need never be disturbed unless tubes are changed. It is likewise advantageous to shield the set, although it is absolutely impossible to make this set oscillate if it is properly constructed.

To find the proper value of the neutralizing condensers it is necessary to tune the set to a very powerful signal. The Flewelling "screamer" makes an excellent oscillator for this case. A paper may be inserted in the socket to cover the filament connections but leaving the plate and the grid free. Then the tube is inserted and the signal is still heard.

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**Eliminating Interference**

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- sharply with the single and multiple turn switch of the tuner. This is in effect an air core transformer coupled amplifier and is equally effective over the entire range of the tuner. The resultant complete circuit is shown in Fig. 2.

**Adapted to Single Circuit Tuners**

For single circuit tuners the amplifier shown in Fig. 3 has proven very effective. As in the first case the output of the amplifier is connected to the input of the tuner. When a receiver such as an R.C. is used where the tuning elements are in one cabinet and the tubes in another, brasses connect the two. The post marked “G” in Fig. 3 connects to the post marked “Grid” on the tuner. When the tuner has no outside connections, such as in an Aerola Senior, a separate wire is run from the grid lead inside the tuner to “G.” On some sets it is necessary to remove the grid leak when it is connected around the grid condenser instead of to the filament.

This arrangement makes a tuned impedance coupling between the first two tubes and is shown below with the detector in Fig. 4.

It is not necessary to install this apparatus in a cabinet, as very excellent table mounted instruments are available. The parts used are:

1. Variometer
2. Potentiometer
3. Rheostat
4. Socket
5. .0025 M.F. Fixed Condenser
6. Amplifier Tube.

I feel confident that any reader who will spend the few dollars necessary to install either of the amplifiers will be well paid by the improvement in his set and I know will be blessed by his neighbors.

**A Practical Neutrodynne Receiver**

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- This is done for the first stage and second stage separately, adjusting each condenser until the signal is no longer heard. I have found it possible to adjust these condensers without going to this trouble by simply setting them at the greatest capacity which would not cause the set to go into an oscillating condition. The action of these condensers is similar to that of the potentiometer in the original radio frequency circuit with

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Constructional Details of the Primury and Secondary Coils of the Neutroformer

The exception of the fact that they need never be changed for different wave-lengths or signal strengths. The complete circuit of the neutroformer receiver is shown in Fig. 8.

If this set is constructed properly it will give results in clearness and sharpness which are superior to any other type of set which has come to my attention. The volume is not extremely loud but audio frequency can be added in the usual manner.

As seen, there are two stages of radio frequency amplification and a detector. The radio frequency transformers, unlike the iron core type, have untuned primary circuits and tuned secondary circuits. The tuning system likewise has an untuned antenna circuit and a tuned secondary circuit. All adjustments are made by the three variable condensers and maximum volume of any one signal will not be obtained until these three circuits are tuned to the same values. This should be kept in mind when operating a neutrodyne receiver. The simplest way for hunting stations on various wave-lengths is to start at zero on all dials and slowly work towards 180 degrees moving the right hand condenser dial a few degrees first, followed by a corresponding adjustment of the second and first dials. Keep progressing until a station is heard. At this point, a fine adjustment of all three dials will be necessary to obtain maximum volume.

If it is desired to add the regenerative feature to this receiver a variometer should be connected in series with the plate of the detector tube and the head-phones. This variometer will allow as well the placing of the detector circuit in an oscillating condition for the reception of C.W. signals and without a chance of re-radiation.

It Is Important That the Radio Frequency Transformers Be Mounted as Shown in the Above Illustration.

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Fig. 5

Fig. 6

Fig. 7

A Small Metal Plate Mounted as Shown Will Serve the Purpose as the Neutralizing Capacity.