Fan May Change Lowly Crystal Into Reflex or Regenerative

Receivers Using Variocoupler, Variable Condenser and Crystal Detector Offer Opportunity for Future Development.—How to Obtain Amplification

BY W. F. CROSBY.

Sooner of later, nearly every one interested in radio is going to try building a complete set. With some people such a set will be a marked success, while with others the chances are that the receiver will not come up to expectations. It is to the latter class that this article is addressed.

The most difficult part of the problem is to pick out a circuit which is adaptable to your particular needs. There are hundreds of different circuits, but close investigation will reveal the fact that many of them are simple adaptations of one or more of the five basic circuits. These are the crystal, the regenerative, the reflex, the tuned radio-frequency and the superheterodyne circuits.

Choose the simplest circuit of them all to begin with, unless you have access to friends who can help you out if you run into difficulty. If you know absolutely nothing about the construction of a radio set, by all means make your first effort either a crystal set or the simplest of one-tube sets.

Suppose, now, that we decide to start off with a simple crystal set using a vario-coupler, variable condenser and crystal detector. This is one of the highest developments of this kind of receiving equipment, and it offers the widest latitude in using these same parts in subsequent sets.

Of course, no batteries whatever are required and fairly good results are to be secured. If the set is operated correctly excellent tuning is to be had.

The circuit diagram appears in Figure 1. There are two courses open in improving this set. It may be made into either a reflex or regenerative receiver; in either case only one vacuum tube is used. If we decide on reflex, every part may be used and in addition we will need a vacuum tube, socket, rheostat, audio and radio frequency transformers and the necessary "A" and "B" batteries.

The radio-frequency transformer may be made and does not have to be purchased. This transformer is tuned by means of a .00035 mfd. variable condenser. The diagram for such a circuit appears in Figure 2. Much of the wiring remains the same.

On the other hand, if we decide to make a regerative set it will be necessary to purchase a variometer, tube, socket, rheostat, grid-leak and condenser and the necessary "A" and "B" batteries. This is the diagram shown in Figure 3.

This set is much harder to tune and most certainly will not give the results that the reflex set will. In the reflex set our tube is acting as both radio and audio frequency amplifier, while the crystal still performs its function of detecting.

In the regenerative set the tube acts as a detector only and no amplifiers are used. The crystal is eliminated. The regenerative set is slightly cheaper. Of course, the crystal is always a weak link in the chain, and unless a good one is used the set will never give satisfactory results, no matter how expensive the apparatus or how well the set is built.

Once the crystal set has been transformed into a tube set it may be amplified, either with further radio-frequency amplifiers or with the customary stages of audio.

One more stage of audio-frequency added to the reflex set will give it plenty of power for a loud speaker. It will take two additional stages to accomplish the same result with the regenerative set. Radio-frequency will be of great assistance on the reflex set, as it will strengthen the incoming signal, which may be too weak to actuate the detector.

This kind of amplification on the regenerative set may work satisfactorily in some cases, but the frequent result is a set which is extremely unstable and hard to tune. In many of the regenerative sets to which radio-frequency has been added, the regeneration control is kept at minimum most of the time and therefore might as well be dispensed with entirely.

It is quite possible, particularly with the reflex set, to eventually work such a circuit into either a four or five tube tuned radio-frequency receiver. In the reflex set we can use everything except the variocoupler and the .0005 mfd. variable condenser. Very little can be used from the regenerative set except the tube and socket, rheostat, batteries and the grid-leak and condenser. Of course, additional parts will be needed in either case.

As for the parts to use, it is, of course, almost impossible to enumerate the many different makes which will prove satisfactory. As may be expected, the better the quality of the parts the better the results on extreme long-distance work.

One of the best ways to build a set at the present time is to buy one of the many kits on the market. These may be secured for almost any kind of receiver from the simplest to the most intricate. Some of the tuned radio-frequency and neutrodyne sets, are particularly well adapted to the beginner's needs. If the latter type of set is used, care must be exercised to see that it is properly neutralized. If this is not the case, the set will howl and whistle even worse than an improperly operated regenerative set.

After the set is finished, bear in mind that you now have to learn to tune it. This subject is one which requires study and patience. Novices cannot master a set for several nights or even longer, depending on the particular outfit used.

Just as experience is required to operate an automobile successfully so is the same thing needed in operating a radio set. Take plenty of time in building the set and then observe such a procedure in learning to tune it and you will be successful.

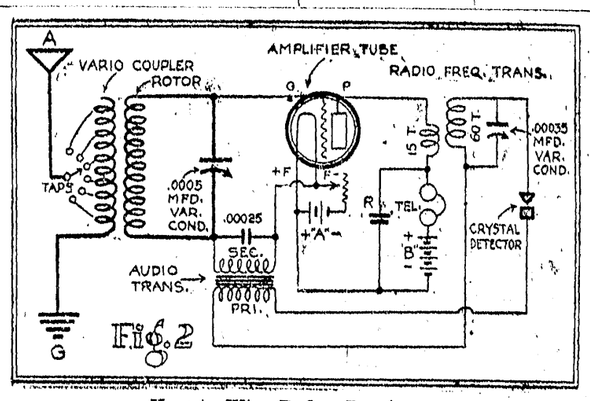


Fig. 2

How to Wire Reflex Receiver

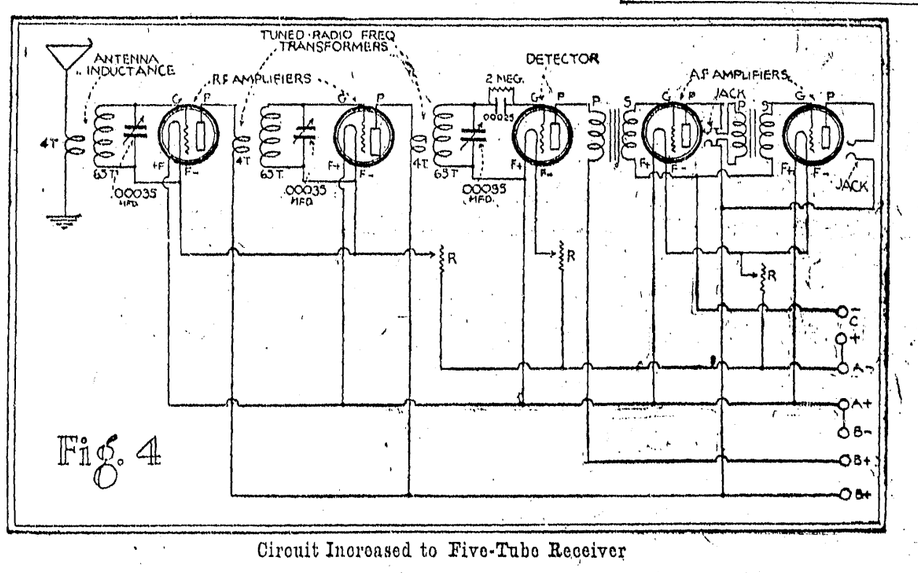


Fig. 4

Circuit Increased to Five-Tube Receiver

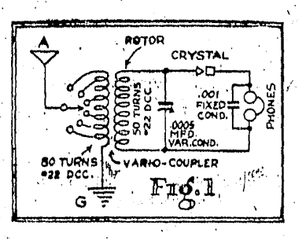


Fig. 1

Diagram of Crystal Set

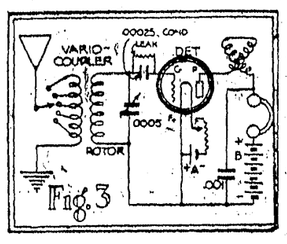
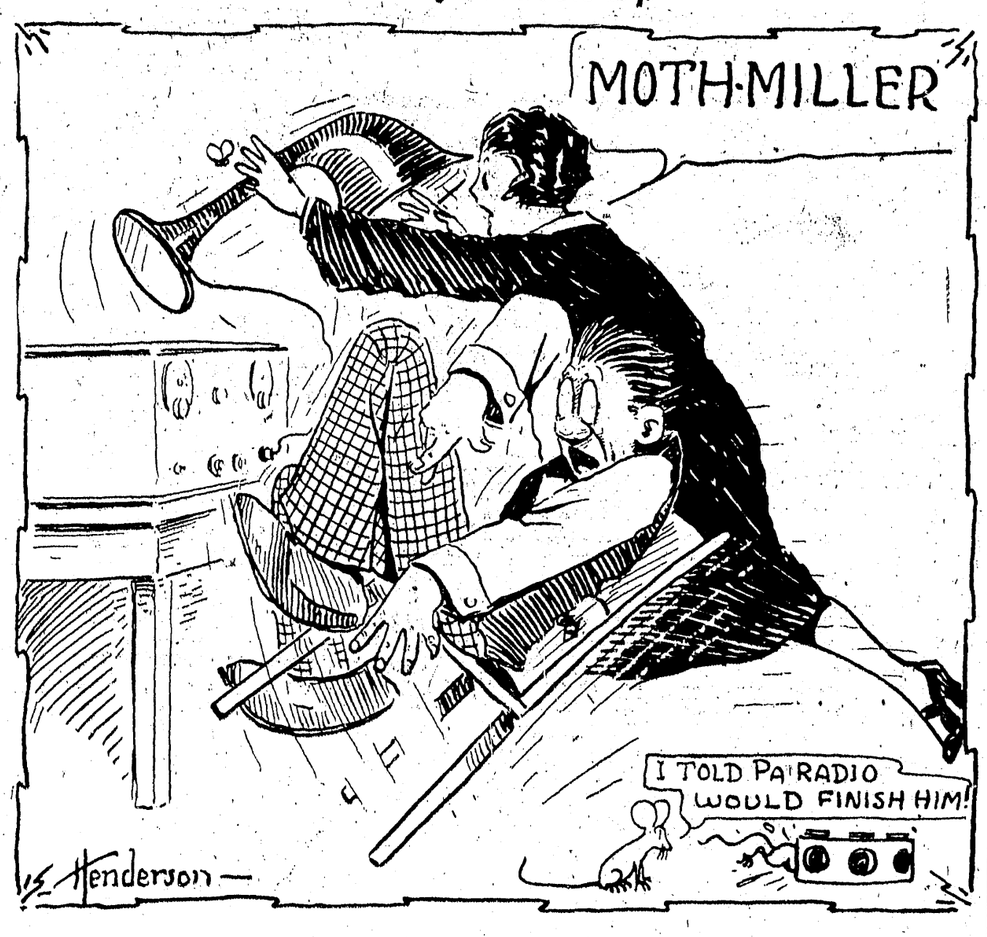


Fig. 3

Regenerative Hook-Up

To-day's Hook-Up



Inside Interference

Twelve Types of Receivers.

The following is a list of different kinds of receivers, with the most selective set at the top and the least selective at the bottom:

1. Superheterodyne with closely tuned intermediate amplifier.
2. Multiple-stage tuned radio frequency amplifier with regeneration and with double-tuned aerial-input circuit.
3. Multiple-stage tuned radio frequency amplifier with regeneration and single-tuned aerial-input circuit.
4. Multiple-stage tuned radio frequency amplifier without regeneration but with double-tuned aerial-input circuit.
5. Simple regenerator with double-tuned aerial-input circuit.
6. Multiple-stage tuned radio frequency amplifier without regeneration, with single-tuned aerial-input circuit.
7. Simple regenerator with single-tuned aerial-input circuit.
8. Multiple-stage untuned radio frequency amplifier with regeneration.
9. Non-regenerative audion detector with double-tuned aerial-input circuit.
10. Crystal detector with double-tuned aerial-input circuit.
11. Non-regenerative audion detector with single-tuned aerial-input circuit.
12. Crystal detector with single-tuned aerial-input circuit.

Dry Cell Battery Lore.

When dry cell tubes are used in a set the operator should take into account the ampere consumption and provide enough batteries so they will not run down prematurely. Not more than .123 amperes should be drained from an ordinary 6-volt dry cell. If a tube is used that consumes .25 amperes, use at least two dry batteries in parallel (i. e., connected plus to plus and minus to minus.) This will not increase the voltage; a 1½ volt tube will not get any more voltage from two batteries in parallel than it will from one and there is no danger of its burning out. Tubes that call for more voltage must, of course, have more batteries hooked up in series (i. e., plus to minus). The more tubes there are in a receiving set the more batteries should be hooked up in parallel, as the ampere drain is greater. The directions accompanying dry cell tubes should be read carefully and voltage and amperage requirements noted.

JOHN SMITH AND HIS RADIO SET

FROM RADIO TO AUDIO.

Smith is one of those rare persons who who always manages to take advantage of disadvantage. There are some nights when reception is not so good, or times when he doesn't like what he can get over the air, but instead of grumbling he recognizes the chance to learn something more about how the set works.

It was on one of these occasions that I happened to find him trying to trace the radio circuits from input to output. The various basic units of the set were becoming as familiar to him as the arrangement of engine, clutch, transmission and differential in his car. He had formed a definite mental picture of the order from aerial to tuner, to radio frequency amplifier tubes, to detector, to audio amplifier tubes and to loud speaker, but it was that changeover from radio to audio that still puzzled him.

"I don't blame you for being puzzled," I cheered him a bit. "There is probably no part of radio theory that is more carelessly explained than the change from radio to audio. I think you've got it pretty well fixed in your mind that the original sound variations or values are carried on electro-magnetic waves oscillating anywhere from 50,000 to 1,000,000 cyles per second, and you recognize this as alternating current, but from the talk you hear it is certainly difficult to know whether the current is alternating or direct after the detector tube has rectified it."

"That's just my problem," he admitted. "I can visualize the radio frequency—those high speed oscillations—reaching the grid of the detector tube. I can see the negative electrons being attracted across the gap to the plate of the tube, which is positively charged with the current from the B battery. I can clearly understand that this arrangement means that the current from the plate to the carphones can go only in one direction because it has been rectified by the tube. But then why do they talk about this rectified current as 'audio frequency?' I thought 'frequency' was the term used to define the number of cycles of any oscillation. And after the current is converted into the audio type it's supposed to go in just one direction!"

Here he pointed to contradictory statements which he had picked from various sources, which certainly left doubt as to just what did happen after the detector got through with the radio frequency form of the current.

"I've been puzzled over just the same point," I told Smith, "but I've finally got it straight from practical electricians. It's a pretty big story, and I guess there's much that has to be taken for granted, but it will ease you considerably to know that the current is no longer alternating after it has passed through the detector, whether you use a crystal for that purpose or a detector tube."

"Fine!" Smith exclaimed. "But then why speak of audio frequency when the current in audio form is not alternating? How can there be oscillations in direct current?"

"That's just where they confuse us," I explained. "You see, all electrical circuits are oscillations. It is the basis upon which radio stands. But the term is rather vaguely used. First they are using it to mean alternations, then to mean pulsations. This is confusing and unnecessary.

"Just picture the current coming in over the antenna as alternating current. Picture it changing its direction thousands of times a second. And regard it as a series of electrical oscillations. Now you have the term 'oscillations' in its most logical sense and you can figure that, used in other connections, it is often somewhat loosely employed. I'll give you an instance:

"On these oscillations of the current being sent out by the broadcasting station are impressed the audio frequencies or sound wave variations. After this current is picked up, amplified and changed by the detector tube to direct current the original oscillations disappear and the only characteristics that remain to influence the direct current are the original sound waves. This causes the direct current to pulsate. Instead of being constant it is really intermittent because it is being controlled by the radio frequency current. These pulsations are often loosely referred to as oscillations.

"An electrician I talked with suggested a simple way to think of this tricky part of radio. He says to consider radio frequency as referring to the number of cycles per second of the oscillations received by the set and to consider audio frequency as the number of cycles per second of pulsations which correspond to the sound waves and which, with the aid of the carphones, are audible to the ear. He said that in the changeover from radio to audio the alternating current merely loses one 'leg.' I thought that about sized it up."

"After losing a leg it can't move so swiftly, I suppose," Smith added, "and we then get a chance to catch the sounds and learn what's going on over the air."

Cushion the Set.

Use of four small air cushion feet, such are are used on typewriter machines, is an improvement to any set. Placing them under the receiving cabinet will stop undesired ringing noises from microphonic pickup action and also prevent audio sound feedback through the table carrying the set and the loud speaker. The cushion feet can be attached without the use of screws.