Reception on Ultra-Short Waves

Many Problems Overcome

By "CATHODE"

WE have now grown familiar with reception on the once-dreaded wavelengths round about 20 or 30 metres. In fact, the enthusiast who delights in facing and conquering difficulties finds little to interest him in reception on wavelengths which offer fewer troubles than did the broadcast band not very long ago.

To such as these we commend as fresh fields for endeavour the wavelengths between 5 and 15 metres. One can feel tolerably certain of inducing a receiver to work on these wavelengths but to obtain really successful results will provide the enthusiast with many hours of interesting experiment. It is almost unnecessary to stress the benefit to the community generally likely to result from increased knowledge regarding these ultra-short waves; every experimenter helps to increase the sum total of this knowledge.

The one great feature which seems to render certain the ultimate commercial use of wavelengths of 10 metres or less is their consistency. Every short-wave listener has had experience of the variation in signal strength experienced on the 20 and 40-metre bands. A station may be heard one night and not the next; it may be heard during day time and not at night; it may even fade right out of audibility in ten minutes or so. This sort of thing is interesting but annoying. To maintain day and night communication entails changing the transmission wavelength from time to time to suit varying conditions.

The reason for these variations in audibility on short waves is now fairly generally understood. The tremendous range of a small short-wave transmitter under favourable conditions is due to the existence of a stratum in the upper atmosphere in a condition of ionisation. This stratum, known as the Heaviside layer, is more or less impervious to wavelengths of the order of 15-100 metres, and reflects them earthward. Thus the audibility of signals depends on the relation between transmitter, Heaviside layer, and receiver.

Were the height and density of the Heaviside layer constant, no difficulties would be encountered in regard to fading. In practice, however, these things are in a state of constant change, varying from hour to hour, and particularly as between daylight and dark. Thus any degree of reliability in communication on these wavelengths is rather difficult to obtain.

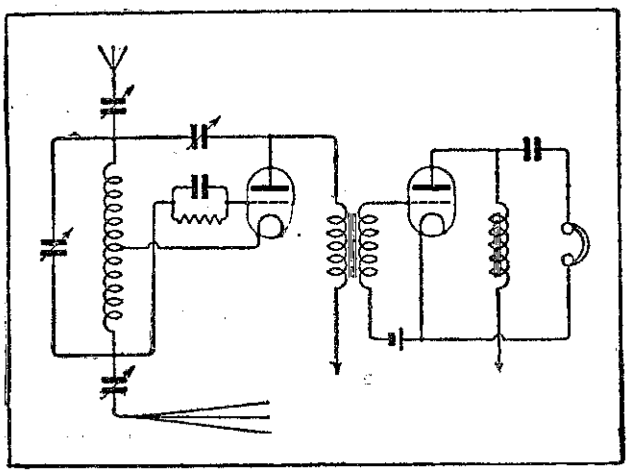

Fig. 1.
Circuit diagram of a two-valve short-wave receiver using a centre-tapped input coil capacity-coupled to aerial and counterpoise.

Wavelengths of the order of 10 metres and less possess very high powers of penetration. That is to say, instead of being reflected earthward by the Heaviside layer, they show a tendency to pierce it and lose themselves in the vastness of space.

At first sight this would seem almost to rule them out as a means of long-distance communication. Yet, in fact, very great distances have been covered with these short-wavelengths, even in their present stage of development. It has been suggested that wavelengths of this order "hug" the earth's surface, either as a result of refraction by a condition of ionisation existing in the lower atmosphere, or as a result of certain magnetic effects exerted by the earth itself. It is highly necessary that as much data as possible regarding these wavelengths should be brought to assist the solution of these and other problems, and it is in this direction that the amateur experimenter can prove himself invaluable.

No Radical Changes.

NO radical changes from the ordinary designs of short-wave receivers are required for operation on wavelengths between 5 and 10 metres. With careful adjustment, almost any good short-wave receiver of the detector and audio type can be induced to operate successfully, smaller coils being required, of course, to bring the tuning range down. Stray capacity effects are apt to be serious, however, and to obtain reasonable ease of tuning a very small tuning condenser is an advantage.

The more elaborate type of short-wave receiver embodying high-frequency amplification by means of screen-grid valves or neutralised three-electrode valves is not a success for work of this kind, 15 metres being about the lowest wavelength on which any amplification can be obtained from the high-frequency valve. More promising results have been secured with circuits of the Armstrong and other super-regenerative types, while there seems to be no reason why a superheterodyne receiver should not be extremely successful.

For a commencement, however, there is no doubt that it is wisest to experiment with a simple receiver of the regenerative detector type, to which a stage of audio can be added if louder signals are desired. The greatest care must be taken in regard to layout to avoid the introduction of stray capacities, but provided this precaution is taken it is usually possible to induce the detector valve to slide into oscillation just as smoothly and gently as on the longer waves.

A circuit diagram of a detector and one audio receiver specially adapted to operation at extremely high frequencies is given in Fig. 1. It will be seen that the tuning coil is centre-tapped, as at this point there is practically no alternating potential, and by connecting the centre of the coil through a suitable battery to A, any desired negative or positive bias may be applied to the grid of the detector valve without interfering with the alternating E.M.F. in the tuned circuit. Generally speaking, the detector operates best with a positive bias of 3 volts or thereabouts.

An open aerial can be coupled to one end of the coil through a midget variable condenser having a maximum capacity of perhaps 50 micromicrofarads. If a counterpoise system is employed as earth, this should be similarly coupled to the other end of the coil. If a definite earth connection is used, however, this must be made to the centre of the coil for the same reasons as are outlined above in regard to the centre-tapping.

Th fact that in this circuit both ends of the tuning inductance are at high alternating potential renders it necessary to so adjust the aerial and counterpoise that they have potential variations impressed by the incoming signals at the ends coupled to the inductance. Thus the length of either should not be an odd multiple of a quarter of the wavelength, since this would result in a potential node at the receiver. To secure the best results with this type of receiver, one must be prepared to experiment with several adjustments, of which the most important are the length of the aerial, the aerial coupling, the reaction, and, of course, the tuning. The correct adjustment of the aerial (and counterpoise) coupling is particularly important, and if it is too great, the radiation resistance of the aerial (which at these short wavelengths is of the order of 50 to 80 ohms), will prevent the detector from oscillating, while if it is too small, the signal strength will be substantially reduced.

The type of constructor who will be tempted to experiment on this waveband is not likely to make anything but an excellent job of his layout and wiring. For this reason no practical layout and wiring diagram is given. A few general hints may not be out of place, however.

Hand Capacity.

DIFFICULTY may be experienced with hand-capacity effects if ordinary methods of layout are adopted. To forestall any trouble of this kind, it is an excellent plan to mount the tuning and reaction condensers on a false panel set three or four inches back from the panel proper. The condensers are then controlled from the dial on the front panel by means of a rod of ebonite or other insulating material; a dry skewer is first rate. If one or both or the panels can be of metal, this also assists in dispelling the hand capacity bogey.

The tuning condenser should have a maximum capacity of about 50 microfarads. A condenser of the midget type having small plates will be best.

(Concluded on page 29.)